UNIVERSITY OF TROMSØ UIT

FACULTY OF HUMANITIES, SOCIAL SCIENCES AND EDUCATION
CENTER FOR ADVANCED STUDY IN THEORETICAL LINGUISTICS

An exploration of minimal and maximal metrical feet

Violeta Martínez-Paricio

A dissertation for the degree of
Philosophiae Doctor

August 2013

An exploration of minimal and maximal metrical feet

Violeta Martínez-Paricio

A dissertation submitted for the degree of Philosophiæ Doctor

University of Tromsø

Center for Advanced Study in Theoretical Linguistics

August 2013

Contents

A Tina y José Antonio,
por animarme siempre
a cruzar fronteras para aprender.

Acknowledgments

In being part of the CASTL community, in the past four years I have had the good fortune to learn from linguists not only in Tromsø, but also abroad, who, with their talks, seminars, comments, advice, summer courses and their own work, have contributed to my linguistics education. I will always be grateful to the University of Tromsø and everyone in CASTL for making this possible.

Martin Krämer has been a wonderful friend and a great supervisor. This thesis has benefited tremendously from long discussions with him. His insightful comments, his constant availability, his enormous confidence in me (very much needed) and his daily encouragement have made this adventure much easier. Even if Martin only became my official supervisor in my final years of the PhD, he has always helped me and given me invaluable feedback in everything I wrote since day one, so *grazie mille per tutto,* Martin.

Armin Mester was my tutor during the semester I spent in Santa Cruz in 2012 and became my external supervisor in my final stage of writing. I thank him so much for being willing to be involved in this project, for all his constructive comments on drafts of this thesis and for always pointing me in the right directions. I am tremendously thankful to Armin for all his help.

Likewise, I am extremely indebted to Bruce Morén-Duolljá, who was my supervisor during the first years of my PhD. As the only graduate phonology student in my year (and the year above and below me), I benefitted from exclusive tutorials with Bruce. Going through foundational phonology works with him and listening to his thoughts and critiques during these tutorials and reading groups helped me not only to fill in gaps in my theoretical phonology background (which I'm still filling in today!), but to develop my own way of thinking. His own thoughts have had a great impact on this dissertation, especially regarding the role of representations in phonological theory. I thank him for that, as well as for his mentoring and advice in my first years.

Ove Lorentz deserves special credit because, in addition to advising me to spend a semester at UCSC, he highly encouraged me to send an abstract to *WCCFL30*. At the moment he made that suggestion, I had just read a paper by Brett Hyde (*A restrictive theory of metrical stress*) and was puzzled by his ambipodal syllables. This reading led me to think about languages and phenomena that I had never considered before due to my Romance background. I thank Hyde for 'giving me' a problem to think about in this dissertation. And I thank Ove for his double advice and for the discussions on Saami feet. Luckily, I did spend a semester in sunny Santa Cruz and my paper at *WCCFL* became a seed for this thesis.

Thanks to all the phonologists and phoneticians at UCSC. Junko Itô, Ryan Bennett, Jaye Padgett, Wendell Kimper, Grant McGuire and all the graduate students at Santa Cruz have greatly contributed to my understanding of phonology with their intelligent questions, criticism and comments during *PhLunches* and lectures. It was so nice to leave the ice for a while and get to know, and learn from, all these people. Ryan Bennett deserves a big thanks for sharing his *foot expertise* with me and for his valuable comments on two of the chapters of the dissertation. Finally, thanks to my Californian families (Bart, Nena and Ella Abicht; Donka and Peter Farkas) for *adopting* me, and to my friend Adam Morgan, for proof-reading this thesis.

Another phonologist that deserves my deepest gratitude is René Kager. I was fortunate enough to meet René eight months ago when CASTL brought him to Tromsø to give a talk, so I could discuss my work with him. Not only did we spend hours and hours talking about metrical phonology, but all these conversations led to hundreds of emails and our current joint project on the typology of quantity-insensitive rhythmic stress systems. It does not need to be said how much this thesis has benefited from these interactions. I thank René for his enthusiasm for this project, for finding good in every idea (no matter how bad it really was!) and for making this collaborative project such an enriching experience.

I also want to thank all the other phonologists in Tromsø and Manchester, especially, Curt Rice, Ricardo Bermúdez-Otero, Patrik Bye, Yuni Kim, Danielle Turton, Kevin Gabbard, Pavel Iosad and Olga Urek. I thank Ricardo for always being so helpful, answering all my doubts about Spanish morphophonology, and for making my short stay at Manchester possible. I am also very thankful to Curt Rice who, despite his loaded schedule, found the time to meet with me in my final year. In CASTL, I would also like to thank the rest of graduate students, past and present, as well as Tore Bentz, Gillian Ramchand, Peter Svenonious and Marit Westergaard, for their help and advice in non-phonological matters.

These acknowledgments would not be complete without mentioning my Catalan teachers. For being my *phonological-godmother*, her constant advice and support, my sincere gratitude to Maria-Rosa Lloret. If it had not been for her lectures in phonology in Madrid in 2007 and her role as the supervisor of my master thesis, I probably would not have written a PhD thesis in phonology. For similar reasons, I am very grateful to Eulàlia Bonet. I am also indebted to the LSA Summer Institutes in Berkeley 2009, Boulder 2011, the LOT School (Nijmegen) and the EGG (Conșťanza) in 2010. Thanks especially to Archangeli & Pulleyblank for their inspiring course at Boulder. Two other linguists and friends have contributed in their own way to my education: Antonio Fábregas and Nino Grillo. Thank you so much for helping me when I most needed it.

If doing a PhD can be a hard experience, imagine doing one in the North Pole when you are hundred percent Mediterranean.... If I made it (and I even enjoyed the North!), it is because I was gifted with the friendship of some wonderful people. For their love, all the shared laughs and adventures, I want to thank my dearest wingman Naoyuki Yamato, *le copepode* Anaïs Aubert, Suvi Vuontela, Anna Wolleb, Perrine Geraudie and Marie Guerbron. I could not have been half as happy here if it had not been for you. The same thanks goes to Marleen van de Vate and Peter Jurgec, who had to leave me earlier than I would have liked. *Tusen takk* to Nina Fagerland, for recharging my batteries with all her invitations to Oslo, and to Sveinung Gabrielsen, Veronica Jakobsen and Ken H. Sulen, for opening their cold northern-Norwegian hearts to me ;-). Thanks also to my other friends in the North: Marco Anelli, Andrea Markus, Arlanda Moreno, Madeleine Halmøy, Davide Michetti and Tiina Portti.

My friends back home in Valencia and Madrid deserve the same amount of gratitude as my Tromsø friends. Despite the distance, they have closely followed my Polar journey. *Muchísimas gracias* a Ali, Blanca, Blanquita, Elena, Estefi, Esther, Elvira, Eva, Fede, Héctor, María, Malvina, Mamen, Migue, Montse and Pau. My friend Isa has contributed to this thesis more than she knows, with her constant encouragement and visits to Tromsø and California. I could not have survived the North without you. Thanks for the endless skypes, all the emails, letters, phone calls and visits.

Last, but not least, I want to thank my family. I'm extremely lucky I have been able to count on the guidance and advice of my parents in several aspects of my academic life, but even more lucky for having their love and support in my personal life. Thank you for raising me with the best of examples. For their love and support, I would also like to thank my sister Irene, who has patiently helped me to prepare all my phonology talks, and my aunt Carmuca.

Abbreviations and Symbols

I. Prosodic representations

μ	mora, unit of weight
σ	syllable
Ft	foot
ω, PrWd	prosodic word
φ	phonological phrase
ι	intonational phrase
υ	utterance
.	syllable boundaries
( )	foot boundaries
[ ]	prosodic word boundaries
H	High tone, in discussions of tone and pitch
	Heavy syllable, in discussions of weight
L	Low tone, in discussions of tone and pitch
	Light syllable, in discussions of weight
h	head of a prosodic domain (in subscript or superscript)
Straight line	Head of a prosodic constituent
Diagonal line	Dependent of a prosodic constituent
HD_{FT}	Head of a foot
$\text{NON-HEAD}_{\text{FT}}$	Dependent of a foot
[ˈ]	Primary stress (also indicated with an acute accent in orthographic forms)
[ˌ]	Secondary stress (also indicated with a grave accent in orthographic forms)

II. Optimality Theory Tableaux

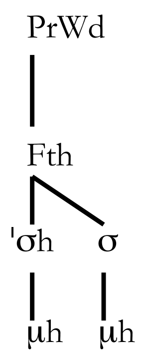
☹	Intended winner
💣	Winner wrongly selected as optimal

1 Introduction and theoretical background

1.1 Introduction

This dissertation develops a principled theory of bounded recursive footing in phonological representations. Current standard theories of prosodic phonology assume that feet are maximally bisyllabic and, universally, they are immediately dominated by the prosodic word (e.g. 1) (Throughout the dissertation, headedness is indicated with straight lines and head constituents are often marked with an <h>).

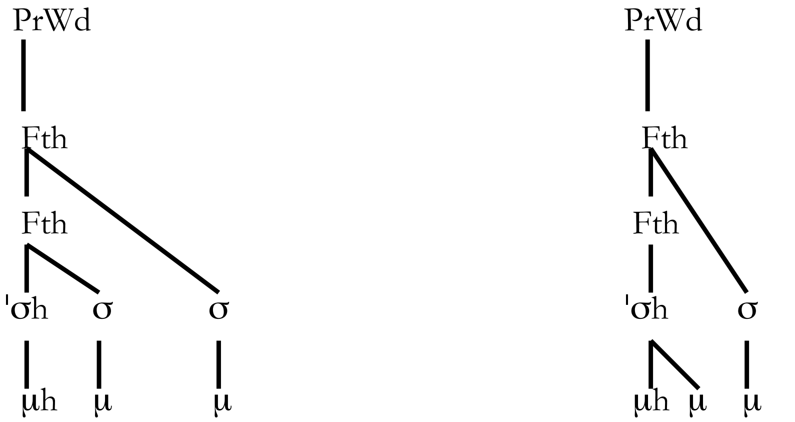
(1) Traditional assumptions: bisyllabic maximal feet and strict layering



However, in this work I challenge both assumptions. Namely, I argue that representations with one instance of recursion at the level of the foot (e.g. 2a-b) are not only possible, but crucially needed in a variety of languages. Hence, universal grammar must provide a means to generate them.

(2) Minimal recursion at the foot level

a. Bisyllabic foot + syllable b. Bimoraic foot + syllable



The idea that a metrical foot might undergo (minimal) recursion, giving rise to a trisyllabic (2a) or a trimoraic foot (2b), is not new in phonological theory. It was originally proposed by Selkirk (1980) and Prince (1980) in their early works on English and Estonian foot structure, largely inspired by Liberman (1975) and Liberman & Prince (1977). Additionally, internally layered ternary feet of this sort, or fairly similar structures, have been posited in other studies (Hayes 1980; McCarthy 1982; Leer 1985; Grijzenhout 1990; Dresher & Lahiri 1991; Hewitt 1992; Rice 1992; Kager 1994, and more recently, Jensen 2000; Yu 2004; Caballero 2008, 2011; Bennett 2012; Kager 2012 among others). Despite their presence in the literature, such proposals have not been able to rely on approval within standard metrical theories; on the contrary, the inclusion of ternary feet in the inventory of feet has been often regarded as defeat.[1] In particular, these proposals have been said to incur "the great cost of enriching the inventory of foot types, a cost that some might find too high" (Harris 2013: 347). To avoid this cost, feet have generally been considered to be maximally bisyllabic (e.g. Hammond 1990; Hayes 1995; Elenbaas & Kager 1999; Kager 1999; Hyde 2002).

The main goal of this thesis is to show that, rather than *a cost*, the introduction of recursive feet in phonological representations comprises an improvement of our theory, allowing us to provide a unified account of a wide

[1] Some early exceptions to this *maximal binary trend* are a manuscript by Halle & Vergnaud (1978) cited in Hayes (1995), McCarthy (1979), Levin (1985, 1988) and Halle & Vergnaud (1987). Rice (2007) and Buckley (2009) have recently reopened the debate by questioning the validity of this restriction from an optimality theoretic perspective.

range of phonological phenomena which would otherwise remain unexplained.

Since recursive feet were already postulated decades ago, one might wonder why they have resisted acceptance in the literature. There seem to be at least three sources for the traditional *recursive-foot/ternarity animadversion*. First, as Rice observes (2007, 2011), ternary feet have often been excluded from foot inventories on the basis of descriptive typological observations. The overwhelming majority of languages with iterative rhythm display a binary alternation between stressed and unstressed syllables, and only a small handful exhibit iterative ternary stress —some of which were unattested at the time that the standard metrical theory was being developed. The scarcity of languages with iterative ternary stress was used as an argument against theories that adopted ternary feet to model the distribution of stress. In particular, the (incorrect, as has been shown) fear of overgenerating systems with iterative ternary stress led scholars to reject ternary feet (e.g. Hayes 1995; see Rice 2011: §8 for discussion).

Second, some linguists have precluded ternary feet on the basis of *locality*. Consider, for instance, the following quote from Hayes (1995):

> In phonology, the principle of locality often takes the form of limiting what can be counted: a reasonable conjecture is that phonological rules can count only to two (...) foot inventories have usually excluded feet that require any counting higher than two (Hayes 1995: 307)

Binary feet with two terminal nodes conform to this locality principle, whereas ternary flat feet with three terminal nodes presumably violate it. Note, however, that this interpretation neglects the fact that ternary feet can have internal binary-branching structure as in (2a,b). In such cases, the *locality* argument is flawed: a ternary foot arises by adjoining one syllable to a binary foot; hence, the phonology never refers to more than two elements. [2]

Third, early works in prosodic phonology assumed that the Strict Layer Hypothesis was inviolable (Selkirk 1981, 1984, 1986; Nespor & Voger 1982, 1986). One of the assumptions of this hypothesis is that a prosodic category C^i cannot dominate a prosodic category of its same nature (i.e. C^i cannot

[2] Furthermore, it is not completely clear that rules or constraints can only refer to two elements. Alignment constraints, for instance, often refer to three elements, even if one of them is generally not explicitly mentioned and yet, they are local. For discussion see, *inter alia,* McCarthy (2003), Hyde (2008, 2012a), Jurgec (2010) and Martínez-Paricio & Kager (2013).

dominate C^i). Representations in which a foot dominates another foot were, therefore, ruled out.

As a consequence of these factors, rather than exploring the implications/predictions of metrical structures with recursive feet, the mainstream effort in phonology has concentrated on exploring alternative accounts of ternary rhythm (and other phenomena that seemed to need ternary feet), maintaining two as the maximum number of syllables in a foot. This has especially been the case since the advent of Optimality Theory, where the foot inventory results from the interaction of universal constraints (e.g. Ishii 1996; Elenbaas & Kager 1999; Kager 2001, 2005; Hyde 2001, 2002; Gordon 2002; Houghton 2006). [3]

In opposition to this general trend, in this dissertation I propose rehabilitating (minimal) recursive feet in metrical representations. To this purpose, I undertake a cross-linguistic study of a wide variety of phonological phenomena in several related and unrelated languages. I demonstrate that a unified account of these phenomena is achieved once recursive feet are admitted in phonological representations. Importantly, contrary to the general belief that ternary feet's unique *raison d'être* is their ability to model ternary rhythm (or other ternary phenomena), I show that the need for recursive feet in phonological representations is supported on empirical grounds that go well beyond the account of ternary stress. In sum, while recursive feet had been sporadically proposed for a few languages, this dissertation constitutes the first systematic investigation of the empirical and theoretical consequences of a metrical framework that allows recursive feet in phonological representations.

Besides presenting novel evidence for recursive feet in various languages, the thesis constitutes a thorough investigation of the specific factors that might cause or block recursion at the level of the foot. The details of the new approach to metrical phonology are set within the Recursion-based Subcategories model of Itô & Mester (2007a,b, 2009a,b, 2012a, 2013), framed in the broader research program of Prosodic Hierarchy Theory (Selkirk 1978 *et seq.*; Nespor & Vogel 1986; Hayes 1989a; McCarthy & Prince 1986/1996; *inter alia*). Nevertheless, as I will discuss below, I crucially depart from this model in that I do not restrict the mechanism of recursion to *interface categories*, i.e. high

[3] Although see Rice (2007) and Buckley (2009) for some discussion on the possibility of allowing amphibrachic feet (i.e. ternary feet with a head flanked by two non-heads) in Optimality-theoretic analyses of ternary rhythm. Blevins & Harrison (1999) and Kager (2012) also allowed ternary feet (in particular, ternary feet with binary heads) and, more recently, Caballero (2011) (based on Zoll 2004), Bennett (2012) and Martínez-Paricio (2012) have argued for the need to allow different types of recursive feet (i.e. not only amphibrachs) in Optimality-theoretic analyses of different phonological phenomena.

categories in the prosodic hierarchy that are defined/regulated by their closer relation to syntax (i.e. the prosodic word, phonological phrase, intonational phrase, utterance). To the contrary, the rhythmic category of the foot will be shown to occasionally undergo recursion. From the computational point of view, this thesis assumes Optimality Theory. Thus, particular metrical representations arise via constraint interaction. All in all, since the major contribution of this dissertation falls on the representational side of phonological theory, I hope that the overall conclusions may be of profit to non-constraint based frameworks interested in the nature of (accentual and non-accentual) metrically-conditioned phenomena as well.

The empirical contribution of the thesis is threefold. First, I demonstrate that a recursive-foot based approach to the metrical system of several languages (e.g. Wargamay, Yidiɲ, Seneca, Ryukyuan, Chugach, Tripura Bangla, Cayuvava, Dutch, German, English and Gilbertese) provides a unified account of miscellaneous phonological phenomena. Interestingly, these phenomena are not exclusively accentual, but also non-accentual. Therefore, the findings of this dissertation supply further support for the need to consider the foot as a primitive universal prosodic category beyond its role as an accentual domain (i.e. for stress assignment and/or tone assignment). Second, in arguing for the need for recursive feet in phonological representations, I identify new strength relations in prosodic systems. Besides the well-established strength dichotomy between the head of a foot (i.e. the strong branch of a foot) and the dependent of a foot (i.e. its weak branch), I show that languages may distinguish between further metrical prominence positions. Interestingly, these *extra* required positions do not need to be stipulated as they come for free in a framework that allows recursion at the level of the foot. Third, the recursive-foot-based approach to rhythmic stress systems pursued in the thesis blurs out the traditional strict dichotomy between *binary* and *ternary* stress systems. In sum, I demonstrate that binarity and ternarity may coexist in prosodic systems, even in languages that display a strict alternation between stressed and unstressed syllables (see also Martínez-Paricio & Kager 2013).

1.2 Outline of the dissertation

The thesis is organized in seven chapters. In the remainder of this chapter I introduce the main tenets of the theories in which the thesis is couched. In particular, I contextualize the role of the metrical foot within Prosodic Hierarchy Theory and present the main ideas of the Recursion-based

Subcategories model of Itô & Mester. In addition, I briefly acknowledge previous studies that posited some sort of ternary or recursive foot in phonological representations, highlighting the major differences between those proposals and the present one.

Chapter 2 serves as a cornerstone for the rest of the thesis: I outline there the basic architecture of the metrical framework to be used in the dissertation. In particular, I discuss the principal representational assumptions and phonological constraints adopted in the thesis. By doing so, I anticipate the main reasons for the emergence of recursive feet in natural language, as well as the empirical and theoretical predictions of a metrical framework that allows recursive footing.

The details of the theory are illustrated with particular case studies in Chapters 3 through 6. First, in Chapter 3, I provide a recursion-based analysis of the accentual and lengthening patterns in Wargamay and Yidiɲ, two Australian languages with binary rhythm. In this chapter I argue that recursive feet can arise in binary systems as a last-resort device to ensure exhaustive parsing of syllables (similar ideas have been explored in van der Hulst 2010 and Bennett 2012). Thus, even if scarce, I argue that internally layered ternary feet can be present in binary systems. Additionally, this chapter demonstrates that languages may occasionally distinguish between two types of foot heads: the head of a recursive foot and the head of a traditional (non-recursive) foot. The chapter closes by presenting further concrete evidence for the construction of recursive feet as a last-resort mechanism in Huariapano, a Panoan language recently analyzed via recursive feet by Bennett 2012.

Chapter 4 turns to examining languages with ternary rhythm and proposes that ternary stress languages may display recursive feet too, but for substantially different reasons. In ternary systems, recursion at the foot level is not a last-resort parsing mechanism, but a default —or at least more common— parsing mode. If Chapter 3 focused on the behavior of foot heads, this chapter concentrates on the particular phonological properties of foot dependents. The heart of the chapter is devoted to the in-depth study of Chugach Alutiiq word-level prosody. One of the main reasons for analyzing this language is its ample evidence for recursive footing from a wide range of phonological phenomena (e.g. fortition, gemination, stress assignment, tonal distribution, etc.). Additionally, the Chugach data are particularly valuable because they provide further support for the present theory, which allows for a subtle distinction between different types of unstressed syllables. I close this chapter by extending the Optimality Theory analysis of Chugach to *more radical* ternary rhythmic systems (e.g. Cayuvava and Tripura Bangla), presenting some of the findings of Martínez-Paricio & Kager (2013).

To provide additional support for the present theory, Chapter 5 and Chapter 6 are a guided tour through selected further evidence for recursive feet. On the one hand, Chapter 5 demonstrates that a theory that structurally differentiates between two types of foot dependents provides a uniform and straightforward account of the dual patterning of non-prominent, but metrically relevant, syllables in several Germanic languages (Dutch, German, English and Old English). On the other hand, Chapter 6 provides additional typological support for recursive footing in natural language based on the distribution of tones in three unrelated languages: Gilbertese, Irabu Ryukyuan and Seneca. The case of Seneca is interesting because it provides support for the ideas presented in Chapter 3. Namely, I show that Seneca is another example of a language where the phonology distinguishes between the head of a traditional (i.e. non-recursive) foot and the head of a recursive foot.

The main conclusions of the dissertation, and possible expansions in future research, are outlined in Chapter 7.

1.3 Theoretical background and assumptions

In this section I outline the main tenets of Prosodic Hierarchy Theory (Section 1.3.1), I discuss the role of the metrical foot within the framework (Section 1.3.2) and present the Recursion-based Subcategories model of Itô & Mester, adopted in the dissertation (Section 1.3.3).

1.3.1 Prosodic Hierarchy Theory

Prosodic Hierarchy Theory (PHT) proposes that the mental representation of speech is hierarchically organized in a small set of universally available prosodic constituents, as shown in (3) (Selkirk 1978 *et seq.,* Nespor & Vogel 1986; McCarthy & Prince 1986/1996; Pierrhumbert and Beckman 1988; Hayes 1989a *inter alia*). This dissertation focuses on the particular behavior of one of these constituents: the metrical foot.

(3) Universal Prosodic Hierarchy[4]

Utterance	υ	Interface categories
Intonational Phrase	ι	
Phonological Phrase	φ	
Prosodic Word	ω	
Foot	Ft	Rhythmic categories[5]
Syllable	σ	
Mora	μ	

The explanatory benefits of PHT have been corroborated by detailed research in particular languages. In particular, it has been shown that rather than targeting arbitrary segments in the phonological string and/or syntactic constituents, the rhythmic patterns of languages (i.e. the assignment of lexical and post-lexical stress/tone) and the specific properties of certain phonological and morphophonological processes (e.g. fortition, deletion, truncation, reduplication, etc.) are best modeled by referring to the small set of innate constituents in (3) and the universal way in which they are organized. These constituents, and their particular domination relations, are phonological in nature.

As pointed out by Nespor and Vogel, "not only is each prosodic constituent characterized by the different rules that apply in relation to it, but also by the different principles on the basis of which it is defined" (Nespor & Vogel 1986: 2). Although varied, the nature of the principles that define each universal category can be grouped into two major classes. On the one hand,

[4] This is the most standard version of the Prosodic Hierarchy, but there has been some debate on whether additional categories are needed. For instance, some authors like Nespor & Vogel (1986) and Hayes (1989a) posited an additional universal category, the *clitic group* above the prosodic word. However, subsequent studies have shown that there is no need for such a constituent (e.g. Selkirk 1996). Similarly, research in particular languages claimed that the phonological phrase should be split in two categories (the *minor* and the *major* phrase), although see Itô & Mester (2012a, 2013) for a different interpretation of the facts which does not resort to the postulation of an additional category.

[5] The terms 'interface' *vs.* 'rhythmic' categories are borrowed from Itô & Mester (2007 *et seq.*).

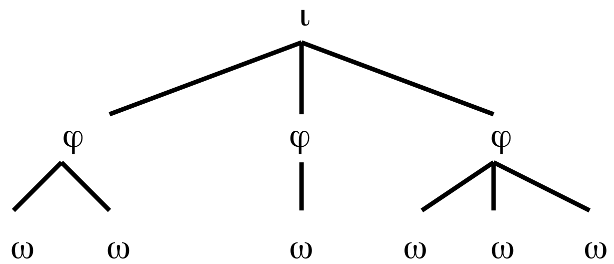
categories in the lower levels of the prosodic hierarchy (word-internal units) are purely phonological in the sense that they are "intrinsically defined in terms of sonority-related phonetic factors and speech rhythm" (Itô & Mester 2012a: 280). On the other hand, the definition and parsing of higher levels in the prosodic hierarchy (i.e. categories above the foot) are partly regulated by the "correspondence between syntactic/morphological and phonological constituents" (Itô & Mester 2012a: 280). Following Itô & Mester (2007a,b, 2009a,b, 2012a, 2013), I will often refer to the latter categories as *interface categories,* whereas word-internal categories will be grouped under the *rhythmic categories* label. The fact that higher categories in the hierarchy can be, to some extent, modeled by syntactic information does not entail that they are not phonological. Well-formedness constraints on prosodic structure (e.g. on the size/shape of a domain, on the location of the head of a domain, etc.) alone may affect the shape/size of prosodic constituents in the hierarchy; that is, the exact coincidence between phonological and syntactic constituents can be disrupted by the action of purely phonological constraints (see Selkirk 2011: §3 and references therein for a repertoire of well-established markedness prosodic constraints). In fact, the observation that phonological representations were different from syntactic representations was one of the main reasons that lead to the postulation of the prosodic hierarchy and the Strict Layer Hypothesis, the principle that regulates the domination relations within the hierarchy (4) (Selkirk 1981, 1986, 1996; Nespor & Vogel 1982, 1986; Hayes 1989a among others).

(4) THE STRICT LAYER HYPOTHESIS

A category of level i in the hierarchy immediately dominates a (sequence of) categories at level i-1 (Selkirk 1984: 24)

Complete adherence to *Strict Layering*, can lead to prosodic trees that are substantially different from binary syntactic trees:

(5) Prosodic tree respecting the Strict Layer Hypothesis (Selkirk 2011: 437)



The Strict Layer Hypothesis was originally conceived as an inviolable constraint on the prosodic hierarchy. Nevertheless, further developments of PHT showed that the initial universal assumption regarding the nature of the Strict Layer Hypothesis needed to be loosened up (e.g. Inkelas 1990; Itô & Mester 1992/2003; Selkirk 1996). Furthermore, rather than being conceived as a unique requirement/sole constraint on the hierarchy, these works argued for a decomposition of the Strict Layer Hypothesis into independent constraints. These constraints are formulated in (6), following Selkirk 1996.

(6) Constraints on Prosodic Domination (Selkirk 1996: 192)

a. LAYEREDNESS
No C^i dominates C^j, $j > i$
e.g. "No σ dominates a Ft"

b. HEADEDNESS
Any C^i must dominate a C^{i-1}
"A PrWd must dominate a Ft"

c. EXHAUSTIVITY
No C^i immediately dominates a constituent C^j, $j < i-1$
"No PrWd immediately dominates σ"

d. NONRECURSIVITY
No C^i dominates C^j, $j = i$
"No Ft dominates a Ft"

As discussed in Selkirk (1996), the two initial constraints, (6a,b), are inviolable: all possible phonological representations conform to them. In Optimality Theory, this amounts to stating that LAYEREDNESS and HEADEDNESS are universal restrictions on GEN. That is, the specific layering in the prosodic hierarchy in (3) is always respected: particular grammars will never generate a structure in which a foot dominates a prosodic word or a prosodic word dominates a phonological phrase. Likewise, by HEADEDNESS, every constituent must dominate a constituent from a lower level category. Furthermore, following Zec (1988, 2003) and Itô & Mester (1992/2003), among others, in this dissertation I assume the more strict definition of HEADEDNESS provided in (7).

(7) HEADEDNESS

A prosodic constituent must contain **a head**, i.e. constituent n must immediately dominate exactly one constituent n-1 **designated as its most prominent element** (Zec 2003: 126; highlighting is mine; see also Proper Headedness in Itô & Mester 1992/2003: 12)

This definition not only ensures that every prosodic constituent dominates at least one constituent from the subsequent layer, but that one of the constituents in this layer is singled out as the phonological/structural head of the higher constituent.

The other two constraints, EXHAUSTIVITY and NONRECURSIVITY, are violable. Their particular ranking, and their interaction with other constraints, may occasionally give rise to structures in which "a level has been skipped" (Itô & Mester 1992/2003) —when EXHAUSTIVITY is low ranked— or a level has been repeated —when NONRECURSIVITY is violated. The violation of these constraints, thus, goes against the original inviolable definition of *strict layering*. In the next chapter I examine the effects that these constraints might have on the metrical foot and show that their interaction with other well-established markedness constraints may in fact result in recursion at the level of the foot.

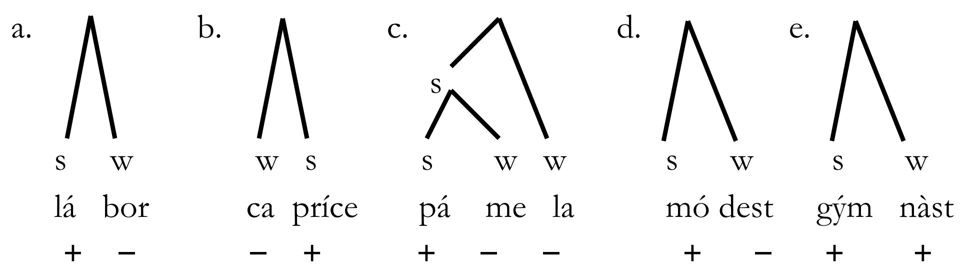
Initially, prosodic structure was thought to be fundamentally non-recursive. However, this assumption was already questioned in the fist decade of PHT when some scholars pointed out the need for admitting some kind of recursive prosodic structure in phonological representations (e.g. Ladd 1986, 1988; Gussenhoven 1991; Booij 1996; Kager 1996a; Peperkamp 1997 among others). Nevertheless, it has not been until fairly recently that the explanatory and restrictive power of prosodic recursion has been explored in more detail. In particular, building on previous research on prosodic recursion (e.g. Ladd 1996; Kubozono 1988, 2005; Gussenhoven 1991; Truckenbrodt 1999; Féry & Truckenbrodt 2005; Wagner 2005, 2010; Schreuder 2006), Itô & Mester have developed a line of research which highlights the benefits of enriching the prosodic hierarchy via recursion (see also Elfner 2011, 2012). Before presenting an overview of the main insights of Itô & Mester's approach to the prosodic hierarchy, the next section discusses the main properties of the metrical foot within prosodic hierarchy.

1.3.2 The metrical foot as a prosodic domain

Most of the initial arguments in favor of the metrical foot in phonology came from the distribution of stressed and unstressed syllables in particular languages. More specifically, the concept of the *foot* as an accentual domain stemmed from the pioneering work on phrasal and word stress by Liberman (1975) and Liberman & Prince (1977). The originality of these works relied on the *relational* approach to stress: stress was conceived as a relative prominence relation between two elements.

Previous research had assumed, instead, that stress was an individual property/feature of a given segment (or syllable) (cf. [± stress] in Chomsky & Halle's 1968). Hence, the *relational* interpretation of stress comprised a real novelty in the field. Even though Liberman & Prince (1977) retained the feature [±stress], they were the first to propose that stress is the manifestation of abstract hierarchical binary-branching relation in which the constituents of a word are organized in strong and weak nodes (Liberman & Prince 1977: 249). Within such a conception, it is not unexpected that languages display variation on the specific way in which they materialize such an abstract hierarchical relation. A few examples illustrating Liberman & Prince's (1977) approach to word stress are presented in (8), where <s> and <w> stand for strong and weak respectively. One of the reasons that Liberman & Prince kept the feature [± stress] was to mark the distinction between words like *módest* (8d), which has primary stress in the first syllable, and *gýmnàst* (8e), which has primary stress in the first syllable and secondary stress in the final one.

(8) Word trees in Liberman and Prince (1977: 264-265)

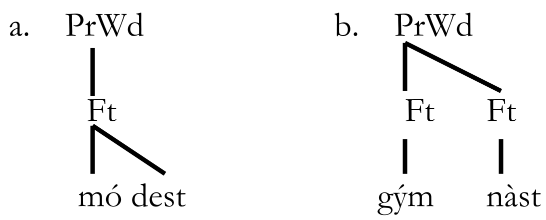


Further developments of this approach led to the complete abandonment of the feature [±stress] and the introduction, instead, of a relational category in between the syllable and the prosodic word: the *metrical foot* (Selkirk 1978b, 1980: 570; Prince 1980 and Hayes 1980).[6] This constituent was claimed to be

[6] Selkirk (1980) originally refered to this category as the *stress foot*. This terminology shows to what extent the initial motivation of the foot was stress-based.

responsible, among other things, for the distribution of stressed syllables in a word: each foot consists of at most one head (the metrically strong constituent, generally realized with greater relative prominence) and a non-head (the metrically weak constituent). Although feet are generally binary branching, along the lines of these studies, in this dissertation I assume that degenerate (non-branching) feet are occasionally possible and, in such cases, they consist of just a head. As can be seen in (9), once the foot is introduced as a prosodic constituent, the feature [± stress] becomes superfluous: the different stress patterns in *módest* and *gýmnàst* are due to their different foot structure (cf. 8e *vs.* 9b) and not the presence of a particular value of the feature [stress] (Selkirk 1980: 564).

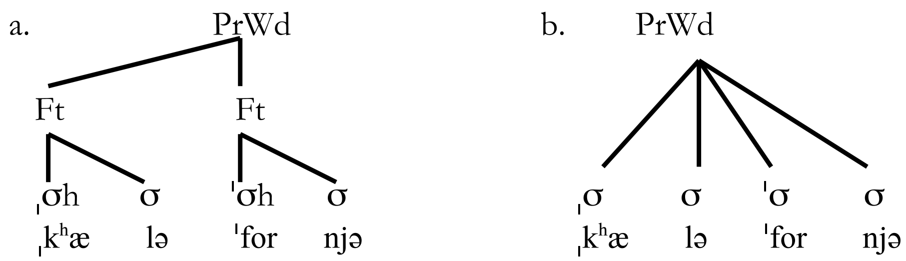
(9) The foot in Selkirk (1980: 565)



The recognition of this intermediate rhythmic category between the syllable and the prosodic word has led to enormous insights in metrical theories of stress but also in prosodic phonology studies (e.g. Kiparsky 1979; Yip 1980; van der Hulst and Smith 1982; Leer 1985; McCarthy 1982; Hammond 1984; Hyman 1985; McCarthy & Prince 1986/1996; Nespor & Vogel 1986; Halle & Vergnaud 1987; Kager 1989; Itô & Mester 1992/2003; Rice 1992; Kenstowicz 1993; Hayes 1995; Bennett 2012; Harris 2013 among many others). By assuming that syllables are grouped into feet rather than directly linked to the prosodic word, the particular distribution of stressed and unstressed syllables, as well as the conditioning factors and domain of a wide range of phonological and morphophonological phenomena, receive all a unified account.

To illustrate the role of the foot in the placement of stress, consider the word *California*. Native speakers of English realize with greater relative prominence the first and third syllables in this word: ***Cà**li**fó**rnia*. If we assume that the word is decomposed in two adjacent feet as in (10a), and stress is the realization of a foot head, it is obvious why all speakers realize the first and third syllables in the word with greater relative prominence: these syllables correspond to the head of some foot (remember that headedness is indicated with straight lines). By contrast, the second and fourth syllables in (10a) are realized with less relative prominence because they appear in the weak branch of a foot, i.e. in a non-head position. Furthermore, note that a structural approach to stress can also account for the greater relative *strength* of the third syllable (with primary stress) when compared to the first syllable (with secondary stress): the former is slightly stronger because it is the head of the prosodic word. An alternative representation without feet (e.g. 10b) would have to stipulate the location of stress (or derive it by other means, as with the metrical grid, e.g. Prince 1983; Selkirk 1984; Halle & Vergnaud 1987; Halle & Idsardi 1995; Gordon 2002 among others),[7] since in (10b) all syllables are structurally identical. The best that a non-structural account of stress could do is to place stress at an edge of the prosodic word but, as is clearly the case for English, this cannot predict all attested accentual patterns.

(10) Metrical feet in phonological representations



Interestingly, in recent research, Bennett (2012) has shown that even in languages with non-iterative edge-based stress, stress placement is still assigned within a bounded binary foot (see Bennett's 2012 discussion of Irish and Uspanteko; for the latter see also Bennett & Henderson 2013). In other words, even in stress systems where the distribution of stress could *a priori* be analyzed without reference to a foot, there is independent evidence for the existence of feet. Such evidence stands as clear support for PHT, where the foot is seen as a phonological universal primitive, independent from its role in predicting the location of stress. Therefore, even if alternative metrical frameworks like grid based theories can do a good job in predicting most of the attested stress patterns, the independent evidence for maximally binary branching feet (and the scarce evidence for other types of constituents that emerge from grid-based approaches, e.g. unbounded constituents, cf. Prince

[7] Some of these aproaches to stress still refer to feet; however, the mechanism that is entirely responsible for stress assignment is the assignment of gridmarks and constituent boundaries.

1985; McCarthy & Prince 1986/1996; Kager 1989) stands as further support for PHT, where the foot is seen as a universal phonological primitive (for detailed discussion and comparison of PHT and gridmark theory, see the discussion in Bennett 2012: §1.4.2.1).

There is a final clarification regarding the relation between metrical structure and stress that I would like to make explicit since I will be taking it for granted in future discussions. In this dissertation I will follow Hayes (1995), Buckley (2009) and Bennett (2012), among many others, and assume that stress is the manifestation of a foot head, although there can be foot heads that lack stress correlates.[8] Classic examples of languages with stressless feet are Cairene Arabic (Hayes 1995), Seminole (Tyhurst 1987) and Ceek (Haas 1977) (see Buckley 2009: §4.1 for discussion). In these languages, secondary feet need to be built to derive the correct location of main stress, notwithstanding their lack of secondary stress. Another example of a language with stressless feet is Kashaya (Buckley 1994, 2009). According to Buckley, this language "requires iterative feet for iambic lengthening": even though only one foot receives pitch prominence, the other feet and their foot heads are needed for the correct location of the lengthened syllable (Buckley 2009: 412). Further examples of languages with stressless feet come from various pitch-accent and tonal languages, which exhibit evidence for metrical structure but, very often, lack stress (see Chapter 6 and references therein).

An alternative interpretation for the existence of stressless feet appears in Crowhurst (1991, 1996), Crowhurst & Hewitt (1995), Hagberg (2006), Krämer (2009a,b) and Apoussidou & Nordhoff (2008). Rather than allowing a head to surface without stress, these authors propose that some feet are stressless because they are headless. As Buckley (2009) points out, sometimes it is empirically impossible to distinguish between the two approaches (a foot head without stress *vs.* a headless foot). However, the fact that in most of the languages with stressless feet one of their constituents displays some kind of phonological and phonetic prominence weakens the headless foot account. Thus, in this dissertation I will assume that feet that do not have stress still have a head. Note that the requirement that every foot has a head conforms better to the *relational* intrinsic nature of a foot: if the core motivation for this rhythmic unit arises from establishing a head-dependent relation between two elements, it is reasonable to assume that a foot will always have a head. Furthermore, in a way, "foot-dependent" is a derived notion: it presumes the existence of a head. Thus, even in cases of degenerate feet, the standard

[8] Bennett refers to this assumption as the Head Homomorphism Principle: "All stressed syllables are foot heads, though not all foot heads are stressed" (2012: 37).

assumption regards such feet as consisting of a head. That said, future research in the phonology of languages with stressless feet will help in clarifying whether headless feet should be completely ruled out from universal grammar or, by contrast, if they should be allowed in specific circumstances.

Although some studies have denied the role of the foot in determining the location of stress, the fact that the metrical foot serves as the domain of a wide range of non-accentual phenomena stands as clear support for theories like PHT, where the foot is not a mere artifact to derive stress, but it is a universal primitive to which phonology may refer. Hence, within PHT, the metrical foot is also the target and/or it can condition the application of non-accentual phenomena (see Nespor & Vogel 1986: § 3.2; Kenstowicz 1993; Rice 1992 and Bennett 2012 *inter alia* for discussion and concrete examples of non-accentual metrically-conditioned phenomena).

To illustrate the role of the foot in conditioning non-accentual phonological patterns, consider the distribution and deletion of *r* in what Harris (2013) defines as "broad non-rhotic" dialects of English. In the following table, Harris provides a summary of the contexts in which some consonantal reflex of historical *r* has been maintained or deleted in three different English dialects. Following Harris (2013: 333), the <+> indicates a consonantal reflex of historical *r* and the <−> indicates a (categorically or variably) vocalized or deleted reflex. The first two systems in the table illustrate the classical distinction between rhotic (R1) and (narrow) non-rhotic dialects (R2). The third system, described in detail in Harris' paper, illustrates the less-studied "broad non-rhotic" variety (R3), slightly different from the "narrow non-rhotic" dialects (R2). Note that the latter preserves rhotics in a great number of environments.

(11) Three English r-systems: rhotic (R1), narrow non-rhotic (R2) and broad non-rhotic (R3) (from Harris 2013: 333)

			R1	R2	R3
(a)	[*r*v́	**red, rack, rude**	+	+	+
(b)	[*r*v̆	**ravine, revolt, resort**	+	+	+
(c)	C*r*	**tray, agree, petrol**	+	+	+
(d)	V*r*v́	**around, terrain, bereave**	+	+	+
(e)	*r*v̆	**very, parent, sheriff**	+	+	−
(f)	*r*]v̆	**bear a, before a, poor again**	+	+	−
(g)	*r*]v́	**bear up, before eight, poor Eva**	+	+	−
(h)	*r*C	**board, cart, source**	+	−	−
(i)	*r*]C	**bear to, before nine, poor man**	+	−	−
(j)	*r* ‖	**bear, before, poor**	+	−	−

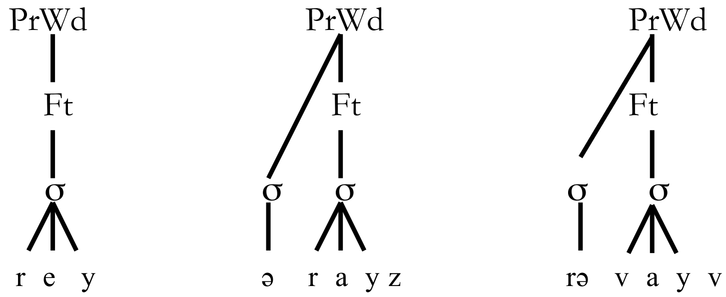
To illustrate the importance of the foot in conditioning the distribution of *r* in these English dialects, I here focus on the third system, drawing on Harris' (2013) data and analysis. As can be seen in (11), this system suppresses (or vocalizes) *r* preconsonantally (11h, i), in word- and phrase-final position (11f, g, i, j), and in some prevocalic contexts (11e-g). Namely, in intervocalic position *r* is variably deleted when the following vowel is unstressed (11e, e.g. *vé~~r~~y*, *Cà~~r~~olína*), but it is always preserved when the following vowel is stressed (11d, e.g. *aróund, paráde*) (Harris 2013: 335). However, as Harris remarks, stress alone cannot be the only conditioning factor determining the preservation/deletion of *r*, since the contexts in (11f, g) behave similarly despite the difference in tonicity of the vowel following *r*.

Harris offers a straightforward domain-based explanation for the locus of the retention of *r* and discusses the shortcomings of alternative analyses. In particular, based on the greater general phonetic and phonological prominence of initial positions within a prosodic domain, Harris proposes that speakers of R3 preserve rhotics in foot- and word-initial domains (see 12a below). The greater relative strength of initial elements in prosodic domains is a well-attested property of prosodic systems. Generally, more contrasts tend to be maintained in the initial constituents/segments of a domain, augmentation processes preferably target the initial elements of prosodic constituents (over medial or final elements), initial segments may resist better temporal compression, etc. In sum, there is wide phonetic, phonological and psycholinguistic evidence in favor of greater domain-initial strength (e.g. Trubetzkoy 1939; Steriade 1994; Pierrehumbert & Takin 1992; Byrd 1996; Fougeron & Keating 1997; Beckman 1998; Alber 2001; Keating et al. 2003; Smith 2005; Becker, Nevins & Levine 2012; Bennett 2012 *inter alia*). Given this, it makes sense that rhotics are only preserved in the foot- and word-initial domain. In the remaining environments (domain-medial and domain final), the *r* is deleted or vocalized (12b) (Harris 2013: 341-342). Without making any reference to the foot, it is difficult to capture the domain of *r* preservation in a unified and simple way.

(12) Broad non-rhoticity (from Harris 2013: 342)

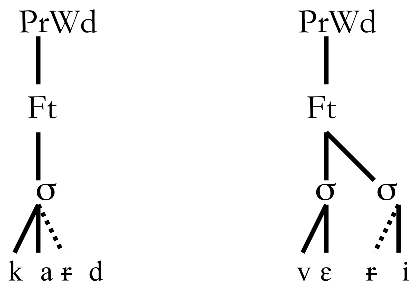
a. Domain-initial: r preserved

(i) ray (ii) arise (iii) revive



b. Domain-medial: r deleted (or vocalized)

(i) card (ii) very



Furthermore, building on Davis (1999), Harris draws an interesting parallelism between broad non-rhoticity and other segmental phonotactics in English, providing further support for his foot-based analysis. Davis (1999) had already shown that the preservation/deletion of [h] (13a) and the occurrence of aspirated and non-aspirated stops allophones (13b) may all receive a unified account if one can refer to the initial segments of a prosodic domain: segments (or the strongest variants of a segment) are maintained in the foot- and word-initial domain (see also Jensen 2000 and Davis & Cho 2003). Interestingly, Harris notes that the conditions that license the deletion of *r* in broad non-rhotic dialects correspond to licensing conditions for other phonological patterns in various English dialects, as illustrated in (13).

(13) The importance of the domain-initial position (from Harris 2013: 343)

a. <u>Defective *h*</u>

	Word	
Foot	Initial	Non-Initial
Initial	([h]it)	be([h]ind)
Non-initial	[h]is(tori)cal	(ve~~h~~i)cle

b. <u>Aspirated *vs.* glottalled t</u>

	Word	
Foot	Initial	Non-Initial
Initial	[t^h]in	re([t^h]ain)
Non-initial	[t^h]o(morrow)	(bi[ʔ]) (a[ʔ]las) (pi[ʔ]y)

To summarize, these data demonstrate that phonological non-accentual patterns can clearly benefit from allowing the phonology to refer to the foot. For further examples of foot-conditioned phonotactics in a wide range of languages, see, among others, Nespor & Vogel (1986: §3.2), Kenstowicz (1993), Rice (1992) and Bennett (2012).

Importantly, once I have introduced Itô & Mester's model in the next section, I will come back to some of the examples presented above and, based on previous proposals (e.g. Jensen 2000; Davis & Cho 2003; Davis 2005; Harris 2013), I will show that a recursive-foot based approach may complement the already presented insights of the foot/word-initial domain.

1.3.3 Recursion-based Subcategories

The research program of PHT has led to enormous insights in our understanding of suprasegmental phonology. Yet, the restrictive power of the theory has been somewhat weakened since its advent. Specifically, the strong universal hypothesis of PHT —the idea that every language contains a small number of hierarchically organized universal constituents and no more— has been substantially undermined by the proliferation of language-particular prosodic categories (e.g. the clitic group, the colon, the accentual phrase, the minor and major phonological phrase, etc.). This is best summarized in Itô & Mester's own words:

> The proliferation of prosodic categories, each empirically well-founded in specific cases, has resulted in a dissolution of the original tightly organized universal hierarchy into an ungainly collection of a large number of prosodic types, each instantiated here and there in

> different languages but never simultaneously realized within a single language (Itô & Mester 2013: 22)

Hence, contrary to the original motivations of PHT, "the underlying research program has valued the postulation of new descriptive categories over restrictiveness" (Itô & Mester 2007b: 4). Unfortunately, the explosion of language-particular prosodic categories seriously challenges the universality hypothesis of the prosodic hierarchy (i.e. the idea that there is a small number of universal prosodic primitives), one of the central theoretical desiderata of the overall research program.

A reasonable solution to this challenge has been explored, and modeled, in recent research by Itô & Mester (2007a,b, 2009a,b, 2012a, 2013). In particular, these authors have argued that the fixed number of universal prosodic primitives can still be maintained by broadening the structural possibilities of the hierarchy. Building on extensive research on prosodic recursion (*inter alia* Ladd 1986, 1996; Kubozono 1988, 2005; Gussenhoven 1991; Truckenbrodt 1999; Féry & Truckenbrodt 2005; Wagner 2005, 2010; Schreuder 2006), Itô & Mester propose that additional layers in the prosodic hierarchy may arise through recursion, specifically, through adjunction. The need for admitting prosodic recursion at *interface categories* (i.e. suprafoot categories) has been put forward in a number of studies, a few of which appear listed in (14).

(14) Prosodic recursion at interface categories

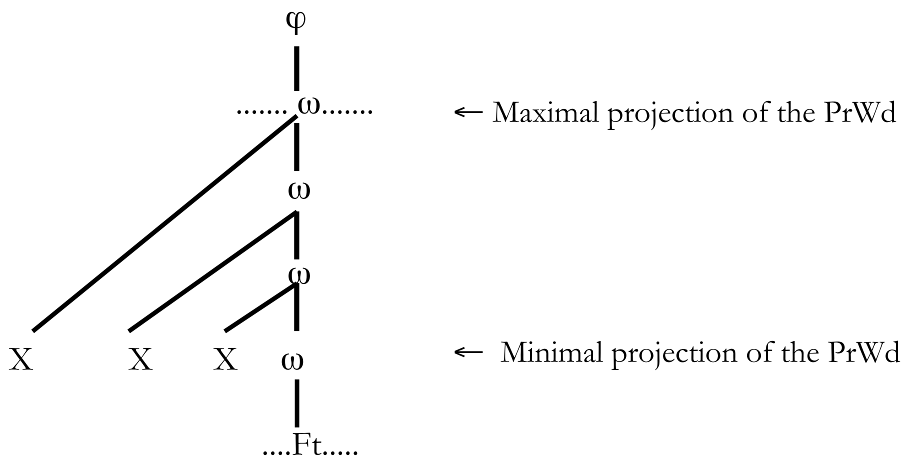
a. <u>Prosodic word (ω) recursion</u>
Booij 1996; Kager 1996a; Selkirk 1996; Féry & Truckenbrodt 2005; Peperkamp 1997; Raffelsiefen 1999; Anderson 2005; Itô & Mester 2007a, 2009a,b; Kabak & Revithiadou 2009.

b. <u>Phonological phrase (φ) recursion</u>
Gussenhoven 1991; 2005; Truckenbrodt 1999; Féry 2010; Elfner 2011, 2012; Schreuder *et al.* 2009; Hunyadi 2010; Itô & Mester 2012a, 2013.

c. <u>Intonational phrase (ι) recursion</u>
Ladd 1986; 1988; Féry 2010.

Itô & Mester formalize the insights of these works and propose that, just as syntactic heads can project and build more complex objects via recursion, prosodic constituents above and including the prosodic word can exhibit minimal and maximal projections of a given prosodic category via prosodic recursion. By exploiting this recursion-building-mechanism, the universality and restrictiveness of the prosodic hierarchy is preserved: there is no need to postulate new, independent prosodic categories. For instance, by allowing prosodic word-recursion (see 15 below) and permitting the reference of phonological processes to the minimal and maximal projections of the prosodic word, Itô & Mester accurately predict several phonological phenomena in Japanese, English and German, without introducing new categories to the hierarchy, as had been done in previous analyses.

(15) Prosodic word recursion (in Japanese compounds, Itô & Mester 2007a, in English and German function word complexes 2009a, b)



The concrete definition for minimal and maximal prosodic projections is given in (16), where α refers to any of the interface categories (i.e. any prosodic category above the metrical foot).

(16) Definitions from Itô & Mester (2007a, 2009a,b, 2012a, 2013: 22)

a. Maximal (projection of) $\alpha =_{def}$ α not dominated by α

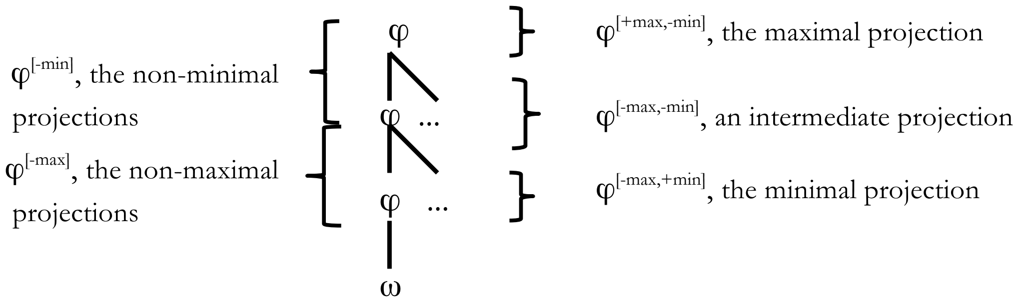
b. Minimal (projection of) $\alpha =_{def}$ α not dominating α

Itô & Mester employ the binary projection features [±max] and [±min] from Haider (1993: 40 and references therein) as a way to represent the natural classes of recursive subcategories. Thus, in addition to maximal and minimal projections, prosodic systems may display non-minimal and non-maximal projections (see Elfner 2011, 2012 for the need of non-minimal phonological phrase projections in Conamara Irish; further evidence for a "non-minimal" natural class will be presented later in this thesis).

(17) a. Non-maximal (projection of) α $=_{\text{def}}$ α dominated by α
b. Non-minimal (projection of) α $=_{\text{def}}$ α dominating α

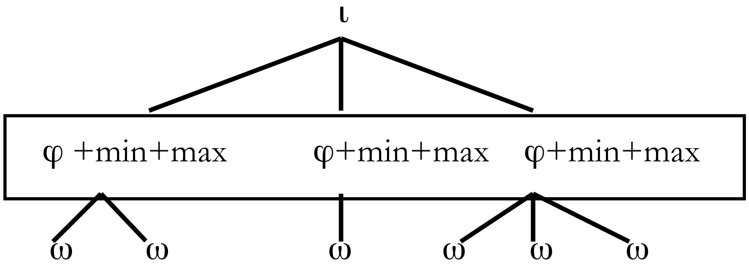
To exemplify the type of natural classes that might arise from the combination of the definitions in (16) and (17), consider (18). In this figure, Itô & Mester present the possible projections of a phonological phrase.

(18) Projections of the phonological phrase (from Itô & Mester 2013: 23)



Note that within this proposal, a category that does not display any instance of self-embedding (i.e. a non-recursive category) is maximal and minimal at the same time, as shown in (19).

(19) Non-recursive φ, i.e. neither dominating nor dominated by another φ



It is important to highlight that within this model the notations [±minimal/maximal] are not actually features, i.e. they are not independent units of the theory. They are just relational terms: they provide information about the structural relations of a given prosodic category. More specifically, they codify local domination relations. Thus, the specific characterization of a given category (α^i) as minimal/maximal/non-minimal/non-maximal can always be inferred by looking at its immediate prosodic layers (i.e. α^{i-1} and α^{i+1}). On the one hand, if a given α^i is dominated by another α, we immediately know that this α^i is a non-maximal projection of α; if α^i dominates another α, α^i is non-minimal. On the other hand, if α^i is dominated by a different category (i.e. β), this α^i is a maximal projection of α; similarly, when α^i immediately dominates a different category (i.e. β), this α^i must be the minimal projection of α.

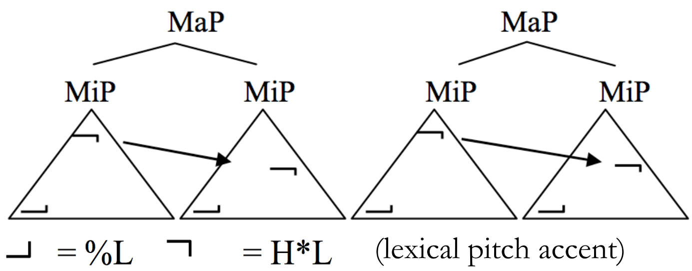
At first sight, and without illustrating the Recursion-based Subcategories model with a concrete language example, one could think that the new recursive layers (i.e. minimal, maximal, non-minimal, non-maximal) are mere notational variants for independent, novel prosodic categories. If that were the case, the recursive model would not be a real alternative to the proliferation of language-particular categories. As Itô & Mester carefully show in a number of studies, however, there are important differences between the *single-category approach,* based on recursion, *vs.* a model that posits *additional language-particular categories*. Crucially, the former is superior in its explanatory and restrictive power (for details, see Itô & Mester 2007a,b; 2009a,b; 2012a; 2013). To demonstrate this, consider Itô & Mester's (2012a, 2013) analysis of several phrasal phenomena in Japanese.

Traditionally, many scholars have posited two phrasal categories in Japanese, introducing an additional category to the prosodic hierarchy (i.e. the 'major' or 'intermediate' phrase and the 'minor' or 'accentual' phrase) (e.g. McCawley 1968; Haraguchi 1977; Poser 1984; Beckman and Pierrehumbert 1986; Kubozono 1988; Selkirk and Tateishi 1988 among others). The main argument for such a distinction is that each category is the domain of a different process, as shown in (20).

(20) Two phrasal categories in Japanese (Itô & Mester's 2012a: 283, 2013: 23)

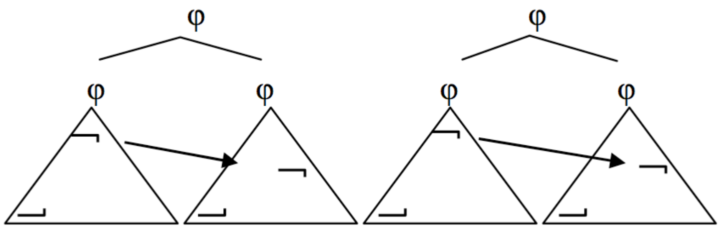
a. Minor phrase (MiP)
- Domain of accent culminativity
(i.e. at most one accent per MiP)
- Domain of initial raise

b. Major phrase (MaP)
- Domain of downstep



However, Itô & Mester (2012a) demonstrate that there is no need to refer to two independent language-particular categories but, to the contrary, these phenomena can be modeled with a *single* and *undifferentiated* phrasal category, once the phrase is allowed to undergo recursion:

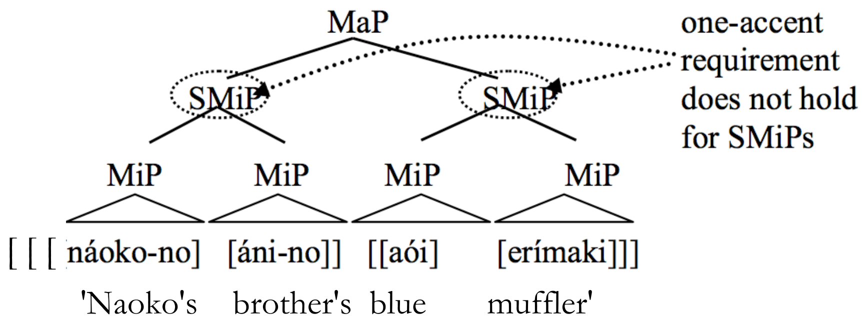
(21) Single-category approach



Let's briefly review a few of the arguments in favor of (21) over (20) (for a complete analysis and list of all the arguments in favor of (21), the reader is referred to Itô & Mester 2012a and 2013).

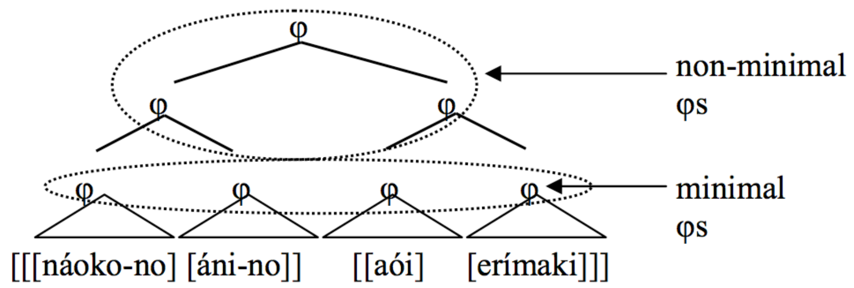
On the one hand, Itô & Mester (2012a: 288) show that the two-phrases approach does not provide enough structure to represent the ways downstep is realized in Japanese (based on Kubozono 1993: 205-208). For example, consider a sequence of four accented MiP's, with the grammatical structure [ÁB́] [ĆD́]. This structure is realized in Japanese with downstep throughout and, thus, constitutes a single MaP. However, the third constituent (i.e. C) has a systematically higher pitch than what would predict the flat prosodic structure [MiP MiP MiP MiP]$_{MaP}$. In light of these facts, Kubozono (1989: 58-59) posited that the metrical boost at the beginning of the third constituent is a reflex of a binary, recursive MiP, e.g. [[MiP MiP]$_{MiP}$[MiP MiP]$_{MiP}$]$_{MaP}$. However, this type of structure makes an undesired prediction: the recursive MiPs should have only one accent (respecting accent culminativity). The fact is, however, that they each have two accents (Shinya, Selkirk and Kawahara 2004). To avoid the undesired prediction, another intermediate category between MiP and MaP was introduced in Japanese: the Superordinate Minor Phrase (SMiP). This category *took care* of the metrical boost in C, while the culminativity requirement was restricted to MiP. This is illustrated below in (22).

(22) Three phrasal categories in Japanese (from Itô & Mester 2012: 290)



Itô & Mester (2012) show that by positing only one phrase, the same facts can be predicted in a simpler way, without the need to enlarge our assumptions about universal grammar. This is illustrated in (22): the minimal projection of the phrase is the domain of culminativity and the metrical boost is associated with a phrase in a right branching, recursive configuration, which is necessarily non-minimal (see Itô & Mester (2012a) for further compelling arguments in favor of the single-category approach).

(22) Recursion-based approach (from Itô & Mester 2012a: 290)



1.3.4 Interface *vs.* rhythmic categories

In the Recursion-based Subcategories model, recursion is restricted to *interface categories* (i.e. prosodic categories above the foot). Since syntactic structure can be recursive, it is not surprising that a certain degree of recursion is inherited and/or reflected in the prosodic structure of these categories, regulated to a great extent by syntax-phonology mappings. The situation is different in the parsing of *rhythmic categories* (i.e. the foot, the syllable or the mora). As pointed out by Itô & Mester, the definition of these categories is fundamentally distinct from interface categories since it mainly attends to sonority and/or rhythmic factors. Building on this difference, Itô & Mester restrict recursion to prosodic categories that have a closer relation with syntax, i.e. the prosodic word and other word-external categories.

Such an interpretation of the facts, however, disregards the idea that the interaction of purely prosodic constraints might also cause prosodic recursion. As exemplified below in (23), the particular interaction of three well-established prosodic constraints might give rise to recursive prosodic structure too. More specifically, this tableau shows that a phonological phrase can occasionally undergo recursion when the NONRECURSIVITY constraint is ranked below other markedness constraints; namely, when it is ranked below EXHAUSTIVITY and BINARY(φ). The definition of EXHAUSTIVITY and NONRECURSIVITY was already given above in (6), when I presented the constraints on prosodic domination. Recall that EXHAUSTIVITY bans "level skipping" (Itô & Mester 1992/2003; Selkirk 1996); the specific non-recursivity constraint *RECURSIVE(φ) in (23) prohibits recursive phonological phrases. Finally, the third prosodic constraint in (23) is BINARITY, one of the most well-established constraints on the shape/structure of prosodic categories, which favors binary branching categories (Inkelas & Zec 1990; Itô & Mester 1992/2003; Selkirk 2011; Elfner 2012). In particular, BIN(φ) in (23) favors binary branching phonological phrases. Interestingly, when BIN(φ) and EXHAUSTIVITY are ranked above *RECURSIVE(φ), three prosodic words can be parsed via φ-recursion (23c). Alternative parsings in which a word is directly linked to the intonational phrase (23a) or the three words are parsed in one phonological phrase (23b) are ruled out because these candidates violate the more highly ranked EXHAUSTIVITY and BINARY(φ) constraints, respectively.

(23) EXHAUSTIVITY, BIN(φ) >>*REC(ω)

ω ω ω	EXHAUST	BIN(φ)	*REC(φ)
a. [[ωω]$_{\varphi}$ ω]$_{\iota}$	*!		
b. [ω ω ω]$_{\varphi}$		*!	
☞ c. [[ω ω]$_{\varphi}$ ω]$_{\varphi}$			*

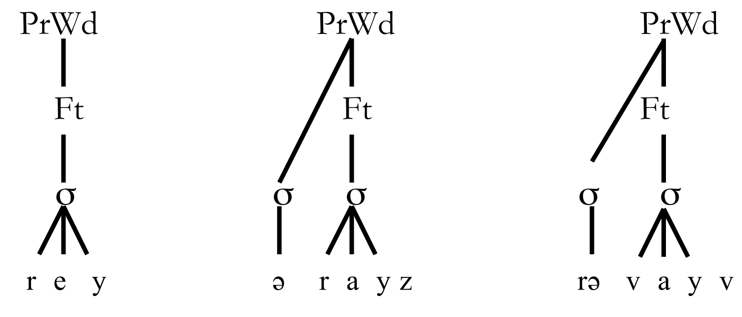
In short, since purely phonological markedness constraints may give rise to recursion at higher layers of the hierarchy, it would not be completely unreasonable if similar constraints created recursive prosodic structure below the prosodic word. In fact, it is one of the goals of this thesis to explore the hypothesis that the rhythmic category of the foot displays limited recursion, i.e. just one layer of recursion. In the next chapter I show that a ranking similar to the one in (23) gives rise to recursive feet in prosodic representations. Although the syllable and the mora could, in principle, undergo recursion too, the exploration of such a possibility remains out of the scope of this thesis (but see Lorentz 1990; Smith 1999; Morén 2007; van der Hulst 2010; Iosad 2013). Despite the shared "rhythmic" nature of word-internal categories (foot, syllable, mora), these constituents are sufficiently different from each other so that arguments in favor of recursion at the level of the foot may not necessarily hold at subsequent levels of the hierarchy.

Once foot-recursion is incorporated as a metrical parsing mechanism, and feet larger than two syllables are admitted in prosodic representations, one might wonder why recursion should be *limited*, excluding unbounded feet (i.e. feet with unlimited recursion, cf. Halle & Vergnaud 1987; Halle 1990 *inter alia*) from representations. The scarcity of evidence for such feet (e.g. Prince 1985; Kager 1989; McCarthy & Prince 1986/1996; Vaysman 2009, Bennett 2012 *inter alia*) and the undesired typological strength predictions that arise from feet with unlimited recursion, provides strong support for the upper limit on the number of layers of recursion allowed at the foot level (see Chapter 2 for discussion).

In the remainder of the thesis I discuss the motivations that might cause recursion at the level of the foot and the empirical and theoretical predictions of a framework that allows minimal recursive footing in metrical representations. As a brief preview of the benefits of introducing recursive footing in phonological representations, consider the third representation in (24), where I return to the context of preservation of *r* in the "broad-rhoticity" English systems discussed in Section 1.3.2.

(24) Domain-initial: r preserved

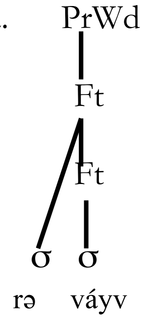
(i) ray (ii) arise (iii) revive



Recall that *r* was preserved in word- and foot-initial domain. However, as Harris (2013) suggests, there is a possibility to collapse both domains into one. Specifically, this can be done if one assumes that the first syllable in *revive* is adjoined to the following foot in a subsequent projection of a foot (25). Under this analysis, it can be stated that the domain where *r* is preserved is the foot-initial domain.

(25) Foot recursion in English (Harris 213: 347)

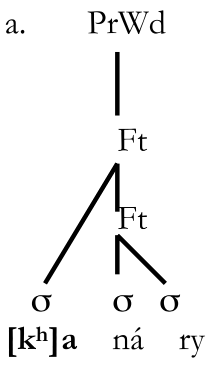
a.



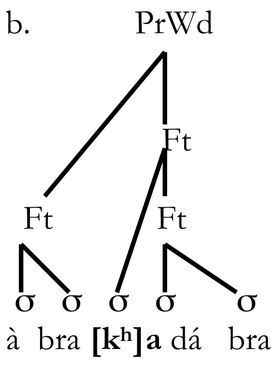
Such an interpretation of the facts matches previous findings in English, where this extra-foot layer was independently needed to account for the distribution of aspirated and unaspirated stop allophones (e.g. Kiparsky 1979; Whitgott 1982; Jensen 2002; Davis & Cho 2003; Davis 2005, see Chapter 5 for further details) as well as some prosodic phonological patterns (e.g. expletive infixation, McCarthy 1982; Homeric infixation, Yu 2003, 2004). Interestingly, as can be seen in (26), the need to refer to a recursive foot is not just a matter of elegance: without allowing recursive footing, the foot-/word-initial domain account alone cannot predict the aspiration of the stop in the third syllable in *abracadabra* (26b). However, if the third syllable is parsed with the subsequent foot rather than left unfooted, it is clear why this consonant is aspirated (Jensen 2000 based on Whitgott 1982; Davis & Cho 2003; Davis 2005).[9]

(26) Foot recursion in English

a.



b.



[9] In Selkirk's (1980) analysis of English stress, which also allows recursive feet, the third syllable in *abracadabra* is parsed instead with the preceding foot, creating a dactyl (e.g. ((a.bra)ca)(dabra). Even though such a structure predicts the correct location of stress, the above mentioned studies show that adjoining this syllable to the following foot instead provides a straighforward explanation for its aspiration.

Positing a different category (e.g. a superfoot, a colon) rather than recursion at the level of the foot would entail a loss in restrictiveness. Not only would it be predicted that such an intermediate category should be instantiated in other languages, but the analysis of English would need to stipulate the superfoot-initial domain as another environment where *r* is preserved, and consonants aspirate.

Finally, it should be highlighted that even if I slightly depart from Itô & Mester in that I allow a rhythmic category to undergo recursion, the distinction between *interface categories* and *rhythmic categories* will be shown in Chapter 2 to still be a useful one in the present model. In particular, in the next chapter I show that the rhythmic nature of the foot precisely conditions the number of recursive layers this category permits.

1.3.5 Bounded metrical constituents larger than a binary foot

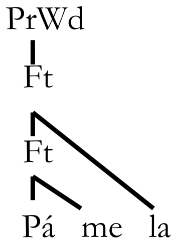
As I anticipated in the introduction, the proposal to relax the two syllable restriction on foot size has already appeared in earlier works on foot structure. The general idea within these studies is that the foot inventory should include some sort of trisyllabic foot —either with ternary flat structure, e.g. (σσσ), or binary branching internal layering, e.g. ((σσ)σ)— or the prosodic hierarchy should incorporate an additional, independent rhythmic category in between the foot and the prosodic word (e.g. the colon, superfoot, etc.). This section briefly highlights the main properties of these proposals, drawing the similarities/points of divergence with respect to the present model.

1.3.5.1 Restricted recursion at the level of the foot

In their early works on foot structure, Selkirk (1980) and Prince (1980) already proposed that a metrical foot could undergo recursion by adjoining an unstressed syllable to a preceding/following binary foot. For instance, in her analysis of English word stress, Selkirk included a 'stress superfoot' among the types of possible feet in English. This 'superfoot' consisted of a foot followed by another syllable (Selkirk 1980: 570).[10]

[10] In later studies, feet that have an adjoined syllable to a following foot are shown to be needed in English too, e.g. McCarthy 1982; Jensen 2000; Davis & Cho 2003; Davis 2005; Bermúdez-Otero & McMahon 2006; etc., as discussed above.

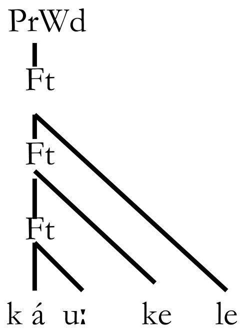
(27) Superfoot in English = foot + adjoined syllable (Selkirk 1980: 571)



Even if Selkirk employed a different label for this new layer, the structure and status of her *superfoot* is similar to the type of recursive foot put forward in this thesis. That is, *foot* and *superfoot* were actually conceived as instances of the same prosodic category, being the domain of similar processes (see Selkirk 1980 for details).

Prince (1980) also proposed that a foot could be recursive in his account of stress assignment and quantity distributions in Estonian. However, Prince's proposal slightly differed from Selkirk's (and the one argued for in this thesis) in that he occasionally allowed two layers of foot embedding (rather than only one), in cases where the innermost foot was a heavy syllable, as in (28).

(28) Two maximal layers of foot-recursion (Prince 1980: 528)



'far away'

This restriction on the shape of the inner foot ensured that feet with four light syllables and two layers of recursion, e.g. $(((\sigma\ \sigma)_{\mathrm{Ft}}\ \sigma)_{\mathrm{Ft}}\ \sigma)_{\mathrm{Ft}}$ were precluded in Estonian. In Chapter 2, I discuss some of the problems with such a type of foot. Note that even if Prince allowed two layers of recursion rather than only one, his proposal parallels Selkirk's and the present one in not allowing feet with more than three syllables.

After Selkirk (1980) and Prince (1980), subsequent studies demonstrated that the use of recursion at the level of the foot was not only useful in the account of phonological patterns, but prosodic morphology phenomena clearly benefitted from recursive foot-based accounts. For example, McCarthy

(1982) and Yu (2003, 2004) have demonstrated that a recursive-foot based account of expletive infixation (e.g. *fan-fuckin-tastic*, *Tata-fuckin-magouchee* or *Tatama-fuckin-gouchee*; McCarthy 1982) and Homeric infixation (e.g. *Missi-ma-ssipi*, *saxo-ma-phone*; Yu 2003, 2004) shed light in the locus where the infixes occur. Namely, once phonology can refer to the boundaries of feet, the location of infixes within the word becomes straightforward (see e.g. McCarthy 1982: 581 and Yu 2004 for details). Even though McCarthy (1982) referred to this extra-foot layer as if it were indeed an independent category in the hierarchy, his treatment of the *superfoot* and the analysis he provides of other foot-conditioned phonotactics (e.g. flapping, see McCarthy 1982: 582 and Chapter 5) are consistent with a proposal under which *foot* and *superfoot* are not two different categories but just two different layers of a unique prosodic category, i.e. the foot.

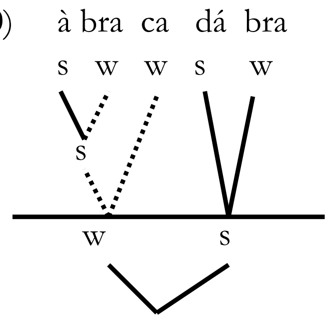
Similarly, more recent research (e.g. Jensen 2000; Zoll 2004; Caballero 2008, 2011; Bennett 2012; Martínez-Paricio 2012; Morén-Duolljá 2013) has invocated and explored the usefulness of introducing recursive footing in particular languages. This thesis pays tribute to all these previous studies aiming at exploring in detail the implications, benefits and predictions of a metrical model that allows limited recursion at the foot level in metrical representations.

1.3.5.2 Stray syllable adjunction

Even in works that explicitly banned ternary feet as a primitive of the theory, some sort of recursive metrical structure could occasionally arise due to the effect of a late operation in the derivation; namely, due to *Stray Syllable Adjunction* (e.g. Hayes 1980; Kager 1989). This operation, which is defined in (29), was originally proposed in Hayes (1980) and it adjoins unstressed syllables that belong to no foot —either because they were extrametrical or because their foot had been removed— to an already constructed foot. Thus, in some cases, even if *late in the derivation*, final metrical representations could contain feet with adjoined material. This is illustrated in (30), with Hayes's representation for *abracadabra* once all the stress/destress rules have applied. In this representation Hayes uses the strong/weak labeling to indicate head/dependent; everything that appears above the horizontal line signals a foot.

(29) Stray Syllable Adjunction (Hayes 1980: 73)
Adjoin a stray rime as a weak member of an adjacent foot.

(30) (Hayes 1980: 180)

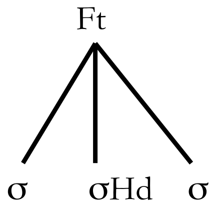


The three first syllables in (30) give rise to a trisyllabic foot. Note that Hayes, like Selkirk (1980), only allowed feet with right adjuncts; however, as I already discussed above, later studies on English aspiration showed that adjoining feet with left adjuncts in English provides a better account for the domain of aspiration (Jensen 2000).[11]

1.3.5.3 Ternary feet

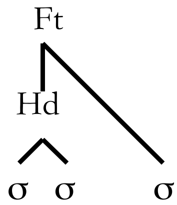
Most of the cases in which some sort of ternary foot has been proposed in the literature aimed at modeling ternary rhythmic alternations (see Rice 2011 and references therein). Ternary feet have come in two flavors: ternary branching feet (31a) and ternary feet with internal binary branching structure, implicating an intermediary binary head (31b).

(31) a. Ternary flat feet



E.g. Levin 1985, 1988; Halle & Vergnaud 1987; Halle 1990; Buckley 2009

b. Ternary feet with binary heads



E.g. Dresher & Lahiri 1991; Rice 1992, 2006a; Hewitt 1992; Kager 1994, 2012; Blevins & Harrison 1999

[11] Prince (1985) also exploited the *Stray Syllable Adjunction* operation. Namely, he proposed that in unbounded stress systems, stray syllables were later "connected to metrical structure" (p. 472). However, Prince directly adjoins such stray syllables to the prosodic word (Prince 1985: 473, 478) and, thus, his maximal foot is bisyllabic.

The only type of ternary branching foot that was allowed in the works cited in (31a) was an amphibrach, i.e. a ternary foot in which the head of the foot was flanked by two unstressed syllables. The ban on dactyls (trisyllabic feet with the foot head in the first branch) and anapests (trisyllabic feet with a foot head in the final branch) had a typological explanation: the only trisyllabic foot that seemed to be needed in order to derive all the attested ternary rhythmic systems was the amphibrach. For the sake of developing a maximally restrictive theory, the other ternary feet were considered to be impossible. However, later studies have shown that other types of (internally layered) ternary feet are in fact required in order to account for certain attested stress patterns (e.g. Caballero 2008, 2011; Kager 2012, Martínez-Paricio & Kager 2013).

As I discussed in the introduction, ternary flat feet were dispreferred on the basis of locality. Furthermore, they were severely criticized on the basis of their undesired typological predictions regarding word minimality restrictions and patterns of reduplication (see McCartney 2003 for an overview of the problems with ternary flat feet). Apart from the need to model ternary stress, there was not much independent evidence for ternary branching feet and, thus, they were soon abandoned.

Instead, some scholars proposed that ternary feet were in fact internally layered. In particular, it was proposed that ternary feet consisted of a binary head and a non-head as represented in (31b) (*inter alia* Dresher & Lahiri 1991; Rice 1992; Kager 1994, 2012). This type of representation is fairly similar to the one advocated in this thesis with recursive feet. The main difference lies in the status of the innermost binary constituent: within recursive-foot based accounts such a constituent is a foot *per se*; within the binary head approach, however, it is a head of a foot. Although this difference between the two models could be felt as a notational variant for the same constituent, in several discussions throughout the dissertation I will show that the two approaches make different predictions regarding the relative strength of the constituents of a foot. Thus, even if a minimal binary foot can be considered to be the structural head of a maximal foot, it is crucial that this innermost foot has its own foot status (for discussion see Chapters 2, 4 and 6).

1.3.5.4 Independent category

Rather than positing a recursive foot (Section 1.3.5.1) or a ternary foot (Section 1.3.5.3), a number of works have instead proposed the introduction of an additional category between the prosodic word and the foot, referred to as the *superfoot* or the *colon* (see, among others, Hammond 1987 on Hungarian; Giles 1988 on Lillooet; Green 1997 on Irish; van Oostendorp 1995 on Dutch; Everett 2003 on Panumari; and Michael in press on Iquito).

(32)
PrWd
|
Colon/Superfoot
|
Ft
|
σ
|
μ

The *superfoot* or the *colon* never had much success in the prosodic literature because they entailed the postulation of a new descriptive category. As argued by Itô & Mester, by introducing language particular categories, the universal hierarchy clearly looses some of its restrictive power. In addition, this new category was not defined in a unified way but, on the contrary, all types of *superfeet/cola* were proposed within the same or different languages (e.g. superfeet consisting of a foot and a syllable, of two feet, of a binary foot, a degenerate foot, etc.). Unlike these unrestricted and category-based definitions, the *superfoot/colon* domain is conceived in this thesis not as an independent additional category in the hierarchy, but a non-minimal projection of the foot, which may occasionally arise via the operation of prosodic adjunction.

1.4 Summary

This chapter has presented the main hypothesis to be explored in the dissertation (i.e. the idea that a syllable can be adjoined to a preceding/following foot, giving rise to a recursive foot) and set the theoretical framework in which this thesis is framed. First, I have outlined the insights to be found in the thesis and briefly discussed the general topics that will be further developed in each chapter. Second, I have introduced the main tenets of the theory in which the dissertation is couched: Prosodic Hierarchy Theory and, more specifically, the model of Prosodic Recursion and Prosodic Subcategories of Itô & Mester (2007 *et seq.*), paying particular attention to the role of the foot within the theory. The chapter has ended by briefly reviewing previous metrical proposals in which some sort of recursive or ternary (or even bigger) foot had been sporadically called into play in the phonology of particular languages and concluded that a single-category approach to metrical phenomena should be preferred.

Now that the reader is familiar with the hypothesis and general goals of the dissertation, I will proceed by looking more closely at the implications and predictions of the recursive-foot based hypothesis and present the architecture of a metrical model that allows recursive feet in phonological representations.

2 Architecture of the theory

This chapter serves as a cornerstone for the rest of the thesis, outlining the basic architecture of a metrical framework that allows recursive footing in phonological representations. In particular, I present here the principal representational assumptions and phonological constraints adopted in the thesis. By doing so, I preview the major motivations for recursive footing in natural language and provide an overview of the crucial empirical and theoretical predictions.

2.1 Introduction

As I mentioned in Chapter 1, this dissertation is couched within the theory of prosodic recursion and prosodic subcategories of Itô & Mester (2007a,b, 2009a,b, 2012a, 2013). According to these authors, it is possible to maintain a small number of universal prosodic primitives, and still account for a wide range of language-particular phenomena, as long as the structural possibilities of the prosodic hierarchy are enlarged. In particular, Itô & Mester enriched the relational side of the prosodic hierarchy by admitting additional layers into the hierarchy via recursion, in the form of prosodic adjunction (§1.3.3).

In Itô & Mester's framework, the mechanism of prosodic recursion is limited to higher-levels of the hierarchy due to their closer relation with syntax. This dissertation proposes minimally relaxing this restriction, exploring the possibility that metrical feet allow one instance of recursion under very specific circumstances. Although this idea is not completely new in the literature (see Section 1.3.4 in the previous chapter for references), the present study constitutes the first systematic investigation of the empirical and theoretical consequences of a metrical framework that recognizes this type of recursive constituent in phonological representations. Four findings in previous research led to the current re-examination of the recursivity hypothesis.

First, various prosodic studies had demonstrated that constraints regulating the correspondence between syntactic constituents and phonological constituents are not exclusively responsible for the prosodic properties of word-external categories. For instance, Itô & Mester's (2012a, 2013) own work on Japanese pitch accent and intonation, together with Elfner's (2011, 2012) analysis of the distribution of pitch in Conamara Irish, demonstrate that purely prosodic well-formedness constraints (e.g. BINARITY, which enforces prosodic categories to be binary, Inkelas & Zec 1990; Itô & Mester 1992/2003; Ussishkin 2000; Selkirk 2011; Elfner 2012) are crucial in shaping the prosodic structure of interface prosodic categories (i.e. categories above the prosodic word). Since prosodic constraints have a say in the emergence and/or absence of prosodic recursion across languages, it is not completely unexpected that the rhythmic category of the foot might exhibit a certain degree of recursion, assuming the relevant constraints that cause recursion are high-ranked. In fact, in Martínez-Paricio (2012) and in this thesis, I argue that a possible way of performing better with respect to the prosodic constraints that require binary branching feet (e.g. FOOTBINARITY, Prince 1980) and exhaustive parsing of syllables (EXHAUSTIVITY, Selkirk 1996) is to adjoin a syllable to a preceding/following foot (for similar ideas in recent research see Bennett's 2012 analysis of Huariapano coda [h] epenthesis, of which a summary of the analysis is presented in Chapter 3).

Second, the idea that the phonology of some languages needs to refer to an intermediate layer between the level of the foot and the prosodic word, sometimes designated as the *superfoot* or the *colon*, has been occasionally appealed to in the literature to account for a wide range of phonological phenomena (e.g. McCarthy 1982; Hammond 1987; Green 1997; van Oostendorp 1995; Davis 2005 *inter* alia). In a sense, this thesis incorporates the insights of these studies, but instead of appealing to a new category in the prosodic hierarchy, it employs the already available category of the foot, following Selkirk's (1980), Prince's (1980) and Hayes's (1980) original idea that languages can adjoin unstressed syllables to a binary foot via adjunction. Remember from previous discussion that the *single category* approach by which the constituent that arises after adjoining a syllable to a foot is still a foot

—and not a different or new category in the hierarchy— is inherently more restrictive than one that enlarges the set of universal categories (see Itô & Mester 2007 *et seq.* and Chapter 1 for details on the greater restrictive power of the single-category approach).

Third, this dissertation incorporates the insights of previous research on metrical stress that had called into question the binary restriction on the maximum number of constituents of a foot on the basis of ternary rhythm, i.e. the phenomenon by which stress is placed on every third syllable or mora, rather than on every second one (Levin 1985, 1988; Halle & Vergnaud 1987; Hammond 1990; Dresher & Lahiri 1991; Hewitt 1992; Rice 1992; Blevins & Harrison 1999; Caballero 2008, 2011 *inter alia*). Interestingly enough, if the mechanism of prosodic adjunction is allowed to build a maximal projection of a foot by adjoining a syllable (or a mora) to a preceding/following foot (e.g. $[((\text{ˈ}\sigma\sigma)_{Ft}\ \sigma)_{Ft}\ ((\text{ˈ}\sigma\sigma)_{Ft}\ \sigma)_{Ft}]_{PrWd}$) it is not surprising that some languages exhibit ternary effects. This idea is further developed in Chapter 4, where I reanalyze in recursive-foot terms a few languages with ternary rhythm (Chugach, Tripura Bangla and Cayuvava) and in Martínez-Paricio & Kager (2013).

Finally, Kager's (2012) recent typological survey and analysis of stress-window systems has demonstrated that a model that assumes representations with weakly layered feet (i.e. internally layered ternary feet) is the only one capable of accounting for the whole typology of stress-window systems while avoiding the prediction of pathological rhythmic effects like the *midpoint pathology,* i.e. when stress is drawn to the center of the prosodic word rather than to the edges (Eisner 1997).[1] I believe that these four facts constitute sufficient motivation for investigating the hypothesis that natural languages can undergo limited recursion at the level of the foot. The primary enterprise of this dissertation is, therefore, to explore this hypothesis and investigate the predictions and motivations of a theoretical model that allows for a contrast between recursive and non-recursive feet.

Before discussing the full representational and computational details of the present theory, it is necessary to make an important clarification. Even if the aim of this thesis is to demonstrate that the mechanism of prosodic recursion is no longer restricted to higher prosodic categories in the prosodic hierarchy (i.e. the prosodic word and above), I do not intend to blur the clear-cut difference between *interface* categories and *rhythmic* categories. On the contrary, as I will show, the different nature of the two groups of categories manifests in different types of motivations for and restrictions on recursion at each layer of the prosodic hierarchy. Whereas prosodic words and higher categories in

[1] For recent discussion on the causes of this metrical pathology, see Hyde (2012a).

the hierarchy display unquestionable evidence for multiple layers of recursion due to the greater influence of constraints on syntax-phonology mappings, I argue that the metrical foot is different from the other categories in that it only allows one layer of recursion. Furthermore, whereas interface categories can exhibit instances of recursive structures in which a maximal projection of a category K^x contains two self-embedded identical categories (i.e. K^{x-1}, K^{x-1}), I will show that a maximal projection of a foot Ft^x can dominate at most one foot (Ft^{x-1}). This Head Uniqueness Principle ensures that the adjoined constituent in a foot is always a lower-level category, i.e. a syllable (and occasionally, a mora; for details see Section 2.2.3.2).

Likewise, it is important to clarify beforehand that the present dissertation only explores the extension of the recursivity hypothesis to the level of the foot. As I anticipated in Chapter 1, the reader will not find any claim with respect to the possibility of encountering recursion at lower levels of the hierarchy (some preliminary work exploring this issue can be found in Lorentz 1990; Smith 1999; Morén 2007; van der Hulst 2010 and Iosad 2013). The inherent relational and rhythmic nature of a foot makes it substantially different from other lower level categories like syllables and/or morae and, consequently, the fact that feet might undergo recursion does not necessarily entail that lower level categories will also do so.

After these clarifications have been made, in the following sections I first provide the structural definition of the possible types of feet allowed in the present model and discuss general issues regarding the predictions of the phonological representations adopted in the thesis (Section 2.2). Secondly, I present the main motivations and constraints responsible for the emergence and location of such feet in natural languages (Section 2.3).

2.2 Phonological representations

2.2.1 Definitions of minimal and maximal feet

Building on the theory of prosodic recursion and prosodic subcategories developed by Itô & Mester (2007 *et seq.*) —which has recently received further support in other scholars' work (e.g. Elfner 2011, 2012; Selkirk 2011; Bennett 2012), I assume phonology can distinguish between minimal and maximal feet (1).

(1) Projections of a metrical foot Ft (based on Itô & Mester 2007 *et seq.)*

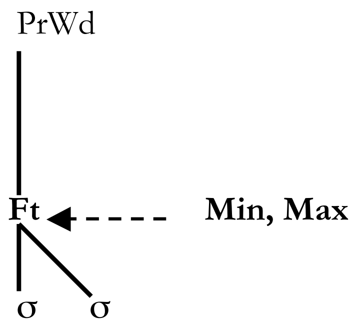
- Maximal: Ft not dominated by Ft — The largest projection of Ft
- Minimal: Ft not dominating Ft — The smallest projection of Ft

Along the lines of Itô & Mester, I do not consider "minimal feet" and "maximal feet" to be independent categories in the hierarchy or prosodic features. On the contrary, I assume that *minimal/maximal* are structural terms that can be fully and locally inferred from domination relations. When applied to the category of the foot, the labels *minimal/maximal* codify structural information about metrical representations: they capture information about the specific daughter of a foot (i.e. whether a particular foot dominates one or two syllables —in which case the foot is *minimal*— or dominates another foot —in which case it is *non-minimal*) and/or its mother node (i.e. whether a foot is dominated by the prosodic word —in which case the foot is *maximal*— or by another foot —in which case the foot is *non-maximal*).

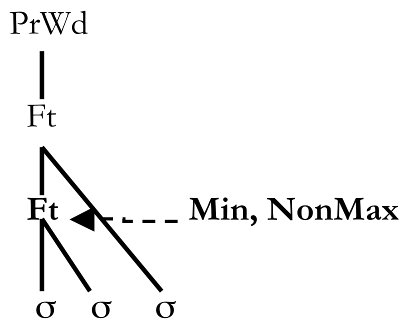
The representations below illustrate the four possible types of foot projections that arise by freely combining the relational terms *minimal* and *maximal* in their positive and negative values (2). In these representations, the adjoined constituent is always a syllable, although other options (namely, the possibility of directly adjoining morae) will be discussed in Section 2.2.3 and Chapter 6. For ease of presentation, in (2) I exemplify the four different vertical options for foot projections with a trochee that contains an adjoined syllable. Note that the same types of foot-projections might occur with iambic feet and, similarly, the relative position of the adjunct may vary across languages (i.e. in some languages the adjoined syllable is on the right of the foot, as in (2), whereas in others it is on the left).

(2) Theoretically possible foot projections

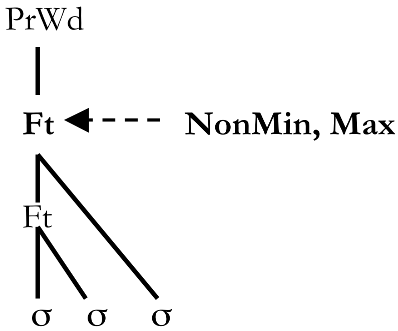
a. Minimal & maximal



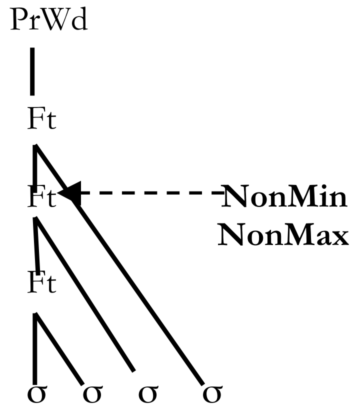
b. Minimal & non-maximal



c. Non-minimal and maximal



d. *Non-minimal & non-maximal



The first structure (2a) represents a traditional foot, i.e. a foot that dominates a syllable and is itself dominated by the prosodic word. It consists of only one projection and, therefore, it is characterized as both minimal and maximal. The second figure (2b) represents a minimal foot that is embedded in another foot. Since it does not constitute the highest projection of the foot, it is non-maximal. The third representation in (2c) is identical to (2b), but the highlighted foot projection is different: in (2c) the highlighted foot dominates a foot (i.e. it is non-minimal) and it is dominated by the prosodic word (i.e. it is maximal). Importantly, most of the evidence that I will present in this thesis in favor of a theoretical model that recognizes recursive footing (i.e. non-minimal feet) in phonological representations comes precisely from the fact that several metrically-conditioned processes need to distinguish between a minimal foot (2a, 2b) and a non-minimal foot that is maximal (2c). The findings of this thesis thus provide further support for Elfner's proposal (2011, 2012), by which phonological phenomena can target non-minimal projections of prosodic categories (see also Itô & Mester 2013 for additional evidence of the phonological activity of non-minimal projections of prosodic categories). Finally, the foot projection highlighted in (2d), which represents an *intermediate* foot (i.e. neither the highest nor the lowest projection of a foot), is a non-maximal and non-minimal foot. By definition, intermediate projections are adjacent to identical categories hierarchically above and below; in (2d), the intermediate foot is dominated by and dominates another foot. In Section 2.2.3.2 I will provide several reasons for banning intermediate foot projections from universal grammar (UG). Although intermediate projections do arise at other layers of the hierarchy (e.g. Itô & Mester's 2013; Elfner 2012), I have not found real empirical evidence that would motivate arguing for the existence of intermediate feet. Even though the lack of evidence does not constitute a strong or sufficient argument for banning a specific structure from universal grammar, in Section 2.2.2.2 and 2.2.3.2.1 I present further arguments that support the hypothesis that intermediate foot projections are prohibited in natural language —that is, no language ever generates feet with three or more projections. Consequently, in the present model, all non-minimal feet are necessarily maximal, i.e. they are dominated by the prosodic word. Leaving aside for the moment the specific reasons for ruling out intermediate foot projections from grammatical systems, the three grammatical representations in (2a-c) can be grouped in two natural classes:

(3)

Natural class	**Defining structural property**
I. Minimal feet = (2a) and (2b)	Dominate a syllable
II. Maximal feet = (2a) and (2c)	Dominated by the PrWd

The table in (3) highlights the purely relational nature of the terms *minimal* and/or *maximal*: the characterization of a given foot (Ft^x) as maximal or minimal (or non-maximal and non-minimal) is directly inferred from its local relations with the vertically adjacent constituents in the hierarchy. A foot Ft^x is *minimal* if the category Ft^{x-1} coincides with a syllable; a foot Ft^x is *maximal* if the category above it (i.e. Ft^{x+1}) coincides with the prosodic word. The natural classes for the negative values of *minimal/maximal* are presented in (4). The structure in (2d) is a clear case of non-minimal and non-maximal foot, but since they are considered to be ungrammatical, they are left out from the present characterization of natural classes.

(4)

Natural classes	**Defining structural property**
III. Non-minimal = (2c)	Dominates a foot
IV. Non-maximal = (2b)	Dominated by a foot

Importantly, in Chapter 4, and in Martínez-Paricio & Kager (2013), it is shown that the differentiation between these natural classes is crucial for the correct location of primary and secondary stresses in rhythmic systems. Additionally, the examination of different prosodic systems throughout this dissertation will provide strong support for the need to allow phonology to distinguish between recursive and non-recursive feet, i.e. between non-minimal (2c) and minimal feet (2a). Specifically, I will demonstrate that the recognition of non-minimal feet in particular languages is the only way to provide a uniform account of a wide range of phonological phenomena such as vowel lengthening, vowel reduction and tone assignment, which otherwise remain unexplained.

2.2.2 Some representational predictions: additional metrical positions

The admission of prosodic adjunction at the level of the foot brings with it a new set of representational and computational predictions. In addition to the obvious prediction by which phonological constraints and phonological computation can manipulate (non-) minimal and (non-) maximal feet (Section 2.3), metrical structures with at most one layer of recursion introduce new positions in phonological representations. Consequently, new potential metrical contrasts might arise. In the rest of this thesis I provide support for these new contrasts in a wide range of languages and argue that the new structural assumptions about possible metrical representations force us to split the traditional dichotomy between foot heads and foot dependents in two types of heads and two types of dependents. This idea is further developed below in Section 2.2.2.2, after reviewing some general properties about strong and weak positions in phonology crucial for understanding the contrast between foot heads *vs.* foot dependents.

2.2.2.1 Background: strong *vs.* weak positions

Most phonological theories have traditionally distinguished between two types of positions in phonology depending on their relative strength. On the one hand, phonologically strong positions tend to support more contrasts than other positions within a given domain and, generally, they are associated with prominence properties. On the other hand, weak positions tend to exhibit exactly the opposite behavior, i.e. they allow fewer contrasts and they tend to be related to low prominence elements. The following table from Zoll (1998/2004) provides some diagnostics for prominent (i.e. strong) and non-prominent (i.e. weak) positions in phonology.

(5) Diagnostics for prominent positions (Zoll 1998/2004: 370)

	Strong Positions	*Weak positions*
I. Contrast	Support more contrast	Support less contrast
II. Reduction	Resist reduction	Yield to reduction
III. Stress	Attract stress	Do not attract stress
IV. Tone	Attract H tone	Do not attract H tone
V. Harmony[2]	Trigger harmony May resist assimilation	Target of harmony

Within the prosodic hierarchy, the contrast between strong and weak positions has been shown to be a fruitful one when accounting for the asymmetrical behavior of certain constituents in various phonological processes (e.g. phonological augmentation, phonological weakening and/or the distribution of stress and tones across languages). Furthermore, this contrast has been generally equated with the structural difference between prosodic heads and prosodic non-heads: whereas phonological heads are inherently stronger, phonological non-heads tend to be weaker. Therefore, it is very common that prosodic heads are phonetically manifested with prominence cues such as the phonetic correlates of stress and/or high tone (greater intensity and duration, specific formant frequencies, etc.). Additionally, prosodic heads are, in a way, privileged positions in prosodic representations because they often allow more structure and/or contrasts than non-heads (for details and examples of this type of *complexity asymmetries* between heads and non-heads see Dresher & van der Hulst 1998: 319-328). Finally, it has also been claimed that the structure of heads is generally more accessible than that of dependents for some phonological processes (i.e. *visibility asymmetries*, Dresher & van der Hulst 1998). However, while this is true for several phonological augmentation processes, weakening processes seem to target weak positions. [3]

[2] Note that "harmony" is not the clearest parameter to determine the relative strength of a constituent since in some languages the target of harmony is precisely the opposite: the strongest syllable in the word undergoes harmony (i.e. the syllable with main stress). This is the case, for example, in Pasiego Spanish (Penny 1969), in the Italian dialect Servigliano (Camilli 1929) and other Romance dialects that display metaphony (see Walker 2005, 2011 and references therein).

[3] This is true, for instance, within the domain of the foot where foot heads are generally more visible for strengthening processes, but foot dependents are very often the target of weakening processes (references and a further exploration of this claim are provided in Chapter 5).

It is nevertheless important to keep in mind that in addition to the head/non-head nature of a given prosodic constituent, other contextual factors might influence the particular strength of a constituent. For instance, there is phonetic and phonological evidence that initial constituents in prosodic domains tend to be stronger than those in prosodic medial or prosodic final domains, whether or not they correspond to a phonological head. This is true, for example, for the root- and word-initial domain (e.g. Trubetzkoy 1939; Steriade 1994; Byrd 1996; Beckman 1998; Casali 1998; Alber 2001; Smith 2005; Cabré & Prieto 2006; Becker, Nevins & Levine 2012; Chapter 4 of this thesis), for initial constituents at higher-levels in the hierarchy (e.g. Fougeron & Keating 1997; Keating et al. 2003; Selkirk 2011) as well as at lower layers in the hierarchy, like the foot-initial position (e.g. Rice 1992; Vijver 1998; Davis 1999; Jensen 2000; Bennett 2012; Harris 2013) and/or syllable-initial position (Prince & Smolensky 1993/2004).

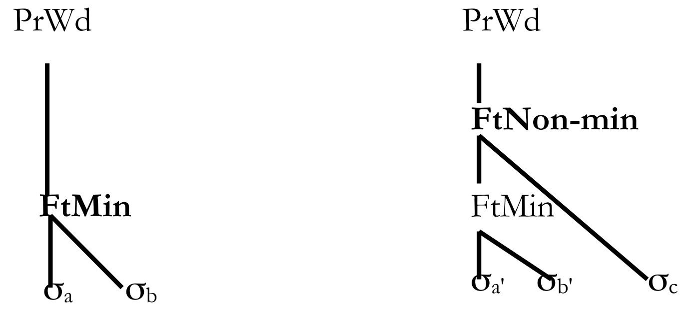
In sum, it is not always straightforward to classify a phonological constituent as strong or weak. Several factors should be considered and contrasted when determining the relative strength of a given phonological constituent (e.g. inherent prominent or non-prominent nature of a particular constituent, position within a broader domain, etc.). With respect to the category of the foot, this is especially important in the light of Bennett's findings on foot-initial strengthening processes. Bennett (2012) shows that despite the inherent weak nature of the non-head of an iambic foot, it can be strengthened due to its initial position. Interestingly enough, similar strengthening effects do not seem to occur in the weak branch of a trochaic foot, which is final within the foot domain (see Bennett 2012: §2.5 for details).

2.2.2.2 Two types of foot-heads and two types of foot-dependents

Leaving aside the potential greater strength of initial constituents/segments in a foot, the contrast between strong and weak positions in metrical models is generally considered to be an expression of the contrast between foot heads (i.e. the constituent in the strong branch of a foot) and foot dependents (i.e. the constituent in the weak branch of a foot). Traditionally, feet had one projection and, thus, there was claimed to be a contrast between the constituents that occupied the head of a foot *versus* the constituents that appeared in the dependent of a foot. Importantly, a theoretical model that permits metrical structures with two projections of a foot (i.e. with non-minimal feet) opens up the possibility for a new set of phonological contrasts between strong and weak positions. This can be inferred by comparing the two representations given below in (6).

(6) Foot heads and foot dependents in minimal *vs.* non minimal feet

a. Minimal foot b. Non-minimal foot



A traditional foot (i.e. minimal and maximal, 6a), consists of a foot head (σ_a in 6a) and a foot dependent (σ_b in 6a), however, if prosody adjoins a syllable to a preceding/following foot, a new set of strong and weak positions arises. In (6b), the syllable that is the phonological head of the non-minimal foot (marked with an *a* prime) has a double-head status, i.e. it is the head of two foot-projections.[4] By contrast, in (6a), σ_a is the head of only one foot projection, i.e. the minimal foot. Consequently, languages with non-minimal and minimal feet can potentially exploit this structural difference between the two types of foot-heads. In fact, in Chapter 3 I will show that this prediction is borne out in Wargamay and Yidiɲ. These two Australian languages need to distinguish between the head of a minimal foot and the head of a non-minimal foot in order to account for a puzzling lengthening process which only affects forms with an odd number of syllables. Interestingly, alternative analyses by which the syllable that lengthens is the head of the prosodic word, or every head of a foot, cannot provide an adequate description and/or explanation of the facts. An additional example of a language that displays a contrast between the head of a minimal foot *vs.* the head of a non-minimal foot will be given in Chapter 6, where I argue that in the non-related pitch-accent language Seneca (an Iroquoian language) only the heads of non-minimal feet are eligible for a high tone.

Minimal recursion at the level of the foot does not only predict a potential contrast between two types of foot heads (the head of a minimal foot *vs.* the

[4] Note that the double-head status of a non-minimal foot is shared by a non-maximal foot since, assuming only one layer of recursion is allowed at the level of the foot, every non-minimal foot must by definition dominate a non-maximal foot.

head of a non-minimal foot), but also between two types of foot dependents (the dependent of a minimal foot *vs.* the dependent of a non-minimal one). This is illustrated in (6b), where the non-minimal foot presents two unstressed syllables, σ_b and σ_c. These syllables are structurally different: whereas σ_b is immediately dominated by a minimal foot, σ_c is immediately dominated by a non-minimal foot. In later chapters I will show that particular languages might exploit this structural difference for some phonological processes. For instance, in Chapter 4 I will demonstrate that Chugach (an Eskimo language) needs to rely on the distinction between the two types of foot dependents (the dependent of a minimal foot *vs.* the dependent of a non-minimal foot) for the correct distribution of low tones. I will show that an alternative account that relies instead on the difference between dependent of a (minimal, non-recursive) foot and an unparsed syllable fails to account for the Chugach facts. Likewise, in Chapter 5 I demonstrate that several phonological weakening processes in various languages all receive a uniform account once phonology is able to differentiate among unstressed syllables depending on whether they are dominated by a minimal foot or a non-minimal foot. While a few of these processes could, in principle, receive an alternative account by exploiting the already existing structural difference between the (unstressed) unfooted syllable and the (unstressed) syllable in a foot dependent, the analysis presented here is to be preferred since most of the relevant cases can only be fully explained by referring to the contrast between dependents of a minimal foot and dependents of a non-minimal foot. The relative strength of foot dependents across several prosodic systems (i.e. whether the dependent of a minimal foot is stronger or weaker than the dependent of a non-minimal foot), and a possible way to capture their different behavior in an OT framework, are explored in further detail in Chapters 4-5.

Drawing a parallel between the double-head status of constituents that are in the head of a non-minimal foot ($\sigma_{a'}$ in 6b) and the single-head status of constituents that are in the head of a minimal foot (σ_a in 6a), it could be argued that languages may distinguish between weak syllables that are dominated by only one foot, i.e. the dependent of a minimal foot (σ_b in 6a), and weak syllables that are dominated by two feet, i.e. the dependent of a non-maximal foot ($\sigma_{b'}$ in 6b), the latter being slightly weaker than the former due to its double-dependent status. Although such an option is a structural possibility, I have not found any processes in the languages studied here that rely on such a distinction. By contrast, what seems to be crucial in determining the specific behavior of foot dependents is the nature of the foot projection that directly dominates the unstressed syllable, i.e. whether this is immediately dominated by a minimal foot or a non-minimal foot.

To complete the inventory of possible prominent and non-prominent positions within a prosodic word, two additional cases need to be included in our repertoire of prominent and non-prominent positions: (i) the head of the prosodic word, which necessarily corresponds to the head of some foot, and (ii) the aforementioned unfooted syllable, i.e. a non-prominent syllable that is directly linked to the prosodic word.

(7)

Prominent Positions	*Non prominent positions*
Head of FtMin	Dependent of FtMin
Head of FtNon-min	Dependent of FtNon-min
Head of ProsodicWord	Unfooted material

The difference between the head of the prosodic word and the heads of the feet is evident: only the former is selected as the head of the upper level category, the prosodic word. Less obvious is the structural difference between the three types of unstressed syllables, represented in (8). (In (8) the underlining marks the relevant syllable, which is described in the prose below.)

(8) Three types of unstressed syllables

a. Footed, dependent of a FtMin $[\,(\underline{\sigma}\,{}^{\prime}\sigma)_{Ft}\,({}^{\prime}\sigma)_{Ft}\,]_{PrWd}$

b. Footed, dependent of aFtNon-min $[((\sigma\ {}^{\prime}\sigma)_{Ft}\ \underline{\sigma})_{Ft}\,]_{PrWd}$

c. Unfooted, directly linked to PrWd $[\,(\sigma\,{}^{\prime}\sigma)_{Ft}\ \underline{\sigma}\,]_{PrWd}$

Since the structures in (8) all have a non-prominent status, one might wonder if there is a real difference between a foot dependent and an unfooted constituent or, by contrast, if dependents of non-minimal feet (8b) in the present model can subsume the traditional role of unfooted syllables (8c). Importantly, despite the shared *non-prominent status* of unstressed unfooted/footed material, I believe there is a crucial difference between unfooted constituents and footed material in the weak branch of a foot that needs to be maintained. In particular, I will assume that, whereas unfooted syllables are completely irrelevant for metrical purposes (i.e. they remain outside of the domain of metrical rules/constraints), foot-dependents can directly shape and condition the overall prosodic and metrical form of a prosodic word. For instance, whereas an unfooted syllable/segment will never attract stress and/or it will not display a particular preference for a specific marked tone in languages where tone is metrically-conditioned, material in the dependent of a foot can determine the assignment of stress and/or display some preferences for particular tones and specific vowels (Kenstowicz 1997; de Lacy 2002a,b; see also Chapter 4 and Chapter 6). Furthermore, I assume that segments in foot dependent positions can be the target of specific metrically-conditioned processes, which do not necessarily affect all the other unstressed syllables in the prosodic word (Jensen 2000; McCarthy 2008; Bennett 2012).

As an illustration of what it means to say that an unfooted syllable *remains outside of the domain of metrical rules*, imagine a language that is quantity-sensitive, with trochaic footing, and stress on every heavy syllable. Initial syllables could be characterized as being left out of the rhythmic domain (i.e. unfooted) if they never surfaced with stress, even when they contained a heavy syllable as in (9a-b). In this example, round brackets indicate feet, and <> indicate that a constituent is directly linked to the prosodic word, i.e. it is unfooted.

(9) Initial unfooted syllable in Language X

a. <μμ>. (ˈμ . μ). (ˈμμ)

b. <μμ>. (ˈμμ). (ˈμμ)

c. <μ>. (ˈμ . μ). (ˈμ. μ)

d. <μ>. (ˈμμ). (ˈμμ)

In Chapter 6 I will show that Seneca instantiates this type of contrast between non-prominent syllables. In particular, I will show that whereas the configuration and moraic content of the dependent of a foot is crucial in the assignment of a high tonal accent, the moraic content of the initial syllables is always completely irrelevant for tonal assignment purposes (or any other prosodic peculiarity of the language). That is, the weight of the initial syllable does not condition at all the specific prosodic make-up of Seneca words, but the weight of a dependent of a foot does.

The opposite case, a language in which the initial syllable is parsed in a dependent of a non-minimal foot rather than left unparsed, is illustrated in (10). This language is fairly similar to the one illustrated in (9). The crucial difference between language X (9) and language Y (10) lies on the status of the initial syllable: in (10), the initial syllable can constitute a foot of its own when it is heavy (10a,b) and, thus, it is not "completely invisible" for the principles of metrical structure building. Thus, even if initial syllables are occasionally unstressed in this language (10c,d), I assume that they are adjoined to the following foot rather than directly linked to the prosodic word as in (9).

(10) Initial footed syllable in Language Y

a. (ˈμμ). (ˈμ . μ). (ˈμμ)
b. (ˈμμ). (ˈμμ). (ˈμμ)
c. (μ. (ˈμ . μ)). (ˈμ. μ)
d. (μ. (ˈμμ)). (ˈμμ)

In short, within this model, the difference between a non-prominent syllable that is weak, but metrically relevant, and a non-prominent syllable that is also weak, but metrically irrelevant, is a matter of structure: metrically relevant/visible material is parsed in the dependent of a foot, whereas material that is directly linked to the prosodic word *escapes* from the assignment of metrical structure and, hence, it can be metrically irrelevant for rules/constraints of stress assignment and other metrically-related rules/processes.

We just saw a possible diagnostic to differentiate between unfooted syllables (i.e. metrically invisible) and weak footed syllables (i.e. metrically visible): the *potential* relevance (or irrelevance) of their weight. Another not-so-evident diagnostic for determining if an unstressed syllable is footed or unfooted is directly connected to the location of a foot head within the prosodic word. In many languages, footed unstressed syllables do not display a clear contrast with unfooted syllables (i.e. they exhibit similar phonotactics/tonotactics, etc.); still, the former need to be postulated for the correct location of foot heads within a word. This is the case, for example, of Choguita Rarámuri, a language with an initial three-syllable stress window, analyzed in detail by Caballero (2008, 2011). In Choguita Rarámuri, primary stress always falls within one of the three first syllables in the word. The three-syllable window restriction is obvious when lexical stress is placed in another syllable further away from the left edge of the word. In such cases, lexical stress does not surface faithfully, but it is shifted to any of the three first syllables. To better illustrate this, consider the examples in (11). Although default stress (i.e. in the absence of any lexical marking) generally falls on the second syllable of a word (e.g. 11a), under specific circumstances, stress can fall on its third syllable. For example, when a stressed suffix is added to an unstressed trisyllabic root as in (11b), stress surfaces on the third syllable rather than on its fourth syllable. Note, however, that when an unstressed suffix is added to the same unstressed root, stress falls instead on the second syllable of the word (11a).

(11) Stress syllable window in Choguita Rarámuri (Caballero 2011: 781-782)

a. Unstressed root + unstressed (stress neutral) affix

/anat͡ʃa-ki/ (a.ná) t͡ʃaki

'endure-PST.1'

b. Unstressed root + stressed (stress-shifting) affix

/anat͡ʃa-sá / (a (na.t͡ʃá)) sa

'endure-COND'

Assuming that the first syllable in (11b) is unfooted, rather than directly linked to a non-minimal foot, would entail that such syllables are completely invisible for the assignment of metrical structure. However, the first syllable in (11b) is obviously visible: it is crucial to model (and determine) the three-syllable window restriction in Choguita. If the initial syllable were *truly* invisible (and unfooted), stress could have remained in the fourth syllable in (11b) and, furthermore, in other Choguita words, stress would be avoided on word-initial syllables. To the contrary, stress can fall on word-initial syllables in the language. Thus, this syllable is better represented as being part of a non-minimal foot (see Caballero 2011 for further details and arguments against an unfooted account of Choguita). An additional argument for modeling stress-windows via recursive feet rather than unfooted syllables recently appeared in Kager (2012). Specifically, Kager provides typological support for an analysis that models the maximum window size in metrical window systems, which equals three syllables at both edges, with internally layered ternary feet. He shows that, even if alternative accounts —with peripheral unfooted syllables, or with gridmarks and LAPSE constraints— could account for some attested window systems, the recursive-foot based account is the only one that is able to model all the attested window-systems, while avoiding overgeneration of pathological patterns (e.g. midpoint pathology, Eisner 1997) (see Kager 2012 for details). Thus, the difference between unstressed syllables that are unfooted *versus* footed is not only crucial from the point of view of the representations (i.e. there are different properties linked to each syllable), but it is also an essential distinction from the computational and typological point of view: as Kager (2012) shows, only a framework that allows recursion at the foot level avoids undergeneration and overgeneration of metrical pathologies.

To summarize, in this dissertation I will assume that footed syllables are not only metrically visible, but crucial for metrical rules, while unfooted syllables are neither. As I anticipated earlier, besides being "metrically visible" —in the sense that they can condition the location of stress (i.e. foot heads)—, unstressed footed syllables are "metrically relevant" in yet another respect: they can directly or indirectly condition the specific sonority degree of the vowels or tones they host, just as foot heads can display certain preferences for certain types of vowels and tones. Later in the thesis I will show that these universal preferences can be modeled via positional markedness constraints, along the lines of Kenstowicz (1997) and de Lacy (2002a, 2004) *inter alia*. The main novelty is that within the metrical model posited here, such constraints will not only refer to foot heads or foot dependents, but they will also be able to refer to the new positions introduced in a recursive foot, i.e. the head of a non-minimal foot and the dependent of a non-minimal foot. Such positions will be shown to be crucial in various languages.

Although nothing prevents other phonological processes (e.g. deletion) from specifically targeting unfooted syllables and/or other markedness constraints from having unfooted syllables as their argument (e.g. alignment constraints, see Section 2.3 for details), in light of the metrical *invisibility* of unfooted syllables, I assume that metrical positional markedness constraints (e.g. on stress, sonority, tones, etc.) only refer to metrical positions that are positively defined, i.e. a foot dependent and a foot head. This, however, does not prevent the interaction of other constraints from occasionally affecting the shape/location of unfooted syllables. In fact, this has been the general approach in some acquisition studies in which children were shown to delete weak unfooted syllables to a greater extent than weak footed syllables (Gerken 1994a,b; Demuth 2001; Titterrington et al. 2006). Nevertheless, since this thesis is mainly interested in stress assignment and metrically-conditioned phenomena, an exploration of the types of constraints and processes that may affect an unfooted syllable remains out of our scope. I will mainly concentrate on exploring the phonotactic preferences (and to a lesser extent tonotactics) of the constituents that are part of a foot.

In a nutshell, and to conclude the discussion on the status of foot dependent syllables and unfooted syllables, rather than reckoning "extrametricality" as an independent device genuine of a few unfooted syllables —those lying at the right edge of the prosodic word, Hayes (1980, 1995)—, in the present framework "extrametricality" is interpreted as the invisibility of certain constituents for metrical purposes. In particular, extrametrical syllables are a representational consequence of unfooted syllables in prosodic representations. Furthermore, as I will show in Chapter 4, since in the present model rhythmic effects (both binary and ternary) arise via the construction of successive feet —i.e. without any intervening syllables—, unfooted syllables will generally appear together (if there is more than one) at one edge of the prosodic word. Thus, we will see that, whereas our theory predicts rhythmic structures like [FtFtFtσ], [σσFtFtFt] or [σσσσσFt], representations like *[FtσFtσFt] or *[σσσFtσσFt] are not allowed. Whenever unfooted syllables are present in a word, they will be chained at one edge or another of the prosodic word (see Chapters 3-4 for further details about the metrical structure of rhythmic systems). The only exception to such a generalization in the present model is instantiated by some edge-based systems that construct a foot at each edge of the prosodic word. In these systems, the head foot is located at one edge of the prosodic word and a secondary foot demarcates the opposite edge of the word, with the possibility of leaving syllables unfooted in between the two feet in very long words, e.g. [Ftσσ...σσFt]. This is the case, for instance, of systems with primary stress on the word-initial syllable and secondary stress on the penultimate syllable (e.g. Watjarri); or languages with primary stress on the final syllable and secondary stress on the initial syllable of the word (e.g. Armenian) (see Gordon 2002 and references therein for further examples). Still, it is important to highlight that these medial unfooted syllables are *invisible/irrelevant* for metrical purposes: the metrical structure of these systems only *cares* about locating a foot at each edge of the prosodic word.

To summarize this section, I have proposed that languages with some instance of recursion at the level of the foot might potentially exploit the difference between two types of foot heads and two types of foot dependents. It should not be inferred from this claim, though, that every language in which minimal feet coexist with non-minimal feet will necessarily present evidence for two types of foot heads or two types of foot dependents. Above all, foot-heads are prominent prosodic positions and foot dependents are non-prominent. In some languages, such a binary contrast will be enough for the phonological processes and phonological activity in the language. Therefore, it should be clear that I do not intend to make the claim that the three types of unstressed syllables and/or the two types of prominent syllables should be instantiated in every language with non-minimal feet. In fact, this would be a rather uncommon situation, given that very long words would be required for such patterns to arise and/or be recognized.

2.2.3 Inviolable restrictions on phonological representations

A major goal of this dissertation is to examine the motivations and factors that can cause minimal recursion at the level of the foot. Since the thesis is couched in the Optimality-theoretical framework of Prince & Smolensky (1993/2004), the emergence/absence of non-minimal feet, as well as the particular shape of minimal and non-minimal feet, will be mostly determined by the specific ranking of the set of universal and violable constraints, outlined below in Section 2.3. Importantly, in addition to these *soft universal* constraints, a grammar consists of *hard universal restrictions,* which cannot be violated under any condition. Within OT, the *locus* of hard universals is GEN, the function that generates all possible outputs for a given input. Thus, before exploring the nature of the violable constraints that are responsible for the emergence of minimal recursion at the level of the foot, in the following pages I briefly present the restrictions on structural complexity that I assume to be part of GEN. I will argue that, for basic structural reasons, there are some metrical representations that will never be available for grammatical evaluation. These representations are: (i) ternary flat feet (Section 2.2.3.1), (ii) feet with two or more layers of recursion (Section 2.2.3.2.1) and (iii) non-minimal feet in which the constituent adjoined to a minimal foot is another foot (Section 2.2.3.2.2).

2.2.3.1 Maximally binary branching feet

The first restriction in GEN, which is adopted by the majority of current metrical models, is the maximally binary branching restriction on feet (Liberman & Prince 1977; Prince 1980; Selkirk 1980; Kager 1989; Hayes 1995). This binary condition on metrical feet stems from the inherent rhythmic and relational nature of the metrical constituent of the foot, which generally arises by combining a head and a non-head in the phonological string (Liberman & Prince 1977; Prince 1980). Although in the late eighties, in order to account for ternary rhythmic effects, a few metrical analyses allowed amphibrachic feet (i.e. ternary branching feet which locate the foot-head in the internal branch of a foot, (σˈσσ), Levin 1985, 1988; Halle & Vergnaud 1987),[5] later studies demonstrated that recognizing ternary branching feet among the primitives of a grammar made undesired predictions (e.g. McCartney 2003 and references therein). For instance, if ternary branching feet existed, minimally trisyllabic word requirements would be expected to exist in some languages. However, word minimality restrictions are always binary.[6] Additionally, as

[5] More recently amphibrachic feet have resurfaced as a possible option for phonological representations in Buckley (2009).

[6] However, there seems to be a counterexample to this claim: Blevins & Harrison (1999) report a trimoraic minimality restriction in Gilbertese, the Micronesian language spoken in the Kirabati islands. This language is further discussed in Chapter 6.

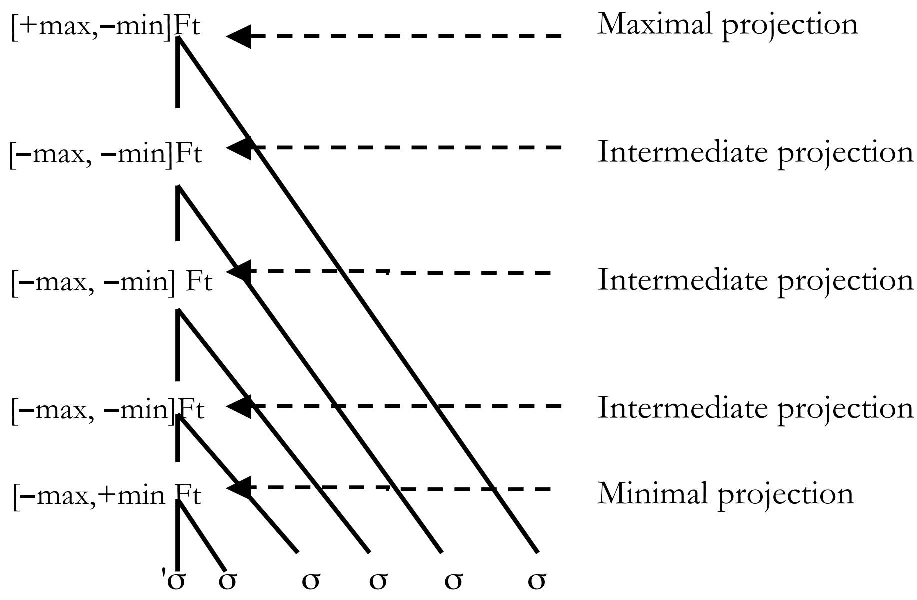
pointed out by McCartney, a model with ternary branching feet predicts reduplicants of the size of ternary branching feet. However, this prediction does not seem to hold: examples of three-syllable reduplication are always instantiations of total reduplication of three-syllable words (McCartney 2003: 22). Finally, a model with ternary flat feet faces several shortcomings when trying to account for the main findings of this thesis. To name one, if ternary feet have a flat structure rather than an internally layered one, foot-dependents are structurally identical and, thus, it is not clear why in some languages they are able to display differing behaviors.

2.2.3.2 Minimal recursion at the foot level

2.2.3.2.1 The One Layer Recursive Foot Hypothesis

When I presented the possible types of projections of a foot in (2), I claimed that intermediate foot projections (i.e. feet that dominate and are dominated by a foot) are ungrammatical under any condition. In OT terms, this amounts to encoding a hard restriction in GEN, by which feet with more than one layer of recursion are never generated. Consequently, all feet are vertically adjacent to at least one prosodic category different from a foot. Since the other interface categories allow intermediate projections (Elfner 2012; Itô & Mester 2013), it is not immediately self-evident why feet behave differently from the rest in restricting recursion to at most one layer. In order to better understand the possible motivations for the upper limit on the number of projections of a foot, it is worth examining the potential properties of a metrical structure that would contain more than two projections of a foot. This is illustrated in (12), where I provide the representation of a five-syllable word with successive instances of recursion.

(12) Five-syllable word with multiple foot projections



Note that, if feet displayed the number of layers of recursion depicted in (12), the rhythmic essence of a foot would be completely lost due to the emergence of long sequences of lapses. Nevertheless, languages with only one foot per prosodic word could arguably be claimed to have multiple layers of recursion as in (12). For such a claim to be worth considering, however, there should be some extra evidence that supports it. Importantly, it is not only that such evidence is lacking, but furthermore that representations with multiple foot projections are controversial in a number of ways. Firstly, they make a number of representational predictions that do not seem to be borne out. On the one hand, note that all the unstressed syllables in (12) have a different structure (i.e. they are each dominated by a different projection of a foot) and, thus, this type of representation predicts at least four types of non-prominent positions in natural language, i.e. the dependent of a minimal foot, the dependent of a maximal foot, the dependent of an intermediate foot and unfooted constituents. On the other hand, the metrical representation in (12) contains three different types of foot heads: the head of a minimal projection of a foot, the head of a maximal projection of a foot and the heads of intermediate projections of feet. However, as I have previously discussed, the review of several prosodic systems pursued in this thesis provides strong support for the existence of two types of prominent syllables (i.e. the head of a minimal foot and the head of a non-minimal foot) and three types of non-prominent syllables (i.e. the dependent of a minimal foot, that of a non-minimal foot and an unfooted syllable), but not more. The existence of metrical structures with intermediate foot projections (12), however, predicts additional strength distinctions that are unattested.

Secondly, it is not entirely surprising that metrical feet are the only categories in the hierarchy that display minimal recursion, with categories higher than feet able to display additional layers of recursion. As pointed out by Itô & Mester (2007b, 2013), the nature and *raison d'être* of prosodic categories above and below the prosodic word is entirely different. Phonological words and other higher categories in the hierarchy may exhibit greater levels of embedded prosodic structures because the prosody of these categories is heavily influenced by constraints on the correspondence between morphosyntactic and phonological constituents. Since syntax allows unlimited recursion, it is reasonable to find greater recursion among the prosodic categories that are partly dependent on syntactic information. The foot, however, is substantially different from the interface categories and it is intrinsically defined in terms of sonority-related phonetic factors, quantity and speech rhythm (Itô & Mester 2007b, 2013). The expectation is therefore that recursion should be more restricted, if not completely banned, at this level.

Thirdly, if the One Layer Recursive Foot Hypothesis is on the right track and maximal feet consist of at most three syllables, we have a straightforward account of the maximum size of the stress windows (Kager 2012). Even though earlier typological studies posited an asymmetry in the size of the stress window at the left and the right edge of the prosodic word —in particular, initial lapses were thought to be ungrammatical—, Kager's recent survey of metrical window systems confirms that the maximum size of the stress window equals three syllables at both edges.[7] Furthermore, if the biggest foot possible contains three syllables, as claimed in Kager (2012), there is a straightforward account for the restriction on the position of stress in some languages, where stress cannot fall more than three syllables away from the left or the right edge of the prosodic word. By contrast, if the grammar allows quaternary feet with intermediate foot projections, languages with a four-syllable window would be predicted, but these seem to be nonexistent (see discussion in Kager 2012 against the existence of windows longer than three syllables).

Further arguments against feet with more than three syllables can be found in Heinz (2006). This author demonstrates that binary and ternary rhythmic patterns can be learned via a computational model that relies on the structural

[7] Interestingly, a recent artificial language learning experiment has demonstrated that initial and final windows are both equally learnable (Kwon 2013).

notion of locality to infer target rhythmic patterns from samples. By contrast, higher *n*-ary rhythms are not learnable. The findings of this study can be taken as further support for the One Layer Recursive Foot Hypothesis: feet with one layer of recursion are learnable, but feet with more layers of recursion are not.

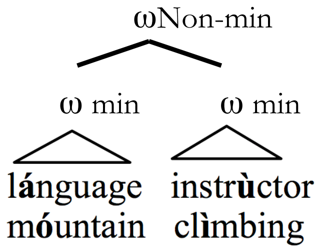
Finally, while there is growing evidence from several metrically-conditioned processes (e.g. Caballero's 2008, 2011 analysis of the stress pattern of Choguita Rarámuri, Bennett's 2012 analysis of [h] coda epenthesis in Huariapano, Chapters 3-6 in this thesis) and prosodic morphology phenomena (e.g. expletive infixation in English, McCarthy 1982; *Homeric* infixation in English, Yu 2003, 2004) that feet may consist of a foot plus an adjoined syllable, as far as I know, there are no processes that need to rely on the existence of feet with two adjuncts.

For all these reasons, and given the inadequate theoretical and empirical predictions of a model with intermediate feet, I will assume that GEN never produces feet with more than one instance of recursion.

2.2.3.2.2 The Head Uniqueness Principle

Another important universal restriction on the possible types of recursive feet concerns the upper limit on the number of feet a non-minimal foot can dominate. Crucially, whereas non-minimal prosodic categories often dominate more than one self-embedded minimal projection (e.g. 13 below), prosodic adjunction at the level of the foot is more restricted in yet another respect. In particular, non-minimal feet must always dominate one, and only one, minimal foot and one prosodic category from a lower level (generally the syllable, but occasionally the mora, see Section 2.3 and Chapter 6). Thus, metrical representations in which a non-minimal foot dominates two minimal feet are never generated by GEN, i.e. they are not available for evaluation. The different restrictions on prosodic adjunction at interface categories and at the foot level are illustrated below in (13-14). In (13) I provide the prosodic structure for English compounds (Itô & Mester 2007a), where a non-minimal prosodic word dominates two minimal prosodic words. In (14a) I show that a similar structure at the foot level is not possible.

(13) Prosodic structure for English compounds (from Itô & Mester 2007a)



(14) a. FtNon-min ✗ b. FtNon-min ✓

To rule out recursive structures like the one in (14a), I assume that the Head Uniqueness Principle defined in (15) is a universal restriction in GEN. In a general vein, this principle ensures that every non-minimal foot contains at most one self-embedded foot.

(15) The Head Uniqueness Principle
Every foot has at most one head; the head of a non-maximal foot must coincide with the head of a non-minimal foot.

The ban on recursive metrical structures like the one in (14a) can be seen as a direct consequence of the intrinsic relational nature of a *foot* (Liberman & Prince 1977; Selkirk 1980; Prince 1980; Hayes 1980, 1995). In general terms, a foot can be defined by its structurally relational, rhythmic nature, which groups a phonological head with a phonological non-head, although feet that consist of only a head may also occasionally exist (i.e. monomoraic degenerate feet, Hayes 1995). By contrast, feet that consist of only a dependent are theoretically impossible, since there cannot be a dependent if there is not a head on which to depend (although see the discussion in Section 1.3.2 and references therein, for some works that argue for the existence of headless feet). I assume, therefore, that every foot has at most, and at least, one head.[8] Thus, if the defining property of a foot is its head (in the case of a degenerate

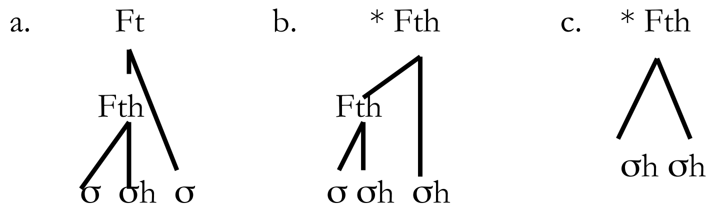
[8] Remember, though, that heads can be stressless (Section 1.3.2).

foot) or, more often, the relation between a head and a non-head, the presence of a foot-head will necessarily entail the presence of a foot. That is why recursive structures with two foot-heads (e.g. 14a) cannot give rise to one maximal foot, but rather two independent maximal feet. Additionally, note that if a language allows structures like (14a) in longer words with subsequent feet, additional contrasts between different types of foot heads and foot dependents would arise (i.e. whether they belong to a FtMin that is the head or the dependent of a FtNon-min; whether they belong to a FtMin that is maximal; whether they belong to a FtMin that is the head of the prosodic word, etc.), entailing an unwarranted explosion of prominent and non-prominent additional positions.

The fact that a maximal foot can have at most one foot head —either due to the effect of the general HEADEDNESS constraint ("a foot Fx has at most one designated head from a lower level category") or the Head Uniqueness Principle— has a direct effect on the type of metrical recursive structures allowed by GEN. Namely, every foot-head of a non-maximal foot must pervasively percolate through higher projections of the foot, i.e. from a non-maximal projection to a non-minimal projection. This notion of *headedness percolation* (Zec 2003) is illustrated in (16), where the subscript <h> indicates the head of each constituent. The maximal foot in (16a) is a possible foot because it has a unique head that strictly percolates from a lower-level category. By contrast, (16b) is ungrammatical because its maximal foot has two heads at the next lower level: the minimal foot and the adjoined syllable at the right. For the same reason, a minimal and maximal foot with two-heads like (16c) is not possible within the present model (although cf. Bye 1996, based on Kager 1996b, and Kristoffersen 2008 who have proposed two-headed feet in Guugu Yimidhirr and Norwegian, respectively). [9]

[9] I believe these and other languages that have been claimed to have two-headed feet can be reanalyzed with feet that only have one head: either the two heads of a foot are in fact two feet or the two-headed foot has only one head, even though the two constituents of the foot might be realized with similar prominence. For the case of Guugu Yimidhirr, Zoll (1998/2004) proposed two monosyllabic feet where Bye assumed a two-headed foot. For the case of Norwegian and other pitch-accent languages alternative analyses can be posited where only one of the phonetically prominent constituents is the true head or where both constituents are a head of a different foot (see the discussion in Chapter 6). For instance, in Section 6.2 I propose that in Gilbertese (Blevins & Harrison 1999), a language that has been claimed to have feet with two heads, only one of the two alleged heads is the true head (the one that surfaces with stress), whereas the other purported head is strong because it surfaces with an initial boundary H tone.

(16) Headedness percolation

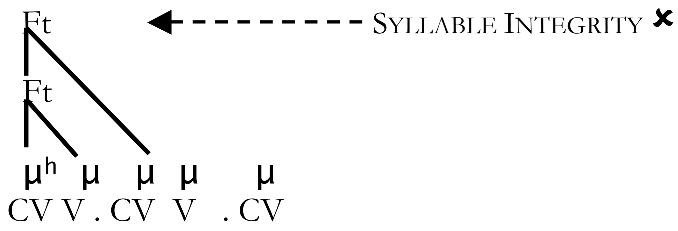


2.2.3.2.3 On the nature of the adjunct

In all the examples of non-minimal feet seen up to here, the adjoined constituent has always been a syllable. In the following chapters we will see that such syllables are generally light, e.g. $[((\sigma\ \ \text{'}\sigma)_{\text{Ft}}\ \sigma_{\text{light}})_{\text{Ft}}]_{\text{PrWd}}$, but in some languages (e.g. Seneca) they can also be heavy, e.g. $[((\sigma\ \ \text{'}\sigma)_{\text{Ft}}\ \sigma_{\text{heavy}})_{\text{Ft}}]_{\text{PrWd}}$. Additionally, in the previous section we have seen that a foot cannot be adjoined to a minimal foot since this would incur a violation of the Head Uniqueness Principle. However, there is another adjunction possibility that could in principle be exploited by some languages. In particular, in a few *mora-counting* languages where moraic distinctions are crucial in defining metrical structure, a mora can occasionally be adjoined to a minimal foot, giving rise to a non-minimal foot. This type of metrical structure in which the adjunct is a mora and not a syllable would look like the representation in (17). I do assume that syllables mediate between morae and feet in (17), but for ease of presentation, syllable boundaries are indicated with a dot.[10] Note that the topmost foot in (17) violates the Syllable Integrity Principle (SIP, Prince 1976, 1980; Rice 1988, 1992; Hayes 1995), the principle that ensures that the edges of a foot coincide with the boundaries of some syllable. Thus, the second syllable in (17) is split in two.

[10] Although the universality of the syllable has been recently denied in several studies (e.g. Labrune 2012; Evans & Levinson 2009; Schiering, Bickel & Hildebrandt 2010), I assume that the syllable is a universal constituent. Even in languages where footing cares only about morae, other phonological processes seem to benefit from a syllabic interpretation. Furthermore, even in languages in which the syllable is not phonologically active, or at least not as much as in the majority of languages, it could be argued that the syllable coincides with a higher or lower level constituent, for which there is in fact evidence. In short, the lack of evidence of X is not strong support to deny the universality of X. Especially if X plays an undeniable role in the vast majority of languages and many insights would be lost without referring to X.

(17) Non-minimal feet with an adjoined morae



Even though the SIP has always been considered to be inviolable and, thus, feet were thought to never dissect syllables, several studies on a few quantity-sensitive languages have questioned the inviolability of such a principle (e.g. Buller, Buller & Everett 1993 and Everett 1998 for Banawá; Blevins & Harrison 1999 for Gilbertese; Sapir 1930 and Cairns 2002 for Southern Paiute). In light of these scarce facts, rather than assuming that SIP is an inviolable condition on GEN, scholars like Blevins & Harrison (1999) have suggested that the SIP is an alignment constraint that can be violated by some languages in which the edges of a foot break the integrity of syllables.

In this thesis, the vast majority of cases of recursion at the foot level will consist of a foot plus an adjoined syllable. This is the case for all the (quantity-sensitive and quantity-insensitive) languages examined in Chapters 3, 4 and 5, and it seems to be the overwhelming and default tendency. Thus, whether it is a restriction on GEN or a constraint in CON, SIP seems to be respected by the vast majority of languages. Nevertheless, since the prosodic category of the foot is unique in that it can have a double nature (it can be moraic or syllabic), it is not completely unexpected that in languages in which moraic distinctions are relevant for footing, the adjunct of a non-minimal foot might occasionally be a mora. In Chapter 6 I will explore in greater detail such a possibility and conclude that, even if uncommon, non-minimal feet with moraic adjuncts seem to be a grammatical option in some languages. In particular, concrete support for such a claim will be instantiated from the prosodic systems of Seneca (Chafe 1977, 1996; Michelson 1988; Melinger 2002), Irabu (Shimoji 2009) and Gilbertese (Blevins & Harrison 1999).

As a summary of Section 2.2.3 (*Inviolable restrictions on phonological representations*), the following box in (18) presents the most crucial restrictions on GEN adopted in the present metrical model.

(18) Restrictions on GEN

- Feet are maximally binary branching
- Feet have maximally two projections (i.e. One Layer Recursive Foot Hypothesis)
- The head of a non-maximal foot must coincide with the head of a non-minimal foot (i.e. the Head Uniqueness Principle), i.e. non-minimal feet consist of a foot plus a syllable/morae

2.3 Phonological constraints and motivations for recursive footing

In this section I introduce the Optimality Theory machinery (Prince & Smolensky 1993/2004) (henceforth, OT) that regulates the emergence of recursive feet in stress rhythmic systems. By doing so, I anticipate some of the major motivations and constraints that can cause recursive footing in natural language. This section is organized in two parts. First, I examine a small set of traditional prosodic constraints, whose interactions, I argue, can produce systems with highly restricted instances of recursion at the level of the foot (Section 2.3.1). Then, I investigate the interaction of other constraints (i.e. categorical alignment non-intervention constraints, McCarthy 2003), which favor recursive footing in prosodic systems to a greater extent (Section 2.3.2).

The motivations for minimal recursion at the level of the foot, and a closer look at certain crucial constraint interactions, will be further illustrated with concrete language examples in Chapters 3 to 6. In those chapters I mainly concentrate on languages with iterative rhythm, and propose that their metrical representations display minimal recursion at the foot level. The decision to focus on languages with iterative rhythm is a consequence of the overall *representational* goal of the thesis, which aims at proving the need for recursive footing in phonological representations. In order to provide evidence for recursion at the level of the foot, and to better test whether or not domain sensitive processes really treat minimal (i.e. non-recursive) and non-minimal (i.e. recursive) feet differently, it makes sense to examine languages where there is more than one foot per word; otherwise, we cannot be completely sure that the observed properties of a particular foot are due to recursion or, by contrast, due to the fact that this foot is the head of the prosodic word. Likewise, in order to be able to corroborate (or falsify) the representational prediction by which languages with internally layered ternary feet may display two prominent positions (i.e. head of a minimal foot, head of a non-minimal foot) and three non-prominent positions (dependent of a minimal foot, dependent of a non-minimal foot, unfooted syllable), there needs to be more than one potential foot head and foot dependent in the prosodic word. Therefore, this restriction on the scope of the present thesis should not be interpreted as an indication that recursive feet are not possible in languages without iterative rhythm. On the contrary, recent research has demonstrated that recursive feet may arise at one edge of the prosodic word in systems without iterative rhythm too (e.g. Caballero's analysis of Choguita Rarámuri 2008, 2011, where the non-minimal foot is needed to account for the initial three-syllable window), and future research should investigate the recursivity hypothesis in all types of systems.

2.3.1 Recursive feet as a last-resort mechanism

In this section I argue that in binary rhythmic systems (i.e. languages with an alternation between strong and weak syllables), odd-parity forms can exhibit recursion at the level of the foot as a last-resort mechanism to avoid unfooted syllables and/or preventing degenerate feet (for similar ideas in recent research see Bennet's analysis of Huariapano, 2012: §2). To illustrate this, let us schematically examine the prosodic representations of a language with exhaustive trochaic left-to-right syllabic footing. In even-parity forms, iterative binary footing and exhaustive parsing of syllables is perfectly achieved (19).

(19) Even parity forms

a. 2-syllable word: (ˈσσ)

b. 4-syllable word: (ˈσσ) (ˈσσ)

c. 6-syllable word: (ˈσσ) (ˈσσ) (ˈσσ)

d. 8-syllable word: (ˈσσ) (ˈσσ) (ˈσσ)(ˈσσ)

However, in odd-parity forms, how to ensure both binary footing and exhaustivity is not so straightforward since the two requirements are mutually exclusive in the presence of an odd number of syllables. This is illustrated in (20), where underlining indicates a leftover syllable.

(20) Odd parity forms

a. 3-syllable word: (ˈσσ) <u>σ</u>
b. 5-syllable word: (ˈσσ) (ˈσσ) <u>σ</u>
c. 7-syllable word: (ˈσσ) (ˈσσ) (ˈσσ) <u>σ</u>
d. 9-syllable word: (ˈσσ) (ˈσσ) (ˈσσ)(ˈσσ) <u>σ</u>

I will argue that there are essentially three options for parsing the leftover syllable and, crucially, one of them involves adjoining the syllable to the preceding foot. [11] These three options are illustrated in (21).

(21) Possible parsings for the *leftover syllable* in odd-parity forms

a. [(ˈσ σ)$_{Ft}$ (ˈσ)$_{Ft}$]$_{PrWd}$ → Build a monomoraic foot
b. [(ˈσ σ) $_{Ft}$ σ] $_{PrWd}$ → Leave the syllable unfooted and link it to the prosodic word
c. [((ˈσ σ) $_{Ft}$ σ) $_{Ft}$] $_{PrWd}$ → Adjoin the syllable to the preceding foot giving rise to a FtNon-min

Assuming particular grammars consist of different rankings of universal constraints, it is expected that languages will vary in the treatment of the leftover syllable depending on the specific ranking of a small set of basic markedness constraints. These constraints are given in (22-24) and, as we saw in Chapter 1, they are all general constraints that apply to all prosodic categories in the hierarchy (Selkirk 1996, 2011; Itô & Mester 1992/2003). However, for ease of exposition, after each general definition in (a), I provide in (b) their particular formulation referring to the category of the foot.

[11] See Hyde (2012b) for the exploration of three additional possibilities: (i) deleting the leftover syllable, (ii) inserting another syllable or mora into the original input so that a binary foot can be constructed and (iii) allowing ambipodal syllables, i.e. syllables that are linked to two feet as the second syllable in (σ(<u>σ</u>)σ). The two first options involve a violation of FAITHFULNESS and, since I am interested in exploring faithful mappings, they are not considered here. The third option assumes a quite controversial metrical representation, which has been neglected in standard theories of stress. In Chapter 3 and Chapter 4 I come back to this type of intersected prosodic structure and argue that the alleged independent evidence for ambipodal syllables is weak.

(22) EXHAUSTIVITY[12]
a. No C^i immediate dominates a constituent C^j, j<i-1. (Selkirk 1996)
b. No PWd immediately dominates a σ (abbr. EXHAUST).

(23) NONRECURSIVITY
a. No C^i dominates C^i. (Selkirk 1996)
b. No Ft immediately dominates a Ft (abbr. *REC(FT))

(24) BINARITY
a. A prosodic category C^i must be binary branching
b. Prosodic feet are binary branching (based, among others, on Liberman & Prince 1977, Prince 1980, McCarthy & Prince 1986, Kager 1989, 1993) (abbr. BIN(FT))

Before investigating the particular interactions between these three constraints, it is important to highlight that the definition of BIN(FT) given in (24) is slightly different from the traditional one used in OT, which explicitly states that *feet must be binary at the moraic or syllabic level* (Prince & Smolensky 1993/2004). The definition used here, is purely structural: it encodes the preference for binary branching feet, but it says nothing about their specific constituents. This interpretation of binarity at the level of the foot better parallels the rest of the binarity constraints, e.g. the constraint that ensures binarity at the level of the prosodic words (e.g. Itô & Mester 1992/2003, 2007a; Ussishkin 2000) or the constraint that favors binary phonological phrases (e.g. Nespor & Vogel 1986; Inkelas & Zec 1990; Selkirk 2000; Elfner 2012). These constraints and the new definition of foot binarity given in (24) refer solely to the binary branching property of a given category, without specifying the required daughters of X. This is done on purpose, since in the present framework, a foot can also be a constituent of a foot and, thus, the requirement that feet have two syllables or two morae will generally be violated by non-minimal foot projections despite the fact that binary branching is respected. The difference between the old version of foot binarity and the new one in (24) is illustrated in (25). The two constraints forbid non-branching feet: a degenerate foot (25b) performs equally poorly in the two constraints. However, the traditional constraint also rules out trisyllabic feet,

[12] This constraint will be redefined shortly in terms of alignment. For the moment, however, I will keep the traditional definition for ease of presentation. Likewise, in the next subsection I will show that there is no need for an independent *REC(FT) since its effects can be derived by the classical foot head constraints, TROCHEE and IAMB, which are independently needed.

even when they have a binary branching structure (e.g. 25a). By contrast, the new definition of the constraint allows candidates like (25a) since its two feet are perfectly binary branching.

(25) Comparison of new BIN(FT) and traditional FOOTBIN

	BIN(FT)$_{New}$	FTBIN$_{Traditional}$
a. ((ˈσ σ)$_{Ft}$ σ)$_{Ft}$		*
b. (ˈσ)$_{Ft}$	*	*

In Chapters 3 to 6 I will show how other well-motivated constraints determine the particular constituency (syllable *vs.* mora) of a foot. Namely, since the syllable is the immediate layer below a foot, according to the Strict Layer Hypothesis, feet are assumed to be syllabic by default. However, moraic feet will arise due to the action of some particular constraints such as the well-known WEIGHT-TO-STRESS constraint, which bans unstressed heavy syllables (Prince 1991) or a new constraint introduced in Chapter 4, which basically bans bimoraic syllables that are not coextensive with a foot ($\sigma^{\mu\mu}$=Ft, based on Itô & Mester 2012b Ft=PrWd). In the rest of the thesis I will show how the interaction of these two constraints with the rest of the constraints to be proposed in Section 2.3.2 are able to generate syllabic and moraic feet.

Now that this clarification has been made, let us examine how the above-mentioned constraints on the prosodic hierarchy (22-24) interact, giving rise to the three possible outcomes for the leftover syllable sketched in (21). Note that each of the parsing possibilities violates one of the relevant constraints:

(26) Constraints violated in the parsing of an odd-parity form

a.	[(ˈσ σ)$_{Ft}$ (ˈσ)$_{Ft}$]$_{PrWd}$	BINARY(FT)
b.	[(ˈσ σ) $_{Ft}$ σ] $_{PrWd}$	EXHAUSTIVITY
c.	[((ˈσ σ) $_{Ft}$ σ) $_{Ft}$] $_{PrWd}$	*REC(FT)

In the following discussion I present the relevant ranking arguments that generate the outcomes in (26) for words with an odd number of syllables.

a. <u>BINARY (FT) dominated</u>

In order to ensure exhaustive parsing of syllables, the final syllable in (20a-d) can constitute a foot of its own. This occurs when EXHAUSTIVITY and *REC(FT) are more highly ranked than BIN(FT) —assuming that faithfulness constraints on moraic specifications are also high-ranked. The optimal candidate selected by this ranking builds a monomoraic degenerate foot, incurring a violation of BIN(FT) (27a below). (In the following tableaux, round brackets indicate foot boundaries and square brackets signal the edges of the prosodic word. Even though syllabic structure is not specified in the input, and it is assumed to be derived via constraint interaction, for ease of presentation, the following tableaux contain schematic inputs with syllables).

(27) EXHAUSTIVITY, *REC(FT) >> BIN(FT)

σσσ	EXHAUST	*REC(FT)	BIN(FT)
☞ a. [(ˈσσ) (ˈσ)]			*
b. [(ˈσσ) σ]	*!		
c. [((ˈσσ) σ)]		*!	

b. EXHAUSTIVITY dominated

Alternatively, if BIN(FT) and *REC(FT) dominate EXHAUSTIVITY (i.e. the constraint that ensures strict layering in the sense that it bans *level-skipping,* Selkirk 1996), the candidate that surfaces as optimal is (28b), with a final unfooted syllable directly dominated by the prosodic word.

(28) BIN(FT), *REC(FT) >> EXHAUSTIVITY

σσσ	BIN(FT)	*REC(FT)	EXHAUST
a. [(ˈσ σ) (ˈσ)	*!		
☞ b. [(ˈσ σ) σ]			*
c. [((ˈσ σ) σ)]		*!	

c. *RECURSIVE(FT) dominated

Finally, if EXHAUSTIVITY and BIN(FT) dominate *REC(FT), the candidate that arises as optimal is the one in which a syllable is parsed via prosodic adjunction to the preceding foot, giving rise to a non-minimal foot projection.

(29) EXHAUSTIVITY, BIN(FT) >>*REC(FT)

σσσ	EXHAUST	BIN(FT)	*REC(FT)
a. [(ˈσσ) (ˈσ)		*!	
b. [(ˈσσ) σ]	*!		
☞ c. [((ˈσσ) σ)]			*

This hierarchy ensures that recursion at the foot level is highly restricted: it exclusively applies in odd-parity forms. This is confirmed in the following tableau with the evaluation of an even-parity form. Here, the parsing that wins does not display recursion (30a), since the three constraints can be perfectly satisfied with regular binary branching minimal feet. Note that the candidate with recursion (30b) would incur two violations of the low-ranked * REC(FT).

(30) EXHAUSTIVITY, BIN(FT) >>*REC(FT)

σσσσσσ	EXHAUST	BIN(FT)	*REC(FT)
☞ a. [(ˈσσ) (ˈσσ)(ˈσσ)]			
b. [((ˈσσ)σ) ((ˈσσ)σ)]			*!*
c. [(ˈσσ) σ (ˈσσ) σ]	*!*		
d. [(ˈσσ) (ˈσσ) (ˈσ)(ˈσ)]		*!*	

This tableau demonstrates that no matter how these constraints are ranked, recursive footing only arises as a last-resort device to ensure exhaustivity and binary footing in odd-parity forms. Interestingly, in Chapter 3 I will present independent support for this *last-resort metrical strategy* in two binary stress systems, Wargamay and Yidiɲ, and in Chapter 6 I will present further support for this last-resort mechanism in Irabu, a pitch-accent Japonic language.

2.3.2 Economical parsings with recursive feet

We just saw that in languages with binary rhythm, recursive footing is a highly restricted mechanism: it only arises in some systems to ensure exhaustive binary parsings. However, in this section and in Chapter 4, I propose that such a claim must be relaxed so that recursive feet occasionally arise in even-parity forms too. In particular, I will argue that this is a necessary move in order to account for ternary stress systems (Chapter 4, see also Martínez-Paricio & Kager 2013) and/or some metrically-conditioned phenomena in quantity-sensitive languages (Chapter 6).

If some systems allow recursive feet in even-parity forms, there must be additional reasons beyond the adherence to exhaustivity and prosodic binarity that motivate recursion at the level of the foot. In particular, the next tableau points to the fact that constraint(s) X must favor candidate (31b) over candidate (31a). But what could these constraints be?

(31) Deriving non-minimal feet in even-parity forms

σσσσσσ	EXHAUST	BIN(FT)	???	*REC(FT)
a. (σˈσ)(σˈσ)(σˈσ)	✓	✓	*	✓
☞ b. ((σˈσ)σ)((σˈσ)σ)	✓	✓	✓	**

Note that, besides displaying recursion, a crucial difference between candidate (31a) and candidate (31b) is that the latter contains a lower number of maximal feet: (31a) has three FtMax, while (31b) has only two. Thus, constraint X must somehow favor economic parsings with a minimum number of maximal feet per prosodic word. In Chapter 4 I propose that parsings with recursion like (31b) fare better in a small set of categorical alignment constraints, which refer to different projections of a foot and/or a syllable. Moreover, the interaction of these constraints will be shown to have the power of regulating the specific position of different projections of feet and unfooted syllables within the prosodic word. Importantly, all these alignment constraints are categorically evaluated and they are formulated in the non-intervention format of (32) (McCarthy 2003, based on Prince 1983; Houghton 2006 and Hyde 2012a *inter alia*).[13,14]

(32) ALIGN-LEFT/RIGHT (Cat1, *Cat2, Cat3)
For every prosodic category Cat1, assign a violation mark if some prosodic category Cat2 intervenes between Cat1 and the left/right edge of Cat3.

Cat1 is, thus, the category that EVAL looks for to check whether it conforms to a specific configuration (i.e. Cat1 is the potential locus of violation); Cat 2 can be defined as the *intervenor* category and Cat 3 is the superordinate category that dominates both Cat1 and Cat2. To illustrate how this type of alignment constraint can favor economical parsings via recursion, take a look at the constraint given in (33), whose first category is a maximal foot, i.e. FtMax.

[13] For some of the theoretical and typological problems with gradient alignment and the superiority of categorical alignment see, among others, Eisner 1997, 2000; Kager 2001, 2005, 2012; McCarthy 2003; Riggle 2004; Biró 2003, 2004; Heinz, Kobele & Riggle 2005; Hyde 2008, 2012a; Buckley 2009; Martínez-Paricio & Kager 2013.

[14] I am indebted to Ryan Bennett for first drawing to my attention the benefits of non-intervention categorical constraints in generating recursion in even-parity forms.

(33) ALIGN-LEFT/RIGHT ([FtMax, *Ft, ω)
For every maximal foot $FtMax^i$, assign a violation mark if some foot intervenes between $FtMax^i$ and the left/right edge of its containing prosodic word.

Since all alignment constraints in this thesis are categorically evaluated, each locus of violation receives no more than one violation mark (McCarthy 2003). This is exemplified in (34), which presents the specific number of violations of AL-LEFT(Ftmax, *Ft, ω) for two candidates with 6-syllables, one with recursion (34b) and one without recursion (34a):

(34)	AL-LEFT([FtMax, *Ft, ω)	Locus of violation
a. (σ 'σ)**i** (σ 'σ)**j** (σ 'σ)**k**	✗✗	(σ'σ)**k**, (σ'σ)**j**
b. ((σ 'σ)σ)**i** ((σ 'σ)σ)**j**	✗	((σ 'σ)σ)**j**

The first candidate violates twice AL-LEFT(FtMax, *Ft, ω) because there are two maximal feet (i.e. (σ'σ)k, (σ'σ)j) that are separated from the left edge of the prosodic word by *some* intervening foot. Contrary to gradient alignment, categorical alignment does not care about the specific number of feet that intervene between the locus of violation $FtMax^i$ and the left edge of the prosodic word. Since the candidate with recursion only violates this constraint once (there is only one maximal foot Ftj separated from the left edge of the prosodic word by some foot), it will surface as optimal given the hierarchy in (35). Note that alternative candidates that do not violate this constraint at all are ruled out because of their lack of iterative footing and exhaustivity. For instance, candidate (35c) violates the more highly ranked EXHAUSTIVITY constraint.

(35)

σσσσσσ	EXHAUST	BIN (FT)	ALIGN-L (FtMax, *Ft, ω)	*REC (FT)
a. (σ'σ)(σ'σ)(σ'σ)			**!	
☞ b. ((σ'σ)σ) ((σ'σ)σ)			*	**
c. ((σ'σ)σ) σ σ σ	***!			*

In Chapters 3 and 4 I motivate one by one the specific alignment constraints that are needed to regulate the emergence and location of recursive feet in a few binary (Chapter 3) and ternary prosodic systems (Chapter 4). For a complete examination of all the typological predictions derived from use of these types of constraints, as well as a restrictive theory of the non-intervention alignment constraints, see Martínez-Paricio & Kager (2013). In joint work with René Kager, we impose two locality restrictions on the type of categories that can be referred to by the non-intervention constraints responsible for the assignment of stress. These locality conditions conform to McCarthy's guidelines (2003) for local constraints (cf. 36) and they are defined in (37).

(36) Constraints are inherently local because they can never mention more than two distinct constituents and a relation between them, such as **adjacency** or **shared membership in a super-ordinate** constituent (McCarthy 2003: 80; the highlighting is mine)[15]

(37) Locality conditions (Martínez-Paricio & Kager 2013)

a. *Daughterhood Condition*

Cat1 and Cat2 must be immediately dominated by Cat3

b. *Adjacency Condition:*

Cat2-Cat3 are vertically adjacent categories in the Prosodic Hierarchy (e.g. if Cat3 = ω → Cat2 = Ft; if Cat3 = Ft → Cat2 = σ)

The two conditions together restrict the values of Cat2 and Cat3 for a given Cat1. In particular, the Daughterhood condition determines that Cat1 and Cat2 must be direct daughters of the superordinate Cat3. The second condition restricts the type of intervenor category Cat2 given a specific superordinate Cat3 domain. In particular, if the superordinate category is the prosodic word, the intervenor category must be a foot, since feet are in the subsequent layer in the prosodic hierarchy below the prosodic word. Thus, a constraint like ALIGN-L/R (Ft, *[σ]ω, ω) would not be a possible constraint because the Adjacency condition is violated: a syllable (Cat2) does not constitute a category vertically adjacent to the prosodic word in the prosodic hierarchy (Cat3). Likewise, if the superordinate category is a foot, the intervening Cat2 must be a syllable, since this is the next layer in the hierarchy. However, given that feet might sometimes be built over morae, breaking the integrity of a syllable, in Chapter 6 we will see that Cat2 can also be

[15] Even if, as McCarthy states, constraints "never mention more than two distinct constituents" since "shared membership in a superordinate constituent" can be included in the definition of a constraint, some constraints will inevitably refer to three categories, given that one of them (Cat 3) dominates the other two, i.e. $[\text{Cat1 Cat 2}]_{\text{Cat3}}$.

instantiated by a mora when Cat3 is a foot. In sum, assuming that Cat 1 can be instantiated by different projections of a foot and/or an unfooted syllable, we predict two types of non-intervention constraints: (i) non-intervention constraints that regulate the location and number of foot projections within a word (38) and (ii) non-intervention constraints that regulate the location of unfooted syllables (39). These constraints are listed below; their concrete effects and interactions will be illustrated in further detail in Chapter 3-5. In these constraints the superordinate category is always the prosodic word and, consequently, the separator category is a foot. Cat 1 may vary, since both a foot and an unfooted syllable can be immediate daughters of a prosodic word (Cat 3). Below in (41) I will show that two additional types of constraints are predicted when the superordinate category is a foot.

(38) Constraints regulating the location and number of foot projections

a. ALIGN-L/R ([FtMin]ω, *Ft, ω)
For every foot that is minimal and maximal (i.e. $[\text{FtMin}^i]\omega$), assign a violation mark if some foot intervenes between $[\text{FtMin}^i]\omega$ and the left/right edge of its containing prosodic word.

b. ALIGN-L/R ([FtNon-min]ω, *Ft, ω)
For every non-minimal foot FtNon-min^i, assign a violation mark if some foot intervenes between FtNon-min^i and the left/right edge of its containing prosodic word.

c. ALIGN-L/R ([FtMax]ω, *Ft, ω)
For every maximal foot FtMax^i, assign a violation mark if some foot intervenes between FtMax^i and the left/right edge of its containing prosodic word.

d. ALIGN-L/R ([FtMain]ω, *Ft, ω)
For every head foot of the prosodic word FtMain^i, assign a violation mark if some foot intervenes between FtMain^i and the left/right edge of its containing prosodic word (based on ENDRULELEFT/RIGHT Prince 1983, McCarthy 2003).

(39) Constraint regulating the location of unfooted syllables

ALIGN-L/R ([σ]ω, *Ft, ω)
For every unfooted syllable [σ^i]ω, assign a violation mark if some foot intervenes between [σ^i]ω and the left/right edge of its containing prosodic word.

The constraints in (39), ALIGN-L/R ([σ]ω, * Ft, ω) respect both the *Daughterhood* and the *Adjacency* conditions: an unfooted syllable (Cat1) and a foot (Cat2) are direct daughters of the prosodic word and, furthermore, feet (Cat2) are adjacent to prosodic words (Cat3) in the prosodic hierarchy. Even if these constraints are formulated in alignment terms, note that they can be considered to be part of the broader family of EXHAUSTIVITY constraints. Importantly, when the left and right versions of these constraints are undominated, exhaustive parsings are ensured (just as when EXHAUSTIVITY is undominated). However, when the right version of the constraint dominates its left version, unfooted syllables are pulled towards the right edge of the prosodic word, as shown in tableau (40). This tableau compares the effects of the alignment constraints on unfooted syllables and the old EXHAUSTIVITY(σ) constraint. Note that EXHAUSTIVITY alone is not able to differenciate among candidates (40a-c).

(40) ALIGN-R ([σ]ω, *Ft, ω) >> ALIGN-L ([σ]ω, *Ft, ω)

σσσ	AL-R ([σ]ω, *Ft, ω)	AL-L ([σ]ω, *Ft, ω)		EXHAUST (σ)
a. (σ σ) σ (σσ)	*!	*		*
☞b. (σ σ)(σσ) σ		*		*
c. σ (σ σ)(σσ)	*!			*
d. (σ σ) σ σ σ		***!		***!

The opposite ranking AL-L([σ]ω, *Ft, ω) >> AL-R([σ]ω, *Ft, ω) would pull unfooted syllables towards the reverse edge of the prosodic word. Despite the fact that EXHAUSTIVITY might be an independently needed constraint in the prosodic hierarchy (i.e. it regulates the parsing of higher prosodic layers), in Chapter 4 I show that the specific alignment definitions given in (39),—with their extra power of being able to pull unfooted syllables to one edge of the prosodic word or another,— are crucially needed to account for the distribution of unfooted syllables in rhythmic stress systems (see also Martínez-Paricio & Kager 2013). In short, by substituting EXHAUSTIVITY[σ] for the specific left/right alignment constraints stated in (39), it is guaranteed that when unfooted syllables are present, they will be grouped together at one of the edges of the prosodic word. As we will see later in Chapter 4, this is a desirable outcome of the theory. Recall from the previous discussion in Section 2.2.2.2 that there is, however, one type of stress system in which unfooted syllables remain in word-medial positions. This is the case of edge-based stress systems with two feet, one at each edge of the prosodic word, e.g. [Ftσσ...σσFt]. These systems could be difficult to model with constraints that pull unparsed syllables to one edge of the prosodic word. However, such systems can be easily predicted by ranking an independently needed ANCHOR constraint highly, requiring morphological edges of a prosodic word to coincide with the edges of some foot (McCarthy & Prince 1995, 1999). While this constraint is not needed in modeling stress in strictly binary/ternary rhythmic systems (Chapters 3 and 4), it is probably independently required to account for edge-based stress systems with more than one foot per prosodic word.

Finally, the fact that EXHAUSTIVITY can be substituted for the more restrictive alignment constraints ALIGN-L/R ([σ]ω, *Ft, ω) at the level of the metrical foot does not necessarily entail that it should be restated in alignment terms at higher levels of the hierarchy. Future research on the parsing of these higher categories will help determine whether the general EXHAUSTIVITY(PROSODICCAT) is needed as stated or if it too should instead be redefined in directional terms.

To complete the list of non-intervention constraints used in this thesis, the classical TROCHEE and IAMB constraints can also be redefined in the format of (32). Assuming that Cat1 is a foot head, this gives rise to the constraints in (41), which are responsible for locating the position of a foot head within a foot.

(41) a. ALIGN-LEFT(Fthead, *σ, Ft)
For every foot head, assign a violation mark if some footed syllable intervenes between the foot head and the left edge of its containing foot, i.e. the head of a foot is on its left branch (abbr. TROC)

b. ALIGN-RIGTHT(Fthead, *σ, Ft)
For every foot head, assign a violation mark if some footed syllable intervenes between the foot head and the right edge of its containing foot, i.e. the head of a foot is on its right branch. (abbr. IAMB)

These constraints are identical to the traditional trochee/iamb constraints: they favor feet that locate their head on the leftmost (41a) or the rightmost

(41b) branch. Thus, when feet are moraic rather than syllabic —as is the case in languages like Chugach (Chapter 3) and Seneca (Chapter6)—, the separator Cat2 will be considered to be a mora rather than a syllable.

An interesting consequence of these constraints is that they can ban recursive feet and, thus, there is no need to posit an independent *RECURSIVE(FT) constraint. Note that every foot will always get a violation of either TROCHEE or IAMB and, thus, when a recursive foot is built, it will necessarily violate either one foot-head constraint or the other. This is illustrated below in tableau (42), where I show that IAMB can do the job of *REC(FT) by favoring the candidate without recursion (42b) over the candidate with recursion (42a).

(42)

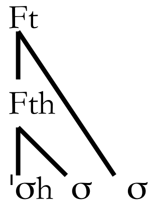
σσσσσσ	TROCHEE	IAMB		REC(FT)
a. ((ˈσ σ) σ) ((ˈσσ)σ)		****!		**!
☞b. (ˈσ σ) (ˈσσ)(ˈσσ)		***!		

Still, since there is evidence for the need for *RECURSIVE(PROSODICCAT) at higher layers of the hierarchy, one could argue that such constraint also affects the category of the foot. The point made here is that, even if *REC(FT) exists, its effects will be always independently ensured by the action of TROCHEE and IAMB.[16] In fact, at various points throughout this dissertation I will make use of the *REC(FT) as a cover constraint for the particular ranking of TROCHEE and IAMB.

Coming back to the specific definition of TROCHEE and IAMB given in (41a,b), note that, for evaluation purposes, a metrical structure like the one in (43a) below will violate IAMB twice because it has two feet in which the head is on the initial branch (in bold), rather than on the final branch. By contrast, a metrical structure like the one in (43b) violates TROCHEE once (its FtMin has its head on the rightmost branch) and IAMB once (the FtNon-min has its head on the left-branch).

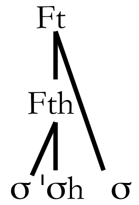
[16] Alternatively, one could argue that the family of *REC constraints is restricted to categories above the foot, where there is ample external motivation (i.e. syntactic) for recursion that does not apply to rhythmic categories.

(43) a. Trochaic FtMin & FtNon-min



TROCHEE: 0 violations
IAMB: 2 violations (FtMin,FtNon-min)

b. Iambic FtMin & Trochaic FtNon-min



TROCHEE: 1 violation (FtMin)
IAMB: 1 violation (FtNon-min)

As shown in the following tableaux, since TROCHEE and IAMB refer to all types of feet (i.e. minimal and non-minimal), their interaction would either favor dactylic feet (tableau 44), or anapestic feet (tableau 45).

(44)

	TROC	IAMB
☞a. ((ˈσ σ) σ)		**
b. (σ (σˈσ))	**	
c. (σ (ˈσσ))	*	*
d. (σˈσ) σ)	*	*

(45)

	IAMB	TROC
a. ((ˈσ σ) σ)	**	
☞ b. (σ (σˈσ))		**
c. (σ (ˈσσ))	*	*
d. (σˈσ) σ)	*	*

Thus, there is need for another set of constraints whose interaction is able to favor amphibrachic structures like the ones in (44c,d and 45c,d), since there is evidence for languages with that type of internally layered ternary foot. This constraint is stated in (46).

(46) ALIGN-L/R(FtMin, *σ, Ft)
For every minimal foot, assign a violation mark if some footed syllable intervenes between the minimal foot and the left/right edge of its containing foot (abbr. NONMINTROCHEE/NONMINIAMB)[17]

This constraint is a specific case within the general headedness constraints. Whereas TROCHEE and IAMB (41a,b) affect all types of feet, the NONMINTROCHEE/NONMINIAMB constraints exclusively care about the structure of non-minimal feet. Consequently, to perceive the effects of NONMINTROCHEE this would need to be ranked above IAMB; likewise, to perceive the effect of NONMINIAMB, this constraint must be ranked above TROCHEE. This latter ranking argument is illustrated in tableau (47), where the

[17] In the rare cases in which the adjunct is a mora, the Cat2 of this constraint will be replaced by a mora (see Chapter 6).

minimal trochaic foot with left-adjunction (47c) is selected as optimal due to the dominance of NONMINIAMB, which favors iambic feet at the level of the non-minimal foot (i.e. feet with an adjoined syllable on the left).

(47) NONMINIAMB >> TROCHEE >> IAMB

σσσ	NONMINIAMB	TROCHEE	IAMB
a. ((ˈσ σ) σ)	*!		**
b. (σ (σˈσ))		**!	
☞ c. (σ (ˈσσ))		*	*
d. (σˈσ) σ)	*!	*	*

In Chapters 3, 4 and 5, I discuss in greater detail the specific effects of the non-intervention constraints presented in this section (38, 39, 41 and 46) and look at some of their most crucial interactions. Further typological evidence for the restrictive power of these constraints can be found in Martínez-Paricio & Kager (2013), where we present the results of the factorial typology generated with OTSoft (Hayes, Tesar & Zuraw 2003) using these types of constraints. Interestingly, the factorial typology verifies that our set of constraints is able to predict all the attested quantity-insensitive rhythmic stress systems with unary, binary and internally layered ternary feet, unlike previous studies that either suffered from undergeneration (i.e. they could not generate all the attested systems) or pathological overgeneration (i.e. they predicted ungrammatical systems with several types of metrical typologies such as the lapse-licensor pathology, Kager 2004; or the midpoint pathology, Eisner 1997, 2000; Kager 2001, 2005, 2012).[18]

2.3.3 Quantity-sensitivity and the symmetric foot inventory

In addition to the constraints presented in the preceding section, four more constraints will be shown to play a crucial role in modeling the metrical structure of different languages. These constraints are stated in (48).

[18] In Martínez-Paricio & Kager (2013) we introduce an additional constraint which specifically regulates the location of unary feet within the prosodic word. However, since such a constraint is not crucial for any of the languages studied here, I leave it out for the sake of simplicity.

(48) a. WEIGHT-TO-STRESS
Assign one violation for every unstressed bimoraic syllable (Prince 1991; Prince & Smolensky 1993/2004)

b. * CLASH
Assign one violation mark for every adjacent pair of stressed syllables (Liberman & Prince 1977; Prince 1983; Selkirk 1984; Kager 1994, 1999; Alber 1997, 2005 *inter alia)*

c. NONFINALITY
Assign a violation mark for every word-final syllable that is stressed (Prince & Smolensky 1993/2004; Hyde 2007 among others)

d. σμμ=FT
Assign a violation mark for every bimoraic syllable that is not coextensive with a foot (based on Selkirk 1978b; Prince 1980; Rice 1992; Kager 1993; Hewitt 1994 among others)

The three first constraints are widely known in the stress literature: WSP is responsible for stressing heavy syllables and, thus, it is crucial for deriving quantity-sensitive stress patterns; *CLASH avoids adjacent stressed syllables and NONFINALITY penalizes forms with word-final stress. The last constraint, which I have labeled σμμ=FT —along the lines of a similar constraint in the prosodic hierarchy forcing prosodic words to be coextensive with binary feet (Itô & Mester 2012b),— has been less used in previous research and, as such, calls for further discussion.

As can be inferred from the definition of σμμ=FT in (48d), this constraint is a specific, and more restrictive, version of WSP. Whereas WSP ensures that a heavy syllable coincides with the head of some foot, σμμ=FT additionally guarantees that the dependent of a foot falls within the limits of the same heavy syllable. In short, σμμ=FT favors moraic feet over syllabic feet and, thus, this constraint is closely related to previous proposals that favored/argued for the existence of moraic feet, i.e. not exclusively for moraic trochees (e.g. Kager 1993; Hewitt 1994 *inter alia*). To illustrate the subtle distinction between σμμ=FT and WSP, consider the tableau in (49), which evaluates a sequence of a heavy-light syllables.

(49)

	CVC^{μ}.CV	σμμ=FT	WSP
	a. [(ˈCV^{μ}C^{μ}. CV^{μ})]	*!	
☞	b. [((ˈCV^{μ}C^{μ}). CV^{μ})]		
☞	c. [(ˈCV^{μ}C^{μ}). CV^{μ}]		

In (49), the ranking σμμ=FT >> WSP ensures that an otherwise uneven syllabic trochee (i.e. ˈHL, 49a) surfaces either with a moraic trochee and internal layering (49b); or, assuming the constraint that ensures exhaustive parsings is low-ranked, with a moraic trochee and an unparsed syllable (49c). Despite the fact that the three forms in (49a-c) place stress on the same syllable (i.e. the heavy syllable), they differ in the specific structure they assign to the unstressed syllable. Importantly, I will show that languages may vary in this respect and, thus, a weak syllable can either be parsed in the dependent of a minimal-foot (49a), in the dependent of a non-minimal foot (49b) or it can be left unfooted (49c). Consequently, universal grammar should be equipped with a means to derive such a subtle distinction.

The contrast among types of unstressed syllables was discussed at length in Section 2.2.2.2 and it will be argued to be vital in languages like Chugach (Leer 1985c; Rice 1992), Old English (Dresher & Lahiri 1991) and Seneca (Chafe 1967, 1977, 1996; Michelson 1988; Melinger 2002) in which unstressed syllables in a dependent of a non-minimal foot behave differently from those in the dependent of a minimal foot or unparsed syllables. Very often, however, in languages with exhaustive parsing of syllables, there will not be specific evidence that allows for distinguishing between structures like (49a) and (49b). In such cases, I will assume that the default parsing is (49a), without recursion. Note that a structure with a recursive foot like (49b) violates IAMB once more than (49a) and, thus, in the absence of positive evidence for high-ranking σμμ=FT, the candidate with a minimal foot (49a) will be preferred, since it displays a more economical and less marked structure, i.e. without recursion at the level of the foot.

Tableau (49) has illustrated the role of σμμ=FT with the evaluation of a trochaic sequence; however, σμμ=FT could also favor moraic iambs. Although fairly uncommon, on the basis of Leer's (1985a,b,c) and Kager's (1993) proposals among others, I will assume that languages in which a rising diphthong is bimoraic (e.g. ($G^{\mu}V^{\mu}$)) can occasionally assign it a moraic iamb structure. Similarly, some languages may opt for parsing bimoraic vowels with a rising contour, so they can be analyzed with a moraic iamb (Leer 1985a,b,c). In sum, even though the intrinsic sonority rise of heavy syllables generally favors monosyllabic trochees over iambs (Prince 1983; Clements 1990; Kager 1993), moraic iambs can potentially arise in some languages. Assuming σμμ=FT is part of CON, such parsings can be easily favored when necessary. Furthermore, since a similar constraint has been posited at other layers of the hierarchy (e.g. Itô & Mester 2012b propose PERFECTWORD a cover constraint that favors coextensive prosodic words and binary branching feet), σμμ=FT could be seen as a particular instantiation of a more general constraint which favors coextensive prosodic categories that are vertically adjacent in the prosodic hierarchy. Interestingly, note that if there is a constraint this general that is part of CON, apparent counterexamples to the universality hypothesis of the prosodic hieararchy that propose that some languages display gaps in the prosodic hierarchy (e.g. Schiering, Bickel & Hildebrandt 2010) could be easily explained without challenging the universality of the prosodic hierarchy (see Chapter 4 for further discussion related to this constraint).

It is important to highlight that, even if moraic iambs and uneven trochees have long ben left out from standard inventories of feet, many studies have shown that several languages allow such structures (e.g. Leer 1985; Rice 1992; Kager 1993; Mellander 2003; Revithiadou 2004; Morén-Duolljá 2013 *inter alia*). Therefore, even if marked, particular grammars should be able to generate them. The reason for previously banning uneven trochees and even iambs was their lack of conformity with the *Iambic-Trochaic Law*. This law (50a-b) was considered to be universal and inviolable, and it directly modeled the inventory of feet (Hayes 1995) (50c).

(50) Iambic/Trochaic Law (Hayes 1995: 80, based on Hayes 1985, 1987)

a. Elements contrasting in intensity naturally form groupings with initial prominence.
b. Elements contrasting in duration naturally form groupings with final prominence.

c. <u>Asymmetric foot inventory predicted by the Iambic/Trochaic Law</u>[19]

SYLLABIC TROCHEE	(* .) σ σ				
MORAIC TROCHEE	(* .) σh σ μh μ	or	(*) σh μh μ		
IAMB	(. *) σ σh μ μhμ	or	(. *) σ σh μ μh	or	(*) σh μh μ

Contrary to this asymmetrical inventory, the representational assumptions presented in Section 2.2 and the interaction of the constraints posited in this

[19] Hayes used both gridmarks and metrical structure, so I provide both representations.

chapter predict a symmetric foot-inventory, along the lines of Rice (1992) and Kager (1993, 2012).

(51) Binary symmetric feet

a. Syllabic trochee:	(ˈσ σ)	b. Moraic trochee:	(ˈμ μ)
c. Syllabic iamb:	(σ ˈσ)	d. Moraic iamb:	(μ ˈμ)

In this dissertation I assume that every language will present at least one of the foot types presented in (51). However, under particular constraint rankings, to be illustrated in the remainder of the thesis, every binary foot in (51) can be expanded by adjoining a syllable, to either the right or the left of the foot.[20] This gives rise to four types of trisyllabic feet (52a,c,e,g), and four types of bisyllabic feet with internal layering, where the heavy syllable in the minimal foot is bimoraic (52b,d,f,h).

(52) Ternary symmetric feet

Trochaic FtNon-min

a. FtMin syllabic trochee:	((ˈσ σ) σ)	b. FtMin moraic trochee:	((ˈμ μ) σ)
c. FtMin syllabic iamb:	((σ ˈσ) σ)	d. FtMin moraic iamb:	((μ ˈμ) σ)

Iambic FtNon-min

e. FtMin syllabic trochee:	(σ (ˈσ σ))	f. FtMin moraic trochee:	(σ (ˈμ μ))
g. FtMin syllabic iamb:	(σ (σ ˈσ))	h. FtMin moraic iamb:	(σ (μ ˈμ))

It is important to highlight that the feet in (52) are not primitives of the theory. Instead, they are grammatical *artifacts* that arise via particular constraint rankings. Whereas all languages display one of the four feet types in (51), only some languages can present some of the feet in (52). Furthermore, the fact that uneven bisyllabic feet in the right column of (52) can be parsed via recursion does not mean that such sequences (e.g. HL, LH) are necessarily parsed via recursion. Such feet can surface as mere syllabic feet (e.g. 51a,c). The particular rankings of WSP, σμμ=FT and the rest of proposed constraints regulating the location of foot heads (at the minimal and non-minimal layer of the foot) will determine the exact structure of the foot in a particular language.

[20] In the following chapters I will show that the adjoined syllable is generally light but, under specific circumstances, the adjunct might be a heavy syllable too. This is sometimes the case in Old English (Chapter 5) and Seneca (Chapter 6).

Although the (extralinguistic) basis of the Iambic/Trochaic Law is undeniable in accounting for many linguistic tendencies (e.g. lengthening and shortening patterns) and, as posited by Prince (1991), there might be a universal harmonic scale that favors even trochees and uneven iambs (53), some interactions should favor not-so-harmonic feet. The point made here is that in addition to FOOTBIN and WSP (see Prince 1991), σμμ=FT is one of those constraints.

(53) Harmonic scale of feet
Iambic: {LˈH}≻{LˈL, ˈH}≻ ˈL
Trochaic: {LˈL, ˈH}≻ ˈHL≻ ˈL

2.4 Summary

This chapter has outlined the basic architecture of a metrical framework that allows recursive footing in phonological representations. Contrary to previous studies that limited recursion to higher layers of the prosodic hierarchy, I have proposed that recursive feet can arise in particular languages due to the interaction of fairly standard markedness constraints on the prosodic hierarchy (Selkirk 1996) and categorical alignment non-intervention constraints that are able to refer to different projections of a foot (based on McCarthy's 2003 alignment constraints). The arguments for such a proposal will be presented in Chapters 3-6.

I have further argued that recursion at the level of the foot is not unbounded, but is universally limited to one layer (the One Layer Recursive Foot Hypothesis). Consequently, intermediate feet that are simultaneously non-minimal and non-maximal are ungrammatical. Additionally, I have proposed that the Head Uniqueness Principle restricts the type of recursive feet allowed by universal grammar: recursive feet consist of at most one self-embedded foot. The joint action of the One Layer Recursive Foot Hypothesis and the Head Uniqueness Principle ensures that feet are maximally trisyllabic.

In arguing for the need for recursive feet in phonological representations, I have identified additional prominent and non-prominent metrical positions, which are needed to account for the full range of distinctions attested in prosodic systems. Finally, along the lines of traditional studies (Rice 1992; Kager 1993) and, in light of recent typological findings which demonstrate that metrical systems display more symmetry than originally thought (see

Kager 2012 for discussion), the present model predicts a symmetrical foot inventory.

The remainder of this thesis discusses and exemplifies in detail all these claims and proposals with specific case studies in various related and unrelated language.

3 Recursive feet as a last-resort device

In the preceding chapter I proposed that languages can display recursion at the foot level as a last-resort mechanism to avoid degenerate feet and ensure exhaustive parsing of syllables (similar ideas appeared in van der Hulst 2010; Bennett 2012 and Martínez-Paricio 2012). In this chapter I present concrete arguments, and particular evidence, for such a claim by closely examining the metrical peculiarities of Wargamay and Yidiɲ, two Australian languages extensively described in Dixon's (1977a,b; 1981) works.

3.1 Introduction

Evidence for trisyllabic maximally binary branching feet that arise via recursion (e.g. (σ('σσ)), (('σσ)σ)) comes from a variety of phonological and morphophonological phenomena in a wide range of languages (for some examples in recent research see Caballero 2008, 2011; Bennett 2012 and Kager 2012). The present chapter concentrates on data from Wargamay and Yidiɲ, two Australian languages from the Pama-Nyungan family. These languages are particularly interesting because they exhibit an uncommon lengthening process, by which a subset of the stressed vowels lengthens exclusively in odd-parity forms. Whereas standard metrical theories with maximally binary feet encounter several challenges when trying to account for these complicated lengthening patterns, this chapter demonstrates that a unified and fairly simple analysis of lengthening is possible once recursive feet are made available to natural languages. Therefore, this chapter provides support for one of the most important claims of the thesis: internally layered trisyllabic feet are not a representational device that arises exclusively to account for ternary rhythm, but systems with binary rhythm can also employ this type of foot. In particular, this chapter argues that, in some languages, recursion at the foot level is a last-resort mechanism, which is activated in odd-parity forms to ensure exhaustive parsing of syllables and avoid monomoraic feet.

The organization of the chapter is as follows. Section 3.2 presents a brief background of Wargamay and Yidiɲ. It outlines the main characteristics of the puzzling lengthening patterns and it sketches the general mechanisms responsible for the emergence of recursive feet in the two languages. In Section 3.3 I present a detailed analysis of Wargamay, while Section 3.4 concentrates on Yidiɲ. In Section 3.5 I briefly compare the present recursive-foot based account of Wargamay and Yidiɲ with an alternative analysis that posits *ambipodal syllables* (Hyde 2001, 2002, 2012). Finally, I close the chapter by presenting a brief summary of Bennett's (2012) recent recursive-foot based analysis of Huariapano coda [h] epenthesis, which provides further typological support for the main ideas outlined in the chapter.

3.2 Background

Wargamay (Dyrbalic subfamily) and Yidiɲ (Yidinic subfamily) are two Australian languages originally spoken in North Queensland, in the North-East of Australia. Yidiɲ was spoken by perhaps 2000 members of the Yidindi, Gudandi and Madandi tribes, living in the rain forest just to the south of the city of Carins (Dixon 1977a: xv). Wargamay was spoken along both sides of Herbert River and on Hinchinbrook Island and the adjacent mainland (south of the present town of Cardwell). All the data in this chapter are drawn from the grammars and studies based on Dixon's own fieldwork (Dixon 1977a,b, 1981). Dixon reports that the two languages were on the verge of extinction when the fieldwork was carried out, i.e. during the sixties and seventies. [1] In this section I present the relevant data concerning lengthening and stress in both languages. For a detailed presentation of other aspects of the languages, the reader is referred to Dixon's work.

[1] *Ethnologue* (www.ethnologue.com) reports only 5 speakers for Wargamay and 12 for Yidiɲ in 1981. Based on these data and Dixon's remark, the two languages are most likely currently extinct.

3.2.1 The puzzle: even-parity forms *vs.* odd-parity forms

Wargamay and Yidiɲ have a small inventory of vowels that contrast in length: /i, iː, a, aː, u, uː/. The phonemic contrast is restricted to initial positions in Wargamay, i.e. underlying long vowels only occur word-initially. In addition to underlying length, both languages display a lengthening process, which exclusively targets a subset of the stressed vowels in words with an odd number of syllables. This is illustrated in (1) and (2). In Wargamay, the vowel in the peninitial syllable is lengthened in odd-parity forms (1c,d), but only if the first vowel is not already long (i.e. underlyingly long) (see 1f, where the peninitial vowel remains short, even if the word has an odd number of syllables). Peninitial syllables in even-parity forms do not undergo lengthening (1a,b). In the following examples, the vowel that undergoes lengthening is underlined; underlying long vowels are indicated with an underlying mora in the phonological form.

(1) Wargamay[2]

Even-parity forms

a. /bada/	[ˈba.da]	'dog'
b. /giɟawulu/	[ˈgi.ɟa.ˌwu.lu]	'freshwater jewfish'

Odd-parity forms

d. /gagara/	[ga.ˈga·.ra]	'dilly bag'
e. /ɟuɽagay-miri/	[ɟu.ˈɽa·.gay.ˌmi.ri]	'Niagara Vale-from'
f. /gi$^{\mu}$bara/	[ˈgiː.ba.ra], *[ˈgiː.ba·.ra]	'fig tree'

Yidiɲ lengthens vowels in penultimate syllables. However, as in Wargamay, the process only applies in words with an odd number of syllables (2d-f), i.e. Yidiɲ even-parity words do not undergo lengthening (2a-c).

[2] I follow Dixon's (1981) Wargamay transcriptions. To avoid any confusion, however, I have substitued the character he used for transcribing the voiced laminal stop —which was similar to the IPA symbol for the velar voiced implosive, i.e. [ɠ]— for the phonetic character of a lamino-palatal stop [ɟ]. In Dixon's transcriptions, the rhotic [r] represents an "alveolar trill (sometimes a single flap)" and the retroflex [ɽ] stands for "either a semi-retroflex (post-alveolar) continuant or else a flap or short trill articulated towards the back of the alveolar ridge" (1981: 16). The latter has been occasionally transcribed in some subsequent studies on Wargamay as [ɻ] (e.g. Wilson & Hayes 2008).

(2) Yidiɲ[3]

Even-parity forms

a. /galiŋ/	[ˈga.liŋ]	'go-Present'
b. /madʸindana/	[ˈma.dʸin. ˈda.na]	'walk up-Purposive'
c. /gudagagu/	[ˈgu.da. ˈga.gu]	'dog-Purposive'

Odd-parity forms

d. /galina/	[ga.ˈlíː.na]	'go-Purposive'
e. /madʸindaŋ/	[ma.ˈdʸíːn.daŋ]	'walk up-Present'
f. /gudagudaga/	[gu.ˈda.gu.ˈdaː.ga]	'dog-Redup-Abs'

In Yidiɲ, lengthening always applies (Dixon 1977a,b), whereas in Wargamay the process is frequent, but optional (Dixon 1981: 20). Furthermore, Dixon reports that underlying long vowels in word-initial syllables in Wargamay (e.g. 1f) have "stronger and more consistent quantitative realization" than the vowels that undergo lengthening in the peninitial syllables of some words (1d,e). That is why he generally transcribes them differently: underlyingly long vowels are represented as long, with the diacritic [ː] (e.g. [V́ː]), whereas derived long vowels are coded as semilong (e.g. [V́ˑ]). However, when describing the concrete realization of underlying word-initial vowels, Dixon clarifies that "the actual phonetic length of these vowels appears to depend on the following consonant" (Dixon 1981: 18). The shortest versions appear before a stop and, thus, they could be transcribed as semilong (e.g. /ɟi$^{\mu}$ɟin/ 'swamp wallaby' > [ˈɟiˑ.ɟin]), whereas the longer version occurs before the semi-retroflex rhotic, which he suggests could be transcribed with extra length (e.g. /gu$^{\mu}$ɽɟuɽu/ > [gúːːɽɟuɽu] (Dixon 1981: 18). In short, the difference between the long vowel [V́ː] and the semilong vowel [V́ˑ] should not be interpreted as a direct reflex of the contrast between underlying *vs.* derived length, but rather as the effect of several phonetic factors (e.g. the phonetics and greater prominence of constituents in the word-initial domain, the phonetics of coarticulation, etc.). Since here I will only be concerned with the investigation of the phonological mechanism that causes lengthening in peninitial syllables in Wargamay odd-parity forms and the device that preserves underlying length in initial syllables, I will not be investigating the actual differences in the phonetic

[3] For the Yidiɲ data I also follow Dixon's conventions. The [dʸ] stands for the voiced lamino-alveolopalatal stop as in Dixon (1977b). All stresses are marked as primary, following Dixon, who did not posit any distinction between primary and secondary stresses.

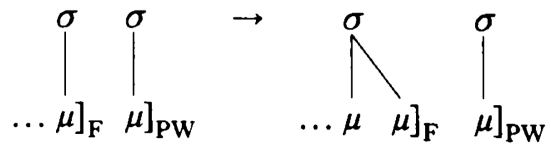
implementation of morae in Wargamay. The following pages will additionally aim to clarify the causes of penultimate lengthening in Yidiɲ odd-parity forms.

As Hyde (2002, 2012b) points out, standard theories of stress do not have a principled way to provide a device for this type of lengthening or to locate the desired syllable which undergoes lengthening in either of the two languages. Indeed, the patterns of lengthening are puzzling in two respects. First, it is not clear why lengthening only applies in odd-parity forms. Second, the vowel that undergoes lengthening does not necessarily coincide with primary stress; thus, it is difficult to single out the target of lengthening without appealing to brute-force stipulation. Take for instance the case of Yidiɲ. Stressed syllables in Yidiɲ are all transcribed with the same acute accent (Dixon 1977a,b), yet lengthening only applies in a subset of them (i.e. the penultimate stressed syllables in odd-parity forms). If one assumes that the rightmost foot is the head of the prosodic word, it could be proposed that the target of lengthening is the head of the prosodic word. This strategy would predict lengthening in penultimate syllables. However, such a solution must be disregarded because it incorrectly predicts lengthening in even-parity forms. Moreover, some scholars have suggested that the leftmost stress is in fact the most prominent one (Hayes 1995: 25, citing personal communications with Keneth Hale; van der Hulst et al. 2010). If these authors are right, lengthening cannot be formalized in terms of a rule/constraint that targets the head of a prosodic word, since the head foot is at the opposite edge of the syllable that lengthens. In any case, independent of the exact location of primary stress in Yidiɲ, the underlying reason for restricting the application of lengthening to just a subset of the penultimate syllables remains obscure.

The examples in (3) illustrate some of the rules that have been proposed in the literature to account for lengthening in Yidiɲ. These rules need to encode the odd syllable-count requirement (3a) and/or some information about the location of stress and its distance to the right edge of the word (3b).

(3) a. Penultimate Lengthening Rule (Dixon 1977a: 43, 1977b: 6)
In every word with an odd number of syllables, the penultimate vowel is lengthened.

b. Penultimate Lengthening Rule (Crowhurst & Hewitt 1995: 57)



Although these rules can restrict lengthening to odd-parity forms, they are not explanatory; the cause of lengthening remains an enigma.

A similar puzzle arises in Wargamay. In this language, lengthening coincides with the primary stressed syllable, but only in words with an odd-number of syllables. Therefore, a rule targeting the head of the prosodic word cannot be called into play: this rule would also lengthen short vowels in primary stressed syllables in even-parity forms, but these syllables do not lengthen (Dixon 1981: 20).[4] Alternatively, rather than referring to the head of the prosodic word, one could formalize a lengthening rule that targets peninitial syllables. However, this rule is equally inadequate since it would predict lengthening of peninitial syllables in words with initial long vowels like *gí:bara* 'fig tree', but peninitial syllables in these words never lengthen.

Expanding on the ideas presented in Chapter 2, the main goal of the following pages is to show that a very simple account of lengthening in Wargamay and Yidiɲ can be achieved when recursion at the level of the foot is a possible grammatical strategy.

3.2.2 Towards a solution: recursive feet and prosodic prominence

In the preceding chapter, I proposed that prosodic recursion might take place in languages with binary rhythm as a means of ensuring exhaustivity. Crucially, since recursion in these languages only arises as a last-resort device to avoid unparsed syllables and/or monomoraic feet, the construction of recursive feet is highly restricted (for similar ideas see Bennett 2012). In the absence of quantity distinctions (i.e. in words with light syllables), recursive feet only surface at the right/left edge of an odd-parity form. For ease of exposition, tableau (4) repeats the crucial ranking arguments. The first tableau evaluates a candidate with an odd number of syllables (5-syllables), whereas the second tableau evaluates an even-parity form (4-syllables). Given the hierarchy in (4), only the odd-parity form presents recursion. For ease of exposition, in these tableaux I use the constraints EXHAUSTIVITY and *REC(FT) as placeholders for their specific definitions in alignment terms. Remember from the discussion in Chapter 2 (Section 2.3.1), that instead of EXHAUSTIVITY(σ) I have adopted the left and right-alignment non-intervention constraints that pull unfooted syllables towards an edge of the prosodic word, i.e. ALIGN-

[4] Although they can be underlyingly long. In Section 3 I provide an account for these different restrictions on underlying length and derived length.

LEFT/RIGHT([σ]ω, *Ft, ω). Likewise, the effects of the antirecursive-foot constraint *REC(FT) can be achieved with the ranking of the alignment headedness constraints, i.e. IAMB and TROCHEE (see Chapter 2 and Sections 3.3 and 3.4 for illustrations of this point).

(4)

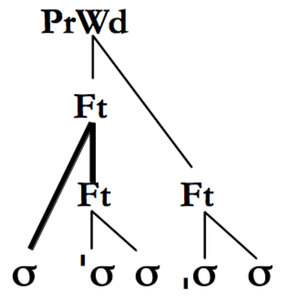
σσσσσ	EXHAUST	BIN(FT)	*REC(FT)
a. ☞[(σ ('σ σ))('σ σ)]ω			*
b. [('σ) ('σσ)('σ σ)]ω		*!	
c. [σ ('σ σ)('σ σ)]ω	*!		
σσσσ	EXHAUST	BIN(FT)	*REC(FT)
a. ☞[('σσ)('σσ)]ω			
b. [((('σσ) σ) ('σ)]ω		*!	*
c. [(('σσ) σ) σ]ω	*!		*

The following pages will demonstrate that Wargamay and Yidiɲ have similar structures to the ones given in (4), in which odd-parity forms present a non-minimal (i.e. recursive) foot, but even-parity forms don't. The question is, then, what makes a recursive foot an adequate/explanatory tool to account for the relatively uncommon patterns of lengthening in the two languages. I will answer this question in the next sections and show that the motivation for the patterns of lengthening in Wargamay and Yidiɲ can be easily captured if lengthening is said to exclusively target the head of a recursive foot (i.e. a non-minimal foot).

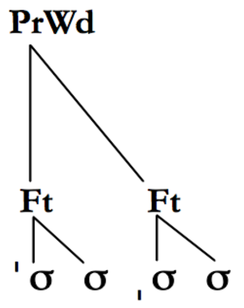
The overarching idea of the analysis relies heavily on the well-established dichotomy between *heads* and *dependents* in the prosodic hierarchy, previously discussed in Chapter 2. Note that, in structural terms, the head of a non-minimal foot is the head of two feet simultaneously: the non-minimal foot and the minimal foot, e.g. $((\sigma\ \underline{'\sigma})_{\text{FtMin}}\ \sigma)_{\text{FtNon-min}}$ (the underlined syllable indicates the head of the two feet). Building on the greater *visibility* and *complexity* of heads over dependents (Dresher & van der Hulst 1998; Section 2.2.2.1 in this thesis), I argue that the double-head nature of a non-minimal foot contributes to its greater *visibility* for phonological augmentation processes (Zoll 1998/2004; Smith 2005, *inter alia*). More specifically, I claim that the head of a recursive foot can be more accessible for augmentation processes than the head of a minimal foot, or the dependents of a foot. In languages like Wargamay and Yidiɲ, this greater visibility allows the head of a non-minimal foot to be singled out as the target of the lengthening process. Furthermore, the insertion of a mora is licensed in the head of a non-minimal foot (rather than the dependents) because heads allow for more complex structures than weaker positions (i.e. complexity asymmetry, Dresher & van der Hulst 1998). In that sense, the greater phonological prominence of the head of a recursive foot finds a clear phonetic correlate in the languages under study. As I demonstrate below, a recursion-based analysis of Wargamay and Yidiɲ provides not only a method for identifying the syllable that lengthens, but also a device/explanation for the lengthening process itself.

The prosodic representation of two Wargamay words, given below in (5), clearly illustrates why lengthening only affects odd-parity forms. The vowel in the peninitial syllable in the 5-syllable word *ɟuɽá·gaymìri* 'Niagara Vale-FROM' (5a) is the only vowel in the prosodic word that is the head of two feet and, consequently, is the unique target of lengthening. The double-head status of the vowel contributes to its greater prominence. It could alternatively be proposed that the greater prominence of the syllable is just a consequence of its status as head of the prosodic word. However, as already pointed out, such an approach would leave unanswered the question of why the process is blocked in even-parity forms. If lengthening targets the head of a prosodic word, words with an even number of syllables like *gíɟawùlu* 'fresh water jewfish' should also lengthen. However, optional lengthening never occurs in even-parity forms (Dixon 1980: 20). A recursion-based analysis overcomes this puzzle by placing the cause of lengthening in the double-head status of peninitial syllables.

(5) a. Odd-parity form: 5σ b Even-parity form: 4σ



ɟu ɽá· gay mì ri
'Niagara Vale-from'



gí ɟa wù lu
'freshwater jewfish'

In the case of Yidiɲ, a recursive foot is built in odd-parity forms at the other edge of the prosodic word, e.g. [(σ ˈσ))((σ ˈσ̲ː) σ)]. Hence, the syllable that has a double-head status is the penultimate and is therefore the one that lengthens. Note that the alternative approach that would lengthen the main stressed syllable (i.e. the head of the prosodic word) is also untenable in Yidiɲ, since both even and odd-parity forms have more than one primary stress per prosodic word. Furthermore, when scholars have distinguished between different degrees of stress in the language, the syllable associated with main stress is located in the word-initial foot. Thus, such an analysis would incorrectly predict lengthening at the opposite edge of the prosodic word, i.e. in the left-most foot rather than the right-most foot.

The analysis is slightly more complicated when words with heavy syllables are considered. Since Wargamay and Yidiɲ exhibit different restrictions on the distribution of underlying long/short vowels and the location of stress, the following sections look more deeply into each language's individual phonology.

I start by analyzing the length contrasts and stress system of Wargamay (Section 3.3). The distribution of long vowels in Wargamay is particularly enthralling because underlying and derived long vowels display different distributional restrictions. I then proceed to an examination of some aspects of Yidiɲ's morphophonology (Section 3.4). This language is especially interesting because length, stress assignment and allomorph selection interact in a very intricate way. Furthermore, the Yidiɲ stress system constitutes an atypical case for metrical theory, since it combines both trochaic and iambic footing depending on quantity distinctions and the parity of the word.

3.3 Wargamay

This section presents an analysis of the underlying length contrast, the lengthening process and the assignment of stress in Wargamay. I first analyze the distribution of (underlying and derived) length in the language (Section 3.3.1) and then turn to examining length's interaction with stress assignment (Section 3.3.2).

3.3.1 Underlying and derived length

The patterns of lengthening in Wargamay are repeated below in a box (6c, d). Remember from previous sections that peninitial syllables exclusively lengthen in odd-parity forms, but only if the vowel in the initial syllable is not underlyingly long (6c-d *vs.* 7c-d). The examples in (6a-b) and (7a-b) show that lengthening does not take place in even-parity forms.

(6) Words with light syllables

<u>Even-parity forms</u>

a. /bada/	[ˈba.da]	'dog'
b. /giɟawulu/	[ˈgi.ɟa.ˌwu.lu]	'freshwater jewfish'

<u>Odd-parity forms</u>

c. /gagara/	[ga.ˈ<u>gaˑ</u>.ra]	'dilly bag'
d. /ɟuɽagay-miri/	[ɟu.ˈ<u>ɽaˑ</u>.gay.ˌmi.ri]	'Niagara Vale-from'

(7) Words with heavy syllables: σ_H are restricted to the initial syllable

<u>Even-parity forms</u>

a. /muᵘba/	[mú:.ba]	'stone fish'
b. /guᵘɲaraɲin/	[gú:ɲaráɲin]	'rubbish-ABL'

<u>Odd-parity forms</u>

c. /giᵘbara/	[gí:bara]	'fig tree'	*gí:<u>baˑ</u>ra
d. /baᵘlbalilagu/	[bá:lbalilágu]	'roll-INTRPURP'	* bá:l<u>baˑ</u>lìlagu[5]

As in other Australian languages (e.g. Nyawaygi or Guugu Yimidhirr), the underlying length contrast in Wargamay is positionally restricted. In particular, underlying long vowels in Wargamay are restricted to the word-initial syllable. The length contrast is present in open and closed syllables, in all roots of any length (e.g. *wi:* 'sun', *gú:gal* 'mud cod', *bú:ŋguray* 'a snore', *gú:ɲaráɲin* 'rubbish-ABL').[6] Some minimal pairs involving the length contrast in Wargamay word-initial position are given in (8).

[5] As Hayes & Wilson (2008: 418) point out, there are not many words with five syllables where the initial syllable is heavy and, unfortunately, from Dixon's data it is not clear if secondary stress in these forms falls on the penultimate *bá:lbalilàgu* or antepenultimate syllable *bá:lbalìlagu*.

[6] There are not many items that exhibit a long vowel: of the 920-word Wargamay list, 90 items involve a long vowel and many of these are verbs (Dixon 1981: 17).

(8) Minimal pairs (examples from Dixon 1981: 17-18)

a.	giba	'liver'	giːba-	'to scratch'
b.	ɟulu	'buttocks'	ɟuːlu	'black'
c.	nuba	'bark bag'	nuːba-	'to sharpen'
d.	ganda-	'to burn, cook'	gaːnda-	'to crawl'
e.	ŋana	'1pl pron.'	ŋaːna	'interrog. pron., object form'

Strikingly, different restrictions hold for the distribution of underlying long vowels and derived length. Whereas underlying long vowels are restricted to word-initial syllables in odd/even parity forms, derived length is limited to peninitial syllables in odd-parity forms. Any analysis of Wargamay must capture these different distributional facts.

The restriction on underlying long vowels can be accounted for by referring to the inherent prominence of the word-initial domain. There is a large amount of evidence indicating that initial elements in a word are phonologically prominent (e.g. Trubetzkoy 1939; Steriade 1994; Byrd 1996; Beckman 1998; Casali 1998; Alber 2001; Smith 2005; Cabré & Prieto 2006; Becker, Nevins & Levine 2012 *inter alia*). Building on this evidence, various positional faithfulness and markedness constraints, which allude to initial segments/constituents in a word, have been proposed in the litetature. In order to account for the maintenance of lexical length in Wargamay word-initial syllables, I propose a positional version of Morén's constraints on reassociation of morae (MAX/DEP-LINKμ[Segment], 9a-b).[7] The positional versions of these constraints, which directly refer to the first syllable of the word, are given in (10a-b):

(9) General MAX/DEP-LINKμ[Vowel] constraints (Morén 1999/2001)

a. MAX-LINKμ[Vowel]
For two corresponding vowels, if V1 (in the input) is associated with a mora, then V2 (in the output) is associated with a mora.

b. DEP-LINKμ[Vowels]
For two corresponding vowels, if V2 (in the output) is associated with a mora, then V1 (in the input) is associated with a mora.

[7] See Morén (1999/2001) for details on the differences and independent need for MAX/DEP-LINKμ and MAX/DEP-μ. Whereas MAX/DEP-LINKμ explicitly refer to corresponding segments and their associations with morae, the general MAX/DEP-μ constraints regulate the overall insertion/deletion of morae.

(10) Positional faithfulness MAX/DEP-LINKμ1 (based on Morén 1999/2001)

a. MAX-LINKμ,σ1[Vowel]
For two corresponding vowels, if V1 (in the input) is associated with a mora, then V2 (in the output) is associated with a mora, where V2 belongs to the first syllable of a word.

b. DEP-LINKμ,σ1[Vowel]
For two corresponding vowels, if V2 (in the output) is associated with a mora, then V1 (in the input) is associated with a mora, where V2 belongs to the first syllable of a word.

By ranking the positional faithfulness moraic constraints in (10) above the markedness constraint against long vowels *Vμμ defined in (11), input length specifications are preserved in word-initial syllables (i.e. no mora is deleted/inserted in such a position). Aditionally, *Vμμ must outrank the general faithfulness constraints on morae MAX/DEP-LINKμ[Vowel] (9a-b). For ease of exposition, in the following discussion I will often refer to these constraints with the cover constraint FAITH-LINKμ, whereas the positional faithfulness version, provided in (10), will be indicated by FAITH-LINKμ,σ1. In (12) I present the specific ranking schema just proposed for Wargamay.

(11) *Vμμ
Assign a violation mark for every long vowel, i.e. a vowel that is linked to two morae (Prince and Smolensky 1993/2004; Rosenthall 1994; Sherer 1994)

(12) FAITH-LINKμ,σ1 >> *Vμμ >> FAITH-LINKμ

The relevant ranking arguments that support the hierarchy given in (12) are provided in tableaux (13-14). Tableau (13) presents the ranking argument for FAITH-LINKμ,σ1 >> *Vμμ, which ensures that inputs with long vowels in the first syllable like /gi^{μ}bara/ 'fig tree' surface faithfully, e.g. [gíːbara]. In the following discussion I make the assumption that all nuclear vowels are forced to have at least one mora by some undominated constraint in Wargamay (Morén 1999/2001: 64). [8] That is, I assume that short vowels are not linked to

[8] For the moment I will remain agnostic as to whether the ban on moraless syllables should be directly encoded in GEN. Despite the fact that according to the inviolable HEADEDNESS constraint (Selkirk 1996 every syllable should dominate at least one mora, since some languages with particular cases of epenthesis have been claimed to have moraless

a mora in the input, but they get one by default in the output. These default output morae will not be marked in the tableaux. For ease of presentation, I will only transcribe the extra morae relevant for our analysis, i.e. the morae that make light syllables heavy.

(13) /gí$^{\mu}$bara/ → [gí:bara] 'fig tree'

gi$^{\mu}$bara	FAITH-LINKμ,σ1[V]	*Vμμ
a. ☞ gi$^{\mu}$.ba.ra		*
b. gi.ba.ra	*!	
c. gib$^{\mu}$.ba.ra	*!	

This tableau shows that the most faithful candidate (i.e. the candidate with an underlying long vowel in the initial syllable) is the one that surfaces as optimal. The other candidates are ruled out because they do not preserve the underlying mora (13b) or because, even if they preserve the input mora, it has been reassociated to another segment (13c).

It is important to note that the positional faithfulness FAITH-LINKμ,σ1 constraints are independently needed to capture the contrast between the minimal pairs presented in (8), which only differ in the first syllable's length specification (e.g. *gánda* 'to burn, cook' *vs. gá:nda* 'to crawl'). The ranking argument for *Vμμ dominating the non-positional constraints on morae specifications, in particular MAXLINK-μ, is presented below in tableau (14). This ranking ensures that an underlying long vowel in positions other than word-initial surfaces as short. For instance, even if the input for a disyllabic word like *báda* 'dog' contained an underlying long vowel in the final syllable, the candidate that preserves the long vowel (14b) would never be selected as optimal. Note also that an alternative candidate in which the underlying mora is preserved in the output, but only by surfacing in the first syllable of the word, e.g. [bá$^{\mu}$.da] (14c), is also ruled out by this hierarchy.

(14) /bada/ 'dog' Ranking argument *Vμμ >> MAXLINK-μ

bada$^{\mu}$	FAITH-LINKμ,σ1	*Vμμ	MAXLINK-μ
a. ☞bá.da			*
b. bá.da$^{\mu}$		*!	
c. bá$^{\mu}$.da	*!	*	*

syllables (see, for instance, Mellander's 2003 and Piggott's1995 analysis of Mohawk), I leave this question open for future research.

In sum, this type of analysis, which employs the ranking schema POSITIONAL FAITH >> MARKEDNESS >> GENERAL FAITH, bans long vowels in every non-initial syllable. However, this is an undesired effect in Wargamay, because derived length surfaces in other positions, i.e. peninitial syllables undergo lengthening in odd-parity forms, e.g. /gagára/ > [gagáˑra] 'dilly bag'. Recall that in previous sections I proposed that peninitial syllables in Wargamay exhibit lengthening due to their intrinsic structural prominence, i.e. they are the head of a non-minimal foot, e.g. (σ(ˈσ̲ˑσ)). However, given the ranking in (12-14), long vowels would be banned in every position except word-initially.

To avoid such a situation, and to license peninitial lengthening in odd-parity forms, I propose that Wargamay has another high-ranked constraint which ensures long vowels in yet another prominent position, i.e. the head of a non-minimal foot. Crucially, even though underlying and derived length are motivated by different factors, they are both restricted to prominent positions: underlying length surfaces in the initial syllable of a word, whereas derived length is only licensed in the head of a non-minimal foot. It is important to highlight, however, that a Positional Faithfulness account alone would not be able to derive the correct distribution of long and short vowels in Wargamay because long vowels in peninitial syllables of odd-parity forms are not present in the input. I propose, thus, that in Wargamay there is another high-ranked constraint that causes derived length.

In particular, I put forward the idea that a specific instance of the STRESS-TO-WEIGHT constraint ("stressed syllables are heavy", Hammond 1986; Myers 1987; Riad 1992; van de Vijver 1998; Gouskova 2003; McGarrity 2003; van Oostendorp 2003; Rice 2006b; *inter alia*) is responsible for the lengthening pattern reported in Wargamay. Note that the traditional STRESS-TO-WEIGHT cannot be the cause of lengthening in Wargamay, because a high-ranked STRESS-TO-WEIGHT would incorrectly lengthen all stressed vowels in the language. Thus, building on Zoll's work on positional markedness (1996, 1998/2004), I propose that a categorical positional markedness constraint from the family of COINCIDE ensures that vowels with a double foot-head status are lengthened. This constraint is formulated in (15), based on Zoll's own formulations of other COINCIDE constraints (1996, 1998/2004: 371).

(15) COINCIDE (Head((Ft)Ft), heavy σ) (abbr. COINC(HdFtFt,σH))
A head of a foot that is dominated by another foot (i.e. the head of a non-minimal foot) contains a heavy syllable.
(i) ∀x (x is a head of a recursive foot)→∃y (y=Heavy Syllable ∧ Coincide (x, y))
(ii) Assess one mark for each value of x for which (i) is false

Whereas the traditional STRESS-TO-WEIGHT constraint ensures that the head of all feet are heavy, COINCIDEHDFTFT,σH guarantees that only the head of non-minimal feet (i.e. a recursive feet) are heavy. I will show that a high-ranked COINCIDEHDFTFT,σH in Wargamay and Yidiɲ is responsible for lengthening the vowel in the head of a non-minimal foot. In particular, in Section 3.4 I will show that this constraint is crucial in generating the lengthening patterns of Yidiɲ. In the case of Wargamay, however, one could instead posit another version of STRESS-TO-WEIGHT which specifically targets the head of the prosodic word, i.e. MAIN-TO-WEIGHT (Hayes 1995; McGarrity 2003; Bye & de Lacy 2008). This constraint is also a positional markedness constraint which can be stated in COINCIDE terms *à la* Zoll, e.g. COINCIDEHDPRWD,σH. Even if the head of the prosodic word does not always lengthen in Wargamay, assuming that such a constraint is ranked below the positional faithfulness constraint FAITH-LINKμ,σ1, we could derive the correct distribution of underlying and derived length in the language. In such a scenario, the ranking FAITH-LINKμ,σ1 >> COINCIDEHDPRWD, σH is crucial because, otherwise, vowels in initial syllables in even-parity forms would incorrectly lengthen (e.g. [ˈba.da] not *[ˈbaː.da] 'dog'). Importantly, independently of whether we adopt the version of COINCIDE that targets the head of a non-minimal foot (COINCIDEHDFTFT,σH) or the one that targets the head of the prosodic word (COINCIDEHDPRWD,σH), the lengthening pattern in Wargamay can be correctly derived. In the case of adopting the latter constraint, however, it is crucial that the positional faithfulness constraint FAITH-LINKμ,σ1 dominates COINCIDEHDPRWD,σH so that the heads of prosodic words with an even number of syllables do not lengthen (e.g. [ˈgi.ɟa.ˌwu.lu]). In Section 3.3.2 I will show that there are independent reasons to believe that odd-parity forms that undergo lengthening are parsed with a non-minimal foot at the left edge of the prosodic word. In such cases, the head of the prosodic word coincides with the head of a non-minimal foot and, thus, since the two COINCIDE constraints (COINCIDEHDFTFT,σH and COINCIDEHDPRWD,σH) are independently motivated in other languages, either of them could be adopted for the analysis of Wargamay. However, since Yidiɲ can only be accounted for with the COINCIDE constraint that refers to the head of a recursive foot, I will use this constraint for ease of presentation in the remainder of this section.

To summarize the main points of the present analysis, the two tableaux in (16) fully account for derived and underlying length in Wargamay (bear in mind that an alternative account that ranks COINCIDEHDPRWD,σH below the positional faithfulness constraint would also predict the correct site for derived length in Wargamay).

(16) Lexical length and derived length in Wargamay[9]

I. Underlying length in word-initial position, e.g. [*gí:bara*]

$gi^{\mu}bara$	FAITH-LINKμ,σ1	COINCIDE HDFTFT, σH	*Vμμ	MAX LINKμ	DEP LINKμ
a.☞((gí$^{\mu}$.ba) ra)			*		
b. (gi (bá$^{\mu}$ra))	*!		*	*	*
c. ((gí.ba) ra)	*	*!		*	

II. Lengthening in peninitial syllables, e.g. [*gagá·ra*]

gagara	FAITH-LINKμ,σ1	COINCIDE HDFTFT, σH	*Vμμ	MAX LINKμ	DEP LINKμ
a.☞ (ga (gá$^{\mu}$.ra))			*		*
b. (ga (gá.ra))		*!			
c. ((gá$^{\mu}$ga) ra)	*!		*		*

The first tableau demonstrates that the ranking FAITH-LINKμ,σ1 >> *Vμμ adequately maintains underlying moraic specifications in vowels when they appear in word-initial syllables (16I). This ranking bans candidates like (16Ib-c), where the moraic lexical specifications have not been preserved. As can be observed in this tableau, candidate (16Ib) has reassociated the first vowel's mora to the second vowel, incurring a violation of FAITH-LINKμ,σ1 (namely, MAX-LINKμ,σ1), whereas candidate (16IIc) disobeys the markedness constraint that enhances prominence on phonological heads, i.e. COINCIDEHDFTFT,σH. In the second tableau on the top of this page I illustrate the ranking that causes peninitial lengthening in Wargamay: FAITHμ,σ1, COINCIDEHDFTFT,σH >> *Vμμ. This tableau shows that even if peninitial syllables are underlyingly short, the positional markedness constraint, COINCIDE, makes sure that the vowels in this position surface as long. Whereas FAITHμ,σ1 rules out (16IIc), COINCIDEHDFTFT,σH bans (16IIb) because the head of the non-minimal foot does not exhibit lengthening.

Remember from previous discussion that lengthening in Wargamay was optional (Section 3.2) and, thus, the candidate without lengthening (16IIb) is sometimes preferred over (16IIa). In order to account for this optionality, I

[9] In Section 3.3.2, where I examine the constraints responsible for stress assignment and merical structure, I show why alternative candidates with two feet like [(gi$^{\mu}$)(bá.ra)] or one foot and an unparsed syllable, e.g. [(gí$^{\mu}$.ba)ra], do not surface as optimal in Wargamay. Likewise, I show the specific rankings that parse a word like *gagá·ra* with a minimal trochaic foot and a non-minimal iambic foot (i.e. (ga(gá·ra)), but *gí:bara* with a trochaic minimal and non-minimal foot, i.e. ((gí:ba)ra).

assume that the constraints COINCIDE (HDFTFT, σ_H) and *Vμμ are not in a fixed domination relationship, but rather in a variable or stochastic ranking (Anttila 1997, 2002; Boersma 1997). When COINCIDE dominates *Vμμ, lengthening occurs (i.e. (16II,a) is selected as optimal); the alternative ranking, prevents lengthening (i.e. (16II,b) surfaces).[10] That is, I assume that lengthening in Wargamay, although optional, is phonological (see also Mellander 2003 and Revithiadou 2004 for a phonological interpretation of other cases of trochaic lengthening).

Phonological lengthening in Wargamay produces an uneven trochee: the innermost (i.e. non-maximal) foot in (16IIa) is a 'HL foot. Even though Dixon coded peninitial vowels as semilong rather than long, this does not entail that they are not moraic: remember that semilong vowels were also a possible outcome for underlying long vowels in initial syllables. As previously discussed in Chapter 2 (Section 2.3.3), the presence of uneven trochees in foot inventories has traditionally been rejected on the basis of the *Iambic-Trochaic Law* (Hayes 1987, 1995; Prince 1991). Many of the works that rejected this type of foot proposed that apparent instances of trochaic phonological lengthening were just cases of phonetic lengthening (Prince 1991; Hayes 1995; Bye & de Lacy 2008 *inter alia*). However, note that a purely phonetic account of lengthening in Wargamay is unable to explain why trochaic lengthening never occurs in even-parity forms; that is, it cannot account for the absence of lengthening in forms like ['ba.da] 'dog' and ['gi.ɟa.ˌwu.lu] 'freshwater jewfish' (recall that these forms never display lengthening of the first syllable, even if this is the head of a trochee). Crucially, as I have just shown, a purely phonological analysis of lengthening can account for: (i) the non-application of lengthening in even-parity forms —in these forms there are only minimal feet and, thus, the target of lengthening is absent from the structure—; (ii) its optional application in odd-parity forms (via variable constraint ranking) and (iii) the exact location of the syllable that lengthens (i.e. the head of a non-minimal foot). Thus, the variability in the application of lengthening in Wargamay does not necessarily entail that the process is phonetic in nature. To conclude the discussion regarding HL feet, along the lines of previous research (e.g. Rice 1992; Mellander 2003; Revithiadou 2004, among others), I assume that, despite the scarcity of 'HL feet, this type of foot does arise in some languages. Consequently, uneven trochees should not be completely

[10] Importantly, this variable ranking does not impeach the preservation of underlying length in word-initial syllables since the ranking FAITHμσ1 >> *Vμμ is fixed, thereby guaranteeing the preservation of lexical length in the initial syllable, even if this syllable is the head of a recursive foot.

excluded from the inventory of feet. Furthermore, in the next chapter I will demonstrate that in some languages there is phonological evidence to motivate positing internal structure in some uneven feet, e.g. (('H)L). In these languages, an uneven trochee/iamb is not a primitive unit of the theory, but it is a grammatical artifact, i.e. an uneven foot arises from adjoining a syllable to a preceding/following bimoraic foot due to constraint interaction. Since in Wargamay there is no phonological evidence in favor of this type of additional bracketing in 'HL trochees, the default assumption will be that uneven trochees are parsed in one bisyllabic foot. This is the case in words with underlying long vowels (e.g. ((gíᵘ.ba) ra), 16I) and words with derived length, (e.g. (ga (gáᵘ.ra)), 16II), where the HL minimal foot has been underlined.

A final note must be said with respect to the reported differences in length in Wargamay. Unfortunately, there are not specific measurements to support Dixon's impressionistic transcriptions and, therefore, any conclusion regarding the difference between semilong and long vowels should be regarded as tentative. Still, as I argued at the beginning of this section, the fact that the realization of a long vowel is not only conditioned by the underlying or derived nature of a mora but also the phonetic makeup of the consonant that follows the vowel —remember that underlying long vowels are shorter when followed by a stop (Dixon 1981: 18)— seems to call for a purely phonetic account of the actual implementation of morae in prosodic representations. For instance, the fact that morae in word-initial syllables are often (though not always) slightly longer than peninitial syllables could receive a phonetic account based on the differences in the realization of segments in initial positions within prosodic domains as opposed to segments/constituents in other positions (e.g. segments in initial positions are realized with greater articulatory effort, which can often be translated into greater prominence of domain-initial constituents). Finally, note that a phonological account that attributes the differences in length to a difference in the phonetic interpretation of a lexical mora (i.e. underlying association lines) and an inserted mora (i.e. derived association lines) is also problematic since it would be unable to account for the full length distinctions in Wargamay, where semilong vowels also occur in word-initial position.

To summarize, the phonological analysis of Wargamay lengthening presented here has provided both a *device* that singles out the stressed syllable that undergoes lengthening in the language (i.e. the head of a non-minimal foot) and an *explanation* of the foundations of lengthening (i.e. the greater inherent prominence of syllables that are the head of two feet simultaneously). The remaining differences between different degrees of length (i.e. long/semilong/extralong vowels) seem to be purely phonetic and would need to be further investigated by phonetic and phonetics/phonology interface theories. However, the lack of measurements (and speakers) leaves this question open for investigation in other languages with similar or closely related lengthening scenarios.

3.3.1.1 More on positional faithfulness *vs.* positional markedness

As highlighted by Zoll (1998/2004), Positional Faithfulness constraints preserve underlying contrasts in strong positions (e.g. input morae word-initially), but they cannot predict unfaithful mappings that introduce marked structure (e.g. an output mora that was not present in the input). That is why in the preceding section I argued for the need of a positional markedness constraint like COINCIDEHDFTFT,σ_H to derive lengthening of peninitial syllables in Wargamay odd-parity forms; a positional faithfulness constraint alone like FAITHμ,σ_1 could not possibly derive the correct lengthening patterns in Wargamay, since derived length occurs in syllables that are not word-initial.

Zoll pointed out that Positional Faithfulness could be problematic in yet another way: Positional Faithfulness predicts that derived marked structure can affect weak positions. Zoll sees this prediction as an important flaw of the theory. Indeed, having marked structure in weak positions seems an undesired effect of any theory of positional prominence. However, the data in Wargamay challenge this intuition and suggest that, under certain circumstances, having marked structure in a weak position should not be regarded as a drawback. In Guugu Yimidhirr —the language Zoll analyzes— allowing marked structure in weak positions is in fact problematic because derived and underlying length are both restricted to exactly the same strong environment. In Wargamay, on the other hand, underlying and derived length show different distributions. Both arise in strong positions, but these strong positions are crucially not the same. It is important to recall from the discussion in Chapter 2 (Section 2.2.2.1) that the concepts of *strong* and *weak* are relative notions and may be measured for different parameters/factors. Thus, it might be the case that a position that has been characterized as weak with respect to one parameter behaves as strong with respect to another parameter. This dual behavior of some positions is evidenced by the distributional facts in Wargamay. In this language, peninitial syllables are weaker than initial syllables, since only the latter can support length contrasts. On the other hand, peninitial syllables can be stronger than initial syllables when they are parsed in the head of a non-minimal foot, receiving stress and being lengthened. This is the case in odd-parity forms with underlying short vowels. In that sense, the prediction of the Positional Faithfulness approach by which derived marked structure can affect weak positions is not totally incorrect (since a position that is weak regarding one parameter can be strong with respect to another).

For the sake of the most economical analysis, one could try to substitute the faithfulness constraint FAITH-μ,σ1 for a positional markedness constraint from the family of COINCIDE. Namely, a COINCIDE constraint that ensures heavy syllables (i.e. long vowels) in initial syllables, e.g. COINCIDEσ_H,σ_1.[11] However, such an account is inadequate because it is unable to generate the difference between minimal pairs such as [ŋana] '1pl pron.' *vs.* [ŋaːna] 'interrogative pron., object form'. As it can be seen in the following tableau, the hierarchy proposed in tableau (17) would only be able to generate outputs with a short vowel in the initial syllable (e.g. candidate 17b), even when the input contained an underlying long vowel. This is so because the positional markedness constraint, COINCIDEσ_H,σ_1 , does not have any effect in the given outputs (17a-b), and the decision concerning the selection of the optimal candidate is made by the lower-ranked markedness constraint *Vμμ.

(17) Alternative ranking with only Positional Markedness

Evaluation of [ŋáːna] 'interrogative pron., object form'

ŋa$^{\mu}$na	COINCσH, σ1	COINCHDFTFT, σ_H	*Vμμ	FAITHμ
a. (ŋa$^{\mu}$.na)			*!	
b. 💣(ŋa.na)				*

From this example it can be concluded that *positional markedness* and *positional faithfulness* are both needed to account for the complete picture in Wargamay: (i) a positional faithfulness constraint keeps the lexical contrast in the initial position and (ii) a positional markedness constraint ensures lengthening in a strong position, i.e. a vowel that is the head of two feet.

Before turning to the examination of the mechanisms responsible for the assignment of stress in Wargamay, the metrical structure of Wargamay monosyllables deserves some attention. In Wargamay, the absolutive case —which marks intransitive subject and transitive object functions— has zero realization, i.e. the prosodic word coincides with the stem and the root (Dixon 1981: 28). Crucially, there are no monosyllabic words with a short vowel. That is, all monosyllables contain a long vowel, independent of whether they are in

[11] The alternative COINCIDEσ1,σH, in which the variable σ1 has scope over σH, cannot be called into play because there are many word-initial syllables that are short.

an open (e.g. [yaː] 'top of a tree') or a closed syllable (e.g. [guːɲ] 'spirit of a man').

To capture the word-minimality requirement, the constraint ensuring binary branching feet BIN(FT) presented in Chapter 2 must dominate FAITH-μ,σ1. Otherwise, an input with a monomoraic stem could surface with a short vowel. This is illustrated in (18) with the evaluation of two monosyllables, one with a lexical long vowel and the other with a lexical short vowel. The tableau on the left demonstrates that the optimal output for an input that contains an underlying long vowel is the most faithful candidate (i.e. the one with a long vowel). When the input has a short vowel (tableau on the right), the same ranking ensures that the unfaithful candidate with a long vowel (i.e. CVː) surfaces as optimal. Alternative candidates which exhibit augmentation by a syllable would also respect BIN(FT). However, I assume such outputs do not surface as optimal due to an undominated constraint against epenthetic segments (i.e. DEP).

(18) Monosyllables always surface with a long vowel, e.g. wiː 'sun'

wi^{μ}	BIN(FT)	FAITH-LINKμ,σ1
a. ☞ (wi^{μ})		
b. (wi)	*!	*

wi	BIN(FT)	FAITH-LINKμ,σ1
a. ☞ (wi^{μ})		*
b. (wi)	*!	

When monosyllabic words are made polysyllabic by the addition of a suffix, the vowel always surfaces as long, e.g. *maːl* > *maːl-du* 'man-Erg'. This seems to suggest that the underlying representation of monosyllables is the one that contains a long vowel. In any case, since rich inputs should be considered, BIN(FT) >> FAITH-LINKμ,σ1 guarantees the complete ban on short vowels in monosyllables. Finally, depending on the specific theoretical model adopted for the interactions between phonology and morphology, the explanation for why there is no vowel that shortens in monosyllables when an affix is added may vary. Within parallel monolitic approaches in OT, it could be assumed that a high-ranked output-output correspondence constraint ensures faithful mappings to the absolutive base (Benua 1997). Alternatively, within stratal OT approaches to grammar (Bermúdez-Otero 1999, 2013, in prep.; Kiparsky 2000), the ban on monosyllables with short vowels could be accounted for by assuming the output of the stem level phonology is the input to the word level phonology. The two models can deal with the Wargamay facts and, since this is not crucial to the main ideas elaborated in the chapter, the reader can choose his/her favorite model for the interface between phonology and morphology.

3.3.2 Stress assignment

3.3.2.1 Words with light syllables

Wargamay distinguishes between light and heavy syllables for stress assignment purposes. The distribution of stress in words with light syllables is illustrated in (19) (the variants in 19b,d are the two possible forms in odd-parity forms, with and without lengthening).

(19) Words with light syllables

a. báda	b. gagáˑra / gagára
c. gíɟawùlu	d. ɟuɽáˑgaymìri / ɟuɽágaymìri

As can be seen from the stress pattern in even-parity forms (19a,c), Wargamay is a trochaic language, i.e. TROCHEE dominates IAMB. The definition of these constraints is given in (20a,b), following the non-intervention format presented in Chapter 2.

(20) a. TROCHEE (i.e. AL-LEFT(Fthead, *σ/μ, FT))
For every foot head, assign a violation mark if some footed syllable/mora intervenes between the foot head and the left edge of its containing foot, i.e. feet are left-headed (based on Hayes 1995; Prince & Smolensky 1993/2004)

b. IAMB (i.e. AL-RIGHT(Fthead, *σ/μ, FT))
For every foot head, assign a violation mark if some footed syllable/mora intervenes between the foot head and the right edge of its containing foot, i.e. feet are right-headed (based on Hayes 1995; Prince & Smolensky 1993/2004)

The following tableau illustrates the ranking argument TROCHEE>> IAMB with the evaluation of an even parity-form, /giɟawulu/ 'freshwater jewfish'. The candidate with trochaic feet (21a) beats the candidate with iambic feet (21b).

(21) /giɟawulu/ > [ˈgi.ɟa.ˌwu.lu] 'freshwater jewfish'

giɟawulu	TROCHEE	IAMB
a. ☞ (gíɟa)(wùlu)		**
b. (giɟá)(wulù)	**!	

In odd-parity forms, the ranking BIN(FT), EXHAUSTIVITY >> *REC(FT) bans non-exhaustive parsings (e.g. *σ(σσ)(σσ)) and parsings with monomoraic feet (e.g. *(σ_L)(σσ)(σσ)). Furthermore, alternatives with exhaustive parsing in which the leftover syllable is lengthened as a means of conforming to BIN(FT) and EXHAUSTIVITY are also ruled out because such candidates violate other high-ranked constraints. For instance, a candidate in which the first syllable is lengthened, e.g. [(σ_H)(σσ)(σσ)], incurs a violation of the undominated FAITH-LINKμ,σ1 constraint presented in the previous section. Additionally, similar candidates which vary in the location of the monosyllabic foot, such as [(σσ)(σσ)(σ_H)] with a final heavy syllable, or [(σσ)(σ_H)(σσ)] with an internal heavy syllable, are also precluded because they incur a violation of NONFINALITY and CLASH respectively. In the following section, which deals with stress in words with heavy syllables, I demonstrate that these two constraints are undominated in Wargamay.

When the ranking ensuring exhaustivity is combined with TROCHEE >> IAMB, exhaustive footing with minimal trochaic feet is guaranteed. However, as I show in the following tableau, such a hierarchy also predicts trochaic non-minimal feet (i.e. a minimal foot with a right adjunct), e.g. as in (22b) and (22d). This is an undesired prediction of the ranking because stress in odd-parity forms with light syllables does not fall on odd-numbered syllables, but even-numbered ones (the sad face in the tableau indicates the intended winner, i.e. the candidate that could correctly capture the distribution of stress and lengthening, but given this hierarchy, is not selected as optimal; the bomb shows the winners that are wrongly selected as optimal).

(22) /ɟuɽagay-miri/ > [ɟu.ˈɽaˑ.gay.ˌmi.ri] 'Niagara Vale-from'

ɟuɽagay-miri	BIN(FT)	EXHAUS	TROC	IAMB
a. ☹ (ɟu(ɽá.gay)) (mí.ri)			*	**
b. 💣((ɟúɽa)gay)(mì.ri)				***
c. (ɟú.ɽa) (gay (mí.ri))			*	**
d. 💣(ɟú.ɽa) ((gáy.mi).ri)				***

To ensure leftward footing and a word-initial non-minimal foot as in (22a), additional constraints (and their interactions) need to be considered. Namely, I propose that the ranking of two types of non-intervention constraints (Chapter 2) are crucial in selecting the correct output in Wargamay, i.e. a candidate like (22a). On the one hand, the location of the non-minimal foot within the prosodic word would be given by the specific ranking of the constraints in (23a,b). On the other hand, the specific ranking of NONMINTROC and NONMINIAMB (24a,b) determines the shape of the non-minimal foot, i.e. with a right or left adjunct. The definition of these constraints is repeated below in (23) and (24).

(23) a. ALIGN-LEFT ([FtNon-min]ω, *Ft, ω) (abbr. AL-LFtNon-min)
For every non-minimal foot FtNon-min ^{i}, assign a violation mark if some foot intervenes between FtNon-min ^{i} and the left/right edge of its containing prosodic word.

b. ALIGN-RIGHT ([FtNon-min]ω, *Ft, ω) (abbr. AL-RFtNon-min)
For every non-minimal foot FtNon-min ^{i}, assign a violation mark if some foot intervenes between FtNon-min ^{i} and the left/right edge of its containing prosodic word.

(24) a. ALIGNLEFT(FTMIN, *σ, FT) (abbr. NONMINTROC)
For every minimal foot, assign a violation mark if some footed syllable intervenes between the minimal foot and the left edge of its containing foot (i.e. non-minimal feet are trochaic).

b. ALIGNRIGHT(FTMIN, *σ, FT) (abbr. NONMINIAMB)
For every minimal foot, assign a violation mark if some footed syllable intervenes between the minimal foot and the right edge of its containing foot (i.e. non-minimal feet are iambic).

The constraints in (23) pull non-minimal feet towards a particular word edge. This is an optimal effect because in rhythmic systems in which stressed and unstressed syllables display a strictly binary alternation, recursive feet occur at the left/right edge of the prosodic word. As a matter of illustration, consider tableau (25). When the leftward ALIGN-LEFT([FtNon-min]ω, *Ft, ω) is ranked above its rightward version, recursive feet are pulled towards the left edge of the prosodic word.

(25) ALIGNL([FtNon-min]ω, *Ft, ω) >> ALIGNR(Ft[Non-min]ω, *Ft, ω)

σ σ σ σ σ σ σ	ALIGN-L (FtNon-min, *Ft, ω)	ALIGN-R (FtNon-min, *Ft, ω)
a.☞(σ ('σ σ)) ('σ σ) ('σ σ)		*
b. ('σ σ) ('σ σ) (σ ('σ σ))	*!	
c. ('σ σ) (σ ('σ σ)) ('σ σ)	*!	*

Candidate (25b) is ruled out because it contains one FtNon-min that is separated from the left edge of the prosodic word by some foot. Candidate (25c) is dispreferred for the same reason. Remember that the alignment constraints used in this thesis assess violations in a categorical way. Thus, in (25b) and (25c), the specific number of intervening feet between the left edge of the prosodic word and the left edge of the non-minimal foot is not relevant. This is why ALIGN-L(FtNon-min, *Ft, ω) assigns the same number of violations to candidate (25b) and candidate (25c), even if the non-minimal foot in candidate (25b) is farther from the left edge of the prosodic word than candidate (25c).

The constraints in (24) are a specific version of the general TROCHEE and IAMB constraints. Whereas TROCHEE and IAMB assign violations to all types of feet, NONMINTROCHEE and NONMINIAMB only care about the shape of the non-minimal foot. In particular, their ranking determines the position of the adjunct in the non-minimal foot. The effects of NONMINTROCHEE and NONMINIAMB can only be perceived when they are ranked above their general version counterpart, i.e. NONMINIAMB >> TROCHEE or NONMINTROCHEE >> IAMB.

To summarize, in Wargamay, the rankings that guarantee that odd-parity forms surface with a non-minimal iambic foot (i.e. with the adjunct on the left of a minimal trochee) in word-initial position are given in (26).

(26) a. AL-L(FtNon-min, *Ft ω) >> AL-R(FtNon-min, *Ft ω)

b. BIN(FT), EXHAUSTIVITY>> NONMINIAMB >> TROC >>IAMB

By ranking BIN(FT) and EXHAUSTIVITY[12] above the foot form constraints, recursion at the level of the foot is restricted to the minimum, i.e. it is a last-

[12] Remember that I use EXHAUSTIVITY as a shorthand for the two non-intervention alignment constraints that pull unfooted syllables to one edge of the prosodic word, i.e. ALIGN-Left/R ([σ]ω, *Ft, ω) and ALIGN-Left/R ([σ]ω, *Ft, ω) (see Chapter 2). When the

resort mechanism that only arises to ensure exhaustive parsing of syllables and binary branching feet. By contrast, when TROCHEE or IAMB (or both) dominate BIN(FT) or EXHAUSTIVITY, recursive feet can arise in other situations, and not only as a last-resort mechanism. This idea is further explored in the next chapter.

The next tableau demonstrates that the rankings in (27) correctly select the candidate with a non-minimal iambic foot in word-initial position and minimal trochaic feet (27a). Since BIN(FT) and EXHAUSTIVITY are undominated, I do not include them in the following tableau and will only consider candidates that already conform to them.

(27) NONMINIAMB>> TROCHEE AL-LFtNon-min >> AL-RFtNon-min

ɟuɽagaymiri	AL-L FtNon-min	NON MIN IAMB	TROC	IAMB	AL-R FtNon-min
a.☞(ɟu(ɽá.gay)) (mì.ri)			*	**	*
b. (ɟú.ɽa) (gay (mì.ri))	*!		*	**	
c. (ɟú.ɽa) ((gìy.mi)ri)	*!	*		***	
d. ((ɟúɽa)gay) (mì.ri)		*!		***	*

In (27), candidates (27b,c) are ruled out because their non-minimal feet are aligned at the right edge of the prosodic word and, thus, they both violate the high-ranked alignment constraint AL-LEFT(FtNon-min, *Ft, ω). Although the non-minimal foot in candidate (27d) is aligned at the left edge of the prosodic word, since it has a trochaic form (i.e. the adjunct occurs at the right edge of its minimal foot) it fares worse in the hierarchy than (27a), which has an iambic non-minimal foot. Furthermore, as we have just seen in Section 3.3.1, since the ranking between COINCIDEHDFTFT and *Vμμ is not fixed, a five syllable word like *ɟuɽagaymiri* may surface with lengthening [(ɟu(ɽá$^{\mu}$.gay))(mì.ri)] or without lengthening [(ɟu(ɽá.gay))(mì.ri)], depending on the specific domination relation between COINCIDEHDFTFT and *Vμμ. The ranking COINCIDEHDFTFT >> *Vμμ would cause lengthening, whereas the opposite ranking would maintain the lexical short vowels.

two constraints are undominated, they have the same effect as EXHAUSTIVITY, i.e. they ensure exhaustive parsing of syllables. However, under specific rankings, they might allow unfooted syllables at the left or right edge of the prosodic word (see Chapter 4, Section 4.5.1 and Martínez-Paricio & Kager 2013 for details).

Rather than parsing the five syllable word with a word-initial, non-minimal foot, as in [(ɟu(ɽá.gay))(mì.ri)], it could be argued that the first syllable is instead left unfooted, i.e. directly linked to the prosodic word as in [ɟu(ɽá.gay)(mì.ri)]. Even though this parsing would not affect the correct location of stress, by treating the first syllable as unfooted, we predict that the word-initial syllable is not relevant for metrical purposes. To the contrary, word-initial syllables in Wargamay are particularly relevant (and visible) for metrical rules/constraints: if they are heavy, they attract stress disrupting the otherwise peninitial stress pattern. Thus, since word-initial syllables are often stressed and, furthermore, their particular weight is determinant in whether other syllables are stressed or unstressed, I assume they are metrically relevant, and therefore part of a foot. (See Chapter 2 for the differences between unstressed and unfooted *vs.* unstressed and foot-dependent in the present framework).

Finally, in order to ensure that primary stress falls in the leftmost foot of the prosodic word, I assume that the ENDRULELEFT constraint is undominated and, crucially, ranked above its right counterpart, i.e. ENDRULERIGHT (based on Prince 1983; Prince & Smolensky 1993/2004; Hayes 1995; McCarthy 2003: 111 *inter alia*). The definition of ENDRULELEFT is given in (28). Note that this constraint is one of the first non-intervention constraints proposed in the literature.

(28) ALIGN-LEFT([FtMain]ω, *Ft, ω) (abbr.ENDRULELEFT)
For every head foot of a prosodic word FtMain^i, assign one violation mark if another foot intervenes between FtMain^i and the left edge of its containing prosodic word (i.e. the leftmost stress is the primary stress) (based on Prince 1983; Prince & Smolensky 1993/2004; Hayes 1995; McCarthy 2003)

Having examined the constraints and representations responsible for the distribution of underlying and derived length, as well as those that account for the location of stress in words with light syllables, the next section will show that these same rankings, with minimal additions, also may account for the location of stress in words with heavy syllables.

3.3.2.2 Words with underlying long vowels

Long vowels in Wargamay are heavy and attract stress. This is especially evident in trisyllabic words: when they contain an initial heavy syllable (29a), stress appears in the initial syllable rather than the peninitial (29b).[13]

(29) Stress assignment in trisyllabic words

a. Underlying long vowel: /g$^{\mu}$bara/ → [gíːbara] 'fig tree'

b. Underlying short vowels: /gagara/→ [gagáˑra] 'dilly bag'

In the previous section I examined how Wargamay parses odd-parity forms with underlying short vowels: trochaic feet are built from right-to-left and the "leftover" initial syllable is adjoined to the first foot, giving rise to a recursive foot, e.g. (ga(gáˑ.ra)) (29b). The picture is slightly different in the presence of an underlying long vowel, where primary stress is located in the initial syllable rather than the peninitial (29a).

To account for the attraction of stress to word-initial heavy syllables, I propose that the constraint banning heavy unstressed syllables, i.e. WEIGHT-TO-STRESS (WSP, Prince 1991), is undominated in Wargamay. The pressure of this constraint, together with FAITH-LINK$\mu,\sigma 1$, guarantees word-initial stress in forms with an underlying initial long vowel. To preclude the peninitial syllable from also bearing stress, the constraint against stress clashes needs to be included in the hierarchy (*CLASH, Liberman & Prince 1977; Prince 1983; Selkirk 1984; Kager 1994, 1999; Alber 1997, 2005). This analysis is illustrated in (30). In particular, this tableau shows that /gi$^{\mu}$bara/, with an underlying long vowel, is parsed as [((gí$^{\mu}$.ba)ra)] 'fig tree' (30a), with primary stress on the first syllable, one level of recursion and a final lapse. In the next tableau, when feet are built over monosyllabic heavy syllables as in (30b-c), I assume that they have a trochaic shape, following Prince (1983) and Kager (1993), among others. (Remember that long vowels and, hence, bimoraic syllables are indicated with a moraic superscript).

[13] Hyde (2012b: 387) recently claimed that there was "no attested pattern where odd-parity forms alternate in their exhibition of directional parsing effects based on the presence or absence of odd-numbered heavy syllables" and, thus, metrical theories of stress should not generate these types of systems. He further stated that the only exception to this claim occurs when the alternation is based on the weight of final syllables only, as in Wergaia (1986), but that this and similar systems can be easily generated with NONFINALITY constraints. Wargamay seems to be a clear counterexample to Hyde's claim, since the weight of the initial syllable is the one that is crucial in the language. In particular, if the initial syllable is heavy, it alters the otherwise leftward trochaic parsing. A metrical theory of stress should be able to model such directional parsing effects, too.

(30) Trisyllabic word with an underlying long vowel, e.g. *gi:bara*

$gi^{\mu}bara$	CLASH	FAIT Hμ,σ1	WSP	COINC HDFTFT,σ_H	*Vμμ	NONMIN IAMB	TROC	IAMB
a.☞((gí$^{\mu}$ba)ra)					*	*		**
b. (gí$^{\mu}$)(ba(rá$^{\mu}$))					**!		*	**
c. (gí$^{\mu}$)((bá$^{\mu}$)ra)	*!				**	*		***
d. (gi (bá$^{\mu}$.ra))		*!			*		*	*
e. (gi$^{\mu}$.bá)ra)			*!		*	*	*	*
f. (gi(bára))		*		*!			*	*

Candidates (30c-f) are all ruled out because they violate one of the more highly-ranked constraints: candidate (30c) presents a stress clash (e.g. *gíbára*), which is completely banned in Wargamay; candidate (30d) does not respect the underlying moraic specification of the first syllable disobeying FAITH-LINKμ,σ1; candidate (30e) violates WSP and (30f) does not preserve the long initial vowel and it does not lengthen the head of the recursive foot. Finally, candidate (30b) incurs two violations of *Vμμ and, thus, candidate (30a) with word-initial stress and preservation of underlying length is the winner candidate.

Finally, there is an additional constraint that crucially needs to dominate NONMINIAMB. This constraint is NONFINALITY, which assigns one violation for every word-final syllable that is stressed (Prince & Smolensky 1993/2004; Hyde 2007 among others). The tableau in (30) had not considered a candidate with a rhythmic reversal such as [(gí$^{\mu}$)(ba. rá)], where the final foot is iambic. Such a candidate would have beaten the desired [((gí$^{\mu}$.ba) ra)]. To prevent this situation, NONMINIAMB needs to be ranked below NONFIN, as in tableau (31). An alternative strategy by which NONMINIAMB is demoted below TROCHEE is not possible since such a ranking is independently needed to guarantee non-minimal iambs in words with underlying short vowels (e.g. (σ('σσ)). Since Wargamay never has final stress, a high-ranked NONFIN is not unexpected.

(31)

$gi^{\mu}bara$	*Vμμ	NONFIN	NONMINIAMB	TROC	IAMB
a.☞((gí$^{\mu}$ba) ra)	*		*		**
b. (gí$^{\mu}$) (ba.rá)	*	*!		*	*

Tableau (32) evaluates a word with four syllables and an underlying long vowel to demonstrate that the given ranking also derives the correct result for even-parity inputs.

(32) Even-parity form with underlying short vowels

/guːɲaraɲin/ → [gúːɲaràɲin] 'rubbish-ABL'

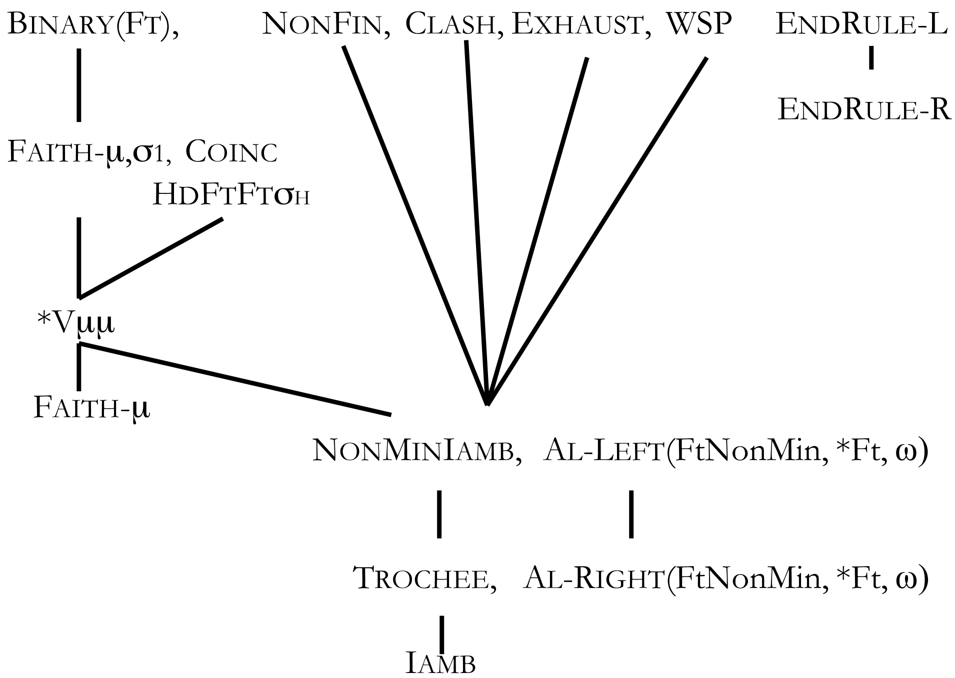
gu$^{\mu}$ɲaraɲin	CLASH	FAITμ,σ1	COINC HDFTFT,σH	NONFIN	*Vμμ	NONMIN IAMB	TROCHEE	IAMB
a.☞(gú$^{\mu}$.ɲa)(rà. ɲin)					*			**
b. (gú. ɲa)(rà. ɲin)		*!						**
c. (gú$^{\mu}$) (ɲa(rá.ɲin))			*!					
d. (gú$^{\mu}$)((ɲá$^{\mu}$.ra) ɲin)	*!				**	*		***
e. (gú$^{\mu}$.ɲa)(ra. ɲìn)				*!	*		*	*
f. (gú$^{\mu}$)(ɲa (rá$^{\mu}$.ɲin))					**!		*	**

This tableau shows that the optimal parsing for a 4-syllable word with an initial heavy syllable is the one with stress on the first and third syllables (32a). The rest of the candidates perform worse in the hierarchy. They either violate one of the high-ranked constraints (e.g. 32b-e) or they violate the markedness constraint Vμμ twice (e.g. 32f).

Finally, as pointed out in Section 3.3.1, the location of secondary stress in 5-syllable words with an initial heavy syllable is not clear from the data. The hierarchy that I have proposed would predict initial primary stress, with secondary stress in the penultimate syllable (i.e. $[((\acute{\sigma}_H\sigma_L)\sigma_L)(\grave{\sigma}_L\sigma_L)]$). This seems to be congruent with the stress pattern in 3-syllable words with an initial heavy syllable. However, it could also be the case that secondary stress falls on the antepenultimate syllable, rather than the penultimate. In such a case, a five syllable word would have a non-minimal foot at the right edge of the prosodic word, with optional lengthening of the antepenultimate (e.g. $[(\acute{\sigma}_H\sigma_L)((\grave{\sigma}_H\sigma_L)\sigma_L)]$). Such an outcome is a bit suspicious, since when Wargamay employs recursive feet, they are always anchored to the left edge of the prosodic word rather than the right. Nevertheless, since the data is lacking and there are no six-syllable words with an initial heavy syllable, this question has to be left unanswered.

To summarize, the Hasse diagram in (33) provides the core rankings that account for stress assignment and the distribution of underlying and derived length in Wargamay.

(33) Derived length and stress assignment in words with light syllables



The next section investigates in detail the patterns of lengthening and stress assignment in Yidiɲ. I will show that despite the differences between Wargamay and Yidiɲ, the two languages may receive a unified recursion-based analysis.

3.4 Yidiɲ

The analysis of Yidiɲ developed in this section incorporates the main insights of previous analyses and attempts to solve their shortcomings, building on the idea that phonological representations allow recursion at the level of the foot.[14] I will argue that, as is the case with Wargamay, recursion in Yidiɲ arises as a last-resort device to avoid unparsed syllables and/or monomoraic feet. In

[14] Yidiɲ's stress system has received attention in multiple studies, *inter alia*, Dixon (1977a,b); Nash (1979); Hayes (1980, 1982, 1999); McCarthy & Prince (1986/1996); Halle & Vergnaud (1987); Hewitt (1992); Kager (1993); Hung (1993, 1994), Crowhurst & Hewitt (1995); McCarthy (2002) and Pruitt (2010). All these works treat lengthening as a synchronic phonological process, except for Hayes (1999), whose proposal is briefly discussed at the end of the chapter.

words with light syllables, recursive feet are also restricted to forms with an odd number of syllables.

This section is organized as follows. Section 3.4.1 presents the general properties of stress assignment and provides an analysis of derived length and stress in Yidiɲ. Section 3.4.2 looks more closely at the morphology-phonology interface, concentrating on the analysis of the distribution of a set of verbal and nominal suffixes that provide further support for the recursion-based analysis. These suffixes are particularly interesting because they exhibit variation that depends on prosodic factors.

3.4.1 The interaction of stress and length

Yidiɲ prosodic words display a strict alternation between stressed and unstressed syllables. In order to comply with this binary rhythmic alternation, the language undergoes a variety of phonological processes, such as vowel lengthening and final syllable deletion (Dixon 1977a,b). Interestingly, as a result of the interaction between these processes and other phonological characteristics of stress assignment (e.g. avoidance of stress clashes and lapses), Yidiɲ undergoes foot-form reversals, i.e. under specific circumstances some feet change their default head location.

Systems that display both trochaic and iambic footing as a consequence of particular foot-form reversals have been previously attested in the literature. For instance, rhythmic reversals are quite common among iambic languages (Prince & Smolensky 1993/2004; Hung 1993, 1994). In these languages, it is not unusual for the final foot to undergo a rhythmic reversal (Prince & Smolensky 1993/2004), due to NONFINALITY (i.e. the constraint banning stress in word-final syllables). In such cases, a final foot is exceptionally parsed as a trochee to avoid word-final stress (e.g. [(σ'σ)(σ'σ)(<u>'σσ</u>)]). These types of reversals are *local,* and they exclusively target the final foot of a word.[15] Crucially, as Pruitt notes (2010: 515-9), Yidiɲ is unique in that its rhythmic reversal is *global*, targeting multiple feet in the prosodic word.

This section provides an OT account of the global foot-form reversal in Yidiɲ, based on the insights of Hung (1993, 1994) and the recursion hypothesis outlined in Section 3.2.2. In contrast to the majority of analyses of Yidiɲ that assume that trochaic footing is the default (e.g. Hewitt 1992;

[15] Besides NONFINALITY there are other factors that can cause foot-form reversals. For concrete language examples and additional motivations of rhythmic reversals see Prince & Smolensky (1993/2004) and Bennett & Henderson (2013) and references therein.

McCarthy 2002 among others), Hung (1993, 1994) analyzed Yidiɲ as an iambic language, in which trochees could occasionally arise due to constraint interaction. In the following discussion, I first examine the stress pattern in even-parity forms (Section 3.4.1.1) and then turn to the metrical structure of odd-parity forms and their peculiar lengthening patterns (Section 3.4.2.1). Whereas the analysis of even-parity forms partially follows Hung (1993, 1994) in the treatment of foot-form reversals, the recursion-based analysis of odd-parity forms is completely original. I demonstrate that an analysis that allows recursive footing sheds light on the process of lengthening, providing not only a method for selecting the target of the process (the head of a recursive foot) but also a motivation for lengthening (prosodic enhancement of strong positions).

3.4.1.1 Even-parity forms

The data in (34) and (35) show that trochaic and iambic feet are both encountered in even-parity forms in Yidiɲ. On the one hand, when a word with an even number of syllables does not contain a long vowel, it is parsed with trochees (34a-b). Additionally, even-parity forms display trochaic parsing when long vowels appear in odd-numbered syllables (34c) (the length mark in the antipassive affix *-ːdʸi* appears on the left of the affix because this is an affix that causes lengthening of the preceding syllable, rather than being itself long, **dʸiː*)

(34) Trochaic footing in even-parity forms (Dixon 1977a,b)

a. /yabulam-gu/ [(yábu)(lámgu)]
'loya cane-PURP'

b. /gudaga-ni/ [(gúda)(gáni)]
'dog-GEN'

c. /wuŋaba-ːdʸi-ɲunda/ [(wúŋa)(báːdʸi)(ɲúnda)]
'hunt-ANTIPASS-DAT SUB'

On the other hand, if an even-parity form contains a long vowel in an even-numbered syllable, the parsing is iambic (35a,b):

(35) Iambic footing in even-parity forms (Dixon 1977a,b)

a. /burwa-ːri-ŋa-ːlda -ɲu/[16] (burwáː)(liŋáːl)(daɲú)
jump-'ASPECT-COMIT-COMING ASPECT-PAST

b. /madʸinda-ŋa-ːli-ɲu/ (madʸín)(daŋáː)(li-ɲú)
walk up-COMIT-GOING ASPECT-PAST

Previous analyses of Yidiɲ highlighted the close relation between the *globality* of this foot-reversal and the fact that long vowels are restricted to stressed syllables, as well as the avoidance of stress clashes and lapses in the language (e.g. Dixon 1977a,b; McCarthy 2002). The present reanalysis of Yidiɲ follows along the lines of previous analyses of local foot-form reversals (e.g. Prince & Smolensky 1993/2004; Hung 1993, 1994), and assumes that the constraints responsible for the surface generalizations described in (34-35) are those given in (36).

(36) a. *CLASH
Assign one violation mark for every adjacent pair of stressed syllables (Liberman & Prince 1977; Prince 1983; Selkirk 1984; Kager 1994, 1999; Alber 1997, 2005, *inter alia*)

b. NONFINALITY
Assign one violation mark for every word-final stress (Prince & Smolensky 1993/2004; Hyde 2007)

c. WEIGHT-TO-STRESS PRINCIPLE (WSP)
Assign one violation for every unstressed bimoraic syllable (Prince 1991; Prince & Smolensky 1993/2004)

The particular interaction between these constraints and TROCHEE and IAMB determines the emergence of left-/right-headed feet in Yidiɲ. On the one hand, since odd-parity forms always display iambic footing (cf. Section 3.4.1.2), I assume that IAMB dominates TROCHEE. However, following Hung (1993, 1994), I also assume that this iambic default footing can be reversed in Yidiɲ in order to avoid a violation of the constraint against word-final stress.[17]

[16] The general aspect marker *-ːri-n* dissimilates to *-ːli-n* after a root showing a rhotic (Dixon 1977a:225).

[17] Although Hung does not employ the NONFINALITY constraint, she employs a RHYTHM constraint which, in the case of word-final stress, has similar effects to

This is illustrated in the following tableau, which displays the ranking arguments NONFINALITY >> IAMB >>TROCHEE.

(37) Even parity forms with underlying short vowels

gúdagágu 'dog-PURPOSIVE'

gudagagu	NONFIN	IAMB	TROCHEE
a. ☞ (gú.da)(gá.gu)		**	
b. (gu.dá)(ga.gú)	*!		**

In (37) it can be observed that even if IAMB dominates TROCHEE, even-parity forms surface with trochees to avoid violations of NONFINALITY and IAMB. The candidate with iambic parsing (37b) violates the higher-ranked NONFIN and that is why it is ruled out from the competition. Furthermore, to ensure that the rhythmic reversal is global (i.e. all feet reverse their default iambic footing into trochees, and not only the final one) the constraint against stress clashes, *CLASH, must be highly ranked (McCarthy 2002). Dixon's pioneer analysis of Yidiɲ (1977a,b) already highlighted the fact that the strict alternation between stressed and unstressed syllables in Yidiɲ is exceptionless. This is shown in the following tableau. If *CLASH were not high-ranked, candidate (38b), with an initial iamb and a final trochee, would have surfaced as optimal.

(38)

Gudagagu	*CLASH	NONFIN	IAMB	TROCH
a. ☞ (gú.da)(gá.gu)			**	
b. (gu.dá)(gá.gu)	*!		*	*

Therefore, tableau (38) demonstrates that Yidiɲ foot-form reversals are global (38a), not local (38b), presenting a contrast to other languages that also ban word-final stress (see Prince & Smolensky 1993/2004 for references and examples on languages with local rhythmic reversals).

This same hierarchy *CLASH, NONFINALITY >> IAMB >>TROCHEE is able to select the correct output in even-parity forms with an underlying long vowel in an odd-numbered syllable, e.g. /wuŋaba$^{\mu}$d^{y}iɲunda/ 'hunt-ANTIPASS-DAT SUB', as shown in (39). This tableau corroborates the idea that NONFIN and *CLASH are decisive in choosing the candidate with trochaic feet (39a) over the candidate with iambic feet (39b) or with a stress clash (39c-d).

NONFINALITY: RHYTHM favors candidates in which stressed elements are followed by an unstressed syllable and, therefore, forms with final stress violate it.

(39) Even parity forms with a long vowel in an odd-numbered syllable
wúŋabá:dʸiɲúnda 'hunt-ANTIPASS-DAT SUB'

wuŋabaᵘdʸiɲunda	*CLASH	NONFIN	IAMB	TROC
a.☞(wú.ŋa)(báᵘ.dʸi)(ɲún.da)			***	
b. (wu.ŋá)(baᵘ.dʸí)(ɲun.dá)		*!		***
c. (wu.ŋá)(báᵘ.dʸi)(ɲún.da)	*!		**	*
d. (wu.ŋá)(baᵘ.dʸí)(ɲún.da)	*!		*	**

In (39) I have not included candidates in which the underlying mora of the third vowel has not been kept because I assume that MAX-LINKμ is undominated in the language, which accounts for the fact that underlying long vowels are always maintained in Yidiɲ. Further independent evidence for the necessity of high-ranking MAX-LINKμ[V] is presented in (40). These words are minimal pairs that only contrast in length (and derivationally, in stress), supporting the argument that the faithfulness constraints that preserve underlying length specification must be high in the hierarchy.

(40) a. Minimal pairs in nouns (examples from Dixon 1977b:2)

malá:n	'right hand'	*vs.*	málan	'flat rock'
wuɽú:	'large river'	*vs.*	wúɽu	'spear handle'

b. Contrast between the absolutive and the locative case in nouns[18]

búlmba	'camp'	*vs.*	bulmbá:	'at the camp'
ŋúnaŋgára	'whale'	*vs.*	ŋunáŋgará:	'in/on the whale'

Finally, there is one more constraint that needs to be included to correctly parse an even-parity form with underlying long vowels, one that incidentally has already been claimed to be crucial in previous analyses of Yidiɲ (e.g. McCarthy 2002). This constraint is WSP, which penalizes unstressed heavy syllables (Prince 1991). WSP is ranked above IAMB and TROCHEE and, thus, in the presence of a long vowel in an even-numbered syllable of an even-parity word, default iambic footing takes place in accordance with the Weight-to-Stress Principle (WSP). This is illustrated in the following tableau (where WSP and *CLASH are separated by a dotted line, not because they are in a variable ranking, but because there are no clear ranking arguments to establish a particular domination relation).

[18] The absolutive case has zero realization and is the citation form in Yidiɲ.

(41) Even parity forms with a long vowel in an even-numbered syllable

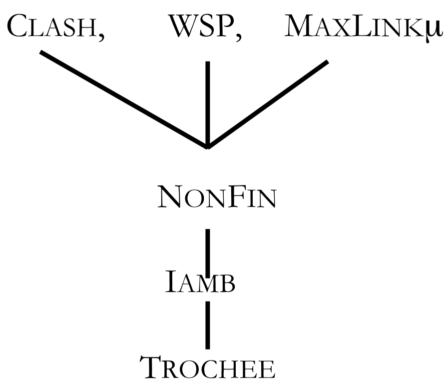
/mad^{y}inda-ŋa-:li-ɲu/ → [(mad^{y}ín)(daŋá:)(liɲú)]
'walk up-COMIT-GOING ASPECT-PAST'

mad^{y}indaŋa$^{\mu}$liɲu	WSP	*CLASH	NON FIN	IAMB	TROC
a.☞(ma.d^{y}ín)(da.ŋá$^{\mu}$)(li.ɲú)			*		***
b. (má.d^{y}in)(da.ŋá$^{\mu}$)(lí.ɲu)		*!		**	*
c. (má.d^{y}in)(dá.ŋa$^{\mu}$)(lí.ɲu)	*!			***	
d. (ma.d^{y}ín)(da.ŋá$^{\mu}$)(lí.ɲu)		*!		*	**

In this evaluation the winning candidate is (41a), with iambic feet. Even if (41a) incurs one violation of the high-ranked NONFINALITY, it does not incur any violations of the higher-ranked WSP and *CLASH. The rest of the candidates (41b-d) all present at least one violation of IAMB, thereby performing worse in the hierarchy than (41a).

The following Hasse diagram summarizes the ranking results seen up to here, which account for stress assignment and the distribution of long vowels in Yidiɲ even-parity forms. In the next section I will complete this diagram, by including the constraints that drive lengthening and stress assignment in odd-parity forms in Yidiɲ and I will provide additional support for an analysis that assumes default iambic footing instead of default trochaic footing. Note that all the constraints presented up to here were also crucial in Wargamay, and most of the rankings remain the same with the important exception in the case of TROCHEE dominating IAMB in Wargamay.

(42) Ranking arguments based on the analysis of even-parity forms



3.4.1.2 Odd-parity forms

Previous analyses of Yidiɲ had already remarked the close connection between rhythmic reversals in even-parity forms, the avoidance of stress clashes, lapses and word-final stress, as well as the requirement of stressing heavy syllables. In that sense, the present analysis has just incorporated previous insights. The crucial difference between this proposal and previous accounts of Yidiɲ is in the analysis of odd-parity forms and the account of penultimate lengthening.

As I proposed in Section 3.2, lengthening only applies to the penultimate vowel in odd-parity forms due to its double-head status. In Yidiɲ, undominated BIN(FT) and EXHAUSTIVITY enforce the construction of a non-minimal foot in odd-parity forms, so as to avoid candidates with non-exhaustive parsings [(σσ)σ] and/or monomoraic feet [(σσ)(σ)]. Thus, the only way to satisfy these high-ranked constraints is by building a non-minimal foot (i.e. a foot that dominates another foot). In order to enhance the intrinsic prominence of the head of a non-minimal foot, the vowel that appears in such a position is lengthened. The relevant data with the specific representations assumed for Yidiɲ are presented in (43) (the syllable that lengthens is underlined). These forms contain minimal iambic feet and a non-minimal trochaic foot at the right edge of the prosodic word. [19]

(43) Penultimate lengthening and metrical structure in odd-parity forms

/gali-n-a/	→ [((galí:)na)]	'go-Purposive'
/madʸindaŋ/	→ [((madʸí:n)daŋ)]	'walk up-Present'
/guda-gudaga/	→ [(gudá)((gudá:)ga)]	'dog-Redup-Abs'

Whereas previous studies proposed different methods to locate the syllable that undergoes lengthening (e.g. a rule that targets the penultimate syllable of the final foot, but only in odd-parity forms), none of these studies proposed a device responsible for the lengthening process as has been done here.[20] In the

[19] An alternative parsing in which the recursive foot consists of a minimal trochee and a non-minimal iamb (e.g. [(σ'σ)(σ('σ:σ))], [(σ('σ:σ))]) instead of a minimal iamb and a non-minimal trochee as in (43) is equally able to account for both the distribution of stress and the lengthening pattern. In fact, the constraints proposed up to this point could select both parsings as optimal. Below, however, I will show that once NONMINTROC/IAMB are incorporated in the ranking, only one type of parsing can surface as optimal.

[20] The only study that proposes a device for lengthening is Hyde (2001, 2002, 2012b), who claims that penultimate syllables in Yidiɲ (and peninitial syllables in Wargamay) lengthen due to their ambipodal nature. However, in Section 3.5 and in Chapter 4 I show this representational device is problematic in many respects and, *contra* Hyde, there is no strong independent evidence for it.

following discussion I first examine the rankings that account for lengthening in odd-parity words, and then explore the mechanisms that cause iambic minimal footing in these forms. For ease of exposition, since I assume that EXHAUSTIVITY and BIN(FT) are undominated, the remaining tableaux will only consider candidates that fully comply with them.

Along the lines of the analysis of Wargamay, I propose that in odd-parity forms in Yidiɲ, a mora is inserted in the head of a non-minimal foot. In Yidiɲ, recursive feet are anchored to the right edge of the prosodic word due to the dominance relation AL-RIGHT(FtNon-min, *Ft, ω) >> AL-LEFT(FtNon-min, *Ft, ω). Remember from the previous discussion that these constraints have the effect of pulling feet towards a particular word edge (see (24) for their exact definition). The next tableau shows that candidates with a word-initial non-minimal foot (44b) perform more poorly in the hierarchy than candidates with a word-final non-minimal foot (44a). From now on, I will adopt this ranking and only consider candidates in which the non-minimal foot appears at the right edge of the word, as in (44a).

(44) Non-minimal feet are anchored to the right edge of the prosodic word

σσσσσ	AL-R(FtNonMin, *Ft, ω)	AL-L(FtNonMin, *Ft, ω)
a.☞(σσ) ((σσ) σ)		*
b. ((σσ) σ) (σσ)	*!	

In (43), where I provided the metrical structure for odd-parity forms in Yidiɲ, I assumed that minimal feet in odd-parity forms were iambic, rather than trochaic. I further assumed that the syllable that was adjoined to the final foot is the final syllable (45a), rather than the antepenultimate syllable (45c). This automatically falls out from the previously established ranking NONFIN >> IAMB >> TROCHEE.

(45)

σσσσσ	NONFIN	IAMB	TROCHEE
a.☞(σˈσ) ((σˈσ) σ)		*	**
b. (ˈσσ) ((ˈσσ) σ)		***!	
c. (σˈσ) (σ (σˈσ))	*!		***

The winning candidate in (45) is the one that contains two minimal iambic feet and a trochaic non-minimal foot, i.e. (45a). However, note that an alternative candidate like the one given below in (46b), with one iambic minimal foot, one trochaic minimal foot and one iambic non-minimal foot, would perform equally well in the hierarchy. Furthermore, the two outputs (46a) and (46b) locate stress in exactly the same syllables. Therefore, in principle, both analyses may be possible.

(46)

σσσσσ	NONFIN	IAMB	TROCHEE
a. ☞ (σˈσ) ((σˈσ) σ)		*	**
b ☞ (σˈσ) (σ (ˈσσ))		*	**

Although this double-option analysis could be felt as a drawback of the present proposal, the truth is that both parsings adequately account for the exact location of stress in even and odd-parity forms and, as we will see below, the lengthening pattern in odd-parity forms which targets penultimate syllables. Importantly, there are theoretical tools presented in this chapter that could allow us to distinguish between these two models. Recall the constraints regulating the shape of non-minimal feet, i.e. NONMINTROCHEE and NONMINIAMB, from the discussion of Wargamay. If NONMINTROCHEE dominates NONMINIAMB, candidate (47a) will be selected as optimal. By contrast, if NONMINIAMB is ranked above NONMINTROCHEE, candidate (47d) will be favored. This is illustrated in the two tableaux below:

(47)

gudagudaga	NONMINTROCH	NONMINIAMB
a.☞(gu.dá)((gu.dá$^{\mu}$) ga)		*
b. (gu.dá)((gu (dá$^{\mu}$.ga)	*!	

gudagudaga	NONMINIAMB	NONMINTROCH
c (gu.dá)((gu.dá$^{\mu}$) ga)	*!	
d.☞(gu.dá)((gu (dá$^{\mu}$.ga)		*

Unfortunately, this language does not present evidence in support of one ranking or the other, and, therefore, the specific relation between NONMINTROCH and NONMINIAMB cannot be established. Based on phonological activity, and assuming speakers build generalizations from the available data, the two analyses are equally plausible. I am inclined to favor the analysis in (47a) based on pattern congruity: in even-parity forms, the foot form reversals of minimal feet are global and, thus, the default assumption is that they are also global in odd-parity forms. However, this is just an intuition which cannot be tested. Importantly, this "dual-option" analysis is only possible for languages with global rhythmic reversals like Yidiɲ. For ease of presentation, in the following discussion I adopt the structures in (47a), but keep in mind that the alternatives (47b,d) are also possible.

Turning now to an examination of penultimate lengthening in Yidiɲ, along the lines of the analysis of Wargamay, I propose that the ranking that prompts lengthening of penultimate vowels in Yidiɲ is COINCIDEHDFTFT,σ_H >> DEP-LINKμ[V]. Recall that this faithfulness constraint forbids the association of morae to vowels, when these vowels were not associated with a mora in the input. Since even-parity forms in Yidiɲ do not contain non-minimal feet, such a ranking only affects odd-parity forms. The two tableaux in (48) illustrate this ranking argument with a 3-syllable word (e.g. *gali:na* 'go-Purposive') and a 5-syllable word (e.g. *gudaguda:ga* 'dog-Redup-Abs').

(48) I. Three-syllable word, e.g. /galina/ → [galí:na] 'go-Purposive'

galina	COINCIDEHDFTFT,σ_H	DEPLINKμ[V]
a.☞ ((galí$^{\mu}$) na)		*
b. ((galí) na)	*!	

II. Five-syllable word, e.g. /gudagudaga/ → [gudágudá:ga] 'dog-Redup-Abs'

gudagudaga	COINCIDEHDFTFT,σ_H	DEPLINKμ[V]
a.☞(gudá)((gudá$^{\mu}$)ga)		*
b. (gudá)((gudá)ga)	*!	
c. (gudá$^{\mu}$)((gudá$^{\mu}$)ga)		**!

As can be seen in the evaluation of /gudagudaga/, this ranking restricts lengthening to penultimate syllables and correctly bans derived length in other positions. This is why candidate (48IIc) is ruled out: lengthening has applied to the stressed syllable in the first foot and, consequently, this candidate incurs two violations of DEP-LINKμ[V]. Rather than lengthening the penultimate vowel, one could alternatively argue that the markedness constraint COINCIDEHDFTFT,σ_H is satisfied by geminating the following consonant (e.g. *galin$^{\mu}$na*). Crucially, Yidiɲ does not have underlying geminates, so the exclusion of outputs with geminate consonants is guaranteed by the undominated constraint DEP-LINKμ[Consonant] (49). This is illustrated in the following tableau, where the candidate with a geminate consonant is ruled out (50c). In short, the ranking arguments in (50) ensure vocalic lengthening in the head of a non-minimal foot.

(49) DEP-LINKμ[Consonant]
For two corresponding consonants, if C2 (in the output) is associated with a mora, then C1 (in the input) is associated with a mora.

(50)

galina	DEP LINKμ[C]	COINC HDFTFT,$σ_H$	DEP LINKμ[V]
a.☞ ((ga.lí^μ) na)			*!
b. ((ga.lí) na)		*!	
c. ((ga.lín^μ) na)	*!		

It is important to highlight that the constraint COINCIDEHDFTFT,$σ_H$ is the only one capable of deriving the correct pattern of lengthening in Yidiɲ. As pointed out at the beginning of the chapter, an alternative analysis that lengthens the head of the prosodic word would be problematic in several respects (see Section 3.2 for details). Thus, the Yidiɲ data —and the very simple recursion-based account provided here— stand as a strong argument in favor of the need for recursive feet in phonological representations.

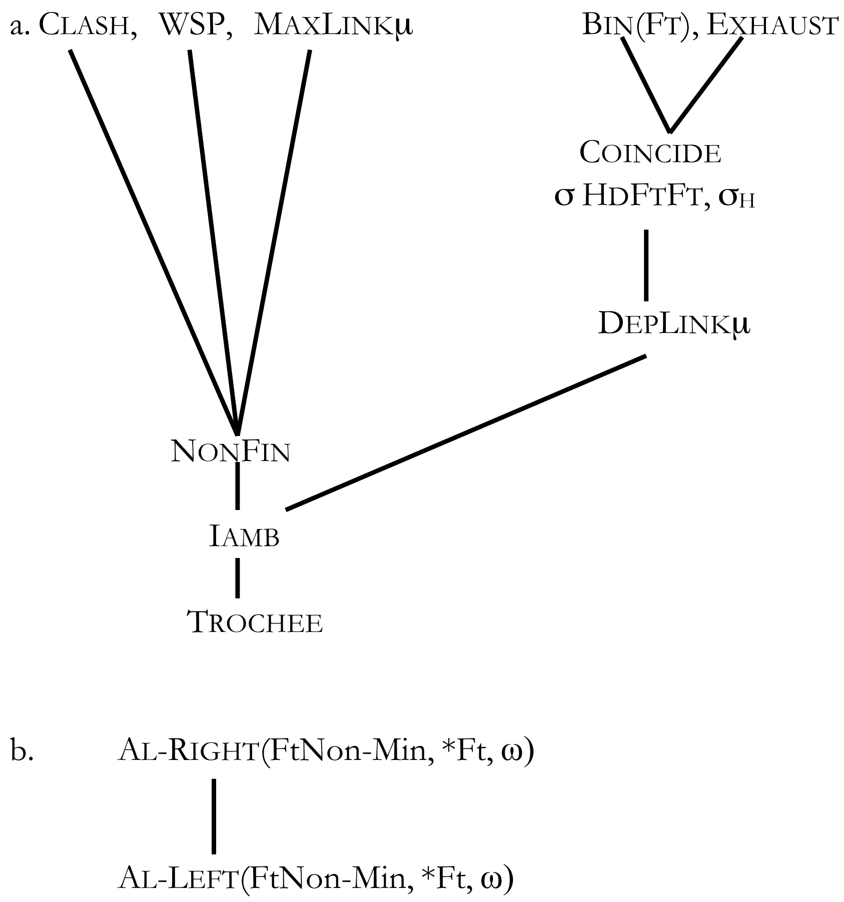
Finally, after having examined the device responsible for lengthening, in the following discussion I will demonstrate that the same constraints and rankings that determined the location of feet and foot heads in even-parity forms are also able to predict the correct location of feet and foot heads in odd-parity forms. In particular, the ranking arguments WSP, CLASH >> NONFIN >> IAMB >>TROCHEE, which were shown to be crucial in the evaluation of even-parity forms (37-41), are equally important in determining the parsing of odd-parity forms. This is demonstrated in tableau (51), with the evaluation of the five-syllable word *gudágudá:ga* 'dog-Redup-Abs'. In this tableau I show that a candidate with minimal iambic feet like [(gudá)((gudá:)ga)] (51a) is preferred over candidate (51b) because it does not present a stress clash, and it only violates IAMB once. Candidate (51c) is dispreferred because it does not conform to WSP, and candidate (51d) is similarly ruled out because it violates another highly ranked constraint, NONFINALITY. Finally, candidate (51e) is ruled out because, even though it doesn't incur a violation of any of the higher-ranked constraints, it contains three trochees, violating IAMB multiple times. Likewise, candidate (51f) is ruled out because it presents two violations of IAMB.

(51)

gudagudaga	CLASH	WSP	NON FIN	IAMB	TROCH
a.☞(gudá) ((gudá$^{\mu}$) ga)				*	**
b. (gudá) ((gú$^{\mu}$.da) ga)	*!			**	*
c. (gúda) ((gú.da$^{\mu}$) ga)		*!		***	
d. (gudá) (gu (da.gá$^{\mu}$))			*!		***
e. (gúda) ((gú$^{\mu}$.da) ga)				***!	
f. (gú.da)((gu.dá$^{\mu}$) ga)				**!	*

To help in the presentation, and as summary of the present section, the Hasse diagram in (52) presents the crucial rankings that account for stress assignment in forms of any parity, as well as the lengthening pattern.

(52) Crucial ranking in Yidiɲ



The vast majority of previous analyses of lengthening had to explicitly encode the odd-parity restriction on lengthening in the grammar (see §3.2). I have just shown this is not necessary: once the correct representations are considered, the constraints are able to derive the lengthening pattern without referring to the number of syllables in the word.

There is one important exception in the literature, which crucially differs from other analyses in that it does not interpret the lengthening pattern as a synchronic process. Based on frequency data regarding the distribution of long vowels in Dixon's corpus and the exceptionless nature of the lengthening rule, Hayes (1999) proposed that odd-parity forms do not undergo lengthening, but, by contrast, long vowels are already specified in penultimate syllables of odd-parity forms. This analysis suggested that, even if the lengthening pattern had once been productive in the history of Yidiɲ, speakers had since reanalyzed it, restructuring the underlying form of words. This restructuring consisted of positing an underlying penultimate long vowel in every odd-parity form.

Unfortunately, the lack of Yidiɲ speakers makes it impossible to test the predictions and psychological reality of either model (synchronic lengthening *vs.* synchronic underlying long vowels). However, note that even if Hayes were correct and every underlying form of an odd-parity word consisted of a penultimate long vowel, the grammar would still need some device to explain why underlying long vowels are restricted exclusively to penultimate position in odd-parity forms. Crucially, only a positional markedness analysis that assumes the type of representations argued for here (i.e. non-minimal peripheral feet anchored at the right edge of prosodic words with an odd number of syllables) can provide such a device. Furthermore, if Hayes is right and all penultimate vowels are specified with a long vowel, it is not clear why in reduplicated forms that copy the first two syllables of the root, the length specification is not copied, e.g. gudaːga 'dog-Abs' ~ gudagudaːga 'dog-Abs' , but *gudaːgudaːga 'dog-Abs'.

Finally, a major difference between the present analysis and previous analyses of Yidiɲ is the adoption of Hung's iambic assumption with respect to default footing in the language (cf. McCarthy 2002). Together with this author, I have assumed that even if iambs are the default foot in Yidiɲ, other high-ranked constraints such as NONFIN, WSP and *CLASH can cause rhythmic reversals that result in trochaic footing.

In addition to lengthening and stress, the ranking proposed in (52) can account for yet another phenomenon in the language. In the following section I show that the conditioning on allomorph selection of some suffixes can be taken as further evidence for the claim that *BINARY(FT) and EXHAUSTIVITY are undominated in Yidiɲ.

3.4.2 Phonologically-conditioned suffix allomorphy

In Yidiɲ, there are about ten suffixes that exhibit two alternants. In such cases, the emergence of one allomorph or the other is generally conditioned by the number of syllables of the stem (i.e. even/odd). This is exemplified in (53). As can be seen from the inflected forms in this table, the past and the dative subordinate suffixes have two allomorphs: [-:ɲ] and [-ɲu] for the past (53a), and [-ɲunda] and [-ɲu:n] for the dative subordinate (53b).[21]

(53)

Root	gali-n 'go'	mad^{y}inda-n 'walk up'
a. Past	gali-:ɲ	mad^{y}inda-ɲu
b. Dative Subordinate	gali-ɲunda	mad^{y}inda-ɲu:n

When an even-parity stem like *gali-n* 'go' is inflected for the dative subordinate, the suffix that surfaces to mark this function is *-ɲunda*; but if the verbal stem contains an odd number of syllables, as in *mad^{y}inda-n* 'walk up', the suffix for the dative subordinate is generally *-ɲu:n*. That the overall number of syllables of the stem, and not the root, is crucial in conditioning the surface allomorph can be observed in (54), where the derivative affix *-ŋa-l* has been added to the intransitive *-n* roots *gali-n* 'go' and *mad^{y}inda-n* 'walk up' to create transitive stems (Dixon 1977a: 302).[22] The derived stems *galiŋa-l* 'go with, take' and *mad^{y}iɲdaŋa-l* 'walk up with, make walk up' have been enlarged by one syllable with respect to their non-derived stems *gali-n* and *mad^{y}iɲda-n*. As a result, their allomorphs for the past and dative subordinate are the opposites of the ones employed by their non-derived counterparts:[23]

(54)

Stem	galiŋa-l 'go with, take'	mad^{y}iɲdaŋa-l 'walk up with, make walk up'
Past	galiŋa-lɲu	mad^{y}iɲdaŋa-:l
Dative Subordinate	galiŋa-lɲu:n	mad^{y}iɲdaŋa-lɲunda

[21] There are three conjugations in Yidiɲ, the *-n*, *-l* and *-ɽ* conjugation. Following Dixon (1977a,b), verbal roots and derivational suffixes are suffixed with their conjugation markers (i.e. -n, -l, - ɽ) to show the conjugation class to which they belong

[22] Note that the derivative suffix changes the conjugation class of the verb from the *-n* conjugation to the *-l* conjugation.

[23] Additionally, the allomorphs for the l-conjugation are slightly different from the n-conjugation in that they include *-l*.

Importantly, the patterns of allomorphy illustrated in (53) and (54) always prioritize outputs with an even number of syllables as long as such outputs conform to the language particular phonotactics. That is why, generally, even- and odd-parity forms behave differently with respect to allomorph selection. All things being equal, a word with an even number of syllables in Yidiɲ will always perform better in the hierarchy than a word with an odd number of syllables, since the latter incurs a violation of *REC(Ft) (e.g. ((σ'σ)σ)), whereas even-parity forms vacuously satisfy this constraint (e.g. ('σσ)('σσ)).[24] The general "unmarkedness" of even-parity forms is further corroborated by the larger number of even-parity forms reported in Yidiɲ texts by Dixon (1977: 4).[25]

Within an OT framework, these facts can be analyzed as a case of allomorphy involving phonological selection between listed allomorphs (Mester 1994; Kager 1996b; Mascaró 1996/2004, 2007; Rubach & Booij 2001; Bermúdez-Otero 2006). Moreover, allomorph selection in Yidiɲ constitutes an example of the *emergence of the unmarked* (McCarthy & Prince 1994, Mascaró 1996/2004, 2007). That is, given the choice between two allomorphs, Yidiɲ selects the one that creates the least marked form from a metrical point of view. In that sense, we can state that allomorph selection in Yidiɲ is driven by prosodic optimization (see Mester 1994 for a similar analysis of allomorph selection in Latin or Kager's 1996b analysis of Estonian allomorphy).[26]

This is illustrated in tableau (55). The dative subordinate has two allomorphs: [-*ɲu*] and [-*:ɲ*]. The grammar will select one or the other depending on the overall performance of the candidates in the hierarchy. For instance, an even-parity stem like *gali-n* 'go' surfaces in the dative subordinate as [(galí:ɲ)] (55). This disyllabic form does not incur any markedness violations and therefore emerges as optimal. The alternative candidate with the [-*ɲu*] allomorph contains a recursive foot (55) and is therefore ruled out. Remember that recursive feet are allowed in Yidiɲ, but only as a last-resort device: when alternative parsings without recursion introduce violations of any of the other

[24] Remember from the preceding discussion that *REC(FT) is used here as a cover constraint for IAMB >> TROCHEE.

[25] Dixon reports that 85% of the words in recorded Yidiɲ texts contain an even number of syllables.

[26] For an alternative interpretation of cases of allomorph selection via prosodic optimization, see Paster (2006) and Bye (2007). These authors deny the phonological and synchronic character of allomorph selection via prosodic optimization; alternatively, they propose subcategorization frames that stipulate the phonological environment of each allomorph in the morphology. It is not the aim of this section to argue against this framework but to show that the independently motivated hierarchy in Yidiɲ could also account for the allomorphy in the language, assuming it is synchronic in nature.

two more highly ranked constraints. Crucially, by listing the two allomorphs in the lexicon, the grammar is free to select the least marked form, which in this case is (55b).

(55) Even-parity stem *gali-n* 'go'

gali-{ɲu, ːɲ}	EXHAUST	BIN(FT)	*REC(FT)
a. ((ga.líː) ɲu)			*!
b. ☞(ga.líːɲ)			

By contrast, an odd-parity verbal stem like *madʸinda-n* surfaces with the other allomorph, i.e. [*-ɲu*] (tableau 56). The optimal candidate *madʸindá-ɲu* (56a) presents two binary feet and, therefore, it is less marked from a metrical point of view than the alternative candidates (56b-c), which entail recursive feet. Furthermore, note that *mádʸindaːɲ* (56b) and *madʸindáːɲ* (56c) also incur violations of other highly ranked constraints such as WSP and NONFIN, respectively.[27]

(56) Odd-parity stem *madʸinda-n* 'walk up'

madʸinda {ɲu, ːɲ}	EXHAUST	BIN(FT)	*REC(FT)
a. ☞ (mádʸin)(dáɲu)			
b. ((mádʸin) daːɲ)			*!
c. (ma (dʸin.dáːɲ))			*!

In light of this and similar facts, it seems clear that allomorph selection in Yidiɲ is driven by prosodic optimization. However, at this point in the argumentation, it should be noted that the different behavior of odd- *vs.* even-parity forms does not directly stem from the parity of the word, as I have been suggesting. The parity conditioning is just a byproduct of the interaction of several prosodic constraints. In fact, there are also cases in which two stems with the same number of syllables select different allomorphs. For instance, take the examples in (57). The words for 'woman', *buɲa-*. and 'bandicoot', *guygal-,* both have an even number of syllables. However, the former selects the genitive allomorph *[ːn]* as the majority of even-parity forms, whereas the

[27] For ease of presentation, I will assume that the representations for odd-parity forms is the one with iambic minimal feet and trochaic non-minimal feet, but keep in mind that the alternative representations with a final iamb and a minimal trochee would also account for the allomorph patterns reviewed in this section.

latter prefers *[-ni]*, like most odd-parity stems (cf. *buɲa-:n* 'woman-GEN'' *vs.* *gudagani* 'dog-GEN').

(57)

Root	buɲa 'woman'	guygal 'bandicoot'	gudaga 'dog'
Absolutive	buɲa	guygal	guda:ga
Genitive	buɲa-:n	guyga:l-ni	gudaga-ni

Even if allomorph selection generally prefers candidates with even-parity forms that avoid a violation of *REC(Ft), the genitive form for 'bandicoot' surfaces with an odd number of syllables and recursion, e.g. *guygal:ni* (58a). In this case, the odd-parity form with *-ni* (58a) is phonologically less marked than the alternative even-parity form (58b) for another reason: the hypothetical **guyga:ln* presents a complex coda and complex codas are completely disallowed in Yidiɲ. Since the markedness constraint against complex codas is more highly ranked than the constraint banning foot recursion, the candidate with the odd number of syllables beats the even-parity candidate. This ranking argument is illustrated in the following tableau with the two relevant forms for the genitive.

(58)

guygal {ni, :n}	*COMPCODA	*REC(Ft)
a. ☞ ((guygá:l) ni)		*
b. (guygá:ln)	*!	

In sum, the present analysis successfully accounts for the distribution of certain allomorphs in Yidiɲ. Importantly, the same ranking that was argued to be responsible for penultimate lengthening in odd-parity words has now been shown to be compatible with the distribution of verbal and nominal allomorphs in Yidiɲ. The allomorphy facts thus provide further support for the importance (i.e. high-ranking) of BIN(FT) and EXHAUSTIVITY in Yidiɲ.

3.4.2.1 Final syllable deletion rather than lexical allomorphy

Dixon (1977) and Embick (2010) present an alternative account of the allomorphy patterns in Yidiɲ. Contrary to the analysis presented above, these researchers propose that only one of the two allomorphs is listed in the lexicon (e.g. Dixon 1977; Embick 2010). The surface allomorphy patterns arise, according to this proposal, due to the action of a *Final Syllable Deletion*

Rule (Dixon 1977a: 58). This rule, presented in (59), deletes final syllables under certain circumstances (59a-c), giving rise to different allomorphs for the same suffix.

(59) Final Syllable Deletion (Dixon 1977a: 48; Embick 2010: 146)
$XV_1C_1\ (C_2)\ V_2\#\rightarrow XV1C_1\#$

a. if is an odd-syllabled word;
b. and C_1 is one of the set of allowable word-final consonants
c. and there is a morpheme boundary between V_1 and C_1

Even though this interpretation seems appealing because it encodes the similarity relation between the two allomorphs (e.g. *ɲu ~ :ɲ*, *ɲunda ~ ɲu:n*), and a similar rule was likely active at some point in the history of the language, a closer look at the rule-based analysis shows that, synchronically, it is empirically inadequate.

The alternative rule-based analysis of allomorphy sketched in (59) assumes that the Final Syllable Deletion Rule applies after another rule, which lengthens penultimate syllables in odd-parity forms. This approach not only misses the real motivation for lengthening in odd-parity forms (which comes for free in a recursive-foot based account) but, furthermore, it needs to stipulate some additional *ad hoc* assumptions and exceptions to the rule and its conditions (59a-c) to provide a correct account of the allomorphy patterns in the language. For instance, as Embick admits (2010: 151), the final syllable deletion rule would delete more suffixes than the ones that actually delete, creating additional allomorphic patterns where these are inexistent. Thus, some suffixes would have to be marked as exceptional to avoid undergoing the rule, even when they are eligible for it. This is the case for the DATIVE affix *-nda*. Within a framework that posits only two possible allomorphs for the affixes that display some kind of alternation, this would not be a problem since an affix that does not alternate would only have one form in its lexical entry. Additionally, Dixon and Embick's proposal is problematic in another respect: the proposed ordering of the rules (i.e. 1st: Penultimate Lengthening, 2nd: Final Syllable Deletion) does not always derive the correct results. To illustrate these points, consider the words *buɲa* 'woman' and *mabi* 'kangaroo'. The rule stated in (59) would incorrectly predict that the dative form of 'kangaroo' is *mabi:-n* (instead of *mabi:nda*) and the ablative form for 'woman' is **buɲa:m* (instead of the attested *buɲam*).

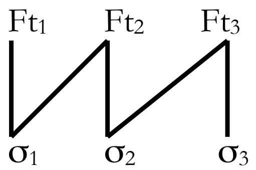
(60)	buɲa-ABL	mabi-DAT
	woman- ABL	kangaroo-DAT
Penult. Lengthening	buɲa:-mu	mabi:-nda
Final Deletion	*buɲa:m	*mabi:n
Actual forms	buɲam	mabi:nda

Even though the full account of all the patterns of allomorphy requires more attention, the proposal sketched in (59) and (60) seems to be clearly problematic in some respects. However, it is not the point of this chapter to argue for or against a particular model of the morphology-phonology interface. The crucial fact is that, whatever model is adopted, this must rely on the correct prosodic representations and, at least in Yidiɲ, the only prosodic representations that are able to model the puzzling patterns of lengthening rely on the existence of recursive feet.

3.5 An alternative account: ambipodal syllables

Hyde (2001, 2002, 2012b) proposes an alternative (non-recursion-based) account for the puzzling patterns of lengthening in Wargamay and Yidiɲ based on the existence of ambipodal syllables (61). An ambipodal syllable is a syllable that simultaneously belongs to two feet. For instance, in (61) the ambipodal syllable σ_2 is the head of the second foot (Ft_2), but it is also the dependent of the third foot (Ft_3).

(61) Ambipodal syllables (Hyde 2001, 2002)



Although improper bracketing has traditionally been rejected with respect to prosodic categories (e.g. Liberman 1975; Itô & Mester 1992/2003; Kenstowicz 1995), improperly bracketed feet are crucial within Hyde's theory of metrical stress (see Hyde 2001, 2002 and 2012b for concrete details). One of the strongest pieces of evidence for these structures at the foot level, Hyde argues, is their usefulness in accounting for the lengthening patterns of Wargamay and Yidiɲ. In particular, just as as ambisyllabic consonants (i.e. consonants linked to two different syllables) display extra length, Hyde claims that ambipodal syllables (i.e. syllables linked to two different feet) may also exhibit lengthening.

More specifically, according to Hyde (2002, 2012b), peninitial syllables lengthen in Wargamay odd-parity forms because they are ambipodal (62a), whereas in Yidiɲ, the ambipodal syllable in odd-parity forms is the penultimate, and is therefore the one that lengthens (62b).

(62) Lengthening in Wargamay: ambipodal syllable in odd-parity forms

a. Even-parity forms b. Odd-parity forms

(63) Lenthening in Yidiɲ: ambipodal syllable in odd-parity forms

a. Even-parity forms b. Odd-parity forms

Even though this device can derive the lengthening patterns in these two languages, I believe there are several aspects that make the ambipodal analysis inferior with respect to the recursive-foot based account.

First, whereas there is ample evidence for recursion at other layers of the prosodic hierarchy (i.e. recursive prosodic words, recursive phonological phrases, etc.), evidence for intersected prosodic structures elsewhere in the prosodic hierarchy is nonexistent —besides ambisyllabic consonants, but these involve the relation between prosodic categories and phonological segments. Second, note that prosodic intersections blur out one of the most important dichotomies in prosodic theories, i.e. *head vs. non-head*. This is so because in Hyde's model, the relation between prosodic structure and stress/relative strength is looser than in standard theories. Although standard theories allow, under specific circumstances, prosodic heads to surface without stress, Hyde goes one step further in neglecting the structural predictions (and relations) derived from the relative strength of heads/dependents. For instance, under

Hyde's model, a syllable that is in a head-dependent position, such as the peninitial syllable in odd-parity forms in Wargamay (see 62b), behaves as *stronger* than syllables that are in a pure head position (e.g. fourth and sixth syllable in 62b). The peninitial syllable in the head-dependent position is the strongest syllable of the prosodic word, i.e. it carries primary stress and, furthermore, it lengthens. However, this is somewhat counterintuitive: one would instead expect this syllable to be *weaker* than the fourth and sixth syllables in the same prosodic word (62b) since the latter are pure heads (i.e. they are not the dependent on any foot). Moreover, they contain the same number of gridmarks as the peninitial syllable. Structurally, then, they are more prominent than syllables in a head-dependent position. Additionally, the mere fact that Hyde needs to rely on two systems to mark prominence (i.e. prosodic constituency and gridmarks), but the recursion-based account is able to derive stress patterns and other strength distinctions by appealing to prosodic constituency, makes the latter approach superior. Finally, even though Hyde has argued that the major power of intersections is to exclude unattested typological patterns —such as trochaic-iambic asymmetries regarding lapse and clash environments (Hyde 2002), as well as other problematic predicted systems within standard theories of stress (e.g. the odd-heavy problem; see Hyde 2012b for details)— I maintain that the validity of a specific analysis cannot be based only on its capacity to generate only attested patterns. As Hale & Reiss (2008) have argued, there is a crucial difference between *attested* languages and *attestable* languages (i.e. *computationally possible systems that have not been attested, but are possible),* and Universal Grammar must model all the attestable languages. Finally, some of the excluded patterns within Hyde's analysis have in fact been attested in further research (Buckley 2009; see also Section 3.2.2.2).

The other type of independent argument in favor of ambipodal syllables comes from the role of ambipodal syllables in modeling ternary stress patterns. In the next chapter, however, I will show that ambipodal syllables are not sufficient to model the phonology of languages with ternary stress (Section 4.2.3.4). In the absence of strong arguments in favor of ambipodal syllables, which notably seem to contradict one of the most important dichotomies in prosodic theories, i.e. head *vs.* non head, I assume these types of structures are ruled out from GEN.

3.6 Further evidence for recursive feet as a last-resort device

Beyond the role of recursive footing in ensuring exhaustivity, in the next chapter I will present additional motivations for recursion at the level of the foot. Before proceeding to the exploration of these phenomena, I close this chapter by adding one more language to the repertoire of prosodic systems in which recursive feet arise as a last-resort mechanism. This language is Huariapano (a Panoan language formerly spoken in Peru, Parker 1994; Loos 1999) and concrete evidence for recursive footing in the language has been recently presented by Bennett (2012). The reader is referred to this work for an insightful analysis of the metrical system of the language.

Interestingly, Bennett shows that recursive feet are built in Huariapano to avoid "trapped" monomoraic syllables (Mester 1994) in prosodic words, while ensuring exhaustivity. The independent evidence for this claim comes from yet another strengthening process, on this occasion targeting the syllables in the initial domain of a maximal foot (rather than the head of a non-minimal foot; for a similar analysis of several aspects of English phonotactics, see the discussion and references in Chapters 1 and 5). In particular, Bennett shows that a straightforward account of coda [h] epenthesis in some syllables can be easily accounted for if coda [h] is inserted in the initial syllable of a maximal foot, assuming that other various phonotactic constraints are satisfied (e.g. coda [h] must appear before voiceless obstruents consonants and it never appears in a coda cluster, see Bennett 2012: §2 for further the details). Such a proposal is able to predict epenthesis in antepenultimate syllables in the odd-parity forms in (64I) as well as the absence of [h] in penultimate syllables in the odd-parity forms (64II) and the correct location of [h] insertion in even-parity forms (Bennett 2012: 73-74). For further examples and a full account of the assignment of primary and secondary lexical and phonological stress in Huariapano, see Bennett (2012: §2).

(64) [h] coda epenthesis in Huariapano (Bennett 2012: 73-74)

I. <u>[h] epenthesis in antepenults in odd-parity words</u>

a. [jò.mɯ.ra<u>h</u>.ká.no]	'let's go hunting	(L̀L)(L_h (ĹL))
b. [ha.jà.ji<u>h</u>.káŋ.ki]	'they possessed, had'	(LL̀)(L_h (H́L))
c. [nɯ<u>h</u>.tɯ́.no]	'day (locative)'	(L_h (ĹL))

II. No [h] epenthesis in penults in odd-parity words

a. [pah̲. t^sá.kɯ] 'we washed' $(L_h\ (\acute{L}L))$

*[pah. t^sáh.kɯ] $*(L_h\ (\acute{L}_hL))$

III. [h] epenthesis in even-parity forms

a. [pah̲. t^sáj.níh̲.kãj̃] 'they are washing' $(\grave{L}_hH)(\acute{L}_hL)$

b. [jò.mɯ.ràh̲.ká.tíh̲.kaj̃] 'they hunted' $(LL)(\grave{L}_hL)(\acute{L}_hL)$

In a nutshell, as Bennett puts it, "recursive adjunction thus serves to foot otherwise unfootable syllables." That is, the motivations for recursive footing in Huariapano parallel those encountered in Wargamay and Yidiɲ: recursive feet are built as a last-resort mechanism to ensure exhaustivity and avoid a violation of the constraint that ensures foot binarity. By allowing feet to undergo recursion, identification of the locus and motivation of [h] epenthesis in Huariapano is straightforward. Previous analyses had to posit different metrical structures for stress assignment and coda epenthesis (see Bennett 2012 and references therein). A recursion-based account, though, provides a unified and simpler account of Huriapano's prosodic system.

3.7 Summary

This chapter has presented several arguments for the need to incorporate recursive feet in phonological representations. In particular, I have argued that languages with binary rhythm like Wargamay and Yidiɲ may build a recursive foot at the left or right edge of the prosodic word as a last-resort device to ensure exhaustive parsing of syllables. The evidence for recursive footing in these languages comes from the puzzling lengthening patterns attested in odd-parity forms and the different behavior (and relative strength) of foot heads, depending on whether they are dominated by a minimal and non-minimal foot, or by a minimal foot alone.

In the next chapter I examine additional facts that motivate an analysis positing recursion at the level of the foot. I will argue that the recursive feet in some languages are not a last-resort mechanism, but are better characterized as a default parsing mode exploited by some prosodic systems.

4 Ternary rhythm: peripheral and non-peripheral recursive feet[1]

In this chapter I propose modeling ternary rhythm in a recursion-based approach. The core of the chapter is devoted to the case study of Chugach Alutiiq, a language well-known for its combination of binary and ternary rhythm. I examine a wide range of phonological phenomena in Chugach and demonstrate that they can only receive a unified account once recursive feet are admitted in phonological representations (Section 4.2).

In the second part of the chapter I expand the analysis of Chugach to account for the location of stress in two other languages with more radical patterns of ternary stress, Cayuvava and Tripura Bangla (Section 4.3).

4.1 Introduction

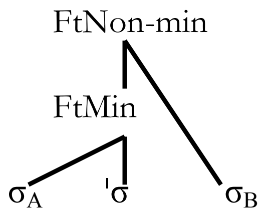
In Chapter 3 I argued that binary rhythmic languages may exhibit recursion at the level of the foot as a last-resort device to avoid degenerate feet and/or unparsed syllables. This chapter argues that, in addition to ensuring exhaustive

[1] This chapter has enormously benefited from discussions with phonologists at Tromsø, UC Santa Cruz and René Kager. On the one hand, the analysis of Chugach (§4.2) was developed during my time at UCSC and I especially want to thank Ryan Bennett, Junko Itô, Wendell Kimper, Martin Krämer, Armin Mester, Jaye Padgett and Curt Rice for their feedback and comments. On the other hand, §4.3 is part of a broader project on quantity-insensitive rhythmic systems developed in collaboration with René Kager (Martínez-Paricio & Kager 2013). I want to thank René for the many discussions and letting me include a part of our findings here.

parsing, recursive feet can have another *raison d'être*: they sometimes arise to guarantee a minimum number of maximal feet per prosodic word without disrupting rhythmicity.[2] But why would languages ever want to *economize* on number of feet? The claim I put forward here is that economic recursive parsing leads to better satisfaction of constraints requiring feet to be oriented towards a particular word-edge while maintaining exhaustivity (i.e. pervasive footing).

Evidence for this additional motivation for recursion comes from languages with mixed patterns of ternary and binary rhythm (i.e. languages in which stress appears in every second and/or every third syllable depending on different factors). To illustrate this, this chapter is dedicated to the case study of Chugach Alutiiq, a language that exhibits a mixed system of binary and ternary stress. I demonstrate that Chugach word-level prosody receives a unified account once the theory of phonological representations permits recursive feet. Furthermore, I argue that the distribution of pitch in Chugach provides additional empirical motivation for the need for recursive footing in natural languages. Whereas in the preceding chapter I showed that allowing non-minimal feet (i.e. recursive feet) was crucial for capturing the difference between the three types of prosodic heads exploited in some languages (i.e. head of a prosodic word, head of a non-minimal foot and head of a minimal foot), here I argue that a distinction between minimal and non-minimal feet is required in Chugach to capture the different behavior of two sorts of foot dependents: (i) the dependent of a minimal foot (σ_A in 1) *vs.* (ii) the dependent of a non-minimal foot, which is not dominated by a minimal foot (σ_B in 1). I will show that the discrimination among foot dependents is crucial for the correct distribution of pitch in Chugach.

(1) Two types of dependents



After the details of the analysis of Chugach have been presented in Section 4.2, in the second part of the chapter I show that the tools that I used in the

[2] The idea that ternary systems display a preference for a minimal number of feet or gridmarks has always been present in the literature on ternary stress (e.g. Kager 1994; Elenbaas & Kager 1999; Gordon 2002; Hyde 2002 *inter alia*).

analysis of Chugach can also account for the location of stress in more radical ternary rhythmic languages, such as Tripura Bangla (Das 2001) and Cayuvava (Key 1961, 1967) (Section 4.3). Based on Martínez-Paricio & Kager (2013), I demonstrate that in these languages, recursion at the foot level is even less restricted than in binary systems (e.g. Wargamay and Yidiɲ) or mixed binary-ternary systems (e.g. Chugach), and it has become a general parsing strategy.

4.2 Chugach Alutiiq

Chugach Alutiiq is a dialect of the Yupik language spoken by a small number of individuals in Alaska, from Cook Inlet to the Prince William Sound. Its rich prosodic system, in particular the distribution of stress in the language, has been the topic of multiple studies and is the primary focus of this chapter. [3] In particular, the main goal of the following pages is to demonstrate that the distribution of stress and pitch, along with a wide range of phonological processes such as consonant fortition and vowel lengthening all receive a unified account if foot-recursive structures are available in Chugach. An in-depth study of Chugach prosody will therefore provide the perfect testing ground to explore the implications of/motivations for a phonological theory that permits adjunction at the level of the foot.

The analysis of Chugach is presented as follows. I begin by illustrating the stress data in Chugach and sketching a possible analysis that appeals to recursive feet (Section 4.2.1). Section 4.2.2 provides evidence, independent from the stress facts, that favors the metrical constituents argued for and proceeds to an analysis of the distribution of pitch in the language. Then, Section 4.2.3 presents the major divergences with traditional analyses, especially those that have greatly influenced the present proposal: Leer (1985c) —where the key idea of this thesis was already present (i.e. the need for an additional layer between the foot and the prosodic word)—, Rice (1992) and Kager (1993). Finally, the section closes by comparing the present analysis with the most recent alternative, Hyde (2001, 2002).

All the data on Chugach are drawn from the series of important descriptive and analytical works based on Leer's own fieldwork (1985a, b, c) and its extensive reanalysis found in Rice's dissertation (1992).

[3] Some analysis of Chugach include Leer (1985a, b, c), Halle & Vergnaud (1987), Halle (1990), Rice (1992), Hewitt (1992), Kager (1993, 1994), Hayes (1995), van de Vijver (1998), Elenbaas & Kager (1999), Hyde (2001, 2002), Houghton (2006).

4.2.1 Stress in Chugach

Chugach has figured prominently in the metrical literature due to its complicated stress system, which combines binary and ternary rhythm. That is, whereas in some words stress appears on every second syllable (e.g. *akútamék*, σ'**σ**σ'**σ**), in other words stress may fall on a subsequent third syllable (e.g. *atúqunikí*, σ'**σ**σσ'**σ**).[4] Furthermore, Chugach is a weight-sensitive language and, thus, the already complicated mixed pattern of stress can be altered by the presence of heavy syllables.

The primary correlates of stress in Chugach are greater intensity and higher pitch. As Leer points out: "because stress and pitch level are commonly covariant in non-tonal languages it is often difficult, if not pointless, to try to dissociate stress from pitch level" (Leer 1985c: 164). In fact, as it will be shown in Section 4.3.2, all stressed syllables exhibit high pitch. Furthermore, Chugach has multiple instances of equally prominent stresses per prosodic word (Leer 1985a,b,c; Rice 1992). Although this is not very common in stress systems, it is frequent in other Yupik languages (Jacobson 1985; Woodbury 1987).

Despite the fact that Leer refers sometimes to "three degrees of stress — zero stress, weak stress and strong stress—", he concludes that there is no actual difference in stress between secondary stress (which he calls *weak stress*) and unstressed syllables (which he characterized as having *zero stress*). The difference between these two types of syllables is rather a difference in pitch: "weakly stressed syllables differ from unstressed syllables not by stress, but in that the weakly stressed syllables are assigned pitch level 1 [the lowest pitch level] whereas the unstressed syllables are not assigned a pitch level of their own"; their pitch is just a transition from their neighboring tones (Leer 1985c: 164). Rice also interprets this difference as a difference in the pitch level (Rice 1992: 140). Thus, following these authors, I assume that Chugach does not have secondary stress (i.e. all stressed syllables have the same degree of stress), but multiple instances of primary stress and two pitch levels: high and low. Since pitch accent systems often exhibit structural properties of 'stress accent' systems and 'tonal' systems (Hyman 2006, 2009), Chugach's violation of the *culminativity* criteria (i.e. at most one primary stress per word, Hyman 2006) — generally respected by canonical stress systems— is not so bizarre.

For ease of presentation, this section starts with the data and analysis of words containing light syllables only. The analysis is then extended to words

[4] When using the symbol <σ> for the syllable, stressed syllables are often indicated in this chapter in boldface and they appear preceded by <'>.

with heavy syllables, which in Chugach are those with long vowels, diphthongs and a subset of the closed syllables (concretely, those appearing in word-initial position).

4.2.1.1 Words with light syllables

Putting aside the words that contain heavy syllables for the moment, the distribution of stress in Chugach words with light syllables is illustrated in (2) (primary stresses are indicated with acute accents in orthographic forms and the IPA symbol <'> in phonetic transcriptions).

(2) Chugach data containing light syllables[5]

a.	2-σ: pə̥náq	'cliff'
b.	3-σ: atáka	'my father'
c.	4-σ: akútamék	'kind of food' (abl sg)
d.	5-σ: atúqunikí	'if he (refl) uses them'
e.	6-σ: pisúqutaqúni	'if he (refl) is going to hunt'
f.	7-σ: maŋársuqutáquní	'if he (refl) is going to hunt porpoise'

Based on the fact that (i) peninitial syllables are always stressed in words of any length and (ii) final stress is very common —with the exception of 3- and 6-syllable words—, I assume that Chugach metrical feet are iambic, in agreement with Leer's original analysis of Chugach (i.e. IAMB >> TROCHEE).[6] I also assume that the direction of footing proceeds from left to right. This is evident in 3-syllable words, where stress falls on the peninitial syllable [(a.tá).ka] 'my father'. If iambic footing proceeded from right to left, the prediction would be that a 3-syllable word would have final stress, as in *[a.(ta.ká)]). Since this is not the case, parsing must be rightwards. Additionally, the ban on degenerate feet in Chugach (Leer 1985a,b,c; Rice 1992) accounts for the fact that the final syllable in (3b) does not constitute a foot on its own. Note that this prohibition against final stress in some words cannot be attributed to a strategy for preventing clashes, since Chugach allows clashes in multiple environments, as we will see when words with heavy syllables are considered.

[5] Following Leer (1985) and Rice (1992), data are given in the standard orthography with the exception of the digraph <ng> that I have substituted for its phonetic value [ŋ]. The rest of the orthography is transparent, and it differs with phonetics only in a few cases: the voiced fricatives [ɣ, ɣ^{w}, ɣ̩, ɣ̩^{w}] are represented with <g, w, r, rw>, respectively; the voiceless fricatives [ɬ, x, x^{w},x̩] with <ll, gg, ggw, rr>; and the voiceless nasals with <hN>.

[6] This is also the case in other Yupik languages (Jacobson 1985; Woodbury 1987).

(3) Default L → R iambic footing

a.	(σ ˈ**σ**)	(pə̥.náq)	‘cliff’	IAMB ✓
b.	(σ ˈ**σ**) σ	(a.tá)ka	‘my father’	IAMB ✓
c.	(σ ˈ**σ**)(σ ˈ**σ**)	(a.kú). (ta.mék)	‘kind of food’ (abl sg)	IAMB ✓

The distribution of stress becomes puzzling in longer (i.e. 5-, 6- and 7-syllable) words. To begin with, we know that these words, as well as 4-syllable words, have iterative footing because they exhibit more than one stressed syllable per prosodic word. Looking only at 4-syllable words in Chugach (e.g. σˈ**σ** σˈ**σ**), one could have drawn the incorrect conclusion that Chugach longer words exhibit a strict alternation between stressed and unstressed syllables, which is the general pattern in languages with iterative stress.

(4) Strict stressed-unstressed expected alternation

a. 5-σ word σ ˈ**σ** σ ˈ**σ** σ
b. 6-σ word σ ˈ**σ** σ ˈ**σ** σ ˈ**σ**
c. 7-σ word σ ˈ**σ** σ ˈ**σ** σ ˈ**σ** σ

However, instead of having a strictly binary iambic alternation between unstressed and stressed syllables, in the absence of a heavy syllable, 5-, 6- and 7-syllable words exhibit a mixed alternation of binary and ternary rhythm. Namely, stress is placed on a subsequent third syllable after the leftmost stressed syllable —which always coincides with the peninitial syllable:

(5) Chugach ternary alternation

a.	atúqunikí	σ ˈ**σ** $\underline{\sigma^1\ \sigma^2\ ˈ\boldsymbol{\sigma}^3}$	(σ ˈ**σ**) σ (σ ˈ**σ**)	IAMB ✓
b.	pisúqutaqúni	σ ˈ**σ** $\underline{\sigma^1\ \sigma^2\ ˈ\boldsymbol{\sigma}^3}$ σ	(σ ˈ**σ**) σ (σ ˈ**σ**) σ	IAMB ✓
c.	maŋársuqutáquní	σ ˈ**σ** $\underline{\sigma^1\ \sigma^2\ ˈ\boldsymbol{\sigma}^3}$ σ **σ**	(σ ˈ**σ**) σ (σ ˈ**σ**) (σ ˈ**σ**)	IAMB ✓

This type of ternary alternation poses a challenge to standard analyses of stress because, in rhythmic languages with exhaustive footing, feet have been traditionally assumed to be maximally binary branching and combine in a strictly local way (i.e. one foot after another). However, if this were the case for Chugach, stress would appear in the second syllable after the peninitial stressed syllable, rather than in the subsequent third one (see 5a,b,c). Therefore, to allow these types of rhythmic alternations, two major solutions have been proposed in the metrical literature.

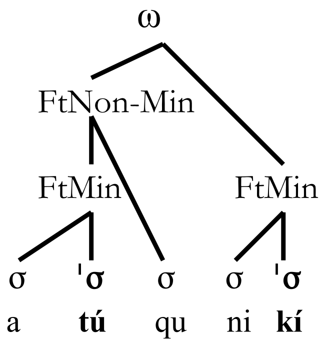
On the one side, certain analyses have proposed increasing the inventory of universal feet, allowing ternary feet —either flat (e.g. Levins 1985; 1988; Halle & Vergnaud 1987; Halle 1990) or with internal hierarchical structure (e.g. Dresher & Lahiri 1991; Rice 1992; Hewitt 1992) (see Chapter 1 and references therein). In Chugach, the combination of binary and ternary feet would indeed correctly predict the location of stress. However, there is no independent motivation for these types of feet apart from being a specific device to account for ternary alternations between stressed and unstressed syllables. Furthermore, whereas there is a great amount of linguistic evidence that binarity is favored in other modules of grammar (e.g. the operation of merge in syntax), ternarity does not seem to be required in other linguistic and non-linguistic faculties. In addition, the introduction of ternary feet as a primitive might increase the expressive power of a metrical theory beyond what is needed. Thus, the introduction of ternary branching feet does not seem a desirable move, and other theoretical tools should be explored before resorting to them.

The second solution that has been proposed to account for ternary rhythm enhances the parsing strategies available in the theory. In particular, it has been claimed that languages with ternary rhythm leave occasional syllables unincorporated into feet. Even though prosodic words in languages with iterative footing generally build binary feet that are strictly adjacent, some languages do not construct feet side-by-side, but they separate them by one unparsed syllable (Weak Local Parsing, WLP, Hayes 1995 drawing on Hammond 1990; Ishii 1996; Elenbaas & Kager 1999; Houghton 2006 *inter alia*). As with ternary feet, even if this parsing strategy is able to predict the distribution of stress in Chugach and other ternary systems, there is no independent motivation for it. That is, it is not very clear why some syllables/morae are linked to a prosodic word rather than to a foot apart from the fact that their non-parsing allows ternary rhythm to arise. Moreover, within the WLP approach, the reasons for leaving unparsed syllables within the same prosodic word can be multiple and disconnected: some syllables are left unparsed to avoid adjacent feet word internally, some others to avoid the parsing of a final syllable, etc. In any case, while extrametricality is active at different levels of the prosodic hierarchy and could arguably be an explanatory force for word-final ternarity, there is no clear reason for the avoidance of adjacent feet. Furthermore, prosodic constituents at other levels of the prosodic hierarchy are always adjacent. Therefore, the violation of adjacency exclusively at the foot level is a bit suspicious, especially, given that there is no independent motivation for this violation. Furthermore, OT accounts that have assumed this weak local parsing mode (i.e. maximal bisyllabic feet separated by at most one syllable) and/or that have used contextual lapse licensing and antilapse constraints to model ternary rhythm (e.g. Elenbaas & Kager 1999; Kager 2001, 2005; Gordon 2002, Houghton 2006) and gradient alignment have been shown to be theoretically and typologically problematic when applied to metrical systems (see, among others, Eisner 1997, 2000; Biró 2003, 2004; Kager 2004, 2012; Rice 2006a, 2007, 2008; Hyde 2008; Buckley 2009). In particular, all previous accounts of rhythmic stress suffered from undergeneration (i.e. they are not able to model all the attested ternary rhythmic stress systems) and/or pathological overgeneration (i.e. they predict metrical systems with all sorts of "pathologies", among others, the *mid-point pathology* (Eisner 1997) or the *licensor attraction* pathology (Kager 2004) (for further details on the problematic aspects of previous accounts of ternary rhythm see Rice 2011 and Martínez-Paricio & Kager 2013).

With the intent of avoiding the shortcomings of previous proposals, this chapter explores a third mechanism that could be responsible for the emergence of ternary rhythm in Chugach. Building on the idea that languages may exhibit recursion —not only at higher levels of the prosodic hierarchy, but also at the level of the foot (Selkirk 1980; Prince 1980; Grijzenhout 1990; Yu 2004; Caballero 2008, 2011; van der Hulst 2010; Bennett 2012; Kager 2012 *inter alia*)— and given the independent evidence for recursive (trisyllabic) feet in strictly binary systems (Chapter 3), I propose that ternary rhythm is a consequence of exhaustively parsing syllables via foot recursion. I already argued that some languages appeal to foot recursion as a means of ensuring exhaustive parsing of syllables without constructing unary feet. Support for this claim came from specific patterns of lengthening in Wargamay and Yidiɲ (Chapter 3) and a process of coda epenthesis in Huariapano (Bennett 2012). In this chapter, I claim that recursive footing is also responsible for ternary alternations in rhythmic languages. In particular, I propose that the distribution of stress in Chugach can be easily predicted if some prosodic words allow the adjunction of a light syllable to a preceding iamb. In particular, I argue that in odd-parity forms the initial foot has a right adjunct. This is illustrated below in (6), where I provide the specific prosodic structure of odd-parity forms in Chugach.

(6) Footing in odd-parity forms: recursive foot at the left edge of ω [7]

a. 5-syllable word



b. Other odd-parity forms

3-σ word ((σ**σ**) σ)
7-σword ((σ**σ**) σ)(σ**σ**)(σ**σ**)

Therefore, this study follows along the lines of previous research that has allowed trisyllabic feet with internally layered structure (Dresher & Lahiri 1991; Rice 1992; Kager 2012 *inter alia*). In these studies, trisyllabic feet consisted of a binary head and a dependent. Instead, I assume that such a *head* is a foot *per se* along the lines of the traditional works on stress of Selkirk (1980) and Prince (1980). As I will show in Section 4.4 such a refinement in the prosodic representation provides a better account of the facts.

Apart from the distribution of stress, which I assume coincides with foot heads, there are two phonological processes that support the specific parsings of (6): (i) a process of consonant fortition (Section 4.2.3.1) and (ii) the assignment of low pitch in Chugach (Section 4.2.3.2). It has been claimed that fortis consonants target foot-initial consonants (Leer 1985; Rice 1992; Kager 1993). Thus, their emergence in one syllable but not in others can be taken as further support for the initial foot boundaries in (6). More importantly, I will show that the assignment of low pitch in Chugach needs to distinguish between two types of unstressed syllables. Furthermore, I will argue that the most appropriate way to represent such a distinction between weak syllables is via recursion at the foot level. Finally, Leer reported a durational difference between foot heads similar to the one encountered in Wargamay and Yidiɲ. Namely, he noticed that the head of a non-minimal foot sometimes is slightly longer than the head of a minimal foot. Although it is not clear that this process is systematic, the sporadically different phonetic interpretation of foot heads could be taken as further support for a recursion-based analysis. These three phenomena are reviewed in further detail below. For the moment, let us

[7] As pointed out by Rice (1992), since all stresses are equally prominent in Chugach, a representation that assumes that one foot is the head of the prosodic word (i.e. more prominent than others) would be misleading. That is why in (6a) none of the feet are connected to the prosodic word by a vertical line.

assume that prosodic representations like the one in (6) are the correct representations of Chugach words.

The idea of having an additional level between the foot and the prosodic word was already proposed for Chugach by Leer (1985c), who conceived of this layer as an independent category (i.e. the superfoot). However, whereas in Leer (1985c) this new layer was the default (i.e. all feet have two projections, whether or not they have an adjoined syllable), recursion at the foot level is much more restricted here. As I will demonstrate, only the type of recursive footing proposed here receives independent support, since it also accounts for the distribution of pitch in the language. Leer's analysis handled these two phenomena separately, adding to the hierarchy yet another prosodic category, the *pitch group*, to account for the pitch facts (Leer 1985c: 168).

4.2.1.2 OT implementation: stress in words with light syllables

Since GEN creates feet that are maximally binary branching (Chapter 2), I propose that ternary patterns result from adjoining certain light syllables to a preceding/following minimal foot. In particular, in Chugach, recursion at the level of the foot stems from two requirements: (i) parsing all syllables while (ii) economizing in terms of the number of feet. In that sense, the ranking BIN(FT), ALIGN-LEFT/RIGHT ([σ]ω, *Ft, ω) >> *REC(FT) that was previously proposed to account for the emergence of recursive feet in Wargamay and Yidiɲ is also active in Chugach. Remember that when the non-intervention constraints regulating the location of unfooted syllables (i.e. ALIGN-L/R([σ]ω, *Ft, ω) are undominated as they are in Chugach, exhaustive parsing of syllables is guaranteed. Likewise, an undominated BIN(FT) ensures that all feet are binary. For ease of presentation, I repeat the definition of these constraints in (7).

(7) a. BINARY(FT)[8]
Feet are binary branching (based, among others, on Liberman & Prince 1977; Prince 1980; McCarthy & Prince 1986; Kager 1989, 1993) (abbr. BIN(FT)).

[8] See the discussion in Chapter 2 (Section 2.3.1) for the differences between the present definition of BIN(FT) and the traditional one.

b. ALIGN-LEFT ([σ]ω, *Ft, ω)
For every unfooted syllable [σi]ω, assign a violation mark if some foot intervenes between [σi]ω and the left edge of its containing prosodic word.

c. ALIGN-RIGHT ([σ]ω, *Ft, ω)
For every unfooted syllable [σi]ω, assign a violation mark if some foot intervenes between [σi]ω and the right edge of its containing prosodic word.

In the tableaux in (8) I illustrate the crucial ranking arguments with the evaluation of a 5-syllable word with only light syllables. While candidates (8b-f) are more harmonic than (8a) in terms of prohibiting recursive feet, they have either a degenerate foot (8b,c) or an unfooted syllable (8d-f), fatally violating BINARY(FT) and ALIGN-LEFT/RIGHT ([σ]ω, *Ft, ω), respectively. For the moment, and for ease of presentation, in the following tableaux I use the constraint *REC(FT) as a shorthand for the relevant ranking of the foot-form constraints, which will soon be presented (see tableau 11).

(8) Recursive footing in odd-parity forms

BIN(FT) >> *REC(FT)

atuquniki	BIN(FT)	*REC (FT)
a. ☞((a.tú)qu) (ni.kí)		*
b. (a.tú)(qú)(ni.kí)	*!	
c. (á).(tu.qú)(ni.kí)	*!	

ALIGN-R ([σ]ω, *Ft, ω), ALIGN-L ([σ]ω, *Ft, ω) >> *REC(FT)

atuquniki	ALIGN-R ([σ]ω, *Ft, ω)	ALIGN-L ([σ]ω, *Ft, ω)	*REC (FT)
a. ☞((a.tú)qu) (ni.kí)			*
d. (a.tú)(qu. ní).kí		*!	
e. a.(tu. qú) (ni.kí)	*!		
f. (a.tú) qu (ni.kí)	*	*!	

Note that there are multiple ways in which the hierarchy in (8) could be satisfied. On the one hand, candidates that build a recursive foot word-finally would perform equally well in the hierarchy. However, such candidates make incorrect predictions regarding the location of stress in Chugach. Thus, to ensure that odd-parity forms align the non-minimal foot at the left edge of the prosodic word, the constraint ALIGNLEFT(FtNon-Min, *Ft, ω) must dominate ALIGNRIGHT(FtNon-Min, *Ft, ω). The exact definition of these constraints is repeated below in (9). Remember these constraints had the effect of pulling non-minimal feet towards a particular word edge:

(9) a. ALIGN-LEFT(FtNon-min, *Ft, ω)
For every non-minimal foot FtNon-min^i, assign a violation mark if some foot intervenes between FtNon-min^i and the left edge of its containing prosodic word.

b. ALIGN-RIGHT (FtNon-min, *Ft, ω)
For every non-minimal foot FtNon-min^i, assign a violation mark if some foot intervenes between FtNon-min^i and the right edge of its containing prosodic word.

Tableau (10) illustrates the ranking argument ALL(FtNon-min,*Ft, ω)>> ALR(FtNon-min,*Ft, ω), which ensures that a candidate with a word-initial non-minimal foot surfaces as optimal (i.e. 10a). Since BIN(FT) and ALIGN-LEFT/RIGHT ([σ]ω, *Ft, ω) are undominated in Chugach, henceforth I only consider candidates that conform to them and, for ease of exposition, I do not include the constraints in the remaining tableaux.

(10)

atuquniki	ALL (FtNon-min,*Ft, ω)	ALR (FtNon-min,*Ft, ω)
a. ☞((a.tú)qu) (ni.kí)		*
b. (a.tú) (qu(ni.kí))	*!	
c. (a.tú) ((qu.ní)ki)	*!	

Remember from the initial discussion on Chugach stress that, in order to ensure the emergence of iambic feet, I proposed that IAMB dominates TROCHEE (see examples 3-5 above). Crucially, the general preference for iambic footing in the language is not observed in non-minimal feet, which locate their head on the left branch of the foot, rather than its right branch (i.e. minimal iambic feet have a right adjunct). Therefore, in order to favor iambic (minimal) feet with a right adjoined syllable over iambic feet with a left adjoined syllable, NONMINTROCHEE, defined in (11), must dominate IAMB. This is illustrated in tableau (12), where candidates (12b) and (12d) are ruled out because their non-minimal feet are iambic. Additionally, this tableau demonstrates that the hierarchy correctly bans candidates with minimal trochaic feet (12c,d).

(11) ALIGN-LEFT(FtMin, *σ, Ft) (abbr. NONMINTROCHEE)
For every minimal foot, assign a violation mark if some footed syllable intervenes between the minimal foot and the left edge of its containing foot.

(12)

atuquniki	NONMINTROC	IAMB	TROCHEE
a. ☞((a.tú) qu)(ni.kí)		*	**
b. (a (tu.qú))(ni.kí))	*!		***
c. ((á.tu) qu)(ní.ki)		***!	
d. (a (tú.qu))(ní.ki)	*!	**	*

In sum, Chugach non-minimal feet are similar to the ones encountered in Yidiɲ. The crucial difference between the two languages relies on the location of the non-minimal foot within the prosodic word: whereas in Chugach non-minimal feet in odd-parity forms are located at the left edge of the prosodic word (i.e. ALL(FtNon-min, *Ft, ω)>> ALR(FtNon-min, *Ft, ω)), in Yidiɲ non-minimal feet occur word-finally, i.e. ALR(FtNon-min, *Ft, ω) dominates ALL(FtNon-min, *Ft, ω) .

It should be highlighted that NONMINTROCHEE is not just an *ad hoc* constraint proposed to rule out non-minimal iambic feet, i.e. (σ(σˈσ)). Chugach exhibits independent support for this constraint. In particular, a process of gemination —which only targets the onset of the second syllable in some Chugach words— together with the contextually restricted weight in word-initial syllables (i.e. closed syllables are heavy word-initially only), provide further evidence for the need of a high-ranked NONMINTROCHEE. This is so because, the ultimate goal of these two processes is the avoidance of non-minimal iambs word-initially, i.e. *[(L(H))...] or *[(L(LL))...]. In other words, Chugach requires that all words start with a minimal foot.[9] The specific data illustrating these facts are reviewed in detail below in Section 4.2.1.2, after all the patterns of stress assignment in words with light syllables have been explored. To aid in the exposition, the Hasse diagram in (13) summarizes the core rankings responsible for the prosodification of words in Chugach seen up to here:

[9] Bennett (2012: 91) reports a similar restriction, but word-finally, in Huariapano, i.e. a minimal foot must be anchored to the right edge of the word in this language.

(13) Bin(Ft), Align-L/R([σ]ω, *Ft, ω), NonMinTroc Al-L (FtNon-min,*Ft, ω)

Iamb Al-R (FtNon-min,*Ft, ω)

Trochee

These rankings prohibit recursive feet in even-parity forms: since exhaustive parsing can be accomplished simply via the construction of adjacent minimal binary feet (see 14a-c), there is no need for recursion to take place.

(14) Predicted avoidance of recursive feet in even-parity forms

a. (σ ˈ**σ**) b. (σ ˈ**σ**) (σ ˈ**σ**) c. (σ ˈ**σ**) (σ ˈ**σ**) (σ ˈ**σ**)

This prediction, however, is not borne out in 6-syllable words. Whereas Chugach 2- and 4-syllable words present stress in even-numbered syllables and, thus, the non-recursive parsings given in (14a,b) are adequate, the parsing of a 6-syllable word in (14c) does not match the distribution of stress in 6-syllable words in Chugach. In such words, Chugach stresses the second and the fifth syllable rather than every even-numbered syllable, e.g. stress in/pisuqutaquni/ 'if he (refl) is going to hunt' is [pi.**sú**.qu.ta.**qú**.ni] and not *[pi.**sú**.qu.**tá**.qu.**ní**]. Crucially, by allowing recursive feet also in 6-syllable words, we could correctly predict the location of stress in these forms. This is not an unreasonable solution since the language already uses recursive feet in other constructions (odd-parity forms) and, more importantly, the parsing with recursive feet is able to predict the exact location of fortis consonants (see Section 4.2.2.1). Consequently, the hierarchy in (13) needs to be amended to allow recursive footing in 6-syllable words too. As it stands now, it would select the wrong parsing in a 6-syllable form, as demonstrated in the following tableau (the bomb indicates the candidate wrongly selected by the hierarchy, and the sad face the intended winner).

(15) Incorrect prediction of the ranking

Stress in a 6-syllable form: /pisuqutaquni/ → [pi.**sú**.qu.ta.**qú**.ni]

pisuqutaquni	Bin (Ft)	AlR/L ([σ]ω, *Ft, ω)	NonMin Troc	Iamb	Troc
a. ☹ ((pisú)qu)((taqú)ni)				*!*	**
b. 💣 (pisú)(qutá)(quní)					***

Since Chugach —and other languages with ternary rhythm—use recursive feet not only as a last-resort mechanism to ensure exhaustivity in odd-parity forms, but also in some even-parity forms (i.e. 6-syllable forms in the case of Chugach), there must be other motivations (and other constraints) that favor recursive parsings. At the beginning of the chapter, I suggested that some languages exhibit recursion at the foot level as a means of guaranteeing exhaustive parsings, but with the smallest number of maximal feet possible (i.e. feet directly dominated by the prosodic word). Within an OT framework, this can be easily achieved via an alignment constraint of the non-intervention type. This constraint is categorical and it is defined in (16):

(16) ALIGN-L/R(FtMax, *Ft, ω)
For every maximal foot FtMax^i assign a violation mark if some foot intervenes between FtMax^i and the left/right edge of its containing prosodic word.

As I showed in Chapter 2, this constraint prioritizes candidates exhaustively parsed with the fewest number of maximal feet and is crucial in the generation of systems like Chugach, with a mixed binary-ternary pattern of stress. In (17) I exemplify again how ALIGN-LEFT(FtMax, *Ft, ω) assigns violation marks. For ease of exposition, I have assigned a specific subindex to every instance of a maximal foot:

(17)		AL-L(FtMax, *Ft, ω)	Locus of violation
	a. (σ ˈ**σ**)**i** (σ ˈ**σ**)**j** (σ ˈ**σ**)**k**	✗ ✗	(σ ˈ**σ**)**k**, (σ ˈ**σ**)**j**
	b. ((σ ˈ**σ**)σ)**i** ((σ ˈ**σ**)σ)**j**	✗	(σ ˈ**σ**) σ)**j**

The candidate with two maximal feet (17b) fares better in this constraint than (17a), with three maximal feet. As indicated in the "Locus of violation" column, in (17a) there are two maximal feet (Ftk and Ftj) that are separated from the left edge of the prosodic word by some intervening foot. By contrast, in (17b) there is only one maximal foot (Ftj) that contains an intervening foot between itself and the left edge of the prosodic word. It is important to highlight that this and all other alignment constraints used in the dissertation are categorical, following McCarthy (2003). Candidate (17a) gets two violations not because it is gradient (i.e. it does not measure any distance), but because there are two maximal feet that violate the constraint.

As can be seen in (17), the candidate with recursion also economizes in terms of minimal feet: whereas (17a) has three minimal feet, candidate (17b) contains only two. Hence, the AL-L([FtMin]ω, *Ft, ω) constraint presented in

Chapter 2 could also accomplish the task of favoring candidates with recursion. In fact, in Section 4.3 I will show that such a constraint is crucial for generating more radical ternary systems, where recursive feet are also favored in words with 3*n*+1 even- and odd-parity forms. For ease of exposition, however, in the rest of the discussion on Chugach metrifications, I illustrate the crucial ranking arguments with AL-L/R(FtMax, *Ft, ω), the constraint that enforces economy of maximal feet, no matter whether they are minimal or non-minimal.

Importantly, as I demonstrate in tableau (18), when AL-LEFT(FtMax, *Ft, ω) dominates the ranking that bans recursion at the foot level (i.e. IAMB >> TROCHEE), a 6-syllable word surfaces with two maximal (recursive) feet (18a), rather than three maximal (non-recursive) feet (18b).

(18) AL-L(FtMax, *Ft, ω)[10] >> IAMB >> TROCHEE

σ σ σ σ σ σ	AL-L(FtMax,*Ft, ω)	IAMB	TROCHEE
a.☞((σ ˈ**σ**)σ) ((σ ˈ**σ**)σ)	*	**	**
b. (σ ˈ**σ**)(σ ˈ**σ**)(σ ˈ**σ**)	**!		***

Tableau (18) shows that once the non intervention constraint AL-LEFT(FtMax, *Ft, ω) is ranked above IAMB, it correctly favors candidates with two maximal (and two minimal) feet (e.g. 18a) over candidates with three maximal feet (e.g. 18b). Furthermore, the joint action of AL-LEFT(FtMax, *Ft, ω) and NONMINTROCHEE selects as optimal the candidate with minimal iambic feet and non-minimal trochaic feet. This is illustrated in (19). In this tableau, candidate (19b) is ruled out due to its violations of AL-LEFT(FtMax, *Ft, ω), whereas candidates (19c-d) are banned because their non-minimal feet are iambic.

(19) NONMINTROC >> IAMB; AL-L([FtMax, *Ft, ω) >> IAMB

σ σ σ σ σ σ	NONMIN TROC	AL-L (FtMax, *Ft, ω)	IAMB	TROCH
a.☞((σ ˈ**σ**)σ) ((σ ˈ**σ**)σ)		*	**	**
b. (σ ˈ**σ**) (σ ˈ**σ**) (σ ˈ**σ**)		**!		
c. (σ(ˈ**σ** σ)) (σ(ˈ**σ** σ))	**!	*	**	**
d. (σ(σ ˈ**σ**)) (σ(σ ˈ**σ**))	**!	*		****

[10] I have used AL-L(FtMax, *Ft, ω), but AL-R(FtMax, *Ft, ω) would have done exactly the same job.

Additionally, the constraint ALIGNLEFT(FtNon-min, *Ft, ω), which served to anchor the non-minimal foot to the left-edge of the prosodic word in odd-parity forms, must be ranked below AL-LEFT([FtMax, *Ft, ω) to prevent a candidate without non-minimal feet from surfacing as optimal.

(20)

σ σ σ σ σ σ	AL-L(FtMax, *Ft, ω)	ALL(FtNon-min, *Ft, ω)	IAMB	TROC
a.☞((σ ˈσ)σ) ((σ ˈσ)σ)	*	*	**	**
b. (σ ˈσ)(σ ˈσ)(σ ˈσ)	**!			***

Finally, remember AL-LEFT(FtMax, *Ft, ω) favors economical parsings (i.e. with few maximal feet) as long as exhaustivity is ensured. To guarantee exhaustivity while aiming at the fewest number of maximal feet in a rhythmic language like Chugach, the constraint AL-LEFT(FtMax, *Ft, ω) must be ranked below the constraints that ensure binary feet (i.e. BIN(FT)) and exhaustive parsing of syllables (i.e. ALIGN-LEFT/RIGHT([σ]ω, *Ft, ω)). This ranking argument is demonstrated below, where words with only one maximal foot (21b-c) are ruled out.

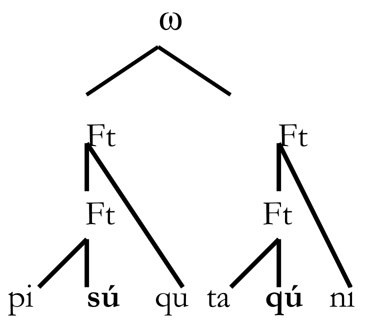
(21)

σ σ σ σ σ σ	BIN (FT)	ALL [σ]ω	ALR [σ]ω	AL-L (FtMax, *Ft, ω)
a.☞((σ ˈσ)σ) ((σ ˈσ)σ)				*
b. ((σ ˈσ) σ) σ σ σ		***!		
c. σ σ σ σ (σ ˈσ)			****!	

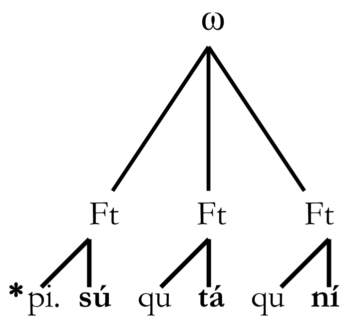
Instead of the alignment pressure favoring few maximal feet, one could imagine an alternative explanation for having two maximal (and recursive) feet rather than three (non-recursive) feet in a six-syllable form. Namely, it could be proposed that Chugach favors recursive parsings in a six-syllable word because such prosodification satisfies the *Binary Branching Principle* at the word level. Binarity is an important principle respected at several levels of the prosodic hierarchy (e.g. Nespor & Vogel 1986; Kager 1989; Itô & Mester 1992/2003, 2007a; Mester 1994; Ussishkin 2000; Selkirk 2011; Elfner 2011, 2012 among others). Thus, it could be argued that a constraint from the family of binarity favoring words with binary branching (e.g. BINARITY(ω)), is responsible for the specific parsing in 6-syllable words:

(22) BINARY(ω) also favors the optimal candidate:

a. BINARY(ω) respected
- Two maximal feet



b. BINARY(ω) violated
- Three maximal feet



However, if BIN(ω) were so highly ranked in Chugach, it would make undesirable predictions with respect to the parsing of longer words. For instance, a 7-syllable word does not respect BINARY(ω) (*maŋársuqutáquní* 'if he(refl) is going to hunt porpoise'), since it contains at least three feet. Furthermore, such a constraint would be constantly violated in words that contain heavy syllables (see below Section 4.2.1.3). Therefore, if a constraint like BIN(ω) exists, it must be low-ranked in Chugach.

To summarize this section, (23) provides the prosodic structure of Chugach words with light syllables (remember each syllable dominates a unique mora in these words):

(23) Recursive feet in words with light syllables

<u>Even- parity forms</u>	<u>Odd-parity forms</u>
a. 2- σ word: **(σ ˈσ)**	d. 3- σ word: **(**(σ ˈ**σ)** σ)
b. 4- σ word: **(σ ˈσ) (σ ˈσ)**	e. 5- σ word: **(**(σ ˈ**σ)** σ) **(σ ˈσ)**
c. 6- σ word: **(**(σ ˈ**σ)** σ) **(**(σ ˈ**σ)** σ)	f. 7- σ word: **(**(σ ˈ**σ)** σ) **(σ ˈσ) (σ ˈσ)**

When the metrical structure of Chugach words in (23) is compared with the metrical structure proposed for binary rhythmic languages in Chapter 3, where non-minimal feet only surfaced in odd-parity forms, we observe that the crucial representational difference between binary rhythmic systems and mixed binary-ternary systems relies on the metrical structure of 3*n* even-parity forms. In particular, whereas Wargamay and Yidiɲ parsed a six-syllable word with three minimal adjacent feet, Chugach prefers to build two non-minimal feet in these words. In Wargamay and Yidiɲ recursion at the foot level is a last-resort device exclusively activated to ensure exhaustive parsings: since a six-syllable word can be exhaustively parsed with three minimal feet, there is no need for recursion to take place. By contrast, in Chugach, in addition to ensuring exhaustive parsings, non-minimal feet contribute to more economical metrical structures in which the fewest number of maximal feet is preferred. Therefore, a 3*n* syllables word is parsed with two non-minimal feet, since such a strategy has the direct effect of *economizing* on one maximal foot (also on one minimal foot). In OT terms, the differences between the two types of systems can be easily captured via constraint reranking. Whereas in binary rhythmic systems the alignment constraint AL-L/R(FtMax, *Ft, ω) ensuring economical parsings is dominated by the constraint that bans recursion *REC(FT) (see 24a), in languages like Chugach, AL-L(FtMax, *Ft, ω) crucially dominates the antirecursivity constraint (see 24b). These crucial rankings are provided in (24). Recall once more that I use the constraint *REC(FT) as a cover constraint for the particular rankings of the TROCHEE and IAMB constraints:

(24) From binary to moderate ternary systems

a. BIN(FT), AL-L/R-[σ]ω>> ***REC(Ft) >>AL-L/R(FtMax,*Ft,ω)** Binary systems

b. BIN(FT), AL-L/R-[σ]ω>> **AL-L(FtMax, *Ft, ω) >> *REC(Ft)** Mixed systems

Now that the crucial differences between binary and binary-ternary mixed rhythmic systems has been established, the following sections aim at providing further support for the recursion-based analysis of Chugach. Until now, the distribution of stress has been taken as the empirical evidence for foot heads. Furthermore, I have advanced that there is additional linguistic motivation — outside the distribution of stressed syllables— that supports the recursion-based analysis. But what are exactly these facts and to what extent do they constitute solid arguments for distinguishing between minimal and maximal projections of feet? The remainder of the chapter deals in detail with these questions. First, though, I will lay out the stress patterns in Chugach words with heavy syllables. When applied to this subset of Chugach words, we will see that the recursion hypothesis also satisfactorily predicts the location of stressed syllables.

4.2.1.3 Words with heavy syllables

In Chugach, syllables with long vowels and diphthongs always attract stress, altering the stress pattern described above. Additionally, CVC syllables also behave as heavy, but only in word-initial position. Before going into the details of the analysis, (25) presents some data illustrating the distribution of stress in words that contain one or more heavy syllables:

(25) Chugach data containing heavy syllables (Rice 1992:112)

a.	taá.ta.qá	'my father'
b.	taá.taá	'her father'
c.	mu.lúk.'uút[11]	'milks' (pl. of N)
d.	naá.'uq	'its burning'
e.	naá.qu.ma.lú.ku	'apparently reading it'
f.	mu.lú.kuút	'if you take a long time'
g.	pa.lát.kaáq	'tent'
h.	pi.lú.liá.qa	'the fish pie I'm making'
i.	úl.'uq	'it flooded'
j.	úl.lúa	'it tongue'
k.	án.ci.quá	'I'll go out'
l.	án.ci.qu.kút	'we'll go out'
m.	qáy.yaá.kun	'by his boat'
n.	úm.yuár.te.qu.té.ka.qá	'I am thinking about it'
o.	naá.ma.cí.quá	'I will suffice'
p.	ág.ku.tár.tuá.ŋa	'I'm going to go'
q.	ág.ŋuá.qu.tár.tuá.ŋa	'I'm going to dance'

The requirement that heavy syllables receive stress (Weight-to-Stress Principle, Prince 1991) is exceptionless in Chugach. This pressure is so strong that it creates clashes whenever two heavy syllables are adjacent, e.g. [(ta$^{\mu}$á$^{\mu h}$)(ta$^{\mu}$á$^{\mu h}$)] 'her father' (henceforth, head morae will be marked with the superscript <h>). I therefore assume that the constraint WEIGHT-TO-STRESS (whose definition is repeated below in (26)) is crucially ranked above CLASH. The pressure of WSP, combined with the other high-ranked constraints (i.e. BIN(FT), AL-L/R([σ]ω, *Ft, ω), IAMB), builds moraic iambs in Chugach (Kager 1993) unless sonority requirements enforce the contrary. That is, when the heavy syllable is of the type (C)VC or (C)VxVy (where Vx is a vowel with a higher degree of sonority than Vy) the most sonorous segment will always be the head of the foot, giving rise to a trochaic monosyllabic foot[12]. To allow

[11] In Chugach orthography, the apostrophe (') is sometimes used to indicate that a preceding C is a geminate or that a fricative has been dropped. In the latter case the orthograpic representation is based on the underlying morphology and does not have any effect on the phonetic form (Leer 1985a: 98).

[12] Leer explicitly reports that in heavy syllables with a long vowel, the second vowel is the most prominent one in Chugach (i.e. long vowels have a rising or iambic contour). However, this is typologically rare. The more general tendency in monosyllabic feet with long vowels is for them to have a falling (or trochaic) contour (Prince 1983; Clements 1990; Kager 1993).

these exceptional monosyllabic trochees, I assume an undominated constraint which guarantees that the most sonorant element in a syllable is the head of the foot. For ease of presentation I leave this constraint out in the following discussion and just consider candidates that respect it —[(CV$^{\mu}$C$^{\mu h}$)] is not a possible foot. The following tableau, below the definition of WSP, illustrates the need for high-ranking WSP (since the number and location of morae are crucial in Chugach, in the remaining tableaux in this chapter, I will indicate all surface morae)

(26) WEIGHT-TO-STRESS (WSP)
Assign one violation for every unstressed bimoraic syllable (Prince 1991; Prince & Smolensky 1993/2004).

taátaá "her father"

taataa	WSP	BIN(FT)	AL.-L/R[σ]ω	IAMB	TROC	CLASH
a.☞(ta$^{\mu}$á$^{\mu h}$) (ta$^{\mu}$á$^{\mu h}$)					**	*
b. (ta$^{\mu}$a$^{\mu}$. ta$^{\mu}$á$^{\mu h}$)	*!				*	
c. (ta$^{\mu}$á$^{\mu h}$. ta$^{\mu}$a$^{\mu}$)	*!			*!		

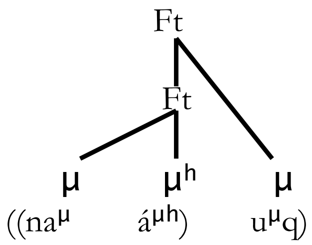
Candidate (26a), with a stress clash and two moraic iambs, fares better in the hierarchy than the other two candidates because its heavy syllables are both stressed, respecting WSP.

In a word with a combination of heavy and light syllables, there are two possible parsings for the light syllables. First, if there is a sequence of two adjacent light syllables, the proposed hierarchy parses them together in an iambic foot: (LĹ), as we saw in the preceding section. This also leads to stress clashes, namely, when the iambic foot is followed by a heavy syllable, e.g. (L.Ĺ)(H́): (mu$^{\mu}$.lú$^{\mu h}$)(ku$^{\mu}$ú$^{\mu h}$t) 'if you take a long time'.

Second, if there is only one light syllable (instead of two) and this is next to a heavy syllable (eg. HL), the light syllable is adjoined to the heavy syllable, which constitutes a foot on its own e.g. ((H́)L) ((na$^{\mu}$á$^{\mu h}$).'u$^{\mu}$q) 'its burning'.[13] Just as light syllables were adjoined to adjacent syllabic iambs via prosodic adjunction (e.g. ((a.tá)ka) 'my father'), prosodic adjunction can also give rise to recursive feet that are built over a monosyllabic foot and an adjacent light syllable. This type of recursive foot is represented in (27).

[13] Remember the apostrophe in *naa'uq* should not be confused with a stress mark. In Chugach orthography, the apostrophe is used to indicate that a preceding C is a geminate or a fricative has been dropped. To avoid confusion, I will leave out the apostrophe in this word in the discussion that follows.

(27) Minimal and Maximal feet in Chugach



The maximal foot in (27) corresponds to an uneven trochee. In the preceding chapter (Section 3.3.1), I proposed that Wargamay uneven trochees should be analyzed as regular bisyllabic feet without recursion, e.g. (H́.L), which is the standard representation for uneven feet in the literature, whether iambic or trochaic. However, I also hinted at the fact that some languages could parse a HL sequence with recursion, e.g. ((H́).L) as in fact has just been proposed for Chugach in (27). But what are the differences between one representation or the other? And why is the one with recursion preferred in Chugach? Note that a bisyllabic trochaic foot would have equally located stress in the correct position, e.g. (na$^{\mu}$á$^{\mu h}$.u$^{\mu}$q). However, as I will show in Section 4.2.3.2, the structure in (27) is the only one that can adequately account for the distribution of pitch in the language. In Chugach, the pitch is sensitive to foot boundaries and, crucially, a low tone is only docked onto adjoined syllables, i.e. the foot dependent that is immediately dominated by a non-minimal foot. If HL sequences were not parsed with recursion, a low would not be expected in the second syllable; however such syllables always get a low tone, providing further support for a recursion-based analysis (see Section 4.2.3.2 for a complete analysis of the pitch facts).

In short, the claim made here is that uneven feet are generally parsed into bisyllabic feet (i.e. without recursion), unless there is some phonological evidence to the contrary (i.e. some process that crucially needs to distinguish between the boundaries of a minimal and a maximal foot within a bisyllabic uneven foot).

Once it has been shown that HL sequences in Chugach should be analyzed via recursive feet, we need to demonstrate how such a representation is computed. One of the core claims of this dissertation is that recursion at the foot level arises as a last-resort device to ensure exhaustivity (see also Bennett 2012 on this claim) and/or to guarantee the fewest number of minimal feet in exhaustive parsings. However, if these are the only motivations for recursive feet, it is not clear why H́L is parsed with recursion. Note that when a bisyllabic form like H́L is prosodified with internal layering as in ((H)$_{\text{FtMin}}$L)$_{\text{FtNon-min}}$, the mechanism of recursion is not a last-resort device, since exhaustivity and fewer feet could equally be achieved with one foot, e.g. [(H.L)]. In fact, the hierarchy of constraints proposed for Chugach (repeated below in tableau 28) would in fact select the candidate without recursion as optimal. This is so because the candidate with recursion (28a) is harmonically bounded by the non-recursive candidate (28b):

(28) naáuq 'it's burning '

$((na^{\mu}\acute{a}^{\mu h}).u^{\mu}q)$	WSP	NONMIN TROC	AL-L (FtMax, *Ft, ω)	IAMB	TROC
a. ☹ $((na^{\mu}\acute{a}^{\mu h}).u^{\mu}q)$				*	*
b. 💣 $(na^{\mu}\acute{a}^{\mu h}.u^{\mu}q)$				*	
c. $(na^{\mu}a^{\mu}.\acute{u}^{\mu h}q)$	*!				*

Candidate (28a) contains an additional (recursive) foot compared to candidate (28b) and, thus, it fares worse in the hierarchy. However, since Chugach presents evidence for representations like (28a), some factor must favor candidate (28a) over (28b). That is, in addition to the triggers of recursion already acknowledged, there must be another cause for prosodic recursion at the foot level. I will argue that this motivation is directly linked to the necessity of building a minimal foot over a heavy syllable.

The traditional WSP constraint encodes the tendency of heavy syllables to be stressed. However, stress *per se* is not a phonological property. It is the phonetic realization of a foot head, which can have multiple correlates (intensity, duration, formant frequencies). In that sense, WSP would be more adequately formulated as in (29):

(29) WEIGHT-TO-STRESS (WSP) (revised)
Assign one violations for every bimoraic syllable that does not coincide with the head of a foot (i.e. every heavy syllable contains a foot head)

The separation between phonological prominence (foot heads) and phonetic prominence (stress correlates) is crucial and it is independently supported in languages that present evidence for stressless feet (see references and discussion in Chapter 1, Section 1.3.2).

A candidate with recursion with a heavy-light sequence of syllables like ((H́)L) respects WSP: the head of the minimal and the non-minimal foot is located in the heavy syllable. However, there is one further condition that feet like ((H́)L) meet which is not observed in non-recursive feet (H́.L). This condition is captured under the constraint σμμ=FT, defined in (30), which favors feet that are coextensive with heavy syllables.

(30) σμμ=FT
Assign a violation mark for every bimoraic syllable that is not coextensive with a foot (based on Selkirk 1978b; Prince 1980; Rice 1992, Kager 1993; Hewitt 1994 among others).

This constraint parallels the PERFECTWORD constraint of Itô & Mester (2012b), which requires a word to be coextensive with a binary branching foot, ω=Ft). Basically, σμμ=FT privileges heavy syllables that consist of a foot dependent and a foot head. In that sense, σμμ=FT is a more restricted version of WSP. Chugach is one of the clearest examples for the need for this type of constraint, but independent evidence of it can be found in languages that need to distinguish between minimal and non-minimal feet in uneven configurations (e.g. H́L, LH́) in order to correctly account for some phonological process. For instance, another example of uneven feet with internal bracketing and recursion can be found in Morén-Duolljá's recent analysis of Götaland Swedish pitch accent (2013). Additionally, in Chapter 6 I show that Seneca's HL trochaic feet are also parsed with a non-minimal foot ((H́)L) rather than a minimal foot (H́L). The former parsing will be shown to be crucial for the correct assignment of accent in the language. Since recursive feet have generally not been included in standard theories of stress, I suspect that further support for σμμ=FT will arise once recursion is considered a possible tool of the theory. Interestingly, σμμ=FT is not an isolated constraint in the prosodic hierarchy, but similar constraints favoring coextensive prosodic categories have been previously proposed in the literature. For instance, Itô & Mester (2012b), drawing on early work by Zec (1999), have posited a constraint that "prefers words to be coextensive with feet (ω=f) when this is at all attainable". This constraint is shown to be crucial in several phonological aspects of Serbian/Croatian, Danish, and Japanese. Future research will help in determining whether constraints which favor coextensive prosodic categories that are adjacent in the hierarchy are also active at higher layers of the hierarchy.

Alternatively, it could be proposed that a constraint against unbalanced trochees, i.e. *'HL, bans 'HL feet (e.g. Itô & Mester 2012b, based on Hayes 1987, 1995; Prince 1991). When highly ranked, this constraint could favor parsings with recursion like ((H́)L) over (H́L). Note, however, that such a constraint would fail to build moraic iambs and/or cause recursion in LH́ iambic feet. However, within the present metrical model and theoretical assumptions (Chapter 2), LH́ feet might also be ocasionally parsed as (L(H́)) in languages where there is evidence for recursive feet. Moreover, as I will show at the end of this section, a constraint against unbalanced trochees is descriptively inadequate since it is not able to derive all the stress patterns in Chugach, where monosyllabic feet are sometimes built over heavy syllables to avoid an LH́ iambic foot (see tableau 42 for details). In sum, since σμμ=Ft is a more general constraint and, furthermore, there is independent evidence for the need for similar constraints at other layers of the hierarchy, an analysis with σμμ=Ft is to be preferred here. Whether the greater markedness of H́L over LH́ should be encoded in CON or, by contrast, the greater frequency of the latter over the former should just be regarded as a consequence of more general cognitive/psychological principles of rhythmic grouping, is a matter for future investigation.

Going back to the analysis of Chugach, in order to amend the hierarchy in (28), we just need to include an undominated σμμ=FT. This is done in (31). Now, the candidate with recursion ((H́)L) (31a) is the one that surfaces as optimal (remember that BIN(FT) and the left and right version of ALIGN-([σ]ω, *Ft, ω) are undominated and, thus, binary feet and exhaustive parsing of syllables are guaranteed).

(31) *naá'uq* "it's burning" σμμ=FT>> WSP

naauq	σμμ= FT	WSP	NONMIN TROC	AL-L (FtMax,*Ft, ω)	IAMB	TROC
a.☞((na$^{\mu}$á$^{\mu h}$).u$^{\mu}$q)					*	*
b. (na$^{\mu}$á$^{\mu h}$.u$^{\mu}$q)	*!				*	
c. (na$^{\mu}$a$^{\mu}$.ú$^{\mu h}$q)	*!	*				*

Furthermore, this hierarchy predicts that when a light syllable can be grouped with another light syllable as in, for instance, a word with a heavy-light-light sequence of syllables, then it will be grouped with the light syllable, e.g. (H́)(LĹ), avoiding the emergence of a recursive foot as in (32b) or (32c).

(32) *taátaqá* 'my father'

taátaqá	σμμ =FT	WSP	NONMIN TROC	ALL (FtMax,*Ft,ω)	IAMB	TROC
a.☞(ta$^{\mu}$á$^{\mu h}$)(ta$^{\mu}$.qá$^{\mu h}$)				*		**
b. ((ta$^{\mu}$á$^{\mu h}$.ta$^{\mu}$)qa$^{\mu}$)	*!				**	
c. ((ta$^{\mu}$a$^{\mu}$.tá$^{\mu h}$)qa$^{\mu}$)	*!	*			*	*

This is a crucial difference between this analysis and previous analyses of Chugach, where HL sequences were unanimously treated as members of the same constituent. For example, the algorithm for stress assignment proposed in Rice (1992) parses a word like *taátaqá* 'my father' with an initial bisyllabic foot and a final unary foot, e.g. [(taá.ta)(qá)]. However, the author needs to add a rule later in the derivation to ensure that *metrical restructuring* takes place, banning forms with a unary foot. Such a rule modifies the initial parsing of [(taá.ta)(qá)] to [(taá)(taqá)]. Crucially, within the present approach, there is no need for restructuring, since the basic foot in the language is the moraic iamb and, thus, HL is not considered a primitive constituent of the theory.

In short, the parsing strategy followed by Chugach words with heavy syllables is *grosso modo* the same as the one observed in words containing light syllables, with the important refinement that σμμ=FT and WSP are stronger than any of the other metrical pressures, their relative ranking being σμμ=FT >> WSP. That is, iambic moraic feet are built whenever possible (heavy syllables and sequences of two light syllables) and a non-minimal projection of the foot arises in order to (i) parse the morae that cannot constitute a foot of their own, and to (ii) better fulfill foot alignment constraints that ensure the fewest number of maximal feet in exhaustive parsings. Furthermore, the ranking NONMINTROCHEE >> IAMB >> TROCHEE ensures that non-minimal feet have the shape of (33b below), i.e. a minimal iamb with a right adjunct. The representations in (33) capture the different type of feet encountered in Chugach. Even though in these figures the feet appear directly linked to the morae, it is assumed that the syllable node mediates between both constituents. Thus, in (33a) and (33b) the minimal foot can be instantiated by either (i) a heavy syllable or (ii) two light syllables.

(33) Minimal and Maximal moraic feet in Chugach

4.2.1.4 More evidence for right adjunction

When I discussed the direction of adjunction in recursive feet I proposed that the adjoined syllable is on the right of the minimal foot, i.e. NONMINTROC dominates IAMB. For instance, in a 5-syllable word, I assumed that the third syllable is adjoined to the preceding foot (34a) rather than the following one (34b):

(34) Right adjunction in Chugach
a. **((LĹ)L)** (LĹ) ✓
b. (LĹ) **(L(LĹ))** ✗

In principle, the two analyses in (34) both adequately locate the position for stress. However, this section provides some evidence that speaks in favor of a right adjunction analysis (34a) (and against a left adjunction analysis, 34b). Further support for the right adjunction analysis will be given in Section 4.2.2, when the process of fortition, the distribution of pitch and the phonetic lengthening of some vowels are reviewed in further detail.

Note that the only prosodic word that could arguably contradict the right-adjunction parsing is one that starts with a light syllable, followed by a heavy one: #LH. In all other cases in which a light syllable appears in other positions, left adjunction is a possible option (as in 34b). However in word-initial position, the only way to ensure exhaustivity while respecting the constraint σμμ=FT would be to build a minimal foot over the heavy syllable and adjoin to this foot the syllable on its left via prosodic recursion, e.g.#(L(H)). Interestingly enough, Chugach bans these types of constructions, i.e. *#LH. More specifically, when an initial CV is followed by a heavy syllable, the onset of the heavy syllable always undergoes gemination to close the preceding open syllable. That is, /(C)VCVV/, /(C)VCVG/ and /(C)VCGV/ surface as [CVC.CVV], [CVC.CGV], [CVC.CVG] (Leer 1985c; Rice 1992: 125). Consequently, the first syllable bears stress because it is bimoraic (see 35a). This never happens in a sequence of two word-initial light syllables (35b):

(35) Gemination in word-initial LH

a.	LHL	/qayaatxun/	→	HHL	[(qáy̱)((yáat)xun)]	'by their boats'
b.	LLL	/qayatxun/	→	LLL	[((qa.yát)xun)]	'by boats'

Crucially, the process of gemination is restricted to word-initial position. That is, LH sequences in other positions never undergo gemination.

(36) Absence of gemination in non-initial LH

a.	HLH	→	[((H)L)(H)]	((án)ci)(quá)	'I'll go out'
b.	LLH	→	[(LL)(H)]	(mu.lú)(kuút)	'if you take a long time'

By geminating the onset consonant of the peninital heavy syllable in #LH, the initial syllable becomes heavy. The process of word-initial gemination together with the positionally-restricted coda weight in word-initial syllables (remember CVC are only bimoraic in the first syllable of a word) can be seen as an instance of prominence enhancement in phonologically strong positions (Beckman 1998; Smith 2005; Bennett 2012 among others; see Chapters 2 and 3 for further references). In the preceding chapter I argued that word-initial segments/constituents are phonologically and/or phonetically prominent. Building on this evidence, I propose deriving Chugach gemination and word-initial moraic codas via the joint action of a high-ranked NONMINTROCHEE and the constraints given in (37). The interaction of these constraints enforces words to begin with a minimal foot and restricts moraic codas to initial syllables.

(37) a. *MORA[CONSONANT] (abbr. *Cμ)
Assign one violation for every consonant associated with a unique mora (Sherer 1994; Rosenthall & van der Hulst 1999; Morén 1999/2001 among others).

b. WEIGHT-BY-POSITION (abbr. WBP)
Assign one violation mark for every coda consonant that is not associated with a unique (i.e. non-nuclear) mora (Hayes 1989b, Morén 1999/2001).

c. INITIALSYLLABLEMORAICCODA (abbr. INITIALCODAμ)
Assign one violation mark for every coda consonant in a word initial syllable that is not associated with a unique (i.e. non-nuclear) mora (Hayes 1989b).

I already demonstrated that NONMINTROCHEE dominates IAMB in Chugach (cf. tableau 12 above); the ranking arguments for the rest of the constraints in (37) are illustrated in the following tableaux. On the one hand, tableau (38) shows that the positional prominence constraint INITIALCODAμ must be higher-ranked in Chugach to restrict moraic coda consonants to initial positions. As can be seen from the evaluation of *ánciqukút*, INITIALCODAμ crucially dominates *Cμ so that moraic consonants are forbidden in all syllables except word-initial ones. Candidate (38b) is ruled out because it does not contain any moraic codas at all, whereas candidate (38c) is excluded because its final coda is also moraic and, thus, it incurs more violations of *Cμ than the optimal candidate (38a).

(38) Word initial moraic consonants

INITIALCODAμ >> *C μ>> WBP áncіqukút 'we'll go out'

anciqukut	INITIALCODAμ	*Cμ	WBP
a.☞((á$^{\mu h}$n$^{\mu}$) ci$^{\mu}$)(qu$^{\mu h}$.kú$^{\mu}$t)		*	*
b. (á$^{\mu h}$n.ci$^{\mu}$) (qu$^{\mu}$. ku$^{\mu h}$t)	*!		**
c. (á$^{\mu h}$n$^{\mu}$)(ci$^{\mu}$ .qu$^{\mu h}$)(ku$^{\mu h}$t $^{\mu}$)		**!	

On the other hand, tableaux (39I) and (39II) display the evaluation of two near-minimal pairs: /*qayaatxun*/ 'by their boats' (a LHL word) and /*qayatxun*/ 'by boats' (a LLL word). The comparison of these two tableaux shows that gemination only applies to word-initial LH, i.e. only /*qayaatxun*/ 'by their boats' surfaces with gemination, e.g. [qáyyaátxun] (see 39I).

(39) Gemination of the onset restricted to initial light-heavy sequences

I. /qayaatxun/ → [(qáy̲)(yaát)xun)] 'by their boats'

qayaatxun	BIN (FT)	NONMIN TROC	INITIAL CODAμ	*Cμ	WBP
a.☞(qá$^{\mu h}$y$^{\mu}$)((ya$^{\mu}$á$^{\mu h}$t) xu$^{\mu}$n)				*	**
b. (qa$^{\mu}$ (ya$^{\mu}$á$^{\mu h}$t)) (xu$^{\mu h}$n$^{\mu}$)		*!		*	*
c. (qá$^{\mu h}$) ((ya$^{\mu}$á$^{\mu h}$t) xu$^{\mu}$n)	*!				**

II. /qayatxun/ → [(qa.yát)xun)] 'by boats'

qayatxun	BIN (FT)	NONMIN TROC	INITIAL CODAμ	*Cμ	WBP
a.☞((qa$^{\mu}$.yá$^{\mu h}$t) xu$^{\mu}$n)					*
b. (qá$^{\mu h}$y$^{\mu}$)(ya$^{\mu}$t.xú$^{\mu h}$n)				*!	
c.(qa$^{\mu}$(yá$^{\mu h}$t$^{\mu}$)) (xú$^{\mu h}$n$^{\mu h}$)		*!		**!	
d. (qa$^{\mu}$.yá$^{\mu h}$t)(xu$^{\mu h}$n$^{\mu}$)				*!	*

In the first tableau (39I), I illustrate the ranking arguments BIN(FT), NONMINTROCHEE >>*Cμ, WBP. Candidate (39Ib) is ruled out because its non-minimal foot is iambic, i.e. the adjoined syllable is on the left of the minimal foot (i.e. it violates NonMinTroch). Candidate (39Ic) is also forbidden because, even if it respects NonMinTroch, its first foot is not binary branching. Therefore, the optimal candidate is (39Ia) [(qá$^{\mu h}$y$^{\mu}$)((ya$^{\mu}$á$^{\mu h}$t)xu$^{\mu}$n)] with an initial moraic coda consonant that surfaces due to the gemination of the onset of the second syllable.

In the second tableau (39II), an LLL word is evaluated. Since the two first syllables of the optimal candidate [((qa$^{\mu}$. yá$^{\mu h}$t) xu$^{\mu}$n)] constitute a minimal foot, there is no need to geminate the onset of the second syllable. The candidate with gemination (39IIb) *qáyyatxún* is ruled out because it incurs a violation of *Cμ, and this constraint is ranked higher than WeightByPosition. Candidate (39IIc) is eliminated because its non-minimal foot is iambic, whereas candidate (39IId) is ruled out because it has a moraic coda that is not in a word-initial syllable.

Finally, the next tableau shows the use of Dep-Link[Vowel]. Recall from the discussion in the previous chapter that this constraint bans outputs that present surface vocalic lengthening. Here we see that Dep-Link[Vowel] must dominate *Cμ to ensure that word-initial LH sequences are not avoided by lengthening the vowel of the first syllable, but instead by geminating the onset of the second syllable. This ranking argument is presented in (40).

(40) DepLink[Vowel] >> *Cμ

/qayaatxun/ → [(qáy̱)(yaát)xun)] 'by their boats'

qayaatxun	Dep Link[V]	NonMin Troc	Bin (Ft)	Init Codaμ	*Cμ	wbp
a.☞(qá$^{\mu h}$y$^{\mu}$)((ya$^{\mu}$á$^{\mu h}$t)xu$^{\mu}$n)					*	**
b. (qá$^{\mu\mu h}$) ((ya$^{\mu}$á$^{\mu h}$t)xu$^{\mu}$n)	*!					**

To sum up, this section has shown that words with heavy syllables are parsed in a very similar way to words with light syllables. On the one hand, iambic moraic feet are generally built whenever possible: (i) a sequence of two light syllables can form a moraic iamb but also (ii) a heavy syllable with a long vowel or a diphtong. In this latter case, the moraic iamb arises because of the action of the higher-ranked σμμ=Ft, and Iamb >> Trochee. On the other hand, due to the pressure of Bin(Ft) and Align-Left/Right([σ]ω, *Ft, ω), a non-minimal foot arises to parse monomoraic syllables that cannot constitute a foot of their own and/or would otherwise remain unfooted. In addition, along the lines of the prosodification of six-syllable words with light syllables, in which a high-ranked AL-LEFT(FtMax, *Ft, ω) forces the emergence of recursive feet in order to ensure economical exhaustive prosodifications (i.e. with the fewest number of maximal feet), this constraint can also favor economical parsings in words with heavy syllables. For instance, the given hierarchy parses a word with one heavy syllable and four light syllables as *naáqumalúku* 'apparently reading it' with two recursive feet due to the action of the high-ranked constraints σμμ=FT and AL-L(FtMax, *Ft, ω). This is illustrated below in tableau (41).

(41) *naáqumalúku* 'apparently reading it'

naaqumaluku	σμμ=FT	NON MIN TROC	AL-L(FtMax *Ft, ω)	IAMB	TROC
a.☞((na^{μ}á^{μh})qu^{μ})((ma^{μ}.lú^{μh})ku^{μ})			*	**	**
b. (na^{μ}á^{μh})(qu^{μ}.ma^{μh})(lú^{μ}.ku^{μh})			**!		**
c. (na^{μ}á^{μh}.qu^{μ})((ma^{μ}.lú^{μh}) ku^{μh})	*!		*	**	*

The form /naaqumaluku/ contains six morae and is parsed with two recursive feet as in (41a). The alternative parsing with three maximal feet and no recursion (41b) incurs more violations of ALIGN-LEFT(Ftmax, *Ft, ω). Finally, candidate (41c) performs worse in the hierarchy than (41a), because even if it only presents one instance of recursion, its word-initial syllable fatally violates σμμ=Ft.

It is important to highlight that not all words with six morae are necessarily parsed with two maximal feet. The given hierarchy can parse forms with 6-morae differently, depending on how these morae are distributed in the word. For instance, as can be observed in the following tableau, the word *naámacíquá* 'I will suffice' has six morae, but the hierarchy parses it with three maximal minimal feet (42a). This tableau shows that σμμ=FT and NONMINTROCH crucially dominate ALIGN-LEFT(Ftmax, *Ft, ω).

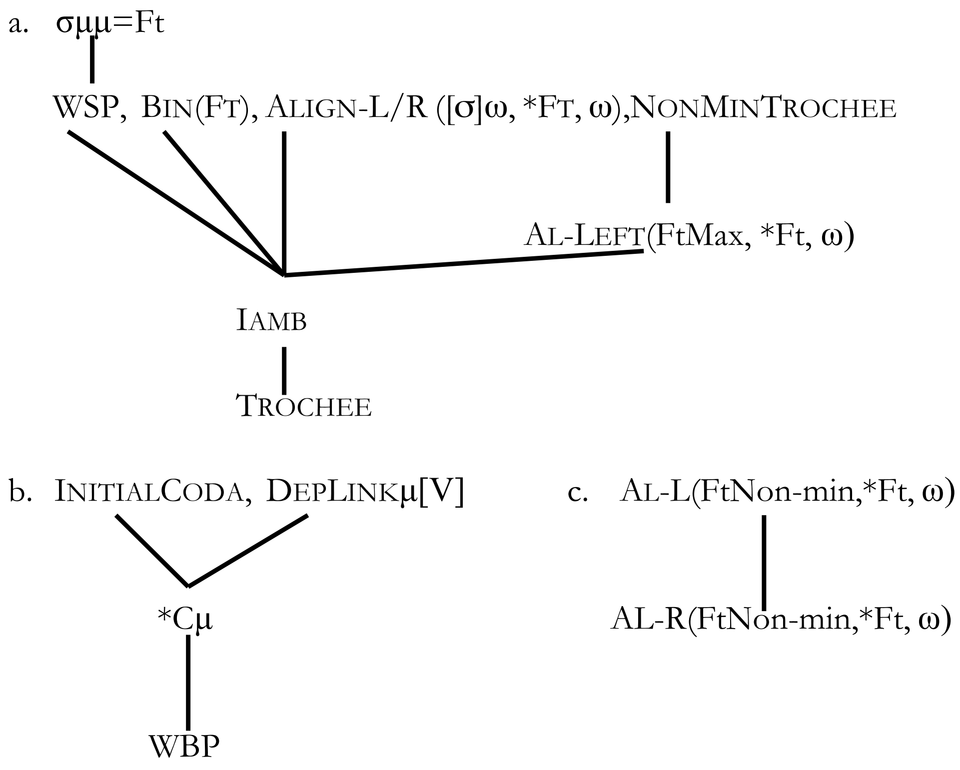
(42) *naámacíquá* 'I will suffice'

naamaciqua	σμμ =FT	NON MIN TROC	ALL (FtMax, *Ft, ω)	IAMB	TROC
a.☞ (na^{μ}á^{μh}) (ma^{μ}.cí^{μh})(qu^{μ}á^{μh})			**		***
b. ((na^{μ}á^{μh})ma^{μ}) (ci^{μ}(qu^{μ}á^{μh}))		*!	*	*	***
c. ((na^{μ}á^{μh})ma^{μ}) ((ci^{μ}.qú^{μh})a^{μh})	*!		*	**	**
d. ((na^{μ}á^{μh})ma^{μ}) (ci^{μ}.qu^{μ}á^{μh})	*!		*	*	**

In (42), candidate (42b) is ruled out because its word-final foot has a left adjunct, incurring a fatal violation of NONMINTROCHEE. Other possible parsings in which NONMINTROCHEE is respected are candidates (42c) and (42d). Yet these outputs are ruled out because their final syllables violate the constraint that favors heavy syllables that are coextensive with feet. This tableau constitutes further support for the high-ranked position of σμμ=Ft in Chugach. Note that if it were not for this constraint, candidate (42d) could have been selected as optimal. However, only candidate (42a) can account for the correct distribution of stress in this word.

To summarize the analysis of stress assignment in Chugach, the Hasse diagram in (43) presents the crucial ranking arguments in the language. Furthermore, with the goal of better illustrating the specific metrical structure of words containing a mixture of heavy and light syllables predicted by the hierarchy, (44) provides the prosodification of some words in Chugach.

(43) Ranking arguments for Chugach



(44) Metrical structure of words with light and heavy syllables

a. (á$^{\mu h}$g$^{\mu}$)(ŋu$^{\mu}$á$^{\mu h}$)(qu$^{\mu}$. tá$^{\mu h}$r) ((tu$^{\mu}$á$^{\mu h}$)ŋa$^{\mu}$) "I'm going to go"

b. (á$^{\mu h}$g$^{\mu}$) (ku$^{\mu}$.tá$^{\mu h}$r) ((tu$^{\mu}$á$^{\mu h}$)ŋa$^{\mu}$) "I'm going to dance"

c. (mu$^{\mu}$.lú$^{\mu h}$) (ku$^{\mu}$ú$^{\mu h}$t) "if you take a long time"

d. ((í$^{\mu h}$q$^{\mu}$)llu$^{\mu}$) (ni$^{\mu}$r.tú$^{\mu h}$q) "he stopped lying"

e. (ú$^{\mu h}$m$^{\mu}$)((yu$^{\mu}$á$^{\mu h}$r)te$^{\mu}$)(qu$^{\mu}$.té$^{\mu h}$)(ka$^{\mu}$.qá$^{\mu h}$) "I am thinking about it"

4.2.2 Further support for the two projections of the foot

4.2.2.1 Consonant fortition

Fortition is a process of strengthening characterized as "a kind of preclosure" —but not to the point of gemination— that leads to extra length in fortis consonants as compared to their lenis counterparts (Leer 1985a: 84). According to Leer, this process provides independent support for metrical structure, since the consonants that trigger fortition can be said to coincide with the left edge of a foot. In fact, the left edge of every (minimal and maximal) foot that I have proposed in Chugach coincides with the distribution of fortis consonants in the language. This can be seen in (45), where the metrical structure and fortis consonants (indicated in boldface) of some Chugach words is presented.

(45) Fortition in Chugach

a. (**m**u.lúk)('uút)
b. ((**n**aá)qu) ((**m**a.lú).ku)
c. ((**t**a.qú)ma)(**l**u.ní)
d. ((**s**a.rá)ni) ((**w**a.kár) tuq)
e. ((án)ci) (**q**uá)
f. (akú) tar) ((**t**unír)tuq)
g. ((**p**a.lá) yaq)
h. (**t**aá) (**t**aá)
i. (a.kú)(**t**amék)
j. (**n**aá) (**m**a.cí)(**q**uá)

A 6-syllable word like *saràniwakártuq* (45d) presents two fortis consonants, one in the onset of the first syllable, and another in the onset of the fourth syllable. If this word had been parsed with three maximal feet (e.g. (σσ)(σσ)(σσ)) rather than two maximal feet (e.g. ((σσ)σ)((σσ)σ)), fortis consonants should have emerged on every odd-numbered syllable. However, this is clearly not the case in *saràniwakártuq* (45d). These data constitute further evidence for the right-adjunction hypothesis: if in (45d) the third syllable were adjoined to the following foot rather than the preceding one, the onset of the third syllable should present fortition, but it doesn't. In sum, since foot edges may have a concrete phonetic manifestation —just as foot heads—, the fortition of consonants in Chugach can be taken as further evidence for the metrical analysis given Section 4.2.1.

Importantly, an alternative stress-based (or metrical grid) account of fortition is not possible. Note that, even though Chugach minimal feet are iambic and, thus, fortis consonants could be said to target pretonic positions (e.g. [((**s**a.rá)ni) ((**w**a.kár)tuq)]), a foot-initial position does not always coincide with pretonic positions. For instance, in a form like [((án)ci)(**q**uá)] 'I'll go out' (45e), fortition is reported in the third syllable. A purely stress-based account that posited fortis consonants in pretonic positions would have incorrectly predicted a fortis consonant in the second syllable of *án**ci**quá. A metrical account is, therefore, clearly superior to a stress-based account because it provides both a method and a device that correctly locate fortis consonants in Chugach words. With respect to the motivation for locating fortis consonants in foot-initial position, Bennett (2012) has recently identified a variety of iambic languages outside the Yupik family that also undergo some kind of strengthening in the left edge of an iamb. Moreover, this author has demonstrated that a unified account of all these languages is possible when the foot-initial position is included among the rest of domain-initial prominent positions (recall his account of coda [h] epenthesis in Huariapano, which targets the left edge of maximal feet, Section 3.6). Following this work, and along the lines of the positional prominence analysis of context-dependent coda weight and word-initial gemination, I assume that fortition is another way of enhancing a prosodically prominent position; the foot-initial position. This interpretation may strike some readers as odd since iambic feet usually exhibit strengthening effects in their heads rather than their dependents.[14] All in all, as Bennett demonstrates, the foot-initial prominence hypothesis makes the desired predictions with respect to strengthening processes in a wide range of languages, not only iambic, but also trochaic. I will therefore adopt it here as well (see Bennett 2012: §2.4, §2.5 for further details and discussion).

Although the process of fortition is clearly indicative of the starting point of a metrical foot, it does not constitute sufficient support for a recursion-based analysis. In fact, the distribution of fortis consonants in Chugach would not occlude an analysis that includes ternary feet or an account that combines exhaustive and weak parsing, allowing certain syllables to be unincorporated into feet (Hayes 1995; Elenbaas & Kager 1999 *inter alia*). In other words, although fortition can be interpreted as the manifestation of the left edge of a foot, the process *per se* says nothing about the internal configuration/right edge of a foot. Therefore, it is important to look more deeply into the

[14] In addition, in iambic languages that exhibit reduction or syncope, it is generally the element in the weak branch (i.e. foot-initial position) that undergoes this process of weakening.

phonology of Chugach before postulating the superiority of a recursion-based analysis.

The next section looks closely at the distribution of pitch in the language and argues that the assignment of low/high pitch can be easily captured within a recursion-based analysis. Interestingly, previous proposals run into several complications/problems when dealing with the distribution of pitch in Chugach. Furthermore, a phonetic process of vowel lengthening, which only affects some stressed vowels, seems to speak in favor of a recursion-based approach.

4.2.2.2 Metrically-driven pitch in Chugach

Chugach is a non-tonal language (i.e. tone is not lexically specified) that uses pitch in a non-contrastive but principled way. Leer reports that syllables are assigned three different pitch levels: high (H), low (L) and no pitch level (∅), i.e. the pitch in these syllables is dependent on the pitch of their neighbouring syllables (Leer 1985c: 164). Furthermore, under certain conditions, some syllables with high pitch are up-stepped (¡H).

The assignment of one or another pitch level in Chugach is tightly related to stress. However, intriguingly enough, it is not possible to predict the pitch of a given syllable within a non-structural stress-based approach. Although stressed syllables are always realized with a high pitch —and this can be predicted in a structural and non-structural analysis— unstressed syllables exhibit a dual behavior: sometimes they are assigned a low pitch, and sometimes they are not assigned a pitch of their own (i.e. their pitch is dependent on the pitch of their neighbouring syllables). To illustrate the distribution of pitch in Chugach, (46) provides some words with their respective pitch contours (words appear syllabified by dots):

(46) Chugach pitch distribution

```
a. sa. rá. ni. wa. kár. tuq        b. ta. qú. ma. lu. ní
       |   |        |    |                |   |        |
       H   L        H    L                H   L        H

c. taá. ta. qá                      d. án. ci. quá
    |        |                          |   |    |
    H        ¡H                         H   L    H
```

```
e.  naá. ma. cí. quá            f.  qáy.  yaá. kun
     |        |    |                 |      |    |
     H       ¡H    H                 H     ¡H    L
```

As can be seen in (46), stressed syllables are always high, and some of them are up-stepped (¡H). In particular, a H is up-stepped when it is preceded by another H (even if the two Hs are not adjacent) and there is no intervening low between them, e.g. (46c, e, f). This up-stepping of a H when preceded by another H is common in the literature of tone and intonation (Goldsmith 1976; Pierrehumbert 1980; Yip 2002; Gussenhoven 2004, etc.) and can be derived by rule or constraint interaction (e.g. HH→ H¡H)

What is puzzling in Chugach is the distribution of lows. Some unstressed syllables are assigned low pitch accent (46d, f), but some others are not assigned a pitch level of their own (46c, e). Furthermore, the emergence of L or ∅ cannot be characterized by referring to the stressed syllable, since L and ∅ appear in both pretonic and postonic positions. Compare for instance the distribution of pitch in *taá*$_{\mathrm{H}}$*.ta.qá*$_{\mathrm{H}}$ 'my father' (46c) with *án*$_{\mathrm{H}}$*.ci*$_{\mathrm{L}}$*.quá*$_{\mathrm{H}}$ 'I'll go out' (46d). Even though the two words have similar length (i.e. they are 3-syllable words) and primary stress is located in exactly the same syllables (i.e. the first and the third syllable), the second syllable in *án*$_{\mathrm{H}}$*.ci*$_{\mathrm{L}}$*.quá*$_{\mathrm{H}}$ has low pitch, whereas the second syllable in *taá*$_{\mathrm{H}}$*.ta.qá*$_{\mathrm{H}}$ does not have a pitch of its own, i.e. its pitch is just a transition from its neighboring tones.

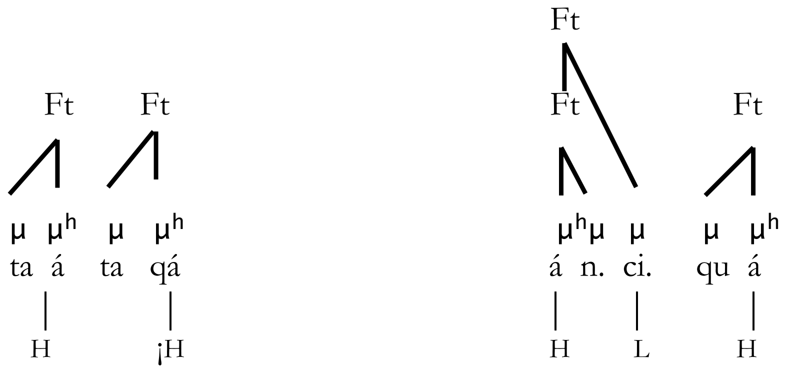
Although the pitch of unstressed syllables in Chugach is puzzling from a non-structural approach, it can be straightforwardly predicted if the metrical structure of the word is considered. Thus, I assume that pitch accent and stress accent systems may overlap in their common use of metrical representations.[15] More specifically, I propose that Chugach —and possibly other languages— may exploit a distinction between two types of foot dependents. In the case of Chugach, this distinction is crucial for the distribution of pitch. In a nutshell, I propose that the phonology of languages may differentiate between the dependent of a minimal foot (i.e. non recursive) and the dependent of a non-minimal foot (i.e. recursive foot). Chugach employs this representational distinction in the assignment of pitch: low pitch

[15] This theoretical assumption is adopted in several studies (e.g. Hyman 1978, 2006, 2009; Kim 1997; de Lacy 2002a; Downing 2004; Pearce 2006; Köhnlein 2011; Kager 2012 *inter alia*) and also in previous analyses of Chugach (e.g. Leer 1985; Hewitt 1991 and Rice 1992). However, since the representations assumed in the analyses of Chugach were different from the ones adopted here, their account of the distribution of pitch is also different, and slightly more complicated than the present one, as will be shown in Section 4.2.3.

level is assigned to foot dependents that are directly linked to a non-minimal foot, whereas no specific pitch is assigned to dependents of minimal feet. This is illustrated in (47).

(47) Distribution of pitch in unstressed syllables in Chugach

a. Dependent of a FtMin: ∅ b. Dependent of a FtNon-min: L

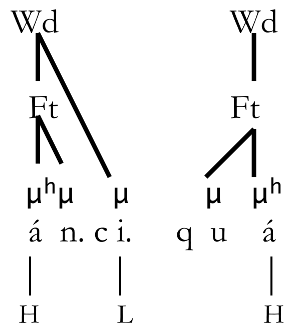


The distribution of pitch in Chugach, thus, constitutes additional empirical evidence for the need of recursive footing in natural languages. Namely, the recursion-based representational device allows the different behavior of the two types of unstressed syllables to be captured. In particular, assuming that phonological representations might display recursive footing, the assignment of lows in Chugach becomes straightforward: lows only arise in the dependent of a non-minimal foot (47b). This explains why a word like (taá$_{\mathrm{H}}$)(taqá$_{\mathrm{H}}$) 'my father' (47a) has no lows at all: this word does not exhibit any instance of recursivity. By contrast, in a word like ((án$_{\mathrm{H}}$)ci$_{\mathrm{L}}$)(quá$_{\mathrm{H}}$) 'I'll go out" (47b) there is one non-minimal foot aligned to the left edge of the prosodic word and, consequently, its dependent (i.e. *ci*) surfaces with a low pitch level.

This particular interpretation of the facts also explains why we never encounter rising and falling pitch contours within a single heavy syllable: a syllable that has two morae always constitutes a foot of its own, but this foot is always minimal. Furthermore, there is no need to stipulate that the syllable is the bearing unit for pitch. This is just a side effect of lows docking onto dependents of non-minimal feet and highs docking onto heads.

Hewitt (1991) proposed an interpretation of the facts very similar to the one argued for in this dissertation. However, rather than considering the possibility that feet are recursive and that the unstressed syllable is directly dominated by a FtNon-min, Hewitt (1991) assumed that the ternary category that consists of a foot and a light syllable is in fact a prosodic word. His proposal is illustrated in (48) (for details, see Hewitt 1991: §2.2)

(48) Pitch and the Prosodic Word (adapted from Hewitt 1991: 50, 53)



Note however that if the category that dominates a minimal foot is a bounded prosodic word, as argued by Hewitt, many phenomena that were predicted to occur in word-initial syllables should also target the third syllable in *ánciquá*. For instance, by multiplying the number and boundaries of prosodic words, there is no way to account for the weight-by-position restriction in word-intial syllables. Assuming Hewitt's representations, codas should be moraic in many more locations of the word, but this is not the case: codas are only moraic in the very first position within the prosodic word. Furthermore, the reasons and motivations for the context of gemination would also be lost, and consonants would be predicted to geminate in many more syllables than they do. However, all these processes receive a unified account if feet can be recursive. Under Hewitt's account all these processes would remain unexplained. Therefore, it is crucial that the layer that consists of a foot and a syllable is characterized as a foot and not a prosodic word.

An alternative analysis that captures the contrast between the two types of unstressed syllables in Chugach and other languages —which in fact has been previously employed in the literature— could differentiate between: (i) unstressed syllables that are in the dependent of a minimal foot (i.e. non-recursive foot) and (ii) unstressed syllables that are unfooted, i.e. directly linked to the prosodic word (Kager 1989; Elenbaas & Kager 1999; McCarthy 2008; Itô & Mester 2011 among others). However, remember from the discussion in Chapter 2 that "unfooted syllables" cannot just be equated to syllables that are in the "dependent of a non-minimal foot". To the contrary, the three non-prominent positions (i.e. unfooted, dependent of FtMin and dependent of FtNon-min) seem to be needed to account for the full range of possible behaviors of unstressed syllables in prosodic systems. In Section 4.2.3, where I review previous analyses of Chugach, I will show that such an alternative account in which low tones dock onto unfooted syllables encounters several problems when trying to account for the distribution of pitch in the language. Note that in Chugach, an explanation for the distribution of pitch based on the distinction between footed and unfooted elements would need to assign a low tone to exactly those syllables that are left unfooted/unparsed. However, the universal preference for low tones to dock onto foot dependents (de Lacy 2002a) would predict the emergence of a low pitch in the dependent of a foot. Moreover, it seems counterintuitive that something that is unparsed or unfooted becomes the target of a specific pitch contour (stress or tone). Generally, extrametrical/unparsed elements do not contribute to the prosodic profile of a word (e.g. they do not count for stress or pitch purposes) and, thus, assigning a low tone to an unfooted syllable rather than to a foot dependent is unexpected. All these arguments, and additional ones presented in the rest of the section, point to the greater adequacy of a recursion-based analysis of the distribution of pitch in Chugach.

The next subsection presents an OT implementation of the representational analysis of the distribution of pitch in Chugach sketched in this section.

4.2.3.2.1. OT analysis

The type of metrically-driven distribution of pitch, by which heads are high and non-heads are low —or, in the case of Chugach, a subset of the non-heads— is typologically supported, as argued in de Lacy (2002a, 2004). In order to capture this universal preference for high foot heads and low foot dependents, de Lacy (2004) proposed combining the tonal prominence scale given in (49) with the structural positions of foot head (HEAD$_{FT}$) and foot dependent (NON-HD$_{FT}$) into a Stringency Hierarchy of constraints. These constraints are illustrated in (50). Henceforth, I follow de Lacy and use the term NONHEAD$_{FT}$ to refer exclusively to the dependent of a foot. In other words, an unstressed syllable that is not footed is not an instance of a NONHEAD$_{FT}$.

(49) Tonal prominence scale

HIGH (H) > MID (M) > LOW (L)

(50) Stringency Hierarchy for tone constraints (de Lacy 2004:195)

a. Constraints on heads	b. Constraints on dependents
*HD$_{FT}$/L	*NONHD$_{FT}$/H
*HD$_{FT}$/L, M	*NONHD$_{FT}$/H, M
*HD$_{FT}$/L, M, H	*NONHD$_{FT}$/H, M, L

The constraints given in (50) favor prominent elements (e.g. a high tone) in strong positions (e.g. foot heads). I adopt the strigency hierarchy of de Lacy (2004) rather than a universal fixed hierarchy, because de Lacy (2004) showed that only the former hierarchy can account for cases of *markedness conflation* between adjacent members in a hierarchy while still explaining the universal dominance relations in languages.[16] A markedness conflation occurs when a language ignores a markedness distinction between two adjacent categories in a hierarchy in a specific phonological phenomenon.[17] Since this is not directly relevant for Chugach, where there is no instance of markedness conflation, a universal hierarchy would have also made the desired predictions regarding the assignment of pitch. However, since the Stringency Hierarchy has been shown to be superior, I adopt it in the present analysis (the reader is referred to de Lacy 2004 for further examples and details on the superiority of the Strigency Hierarchy).

The attraction of tone —and in particular of high tones— to foot heads was already described in the pre-OT literature (e.g. Goldsmith 1987; Bickmore 1995). De Lacy's major insights, then, were to highlight and formalize the tonal preference of foot non-heads (50b). Importantly, de Lacy (2002a) remarked that in some languages, it is crucial to make a distinction among unstressed syllables, differentiating unstressed syllables that are not parsed in a foot from unstressed syllables that are in a foot-dependent position. Evidence for this comes from languages like Ayutla, a tonal language with trochees and left-aligned feet. As de Lacy points out, if the constraints in (50a) referred to unstressed syllables (i.e. *UNSTRESSED/H) rather than foot-dependents (*NON-HD$_{FT}$/H) it would be impossible to distinguish between candidate (51a) and (51b), since both have an unstressed syllable with a high tone. Crucially, the constraint *NON-HEAD$_{FT}$/HIGH is able to differentiate between these two outputs and select as optimal the candidate with low tone in the foot dependent:

[16] In a universal fixed hierarchy, constraints refer to isolated elements in the hierarchy, and they are universally ranked in a fixed way, starting with the most marked element, but excluding the most unmarked one. According to this, the fixed hierarchy for tones would be: (a) *HD$_{FT}$/L >>*HD$_{FT}$/M and (b) *NONHD$_{FT}$/H >> *NONHD$_{FT}$/M (de Lacy 2002a, based on Prince & Smolensky 1993/2004) (for the particular problems with fixed universal prominent hierarchies, see de Lacy 2004)

[17] See de Lacy (2004) for concrete examples of markedness conflations on sonority in cases of stress assignment.

(51) Tableau adapted from de Lacy (2002a: 11)

$lu_H\ lu_Hra_L$	$*$NON-HD$_{FT}$/H	ALLFTL
a. ('$lu_H\ lu_H)ra_L$	*!	
b. ☞ lu_H ('lu_Hra_L)		*

Expanding on de Lacy's theory, and applying it not only to tonal languages, but also to pitch accent languages, the claim made here is that a finer classification has to be posited for non-head syllables. In particular, once recursive footing is a grammatical option, the constraints on NON-HEAD$_{FT}$ should be able to distinguish between different types of foot-dependents, differing in whether they belong to a minimal or a non-minimal projection of the foot. Chugach constitutes clear evidence for this subclassification between foot-dependents, since only the dependents of non-minimal foot receive a low. Further evidence for this distinction will be presented in chapter 5, where other phonological phenomena are shown to treat the dependents of minimal and non-minimal feet differently.

The Chugach data call for a refinement of de Lacy's tone scale. Notice that the head constraints proposed above in (50a) clearly favor Chugach candidates with stressed syllables and high pitch, whereas the constraints in (50b) prioritize candidates with low pitch in the dependent of a foot. Since Chugach has two types of dependents and, importantly, only one of them receives a low (i.e. the dependent of a minimal foot), I propose splitting the foot-dependent constraints in two. This is done in (52).

(52) a. Dependents of a FtMin / b. Dependents of a FtNon-min

a. Dependents of a FtMin	b. Dependents of a FtNon-min
*NONHD$_{FTMIN}$/H	*NONHD$_{FTNONMIN}$/H
*NONHD$_{FTMIN}$/H, M	*NONHD$_{FTNONMIN}$/H, M
*NONHD$_{FTMIN}$/H, M, L	*NONHD$_{FTNONMIN}$/H, M, L

The crucial ranking arguments, which restrict lows to unstressed syllables immediately dominated by a non-minimal foot, are reviewed below. Since Chugach does not have a mid tone, I exclude the mid tones from the constraint set for ease of presentation and assume the ones given in (53)

(53)

a. Dependents of a FtMin	b. Dependents of a FtNon-min
*NONHD$_{FTMIN}$/H	*NONHD$_{FTNONMIN}$/H
*NONHD$_{FTMIN}$/H, L	*NONHD$_{FTNONMIN}$/H, L

To ensure that stressed vowels in a foot head position receive a high, *HD$_{FT}$/L must dominate SPECIFY(TONE) —the constraint that ensures that every tone bearing unit has a pitch of its own (Prince & Smolensky 1993/2004; Yip 2002)— and this must outrank *HD$_{FT}$/H, L. These rankings are illustrated in the following tableau:

taqú$_H$ma$_L$luní$_H$

(54)

taqumaluni	*HD$_{FT}$/ L	SPECIFY(T)	*HD$_{FT}$/L, H
a. ☞ ((ta qú$_H$) ma$_L$) (luní$_H$)		**	**
b. ((ta qú$_L$) ma$_L$) (luní$_L$)	**!	**	**
c. ((ta qú$_H$) ma$_L$) (luní$_L$)	*!	**	**
d. ((ta qú) ma$_L$) (luní)		****!	

The candidate in (54a), with a high tone in every stressed syllable and a low in the syllable adjoined to the first minimal foot, surfaces as optimal. The second and third candidates (i.e. 54b-c) are ruled out because one or both of their foot heads surfaces with the least prominent pitch (i.e. L), incurring some violations of *HD$_{FT}$/L. Finally, (54d) is eliminated because four of its syllables are not assigned a specific pitch. Note that, given the hierarchy in (54), an alternative candidate like [((ta$_L$qú$_H$)ma$_L$)(lu$_L$ní$_H$)], in which all the dependents are assigned a low tone, would incorrectly surface as optimal. This is shown in (55).

taqú$_H$ma$_L$luní$_H$

(55)

taqumaluni	*HD$_{FT}$/ L	SPECIFY(T)	*HD$_{FT}$/L, H
a. ☹ ((ta qú$_H$) ma$_L$) (luní$_H$)		**	**
b. 💣((ta$_L$ qú$_H$) ma$_L$) (lu$_L$ní$_H$)			**

To ensure that the only unstressed syllables that receive a low tone are those that are directly dominated by a non-minimal foot, the constraints *NONHD$_{FTMIN}$/H, L and *NONHD$_{FTNONMIN}$/H must outrank SPECIFY(TONE). Additionally, SPECIFY(TONE) must dominate NONHD$_{FTNONMIN}$/H, L. These three ranking arguments are illustrated in the following tableaux (56-57). Namely, tableau (56) demonstrates that *NONHD$_{FTMIN}$/H, L dominates SPECIFY(TONE). Candidates (56b-d) all have a specific pitch in the dependent of a minimal foot and, thus, they violate the high-ranked constraint *NONHD$_{FTMIN}$/H, L.

(56) Ranking argument * NONHD$_{\text{FTMIN}}$/H, L >> SPEC(TONE)

taqumaluni	*NONHD$_{\text{FTMIN}}$/H, L	SPEC(T)
a.☞((ta qú$_H$)ma$_L$)(luní$_H$)		**
b. ((ta$_L$qú$_H$) ma$_L$)(lu$_L$ní$_H$)	**!	
c. ((ta$_L$qú$_H$)ma)(lu$_L$ní$_H$)	**!	*
d. ((ta$_H$qú$_H$)ma$_L$)(lu$_H$ní$_H$)	**!	

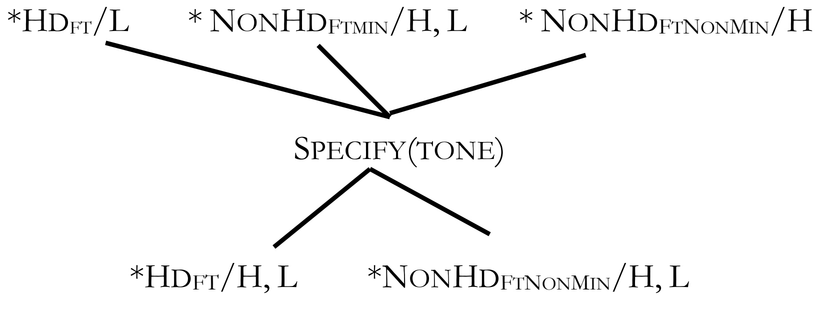
Additionally, SPECIFY(TONE) must be ranked below *NONHD$_{\text{FTNONMIN}}$/H in order to rule out candidates with a H in a non-minimal foot dependent. That is why candidate (57c) in the following tableau is ruled out. Finally, SPECIFY(TONE) is crucially ranked above NONHD$_{\text{FTNONMIN}}$/H,L, to make sure that dependents of a non-minimal foot get their low value.

(57) *NONHD$_{\text{FTNONMIN}}$/H >> SPEC(T) >> NONHD$_{\text{FTNONMIN}}$/H, L

taqumaluni	*NONHD$_{\text{FTMIN}}$ /H, L	*NONHD $_{\text{FTNONMIN}}$/H	SPEC(T)	*NONHD$_{\text{FTNONMIN}}$ /H, L
a.☞((ta qú$_H$)ma$_L$)(luní$_H$)			**	*
b. ((taqú$_H$) ma) (luní$_H$)			***!	
c. ((ta qú$_H$) ma$_H$) (luní$_H$)		*!	**	*

To aid in the exposition, the following Hasse diagram presents the crucial ranking arguments responsible for the distribution of pitch in Chugach:

(58)



The OT analysis posited here, in which there are independent constraints on minimal foot dependents (e.g. *NONHD$_{\text{FTMIN}}$/TONE) and non-minimal foot dependents (e.g. *NONHD$_{\text{FTNONMIN}}$/TONE) does not take a position on the universality of the relative strength of the dependents of minimal and non-minimal feet. Given that the constraints on minimal foot dependents and non-minimal foot dependents are freely rankable, dependents of non-minimal feet can behave as stronger or as weaker than the dependents of minimal feet. In Chapter 5 I will show that this is a desired prediction of the theory, since there are languages in which dependents of minimal feet are weaker than dependents of non-minimal feet, but the opposite situation (i.e. languages in which dependents of non-minimal feet are weaker than dependents of minimal feet) is also attested.

For the concrete case of Chugach, it looks like dependents of non-minimal feet (i.e. the ones that get a low) are slightly stronger than dependents of minimal feet. In particular, assuming that strong elements allow more contrasts than weak elements (Dresher & van der Hulst 1998), the dependent of a non-minimal foot can be characterized as stronger than the dependent of a minimal foot in Chugach, since only the former licenses a low. Along these lines, it could also be stated that the dependent of a non-minimal foot is stronger because it is *more visible* than the dependent of a minimal foot, at least for the assignment of pitch. In other languages (e.g. the ones analyzed by de Lacy 2002a), however, dependents of minimal feet often display a preference for low tones and, thus, future research should investigate whether those languages present any evidence for recursive feet. If any of those languages do display such evidence, whether or not the dependents of their minimal feet behave any differently from the dependents of non-minimal feet should be explored. Of particular interest would be the case in which the distribution of lows is the opposite of that found in Chugach.

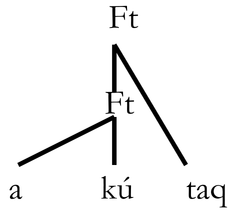
In Chapter 5 I look more closely at other languages and phenomena and conclude that the relative strength of foot dependents is not universal, but it is probably determined on a language particular basis. In many languages the dependent of a minimal foot behaves as weaker than the dependent of a non-minimal foot, as in Chugach. However, there is at least one clear example of a language in which the dependent of a minimal foot is stronger than the dependent of a non-minimal foot, and here, non-recursion based analyses are untenable (see the discussion in Section 5.5 on Old English). There are also languages with recursive feet in which the two types of foot dependents exhibit a similar strength, i.e. they are just non-prominent. The grammar should be able to model all these variations in strength. In this dissertation I only review a small number of languages, but future research in the phonology of other prosodic systems with recursive feet needs to be carried out to further supportting for the present proposal.

The next subsection presents the last phenomenon in Chugach that can be taken as further support for the recursion-based analysis.

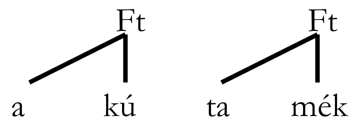
4.2.2.3 Vowel lengthening

Leer reports that stressed vowels are generally lengthened in syllables that are not closed by a consonant. Interestingly, Leer notes a subtle durational difference among those lengthened vowels: some of them are longer than the rest. For instance, when comparing the duration of the second syllable in *akútaq* 'an item of food' and *akútamék* 'kind of food' (abl. sg.) Leer states: "the syllable *ku* is lengthened in both cases, but *u* is longer in *akutaq*" (1985c: 164). This durational difference between the two words is relatively straightforward if one considers the differences between their metrical structure, given in (59).

(59) a. *akútaq*



b. *akútamék*



Along the lines of the analysis of Wargamay and Yidiɲ, I believe that the *u* in *akútaq* (59a) is longer than the *u* one in *akútamék* (59b) due to its double-head status. That is, the length distinction between (59a) and (59b) is a prosodic prominence effect. Unfortunately, Leer does not provide a detailed description of the systematicity of the lengthening process and it is not clear if all words with recursive feet exhibit slightly longer vowels or not. Therefore, it is not possible to establish whether this lengthening distinction should be encoded in the phonological module of grammar (in the form of a constraint/rule) or, by contrast, it is just a matter of phonetic implementation, by which vowels that are heads of multiple projections of feet in open syllables sometimes exhibit extra length.

4.2.3 Overview of previous analyses

The number of Chugach analyses one can find in the literature is very vast. However, they can be grouped in two main classes depending on whether they account for ternary rhythm by resorting to ternary feet —either flat or with internal layering— or by allowing weak local parsing (see Section 4.2.1.1 for discussion on previous accounts of ternary systems). This subsection briefly reviews three earlier analyses of Chugach, those that have most significantly influenced the present analysis, but differ from it in some crucial respects.

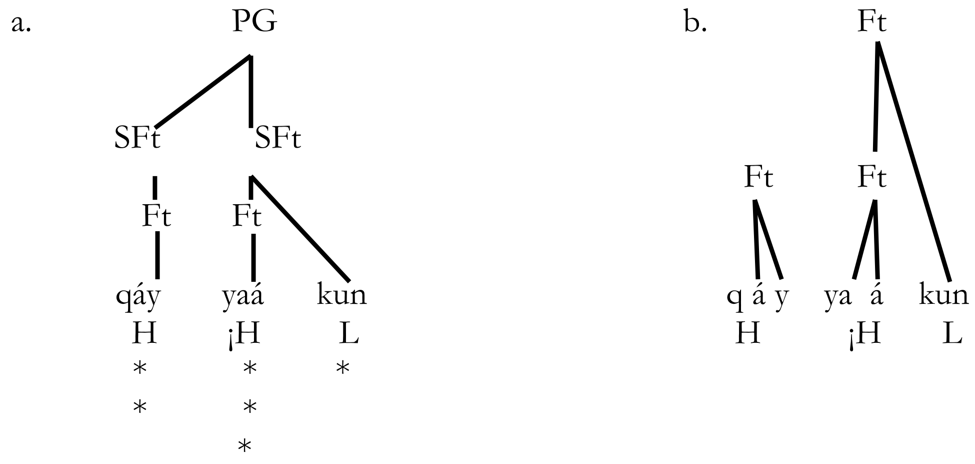
These are Leer (1985), Rice (1992) and Kager (1993). More than aiming to simply highlighting the shortcomings of previous research, the goal of this comparison is to deepen in some crucial properties of the present analysis, which might have passed unnoticed. Finally, this section closes with one of the most recent proposals of Chugach stress by Hyde (2001, 2002), which crucially deviates from previous studies in the type of prosodic representations that it allows.

4.2.3.1 Leer (1985c): a superfoot analysis

The original idea of having an additional prosodic layer between the prosodic word and the metrical foot can already be tracked in the primary source of Chugach, i.e. Leer (1985c). However, Leer's approach differs from the present one in an important number of ways. On the one hand, Leer posits two intermediate levels between the prosodic word and the metrical foot, which he labels as the *superfoot* (SFt) and the *pitch group* (PG). These categories are conceived as independent universal categories. The superfoot is immediately above the foot; it sometimes coincides with the foot (e.g. see the first SFt below in 60a) and sometimes consists of a foot with an adjoined syllable, in a similar setup to our non-minimal feet. Furthermore, some pairs of superfeet can be grouped in another higher category, i.e. the *pitch group* (although not every pair of superfeet constitutes a pitch group, see Leer 1985c:168 for the details). Unfortunately, Leer does not provide independent motivation for these *pitch groups*, so their existence comes across as a stipulation, i.e. they seem to be explicitly posited to account for the pitch facts in the language.

On the other hand, within Leer's model, the formation of feet, superfeet and pitch groups is determined by highly specific structure building rules (e.g. Leer 1985c: 168). These fairly *ad hoc* rules assign prosodic structure and metrical gridmarks to sequences of segments in Chugach. For details on the formalization of these rules, the author is referred to Leer's work. Here I am mainly interested in the type of prosodic structures that are constructed by these rules. An illustration of Leer's representations is given in (60a). For ease of comparison, (60b) gives the corresponding structure of the same word in the present framework.

(60) Leer's superfeet (SF) and pitch group (PG)



Leer's representations (60a) are not so different from the ones proposed in the present reanalysis (60b), but they crucially differ in three aspects. First, Leer assumes the Strict Layer Hypothesis is inviolable, i.e. prosodic levels cannot be skipped in prosodic representations. That is why Leer's feet are all dominated by at least one superfoot, even when there is no evidence for such a superfoot. Many of the superfeet proposed by Leer, thus, coincide with the feet they dominate (e.g. the first syllable in 60a). However, in these cases, it is not very clear why feet and superfeet constitute different categories, especially since they do not exhibit different phonological behavior. Additionally, whereas the present analysis has provided a restrictive theory for the emergence of the particular additional level of the non-minimal foot, Leer's proposal is unrestrictive. That is, although Leer's analysis is empirically adequate (i.e. his set of rules covers the descriptive facts), it is not restrictive in that other rules could be posited to create additional layers in the hierarchy. Finally, note that Leer makes use of two systems to mark prominence: the prosodic hierarchy and the metrical grid. By contrast, the present proposal has provided an account of stress and pitch by using only one prominence system (i.e. the prosodic hierarchy) and, thus, it is preferred for being more economical.

In short, the present reanalysis of Chugach owes much of its success to Leer's first analysis, where the need for an additional layer between the prosodic word and the foot and the metrically-driven account of pitch were already proposed. However, the present reanalysis has proven more restrictive and economical than Leer's original proposal, since no additional universal categories need to be included in the prosodic hierarchy.

4.2.3.2 Rice (1992): Ternary feet with binary heads

Rice's (1992) analysis of Chugach word-level prosody has greatly influenced the present proposal. In particular, the reinterpretation of secondary stress as pitch accent and the claim that ternary feet must have some kind of internal structure find their basis in Rice's work. There are, however, crucial differences between the two proposals. One of the most important differences concerns the type of feet postulated in each analysis and, more precisely, the type of foot heads these feet might exhibit. In particular, I have assumed that foot heads in Chugach (and in any natural language) are strictly unary (see the discussion on foot headedness and the Head Uniqueness Principle in Chapter 2). By contrast, Rice assumed binary foot heads. Within his proposal, all feet in Chugach (i.e. binary and ternary) must have a binary (moraic or syllabic) head.

This difference between the unary *vs.* binary head condition on feet is better illustrated with a concrete example in (61). On the left, I present Rice's metrical structure for a word like *saráníwakártuq* and, on the right, I provide the structure I have argued for in the present analysis. In Rice's notation, foot heads are indicated by an <X> in the metrical grid level and their constituents appear in between square brackets [ ]; the boundaries of a foot are marked with round brackets ( ), and foot dependents are marked with a dot.

(61) a. Rice (1992)

(x .) (x .)
[μ μ] μ [μ μ] μ
sa rá ni wa kár tuq
H L H L

b. Martínez-Paricio (2013)

((μ 'μ) μ) ((μ 'μh) μ)
sa rá ni wa kár tuq
H L H L

As can be seen in (61a), the two structures are very similar. In general, Rice's binary heads coincide with the boundaries of minimal feet in a recursion-based approach. For instance, within Rice's representation, the head of the first foot in (61a) is [$sa^{\mu}.rá^{\mu}$]. Note, however, that within heads *à la Rice* (i.e. with two constituents) there is always one constituent in the head that is *more* head-like than the other, in the sense that only one of them is singled out for stress/pitch assignment purposes. For instance, even if the first two morae in (61a) constitute the head of the first foot, only one of them —the second one— receives stress. That is, the second mora is systematically more prominent than the first one. In that sense, the second mora seems to be the true head of the foot. However, the types of representations given in Rice (1992) with symmetrical binary heads (i.e. binary heads with flat structure) do not capture the different behavior of the two constituents that form the head.

Within the present approach, by contrast, foot heads can never have two constituents; not in Chugach, and not in any other language.

There is an additional problem with models that posit binary-heads: they predict that the constituents of the head will be stronger than the constituents in the dependent of a foot. This is in fact the case in Old English, one of the first languages to be analyzed with binary heads and a foot dependent, but in many languages (Chugach being one of them) one of the constituents of the "binary-head" is phonologically and phonetically weaker than the constituent in the non-head of a foot (see also Chapter 5 for further examples). Thus, it seems more appropriate to treat traditional binary flat heads as a foot on their own, where one constituent is the true head and the other one is a foot dependent.

The other crucial difference between the two analyses relies on their respective accounts of the pitch facts. Whereas the distribution of pitch receives a fairly simple account in a theory that allows recursion at the foot level (i.e. foot-heads received high pitch, whereas the outermost dependent of a non-minimal foot receives low pitch), Rice's account is less straightforward. Rice proposes that a bitonal sequence H*L is inserted for each instance of primary stress. Crucially, Rice needs to stipulate that the bitonal sequence must be linked within the same metrical foot and that, when this is not possible, a low tone deletion rule applies to erase a floating low. Both, the restriction of the bitonal sequence within the same metrical foot and the low tone deletion rule, conspire so that an unstressed syllable following a stressed syllable with high tone, does not receive a low when it is followed by a light syllable (cf. 62 below). This gets the right results, as long as the *metrical restructuring rule* that Rice proposes to get rid of degenerate feet applies before the low deletion rule. An illustration of the application of these rules is given in (62) and (63):

(62)

Stress algorithm →	Restructuring →	*HL linking →	Deletion of floating L
(x .) x	(x) (x)	(x) (x)	(x) (x)
[μμ] μ [μ]	[μμ] [μ μ]	[μμ] [μ μ]	[μμ] [μ μ]
taá ta qá	taá ta qá	taá ta qá	taá ta qá
		HL HL	H H

(63)

Stress algorithm →	*HL linking →	Floating L deletion
(x .) (x)	(x .) (x)	(x .) (x)
[μμ]μ [μμ]	[μμ] μ [μμ]	[μμ] μ [μμ]
án ci quá	án ci quá	án ci quá
	H L HL	H L H

The specification that the bitonal HL must apply within the same metrical foot comes as an *ad hoc* stipulation. Without it, the second syllable in (62) would have received a low pitch. Finally, Rice's analysis has to stipulate that the tone bearing unit is the syllable rather than the mora. Otherwise, it remains unclear why in (62) the bitonal pitch HL cannot just be docked within the same syllable, since the two morae in the first syllable are part of the head of the foot.

4.2.3.3 Kager (1993): degenerate feet and weak local parsing

Kager's (1993) analysis of Chugach has influenced the present one in the use of moraic iambs. However, it crucially differs in the treatment of some unstressed syllables. For instance, Kager (1993) analyzes some of the syllables that I have suggested are adjoined to a preceding foot as unary feet. This is illustrated in (64):

(64)	Kager (1993)		Martínez-Paricio (2013)
	a. (taqú)(ma)(luní)	~	a'. (taqú)ma)(luní)
	b. (akú) (taq)	~	b'. ((akú)taq)
	c. (akú) (tamék)	~	c'. (akú)(tamék)

In a four-syllable word like *akutamek* 'kind of food (abl. sg)' (64c) the two analyses propose the same metrical structure. The crucial difference comes from forms like (64a,b) where there is a leftover syllable that cannot be parsed in a minimal foot. Although the parsings proposed by Kager are totally plausible, I believe the structures given in (64a') and (64b') provide a better account of the facts in Chugach. First, within Kager's analysis, it is not clear why the unary feet in (64a,b) do not receive stress or high pitch, given that heads in Chugach are always stressed and associated with high pitch. This is even more suspicious because clashes are allowed in the language and, thus, the avoidance of clashes cannot be responsible for the absence of stress in a degenerate foot. One possible explanation for the absence of stress in these monomoraic feet is that they do not comprise a head, but a dependent. Still, as previously argued, within metrical theories, it is generally assumed that degenerate feet only arise when they have a head (Hayes 1995). Furthermore, even if our theory of representations allowed headless feet which surface without stress (Crowhurst 1991, 1996; Crowhurst & Hewitt 1995; Krämer 2009a,b *inter alia*), it would still not be clear why the unary foot in those forms does not present fortition (recall fortis consonants target the left edge of a foot, not its head). For all these reasons, I assume the representations in which these syllables are adjoined to a preceding foot are descriptively more adequate. Note also that the parsing in (64b) and (64c) does not readily lend itself to an obvious explanation for why the second syllable in (64b) is slightly longer than the one in (64c) (see Section 4.2.2.3). By contrast, if the third syllable in (64b) is adjoined to the preceding foot, giving rise to a non-minimal foot that dominates another foot, it is expected that prosodic prominence ensures that such a head surfaces with more prominence than the heads of ordinary feet.

Elenbaas & Kager (1999), Hayes (1995) and Houghton (2006), among others, have assumed parsings similar to the ones given in Kager (1993), but with the important difference that unary feet are not built over the leftover syllables. Instead, these studies propose that such syllables are instead left unparsed, i.e. Chugach is an example of a language with *weak local parsing*. Within a weak local parsing (WLP) mode, a word like *taqúmaluní* (64a) would be parsed as in [(taqú)ma(luní)]. However, there is no independent motivation for parsings like this. That is, it is not very clear why some syllables/morae are linked to a prosodic word rather than to a foot apart from the fact that not parsing them allows ternary rhythm to arise. Moreover, as I previewed earlier, under the WLP approach, the reasons for leaving unparsed syllables within the same prosodic word are multiple and disconnected (e.g. some syllables are left unparsed to avoid adjacent feet word-internally, others to avoid the parsing of a final syllables, etc.). Furthermore, while extrametricality is active at different levels of the prosodic hierarchy and could arguably be an explanatory force for word-final ternarity, there is no clear reason for the avoidance of adjacent feet. Moreover, prosodic constituents at other levels of the prosodic hierarchy are always adjacent and, thus, the violation of adjacency exclusively at the foot level is a bit suspicious.

In addition to these general problems intrinsic to WLP analyses, the WLP approach encounters several problems when trying to account for the distribution of pitch. In a structure like [(taqú)ma(luní)] it is difficult to account for the assignment of a low to the third syllable, which is precisely the one that remains unfooted, e.g. taqú$_{H}$ma$_{L}$luní$_{H}$. If de Lacy's (2002a, 2004) generalization regarding the universal tendency of foot dependents to attract lows is on the right track, it is not clear what bans the other unstressed syllables from receiving a low tone. The hierarchy of constraints proposed in de Lacy (2002a, 2004) would, in fact, predict that foot-dependents attract lows.

Furthermore, even if de Lacy's generalization regarding the attraction of lows by foot dependents proved to be wrong and, instead of constraints on the preferences of foot dependents, one assumed constraints on the tone preferences of unstressed and stressed syllables (e.g. *UNSTRESSED/Tone$_X$ and *STRESSED/Tone$_X$, respectively), it would be impossible to generate a distinction between unstressed syllables, where only a subset of them receive a particular pitch as it occurs in Chugach. Note that within such an approach all the unstressed syllables, weather footed or unfooted, would behave similarly (attracting or repelling tone). This is exemplified in the following tableaux, which evaluate a 6-syllable word *sará$_H$ni$_L$wakár$_H$tuq$_L$*. No matter how we rank the constraints SPECIFY(TONE) and *UNSTRESSED/H,L, the hierarchy would never be able to produce an output that assigns different values to its unstressed syllables. That is why the hierarchy either selects a candidate without specific pitch in all unstressed syllables (tableau 65, candidate 65a) or a candidate with all unstressed syllables low (tableau 66, candidate 66b).

(65) Using constraints on unstressed syllables rather than foot dependents

* UNSTRESSED/H,L >> SPECIFY (TONE)

saraniwakartuq	*STRESS /LOW	*UNSTR /HIGH	*UNSTR /H, L	SPEC (T)
a. 💣 (sará$_H$)ni(wakár$_H$) tuq				****
b. (sa$_L$rá $_H$)ni$_L$(wa$_L$kár$_H$)tuq$_L$			****	
c. (sa$_L$rá $_H$)ni(wa$_L$kár$_H$)tuq			**	**
d. ☹ (sará $_H$)ni$_L$(wakár$_H$) tuq$_L$			**	**

(66) *SPECIFY (TONE) >> * UNSTRESSED/H,L

saraniwakartuq	*STRESS /LOW	*UNSTR /HIGH	SPEC (T)	*UNSTR /H, L
a. (sará$_H$)ni(wakár$_H$)tuq			****	
b. 💣(sa$_L$rá $_H$)ni$_L$(wa$_L$kár$_H$)tuq$_L$				****
c. (sa$_L$rá $_H$)ni(wa$_L$kár$_H$)tuq			**	**
d. ☹ (sará $_H$)ni$_L$(wakár$_H$)tuq$_L$			**	**

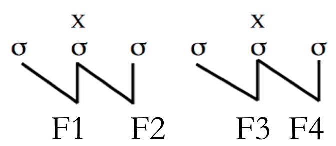
However, as I demonstrated in Section 4.2.3.2, a reasonable solution to this problem can be achieved within a recursion-based analysis that admits different types of constraints on foot dependents.

4.2.3.4 Hyde (2002): Ambipodal syllables

As I explained in the preceding chapter (Section 3.5), Hyde (2001, 2002) proposed important modifications to the type of phonological representations allowed by universal grammar. In particular, one of the major representational divergences between standard theories of stress and Hyde's own proposal was shown to be the inclusion of ambipodal syllables in metrical representations. As we saw in his analysis of Wargamay and Yidiɲ, ambipodal syllables are syllables that are linked to two different feet. As a result, these syllables are structurally *bipolar* in the sense that they are simultaneously the head of one foot Ft^x and the dependent of another foot Ft^y.

In Chapter 3 I reviewed some of the general problems with these types of metrical intersections. Still, since Hyde explicitly claimed that languages with ternary rhythm constitute independent and strong support for ambipodal syllables, in this section I briefly illustrate how ambipodal syllables can serve as a metrical device responsible for ternary stress alternations. However, when applied to Chugach's whole prosodic system, we will see that the ambipodal analysis has clear shortcomings, among which is the fact that it is unable to predict metrically-conditioned processes in the language beyond stress. Consider a word with six light syllables in Chugach; in these forms, stress falls on the second and the fifth syllables. Hyde's proposal is that languages with ternary stress locate stress on ambipodal syllables, i.e. on the second an fifth syllables in (67) (Hyde 2002: 353).

(67) *Chugach ternary stress* (vertical lines indicate heads):



The second and fifth syllables in (67), apart from being ambipodal, are the only ones that have a gridmark and, therefore, the only ones that receive stress. Other syllables that are in a foot head position (e.g. the third and sixth syllables) surface without stress. There is ample evidence for the existence of stressless feet in several languages (e.g. Hayes 1995; Buckley 2009 and references therein) and, thus, the fact that Chugach has stressless feet is not necessarily a drawback of Hyde's proposal. However, note that according to Hyde the only syllables that receive stress in Chugach are the ones simultaneously located in a head and a dependent position. This feels a bit counterintuitive, since syllables that are in purely head positions would be expected to be slightly stronger than those that are in a head-dependent position. If the notions of *headedness* and *foot head* (and foot dependent) are not mere diacritics in prosodic theory, but they are the expression of hierarchical relations of relative prominence —as I have assumed throughout this dissertation— elements in dependent positions are predicted to be weaker than elements in strong positions (e.g. foot head). However, within Hyde's theory, the relation between prosodic structure and relative strength (and stress) is looser than in standard theories. Hence, constituents that have both dependent and head status can be stronger than constituents that only have head status. Furthermore, this is only possible once there are two systems/devices to mark prominence: the metrical grid and prosodic constituency (i.e. feet and syllables). Even if ambipodal syllables could be characterized in prosodic terms as weaker than syllables in a foot head position, since the former have a gridmark, they are the ones that display greater prominence.

Beyond the need for an additional system to mark prominence in order to derive the correct patterns of stress, an analysis of Chugach in ambipodal terms is problematic in two further respects. More concretely, the major shortcoming of an ambipodal analysis of Chugach is that it cannot account for several metrically-driven phonological processes in the language, i.e. it is descriptively inadequate. On the one hand, note that if one assumes the intersected representations in (67), the fortition facts are missed (i.e. the fact that foot-initial consonants display fortition). The representation in (67) predicts fortition in the first, second, fourth and fifth syllable; however, fortition only targets the onsets of the first and fourth syllable (Section 4.2.2.1) On the other hand, Hyde's analysis would encounter several problems when trying to account for the distribution of pitch in the language. Recall that in a six-syllable word, a low tone is docked onto the third and sixth syllable. To *save* Hyde's analysis, one could propose that lows only dock onto foot heads. However, this would also insert a low in ambipodal syllables, since they also have head status. Yet, these syllables receive a high tone instead.

To conclude, even if an ambipodal-syllable account of ternary rhythm is able to predict ternary stress alternations —building on non-standard representational assumptions and relying on the use of two systems to mark prominence—, Hyde's ambipodal analysis of Chugach presents several shortcomings and it is descriptively inadequate. The prosodic system of a language is more than an alternation between stressed and unstressed syllables and any theory of prosody and metrical stress should be able to predict further properties that are metrically conditioned. Hence, at least in the case of Chugach, a recursion-based analysis is clearly superior since it provides a unified and simpler account of several word-level phenomena.

4.3 From moderate ternarity to radical ternarity[18]

4.3.1 Quantity-insensitive stress in Cayuvava and Tripura Bangla

This section expands the analysis of Chugach in order to account for more radical ternary systems such as Tripura Bangla (Das 2001) and Cayuvava (Key 1961, 1967). In particular, I make the case that the emergence of recursive feet is less restricted in these languages than in languages with binary rhythm (Wargamay, Yidiɲ) and/or mixed binary-ternary stress patterns like Chugach. Whereas in Wargamay, Yidiɲ and Chugach recursion has been shown to arise as a means to ensure exhaustivity (with or without economizing on the number of minimal and maximal feet), in ternary systems like that of Cayuvava (Key 1961, 1967) and Tripura Bangla (Das 2001), the requirement of footing every syllable is not as important. Still, recursive feet (i.e. non-minimal feet) emerge in most forms in these languages due to the pressure of other high-ranked constraints.

The relevant data for Cayuvava and Tripura Bangla are given in (68-69), respectively.[19] Cayuvava is a quantity-insensitive language. As can be seen in (68), all words of all lengths present at least one instance of ternarity. For example, 3-, 4- and 5-syllable words exhibit primary stress in the third syllable from the end (68b-d). Additionally, in words where there is more than one instance of a sequence of three syllables (i.e. in 6-, 7- and 8-syllable words), a secondary stress appears three syllables before the antepenultimate syllable (68e-g). Cayuvava has been traditionally considered one of the ternary languages *par excellence*. This language does not have any binary stress alternation; all stress is ternary.

[18] This section stems from collaborative work with René Kager on the typology of quantity-insensitive rhythmic systems. Here I only present some of the crucial findings of this joint work in order to support the recursion-based approach to rhythmic stress systems pursued in this thesis. However, for a complete factorial typology of quantity-insensitive rhythmic systems, the details of the OT analysis, and a thorough discussion of the advantages of the "non-intervention" alignment constraints see Martínez-Paricio & Kager (2013).

[19] Tripura Bangla is a dialect of Bangla, spoken in Tripura, a small hilly state in the northeastern part of India. Das, who is a native speaker of the language, describes it as the "non-official medium of communication for the non-tribal population of the entire state. This is also the common means of interaction between the various tribes and non-tribes of the state." For further details about the peculiar sociolinguistic context in which Tripura arose, the reader is referred to Das (2001: v-vii). Cayuvava is an extinct language originally spoken in Bolivia. All the data presented here comes from the original sources Das (2001) for Tripura, and Key (1961, 1967) for Cayuvava.

(68) Cayuvava

a.	2-σ:	dá.pa	'canoe'
b.	3-σ:	tó.mo.ho	'small water container'
c.	4-σ:	a.rí.po.ro	'he already turned around'
d.	5-σ:	a.ri.pí.ri.to	'already planted'
e.	6-σ:	à.ri.hi.hí.be.e	'I have already put the top on'
f.	7-σ:	ma.rà.ha.ha.é.i.ki	'their blankets'
g.	8-σ:	i.ki.tà.pa.ra.ré.pe.ha	'the water is clean'

Tripura Bangla exhibits a contrast between light and heavy syllables; however, for ease of comparison and the sake of simplicity, here I only concentrate on the data with light syllables. A full analysis of Tripura Bangla quantity-sensitive stress and other metrically-conditioned processes in the language needs to be worked out in future research. As can be seen in (69), Tripura is also a ternary stress language: words with 3*n* syllables (i.e. 3- & 6-syllable words; 69b,e), with 3*n* +1 syllables (i.e. 4- & 7-syllable words; 69c,f) and 3+*n* 2 syllables (i.e. 5- & 8-syllable words), present all stress in every third syllable rather than every second. In bisyllabic words, stress falls on the first syllable.

(69) Tripura Bangla: words with light syllables

a.	2-σ:	rá.za	'king'
b.	3-σ:	gó.ra.li	'ankle'
c.	4-σ:	bɛ́. na.ro.ʃi	'Benaras silk'
d.	5-σ:	ʃɔ́.ma.lɔ.sɔ̀.na	'criticism'
e.	6-σ:	ó.nu.kɔ.rò.ni.jɔ	'imitable'
f.	7-σ:	ɔ́.no.nu.dà.βo.ni.jɔ	'unintelligible'
g.	8-σ:	ɔ́.no.nu.kɔ̀.ro.ni.jɔ̀.ta	'inimitability'

Cayuvava and Tripura Bangla display fairly similar patterns of stress: the two languages favor ternary stress in a more *extreme* way than Chugach.

Along the lines of the analysis of ternary alternations in languages with mixed binary-ternary stress patterns, I propose that in Cayuvava and Tripura ternary rhythm reflects the presence of trisyllabic non-minimal feet in phonological representations, i.e. recursive feet. However, the construction of non-minimal feet in these languages is not a last-resort mechanism that arises to ensure exhaustivity, as it was argued in Chugach (and Wargamay and Yidiɲ). To the contrary, in Cayuvava and Tripura, recursion at the foot level is a default parsing strategy. This is so extreme in Cayuvava, that only allows maximal feet that are not-minimal, i.e. recursive. Hence, very often the construction of non-minimal feet leaves certain syllables underparsed. For example, as I will shortly illustrate, in 4-syllable words, rather than building two minimal feet as in Chugach, e.g. [(a.kú)(ta.mék)], Cayuvava and Tripura favor parsings with one non-minimal foot, even if this leaves one syllable unparsed, e.g. Cayuvava: [a ((rí.po)ro)] 'he already turned around'; Tripura: [((bɛ́.na)ro) ʃi] 'Benaras silk'. This preference for non-minimal feet is precisely the reason why the two languages exhibit more radical patterns of ternary stress when compared to Chugach, where binary feet are often preferred over internally layered ternary feet.

Although Cayuvava and Tripura display ternary alternations, I will argue that there is a small but crucial difference between their metrical representations. More specifically, the former can be considered to be *more* ternary than the latter since every minimal (binary) foot in Cayuvava must be dominated by another foot (except in bisyllabic forms, where a minimal foot must be necessarily maximal). This is illustrated in the following table in (70), where I provide the metrical representations for Cayuvava (70a) and Tripura (70b). I also include the representations for Chugach for ease of comparison. The table shows that all feet in Cayuvava display two projections, i.e. they are non-minimal. In Tripura, this is also generally the case, with the only exception being that in $3n+2$ words, a bisyllabic minimal foot is built over the two leftover syllables (compare the parsing of 5- and 8-syllable words in 70a and 70b). In short, whereas Tripura allows underparsings of at most one syllable, in Cayuvava this restriction is more flexible, permitting two unparsed syllables at the edge of the prosodic word. In the following examples the underlined syllable signals the foot head, underparsed syllables are highlighted in red and the shaded cells (in $3n+2$ forms) highlight the main difference between Cayuvava, Tripura and Chugach.

(70) Metrical structure in Cayuvava and Tripura Bangla

Num. of σ		a. Cayuvava	b. Tripura Bangla	c. Chugach
	2σ	(σσ)	(σσ)	(σσ)
3*n*	3σ	**((σσ)σ)**	**((σσ)σ)**	**((σσ)σ)**
3*n*+1	4σ	σ ((σσ)σ)	((σσ)σ)σ	(σσ)(σσ)
3*n* +2	5σ	σ σ **((σσ)σ)**	**((σσ)σ)**(σσ)	**((σσ)σ)**(σσ)
3*n*	6σ	**((σσ)σ)((σσ)σ)**	**((σσ)σ)((σσ)σ)**	**((σσ)σ)((σσ)σ)**
3*n*+1	7σ	σ **((σσ)σ)((σσ)σ)**	**((σσ)σ)((σσ)σ)**σ	**((σσ)σ)**(σσ)(σσ)
3*n*+2	8σ	σσ **((σσ)σ)((σσ)σ)**	**((σσ)σ)((σσ)σ)**(σσ)	**((σσ)σ)((σσ)σ)**(σσ)[20]

Since Cayuvava allows underparsing of two syllables in 3*n*+2 forms, but Tripura doesn't, words with five and eight syllables end up having fewer maximal feet (and one fewer stressed syllable) per word in Cayuvava than Tripura. This is, in fact, the main difference between the two languages (beyond their differences in directionality, i.e. Cayuvava displays leftward footing and Tripura rightward footing). In a similar way, when one compares the parsings of Tripura (70b) with those of Chugach (70c), one can see that the main difference between these two systems lies in the parsings of 3*n*+1 forms: whereas Chugach favors bisyllabic feet in these forms, Tripura exhibits a greater degree of recursion, even when this entails leaving one syllable unparsed. Hence, Chugach 3*n*+1 forms have one extra maximal foot (and one additional stressed syllable) than Tripura 3*n*+1 forms. Finally, if I had included a fourth column with the metrical representations of the binary systems studied in Chapter 3, we would see that the difference between languages with mixed binary-ternary systems like Chugach and systems with binary rhythm like Wargamay and Yidiɲ lies in the parsing of 6-syllable words: these are parsed via recursion in Chugach, but without recursion in Wargamay and Yidiɲ. That is, 3*n* forms that are longer than trisyllabic forms contain one more maximal foot (and an additional stressed syllable) in binary systems than they do in binary-ternary systems.

In sum, rhythmic systems can be located along a continuum that goes from purely binary stress languages which only allow recursion as a last-resort device (e.g. Wargamay, Yidiɲ) to radical ternary systems like Cayuvava, where recursive feet are the default parsing mode, even when this entails the

[20] I have not found forms with eight light syllables in the Chugach data, but this is the stress pattern that one would expect to arise based on pattern congruity.

underparsing of one and two syllables in 3*n*+1 and 3*n* +2 forms, respectively. This is illustrated in (71).

(71) The binary-to-ternary continuum

TERNARY ⟷ **BINARY**

➢ **INSTANCES OF RECURSION**

Cayuvava	Tripura	Chugach	Wargamay, Yidiɲ
▪ Default parsing in all forms ▪ Underparsing of syllables	▪ Default parsing in all forms ▪ Underparsing of at most one syllable	▪ In odd-parity forms, 3*n* and 3*n*+2 forms ▪ No underparsing	▪ Only in odd-parity forms ▪ No underparsing

➢ **CAUSES OF RECURSION**

▪ To be explored (next section)	▪ To be explored (next section)	▪ To ensure exhaustivity ▪ To ensure minimal number of maximal (or minimal) feet in 3*n* forms	▪ To ensure exhaustivity

The reader is referred to Martínez-Paricio & Kager (2013) for a complete picture and further examples of languages that display similar rhythmic patterns. Moreover, whereas in this thesis I have not considered/analyzed any language with unary feet —BIN(FT) is undominated in all the languages under investigation here— in Martínez-Paricio & Kager (2013) we expand the present analysis and typological predictions by also accounting for the stress patterns of rhythmic languages that allow unary feet under specific circumstances. Likewise, in the following section I present some of the most crucial ranking arguments that cause recursion in Cayuvava and Tripura. For a full OT analysis with all the crucial ranking arguments responsible for all the rhythmic stress patterns in quantity-insensitive languages, see Martínez-Paricio & Kager (2013).

4.3.2 OT implementation: a sketch of an analysis

We have just seen that in ternary systems like Cayuvava and Tripura, non-minimal feet surface not only in odd-parity forms (as in Wargamay and Yidiɲ) and/or 3*n* forms (e.g. 6-syllable words in Chugach), but they also occur in other forms, even when this entails leaving some syllables unparsed as, for example, in 4- and 7-syllable words (70a,b).

In this section, I propose that, in OT terms, the crucial differences between languages with binary rhythm (Wargamay and Yidiɲ) or mixed binary-ternary rhythm (Chugach) and more radical ternary systems like Tripura and Cayuvava, lies in the different ranking of the constraints that pull unfooted syllables to one edge of the prosodic word, i.e. ALIGN-LEFT/RIGHT([σ]ω, *Ft, ω). In systems with binary and/or moderate ternary patterns, these constraints are undominated (see Chapter 3 and Section 4.2 in this chapter) and they therefore guarantee exhaustive parsing of syllables. Meanwhile, in ternary systems like Cayuvava and/or Tripura, the left or right version of this constraint is crucially dominated by its counterpart and other constraints, which gives rise to the underparsing of syllables.

To better illustrate this, consider a 4-syllable word in Tripura with stress on the word-initial syllable, e.g. *bɛ́naroʃi*. In the preceding section, I proposed that Tripura parses 4-syllable words with an initial non-minimal foot, leaving unparsed one syllable at the right edge of the prosodic word, e.g. $[((\text{bɛ́.na})_{Ft}\ \text{ro})_{Ft}\ \text{ʃi}]_{PrWd}$. Since unparsed syllables in the language are only permitted at the right edge of the prosodic word, ALIGN-RIGHT([σ]ω, *Ft, ω) must be ranked above ALIGN-LEFT([σ]ω, *Ft, ω). This ranking ensures that, in the presence of unparsed syllables, they are pulled towards the right edge of the prosodic word. This is illustrated in tableau (72). Tripura feet are trochaic at all layers (i.e. minimal and non-minimal projections) and, thus, for the remainder of this section I will assume that TROCHEE and NONMINTROCHEE dominate IAMB and NONMINIAMB and only consider trochaic feet for evaluation.

(72) Unparsed syllables at the right edge of the prosodic word

bɛ́naroʃi	AL-R([σ]ω,*Ft, ω)	AL-L([σ]ω,*Ft, ω)
a. ☞ ((bɛ́.na)ro) ʃi		*
b. (bɛ́.na). ro.ʃi		**!
c. bɛ ((ná.ro)ʃi)	*!	

On the one hand, the candidate without recursion (72b) is ruled out because it violates the lower ranked AL-L([σ]ω,*Ft, ω) twice, whereas the winner candidate (72a) only violates it once. On the other hand, the candidate with the unfooted syllable in word-initial position (72c) is banned because it incurs a violation of the high-ranked non-intervention constraint AL-R([σ]ω,*Ft, ω), which bans unparsed syllables that are followed by some foot. Hence, the ranking AL-R([σ]ω,*Ft, ω), >> AL-L([σ]ω,*Ft, ω) selects candidate (72a) as optimal. It is important to highlight that the more general constraints EXHAUSTIVITY(σ) (or PARSE(σ)) would not have been able to distinguish between candidate (72a) and (72c) and, crucially, this is one of the main motivations for redefining these constraints in alignment terms (see the discussion in Chapter 2). When AL-R([σ]ω,*Ft, ω) and AL-L([σ]ω,*Ft, ω) are both undominated, they have exactly the same effect as EXHAUSTIVITY(σ), i.e. they ensure exhaustive parsing of syllables. However, as soon as one of them dominates the other, unfooted syllables are occasionally allowed and pulled towards an edge of the prosodic word, either left or right (depending on the ranking).

Still, there must be another constraint ranked above AL-L([σ]ω,*Ft, ω) in Tripura so that 4-syllable forms are parsed with recursion (and an unfooted syllable), rather than with two minimal adjacent feet as in (73b). Note that the ranking of (73) would incorrectly select as optimal the candidate with binary rhythm.

(73)

bɛ́naroʃi	AL-R([σ]ω,*Ft, ω)	AL-L([σ]ω,*Ft, ω)
a. ((bɛ́.na)ro) ʃi		*
b. 💣 (bɛ́.na)(ró. ʃi)		

Looking only at forms with 4-syllables, it could be proposed that the constraint that must be ranked above AL-L([σ]ω,*Ft, ω) is the non-intervention constraint that favors economical parsings with few maximal feet (AL-R (FtMax,*Ft, ω)). As shown in tableau (74) below, this ranking would indeed favor the intended optimal candidate in 4-syllable words (i.e. 74a, with recursion). However, this same ranking would incorrectly select a candidate with only one maximal foot and multiple unparsed syllables in a 7-syllable word (i.e.74d) rather than the intended winner (74c) with two non-minimal feet and one unparsed syllable (74c). (Since in all the non-intervention constraints used in the present discussion the intervenor category Cat2 is always a foot (*Ft) and the container category Cat3 is always a prosodic word (ω), for ease of presentation I only indicate the first category (Cat1) in the subsequent tableaux).

(74) Ternary rhythm in 3*n*+1 forms

4-syllable word

bɛ́naroʃi	AL-R[σ]ω	AL-RFtMax	AL-L[σ]ω
a. ☞ ((bɛ́.na)ro) ʃi			*
b. (bɛ́.na)(ró. ʃi)		*!	

7-syllable word

ɔ́nonudaβonijɔ	AL-R[σ]ω	AL-RFtMax	AL-L[σ]ω
c. ☹ ((ɔ́.no) nu) ((dà.βo) ni).jɔ		*!	*
d.💣 ((ɔ́.no) nu). da. βo. ni. jɔ			****
e. ((ɔ́.no) nu) (dà.βo) (ní.jɔ)		**!	

Reranking AL-R(FtMax,*Ft, ω) and AL-L([σ]ω,*Ft, ω) would not solve the problem since AL-L([σ]ω,*Ft, ω) >> AL-R (FtMax,*Ft, ω) would instead favor candidate (74e) over (74c). To solve this problem and ensure ternary rhythm in all 3*n*+1 length words, we can appeal to yet another non-intervention constraint from the small set of constraints provided in Chapter 2. Specifically, in the following tableaux I show that when AL-R([FtMin]ω,*Ft, ω) is ranked above AL-L([σ]ω,*Ft, ω), the correct parsings are predicted in Tripura. Note that this constraint also favors economic parsings with few maximal feet, but, crucially, these maximal feet must be minimal, i.e. directly dominated by the prosodic word. In that sense, AL-R([FtMin]ω,*Ft, ω) is a more specific version of AL-R(FtMax,*Ft, ω).

(75) Ternary rhythm in 3*n* +1 form:

AL-R([σ]ω, AL-R[FtMin]ω >> AL-R([σ]ω

4-σ word	AL-R [σ]ω	AL-R [FtMin]ω	AL-L [σ]ω	AL-L [FtMin]ω	AL-R FtMax
a. ☞ ((ˈσσ)σ)σ			*		
b. (ˈσσ) (ˈσσ)		*!		*	*
7-σ word					
c. ☞((σσ)σ) ((σσ)σ) σ			*		*
d. ((σσ)σ) (σσ) (σσ)		*!		*	**
e. ((σσ)σ) σσσσ			**!**		

This same ranking predicts the correct forms for 3*n* forms (tableau 76) and 3*n*+2 forms (tableau 77). As I proposed previously, TROCHEE is very high-ranked in Tripura and, therefore, all feet are trochaic. In the following tableau I also include IAMB, which is dominated by TROCHEE, but also by other non-intervention constraints, to show that this constraint disfavors candidates with recursion and, in general, with a greater number of feet.

(76) 3*n* forms in Tripura: e.g. ((ó.nu) kɔ) ((rò.ni) jɔ)

AL-R[σ]ω, AL-R[FtMin]ω >> AL-R[σ]ω

6-σ word	AL-R [σ]ω	AL-R [FtMin]ω	AL-L ([σ]ω	AL-L [FtMinω	IAMB
a. ☞((ˈ**σ**σ)σ) ((ˈ**σ**σ)σ)					****
b. ((ˈ**σ**σ)σ) (ˈ**σ**σ) σ			*!	*	***
c. (ˈ**σ**σ) (ˈ**σ**σ) (ˈ**σ**σ)		**!		**	***
d. σ ((ˈ**σ**σ)σ) (ˈ**σ**σ)	*!			*	***
e. ((ˈ**σ**σ)σ) σ (ˈ**σ**σ)	*!		*	*	***

(77) 3n+2 forms in Tripura: eg. ((ʃɔ́.ma).lɔ) (sɔ̀.na)

AL-R[σ]ω, AL-R[FtMin]ω >> AL-L[σ]ω >>AL-L[FtMin]ω

5-σ word	AL-R [σ]ω	AL-R [FtMin]ω	AL-L [σ]ω	AL-L [FtMinω	IAMB
a. ☞ ((ˈ**σ**σ)σ) (ˈ**σ** σ)				*	***
b. ((ˈ**σ**σ)σ) σ σ			**!		**
c. σ σ ((ˈ**σ**σ)σ)	**!				**
8-σ word					
c.☞((ˈ**σ**σ)σ) ((ˈ**σ**σ)σ) (ˈ**σ**σ)				*	*****
d. (ˈσσ)σ) ((ˈσσ)σ) σσ			*!*		*****
e. ((ˈσσ)σ) σσσσ			*!***		**
f. σσσσ (ˈσσ)σ	****!		*		*

Cayuvava presents similar stress patterns to Tripura, with the only difference being that in 3*n*+2 forms, Cayuvava avoids building a minimal foot. Instead, in 3*n*+2 forms, Cayuvava presents non-minimal feet and two unfooted syllables. Furthermore, whereas in Tripura underparsed syllables always occur at the right edge of the prosodic word, Cayuvava unfooted syllables are located at the left edge of the prosodic word. Hence, a five syllable word like *aripírito* [a.ri ((pí.ri) to)] 'already planted' surfaces with one maximal (non-minimal) foot and two unfooted syllables. In order to favor the underparsing of two syllables, the ranking in Cayuvava minimally differs from that of Tripura —where 3*n*+2 forms were exhaustively parsed (77)— in that the two versions of Al-[FtMin]ω must be ranked above the non-intervention constraint that bans unfooted syllables at the right edge of the prosodic word, i.e. Al-R[σ]ω. This ranking is illustrated below in tableau (78). In particular, this tableau demonstrates that 3*n*+2 forms like *aripírito* 'already planted' and/or *ikitàpararépeha* 'the water is clean' surface with stress in the antepenultimate syllable and, in the case of the 8-syllable word, in the subsequent third syllable before the antepenultimate (78b, 78d).

(78) **AL-LEFT[σ]ω, AL-RIGHT/LEFT [FtMin]ω >> AL-RIGHT[σ]ω**

5-σ word	AL-L [σ]ω	AL-R [FtMin]ω	AL-L [FtMin]ω	AL-R [σ]ω	IAMB
a. (ˈ**σ** σ) ((ˈ**σ**σ)σ)		*!			***
b. ☞ σ σ ((ˈ**σ**σ)σ)				**	**
c. ((ˈ**σ**σ)σ) σ σ	**!				**
8-σ word					
c. ((ˈ**σ**σ)σ) ((ˈ**σ**σ)σ) (ˈ**σ**σ)			*!		*****
d. ☞ σσ (ˈσσ)σ) ((ˈσσ)σ)				**	****
e. (ˈσσ)σ) ((ˈσσ)σ) σσ	**!				****
f. σσσσ ((ˈσσ)σ)				***!*	**
g. σσσσ (ˈσσ)σ	*!			****	*

The ranking in (78) correctly predicts the location of stress in words with 3*n* and 3*n*+1 syllables too. This is demonstrated below in (79), where I show the evaluation of a 6- and 7-syllable word.

(79) **AL-LEFT[σ]ω, AL-RIGHT/LEFT [FtMin]ω >> AL-RIGHT[σ]ω**

6-σ word (3*n*)	AL-L [σ]ω	AL-R [FtMin]ω	AL-L [FtMin]ω	AL-R [σ]ω	IAMB
a. ☞ ((ˈσσ)σ) ((ˈσσ)σ)					****
b. (ˈσσ) σ ((ˈσσ)σ)	*!	*		*	***
c. (ˈσσ) (ˈσσ)(ˈσσ)		**!	**		***
7-σ word (3*n*+1)					
a. ☞ σ ((ˈσσ)σ) ((ˈσσ)σ)				*	****
b. (ˈσσ) (ˈσσ) ((ˈσσ)σ)		**!	*		****
c. σσ (ˈσσ) ((ˈσσ)σ)		*!		**	***
d. σ σ σ σ ((ˈσσ)σ)				**!**	**

As I mentioned at the end of the preceding section, here I have only concentrated on presenting the most crucial ranking arguments responsible for the specific metrical structure of Cayuvava and Tripura Bangla words. However, for a full factorial typology that includes the complete set of constraints (e.g. Al-R/L(FtNon-Min, *Ft, ω), the headedness constraints, etc.) as well as further examples and predictions of a theory that uses these types of constraints, see Martínez-Paricio & Kager (2013). Importantly, in that work we show that the metrical model outlined in this thesis is able to generate all the attested patterns of quantity-insensitive rhythmic stress while avoiding the generation of pathological systems. Finally, the hierarchy posited for Tripura Bangla needs to be further investigated in future research, since words with heavy syllables have not been considered and they often alter the stress patterns reviewed here (Das 2001).

To summarize, the following tables (80-83) present in a very schematic way (not marking headedness and with only non-minimal trochaic feet), the main parsings for words with binary and ternary rhythm. In the first languages, which roughly correspond to the ones analyzed in Chapter 3, recursion is highly restricted; in the last table, by contrast, recursive feet are the most common structure present in all forms.

(80) Binary systems: FtNon-min only in the periphery of odd-parity forms

	Odd-parity forms		Even-parity forms
3n	**((σσ)σ)**	3n+1	(σσ)(σσ)
3n+2	**((σσ)σ)**(σσ)	3n	(σσ)(σσ)(σσ)
3n+1	**((σσ)σ)**(σσ)(σσ)	3n+2	(σσ)(σσ)(σσ)

(81) Mixed binary-ternary systems: FtNon-min in odd-parity forms and in 3n forms, whether they have an odd/even number of syllables.

	Odd-parity forms		Even-parity forms
3n	**((σσ)σ)**	3n+1	(σσ)(σσ)
3n+2	**((σσ)σ)**(σσ)	3n	**((σσ)σ)((σσ)σ)**
3n+1	**((σσ)σ)**(σσ)(σσ)	3n+2	**((σσ)σ)**(σσ)(σσ)

(82) Ternary system with unary underparsing: FtNon-min in all forms

	Odd-parity forms		Even-parity forms
3n	**((σσ)σ)**	3n+1	**((σσ)σ)** σ
3n+2	**((σσ)σ)**(σσ)	3n	**((σσ)σ)((σσ)σ)**
3n+1	**((σσ)σ) ((σσ)σ)** σ	3n+2	**((σσ)σ)**(σσ)(σσ)

(83) Ternary system with binary underparsing: FtNon-min in all forms

	Odd-parity forms		Even-parity forms
3n	**((σσ)σ)**	3n+1	**((σσ)σ)** σ
3n+2	**((σσ)σ)** σσ	3n	**((σσ)σ)((σσ)σ)**
3n+1	**((σσ)σ)((σσ)σ)**σ	3n+2	**((σσ)σ)((σσ)σ)**σσ

4.4 Summary and conclusions

In this chapter I have presented an in-depth study of Chugach word-level prosody and shown that several metrically-conditioned phenomena (e.g. gemination of onset consonants in peninitial syllables, consonant fortition, stress assignment, the distribution of pitch, etc.) all receive a unified account once recursive feet are admitted in phonological representations. Furthermore, I have argued that constraints on the tonal preferences of foot dependents (de Lacy 2002a, 2004) must be split in two in order to account for the diverse behavior of unstressed syllables in Chugach. Further evidence for such a claim will be presented in the next chapter.

Importantly, I have also demonstrated that alternative analyses of Chugach (stress-based and/or analyses that posit additional categories in the hierarchy) cannot provide a unified account of all the phenomena examined in this chapter. Finally, to demonstrate the power of the present theory, I have illustrated how this system successfully models more radical ternary patterns, like the ones attested in Tripura and Cayuvava (Martínez-Paricio & Kager 2013).

Hayes (1995) provided several guidelines that should ideally be met by any analysis of ternary rhythm.

> (a) Ideally, most of the formal apparatus needed should already be present in the theory; (b) The theory should provide a formal means of characterizing ternary alternation as marked, since it seems fairly certain (*pace* Levin 1988a) that the phenomenon is quite unusual, especially in comparison to binary alternations. (...); (c) An adequate theory should be restrictive in allowing for the attested ternary cases, but not expanding the power of the framework to the point where it can describe anything. For example, stress alternation at four-syllable intervals appears to be completely unattested, and an adequate theory should exclude it (Hayes 1995: 307-308)

I believe the model outlined in this dissertation and in Martínez-Paricio & Kager (2013) are a good attempt to provide such a theory of ternarity. The reasons for such a statement are decomposed in the following table.

(84)	Hayes guidelines		In this thesis...
A.	The formal **apparatus** to derive ternarity should **already be present** in the theory	✓	Recursive feet are independently needed in binary systems (Chapter 3) and in systems that present further strength distinctions beyond the strong-weak dichotomy (Chapter 3-6)
B.	Account for the **markedness** of ternarity	✓	Every ternary foot consists of two feet and, thus, a ternary foot is more marked with respect to a binary foot in the sense that the former will always incur an extra violation of TROCHEE/IAMB. However, one of the goals of this thesis is to demonstrate that internally layered ternary feet are not as marked as we previously thought.
C.	**Restrictive** power	✓	See Martínez-Paricio & Kager (2013): avoid undergeneration and pathological overgeneration

The next two chapters will present further support for the type of metrical representations proposed in this thesis.

5 Further evidence for the foot-dependent dichotomy

In this chapter I discuss additional phonological phenomena that crucially need to distinguish between minimal and non-minimal feet. In particular, I review several prosodic systems in which unstressed syllables exhibit a dual behavior (Dutch, German, English and Old English) and demonstrate that a theory that structurally differentiates between two types of foot dependents provides a uniform and straightforward account of the dual patterning of non-prominent, but metrically relevant, syllables.

5.1 Introduction

The weak branch of a foot has traditionally been characterized as the target of various phonological weakening processes. Cross-linguistic evidence for this claim comes, for instance, from cases of vowel reduction, vowel syncope, vowel deletion and consonant lenition (e.g. Booij 1977; Whitgott 1982; Kager 1989; Harris & Kaye 1990; Dresher & Lahiri 1991; Hayes 1995; Gouskova 2003; McCarthy 2008; Bye and de Lacy 2008; among others). These and other studies reveal that segments in the weak branch of a foot are more prone to reduce, lenite and/or delete than segments in other unstressed syllables. In a nutshell, it can be stated that, whereas phonological augmentation processes preferentially target foot heads (Chapter 3), weakening processes are very often restricted to foot dependents.

Furthermore, in addition to weakening processes, several segmental foot-conditioned phonotactic restrictions have been claimed to target the weak branch of a foot (e.g. flapping in English, Kiparsky 1979; Whitgott 1982; Jensen 2002). Likewise, foot dependents —as opposed to foot heads or other unstressed syllables in the prosodic word— often display certain preferences for non-prominent vowels (i.e. low-sonority vowels) and non-prominent tones (i.e. low tones) (Kenstowicz 1997; de Lacy 2002a, 2006; Chapter 4 this thesis). All these facts corroborate the idea that the phonology seems to be able to single out the dependent of a foot in a variety of processes, which tend to enhance the intrinsic non-prominent nature of this position.

The goal of this chapter is to review few phonological processes in some of the languages that have been claimed to treat their unstressed syllables differentially for metrically-conditioned phenomena. I will propose that such dual behavior derives from the representational difference between the dependent of a minimal foot and the dependent of a non-minimal foot. As I discussed earlier in Chapter 2 (Section 2.2.2.2), the present framework proposes that there are three types of non-prominent syllables: (i) unstressed syllables that are directly dominated by a minimal foot $[(\text{ˈ}\sigma\ \underline{\sigma})_{\mathrm{Ft}}]\omega$, (ii) unstressed syllables that are immediately dominated by a non-minimal foot $[(\underline{\sigma}\ (\text{ˈ}\sigma\ \sigma)_{\mathrm{Ft}})_{\mathrm{Ft}}]\omega$ and (iii) unstressed syllables that are unfooted, i.e. directly linked to the prosodic word $[\ \underline{\sigma}\ (\text{ˈ}\sigma\ \sigma)_{\mathrm{Ft}}]\omega$.

The specifics of the characterization and properties of each type of non-prominent syllable were largely discussed in Chapter 2. On the basis of different kinds of evidence (e.g. stress assignment, metrically-conditioned phonological processes, the size of the stress window, typological predictions, etc.), I argued that languages must be able to structurally differentiate between syllables that are non-prominent but metrically relevant (those that are in any foot dependent position) and non-prominent syllables that are metrically invisible/irrelevant for stress assignment and other metrical rules (those that are unfooted). The crucial difference between foot dependents and unfooted syllables lies, thus, in their particular behavior with respect to metrics-related rules. Whereas foot dependents may condition the location of primary and secondary stress and/or directly determine the overall metrical structure of prosodic words being the target of metrically-conditioned processes and markedness constraints on tonal and sonority preferences, unfooted syllables are assumed to be invisible for these types of processes. For instance, in quantity-sensitive languages, being *invisible* would entail that the weight of unfooted syllables is irrelevant for stress assignment and/or the location/structure of these unfooted syllables does not condition the location of the head of the prosodic word. By contrast, the location and structure of foot dependents can determine the accentual pattern of a language (see Section 2.2 and Section 6.4 for further details and examples on the difference between unstressed unfooted *vs.* unstressed footed).

In this chapter I look more closely at unstressed syllables that are metrically relevant and show that languages may have two types of these syllables. I argue that this dual behavior of metrically relevant unstressed syllables can be captured by referring to the structural difference between the dependent of a minimal foot and the dependent of a non-minimal foot. Just as Chugach needed to distinguish between the dependent of a minimal foot and the dependent of a non-minimal foot for the correct distribution of tones (Section 4.2.3.2), other languages may exploit this structural difference for other phonological processes.

While a few of the processes reviewed in this chapter could, in principle, receive an alternative account by exploiting the traditional structural difference between (unstressed) unfooted syllables and (unstressed) footed syllables, since most of the cases can only be fully explained in terms of recursive feet (e.g. Chugach, English, Huariapano), this latter analysis is the one to be preferred here. Furthermore, note that by restricting unfooted syllables to those that are completely invisible for metrical processes, we achieve a more coherent and unified theory of metrical representations.

Importantly, the exploration of the dual behavior of foot dependents in this chapter and Chapters 2 and 4 provides independent support for the One Layer Recursive Foot Hypothesis (Section 2.2.3.2): while particular languages exhibit evidence for one or two types of foot dependents, no language displays evidence for additional foot dependents, as a model with unlimited recursion at the level of the foot would predict.

In a more general vein, by exploring various processes that treat foot dependents differentially, this chapter aims at answering the question of whether the dependent of a minimal foot is universally weaker (or stronger) than the dependent of a non-minimal foot. Even though future research exploring additional prosodic systems needs to be carried out, the brief exploration of the relative strength of foot dependents pursued in this chapter leads to the conclusion that, even if foot heads are inherently prominent positions and foot dependents are intrinsically non-prominent, the relative strength of particular foot dependents can vary across languages. That is, in some languages the dependent of a minimal foot will be slightly weaker than the dependent of a non-minimal foot (e.g. in Chugach, Section 4.2.3.2), whereas in other languages, the opposite generalization holds (as in Old English, Section 5.5.). Additionally, in some prosodic systems, what really matters is whether the dependent of a foot is in an initial (or non-initial) position of a maximal foot, independently of its minimal/non-minimal nature. This was shown to be the case in Huariapano (Section 3.6) and in English

(Section 1.3.3.1, and further details in Section 5.4 in this chapter). In these cases, the foot-initial domain displays greater strength than other positions within the foot, along the lines of the greater strength of other constituents in prosodically initial position at other layers of the hierarchy (Trubetzkoy 1939; Fougeron & Keating 1997; Beckman 1998; Keating et al. 2003; Nevins & Levine 2012, among many others).

Before reviewing the phonological evidence that speaks in favor of the dichotomy between foot-dependents, two clarifications about the present proposal should be made explicit. First, the fact that some languages with recursive feet present a phonological process that distinguishes between two types of unstressed syllables does not entail that every language with recursion at the level of the foot must obligatorily display a phonological process that relies on such a distinction. In fact, this has not been the case for many of the languages for which I have proposed two projections of a foot (e.g. Wargamay, Yidiɲ, Tripura Bangla...). The theoretical claim is slightly different: the phonology of a language with minimal and non-minimal feet might *potentially* rely on the structural difference between its two types of foot dependents, as in Chugach. Second, the alleged contrast between two types of foot dependents should not be interpreted as a refutation of the existence of unfooted syllables. As I proposed in Chapter 2 and restated at the beginning of this section, the present model allows for three types of non-prominent syllables (i.e. dependent of FtMin, dependent of FtNon-min and unfooted syllable). The metrical positional markedness constraints (on stress, sonority/tonal preferences, etc.) proposed in this thesis all refer to metrical positions that are positively defined. That is, there are constraints on the sonority/tone preferences of foot heads (favoring high prominence vowels and tones) and constraints on the sonority/tone preferences of foot dependents (favoring low prominence vowels/tones). This does not prevent the interaction of other constraints from occasionally affecting the shape/location of unfooted syllables, which tend to be chained at one edge of the prosodic word (see Section 2.2.2 for discussion and examples).

Finally, it should be clear that I do not intend to reanalyze in terms of recursive footing every previous analysis which, in order to account for some dual behavior of unstressed syllables, alluded to a contrast between footed *vs.* unfooted syllables rather than to a contrast between two types of foot dependents. On the contrary, I incorporate their main insight: the idea that phonology can single out the weak branch of a foot for some weakening processes and/or other phonological phenomena. However, since the footed-unfooted approach proves insufficient in several cases (e.g. Chugach pitch, English aspiration, Seneca accent assignment) and, furthermore, since there is independent evidence for recursive footing in representations, I suggest that we exploit the already available structural device that distinguishes between non-prominent syllables and leave the notion of "unfooted/unparsed" material for elements that are completely invisible for metrical purposes (e.g. accent assignment).

The chapter is organized as follows. First, I review a few classical examples in which the weak branch of a minimal foot behaves more weakly than other unstressed syllables in the prosodic word. In Section 5.2 I review the interesting patterns of vowel reduction in Dutch (Booij 1977; Kager 1989). Then, I examine the particular distribution of German schwa and its pre-stressed nature (based on Féry 1998; Zonneveld, Trommelen, Jessen, Rice, Bruce & Árnason 1999 and references therein; Itô & Mester 2011, Section 5.3) and in Section 5.4 I look at the distribution of English voiceless aspirated and unaspirated stop allophones (e.g. Whitgott 1982; Jensen 2000; Davis 2005 *inter alia*). Second, in Section 5.5 I present a prosodic system in which the dependent of the minimal foot is stronger than the dependent of the non-minimal foot. This is the case of one of the most traditional examples for internally layered ternary feet: the Germanic foot of Dresher & Lahiri (1991) in Old English. The examination of all these language-particular phenomena leads to the conclusion that a theory of representation needs to be able to structurally distinguish between dependents of minimal feet and dependents of non-minimal feet. Rather than presenting a detailed OT analysis of all these processes, I mainly concentrate on discussing representation-related aspects of these prosodic systems, sketching the main points that will need to be addressed in a constraint-based analysis.

5.2 Vowel reduction in Dutch

One of the most well known cases in which unstressed syllables exhibit a dual behavior depending on their specific position is the process of vowel reduction in Dutch. In this language, reduced vowels are not only excluded as stress-bearing elements but, in certain registers, they only surface in a subset of the non-prominent positions (Booij 1977; Kager 1989). On the basis of these facts, in addition to the traditional dichotomy between *strong* positions (phonological heads) and *weak* positions (non-heads) (Chapter 2), van Oostendorp (1995: 130) introduced a new contrast between *weak* and *semiweak* positions (see also Balogné 2011). In the following pages, I propose that an optimal way to capture this strength subdivision among unstressed syllables is by referring to the structural difference between foot-dependents.

Without entering into a detailed examination of all the conditioning factors of vowel reduction in Dutch (different reduction patterns are attested depending on the quality of the vowel, the style, phonotactics, etc.), a generalization that has been reported in every analysis of the phenomenon is that it often needs to distinguish between two types of unstressed syllables (Booij 1977: 130-135; Kager 1989: 312-317; van Oostendorp 1995: 129, de Lacy 2002b, 2006 *inter alia*). This contrast between two types of unstressed syllables is summarized in van Oostendorp's own words:

> The facts can be demonstrated on the word *fonologie* 'phonology' [fònoloɣí]. In very formal speech, this word is pronounced as just indicated. Two alternative, less formal pronunciations are possible: [fònəloɣí] and [fònələɣí]. The latter one is even more informal than the former. What is crucially impossible is the pronunciation *[fònoləɣí]. If the second vowel reduces, the first one should reduce as well (Booij 1976, 1982)" (from van Oostendorp 1995: 129).

The key generalization for the theory of representations postulated here is that the forms in (1b) are impossible in Dutch.

(1) a. Possible outcomes for *fonologie, lokomotief, individu*:

(i)	Formal register	[fònoloɣí], [lòkomotíf], [ìndividú]
(ii)	Semi-formal register	[fònəloɣí], [lòkəmotíf], [ìndəvidú]
(iii)	Very informal register	[fònələɣí], [lòkəmətíf], [ìndəvədú]

b. Impossible *[fònoləɣí], *[lòkomətíf], [ìndivədú]

In the semi-formal register, only one of the identical unstressed vowels undergoes reduction (1a.ii); crucially, the one immediately following the stressed syllable. Thus, it can be stated that such a syllable is *weaker* than other unstressed syllables in other positions, since the latter escape from reduction. In other registers, the quality of the two vowels is either maintained (1a.i, formal) or reduced (1a.iii, informal). Additional data illustrating the patterns of reduction in the Dutch semi-formal register are presented in (2). The vowel that undergoes reduction in semi-formal speech (underscored in 2) does not reduce in formal speech.

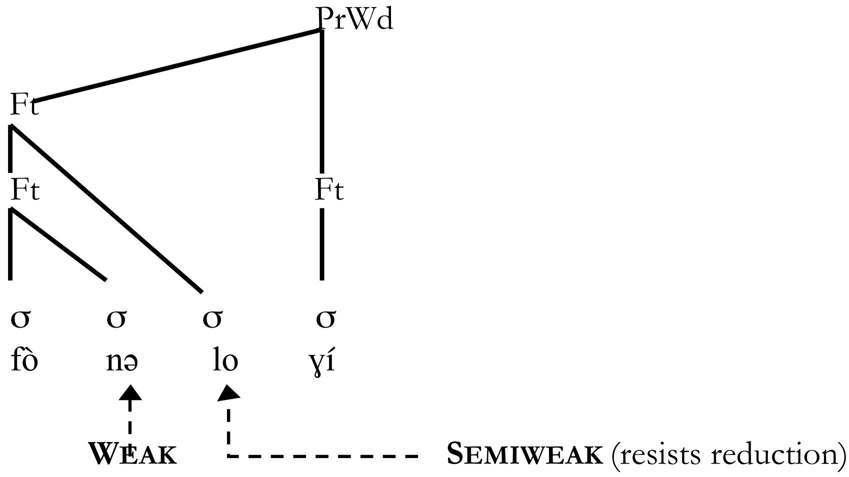
(2) Reduction in semi-formal speech (Kager 1989: 309-316)

	Transcription	Orthography
a. Reduction of /a/	[kàrəmέl]	*karamel*
	[jèryzəlέm]	*Jerusalem*
b. Reduction of /e/	[èkənòmətrí]	*econometrie*
	[àntəsədέnt]	*anctecedent*
c. Reduction of /o/	[fònəloɣí]	*fonologi*
	[lòkəmotíf]	*lokomotief*
d. Reduction of /i/	[indəvidú]	*individu*
	[sèrtəfikát]	*certificaat*
f. /y/ and /u/ do not reduce		
	[kòmyníst]	*communist*
	[kàmufláʒə]	*camouflage*

Here I will only focus on analyzing the positional restriction illustrated in examples (1ii, 2c,2d). In these data there are two identical unstressed vowels — namely, /i/ and /o/—, but only one of them reduces in semi-formal speech. For a full analysis of all the other factors that condition vowel reduction in Dutch (quality of the vowel, phonotactics, etc.) the reader is referred to Kager 1989; van Oostendorp 1995 and de Lacy 2002b, 2006.

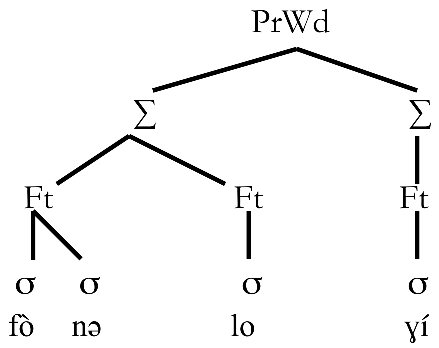
One possible way to capture the contrast between attested [fònəloɣí] *vs.* unattested *[fònoləɣí] —in van Oostendorp's words, the contrast between *weak* (e.g. *fò**no**logíe*) and *semi-weak* unstressed syllables (e.g. *fònologíe*) in Dutch— is to rely on their structural differences. In semi-formal speech, an unstressed syllable that is directly dominated by a minimal foot behaves as *weaker* than an unstressed syllable that is directly dominated by a non-minimal foot. The following representation in (3) illustrates this contrast in strength, typical of the semi-formal register in Dutch.

(3) Dependent of a minimal foot *vs*. dependent of a non minimal foot



The representation in (3) is inspired by van Oostendorp's original analysis. This author proposed that the Dutch facts could benefit from the inclusion of an intermediate prosodic category between the metrical foot and the prosodic word in the prosodic hierarchy: the superfoot. For the sake of comparison, van Oostendorp's representation for *fonologie* is given in (4). The symbol ∑ is the abbreviation for superfoot, the prosodic category above the foot.

(4) Dependent *vs*. head of non-branching foot (van Oostendorp 1995: 130)

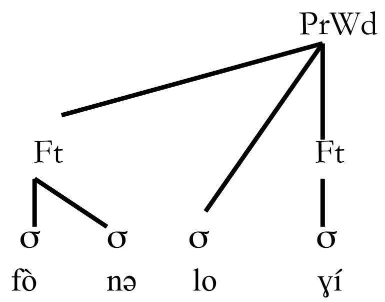


*[fònoləɣí]

According to van Oostendorp's superfoot analysis, *-lo-* does not reduce in semi-formal speech because it is in a foot-head position, and foot-heads resist reduction; on the contrary, *-no-* is in a non-head position and its non-prominent status favors reduction. Despite the descriptive adequacy of this analysis, there are two reasons for favoring a recursive foot-based account (3) over a superfoot account (4). On the one hand, van Oostendorp needs to posit a new category in the prosodic hierarchy: the superfoot. By contrast, the analysis in (3) is based on independently well-established categories in the prosodic hierarchy and, thus, it makes fewer assumptions about universal constituents (see Itô & Mester 2007 *et seq.* for the superiority of a single-category approach as opposed to a model that introduces new categories in the hierarchy, as well as Chapter 1). On the other hand, as a direct consequence of the superfoot approach and strict adherence to the EXHAUSTIVITY requirement in the prosodic hierarchy (i.e. a category Xj must dominate a category Xj-1) in (4), van Oostendorp's representation presents a greater number of feet and superfeet, even if there is not always independent evidence for all these categories. For instance, it is not completely evident what the motivation for projecting a superfoot in the last syllable in the word and/or a degenerate foot in the third syllable in (4) would be. Note that the degenerate foot in *-lo-* could in principle predict tertiary stress in this syllable, causing a stress clash with the following syllable. To preclude this prediction, it could be simply stated that Dutch allows covert feet (i.e. feet without overt manifestation of stress), *-lo-* being one of them. Likewise, it could be argued that *-lo-* does not carry stress because it is in the non-head position of a superfoot and, maybe, Dutch assigns stress only to heads of superfeet. Although these explanations are all possible, the recursion-based account in (3), in which both *-no-* and *-lo-* are in a structurally different non-prominent position (i.e. dependent of FtMin and dependent of FtNon-min) provides a simpler and more economical account of the facts: it assumes fewer prosodic categories and primitives.

In previous analyses, the dual behavior of unstressed syllables in Dutch was explained in terms of feet, but in a slightly different way. Specifically, Kager (1989: 312) proposed that the different behavior of unstressed syllables in Dutch was due to the structural difference between stray syllables (i.e. unfooted syllables that are directly linked to the prosodic word) and syllables that are in the weak-branch of a foot (i.e. dependent of a minimal foot). This representational account is illustrated in (5). According to Kager's explanation, unfooted syllables are stronger than footed syllables and, thus, it is not surprising that only the second syllable undergoes reduction.

(5) Unstressed syllables: footed *vs.* stray syllables



*[fònoləɣí]

Given the representation in (5), one might wonder if recursive footing is really necessary to account for the double behavior of unstressed syllables in Dutch, since the contrast between unfooted and foot dependent would also be able to predict the dual pattern of unstressed syllables. Note, however, that whereas there is independent evidence for the need of recursive footing in languages with rhythmic stress (e.g. binary and ternary rhythm, the particular distribution of pitch, segmental phonotactics, etc.) there is not so much evidence for the presence and causes for leaving unfooted material in word-medial position in languages with iterative stress. Hence, the independent motivations for leaving *-lo-* unfooted are not clear. Recall that within the present framework, iterative rhythm results from placing maximal feet one after another (whether minimal or non-minimal). Therefore, unfooted syllables are not predicted to occur word-medially in languages with iterative stress. [1] Furthermore, while extrametricality could be appealed to as an explanation for why syllables are left unfooted at word-edges, the reason for avoiding adjacent feet in Dutch (and other languages) presenting unfooted syllables word-medially is not self-evident. Finally, whereas there is ample evidence for prosodic recursion at several layers of the prosodic hierarchy and, thus, recursive feet could in principle be possible, prosodic constituents at other levels of the prosodic hierarchy are generally adjacent (unless some syntactic force breaks the general adjacency of categories within the same layer) and the violation of adjacency exclusively at the foot level, as proposed in (5), is therefore a bit suspicious. In short, although one could resort to the shared non-prominent status of material that is not in a foot head position to account for the Dutch facts, since there is growing evidence for the need for recursion at the level of the foot in phonological representations (Caballero 2008, 2011; Bennett 2013, Kager 2012, Chapters 3 & 4 in this thesis) and the evidence and/or motivation for word-internal unfooted syllables in rhythmic systems is not clear, the recursion-based analysis is preferred here.

In Section 5.2.2 I explore the hierarchy of constraints that can account for the greater *weakness* of dependents of minimal feet in Dutch within an OT framework. This analysis takes for granted the representations with recursive

[1] The only instances of languages with unfooted word-medial syllables are languages with edge-based stress systems in which there are only two feet and two stresses per word, each one anchored at one edge of the prosodic word, e.g. Watjarri, Armenian, Udihe, Georgian... (see Gordon 2002 for more examples). Still, these systems are not *purely* rhythmic systems, but their rhythmicity is a consequence of the requirement that at each edge of the prosodic word there must be a foot. This is not the case in Dutch, since long words can display more than two stresses per prosodic word, e.g. *specificiteit* [(spèsə)(fisə)(téit)].

footing in (3). Before presenting the analysis of Dutch, however, the following section presents the general OT tools that will be exploited to capture the general differences in the behavior of foot-dependents across languages.

5.2.1 Sonority preferences of foot dependents and their relative strength

It has long been acknowledged that vowels may exhibit certain preferences for specific metrical positions. In particular, high sonority vowels are often preferred in the head of a foot, whereas low sonority vowels are generally attracted to the dependent of a foot (Kenstowicz 1997; de Lacy 2002a, 2004). To capture these metrical preferences, de Lacy (2004) postulated the stringency hierarchies of sonority constraints given in (6a,b). These hierarchies ban non-prominent vowels (i.e. low sonority vowels) in the prominent position of a foot (i.e. its head) (6a) and penalize prominent vowels in non-prominent positions, i.e. the dependent of a foot (6b) (de Lacy 2004: 147). Following de Lacy, *a* stands for low peripheral vowels, *e•o* for mid peripheral vowels, *i•u* for high peripheral vowels and *ə*, ɨ for mid and high central vowels, respectively. I will use these shortcuts for vowels in the subsequent discussions too.

(6) Stringency Hierarchy sonority constraints (from de Lacy 2004: 147)

a. Head of a foot	b. Dependent of a foot
*HDFT/ɨ	*NON-HDFT/a
*HDFT/ə, ɨ	* NON-HDFT/a, e•o
*HDFT/i•u, ə, ɨ	* NON-HDFT/a, e•o, i•u
*HDFT/e•o, i•u, ə, ɨ	* NON-HDFT/a, e•o, i•u, ə,
*HDFT/a, e•o, i•u, ə, ɨ	* NON-HDFT/a, e•o, i•u, ə,ɨ

Since the present thesis envisages the possibility that languages allow recursive footing, the *NON-HEADFOOT constraints can be satisfied (or violated) by the two weak branches of a recursive foot, i.e. ((ˈσ σ̲) σ̲). Such an approach predicts exactly the same behavior in the two dependents of a foot, independent of whether they are immediately dominated by a non-minimal foot ((ˈσσ)σ̲) or a minimal foot ((ˈσσ̲)σ). Nevertheless, the Dutch data just reviewed, as well as the Chugach data presented in Chapter 4, highlighted the necessity of distinguishing between two types of unstressed footed syllables. Crucially, in languages in which unstressed footed syllables exhibit a dual behavior, the node that immediately dominates the unstressed footed syllable (i.e. FtMin or FtNon-min) may determine its particular phonological activity. Consequently, any appropriate theory of recursive footing must be able to formally distinguish between two types of foot dependents.

Along the lines of the strategy followed in Chapter 4 for the tonal hierarchy of foot dependents (Section 4.2.3.2), I propose splitting de Lacy's (7b) general sonority constraints on foot dependents in two, one referring to the dependent of a FtMin (7a) and the other one alluding to the dependent of a FtNon-min (7b).

(7) Two types of foot-dependents

a. Dependent of FtMin	b. Dependent of FtNon-Min
*NON-HD$_{\text{FTMIN}}$/a	*NON-HD$_{\text{FTNONMIN}}$/a
* NON-HD$_{\text{FTMIN}}$/a, e•o	* NON-HD$_{\text{FTNONMIN}}$/a, e•o
* NON-HD$_{\text{FTMIN}}$/a, e•o, i•u	* NON-HD$_{\text{FTNONMIN}}$/a, e•o, i•u
*NON-HD$_{\text{FTMIN}}$/a, e•o,i•u, ə	*NON-HD$_{\text{FTNONMIN}}$/a,e•o,i•u,ə
*NON-HD$_{\text{FTMIN}}$/a,e•o,i•u,ə,ɨ	*NONHD$_{\text{FTNONMIN}}$/a,e•o,i•u,ə,ɨ

The two sets of constraints in (7a,b) favor low-sonority vowels in weak branches of feet. However, by splitting de Lacy's general sonority constraints in two specific constraint sets —one referring to minimal foot dependents and the other one referring to non-minimal foot dependents— it is possible to account for the warranted dichotomy among unstressed footed syllables. For instance, the ranking *NON-HD$_{\text{FTMIN}}$/...>>*NON-HD$_{\text{FTNONMIN}}$/..., in which the sonority constraints on dependents of FtMin dominate the constraints on dependents of FtNonMin, predicts a greater *weakness* in dependents of minimal feet. Remember from the discussion in Chapter 2 that being *phonologically weaker* entails licensing fewer contrasts, allowing less structure, exhibiting a preference for non-prominent material, being the target of weakening processes, etc. (Section 2.2.2.1). In the particular context of sonority distributions, being *weaker* entails licensing fewer high-sonority vowels in comparison with the vowels licensed in foot heads and dependents of non-minimal feet. This is in fact the case of Dutch and German (Section 5.3 below), whose minimal foot dependents tend to behave as weaker. However, in other systems, dependents of non-minimal feet are weaker than dependents of minimal feet (Section 5.5). In sum, even though dependents of FtNon-min and FtMin both show a general preference for non-prominent vowels (and non-prominent tones, non-prominent structures, etc.), having two distinct constraints on foot dependents permits us to capture language particular differences regarding the relative strength of foot dependents. Note that the opposite ranking (i.e. *NON-HD$_{\text{FtNonMin}}$/...>>*NON-HD$_{\text{FtMin}}$/...), in which the constraints on non-minimal foot dependents outrank those on minimal feet, predicts a greater strength in the dependent of a minimal foot. Although it seems to be cross-linguistically more common that dependents of minimal feet behave as weaker than dependents of non-minimal feet, an exploration of the strength of non-heads in this chapter reveals that the relative strength of foot-dependents is in fact language particular. Therefore, our theory should be able to predict this type of variation too. In Section 5.5 I will show that the widely discussed process of high-vowel deletion in Old English (Dresher & Lahiri 1991; Rice 1992) constitutes a clear counter-example to the greater strength of dependents of non-minimal feet. In Old English, it was precisely a high vowel in the dependent of a non-minimal foot that underwent deletion, but high vowels in dependents of minimal feet resisted deletion.

As we saw in Chapter 4, additional evidence for the language particular strength of non-heads comes from the distribution of tones. In particular, when the distribution of tones is at stake, a language with recursive footing may exhibit a preference for low tones in either the dependent of a minimal foot or the dependent of a non-minimal foot. In terms of relative strength, the dependent that attracts a low tone in a given language can be interpreted as somewhat stronger than the dependent of a foot that is not assigned a specific tone at all. Interestingly, in Chapter 4 I argued that, in addition to de Lacy's (2002a) cases in which a low is attracted to the dependent of a minimal foot, there are instances in which the low is instead attracted to the dependent of a non-minimal foot, as in Chugach.

To summarize the main proposal of this section, the following table captures the types of interactions between foot-dependent constraints and their respective predictions. Although the primary goal of this section was to provide an account for the metrical preferences of foot dependents as related to sonority, the following ranking schema can be adopted for other prominence scales (e.g. tonal, Chapter 4) as well as other phonological properties that might be metrically conditioned (e.g. epenthesis, deletion, etc.). In (8-10) X stands for a particular sonority or tone value, as above in (7).

(8) FtMin dependent constraints ~ FtNon-min dependent constraints

Possible rankings	Predictions
(i) *NON-HD$_{\text{FtMin}}$/X>>*NON-HD$_{\text{FtNonMin}}$/X	– Dependents of minimal feet are weaker (e.g. they license fewer high-sonority vowels; they allow fewer tone contrasts, fewer prominent segments, target deletion, etc.)
(ii) *NON-HD$_{\text{FtNonMin}}$/X >>*NON-HD$_{\text{FtMin}}$/ X	– Dependents of non-minimal feet are weaker

The particular ranking of the specific constraints on foot dependents (i.e. whether *NON-HD$_{\text{FtMin}}$/X dominates *NON-HD$_{\text{FtNonMin}}$/X (8i) or the other way round, (8ii)), determines the relative strength of foot dependents in a particular language. As I will demonstrate later, this is a desirable prediction since the exploration of the strength of foot-dependents in several prosodic systems reveals linguistic variation within this respect. For instance, even if dependents of minimal feet tend to be weaker than those of non-minimal feet, the reversed strength relation is also attested (i.e. dependents of non-minimal feet being weaker than dependents of minimal feet).

For this same reason, the two logically possible alternatives to account for the dual behavior of unstressed footed syllables sketched in (9) and (10), which involve the use of a general constraint on all types of foot dependents (i.e. *NON-HD$_{\text{Ft}}$/X) and a specific constraint on dependents, either on minimal feet (*NON-HD$_{\text{FtMin}}$/X) or on non-minimal feet (*NON-HD$_{\text{FtNonMin}}$/X), are disregarded. Note that the ranking schema in (9) characterizes the dependent of a minimal foot as universally weaker than the dependent of a non-minimal foot, whereas the ranking schema in (10) predicts exactly the opposite situation, i.e. the dependent of the non-minimal foot is universally weaker. To illustrate the greater restrictive power of this type of general-specific approach, the following tables summarize the main predictions of these two alternative analyses. As might be expected in any Paninian relation, the action of these sets of constraints can only be perceived when the specific constraint outranks the respective general constraint on foot dependents.

(9) General Ft dependent constraints ~ MinFt dependent constraints

Possible rankings	Predictions
(i) *NON-HD$_{\mathrm{FT}}$/X >> *NON-HD$_{\mathrm{FTMIN}}$/X	- All dependents display the same behavior
(ii) *NON-HD$_{\mathrm{FTMIN}}$/X >> *NON-HD$_{\mathrm{FT}}$/X	- Dependents of minimal feet are weaker

(10) General Ft dependent constraints~ NonMinFt dependent constraints

Possible rankings	Predictions
(i)*NON-HD$_{\mathrm{FT}}$/X>>*NON-HD$_{\mathrm{FTNONMIN}}$/X	- All dependents display the same behavior
(ii) *NON-HD$_{\mathrm{FTNONMIN}}$/X >>*NON-HD$_{\mathrm{FT}}$/X	- Dependents of non-minimal feet are weaker

To conclude, the only strength generalizations that seem to hold universally are the following: (i) foot heads are universally stronger than foot dependents, (ii) the phonology of particular languages treats heads and dependents of feet differently and (iii) phonology can single out a subset of the foot-dependents to the exclusion of other non-prominent syllables for some phonological processes. Consequently, the specific behavior of foot-dependents might vary across languages. Future research investigating the phonology and morphology of languages that present some evidence for recursive feet will help to provide further support on the language particular strength of foot-dependents.[2]

5.2.2 Sketch of an OT analysis

In this section I demonstrate that the interaction of the foot-dependent constraints proposed in (7) are able to correctly account for the positionally conditioned dual behavior of unstressed syllables in Dutch. The present reanalysis relies on de Lacy's original analysis (2002b); however, his initial insights have been adapted here to conform to the new representational assumptions, by which prosodic recursion can target the category of the foot.

[2] It would be interesting, for instance, to investigate processes of syncope and/or truncation in languages with recursive footing, to see if there is a preference for deleting segments/syllables of a specific foot-dependent.

Remember that in the semi-formal register, words like *fonologie* may exhibit reduction in the dependent of a minimal foot, e.g. [((fònə)lo)(ɣí)] but crucially not in the dependent of a non-minimal foot *[((fòno)lə)(ɣí)]. To predict these patterns within an OT framework, we simply rank the constraint against non-central vowels in minimal foot dependents (i.e. *NON-HD$_{\text{FTmin}}$/a, e•o, i•u) above the faithfulness constraint that preserves the relevant underlying vocalic feature specifications. Since here I am mainly interested in the positional restrictions on reduction, for ease of presentation I use the constraint IDENT{o,i} as a placeholder for such a constraint, but see van Oostendorp (1995) and de Lacy (2002b, 2006) for a more elaborated analysis of this point.[3] This ranking is illustrated in tableau (11). This tableau also shows that the constraint on dependents of non-minimal feet (i.e. *NON-HD$_{\text{FTNONMIN}}$/a, e•o, i•u) must be ranked below *NON-HD$_{\text{FTMIN}}$/a, e•o, i•u so that the only unstressed vowels that undergo reduction are the ones that are immediately dominated by a minimal foot.

(11) Semi-formal style: [fònəloɣí]

fonoloɣi	* NON-HD$_{\text{FTMIN}}$ /a, e•o, i•u	ID{i,o}	* NON-HD$_{\text{FTNONMIN}}$ /a, e•o, i•u
a.☞((fònə)lo)(ɣí)		*	*
b. ((fòno)lə)(ɣí)	*!	*	
c. ((fòno)lo)(ɣí)	*!		*
d. ((fònə)lə)(ɣí)		**!	

By re-ranking these constraints, which correctly account for the particular pattern of reduction in Dutch semi-formal register, we are able to generate the reduction patterns in the informal register (tableau 12), where both unstressed syllables reduce (e.g. [fònələɣí]), and in the formal register (tableau 13), where none of the vowels in a foot dependent position reduce (e.g. [fònoloɣí]). These tableaux corroborate the prediction that the two dependents of a non-minimal foot can reduce when the two constraints against reduction are ranked at the top of the hierarchy (tableau 12). By contrast, reduction is

[3] As I anticipated and illustrated in (2), vowel quality also conditions the patterns of reduction. In particular, in semi-formal speech /a/ and /e/ can reduce in both positions (dependent of FtMin and dependent of FtNon-min) whereas /y/ and /u/ never reduce in a foot-dependent. Therefore, a complete analysis of vowel reduction in Dutch should account for the different vocalic classes/features which can condition the process, i.e. whatever constraint preserves /y, u/ must be undominated and the one preserving /a,e/ would need to be ranked below NON-HD$_{\text{FTmin}}$/a, e•o, i•u.

completely blocked if the faithfulness constraint preserving the relevant underlying vocalic features is more highly ranked, as in tableau (13). It can be concluded, then, that an analysis that allows (i) recursive footing and (ii) splitting the constraints on foot dependents in two is able to account for the dual behavior of unstressed syllables in Dutch.

(12) Informal style: [fònələɣí]

fonoloɣi	* NON-HD$_{\text{FtMin}}$ /a, e•o, i•u	* NON-HD$_{\text{FtNonMin}}$ /a, e•o, i•u	ID{i,o}
a. ((fònə)lo)(ɣí)		*!	*
b. ((fòno)lə)(ɣí)	*!		*
c. ((fòno)lo)(ɣí)	*	*!	
d.☞((fònə)lə)(ɣí)			**

(13) Formal style: [fònoloɣí]

fonoloɣi	ID{i,o}	* NON-HD$_{\text{FtMin}}$ /a, e•o, i•u	* NON-HD$_{\text{FtNonMin}}$ /a, e•o, i•u
a. ((fònə)lo)(ɣí)	*!		*
b. ((fòno)lə)(ɣí)	*!	*	
c.☞((fòno)lo)(ɣí)		*	*
d. ((fònə)lə)(ɣí)	**!		

To sum up, in this section I have argued that the recursive-footing machinery is suitable for capturing yet another phonological aspect: the strength difference between unstressed syllables in Dutch. I have argued that this dual patterning of unstressed syllables with respect to weakening processes can be interpreted as further support for the proposal made in chapter 4, by which constraints on dependents of a foot should be split in two. To illustrate this, I have shown that the interaction between constraints on minimal foot dependents and constraints on non-minimal foot dependents is crucial and necessary to generate the attested patterns of vowel reduction in Dutch. Further evidence for the greater weakness of the dependent of a minimal-foot —and, consequently, for the need for specific constraints that target such a position— has been reported for other languages apart from Dutch (e.g. de Lacy 2002a,b; McCarthy 2008; Itô & Mester 2011). The next subsections review some of this evidence in German and English.

5.3 The pre-stressed nature of German schwa

Building on previous research on German stress (Giegerich 1985; Féry 1998; Fuhrhop 1998; Zonneveld, Trommelen, Jessen, Rice, Bruce & Árnason 1999 and references therein), in a recent paper, Itô & Mester (2011) provide compelling evidence for the need to distinguish between two kinds of unstressed syllables in German: (i) those appearing in the weak branch of a trochaic foot *vs.* (ii) the rest of unstressed syllables. In particular, Itô & Mester demonstrate that schwa in German *must occupy the weak branch of a trochaic foot, attracting stress to the preceding syllable* (Itô & Mester 2011: 27). Although Itô & Mester's analysis is not couched in a recursive foot-based framework, their findings regarding the pre-stressed nature of schwa constitute further cross-linguistic support for the cornerstone idea of this chapter: phonology might impose different restrictions on unstressed syllables depending on their particular prosodic structure.

In this section I review Itô & Mester's arguments in support of the pre-stressed nature of schwa and propose that this peculiarity of German can be accounted for via the interaction of the independently motivated sonority constraints presented in the preceding section in (7) (based on Kenstowicz 1997 and de Lacy 2004). Before summarizing Itô & Mester's main arguments (5.3.2), however, it will be necessary to familiarize ourselves with the general patterns of stress assignment in the language (5.3.1).

5.3.1 Default stress in German

Primary stress in German monomorphemic words is generally subject to the three-syllable window, i.e. it is limited to the last three syllables of the word (Zonneveld *et al.* 1999). Even though stress is sometimes lexically determined, there is a default pattern of stress, which arises in the absence of specific underlying stress specifications. An illustration of the default pattern of stress in German as understood by Itô & Mester (2011:31) is given in (13). Default stress in German is quantity-sensitive and it favours stress in heavy syllables (e.g. Giegerich 1985; Alber 1997; Féry 1998).[4] Note that Itô & Mester's analysis is based on the assumption that word-final consonants are

[4] Although some works deny the weight-sensitive nature of German stress (e.g. Wiese 1996; Levelt et al. 1999).

extrametrical.[5] According to the authors, stress is final when the word ends in a (super) heavy syllable, i.e. a syllable with either (i) a long vowel followed by at least one consonant, (ii) a short vowel followed by at least two consonants or (iii) a diphthong (14a); if the final syllable is instead light, stress falls on the penultimate syllable when it is heavy (14b) or on the antepenultimate syllable when the penultimate is light (14c). There is a lot of debate regarding the specific moraic structure of stressed tense vowels in open syllables in German (14c) but, generally, it has been assumed that they are light and lengthen as consequence of stress. Note that even if they where heavy, stress would fall on the antepenultimate syllable, since the penult is light.

(14) Summary of the stress-pattern from Itô & Mester (2011: 31)[6]

a. Final superheavy	pa.pa.ˈgei L L **(H)**	'parrot'
b. Heavy penult	hi. ˈbi s. ku<s> L **(H L)**	'rose mallow'
c. Light penult and antepenult	[ˈtre:].mo.lo **(L L)** L	'quaver'

As previewed in Chapter 2, in a recent study on the typology of stress window systems, Kager (2012) argues that the most suitable representation to account for the three-syllable window restriction in languages is to posit an internally layered ternary foot at the edge of the prosodic word. Interestingly, Kager shows that such an analysis is the only one capable of generating the full typology of window systems without overgenerating metrical pathologies (see Kager 2012 for discussion). On the basis of these findings, I slightly modify Itô & Mester's metrical representations for words with antepenultimate stress to accommodate Kager's observation. This gives us the structure in (15).

---

[5] Itô & Mester assume that antepenult stress can be sometimes assigned by default (specifically, when the last three syllables are light). However, previous quantity-based approaches assumed that only penultimate and final stress is assigned by default, whereas antepenult has to be always lexically specified (see Domahs et al. 2013 and references therein).

[6] Following Itô & Mester, I code the examples in German orthography, indicating phonetic details like schwa, stress and vowel length.

(15) Three syllable-window in German

c. Antepenult stress ˈtre. mo. lo

((μ^h μ) μ)

5.3.2 Alteration of default stress

The interesting fact about German is that the patterns outlined in (14) can be systematically altered in the presence of a schwa (see Zonneveld *et al.* 1999 and references therein). For instance, when a final vowel has historically been reduced to schwa, stress shifts from expected antepenult to penult, e.g. ˈvi.o.la > vi.ˈo.l[ə], ˈge.ne.sis > ge.ˈne.s[ə] (Giegerich 1985; Zonneveld *et al.* 1999: 522). Additionally, the pre-stressed nature of schwa is evident in some borrowings from English and Spanish (e.g. ˈmor.mon > mor.ˈmo.n[ə], ˈi.ro.quois > i.ro.ˈkés[ə]) (Koepcke 1995) and in other German words, as for example the nouns ending in *–or*, which shift their stress when a schwa syllable is added to them, e.g. ˈdok.to.r > dok.ˈto.r[ə]n (Zonneveld *et al.* 1999; Itô & Mester 2011).

Additionally, the pre-stressed nature of German schwa is corroborated by Féry's (1998) corpus search, which reports that monomorphemic trisyllabic words with final schwa tend to have penultimate stress (e.g. zi.ˈtr[oː]..nə 'lemon', me.ˈth[oː].də 'method', ta.ˈp[eː].tə 'wallpaper' (see Zonneveld *et al.* 1999 for more examples) rather than the expected antepenultimate stress (cf. 14c). Interestingly, most of the monomorphemic trisyllabic words with antepenultimate stress have a final full vowel, and not a schwa (e.g. ˈtr[eː].mo.lo 'quaver', ˈd[oː].mi.no 'domino'. A final piece of evidence in support of the pre-stressed nature of schwa comes from German names for inhabitants of countries. In particular, Fuhrhop (1998) and Itô & Mester (2011), among others, show that the allomorphs for demonyms are often selected in a way that a schwa is favored on a foot-dependent position. The two main allomorphs to form demonyms in German are *-ə* and *-ər* (16a, b). These allomorphs can appear alone or preceded by an interfix (e.g. *es-ə*, *an-ər*) depending on the base word, as illustrated in (16c,d).

(16) Demonyms' allomorphs in German (from Itô & Mester 2011:38)

a. Af ˈghanistan	Af (ˈghan-ə)	b. Äˈgypten	Äˈgypt-ər)
c. ˈSenegal	Senega (ˈl-es-ə)	d. ˈMexiko	Mexi(ˈkan-ər)
	*(ˈSene)gal-ə		*(ˈMexi)ko-ər
	*Se(ˈne.ga)l-ə		*(ˈMexi)k-ər
			*Me(ˈxik-ər)[7]

The facts that the forms in (16c) and (16d) surface with the interfix and that "the number of country demonyms where stress falls on the pre-ə syllable is overwhelming" lead Itô & Mester to the conclusion that "the interfix occurs mainly (but not exclusively) to attract the word stress to the pre-ə syllable"(Itô & Mester 2011: 37).

5.3.2.1 Sketch of an OT analysis

To account for the pre-stressed nature of schwa in German, Itô & Mester posit the constraint in (17), which bans schwas in other positions than the weak branch of a foot (17). This constraint has a double effect: it assigns a violation mark for every schwa that is in a foot head position and every schwa that is in an unfooted syllable.

(17) FOOTTAIL-Ə
Obligatory position for ə: (X .)
ə

Although this constraint is able to derive the correct results for German (i.e. it restricts schwas to the weak branch of a foot), since the same effects can be achieved with the independently motivated sonority constraints presented in the preceding section, I propose substituting FOOTTAIL-ə for the already available constraints in (6-7). This is possible because the double effect of Itô & Mester's FOOTTAIL-ə constraint is subsumed under HD_{FT}/ə (i.e. the constraint that bans schwas in foot-head positions) and (ii) *NON-HD_{FTmin}/a, e•o, i•u (i.e. the constraint that bans all non-central German vowels but schwa in the dependent of a minimal foot; remember that <*a,e,o,i,u*> stand as shorthand for low, mid and high vowels). Thus, rather than assuming a specific constraint which favors schwas in the tail of a foot and penalizes them

7 This form would conform with the post-stressed nature of schwa, but it does not exist.

in other positions, I propose that schwa surfaces in the tail of a foot as a result of the interaction of general sonority preferences of foot heads and foot dependents. Specifically, I suggest that schwa surfaces in the weak branch of a foot because vowels of higher sonority are *bad* (or not as good as schwa) in these metrical positions. This is illustrated in tableaux (18) and (19) on the next page.

The first tableau shows that default antepenultimate stress in words with light syllables shifts to penultimate stress in the presence of a final schwa. Thus, a word like *zitronə* receives penultimate stress. The crucial ranking here is *NON-HD$_{\mathrm{FTmin}}$/a, e•o, i•u >> DEFAULT, where DEFAULT is used as a cover constraint for the hierarchy of constraints responsible for default stress in German (i.e. final stress in words with heavy final syllables and in words with final light syllables, penultimate stress when the penultimate is heavy and antepenultimate stress when the penultimate is light). In tableaux (18-19), I provide Itô & Mester's representations and their equivalents assuming internally layered feet, which I indicate with a prime. Note that this is not relevant for accurate location of stress: no matter whether these representations contain an internally layered ternary foot, or a traditional binary foot as in Itô & Mester's analysis, the proposed constraints can predict the correct location of stress. I also follow Itô & Mester and assume that a highly ranked IDENT(PLACE)-VOWEL ensures faithfulness to underlying place specification in vowels. Moreover, since schwas are completely banned in a foot head position, I assume that the constraint against foot heads with schwas is undominated in German.

(18) Monomorphemic trisyllabic word with light syllables and final schwa

zitronə	*HD$_{\mathrm{FT}}$/ə	IDENT-V	*NON-HD$_{\mathrm{FTMIN}}$ /a, e•o, i•u	DEFAULT
☞a. zi.(ˈtro.nə)				*
☞a'. (zi.(ˈtro.nə))				*
b. (ˈzi.tro).nə			*!	
b'. ((ˈzi.tro).nə)			*!	
c. (ˈzi.trə).no		**!		
c'. ((ˈzi.trə).no)		**!		

The optimal candidate in (18) is the one with penultimate stress and schwa in the dependent of a minimal foot (18a,a'). Candidates (18b,b') are ruled out because the dependents of their minimal feet do not contain a schwa.

Candidates (18c,c') lose in the competition due to the unfaithful mapping of underlying place specifications in the penultimate and final vowels.

The next tableau shows that, in the absence of an underlying schwa, default stress arises. Even though candidates (19b&b') violate *NON-HD$_{\text{FTmin}}$/a, e•o, i•u, they respect the higher ranked constraints that preserves the identity of the vowels and, furthermore, they present the default stress pattern, as opposed to (19a, a') and, consequently, they surface as optimal.

(19) Monomorphemic trisyllabic word with light syllables and final full V

tremolo	*HD$_{\text{FT}}$/ə	IDENT-V	*NON-HD$_{\text{FTMIN}}$ /a, e•o, i•u	DEFAULT
a. tre. (ˈmo.lo)			*	*!
a'. (tre. (ˈmo.lo))			*	*!
☞ b. ((ˈtre.mo).lo)			*	
☞ b'. ((ˈtre.mo).lo)			*	
c. ((ˈtre.mə).lo)		*!		
c. ((ˈtre.mo).lə)		*!	*	

In conclusion, the interaction of the already available constraints on the sonority of foot heads and foot dependents for which there is independent evidence from other languages (Kenstowicz 1997; de Lacy 2004) can also account for the particular pre-stressed nature of German schwa.

5.4 English aspirated and unaspirated stops

As I proposed in Chapter 1, the particular distribution of aspirated and unaspirated stops in English constitutes another long-standing example of the usefulness of recursive footing in phonological representations (e.g. Whitgott 1982; Jensen 2000; Davis & Cho 2003; Davis 2005; Bennett 2012 *inter alia*). Interestingly, by assuming recursive feet in English, it is possible to capture the different behavior of non-prominent syllables in English.

Although there is a fair amount of variation in the realization and relative strength of aspirated and non-aspirated voiceless stops in English dialects, most dialects display some degree of aspiration at the beginning of a word —in stressed (20a) and unstressed syllables (20b)— and at the beginning of stressed syllables (20b,c) (Kahn 1976; Kiparsky 1979; Whitgott 1982; Nespor and Vogel 1986; Jensen 2000; Davis 2005; Balogné 2011). The examples in

(20) come from American English, but aspirated stops in other varieties of English display a similar distribution.

(20) Environments of aspirated stops in American English (Davis 2005: 111)

Word-initial aspiration		Stressed syllable
a. [p^h]óny	b. [p^h]acífic	c. Chésa[p^h]èake
[t^h]érrible	[t^h]ómato	A[t^h]àscadéro
[k^h]ándy	[k^h]anáry	a[k^h]úte

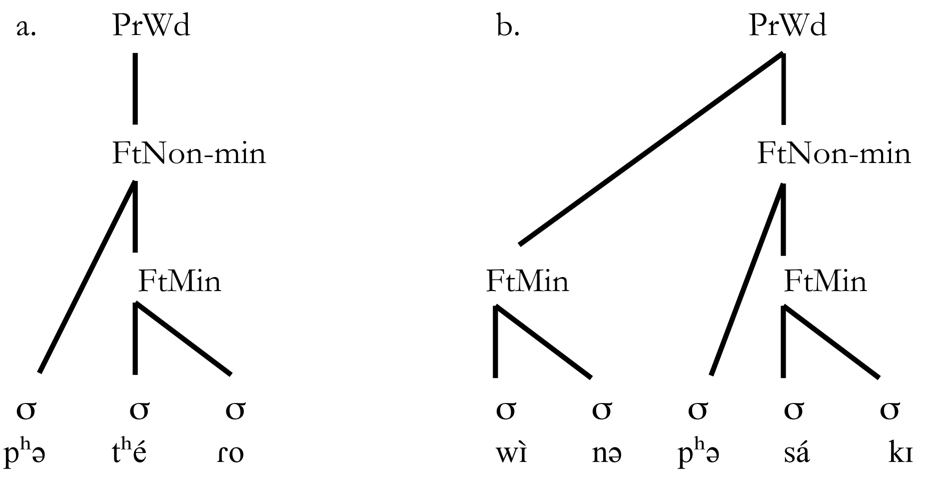
Additionally, aspiration has been attested in another unstressed position: pre-stressed syllables in word-medial position (21).

(21) Environments of aspirated stops: pre-stressed syllables

Wìnne[p^h]esáukee
Mèdi[t^h]erránean
àbra[k^h]adábra

The rest of unstressed syllables are generally realized without aspiration and, in the case of flapping varieties of North American English, the /t/ can be tapped, e.g. *cí[ɾ]y, á[ɾ]om* (for a summary of other outcomes in non-flapping varieties see Balogné 2011). The relevant fact for the discussion pursued in this chapter is that the environment of aspiration finds a straightforward account in analyses that allow structural distinction between two types of unstressed syllables within the foot (e.g. Witgott 1981; Jensen 2000; Davis & Cho 2003; Davis 2005). In particular, these studies show that by allowing pre-stressed syllables to be adjoined to a following trochaic minimal foot, the target of aspiration can be defined in foot terms: aspirated voiceless consonants appear in foot-initial positions. This is illustrated in (22) with two examples adapted from Davis (2005: 112-3). The representation in (22a) presents the metrical structure for words like *potáto*, with two instances of aspiration (word-initial and foot-initial), and *Wìnnepesáukee* (22b) represents the structure of a five-syllable word with an aspirated stop in the third syllable.

(22)



The crucial factor that determines the greater strength and aspiration of English pre-stressed and stressed syllables (e.g. *potáto, Wìnnepesáukee*) is their foot-initial position (see Section 4.2 and Bennett 2012 for additional cases in which the foot-initial position is the target of strengthening processes, even in iambic languages in which the foot-initial position coincides with an unstressed syllable). Note that an alternative analysis that leaves unfooted the first syllable in *potato* and the third syllable in *Wìnnepesáukee* would not be able to account in a unified way for the locus, and motivation, of aspiration. Likewise, the emergence of lenited variants in the post-stressed syllable in *potáto* and *Wìnnepesáukee*, as opposed to other unstressed syllables in the word, has a structural explanation: in English, as in Dutch and German, unstressed syllables display different properties depending on whether they are immediately dominated by a minimal foot or a non-minimal foot. In English, syllables in the weak branch of a minimal foot present weaker allophones than other unstressed syllables. And as we saw in Chapter 1, besides the distribution of aspirated and unaspirated stops, there are additional segmental distributions that back up the recursion-based analysis (see Section 1.3 for details).

Interestingly enough, allowing recursive footing in phonological representations not only permits us to capture the occasionally reported dual-behavior among unstressed syllables in languages (e.g. Dutch, Chugach, German, Ayutla, etc.), but it also enables us to capture the reported similarities between stressed and unstressed syllables in languages like English. In particular, within metrical accounts, a subset of the unstressed syllables in English (i.e. the pre-stressed ones) can share some property with stressed syllables due to their similar metrical position (i.e. the foot-initial domain). Furthermore, the case of English is relevant because it highlights the need for considering multiple factors when determining the relative strength of a specific metrical position. In short, as I anticipated in Chapters 2 and 3, characterizing a syllable as being strong or weak is not a black-and-white decision, but the particular strength of a syllable is determined by a collection of factors: its position within the foot (head *vs.* dependent, initial *vs.* final), within the prosodic word (initial vs. medial/final) and possibly within even higher domains in the hierarchy.

In order to understand the particular behavior of unstressed syllables in English, in particular the reported difference between the realization of /t/ in forms like *sánity* or *cápital* as opposed to the /t/ in forms like *Méditerránean*, it is crucial that many such factors be taken into consideration. Even though the /t/ in all of these words appears in similar contexts (i.e. in unstressed syllables, after a sequence of stressed-unstressed syllables), the /t/ in forms like *Méditerránean*, where the syllable with a /t/ is not final, has generally been described as having a greater degree of aspiration compared with the /t/ in word-final syllables like in *sánity* and *cápital,* which generally present higher frequency of tapping in tapping dialects and, when aspirated, have shorter VOT than other aspirated syllables (Davis & Cho 2003; Davis 2005; Balogné 2011 *inter alia*). Once again, the strength difference between *sánity/cápital* vs. *Méditerránean* can be attributed to their different metrical structure: even though the /t/ in the two types of words occurs in the dependent of a non-minimal foot (23b,c) and is therefore slightly stronger than the /t/ in syllables that occur in the dependent of a minimal foot (23a), in *Méditerránean* the /t/ is in a foot-initial position (23c), whereas in *sánity/cápital*, it is not (23b).

(23) Strength contrasts in unstressed syllables in English

a.	(á.tom)	Dependent FtMin	WEAK
b.	((sá.ni)ty)	Dependent FtNon-min, foot final	
c.	(Médi) (te(rránean))	Dependent FtNon-min, foot initial	STRONG

In traditional analysis of English, e.g. Hayes (1980) and McCarthy (1982), the structure of forms like *Mèditerránean* or *Wìnnepesáukee* was taken to be ((*Wìnne)pe)(sáukee)* and ((*Mèdi)te)(rránean)*, with the third syllable adjoined to the preceding foot rather than the following foot as in (22b, 23c). However, as pointed out by Davis (2005), an analysis that assumes adjunction of the third syllable in these words to their following foot provides a more accurate account of the facts, since unstressed syllables preceded by unstressed syllables behave differently depending on whether they occur in pre-stressed (23c) or final (23b) position. Even though Davis (2005) does not assume a ternary foot with internal layering for forms like *sánity* or *cápital* —he proposes ternary flat feet for these types of words—, the fact that the /t/ in *cápital* or *sánity* is not always flapped or lenited, or at least not to the same extent as the post-stressed ones (e.g. *átom*), provides further support for a recursion-based analysis which is able to distinguish between dependents of FtMin and dependents of FtNon-min. Furthermore, besides the structural contrast between different metrical positions (head of a foot, dependent of FtMin/FtNon-min), the specific position within a maximal foot (initial or non-initial) is crucial for accounting for the subtle difference between dependents of FtNon-min: whether they are in a foot-initial position (e.g. *Mèditerránean*) or not (e.g. *sánity*), with the former being slightly stronger than the latter.

Moreover, this type of analysis, which relies on the existence of internally layered ternary feet, can also capture the specific behaviour of onset consonants in words with two successive unstressed syllables, i.e. two potential lenition sites. McCarthy (1982) reports that, even if there is variation in the realization of the /t/ in American English depending on speech rate, the forms in (24) are all possible except for (24d), in which the post-tonic is aspirated and the syllable after the post-tonic is flapped:

(24) McCarthy 1982:581-582 (forms listed in order of increasing speech rate or relatively less careful style)

a. repé[t^h]i[t^h]ive ✓
b. repé [ɾ]i[t^h]ive ✓
c. repé [ɾ]i[ɾ]ive ✓
d. *repé[t^h]i[ɾ]ive ✗

Additionally, in some varieties of English, as reported by Harris and Kaye (1990: 261) for the London glottalling English, the forms in (25a-c) have been encountered. Crucially, however, the form in (25d) *appears to be ungrammatical* (see also Balogné 2011:81 for discussion).

(25) Attested and unattested lenition sites in *compétitive* (Harris & Kaye 1990: 261, Balogné 2011: 83)

a. compé[t]i[t]ive ✓
b. compé[ʔ]i[t]ive ✓
c. compé[ʔ]i[ʔ]ive ✓
d. *compé[t]i[ʔ]ive ✗

Assuming that the final three syllables in words like *competitive* or *repetitive* constitute a trochaic foot with an adjoined syllable (e.g. [com((pé.ti)tive)], [re((pé.ti)tive)] would account for the different behavior of the two unstressed syllables in these words and the ungrammaticality of forms like (24d, 25d). Specifically, since in English the dependent of a non-minimal foot is stronger than the dependent of a minimal foot, the former can only display lenition (in this case, a glottaled consonant) if the latter also exhibits a lenited variant. This particular restriction in the occurrence of the glottal stop or the flap is analogous to the restriction on the reduction of vowels in Dutch, where the syllable in the dependent of a non-minimal foot cannot be reduced if the dependent of the minimal foot has not been reduced too. [8]

Although there is much debate on the actual data in terms of degrees of aspiration in different syllables, Balogné (2011) has recently raised several critiques against recursion-based representations similar to the ones in (23b). Balogné claims that such structures miss the fact that the aspiration of /p/ *is undoubtedly stronger word initially* (e.g. in *potato*) than word-medially (e.g. in *Wìnnepesáukee*) (Balogné 2011: 88). However, the recursive-footing analysis of Jensen (2000), Davis (2005) and many others, repeated here under (23-24), does not really miss such a fact: if the /p/ in *potato* is more aspirated than the one in *Wìnnepesáukee* this can be attributed to its word-initial status, which is well-known for being a phonologically strong position (e.g. Trubetzkoy 1939; Steriade 1994; Byrd 1996; Beckman 1998; Casali 1998; Smith 2005; Cabré & Prieto 2006; Becker, Nevins & Levine 2012; Chapter 3 in this thesis). In short, whereas /p/ in both words appears in the prominent foot-initial position, in *potato* the foot-initial position coincides with the word-initial position, resulting

[8] Further support for the internal layering of ternary feet in English comes from the behaviour of vowels. Even though the data is under debate, Burzio (1994:113) suggests that in words like *pánama,* the second syllable reduces more easily than the third one, which in some speakers does not reduce at all. The same account for the behavior of consonants predicts this potential difference with respect to vowel reduction.

in double prominence, whereas in *Wìnnepesáuke* the /p/ is solely in foot-initial position.

The second concern of Balogné (2011) has to do with the fact that the syllables with aspiration, like the initial syllable in [p^{h}ət^{h}éɾo], contain a schwa. However, within a framework that allows two types of foot-dependents, the fact that a vowel displays reduction is not problematic. Even if the foot-initial (or word-initial) position is a strong one, note that the relevant syllables are still in a foot-dependent position, and foot-dependent positions favor vowels with lower sonority due to their non-head status. Thus, it is not unexpected that the initial syllable in *potato* should have a schwa.

For further support for internally layered ternary feet in English the reader is referred to work by Yu (2003, 2004) and McCarthy (1982), who provide evidence from prosodic morphology —namely, from particular cases of infixation— which crucially rely on the contrast between different projections of a foot for the correct location of the Homeric infix (Yu 2003, 2004) or the expletive infix in English (McCarthy 1982).

5.5 High vowel deletion in Old English

In this section I propose that we can add Old English to the repertoire of languages that display a dichotomy between two types of foot dependents. Until now, all the prosodic systems that have been reviewed display a uniform strength relation, by which dependents of non-minimal feet ((ˈσσ)$\underline{\sigma}$) are stronger than dependents of minimal feet ((ˈσ$\underline{\sigma}$)σ). However, in this section I argue that Old English provides evidence for the opposite strength relation: the dependent of a minimal foot is relatively stronger than the dependent of a non-minimal foot. Consequently, it can be stated that, even if foot dependents are universally weaker than foot heads, the relative strength of dependents of minimal feet and dependents of non-minimal feet varies across languages, i.e. it is not universally determined.

Based on Dresher & Lahiri's (1991) insightful analysis of Old English, I argue that dependents of non-minimal feet can be characterized as weaker than dependents of minimal feet since the former are the target of the most extreme weakening process, i.e. deletion, while the latter block the process. In Dresher & Lahiri's account of stress assignment and high vowel deletion in Old English (e.g. *wérudu* 'troops' → *werud*, *héafudes* 'head, gen. sg'→ *héafdes*) the authors propose that the target of deletion was metrically conditioned. In particular, they claim that deletion of high vowels targets the weak branch of the Germanic Foot, i.e. *a maximally binary and left-headed foot, where the head must dominate at least two moras* (Dresher & Lahiri 1991: 251). Such a foot comprises trochees of the following shapes (I indicate the head with a subscript): (i) bisyllabic '(LH)$_{Hd}$, '(LL)$_{Hd}$, '(H)$_{Hd}$L and (ii) trisyllabic '(LH)$_{Hd}$L and ('LL)$_{Hd}$L. Based on these structural representations, and assuming some later-stage destressing rules (26.III), Dresher and Lahiri correctly accounted for the distribution of stress and the locus of deletion. Their analysis is exemplified in (26) (glosses and further examples are provided below in 29-30).

(26) Deletion of high vowels in the weak branch of the Germanic Foot and final destressing (Dresher & Lahiri 1991: 252-253)

	I. Footing		II. Deletion			III. Final Destressing
a.	(wé.ru) du)	→	wérud		→	_____
b.	((níi). te) (nú)	→	_____	níitenú	→	níitenu
c.	((héa) fu)(dés)	→	héafdés		→	héafdes
d.	(sín) ((gén) de)	→	_____	síngènde	→	_____

In (26) we see that forms like (26a) and (26c) have undergone deletion, whereas (26b) and (26d) have not. According to Dresher and Lahiri, this is the case because high vowels only delete in the weak branch of a foot, as long as they appear in an open syllable. Their rule, then, deletes high vowels in the weak branch of a foot. For their analysis to be adequate, a final destressing rule (Dresher & Lahiri 1991: 261) must be ordered after deletion, to avoid final stresses in Old English (cf. 26b,c).

Looking at the examples in (26), and drawing on the importance of the moraic trochee in other Germanic languages (Riad 1992), one could alternatively propose that Old English builds moraic trochees and the syllables that delete are in fact those that are left unfooted. This alternative approach is illustrated below in (27). However, as I show in (27b), this analysis is clearly defective: a moraic trochee account that deletes unfooted syllables would not be able to predict the correct pattern of stress and/or absence of deletion in words like *níitenu,* with stress on only the first syllable and retention of the high vowel.

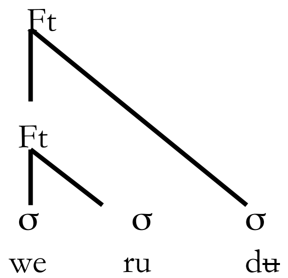
(27) Moraic trochees and deletion of high vowels in unfooted syllables

	I. Footing		II. Deletion		III. Final Destressing
a.	(wé. ru) du	→	wérud	→	_____
b.	(níi) (té. nu)	→	_____ níiténu	→	*níiténu
					(cf. níitenu)
c.	(héa) fu (dés)	→	héafdés	→	héafdes
d.	(sín) (gén) de	→	_____ síngènde	→	_____

Note that the final destressing rule (or a high-ranked NONFINALITY constraint against final stressed syllables) could avoid the secondary stress in the final syllable in (27c). However, that same rule/constraint would not be able to remove the stress in the peninitial syllable in (níi)(ténu) (27b). Furthermore, other versions of this rule (or NONFINALITY) in which the banned structure is a stressed word-final foot are equally problematic since other words in Old English do display stress in final feet (for examples, see 29-31 below).

Therefore, I propose that we incorporate Lahiri and Dresher's insights to the current recursion-based framework. In a nutshell, the idea is that a high vowel deletes in a dependent of a non-minimal foot, but it is kept in the dependent of a minimal foot. That is, high vowels are protected from deletion in the dependent of a FtMin because, in Old English, this metrical position is stronger than the dependent of a non-minimal foot. This is illustrated in (28).

(28) Deletion of high vowels in dependents of FtNon-min[9]



The data below in (29-30) illustrate with a few examples the pattern of deletion assuming representations with minimal and non-minimal feet.

[9] To ensure that only high vowels delete in this position, a MAX constraint preseving mid- and low-vowels would need to be ranked above *NonHeadFtNon-min/a,e•o, i•u. This ranking ensures that only high vowels delete in such poisitions.

Following Dresher & Lahiri (1991), I assume that coda consonants in Old English are moraic; in OT terms this would entail having an unranked WEIGHT-BY-POSITION (Hayes 1989b). The examples in (29a-e) show that deletion of a high vowel generally takes place whenever it would have otherwise surfaced in the dependent of a non-minimal foot. For the sake of illustration, I give both the surface form and, next to it, the prosodic structure that would have surface had it not been avoided via deletion. In (29-31) I show that high vowels are maintained in other positions, i.e. the dependent of a minimal foot (29c, 31a) and unfooted syllables (30a). Likewise, other vowels in dependents of non-minimal feet are also maintained (30a,b). Note that forms with non-minimal feet are in general allowed (30a,b), so the ultimate reason for deleting segmental material in the dependent of a non-minimal foot cannot be said to be avoiding recursion in metrical representations: recursion is only avoided if the adjoined syllable would have a high vowel. Therefore, deletion in Old English can be seen as another case in which a phonological phenomenon targets the weak branch of a non-minimal foot. The examples in (31) show that dependents of minimal feet are protected from deletion. In the examples in (29-31) I only indicate the morae of long vowels.

(29) High vowels are avoided (deleted) in the dependent of a FtNon-min

	Underlying	Surface		Deletion?
a.	/go$^{\mu}$du/ 'good nom. pl. neut'	[gó:d]	*((gó$^{\mu}$). d~~u~~)	Yes
b.	/he$^{\mu}$afudes/ 'head, gen. sg'	[hé:afdes]	*((he$^{\mu}$a). f~~u~~) des	Yes
c.	/werudu/ 'troops'	[wérud]	*((wé. ru) d~~u~~)	Yes
d.	/færeldu/ 'journey nom. acc. sg'	[fǽreld]	*((fǽ. rel) d~~u~~)	Yes
e.	/fulwihtu/ 'baptism'	[fúwhiht]	*(fúl). ((wíh) t~~u~~)	Yes

(30) Non-high vowels are maintained in the dependent of a FtNon-min

	Underlying	Surface	Prosodic structure	Deletion?
a.	/ni$^{\mu}$tenu/ 'animals'	[ní:tenu]	((ní$^{\mu}$) te). nu	No
b.	/wesende/ 'to be, pes.part.'	[wésende]	((wé. sen). de)	No

(31) All segments in the dependent of a FtMin are maintained[10]

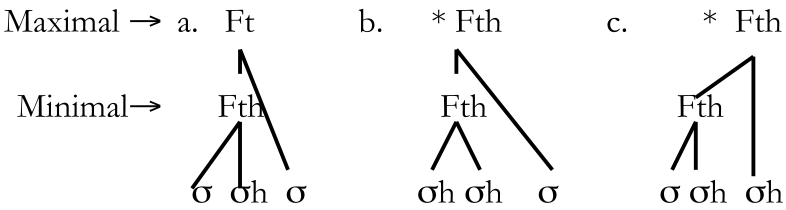
	Underlying	Surface	Prosodic structure	Deletion?
a.	/lofu/ 'praises'	[lófum]	(ló. <u>fu</u>)	No
b.	/singende/ 'sing, pres. part' C35	[síngénde]	(sín) (gén.de)	No
c.	/æþelinges/ 'prince, gen.sg.'	[ǽþelínges]	(ǽ$^{\mu h}$. þe) (lín. ges)	No
d.	/inwid$^{\mu}$a/ 'evil one,sg. masc' C34	/ínwìd:a/	(ín) (wíd. da)	No
e	/o$^{\mu}$perne/ 'other acc. sg.masc'	[ó:pérne]	(ó$^{\mu}$) (pér. ne)	No

Note that the surface forms of some of these words include trochaic feet of the shape HH (e.g. 29b, e) and LH (e.g. 29d). In OT terms this could be explained due to the effect of undominated TROCHEE and NONFIN, which ban iambs and final stress respectively. When these constraints are ranked above IAMB and WSP, such relatively uncommon trochees may arise. Still, it is important to highlight that none of the candidates in (29-31) violate BIN(FT), since all feet are binary branching; either at the level of the syllable or the mora.

[10] The three forms in (30b-d) could also be parsed with two minimal feet, e.g (sín).(gén.de), instead of recursion. Either parsing (with or without recursion) correctly predicts that the first and third syllables are stressed.

Even though the details of the OT analysis need to be worked out, I believe these representational assumptions, which incorporate Dresher & Lahiri's proposal to the present framework, point towards the correct analysis of high vowel deletion and stress assignment in Old English. In general terms, what was considered to be a *binary head* in Dresher & Lahiri's analysis is interpreted here as a minimal trochaic foot. Although at first sight this reinterpretation may seem to be a simple relabeling —what was previously called a head now has foot status—, I have argued throughout the thesis that the nuance of *binary head* and *binary minimal foot* is an important one that should be maintained. As I discussed in Chapter 2 and 4, representations with binary heads and representations with minimal recursion at the foot level make different predictions. First, note that if heads are binary *à la* Dresher & Lahiri (1991) —or *à la* Rice (1992) (Chapter 4)—, an important prediction related to the strength of the binary head arises: its two constituents are predicted to be phonologically strong (i.e. have some kind of phonetic prominence, be the target of augmentation processes, resist weakening processes, etc.). In that sense, it could be argued that Old English supports such a prediction: even if only one element in the head of the Germanic Foot receives stress, the two elements are protected from deletion and, thus, both can be characterized as strong. However, cross-linguistic data presented in Chapter 4 and in this chapter do not seem to support such a prediction. On the contrary, they pose a challenge: unstressed elements in *binary heads* (or minimal feet) often exhibit a greater degree of weakness than other elements in the word. More specifically, one of the two constituents in the head (namely, the dependent of the FtMin) is weaker than the other. Furthermore, this same element is sometimes even weaker than other non-heads in the prosodic word (i.e. dependents of a FtNon-min). Secondly, a *binary head* approach contradicts one of the most important principles of the prosodic hierarchy: the HEADEDNESS principle. As we saw in Chapters 1 and 2, this inviolable constraint states that every prosodic constituent possesses a head, corresponding to one constituent at the next lower level (Zec 1988, 2003; Itô & Mester 1992/2003; Selkirk 1996). However, as I showed in Chapter 2, and as repeated below in (32b), in a binary head approach the *head* constituent has two heads in the lower level, i.e. the syllabic node. Since the "binary head" has a symmetrical structure, and the two constituents below this node are both heads, these representations cannot account for asymmetric behaviors between the two constituents. However, within a recursive foot analysis and the standard prosodic hierarchy theory, only one constituent from level X-1 can be the head of level X. Within the level of the foot this entails that headedness percolates from a unique lower level category to the maximal projection of a foot. Thus, when a maximal foot is non-minimal, its true head will be one (and only one) constituent within the domain of the minimal foot. For ease of presentation, the notion of *headedness percolation* (Zec 2003) is repeated again in (32) where the subscript <h> indicates the head of each constituent. Remember that within the present model, only the maximal foot in (32a) is a possible foot in the theory because it is the only one with a unique head that strictly percolates from a lower-level category. By contrast, note that (32b), whose minimal foot would corresponds to the *binary head* of Dresher & Lahiri (1991), is not a possible foot structure according to *headedness* since its minimal foot has not one, but two, heads. A representation like (32c) is not grammatical for the same reason: its maximal foot has two heads (for related discussion and the Head Uniqueness Principle see Section 2.2.3.2).

(32) Headedness percolation



To summarize, a symmetrical head/foot like the one in (32b), which reproduces the binary head approach in previous metrical models, cannot capture any differences between the two members of the head/foot. This is a significant shortcoming of the theory, since the constituents of a binary foot/head are never homogeneous.

5.6 Summary

This chapter has examined a few languages in which metrically relevant unstressed syllables exhibit a dual patterning. In particular, I have argued that such a dual patterning receives a unified account within the present framework, which allows for two types of foot dependents: FtMin and FtNon-min. Furthermore, I have proposed that languages may show variation with respect to the relative strength of FtMin dependents and FtNon-min dependents. That is, whereas in some languages the dependent of a minimal foot is weaker than the dependent of a non-minimal foot, the opposite pattern is equally attested. Likewise, there are also languages in which all foot dependents display similar strengths (e.g. see Chapter 3 and Chapter 5).

Even if some of the processes analyzed here could arguably receive an alternative account without recursive footing by appealing to the difference between unstressed, unfooted syllables and unstressed, footed syllables (e.g., the Dutch and German data), since structures with recursive feet are independently motivated in a wide range of languages and, more importantly, in a wide range of phonological processes, we may conclude that recursive footing is a legitimate way to capture the dichotomy between unstressed syllables.

6 Further evidence for recursive feet in metrically-conditioned tone systems

In this chapter I present further supporting evidence for recursive footing in metrical representations based on the distribution of tones in three pitch-accent languages: Gilbertese, Irabu Ryukyuan and Seneca. Rather than developing a complete OT analysis of the phonology of each of these languages, the chapter highlights the benefits of extending the recursivity hypothesis beyond its use in the account of stress assignment and stress-related phenomena. In hopes of opening up a promising area of future research —which already proved fruitful in the analysis of Chugach—, I point to some directions in which recursive feet might offer an adequate account of tone placement in systems where it is metrically conditioned. In a more general vein, this chapter relaxes the claim that only syllables can be adjunct material in non-minimal feet and discusses the implications of a theory that allows morae to be adjoined to an adjacent minimal foot.

6.1 Metrically-conditioned accent

A number of studies on tonal languages have shown that tones can interact with metrical structure (Hyman 1978, 2006, 2009; Kim 1997; Yip 2001; de Lacy 2002a; Downing 2004; Pearce 2006; Köhnlein 2011; Caballero 2012; Bennett & Henderson 2013; Morén-Duolljá 2013; Michael in press, among many others). For instance, as discussed in Chapter 4, tonal systems may exhibit a preference for certain tones on foot heads and/or foot dependents. Furthermore, other types of interactions between tone and metrical structure have been described in the literature. Preferences for particular tonal melodies in certain foot types and/or deletion of tones in foot dependents, for example, are just a few of the possible attested interactions between tone and metrical structure (Pearce 2006: 260-261).

Given that metrical representations might exhibit prosodic recursion at the foot level, and tonal distributions can be metrically driven, one might expect to encounter other languages like Chugach where the distribution of tone is partially (or totally) dependent on metrical representations with recursive feet. The goal of this section is to draw the reader's attention to a few of those languages (for an exploration of similar ideas, see Morén's (2013) recent analysis of Götaland Swedish prosody).

The chapter is organized as follows. First, in Section 6.2 I present a summary of Blevins & Harrison's (1999) analysis of Gilbertese, a Micronesian language spoken in the Kiribati Islands whose prosodic system crucially relies on ternary constituents. In particular, Blevins & Harrison (1999) proposed that ternary feet with a binary head were needed in Gilbertese to account for the distribution of stress and tones. Building on their analysis, I suggest that the language can be reanalyzed with minimal feet that have undergone recursion. Furthermore, I show that Gilbertese is similar to other ternary stress languages in that recursion is not a last-resort mechanism that ensures exhaustivity, but rather a default-parsing mode exploited by its grammar. Second, in Section 6.3 I examine the distribution of high (H) and low (L) tones in Irabu Ryukyuan, a northwestern variety of Miyako Ryukyuan, spoken in Okinawa Prefecture, Japan (Shimoji 2009). Based on Shimoji (2009), who first proposed that Irabu could occasionally present trimoraic feet, I argue that the reason for the restricted distribution of ternary feet in Irabu is similar to the one encountered in Wargamay and Yidiɲ: internally layered ternary feet arise to ensure exhaustive parsings and, in Irabu, this is only needed in forms with an odd number of morae. Finally, in Section 6.4 I present an innovative analysis of Seneca, an Iroquoian language spoken in parts of USA and Canada (Chafe 1977, 1996; Michelson 1988; Melinger 2002; Hyman 2009). Even though this language clearly has syllabic trochees (Melinger 2002, Hyman 2006), I show that by positing internally layered structure (i.e. internal recursion) in these trochees, we get a straightforward account of the particular distribution of high tones, and we furthermore predict the existence of (attested) accentless words. While previous analyses had to stipulate the environments that favored or blocked a H tone, a recursion-based approach offers a simple explanation of these factors.

Before proceeding with our case studies, it is important to highlight that none of these languages (Gilbertese, Irabu or Seneca) have lexical tone, but they have been characterized as pitch-accent systems. However, since the term "pitch-accent" is highly problematic in prosodic typology —the term does not refer to a homogeneous group, but to systems that combine properties of canonical stress and tone languages (see Hyman 2006, 2009 for discussion)—, I follow Hyman (2006, 2009) and abandon this denomination. The following quote of Hyman, after examining a database of circa 600 tone systems, captures the problematic nature of the term "pitch-accent" in prosodic typology:

> Since all one can say is that alleged pitch-accent systems exhibit significant **constraints on the distribution of their tonal contrasts**, they do not constitute a coherent prosodic "type". Rather, alleged "pitch-accent" systems **freely pick-and-choose properties from the tone and stress prototypes**, producing mixed, ambiguous, and sometimes analytically indeterminate systems which appear to be "intermediate". There thus is no pitch-accent prototype" (Hyman 2009: 213, highlighting is mine).

Based on Hyman's findings, I assume that the prosodic systems examined here are actually tonal, despite the fact that they place several (metrical) restrictions on the distribution/emergence of tones.

Finally, the investigation of these three prosodic systems will be shown to have an important repercussion in the theory of representations outlined here. In particular, by examining the details of the prosody of these languages, in which quantity distinctions (i.e. number of morae) are crucial for tone assignment purposes, I come to the conclusion that in addition to (light and heavy) syllables, morae too can occupy the adjunct position of a non-minimal foot. Even though other quantity-sensitive languages studied in the thesis did not require mora adjunction (e.g. Chugach, Old English, Yidiɲ), and this is probably a highly marked structure, it seems to be necessary in Gilbertese, Irabu and Seneca. Interestingly, it is very likely that this peculiarity stems from another singular property of these languages: they all violate the Syllable Integrity Principle (Prince 1976, 1980; Rice 1988, 1992; Hayes 1995). That is, the edges of their feet do not necessarily coincide with the edges of their syllables. Thus, since the terminal elements of minimal (traditional) feet in these languages can be moraic, disregarding syllable boundaries, it is not so unexpected that a mora might be occasionally adjoined to an adjacent minimal foot. Further discussion in connection to the *mora-adjunction possibility* is presented below.

6.2 Gilbertese

Blevins & Harrison (1999) were the frist to present a systematic description and analysis of Gilbertese prosody.[1] There are two interesting facts about their proposal, so, given their significance for the present metrical model, I will summarize them in the following sections. On the one hand, they posit that terminal elements of feet are morae rather than syllables and, consequently, the edges of feet do not necessarily coincide with the edges of syllables. Importantly, they argue that Gilbertese feet are trimoraic (Section 6.2.1). On the other hand, as a direct consequence of these trimoraic feet, Blevins & Harrison show that Gilbertese has a trimoraic word minimum restriction, being the only reported language with such a peculiarity (Section 6.2.2).

These two proposals have important consequences for the theory of representations outlined here, which has assumed that terminal elements of feet were generally syllables and occasionally morae when a minimal foot is built over a heavy syllable, e.g. $((\text{ˈ}\mu\mu)_{\text{Syll}})_{\text{Ft}}$. Monosyllabic feet could arise in languages due to the action of two constraints: WEIGHT-TO-STRESS (Prince 1991) and/or $\sigma^{\mu\mu}$=FT, the constraint that favors heavy syllables coextensive with feet (see Chapter 4 for discussion on monosyllabic feet). Notably, the adjunct of a non-minimal foot (i.e. the terminal element immediately dominated by a non-minimal foot) was always shown to be a (light or heavy) syllable, e.g. $((\text{Ftmin})\ \sigma)_{\text{FtNon-min}}$. The Gilbertese data, however, open up the possibility of directly adjoining a mora to a minimal foot. In the following section I present the data from Blevins & Harrison (1999) that seems to corroborate such a proposal.

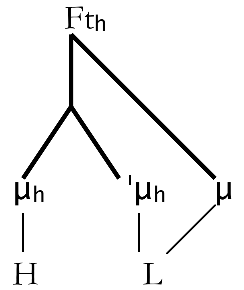
[1] All Gilbertese data in Blevins & Harrison (1999) are taken from Harrison's fieldnotes and tapes. The authors report that at the time the paper was written, the language was spoken by approximately 55000 people in Kiribati. I have generally used the standard ortoghraphy to present the data, although I have exchanged the grapheme <b> for its phonetic value [p], all the velarized-labial consonants appear as [p^w,m^w, β^w] (although in the orthography they are represented respectevily as [bw, mw, w]) and, finally, instead of the digraph for the velar nasal <ng> I have used [ŋ].

6.2.1 Internally layered trimoraic feet in Gilbertese

Blevins & Harrison claim that Gilbertese trimoraic feet are "*characterized by an intensity of loudness peak on the penultimate mora and a pitch peak on the antepenultimate mora. The final mora of a foot has lowered pitch and intensity*".[2] They assume that *prominence in terms of pitch and amplitude spreads over the two first morae*, which according to them constitute a bipartite head (p. 217) as in (1). The examples in (1) corroborate the idea that the stress/pitch patterns are mora-based rather than syllable-based, since trisyllabic (1a,b), bisyllabic (1c,e) and monosyllabic words (1d) all display identical pitch and stress patterns. In the following examples in (1II) I indicate stress with an acute accent and a high tone with a <H> superscript. In the figure on the left in (1I), headedness is marked with a <h> subscript.

(1) Trimoraic feet (Blevins & Harrison 1999:217)

I. <u>Bipartite head</u>



II. <u>Stressed on the penultimate mora</u>

a.	(a^{H}. rá. na)	his/her name
b.	(ka^{H}.mé.a)	dog
c.	(m^{H}.ná.o)	kind of lobster
d.	(a^{H}ói)	dew
e.	(pu^{H}.kín)	end of

Even if in Gilbertese positing the so-called binary head would result in the desired predictions (i.e. greater prominence of its constituents), recall that there are many issues with this type of representation since it violates the headedness principle, (i.e. the foot in (1) has more than one designated mora as its head). The problems with such structures have been widely discussed in previous chapters. In light of the Gilbertese facts, one might wonder whether the assumption that HEADEDNESS is a hard universal is in fact too strict and whether it might be worth allowing it to sometimes be violated. However, even if HEADEDNESS could be argued to be occasionally violable at the foot level (e.g. 1), note that the structure proposed for Gilbertese by Blevins & Harrison (1999) is inadequate in another way. Positing a symmetrical bipartite head predicts identical behavior for the two morae that compose the head.

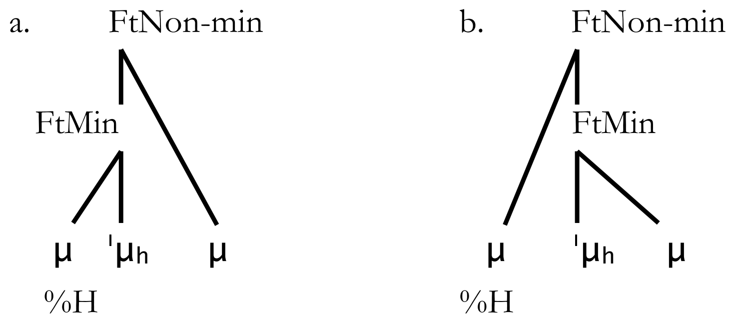
[2] "Stress contours reported for Gilbertese are impressionistic, based on natural and elicited speech collected by the second author before the interest of the stress pattern was appartent" (Blevins & Harrison 1999: 205).

Nevertheless, the constituents of this binary head clearly behave differently, not only in Gilbertese, but in all of the languages reviewed in this dissertation. Furthermore, remember from Chapter 5 that the relative strength of the constituents in the so-called binary head (or minimal feet in the present framework) is cross-linguistically variant: whereas one of them is generally more prominent,[3] the particular strength of the other member in the head (or in the minimal foot) varies across languages, as shown in the preceding chapter.

For all these reasons, I propose slightly modifying the Blevins & Harrison foot in (1) to the form represented by (2). Note that with the new representations in (2) there is no need to stipulate the position of tones, but their distribution can be derived from the insertion of a boundary tone in a foot-initial position. In particular, following Davis & Cho (2003), Bennett (2012) and Harris (2013), among others, I assume that the initial constituent in a foot may exhibit a greater strength in some languages. Furthermore, I propose that in Gilbertese, this greater strength is realized as a boundary H tone foot-initially. I follow Blevins & Harrison in treating the L tone as unmarked. Unfortunately, there is not enough data to decide which of the two structures in (2) corresponds to Gilbertese. How bimoraic sequences are realized, then, would be revealing in this respect; of particular interest would be the patterns of (i) bimoraic prosodic words and/or (ii) forms with a 3n+2 number of morae. Unfortunately, there are no acoustic measurements of the leftover bimoraic sequences in these structures, nor of the bimoraic words. When asked about the realization of bimoraic words or these bimoraic sequences (Harrison (p.c.), Blevins & Harrison 1999: 218), described certain variation/uncertainty: sometimes they seemed to be realized as (μ^{H} ˈμ), with a high initial pitch and a stress on the second mora, whereas in other cases, they seemed to be a *coincidence of pitch and intensity on the first mora, and something more neutral on the second* (Harrison, p.c.). Only future research will be able to determine which of these two structures are instantiated in Gilbertese.

[3] I say generally because I assume that there can be heads without any prominence, as in Cairene Arabic, where secondary feet are not prominent. But even in those cases, I assume that only one constituent is the *true* head, since they are phonologically needed to predict the correct location of primary stress in the head foot (Hayes 1995). In short, I understand *headedness* as a crucial relation throughout the prosodic hierarchy; at the level of the foot this relation is particularly important since it is the underlying force that gives rise to binary and unary feet (for further discussion on headedness, see Chapter 1-2).

(2) Reanalysis of the Gilbertese bi-testal foot in recursive terms



6.2.1.1 Feet with moraic terminal elements

As Blevins & Harrison point out, the fact that the terminal elements of feet are morae rather than syllables might lead to contrasts in the stress patterns of tautosyllabic sequences of vowels like the one illustrated in (3), which were traditionally assumed to be impossible (a similar contrast has been reported for Southern Paiute, Sapir 1930; Cairns 2002). Syllabifications in Gilbertese are supported by what native speakers report to be very clear intuitions, and by a process of vowel assimilation restricted to tautosyllabic vowels (although this process is *non probative*, since it could be restated in non-syllabic terms; see Blevins & Harrison 1999: 207 for details). In the following examples I highlight the tautosyllabic vowel cluster and mark only the edges of maximal feet.

(3) Contrastive V́V ~ VV́

a. (ma^{H}.**túu)** V́V
'to sleep'

b. (a^{H}.í.ka) (ka^{H}ḿβ^{w}o) (ŋo^{H}.**ráa)** V́V
'those of you who are listening'

c. p^{w}a.(ka^{H}ḿ^{w}.na) (a^{H}.kíi) (**ko**^{H}**ó**.ko) (re^{H}ái) VV́
'so that you will not cut me'

Furthermore, if feet are purely moraic, it is predicted that ternary feet might actually dissect a syllable, as in (4) (the dissected syllable is bolded and underlined).

(4) Violations of the Syllable Integrity Principle[4]

a. [(ma^{H} á ki) (ba^{H}.ná.ko)] [(ni^{H} ká.**ka)(a**^{H}. éa)]
and 3P fly away RED-search-3S
'and they flew off in search of him'

b. [ŋke (e^{H} má.**tu)(u**^{H}. ná.ko)][5]
when 3S sleep away
'when he fell asleep'

Gilbertese is not unique in these respects, since maximal feet in a few other *mora-counting languages* like Southern Paiute (Sapir 1930, Cairns 2002) and Banawá (Buller, Buller & Everett 1993; Everett 1998) have been claimed to violate the SIP. It is true, however, that in the majority of these languages, the violations of SIP are all restricted to tautosyllabic sequences of vowels and, thus, one could call into question whether those sequences are really tautosyllabic, as described by the fieldworkers, or if they are in fact heterosyllabic. For instance, assuming that the vowels in (4a, 4b) are heterosyllabic, there would not be an actual violation of SIP.[6] Furthermore, since in Gilbertese there are no quantitative measurements of the intensity and pitch curves (i.e. all the descriptions are impressionistic and/or based on native speakers intuitions), one might wonder to what extent we can rely on the conclusions drawn in (3-4). Overall, the lack of objective methods to clearly measure whether a vocalic sequence is tautosyllabic or heterosyllabic —beyond native speaker intuitions and, occasionally, some kind of phonological activity that provides indirect reference for syllable constituency/boundaries— leaves the question of the violability or inviolability of the SIP relatively open for future discussion. In Section 6.3, however, we will see that in Irabu, tautosyllabic VV sequences are not the only ones that incur violations of SIP and, consequently, analyses that preserve the universality of SIP will be less plausible.

In sum, assuming the data and conclusions in (3-4) are correct, Gilbertese can be placed at the right edge of the binary-to-ternary rhythmic continuum,

[4] For the reasons and details for positing two prosodic words in (4a) and only one in (4b), as well as other principles regulating the syntax-phonology mappings, see Blevins & Harrison.

[5] This is one of the examples in which Blevins & Harrison state that the parsing of the first two morae is "undetermined by the data". It is thus not completely clear whether these two initial morae build a foot, or if they are left unfooted.

[6] See Hayes (1995), who reanalyses Southern Paiute along these lines, but see also Cairns (2002) for a response to that interpretation.

close to other ternary languages like Tripura Bangla and Cayuvava, which favor ternary feet whenever possible. The main difference would be that in Gilbertese, terminal elements of feet are moraic rather than syllabic. Finally, note that a strictly mora-based ternary foot predicts that stress —which in Gilbertese is realized by *an intensity of loudness peak*—, might fall on a consonant, as in [(a^{H} ń.ti)] 'spirit, ghost' (see also (3b,c) above).

Even if future research will definitely need to confirm (or falsify) Blevins & Harrison's description, it seems undeniable that a ternary constituent is responsible for the iterative rhythmic patterns in the language. Further support for this constituent and its moraic nature is presented in the next section. Additionally, in Sections 6.3 and 6.4 we will see that violations of SIP in Irabu and Seneca are instantiated by more than just sequences of vowels, rendering alternative analyses that respect the SIP untenable for these languages.

6.2.2 Gilbertese lengthening and the minimality requirement

The overwhelming majority of prosodic words in Gilbertese have at least three morae. When this is not the case, there is strong evidence that bimoraic lexical words display lengthening to conform to this restriction (see Blevins & Harrison 1999: §4.1). For instance, borrowed names display lengthening to conform to the ternary restriction (5a-c). Furthermore, even if it is not uncommon for lexical words (nouns and verbs) to have two morae, they hardly ever surface alone: they are either accompanied by a proclitic article or a possessive suffix (in the case of nouns) or a proclitic subject marker (in the case of verbs). But in bare verbal and nominal forms, like bare plurals (5e-g) or imperative forms (5h-j), the bimoraic lexical word undergoes lengthening. In (5) I indicate every moraic segment with the superscript <$^{\mu}$>; even if I assume that long vowels consist of one vowel linked to two morae, in the following examples I represent each lengthened vowel as two independent vowels, to better illustrate the lengthening pattern.

(5) Lengthening

Borrowed proper names (p. 216)

a. Ta$^{\mu}$a$^{\mu}$m$^{\mu}$	'Sam'
b. Ti $^{\mu}$i$^{\mu}$me$^{\mu}$	'Jimmy'
c. Bi$^{\mu}$i$^{\mu}$ti $^{\mu}$	'Fiji'

(5)

In bare plural nouns (p. 215)			Noun phrases	
e. bwa$^{\mu}$a$^{\mu}$ta$^{\mu}$	'the/some huts'	cf.	te bwa$^{\mu}$ta$^{\mu}$	'the/a hut'
f. o$^{\mu}$o$^{\mu}$n$^{\mu}$	'the/some turtles'	cf.	te$^{\mu}$ o$^{\mu}$n$^{\mu}$	'the/a turtle'
g. ba$^{\mu}$a$^{\mu}$i$^{\mu}$	'the/some arms'	cf.	ba$^{\mu}$i$^{\mu}$-u$^{\mu}$	'my arms'

In imperative verbal forms (p. 213)			Verbs+subject marker	
h. bi$^{\mu}$i$^{\mu}$ri$^{\mu}$!	'Run!'	cf.	e$^{\mu}$ bi$^{\mu}$ri$^{\mu}$	's/he ran'
i. ni$^{\mu}$i$^{\mu}$m$^{\mu}$!	'Drink them!'	cf.	i$^{\mu}$ ni$^{\mu}$m$^{\mu}$	'I drank them'
j. a$^{\mu}$mw$^{\mu}$ara$^{\mu}$ke$^{\mu}$!	"Eat!"	cf.	i$^{\mu}$ a$^{\mu}$mwa$^{\mu}$ra$^{\mu}$ke$^{\mu}$	'I ate'

Even if the trimoraic restriction is not completely inviolable, and there are a few forms that can surface with two morae (6), these lengthening patterns stand as strong support for feet with moraic terminal elements in Gilbertese. Note that the exceptions occur only in environments in which lengthening would have introduced an extra-long vowel, which are forbidden in the language (6a,b), or a geminate nasal in preconsonantal position, which are also illicit in prevocalic position (6c,d) (Blevins & Harrison 1999: 215). The pitch/stress patterns of these forms are not indicated because they are precisely the ones that were unclear to the authors.

(6) Bimoraic prosodic words (Blevins & Harrison 1999: 215)

Bare plural nouns		
a. ni$^{\mu}$i$^{\mu}$	'some coconut trees'	(cf. sing: te nii)
b. ba$^{\mu}$a$^{\mu}$	'some leaves'	(cf. sing: te baa)
c. nn$^{\mu}$e$^{\mu}$	'some spots'	(cf. sing: te nne)
d. nn$^{\mu}$a$^{\mu}$	'some fleets'	(cf. sing: te nna)

To summarize, even if the data containing vowel clusters presented above in (3,4) should be regarded with some caution, the truth is that allowing internally layered maximal trimoraic feet in Gilbertese provides a unified account of stress assignment, pitch and lengthening. Furthermore, I have shown that a recursion-based reanalysis of Gilbertese is superior to one that just posits a ternary foot with a binary head. In particular, a recursion-based analysis of Gilbertese provides a straightforward explanation for the particular distribution of prominence within the language (i.e. the presence of a high tone before stress): a high tone is a boundary tone that enhances the prominence of the foot-initial position, whereas stress (i.e. greater amplitude and intensity) is the manifestation of a foot head. To put this in perspective, Blevins & Harrison had to stipulate the particular distribution of prominence within the binary head.

6.3 Irabu Ryukyuan

Additional evidence for recursive feet in pitch-accent languages comes from the prosodic system of Irabu, a northwestern variety of Miyako Ryukyuan, spoken in Okinawa Prefecture, Japan.[7] All the Irabu data in this section are drawn from Shimoji's (2009) up-to-date work on Irabu prosody. In this work, the author shows that the distribution of pitch in the language is clearly dependent on foot structure, which is determined by the overall number of morae in a word.

6.3.1 Internally layered trimoraic feet in Irabu Ryukyuan

Abstracting away from the specific details that shape tone assignment in Irabu —there are several rules that may lower the initial or final constituent in a word depending on syllable structure and segmental make-up—, the most relevant fact about Irabu's phonology in connection to this thesis is the existence of trimoraic feet. Although Shimoji assumes ternary flat feet, in light of the findings of the rest of the dissertation, I propose a reanalysis of Irabu with internal binary branching structure. As Shimoji argues, trimoraic feet are marginal in Irabu, but they do occasionally arise and co-exist with binary feet (2009: 99-100). The data in (7) provides the metrical representation and tonal patterns of monomorphemic words with two-to-eight morae. Interestingly, trimoraic feet only occur in odd-parity forms, namely, at the right edge of the prosodic word. Thus, along the lines of the analysis of the stress patterns in Wargamay and Yidiɲ (Chapter 3), I argue that in Irabu, odd-parity forms display recursion in the final foot to ensure exhaustivity, while avoiding feet with only one constituent (i.e. non-branching feet). Hence, Irabu would be placed on the initial side of the binary-to-ternary rhythmic continuum, since it has mostly maximal binary feet, although peripheral maximal (non-minimal) ternary feet arise in odd-parity forms in order to ensure exhaustivity.

[7] The Miyako Ryukyuan language is one of the three major subgroups of Southern Ryukyuan which, together with Northern Ryukyuan, form the language group Ryukyuan, a sister language of Japanese (Shimoji 2009: 87). I'm grateful to René Kager for drawing Shimoji's (2009) paper to my attention.

(7) Tonal patterns of roots with two to eight morae (adapted from Shimoji 2009:99)

		Tonal pattern	Constituent structure
W$_2$:	*pana* 'nose'	HH	$(\mu\mu)_H$
W$_3$:	*katana* 'knife'	$\underline{\text{HHH}}$	$\underline{((\mu\mu)\mu)_H}$
W$_4$:	utugaja 'jaw'	HHLL	$(\mu\mu)_H(\mu\mu)_L$
W$_5$:	bancïkira 'guava'	HH$\underline{\text{LLL}}$	$(\mu\mu)_H\underline{((\mu\mu)\mu)_L}$
W$_6$:	koozaburoo 'Kozaburo'	HHLLLL	$(\mu\mu)_H(\mu\mu)_L(\mu\mu)_L$
W$_7$:	oosïtoraria 'Australia'	HHLL$\underline{\text{LLL}}$	$(\mu\mu)_H(\mu\mu)_L\underline{((\mu\mu)\mu)_L}$
W$_8$:	amififibammai 'rain meal'	HHLLHHLL	$(\mu\mu)_H(\mu\mu)_L(\mu\mu)_H(\mu\mu)_L$

The idea is that Irabu has exhaustive footing, and each foot displays a specific tone pattern. Contrary to the general tendency for foot heads to attract highs, and foot-dependents to attract lows (de Lacy 2002a; Chapter 4 of this thesis), Irabu presents a predictable iterative tonal alternation of highs and lows, in which each tone spans a whole foot. One apparent exception are words with six (W$_6$, in 7) and seven morae (W$_7$, in 7), which present a sequence of two final feet that are L rather than an alternating rise-fall pitch. However, this is due to an independent pressure: monomorphemic and polymorphemic words are subject to a final lowering requirement in Irabu. Importantly, this final-lowering restriction is subsumed within a more important restriction: the requirement that every word have at least one marked syllable for the highest degree of prominence (OBLIGATORINESS, Hyman 2006, 2009). It is for this reason that final lowering can be absent in words with two and three morae: these words only have one maximal foot and lowering this foot would leave the word unaccented. However, interestingly enough, Shimoji reports that some words with two and three morae may in fact exhibit variation: some forms surface with a H tone in all the morae as in (7), but these same words may present final lowering in the last mora, giving rise to bimoraic HL and trimoraic HHL forms.[8]

In a nutshell, the examples above show that forms with an odd number of morae can be analyzed with a non-minimal foot aligned with the right edge of

[8] See Shimoji (2009: 91-97) for a complete description of the pitch contours in monomorphemic words, since other rules of initial lowering can also optionally apply in some forms depending on the specific syllable structure of a form; consequently, a given word (not just bi/tri-moraic words, but longer ones as well) might present two variants, i.e. two possible tonal realizations, but crucially the segmental make-up of the syllabic structure and segmental make-up of the syllables determines the types of variants that are permitted.

the prosodic word. Since recursion in Irabu is a last-resort device that ensures binary exhaustive parsings, it is clear why even-parity forms do not display recursion: minimal feet (i.e. non-recursive feet) can perfectly ensure exhaustivity without incurring a violation of BIN(FT). Thus, the Irabu data seem to confirm the hypothesis that recursive footing is a parsing strategy that can also be exploited by pitch-systems. If words with three, five or seven morae did not parse their final morae with the preceding foot, but they had been unfooted, they could exhibit a different tonal pattern.

In (8) I present additional data with longer words to show that, in polimorphemic words, recursive feet also arise as a means of avoiding monomoraic feet and/or unfooted morae. Furthermore, these data show that exhaustive footing is in fact needed in the language, since the specific tonal pattern of forms with 5, 6 and 7 morae could have lead to an alternative interpretation: Irabu could have been described as having an initial foot which surfaces with a H tonal pattern, and the remaining morae in the word could be said to get a L by default. However, this interpretation would not be able to predict the alternating HL patterns in longer words. The examples in (8) contain polimorphemic words with a root and several affixes or clitics. Within Shimoji's terminology, an affix is stem-specific (e.g. a nominal affix only attaches to a nominal stem; a verbal affix only attaches to a verbal stem) and the term *clitic* is reserved for an affix that is not stem-specific and "its host varies considerably depending on syntactic structure" (2009: 90). Furthermore, while an affix is an internal member of a word, and it may attach to a bound stem, a clitic is an external member of a word, attaching to a host word from outside. However, since Irabu *clitics* and *affixes* display similar prosodic behavior, and Shimoji's terminology can be a bit misleading, in the rest of the discussion I will refer to these affixes as *affix*^{1} (stem specific, it can attach to a bound stem) and *affix*^{2} (not stem specific, it appears after *affix*^{1}). In the examples, I follow Shimoji's convention and *affix*^{1} are preceded by a hyphen <->, whereas *affix*^{2} are preceded by two <=>.

(8) Tonal patterns in polimorphemic words (Shimoji 2011:97)

W_9:	kan-gama-mmi-nagi=nu	$\text{HHLLHH}\underline{\text{LLL}}$
	crab-DIM-PL-and.so.on=NOM	$(\mu\mu)_H(\mu\mu)_L(\mu\mu)_H\underline{((\mu\mu)\mu)_L}$
	'little crabs and so on:nom'	
W_{10}:	kan-gama-mmi-nagi=kara	HHLLHHLLLL
	crab-DIM-PL-and.so.on=from	$(\mu\mu)_H(\mu\mu)_L(\mu\mu)_H(\mu\mu)_L(\mu\mu)_L$
	'from little crabs, and so on'	

W11: kan-gama-mmi-nagi=kara=du HHLLHHLLLLL
crab-DIM-PL-and.so.on=from=FOC (μμ)H(μμ)L(μμ)H(μμ)L((μμ)μ)L
'from little crabs, and so on: Foc'

W12: kan-gama-mmi-nagi=kara=mai HHLLHHLLHHLL
crab-DIM-PL-and.so.on=fromto (μμ)H(μμ)L(μμ)H(μμ)L(μμ)H(μμ)L
'from little crabs, and so on, too'

The data in (8) confirm that words with more than 8 morae display exactly the same pattern as monomorphemic words with 2-8 morae: in odd-parity forms, the final mora is added to a preceding foot to ensure exhaustivity.

In addition to the pitch contours in (7-8), Shimoji provides further evidence for trimoraic feet in Irabu. As he notes, polymoraic roots and affixes (both affix¹ and affix²) "always commence their own footing, i.e. the left boundary of a polymoraic form always coincides with the left boundary of a foot" with a few exceptions (Shimoji 2009: 100). Thus, there must be some alignment constraint that ensures that the left edge of a polymoraic affix coincides with the left edge of some foot. Hence, when a root with an odd number of morae like *katana* 'knife' precedes a bimoraic form like *na*$^{\mu}$*gi*$^{\mu}$ 'and.so.on' (an example of an affix¹ that attaches to nouns) or *ma*$^{\mu}$*i*$^{\mu}$ 'mai' (an example of an affix²), the affixes constitute their own feet. Interestingly, the odd-parity root *katana* displays a H tone throughout the word, whereas the two affixes display a L. Therefore, it seems like the final mora in *katana* has been adjoined to the preceding foot giving rise to a non-minimal foot. If the final syllable in *katana* had been left unfooted, 'na' could have presented no particular tone or maybe a transition between the neighboring H and L. However, the pressure towards exhaustivity is telling here, since 'na' surfaces with a clear H. If, on the other hand, 'na' had been adjoined to the following foot, rather than to the preceding foot, it would have surfaced with a L tone instead. The data in (9) therefore constitutes strong evidence for recursive footing in Irabu.

(9) Polymoraic roots with affixes (Shimoji 2009: 100)

a. katana-nagi ((kata)na)H (nagi)L *(kata)H na (nagi) L
knife-and.so.on *(kata)H ((na na)gi) L
'knife, and so on'

b. katana=mai ((kata)na)H (mai)L *(kata)H na (mai) L
knife=too *(kata)H ((na ma)i) L
'knife, too'

In (10a,b) I show that when affixes are monomoraic, the requirement that a new foot be started does not apply, and thus footing proceeds as in monomorphemic words, i.e. non-minimal feet are aligned with the right edge of the prosodic word. For instance, in (10a) the third syllable in *katana* has a L tone, rather than a H because it has been parsed with the following material in the word, e.g. [(kata)$_{H}$ ((na=u)=du)$_{L}$] (10a). This form clearly contrasts with the previous [((kata)na)$_{H}$(=mai)$_{L}$] (cf. 9a,b).

(10) Monomoraic roots, affixes, clitics (Shimoji 2009: 1001)

a. katana=u=du (kata)$_{H}$ ((nau)du)$_{L}$
knife=Acc=Foc

b. oosïtoraria = u= du (oo)$_{H}$ (sïto)$_{L}$ (rari)$_{H}$ ((au)du)$_{L}$
Australia = Acc= Foc

Again, note that if in (10a,b) the final mora had been left unfooted, it would have not been associated with a specific tone.

Although Shimoji assumes flat ternary feet (μμμ) in his analysis of Irabu (i.e. instead of ((μμ)μ)), the hypothesis that prosodic recursion can target feet captures exactly the same facts, while avoiding the shortcomings of ternary branching feet. As I have argued in this thesis, an approach with recursive footing is generally superior to one with ternary flat feet due to its greater descriptive and explanatory adequacy. Even though it is true that ternary flat feet could in principle be employed to account for a few phonological phenomena (e.g. ternary rhythm), only a recursive footing approach is able to account for the full range of independent phonological processes and generalizations exposed in this thesis. As I have shown throughout, the arguments backing up the superiority of a recursion-based analysis against a ternary-flat-foot analysis go far beyond an argument of elegance and/or theoretical parsimony. Finally, note that in the specific case of Irabu, assuming that binary feet can display ternarity (i.e. recursion) only as a last-resort device to ensure exhaustive parsings provides a better explanation for the restrictive emergence of ternary feet in the language.

6.3.2 Irabu and the violation of the Syllable Integrity Principle

In Irabu, as in Gilbertese, the boundaries of a foot do not necessarily coincide with those of a syllable. This is illustrated in (11). (The forms in (11a-b) have undergone initial lowering).

(11) Violability of the Syllable Integrity Principle (Shimoji 2009: 109)

a. *akjaada* 'merchant'

Pitch pattern	[LH]	[LL]
Foot (2 Ft)	(a kja)$_{H}$	(a da)$_{L}$
Syllable (3 σ)	a . kja	a . da
Mora (4 μ)	a^{μ}. kja^{μ}	a^{μ} . da^{μ}

b. *kudansa* 'Kudansa plant'

Pitch pattern	[LH]	[LL]
Foot (2 Ft)	(ku da)$_{H}$	(n sa)$_{L}$
Syllable (3 σ)	ku . da	n . sa
Mora (4 μ)	ku^{μ}. da^{μ}	n^{μ}. sa^{μ}

c. *fiirna* 'don't give' (< *fii-* give + *-r* (non-past) + *-na* (prohibitive))

Pitch pattern	[HH]	[LL]
Foot (2 Ft)	(fii)$_{H}$	(r na)$_{L}$
Syllable (2 σ)	fii	r. na
Mora (4 μ)	fi^{μμ}	r^{μ}. na^{μ}

The examples in (11b) and (11c) are especially revealing because they show that in Irabu the SIP can also be violated by VC sequences. Hence, an alternative analysis that posits that these sequences are heterosyllabic rather than tautosyllabic —as it occurred in other languages that have been claimed to violate this principle— is not at stake. For instance, in [(ku^{μ}. da^{μ})$_{H}$(n^{μ}. sa^{μ})$_{L}$] 'Kudansa plant' there is little doubt that the syllable boundaries appear after [u, n], yet the third mora has a low tone, as it is part of the second foot. The same applies for [(fi^{μ}i^{μ})$_{H}$ (r^{μ}. na^{μ})$_{L}$] 'don't give'. These facts, therefore, can be taken as further support for the idea that the SIP should be seen as a violable constraint rather than a hard universal.

Even if Irabu feet are somewhat special in that the head of a foot does not exhibit greater prominence than the dependent, the pitch patterns are clearly binary and they heavily rely on foot structure. Other languages with stressless feet have previously been proposed in the literature, and thus, Irabu is not unique in that sense (for some examples, see Hayes 1995 and Buckley 2009 *inter alia*).[9]

6.4 Seneca

Seneca constitutes another example of a language whose pitch distributions are partially dependent on metrical structure (Melinger 2002; Hyman 2006, 2009).[10] Despite the evidence for foot structure in the language (Melinger 2002), Seneca is not a prototypical "stress-type language". It violates the two defining properties of stress-systems: (i) it may have more than one (primary) accent per prosodic word (i.e. it violates the CULMINATIVITY criterion, Liberman & Prince 1977: 262; Hyman 2009: 217) and (ii) it presents accentless words (i.e. it violates the OBLIGATORINESS principle) (Hyman 2006, 2009: 217). These words are claimed to be *produced with a relatively even low tone throughout the word* (Melinger 2002, reporting data from Chafe 1967, 1977, 1996). A few examples illustrating these facts are given in (12).[11]

(12) a. Accentless words (Chafe 1967, 1977; Melinger 2002)

dëgadenyeodëʔ	"I'll put a necktie on"
shagoge:das	"He hates her"

b. Multiple primary accents

deyögwa**déh**at**héʔ**dahgöh	'that which gives us light"
de**yṍk**hi**yáh**do**wéh**danih	'they deliberated for us"

[9] However, see Shimoji's interpretation of the facts. He posits that Irabu feet are headless and that a whole foot is prominent (HIGH) because it is the head of a language-particular constituent, which he calls the *foot-group*. This constituent is a kind of recursive foot, with two embedded feet ((Ft)$_H$ (Ft)$_L$)$_{FTGROUP}$. Nevertheless, note that the alternating HL patterns can be easily derived via the Obligatory-Contour Principle (Odden 1999, and footnote 12 in Shimoji), without having to posit this language-particular constituent, which is clearly in conflict with the rest of findings of this thesis (number of prominent and non-prominent positions, the inexistence of quaternary rhythm, etc.) and is furthermore not independently motivated.

[10] All the data in this section are from Chafe (1967, 1977, 1996) and analyses based on Chafe's work, e.g. Michelson (1988), Melinger (2002) and Hyman (2009: 228), citing Chafe's personal communication.

[11] In the examples I use Seneca's orthography with only one exception: the glottal stop [ʔ] is used instead of its orthographic correlate <’ >; the graphemes <ë> and <ö> in Seneca's orthography represent the nasal vowels [ɛ̃] and [ɔ̃] respectively. A high tone is indicated with an acute accent and is bolded.

One of the most intricate properties of the accentual patterns in Seneca is that "accent is determined by the position and structure of the accented syllable and also by the position and structure of the following (post-tonic syllable)" (Melinger 2002: 287). It is this observation that has been used as clear evidence for trochaic footing in the language. Namely, the generalization has been that a H tone only docks to the first syllable of a trochaic bisyllabic foot if one of the syllables within the foot is closed (Melinger 2002). This generalization applies without exceptions to non-final trochees and is summarized in (13).

(13) Non-final trochees (from Hyman 2006: 244)

a. HIGH tone	b. No HIGH tone
closed.closed (**CV́C**.CVC)	open-open (CV.CV)
closed-open (**CV́C**.CV)	
open-closed (**CV́**.CVC)	

Previous studies on Seneca have shown that accent interacts in a complex way with two lengthening processes that can block the assignment of H in a final foot (Michelson 1988; Melinger 2002). One of these processes, probably a vestige of Proto-Lake Iroquoian penultimate stress (Michelson 1988), might lengthen vowels in the penultimate syllable of a word. The other lengthening process results from the deletion of a glottal fricative. In particular, [VhV] sequences change into [V:V] when the intervocalic glottal is at a morpheme boundary. The specific manner in which these two processes interact with accent assignment poses a challenge to parallel OT, calling for some kind of serial analysis (see Thompson 2010 for discussion).

In the following sections I concentrate on examining the principles governing accent assignment and penultimate lengthening, leaving for future research a complete analysis of the other lengthening process. I start by looking at the structure of non-final feet (Section 6.4.1). Then, I turn to examine the accentual patterns of final feet, exploring the particular interaction of accent assignment and penultimate lengthening (Section 6.4.2).

6.4.1 Seneca non-final feet

Even though the traditional syllabic-trochaic analysis sketched in (13) can account for the location of accent in the first syllables of non-final trochees (e.g. 13a), the absence of stress in trochaic feet with light syllables (13b) needs to be stipulated ("non of its syllables are closed"). In the following discussion I will demonstrate that a reanalysis of Seneca accentual patterns in terms of recursive footing does not need to make such an *ad hoc* stipulation. Furthermore, the reanalysis to be presented not only provides a very simple and explanatory account for the accentless nature of trochaic CV.CV feet, but it also illuminates the reasons for accenting other feet in Seneca.

The schema in (14) from Hyman (2006, 2009), based on Melinger (2002), summarizes the accentual facts of Seneca non-final feet with four types of hypothetical words in the language. Remember that a foot only receives stress if one of its syllables is closed. Melinger (2002) assumed that initial syllables in Seneca are extrametrical —it will be clear why soon—, and maximal feet are trochaic. These assumptions will be maintained in the present reanalysis. Yet, the extrametrical nature of the first syllable in (14) is seen as a side effect of linking the word-initial syllable to the prosodic word. Although Seneca was originally analyzed as an iambic language (e.g. Prince 1983; Kager 1993), Melinger (2002) demonstrated that a trochaic analysis where the initial syllable is considered to be extrametrical (i.e. invisible for metrical rules) provides a better account of the accentual and lengthening patterns. This is also the analysis adopted here, with some modifications. As we will see later with concrete examples (19-22), Seneca comprises one of those languages in which maintaining a distinction between unfooted syllables and foot dependents is crucial to accounting for the different behaviors of various unstressed syllables (Chapter 2). In particular, we know that the initial syllable is left unfooted (i.e. directly adjoined to the prosodic word) because, no matter its weight (i.e. heavy or light), it never affects the overall stress pattern in the language. By contrast, the weight of foot dependents in Seneca are extremely relevant, since they can determine the emergence and/or absence of a H in a foot. This is confirmed in the contrast between stressed trochaic feet with a light head and a heavy dependent, e.g. (**CV́.**CVC) *versus* a trochee with a light head and a light dependent, which remains stressless, e.g.(CV.CV). Concrete examples of the *invisibility* of Seneca initial syllables are given below in (19-22), with words that start with light and heavy syllables. For the moment, in (14) I just use the <σ> symbol to refer to the first syllable, which is unfooted no matter is open or closed.

(14) Hypothetical structure in Seneca non-final trochees (adapted from Hyman 2009:227, and 2006: 244)

a. <σ> (**CV́C**.CV) (CV.CV)... c. <σ> (**CV́**.CVC) (**CV́C**.CV)...

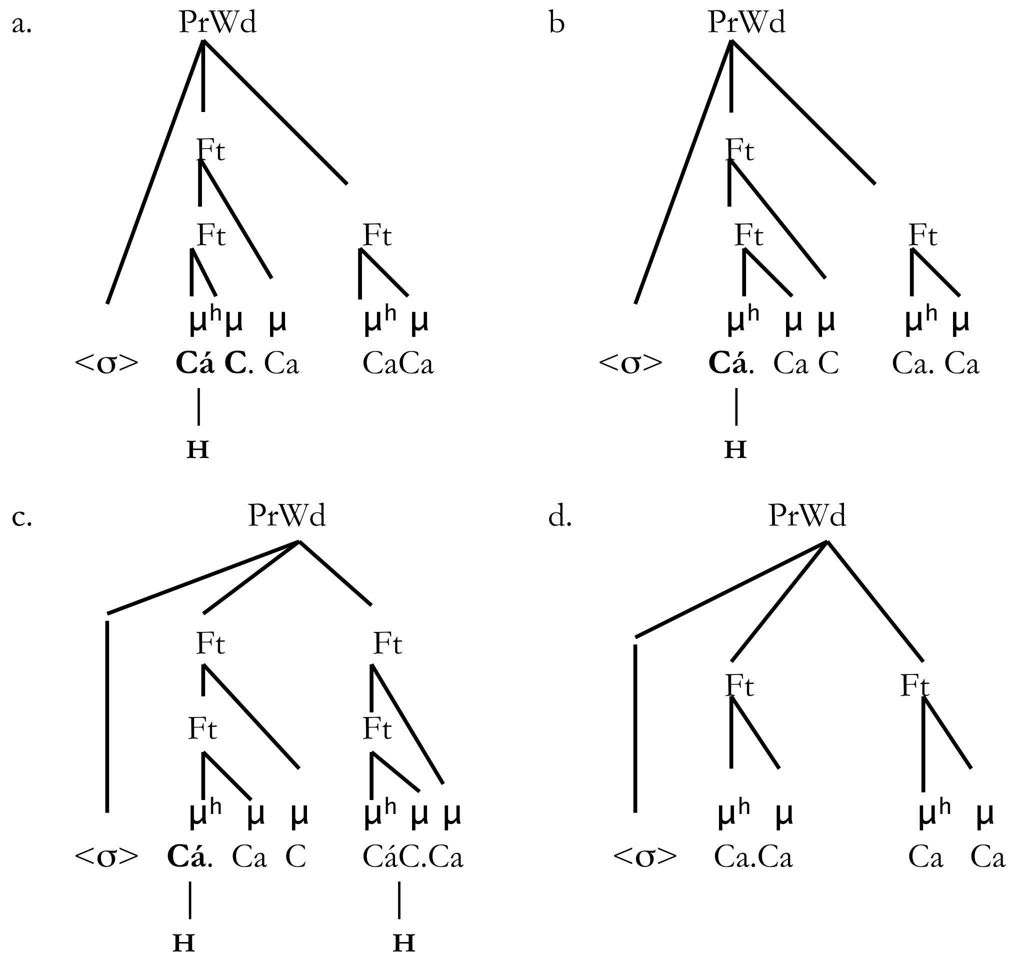
b. <σ> (**CV́**.CVC)(CV.CV)... d. <σ> (CV.CV)(CV.CV)...

As pointed out by Hyman (2006, 2009), what makes accent assignment in Seneca highly singular is that it not only cares about the structure of the accented syllable in the foot (i.e. the head of the foot), but the configuration of the unaccented syllable within the foot is equally crucial. That is why a foot like (**CV́**.CVC) in (14b,c) receives an accent even though the accented syllable is light. Likewise, a representation with only light syllables surfaces without accent because none of the syllables within each foot are closed (14d). In sum, Seneca seems to be a particular type of quantity-sensitive language where the structure of foot heads and foot dependents is equally crucial for the assignment of accent.

Rather than stipulating this requirement on accent assignment, a straightforward representational account of the double head/dependent conditioning of accent assignment is possible if trochaic syllabic feet are taken to entail internally layered structure. More specifically, I will argue that a H docks exclusively onto syllables that occur in the head of a non-minimal trochaic foot. But why should H tones be restricted to heads of non-minimal feet in Seneca? A possible explanation for such a restriction parallels the prosodic prominence account of lengthening in Wargamay and Yidiɲ and it builds on the double-head status of the constituent that is the head of a non-minimal foot (FtNon-min). The argument goes as follows: since foot heads may attract H tones (Goldsmith 1987; Bickmore 1995; de Lacy 2002a), and since a FtNon-min consists by definition of two foot-heads, in a language that displays recursion at the foot level, the phonology can single out the head of a FtNon-min (i.e. the head of two projections of a foot) to the exclusion of the head of a FtMin (i.e. the head of only one projection of a foot) for the assignment of H. More specifically, I will argue that every non-final FtNon-min in Seneca receives a H tone. The unaccentedness of final feet is not uncommon in the metrical literature, where several instances of NonFinality have been proposed.

The present proposal is illustrated in (15), where I demonstrate that an approach that allows recursion at the level of the foot is able to predict the correct accentual patterns of the word types given above in (14a-d). Importantly, this approach assumes that coda consonants are moraic in Seneca (i.e. WEIGHT-BY POSITION is high-ranked) and that feet can be directly built over morae. In short, even if I adopt the traditional bisyllabic trochaic analysis of Melinger (2002), I assume that Melinger's feet might surface with internal hierarchical structure depending on the weight of its constituents. Namely, if the first or second syllable (or both) in a trochee contains a heavy syllable, the morae of the foot will be parsed via recursion (15a-c), producing a FtNon-min. And, as already argued, a H tone will dock onto the head of such a foot. By contrast, since feet with light syllables are exhaustively parsed with minimal feet, they do not undergo internal recursion and, thus, they do not receive accent (15d). In short, the representations in (15) demonstrate that a recursion-based analysis provides a very simple account of the unusual restrictions on accent assignment in Seneca. In these representations, syllable boundaries are indicated with dots for ease of exposition (the representation for a CV́C.CVC non-final foot is discussed below in (18)).

(15) Metrical structure in Seneca non-final feet: H in heads of FtNon-min

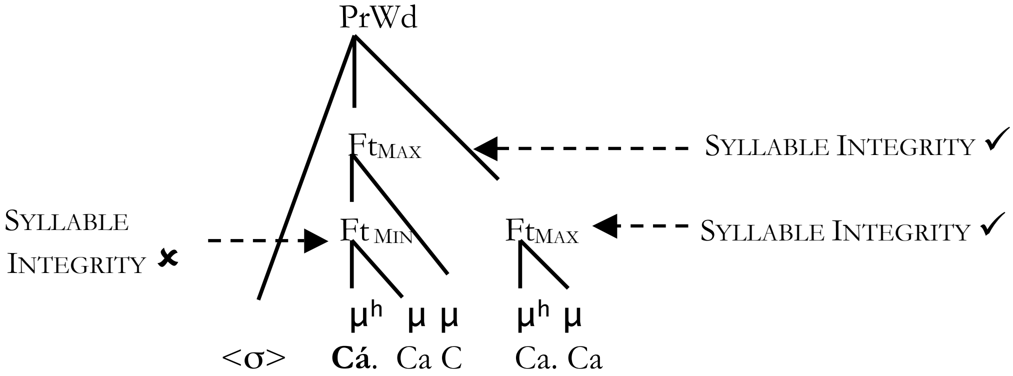


The specific location of the H in (15a) and (15b) is clearly dependent on metrical structure. Both (15a) and (15b) contain a FtNon-min whose head coincides with the second syllable of the word, precisely the only one that gets a H. The same line of reasoning derives the correct pitch patterns in (15c) and (15d): (15c) gets two Hs because it consists of two FtNon-min, whereas (15d) does not get any because its structure only includes minimal feet. Note that this analysis provides a straightforward explanation for the existence of accentless words in Seneca: words might surface without any high-pitched syllable when there is no FtNon-min within the prosodic word. Thus, an analysis allowing prosodic recursion at the level of the foot contributes to a simpler and more explanatory account of the bizarre conditions on Seneca accent location and of the existence of accentless words.

6.4.2 Seneca and the violation of the Syllable Integrity Principle

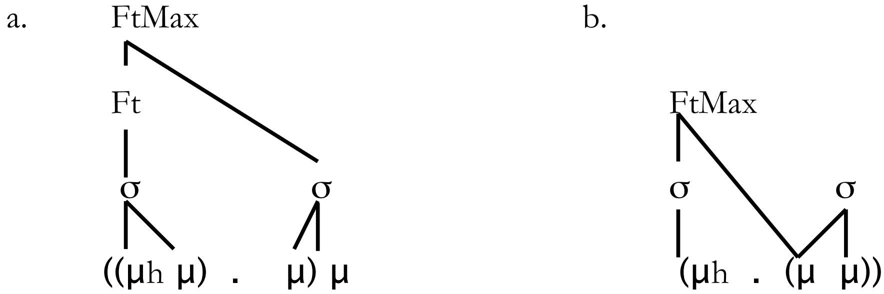
Although the structures in (15) employ the device of prosodic recursion, they differ slightly from the representations seen in previous chapters, just as in a similar way as the representations in Gilbertese and Irabu did. In (15), the adjoined constituent may be a mora, breaking the integrity of the syllable, e.g. (15b-c). However, note that in Seneca the SIP is always respected by the maximal projection of a foot and only minimal feet may violate it. This is illustrated in the following representation.

(16) Seneca's violation of the Syllable Integrity Principle[12]



Assuming that Seneca's representations instantiate a universal inviolable requirement on metrical representations, where only non-maximal projections can violate the SIP, structures like (17a) and (17b) would be ungrammatical, i.e. never generated by GEN. This is so because in (17a-b) the projection that violates SIP is the maximal projection of foot.

(17) Ungrammatical structure: FtMax violate SIP



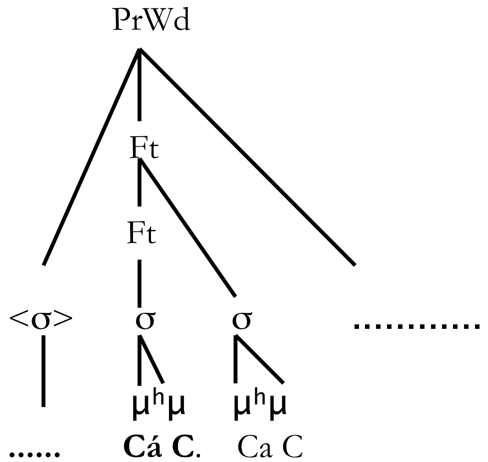
However, this cannot be the case, since Irabu and Gilbertese seem to contradict this claim: as we saw, their maximal feet might also split syllables into two. Thus, languages seem to vary not only in whether they respect or violate the SIP, but also in the type of foot projection that violates/respects the principle. In Seneca, the boundaries of a maximal foot never dissect a syllable in two, i.e. the topmost layer of a foot always respects the SIP.

[12] To avoid a violation of SIP, it could be argued that a foot of the shape (CV.CVC) is parsed instead with a minimal foot over the second syllable and accent (high pitch) docking onto the initial constituent of a non-minimal foot, e.g. $(\text{C}\acute{\text{V}}.(\text{CVC})_{\text{FtMin}})_{\text{FtMax,Non-min}}$ Note, however, that such an alternative analysis is problematic because, as pointed out by Melinger (2002), there are independent cues based on the lengthening patterns in Seneca that point to the fact that CVC syllables have a dependent status in (CV.CVC) feet (see Section §6.4.3 for discussion, examples 22a-c).

However, a non-maximal foot may, under specific circumstances, split a syllable in Seneca, as shown in (16).

Moving past this short digression on the violability of SIP, I continue with the analysis of Seneca. In all the representations/analyses I have provided so far (i.e. 14-16), there was one type of foot missing: one consisting of two heavy syllables (CVC.CVC). As expected, this type of foot also gets a H tone on its first syllable, e.g. (**CV́C**.CVC). Therefore, it must be parsed with a FtNon-min. In particular, I propose that the structure of a foot with two heavy syllables is the one in (18), i.e. a monosyllabic foot plus an adjoined syllable. Remember that feet can maximally have two projections and, thus, independently adjoining each mora within the foot-dependent would entail the presence of three foot layers, e.g. $*[(((\mathbf{C\acute{V}^{\mu}C^{\mu}})_{Ft}.CV^{\mu})_{Ft}\ C^{\mu})_{Ft}]$. However, these structures are impossible since they are never generated by GEN (see the One Layer Recursive Foot Hypothesis, Chapter 2). Alternatively, it could be argued that the last mora is left unparsed and the right edge of the maximal non-minimal foot dissects the second syllable, as in $*[(((\mathbf{C\acute{V}^{\mu}C^{\mu}})_{Ft}.\ CV^{\mu})_{Ft}\ C^{\mu}]$. However, there is no independent evidence for leaving those final morae unparsed and, furthermore, we just saw that maximal feet never violate SIP in Seneca. Hence, the most appropriate representation for (CV́C.CVC) is the one given in (18), where the adjoined material is a heavy syllable. Note also that an alternative analysis that assigns one foot to each heavy syllable (e.g. (CVC).(CVC)) is not possible because it would leave this form unaccented.

(18) Sequences of heavy-heavy in non-final position



Now that the representations for all types of non-final feet have been presented, it is time to describe the behavior of non-final feet and penultimate lengthening. Remember that I have proposed that final non-minimal feet are generally left unaccented because H tones only dock to non-final non-minimal feet. In the next section I show that this assumption predicts the correct accentual patterns for most of the words in Seneca. But before that, let's start by describing the exact context of lengthening.

6.4.3 Seneca word-final feet and penultimate lengthening

Contrary to the patterns of peninitial/penultimate lengthening in Wargamay and Yidiɲ, where lengthening was shown to exclusively apply in odd-parity words, penultimate lengthening in Seneca affects all-parity words. The process, however, is restricted in other ways. Namely, it is conditioned by syllable and metrical structure as I summarize below in (19-23). Furthermore, I assume that penultimate lengthening is a late-stage process only applying after accent assignment.

Before discussing each example/context for lengthening in (19-23) one by one, a few clarifications should be made concerning the metrical representations provided here. As proposed in the preceding section, I assume that Seneca leaves the first syllable unfooted and it builds maximal bisyllabic trochaic feet which, depending on the structure of their syllables, might be internally layered (i.e. they might be dominating a minimal foot if the first or second syllable is heavy). From an OT perspective, extrametrical syllables are only allowed in word-initial position in Seneca due to the ranking: ALIGN-LEFT([σ]ω,*Ft, ω) > ALIGN-RIGHT([σ]ω,*Ft, ω).

Let's start by examining the four factors that condition lengthening. First, as can be seen in (19), penultimate open syllables (CV) always lengthen, no matter whether they fall on an even-numbered syllable (the second syllable in 19a) or an odd-numbered syllable (the third syllable in 19b). Furthermore, these forms demonstrate that the process is not conditioned by the overall parity of the word: both odd (19a) and even-parity forms (19b) display CV penultimate lengthening. For ease of presentation, I underline the vowel that has undergone lengthening. All the syllabifications in the following examples are taken from previous studies, which all agree in their proposed syllabifications (e.g. Michelson 1988; Melinger 2002).[13] Recall that I assume

[13] Since the presence/absence of a coda is extremely relevant for Seneca accentual patterns, it is important to be familiar with the syllabification assumptions in the language (Melinger 2002: 289): obstruent+obstruent, obstruent+glottal, *sn* and *sw* are heterosyllabic. Other consonant clusters, such as obstruent+sonorant, or sonorant+sonorant are

that lengthening applies after metrical structure has been assigned and, thus, penultimate [CV:] syllables do not constitute a foot of their own. Further evidence for the late insertion of lengthening in penultimate syllables will be presented below.

(19) Lengthening of penultimate CV (even and odd-numbered)

a. <oʔ> ((ge:. gë)ʔ) 'I saw it'

b. <oʔ> (sha. go:). (gëʔ) 'I saw her'

The facts get much more complicated when the penultimate syllable is closed (CVC) (20-21). On the one hand, CVC penultimate syllables that are closed by a glottal consonant [ʔ, h] never lengthen (20). Since coda consonants are moraic, word-final syllables may build a monosyllabic foot on their own, when a FtNon-min precedes the final syllable, e.g. $[...((\mu.\mu)\mu)_{\text{FtNon-min}}$. $\mathbf{(\mu\mu)_{FtMin}}]_{\text{PrWd}}$ as in (20c). Given that a FtNon-min already contains two projections, the final syllable cannot be adjoined to it. This would give rise to a maximal foot with three projections, e.g. $*[...(((\mu.\mu)\ \mu)_{\text{FtNon-min}}\ \mathbf{.\mu\mu)_{FtNon\text{-}min}}]_{\text{PrWd}}$. Building a foot over the last syllable, avoids such types of structures and ensures exhaustive parsings at the right edge of the prosodic word. (The exceptional accent in the final feet in (20a-b) will be discussed in detail after all the contexts of lengthening have been presented).

(20) Absence of lengthening in penultimate CVCx, where x=glottal

a. <a>(ge.ga). ((**yéʔ**).oh) 'I'm willing'

b. <de>(**wá**.ge)ʔ). (nyo.da). ((**gë́ʔ**).öh) 'I'm busy'

c. <de>(yö.gwa). ((déh).at). ((**héʔ**).dah) (göh) 'that which gives us light'

On the other hand, the other closed syllables lengthen only if they are in an even-numbered syllable, i.e. a foot head position (e.g. 21a-c), but not if they are in an odd-numbered syllable, i.e. a foot dependent position (e.g. 22a-c). As pointed out by Melinger (2002) and Hyman (2006, 2009), this last restriction on the application of lengthening stands as clear evidence for the trochaic analysis in Seneca: the head of these final trochees lengthen (21), but not the dependents (22).

---

tautosyllabic. Finally, the most important and probably unexpected fact: a single intervocalic glottal is parsed into coda position rather than onset.

(21) Lengthening of penultimate even-numbered CVCx (if Cx is not glottal)

	a.	<ho> ((yë:s). döh)	'he's attractive'
	b.	<oʔ> (**gé**. ga)h). ((a:t). hoʔ)	'I turned it inside out'
	c.	<da> (**gá**. de)ʔ). ((ha:s). döʔ)	'I exerted myself'

(22) Absence of lengthening of penultimate odd-numbered CVC

	a.	<ho>((**dí**.yë)s). (döh)	'they're attractive'
	b.	<ë> ((**yé**.da)k). (heʔ)	'she'll be running'
	c.	<ni>((**wát**).kwen). (yos)	'how much is possible'

A clear generalization can be formulated from the data in (19-22): penultimate lengthening and accent are in complementary distribution (Melinger 2002: 293). More specifically, penultimate long vowels never present accent (19, 21); the cases that do not undergo lengthening (20, 22) are precisely those whose FtNon-min receive accent (20) or are part of an accented foot (22). Note that by stating that a H tone only docks to non-final FtNon-min, and assuming lengthening occurs after H assignment, we can in fact account for all the accentual patterns in Seneca (e.g. 19a-c, 20c, 21a-c, 22a-c) except for those in (20a-b), where a word final FtNon-min receives a H, contrary to our expectations regarding the unaccentedness of final FtNon-min. The fact that these forms contain a glottal obstruent (ʔ, h) along with the fact that glottal consonants in some languages are linked to a particular tonal accent (e.g. Danish stød) could explain the exceptionality of these forms (a point to which I will return below).

Every previous analysis of Seneca has pointed out that the complex interaction between penultimate lengthening and accent called for some kind of serial analysis. To summarize, here I have proposed that (at least) two different stages need to be assumed. These stages are outlined in (23). First, Seneca builds metrical structure (with minimal and non-minimal feet when necessary) and assigns a H tone to every FtNon-min that is not word-final (23I). In a second stage, the lengthening process applies, lengthening penultimate syllables that comply with the requirements previously seen, summarized now in (23II). In contrast to Wargamay and Yidiɲ, where all that mattered was the parity of the word, in Seneca, the segmental make-up and syllable structure of the penultimate syllable is crucial in favoring/blocking the process.

(23) I. Foot structure and accent in non final non-minimal feet

$$((\sigma\ \sigma\ )_{\mathrm{Ft}}\ )_{\mathrm{FtNonMin}}\ .....]\ \omega$$
$$\underset{\mathrm{H}}{|}$$

II. Penultimate lengthening, after accent assignment

a. [CV] → [CV:] / __ σ]ω
b. [CVCx] → $[\mathrm{CV{:}Cx}]_{\mathrm{NONHDFt}}$ / __ σ]ω if x ≠ [ʔ, h]

To demonstrate that the proposal in (23) predicts the right accentual and lengthening patterns in all word types in Seneca, I illustrate the derivation of one representative word from each of the groups in (19-22). I start with words that have a penultimate open syllable. Remember that open syllables always lengthen in penultimate position, no matter whether they are in the head or the dependent of a foot (23II,a). This prediction is borne out in the derivation of *oʔge:gëʔ* 'I saw it', with a penultimate CV coinciding with the head of a foot (19a and 24), but also in *oʔshago:gëʔ* 'I saw her', where the penultimate CV is in a foot-dependent position (19b and 25). Neither of these words receives accent, as expected. This is illustrated in (24) and (25). First, in (24) I show that *oʔge:gëʔ* is accentless because the only FtNon-min in the word is in word-final position and H tones are exclusively assigned to heads of FtNon-min that are not anchored to the right edge of the prosodic word. In a later stage, the penultimate vowel in the form lengthens due to (23II,a).

(24) Derivation for *oʔge:gëʔ* 'I saw it'

I. Foot structure and accent:	<oʔ> ((ge. gë)ʔ)
II. Penultimate lengthening:	<oʔ> ((ge:. gë)ʔ)

In (25) I show why *oʔshago:gëʔ* remains accentless: in (25a) there is not a FtNon-min in the prosodic word. Furthermore, note that even if this type of word were parsed with recursive footing as in (25a'), we would still predict the correct accentual patterns since the FtNon-min in those forms would be final thereby keeping its head from getting a high tone.

(25) Derivation for *oʔshago:gëʔ* 'I saw her'

I. Foot structure and accent:		a.	<oʔ> (sha.go) (gëʔ)
	Or	a.'	<oʔ> ((sha.go) gëʔ)
II. Penultimate lengthening:		b.	<oʔ> (sha.go:) (gëʔ)

Moving now to words with penultimate closed syllables, I first analyze words in which the penultimate CVC syllable is not closed by a glottal consonant (henceforth represented as CVC$_{[-glot]}$). In this type of word the generalization was that penultimate CVC$_{[-glot]}$ syllables would only lengthen if they are in the head of some foot (i.e. an even-numbered syllable). Crucially, every CVC$_{[-glot]}$ that is the head of a final foot is necessarily the head of a FtNon-min, since the only requirement for a foot to be non-minimal is that at least one of its syllables is closed. Again, since the FtNon-min is final, it does not receive a H. However, this word gets accent in the FtNon-min preceding the final foot. Specifically, the head of the first foot in (26I) gets a H because: (i) it is non-minimal and (ii) it is not final within the prosodic word. The second foot in (26I), however, does not get accent because it is final. After accent has been assigned, the penultimate syllable lengthens because it is the head of a foot (26II).

(26) Derivation for oʔ**gé**gaha:thoʔ 'I turned it inside out'
I. Foot structure and accent: <oʔ> (**gé**. ga)h). ((at). hoʔ)
II. Penultimate lengthening: <oʔ> (**gé**. ga)h). ((a:t). hoʔ)

When a CVC$_{[-glot]}$ syllable is the head of a foot, it is eligible for lengthening as in (26II). However, in (27) the penultimate CVC$_{[-glot]}$ is in a foot dependent position and, consequently, it does not lengthen (see 27II). Furthermore, *ëy**é**dakheʔ* 'she'll be running' does not remain accentless because its FtNon-min is not in a word-final position and, thus, it is eligible for accent.

(27) ëy**é**dakheʔ 'she'll be running'
I. Foot structure and accent: <ë> ((**yé**.da)k). (heʔ)
II. Penultimate lengthening: ————————

Note that exactly the same line of reasoning predicts the correct accentual patterns in a word like *deyögwadéhat**héʔ**dahgöh* 'that which gives us light' where the penultimate syllable has a glottal consonant:

(28) deyögwadéhat**héʔ**dahgöh 'that which gives us light'
I. Foot structure and accent: <de>(yö.gwa).((déh).at).((**héʔ**).dah) (göh)
II. Penultimate lengthening: ————————

This word does not lengthen because its penultimate syllable is in a dependent position and its FtNon-min gets a H because it is non-final.

As anticipated above, however, it seems like this cannot be the whole story for words with penultimate closed by a glottal consonant since they also block lengthening when they are in a foot head position, behaving differently from the rest of closed syllables. This difference in the behavior of penultimate closed syllables depending on whether they are closed by a glottal (29a) or by another consonant (26, 27) is illustrated in (29). Compare the final foot in a word like *dewá́geʔnyodagë́ʔöh* 'I'm busy' (29a) with the final feet in *oʔgégaha:thoʔ* 'I turned it inside out' (29b) and *hoyë:sdöh* 'he's attractive' (29c). The penultimate syllable in (29a) does not display lengthening but, on the contrary, exceptional accent. However, exactly the same structure displays expected lengthening (due to the head status of the closed syllable in 29b,c) and expected unaccentedness (due to the non-finality condition of accent) when the coda consonant of the penultimate syllable is not glottal, as in (29b,c).

(29) de**wá**.geʔnyoda**gë́ʔ**öh 'I'm busy'

I. Foot structure and accent: a. <de>(**wá**.ge)ʔ). (nyo.da). (**gë́ʔ**.)öh)

II. Penultimate lengthening:

cf. b. <oʔ> (**gé**. ga)h). ((a:t). hoʔ),

cf. c. <ho> ((ye:s). doʔ)

The present proposal has trouble precisely generating the accentual patterns in forms with a penultimate CV[ʔ/h] syllable in the head of a foot (29a).[14] Specifically, my analysis would incorrectly predict an absence of accent in the final foot in forms like (29a). Nevertheless, note that similar problems would be encountered by other prosodic analyses, since the syllabic and metrical structure of the final feet in (29a) and (29b-c) are identical. The only difference between these feet is the presence or absence of a glottal stop in the penultimate syllable (29a *vs.* 29b-c). In sum, the fact that words with penultimate syllables in the head of a foot containing a glottal coda consonant block lengthening (29a) and, contrary to the general unaccentedness of final FtNon-min, they allow a H tone in the head of their final FtNon-min, is surprising given the general patterns of the language. However, the exceptional behavior of this final FtNon-min can be attributed to the glottal

[14] As I showed in (28), when the penultimate CV[ʔ/h] is in a foot-dependent position, the present analysis does not have problems generating the correct accentual patterns.

consonant *per se*, since they are the only consonants displaying an exceptional behavior, i.e. favoring a H in a FtNon-min. But why are glottal stops special in Seneca? And, more specifically, why are they the only ones that trigger a H tone in a final FtNon-min?

The only attempt that I can think of to explain the exceptional attraction of a H to a final FtNon-min in words with glottal consonants in penultimate syllables that coincide with the head of a foot (e.g. 29a) is to rely on the inherent relation between pitch and glottal consonants. As anticipated earlier, in other languages, like Danish, the realization of a high tone involves certain degrees of glottalization in postnuclear positions, followed by a falling pitch contour, i.e. the so-called stød accent (e.g. Pedersen 1973; Thorsen 1974; Basbøll 2003; Itô & Mester 1997, 2012b). It could be the case that in Seneca, glottal consonants correspond to the realization of a H. If that is the case, it would make sense that words with a glottal consonant always block lengthening: since lengthening and H are in complementary distribution, a syllable that already has a H, or a glottal consonant, cannot lengthen. By contrast, this same syllable can favor a H tone —even in exceptional final FtNon-min position— due to the intrinsic connection between glottal consonants and high tones.[15]

Although the details of the analysis of the exceptional behavior of glottal consonants in Seneca still need to be worked out, I believe that the inclusion of recursive-footing in phonological representations in Seneca illuminates the phonological patterns of the language. On the one hand, the device of recursive-footing is able to capture the double conditioning on Seneca accent, for which the structure of foot heads, as well as foot dependents, is relevant. In previous studies this double requirement had to be stipulated. On the other hand, recursive feet provide a straightforward motivation for the emergence of H: the heads of FtNon-min receive a H in Seneca due to their double-head status. Finally, the interaction between lengthening and accent can be captured in a framework with recursive-feet, as long as the non-finality condition prohibiting H on word-final FtNon-min is posited.

[15] Another possible explanation for this exceptional behavior could be that there is a general requirement in the language, by which FtNon-min must exhibit some kind of greater strength than the rest of the feet in the word due to their double-head status. Note that in Seneca, a FtNon-min either lengthens, or it receives a H, but it never remains *plain* or *non-prominent*. In other words, Seneca does not allow an *unstrengthened* FtNon-min. Yet, this hypothesis does not really explain why glottal stops block penultimate lengthening. This is especially intriguing since Seneca allows syllables with long vowels and a glottal consonant in other positions (Michelson 1988).

6.5 Summary and implications for OT

To summarize, this chapter has provided further support for the need to include recursive footing in phonological representations. Beyond the use of non-minimal feet in stress systems, the representational analysis of the distribution of tone sketched in this chapter adds explanatory power to the recursivity hypothesis explored in the dissertation. Additionally, the investigation of Gilbertese, Irabu and Seneca prosodic systems have contributed to enriching the picture of the metrical representations that can be considered possible in natural language.

On the one hand, the analysis of these languages seems to open up the possibility of treating SIP as an inviolable constraint, rather than a hard universal (although see all the previous discussion in connection to the violability/non-violavility of this principle). A possible option to deal with this kind of misalignment within OT is to posit a violable alignment constraint, as suggested by Blevins & Harrison (1999: 219).

(30) SYLLABLE INTEGRITY[16]
Align the {Right/Left} edge of a foot with the {Right/Left} edge of a syllable (Blevins & Harrison 219) (abbr. σ-Int)

When this constraint is low-ranked, syllables split by a foot boundary can arise, as it has been shown to be the case in Gilbertese, Irabu and Seneca. However, note that this constraint alone is not able to favor purely moraic feet over syllabic feet. For instance, take a language like Seneca, in which a sequence of a light-heavy syllables places stress on the first syllable. We know, for independent reasons, that such a syllabic sequence is parsed with two feet (31a) rather than one (31b). With the existing constraints, a candidate without recursion (31b) will always be favored over a candidate with recursion (31a) (the sad face indicates the intended winner and the bomb signals the winner wrongly selected as optimal).

[16] This constraint could be formulated in a non-intervention format too. I provide Blevins & Harrison's original version of their constraint, acknowledging their insight from more than a decade ago.

(31) Parsing a ĹH sequence

	TROC	IAMB	WSP	$\sigma^{\mu\mu}$=FT	σ-Int
☹ a. (('μh . μ) μ)		**!	*	*	*
💣 b. ('μh . μ μ)		*	*	*	
c. (μ . ('μh μ))	*!	*			

In (31), the candidate (31c) stresses the heavy syllable, e.g. LH́. Therefore, it avoids a violation of WSP, the constraint that favors stressed heavy syllables, and $\sigma^{\mu\mu}$=FT, the constraint that favors heavy syllables coincident with a foot. However, since TROCHEE and IAMB are higher-ranked than the above-mentioned constraints, this candidate is not selected as optimal. Instead, candidate (31b) is the one that surfaces as optimal. Even though (31b) might be a desired outcome in most of the languages that allow uneven ĹH trochees (e.g. Old-English), in order to favor candidate (31a) in a language like Seneca, we need an explicit constraint which favors moraic terminals over syllabic ones. This constraint is generally low-ranked and, therefore, feet are generally syllabic. Due to the action of WSP and $\sigma^{\mu\mu}$=FT, feet are moraic in most of the quantity-sensitive languages, in which heavy syllables are stressed. However, in other languages that are quantity-sensitive in some way, but in which not all heavy syllables bear stress because the languages care more about moraic structure than syllable structure, a constraint favoring strictly moraic feet over syllabic feet is needed. I assume this constraint is FT→ μ. As seen in the next tableau, when this constraint is high-ranked in the hierarchy, it can favor candidates like (32a) with moraic feet and recursion.

(32) Moraic feet with recursion over syllabic feet without recursion

	TROC	FT→ μ	IAMB	WSP	$\sigma^{\mu\mu}$=FT	σ-Int
☞ a. (('μh . μ) μ)			**!	*	*	*
b. ('μh . μ μ)		*!	*	*	*	
c. (μ . ('μh μ))	*!		*			

Future research in the phonology of other quantity-sensitive languages that have been described as *mora counting* —disregarding the edges of syllables— would be needed to confirm or falsify the need for constraints like FT→ μ and σ-INTEGRITY. Note, however, that in general, the overwhelming majority of languages that are quantity-sensitive can be derived without appealing to FT→ μ, as has been demonstrated in all the previous chapters.

7 Conclusions

This dissertation has presented a principled theory of recursive footing. Drawing on early work on foot structure (Selkirk 1980; Prince 1980; Hayes 1980, among others), I have proposed rehabilitating recursive feet in phonological representations. In particular, I have argued that a weak syllable —and, occasionally, a weak mora (Chapter 6)— may sometimes be adjoined to a foot Ft^x, giving rise to one (and only one) intermediate foot layer between Ft^x and the prosodic word, e.g. $[((\sigma\ \sigma)_{Ft^x}\ \sigma)_{Ft}]_{PrWd}$.

Within the present model, this intermediate layer does not constitute an independent universal primitive category in the prosodic hierarchy (e.g. a colon or a superfoot). By contrast, expanding on Itô & Mester's recent research (2007 *et seq.*), I have argued that this layer constitutes a non-minimal projection of a foot, which arises in some languages due to constraint interaction. A recursive foot, therefore, is conceived here as a grammatical artifact, i.e. different grammatical forces favor (or disfavor) its emergence in particular prosodic systems. One of the main goals of this dissertation has been to explore the specific motivations and constraint rankings that may cause (or block) recursive footing in prosodic systems. This task has been pursued in Chapters 2, 3 and 4.

In general, two motivations have been established as the major driving forces behind the presence of recursive feet in natural language. On the one hand, I have argued that recursive feet arise in some languages as a last-resort device to ensure exhaustive parsing of syllables and/or avoid unary, non-branching, feet (Chapter 3; for similar ideas see also van der Hulst 2010 and Bennett 2012). On the other hand, I have proposed that recursive feet are occasionally favored in other languages as a way of economizing the number of maximal and minimal projections of a foot within a given prosodic word. Whereas the former motivation is responsible for the construction of peripheral recursive feet in some binary rhythmic languages (Chapter 3), the latter often results in ternary rhythmic stress alternations (Chapter 4).

In OT terms, the grammatical motivations that may cause recursion at the foot layer have been expressed via two sorts of constraints. First, to guarantee exhaustive parsing of syllables and prohibit non-branching feet, I have relied upon well-established constraints in the prosodic hierarchy and foot structure (Prince 1980; Itô & Mester 1992/2003; Selkirk 1996). Second, to ensure that a recursive foot is not just a sporadic device that arises to ensure exhaustivity, I have formulated a small set of non-intervention alignment constraints, which can target different projections of prosodic categories. These constraints are categorically evaluated and they conform to two locality restrictions. Under certain specific rankings, they can favor default parsings with recursive feet over prosodifications with adjacent minimal feet (i.e. non-recursive feet) (Chapter 4).

As a result of these constraint interactions and the particular representational assumptions outlined in Chapter 2, we have seen that the boundary between *binary* and *ternary* rhythmic systems is not as strict as previously thought. Instead, languages with rhythmic stress can be classified along a continuum. At one end of the continuum we find languages with mostly non-recursive binary feet, and peripheral non-minimal feet only in odd-parity forms; at the other end are languages that only allow feet that have undergone recursion, resulting in radical ternary stress alternations (Chapter 4, see Martínez-Paricio & Kager 2013 for further details and typological confirmation of this approach).

To seriously challenge the general restriction against recursive feet in metrical theory, I have proposed, and demonstrated, that the introduction of recursive feet in phonological representations comprises not only an improvement of our theory of metrical stress, but our theory of prosody immensely benefits from the inclusion of recursive feet in phonological representations (Chapter 2). Throughout the dissertation I have argued that recursive feet will allow us to provide a unified account of a wide range of prosodically-conditioned phenomena. In particular, I have demonstrated that the explanatory and descriptive power of recursive feet in phonological theory is supported on empirical grounds that go well beyond the usefulness of recursive feet in modeling ternary stress alternations, the original motivation for "big feet" in metrical theory (Prince 1980; Levin 1985, 1985; Halle & Vergnaud 1987; Rice 1992; Kager 1994 among others). To provide strong support for this claim, I have undertaken a cross-linguistic study of a wide variety of accentual and non-accentual phonological phenomena in a range of languages from very different backgrounds (e.g. Wargamay, Yidiɲ, Seneca, Ryukyuan, Chugach, Tripura Bangla, Cayuvava, Dutch, German, English and Gilbertese). I have shown that a repertoire of very different phenomena such as several puzzling patterns of vowel lengthening (Chapter 3), instances of consonant fortition, consonant gemination, some examples of metrically-conditioned tonal distributions (Chapter 4, Chapter 6) and, finally, some cases of vowel reduction, vowel deletion, consonant weakening (Chapter 5) and various other prosodically conditioned segmental processes all receive a simpler and more uniform account when recursive feet are allowed in prosodic theory.

Even though it is true that a few of these processes could arguably be explained in non-recursive terms —for example, some alleged differences between foot dependents had been previously accounted for by referring to the structural difference between the dependent of a foot and an unfooted syllable— only a structural, recursive foot-based analysis is able to account for all the details of very different metrically-conditioned processes. Hence, in a way, the findings of this dissertation supply further support for the need to consider the foot as a primitive universal prosodic category. Beyond the role of the metrical foot as an accentual domain (i.e. for stress assignment and/or tone assignment), the analyses presented in Chapters 3 through 6 provide strong support for the idea that languages do in fact make use of feet.

Finally, in arguing for the need for recursive feet in phonological representations, I have identified new strength relations in prosodic systems. Besides the well-established strength dichotomy between the head of a foot (i.e. the strong branch of a foot) and the dependent of a foot (i.e. its weak branch), I have shown that languages may distinguish between further metrical prominence positions. Interestingly, these additional required positions do not need to be stipulated as they come for free in a framework that allows recursion at the level of the foot. In particular, I have shown that some languages need to distinguish between two types of prominent positions: (i) the head of a minimal foot and (ii) the head of a non-minimal foot, which does not necessarily correspond to the head of a prosodic word (Chapter 3). Likewise, I have posited three different types of non-prominent syllables: (i) the dependent of a minimal foot, (ii) the dependent of a non-minimal foot and (iii) an unfooted syllable (i.e. an unstressed syllable directly linked to the prosodic word). The two former positions have been characterized as non-prominent, but metrically relevant (e.g. they can condition the particular location of accent, they display preferences for certain low sonority vowels and/or low prominence tones, etc.). Unfooted syllables, on the other hand, have been assumed to be left out of the domain of metrical rules (Chapter 2 and Chapter 6). Therefore, the traditional notion of *extrametricality* has been recast here as a structural representation in which syllables are directly linked to the prosodic word.

In conclusion, the recursion-based model advanced in this dissertation provides a unified account of a wide range of accentual and non-accentual patterns which would have otherwise remained unexplained. The typological predictions of this model, at least in quantity-insensitive stress systems, have been shown to be justified in Martínez-Paricio & Kager (2013).

Still, since in this dissertation I have only concentrated on exploring a subset of the possible metrically-conditioned phenomena attested in languages, future research will have to determine whether recursive feet provide satisfactory accounts of other prosodically-conditioned phenomena. Promising areas for future work might include foot-conditioned cases of vowel harmony in which the domain of spreading spans three syllables, but not more (p.c. Joan Mascaró and Jesús Jiménez); cases in which metrical feet clearly condition morphophonological patterns (e.g. McCarthy & Prince 1986/1996; Hewitt 1992; Itô & Mester 1992/2003; Yu 2003, 2004) and the investigation of further metrical tonal distributions (e.g. de Lacy 2002a; Hyman 2009). These are just some phenomena that would be interesting to approach from the perspective of a model in which foot-level recursion is available as an analytical tool.

Bibliography

Alber, Birgit. 1997. Quantity sensitivity as the result of constraint interaction. In Geert Booij & Jeroen van de Weijer (eds.), *Phonology in Progress–Progress in Phonology, HIL Phonology Papers III*, 1–45. The Hague: Holland Academic Graphics.

Alber, Birgit. 2001. Maximizing first positions. *Linguistics in Potsdam (Proceedings of HILP 5)*, 1–19.

Alber, Birgit. 2005. Clash, lapse and directionality. *Natural Language and Linguistic Theory* 23, 485–542.

Anderson, Stephen R. 2005. *Aspects of the theory of clitics*. Oxford, UK: Oxford University Press.

Anttila, Arto. 1997. Deriving variation from grammar. In Frans Hinskens, Roealand van Hout & Leo Wetzels (eds.), *Variation, Change and Phonological Theory*, 35–68. Amsterdam: John Benjamins.

Anttila, Arto. 2002. Morphologically conditioned phonological alternations. *Natural Language and Linguistic Theory* 20, 1–42.

Apoussidou, Diana & Sebastian Nordhoff. Feet in Sri Lanka Malay - No stress please. Paper presented at OCP-5, Toulouse. Available online at http://www.fon.hum.uva.nl/diana/presentationfiles/Apoussidou&Nordhoff OCP5.pdf.

Balogné Bérces, Katalin. 2011. Weak and semiweak phonological positions in English. *Journal of English Studies* 9, 75–96.

Basbøll, Hans. 2003. Prosody, productivity and word structure: the stød pattern of Modern Danish. *Nordic Journal of Linguistics* 26, 5–44.

Becker, Michael, Andrew Nevins & Jonathan Levine. 2012. Asymmetries in generalizing alternations to and from initial syllables. *Language* 88, 231–68.

Beckman, Jill. 1998. *Positional faithfulness*. Doctoral Dissertation, University of Massachussetts, Amherst.

Beckman, Mary & Janet Pierrehumbert. 1986. Intonational structure in English and Japanese. *Phonology* 3, 255–309.

Bennett, Ryan. 2012. *Foot-conditioned phonotactis and prosodic constituency*. Doctoral Dissertation, University of California, Santa Cruz.

Bennett, Ryan & Robert Henderson. 2013. Accent in Uspanteko. *Natural Language and Linguistic Theory* 31.

Benua, Laura. 1997. *Transderivational Identity: Phonological Relations between Words*. Doctoral Dissertation, University of Massachusetts, Amherst.

Bermúdez-Otero, Ricardo 1999. *Constraint interaction in language change: quantity in English and Germanic [Opacity and globality in phonological change]*. Doctoral Dissertation, University of Manchester and Universidad de Santiago de Compostela. Available at http://www.bermudez- otero.com/PhD.pdf.

Bermúdez-Otero, Ricardo. 2006. Morphological structure and phonological domains in Spanish denominal derivation. In Fernando Martínez-Gil & Sonia Colina (eds.), *Optimality-theoretic studies in Spanish phonology*, 278–311. Amsterdam: John Benjamins.

Bermúdez-Otero, Ricardo. 2013. The Spanish lexicon stores stems with theme vowels, not roots with inflectional class features. *Probus* 25, 3–103.

Bermúdez-Otero, Ricardo. in prep. *Stratal Optimality Theory* (Oxford Studies in Theoretical Linguistics). Oxford: Oxford University Press.

Bermúdez-Otero, Ricardo & April McMahon. 2006. English phonology and morphology. In Bas Aarts & April McMahon (eds.), *The handbook of English linguistics*, 382-410. Oxford: Blackwell.

Bickmore, Lee. 1995. Tone and stress in Lamba. *Phonology* 12, 307–41.

Biró, Tamás. 2003. Quadratic alignment constraints and finite state optimality theory. *Proceedings of the workshop on finite-state methods in natural language processing*, 119–26.

Biró, Tamás. 2004. When the hothead speaks: Simulated Annealing Optimality Theory for Dutch fast speech Paper presented at CLIN 2004, Leiden.

Blevins, Juliette & Sheldon P. Harrison. 1999. Trimoraic feet in Gilbertese. *Oceanic Linguistics* 38, 203–30.

Boersma, Paul. 1997. How we learn variation, optionality, and probability. *Proceedings of the Institute of Phonetic Science of the University of Amsterdam*, vol. 21, 43–58.

Booij, Geert E. 1977. *Dutch morphology: a study of Dutch word formation in generative grammar*. Dordrecht: Foris.

Booij, Geert E. 1996. Cliticization as prosodic integration: the case of Dutch. *The Linguistic Review* 13, 219–42.

Buckley, Eugene. 1994. Persistent and cumulative extrametricality in Kashaya. *Natural Language and Linguistic Theory* 12, 423–64.

Buckley, Eugene. 2009. Locality in metrical typology. *Phonology* 26, 389–435.

Buller, Barbara, Ernest Buller & Daniel L. Everett. 1993. Stress placement, syllable structure, and minimality in Banawá. *International Journal of American Linguistics* 59, 280–93.

Bye, Patrik. 1996. Scandinavian 'Level Stress' and the Theory of Prosodic Overlay. *Nordlyd* 24, 23–62.

Bye, Patrik. 2007. Allomorphy—selection, not optimization. In Sylvia Blaho, Patrik Bye & Martin Krämer (eds.), *Freedom of analysis?* , 63–91. Walter de Gruyter.

Bye, Patrik & Paul de Lacy. 2008. Metrical influences on fortition and lenition. In Joaquim Brandao de Carvalho, Tobias Scheer & Philippe Ségéral (eds.), *Lenition and fortition*, 173–206. Berlin: Mouton de Gruyter.

Byrd, Dani. 1996. Influences on articulatory timing in consonant sequences. *Journal of Phonetics* 24, 209–44.

Caballero, Gabriela. 2008. *Choguita Rarámuri (Tarahumara) phonology and morphology*. Doctoral Dissertation, University of California, Berkeley.

Caballero, Gabriela. 2011. Morphologically conditioned stress assignment in Choguita Rarámuri. *Linguistics* 49, 749–90.

Cabré, Teresa & Pilar Prieto. 2006. Exceptional hiatuses in Spanish. In Fernando Martínez-Gil & Sonia Colina (eds.), *Optimality-theoretic Studies in Spanish phonology*, 205–38. Amsterdam/Philadelphia: John Benjamins.

Cairns, Chuck. 2002. *Foot and syllable in Southern Paiute*. Ms., City University of New York.

Camilli, Amerindo. 1929. Il dialetto di Servigliano. *Archivum Romanicum* 13, 220–51.

Casali, Roderic F. 1998. *Resolving hiatus*. Taylor & Francis. Available as ROA-215 from the Rutgers Optimality Archive.

Chafe, Wallace. 1967. *Seneca Morphology and Dictionary*. Smithsonian Contributions to Anthropology 4. Washington, DC: Smithsonian Institution Press.

Chafe, Wallace. 1977. Accent and related phenomena in the Five Nations Iroquois languages In Larry Hyman (ed.), *Studies in Stress and Accent*, 169–81. Los Angeles: Department of Linguistics, University of Southern California.

Chafe, Wallace. 1996. Sketch of Seneca: an Iroquian language. In Ives Goddard & William C. Sturtevant (eds.), *Handbook of American Indian Linguistics*, vol. 17, 551–79. Washington, DC: Smithsonian Institution.

Clements, George N. 1990. The role of the sonority cycle in core syllabification. In John C. Kingston & Mary E. Beckman (eds.), *Papers in Laboratory Phonology I: Between the Grammar and Physics of Speech*, 283–333. New York: Cambridge University Press.

Crowhurst, Megan J. 1991. *Minimality and foot structure in metrical phonology and prosodic morphology*. Doctoral Dissertation, University of Arizona.

Crowhurst, Megan J. 1996. An Optimal Alternative to Conflation. *Phonology* 13, 409–24.

Crowhurst, Megan J. & Mark Hewitt. 1995. Prosodic Overlay and Headless Feet in Yidiɲ. *Phonology* 12, 39–84.

Das, Shyamal. 2001. *Some aspects of the phonology of Tripura Bangla and Tripura Bangla English*. Doctoral Dissertation, CIEFL Hyderabad. Available as ROA-493 from the Rutgers Optimality Archive.

Davis, Stuart. 1999. The parallel distribution of aspirated stops and /h/ in American English. *Indiana University Working Papers in Linguistics* 1, 1–10.

Davis, Stuart. 2005. "Capitalistic" vs. "Militaristic": the paradigm uniformity effect reconsidered. In Laura J. Downing, T. Alan Hall & Renate Raffelsiefen (eds.), *Paradigms in phonological theory*, 107–21. Oxford: Oxford University Press.

Davis, Stuart & Mi-Hui Cho. 2003. The distribution of aspirated stops and/h/in American English and Korean: an alignment approach with typological implications. *Linguistics* 41, 607–52.
de Lacy, Paul. 2002a. The interaction of tone and stress in Optimality Theory. *Phonology* 19, 1–32.
de Lacy, Paul. 2002b. *The Formal Expression of Markedness. University of Massachusetts*. Doctoral Dissertation, University of Massachusetts, Amherst. Available as ROA-542 from the Rutgers Optimality Archive.
de Lacy, Paul. 2004. Markedness conflation in Optimality Theory. *Phonology* 21, 145–99.
de Lacy, Paul. 2006. *Markedness: Reduction and Preservation in Phonology*. Cambridge: Cambridge University Press.
Demuth, Katherine. 2001. Prosodic constraints on Morphological development. In Jèurgen Weissenborn & Barbara Hèohle (eds.), *Approaches to Bootstrapping: Phonological, Syntactic and Neurophysiological Aspects of Early Language Acquisition*, vol. 2, 3–21. Philadelphia, PA: John Benjamins.
Dixon, Robert M. W. 1977a. *A grammar of Yidiɲ*. Cambridge: Cambridge University Press.
Dixon, Robert M. W. 1977b. Some phonological rules in Yidin^y. *Linguistic Inquiry* 8, 1–34.
Dixon, Robert M. W. 1981. Wargamay. In Robert M. W. Dixon & Barry J. Blake (eds.), *Handbook of Australian languages*, vol. 2, 1–144. Amsterdam: Benjamins.
Domahs, Ulrike, Elise Klein, Walter Huber & Frank Domahs. 2013. Good, bad and ugly word stress – fMRI evidence for foot structure driven processing of prosodic violations. *Brain & Language* 125, 272–82.
Downing, Laura. 2004. What African languages tell us about accent typology. In Susanne Fuchs & Silke Hamann (eds.), *ZAS papers in linguistics*, vol. 37, 101–36. Berlin: ZAS.
Dresher, B. Elan & Aditi Lahiri. 1991. The Germanic foot: metrical coherence in Old English. *Linguistic Inquiry* 22, 251–86.
Dresher, B. Elan & Harry van der Hulst. 1998. Head–dependent asymmetries in phonology: complexity and visibility. *Phonology* 15, 317–52.
Eisner, Jason. 1997. What constraints should OT allow? Paper presented at 71st Annual Meeting of the Linguistic Society of America, Chicago. Available as ROA-204 from the Rutgers Optimality Archive.
Eisner, Jason. 2000. Directional constraint evaluation in Optimality Theory. *Proceedings of the 18th International Conference on Computational Linguistics (COLING 2000)* 257–63. Saarbrücken, Germany.
Elenbaas, Nine & René Kager. 1999. Ternary rhythm and the lapse constraint. *Phonology* 16, 273–329.

Elfner, Emily. 2011. Recursive phonological phrases in Conamara Irish. In Mary Byram Washburn et al. (eds.), *Proceedings of the 28th West Coast Conference on Formal Linguistics (WCCFL 28)*. Available online: https://sites.google.com/site/wccfl28pro/elfner.

Elfner, Emily. 2012. *Syntax-prosody interactions in Irish*. Doctoral Dissertation, University of Massachusetts, Amherst.

Embick, David. 2010. *Localism versus globalism in morphology and phonology*, vol. 60. The MIT Press.

Evans, Nicholas & Stephen C. Levinson. 2009. The myth of language universals: language diversity and its importance for cognitive science. *Behavioral and Brain Sciences* 32, 429–48.

Everett, Daniel L. 1998. Syllable Integrity. *Proceedings of 16th West Coast Conference on Formal Linguistics (WCCFL 16)*. Chicago: University of Chicago Press.

Everett, Daniel L. 2003. Iambic feet in Paumari and the theory of foot structure. *Linguistic Discovery* 2, 22–44.

Féry, Caroline. 1998. German Word Stress in Optimality Theory. *The Journal of Comparative Germanic Linguistics* 2, 101–42.

Féry, Caroline. 2010. Recursion in prosodic structure. *Phonological Studies*, vol. 13, 51–60. Tokyo: Kaitakusha.

Féry, Caroline & Hubert Truckenbrodt. 2005. Sisterhood and Tonal Scaling. *Studia Linguistica*. Special Issue "Boundaries in Intonational Phonology" 59: 2/3, 223–43.

Fougeron, Cécile & Patricia Keating. 1997. Articulatory strengthening at edges of prosodic domains. *The Journal of the Acoustical Society of America* 10, 3728–40.

Fuhrhop, Nanna. 1998. *Grenzfälle morphologischer Einheiten*. Tübingen: Stauffenburg.

Gerken, LouAnn. 1994a. A metrical template account of children's weak syllable omissions from multisyllabic words. *Journal of child language* 21, 565–84.

Gerken, LouAnn. 1994b. Young children's representation of prosodic phonology: Evidence from English-speakers' weak syllable productions. *Journal of Memory and Language* 33, 19–38.

Giegerich, Heinz J. 1985. *Metrical Phonology and Phonological Structure. German and English*. Cambridge: Cambridge University Press.

Giles, Andrea. 1988. A Metrical Analysis of the Lillooet Stress System. *Working Papers of the Linguistics Circle* 7, 25-40.

Goldsmith, John. 1976. *Autosegmental phonology*. Doctoral Dissertation, MIT [Published in 1979, New York: Garland].

Goldsmith, John 1987. Tone and accent, and getting the two together. In Jon Aske, Natasha Beery, Laura Michaelis & Hana Filip (eds.), *Proceedings of* *the Thirteenth Annual Meeting of the Berkeley Linguistic Society* vol. 13, 88–104.

Gordon, Matthew. 2002. A factorial typology of quantity-insensitive stress. *Natural Language and Linguistic Theory* 20, 491–552.

Gouskova, Maria. 2003. *Deriving economy: syncope in Optimality Theory*. Doctoral Dissertation. University of Massachusetts, Amherst.

Green, Antony D. 1997. *The prosodic structure of Irish, Scots Gaelic and Manx*. Doctoral Dissertation. University of Cornell.

Grijzenhout, Janet. 1990. Modern Icelandic foot formation. In Reineke Bok-Bennema & Peter Coopmans (eds.), *Linguistics in the Netherlands*, 53–62. Dordrecht: Foris.

Gussenhoven, Carlos. 1991. The English Rhythm Rule as an Accent Deletion Rule. *Phonology* 8, 1–35.

Gussenhoven, Carlos. 2004. *The phonology of tone and intonation*. Cambridge University Press.

Haas, Mary. 1977. Tonal accent in Creek. In Larry Hyman (ed.), *Studies in stress and accent,* vol. 4, 195–208. Los Angeles: Department of Linguistics, University of Southern California.

Hagberg, Lawrence Raymond. 2006. *An Autosegmental Theory of Stress* (SIL e-books). SIL International.

Hale, Mark & Charles Reiss. 2008. *The phonological enterprise*. Oxford: Oxford University Press.

Halle, Morris. 1990. Respecting metrical structure. *Natural Language and Linguistic Theory* 8, 149–76.

Halle, Morris & Jean-Roger Vergnaud. 1978. Metrical Structures in Phonology. Ms., MIT. Cambridge, MA.

Halle, Morris & Jean-Roger Vergnaud. 1987. *An essay on stress*. Cambridge, MA: MIT Press.

Halle, Morris & William Idsardi. 1995. General properties of stress and metrical structure. In John Goldsmith (ed.), *The handbook of phonological theory*, 403–43. Oxford: Blackwell.

Hammond, Michael. 1984. *Constraining metrical theory: a modular theory of rhythm and destressing*. Doctoral Dissertation, University of California, Los Angeles [Distributed by the Indiana University Linguistics Club, Bloomington, Indiana].

Hammond, Michael. 1986. The obligatory-branching parameter in metrical theory. *Natural Language and Linguistic Theory* 4, 185–228.

Hammond, Michael. 1987. Hungarian cola. *Phonology Yearbook* 4, 267–9.

Hammond, Michael. 1990. *Deriving ternarity*. Ms., University of Arizona, Tucson.

Haraguchi, Shosuke. 1977. *The Tone Pattern of Japanese: An Autosegmental Theory of Tonology*. Tokyo: Kaitakusha.

Harris, John. 2013. Wide-domain r-effects in English. *Journal of Linguistics* 49, 329–65.

Harris, John & Jonathan Kaye. 1990. A tale of two cities: London glottalling and New York City tapping. *The Linguistic Review* 7, 251–74.

Hayes, Bruce. 1980. *A metrical theory of stress rules*. Doctoral dissertation, MIT [Published in 1985: Garland Press, New York].

Hayes, Bruce. 1982. Metrical structure as the organizing principle in Yidiny phonology. In Harry van der Hulst & Norval Smith (eds.), *The structure of phonological representations*, 97–110. Dordrecht: Foris.

Hayes, Bruce. 1985. Iambic and trochaic rhythm in stress rules. *Proceedings of the Annual Meeting of the Berkeley Linguistics Society*, vol. 11, 429–46.

Hayes, Bruce. 1987. A revised parametric metrical theory. *Proceedings of NELS* vol. 17, 274–189.

Hayes, Bruce. 1989a. The prosodic hierarchy in meter. In Paul Kiparsky & Gilbert Youmans (eds.), *Rhythm and Meter*, 201-60. Orlando: Academic Press.

Hayes, Bruce. 1989b. Compensatory lengthening in moraic phonology. *Linguistic Inquiry* 20, 253–306.

Hayes, Bruce. 1995. *Metrical stress theory: principles and case studies*. Chicago: Chicago University Press.

Hayes, Bruce. 1999. Phonological restructuring in Yidiny and its theoretical consequences. In Ben Hermans & Marc van Oostendorp (eds.), *The Derivational Residue in Phonological Optimality Theory*, 1753–205. Amsterdam: John Benjamis.

Hayes, Bruce, Bruce Tesar & Kie Zuraw. 2003. *OTSoft 2.1*. Software package, http://www.linguistics.ucla.edu/people/hayes/otsoft/.

Hayes, Bruce & Colins Wilson. 2008. A Maximum Entropy Model of Phonotactics and Phonotactic Learning. *Linguistic Inquiry* 39, 379-440.

Heinz, Jeffrey. 2006. Learning quantity insensitve stress systems via local inference. *Proceedings of the Eight Meeting of the ACL Special Interest Group on Computational Phonology at HLT-NSSCL 2006*, 21–30. New York City, USA.

Heinz, Jeffrey, Gregory Kobele & Jason Riggle. 2005. Exploring the typology of quantity-insensitive stress systems without gradient constraints. Paper presented at LSA Annual Meeting, Oakland, California.

Hercus, Luise A. 1986. *Victorian languages: a late survey* (Pacific Linguistics, Series B-77). Canberra: Australian National University.

Hewitt, Mark S. 1991. Binarity and Ternarity in Alutiiq. In Jean Ann & Kyoko Yoshimura (eds.), *Proceedings of Arizona Phonology Conference* vol. 4, 44-60. University of Arizona.

Hewitt, Mark S. 1992. *Vertical maximization and metrical theory*. Doctoral Dissertation, Brandeis Brandeis University, Waltham, MA.

Hewitt, Mark S. 1994. Deconstructing foot binarity in Koniag Alutiiq. Ms. Available as ROA-12 from the Rutgers Optimality Archive.

Houghton, Paula. 2006. Ternary stress. Ms., University of Massachusetts, Amherst. Available as ROA-836 from the Rutgers Optimality Archive.

Hulst, Harry van der 2010. A note in recursion in phonology. In Harry van der Hulst (ed.), *Recursion and human language*, vol. 104. Walter de Gruyter.

Hulst, Harry van der & Norval Smith. 1982. Prosodic domains and opaque segments in autosegmental phonology. In Harry van der Hulst & Norval Smith (eds.), *The Structure of Phonological Representations* 311–36. Dordrecht: Foris.

Hulst, Harry van der, Rob Goedemans & Ellen van Zanten. 2010. *A Survey of Word Accentual Patterns in the Languages of the World*. Berlin: De Gruyter Mouton.

Hung, Henrietta. 1993. *Iambicity, rhythm, and non-parsing*. Ms., University of Ottawa. Available as ROA-9 from the Rutgers Optimality Archive.

Hung, Henrietta. 1994. *The Rhythmic and Prosodic Organization of Edge Constituents*. Doctoral Dissertation, Brandeis University, Whaltman, MA.

Hunyadi, László. 2010. Cognitive grouping and recursion in prosody. In Harry van der Hulst (ed.), *Recursion and human language*, 343–70. Berlin: Mouton de Gruyter.

Hyde, Brett. 2001. *Metrical and prosodic structure in Optimality Theory*. Doctoral Dissertation, Rutgers University. Available as ROA-476 from the Rutgers Optimality Archive.

Hyde, Brett. 2002. A restrictive theory of metrical stress. *Phonology* 19, 313–59.

Hyde, Brett. 2007. Non-finality and weight-sensitivity. *Phonology* 24, 287–334.

Hyde, Brett 2008. Alignment continued: Distance-sensitivity, order-sensitivity, and the midpoint pathology. Ms. Available as ROA-836 from the Rutgers Optimality Archive

Hyde, Brett. 2012a. Alignment constraints. *Natural Language and Linguistic Theory* 30, 789–836.

Hyde, Brett. 2012b. The odd-parity input problem. *Phonology* 29, 383–431.

Hyman, Larry M. 1978. Tone and/or accent. In Donna Jo Napoli (ed.), *Elements of Tone, Stress and Intonation*, 1–20. Washington: Georgetown University Press.

Hyman, Larry M. 1985. *A theory of phonological weight*. Foris Publications.

Hyman, Larry M. 2006. Word-prosodic typology. *Phonology* 23, 225–57.

Hyman, Larry M. 2009. How (not) to do phonological typology: the case of pitch-accent. *Language Sciences* 31, 213–38.

Inkelas, Sharon. 1990. *Prosodic constituency in the lexicon*. New York: Garland.

Inkelas, Sharon & Draga Zec. 1990. Prosodically constrained syntax. In Sharon Inkelas & Draga Zec (eds.), *The Syntax/Phonology Connection*. Chicago: University of Chicago Press.

Iosad, Pavel. 2013. Head-dependent asymmetries in Munster Irish prosody. *Nordlyd* 40, 66–107.

Ishii, Toru. 1996. An optimality theoretic approach to ternary stress systems. *Proceedings of the South Western optimality theory workshop (SWOT II). UCI Working papers in linguistics* 2, 95–111.

Itô, Junko & Armin Mester. 1992/2003. Weak layering and word binarity. In Takeru Honma, Masao Okazaki, Toshiyuki Tabata & Shin ichi Tanaka (eds.), *A new century of phonology and phonological theory: A festschrift for Professor Shosuke Haraguchi on the occasion of his sixtieth birthday*, 26–65. Tokyo: Kaitakusha. Originally published in 1992 as Linguistic Research Center Working Paper LRC-92-09, University of California, Santa Cruz.

Itô, Junko & Armin Mester. 1997. Stødet i dansk [The stød in Danish]. Handout of talk at the 1997 Scandinavian Summer School in Generative Phonology, Hvalfjorður, Iceland.

Itô, Junko & Armin Mester. 2007a. Prosodic adjunction in Japanese compounds. In Yoichi Miyamoto & Masao Ochi (eds.), *Formal approaches to Japanese linguistics (FAJL) 4*, 97–111. Cambridge, MA: MITWPL.

Itô, Junko & Armin Mester. 2007b. Categories and projection in prosodic structures. Paper presented at the *4th Old World Conference in Phonology*, Rhodes, Greece.

Itô, Junko & Armin Mester. 2009a. The extended prosodic word. In Janet Grijzenhout & Bariş Kabak (eds.), *Phonological domains: Universals and deviations*, 135–94. Berlin: Mouton de Gruyter.

Itô, Junko & Armin Mester. 2009b. The onset of the prosodic word. In Steve Parker (ed.), *Phonological argumentation: Essays on evidence and motivation*, 227–60. London: Equinox.

Itô, Junko & Armin Mester. 2011. A note on unstressability. *NINJAL Project Review*, 27–44.

Itô, Junko & Armin Mester. 2012a. Recursive prosodic phrasing in Japanese. In Toni Borowsky, Shigeto Kawahara, Takahito Shinya & Mariko Sugahara (eds.), *Prosody matters: Essays in Honor of Elisabeth Selkirk*, 280–303. London: Equinox. [Slightly similar version of the paper appeared in 2010 in the Proceedings of the 18th Japanese/Korean Conference. CSLI, Stanford, CA].

Itô, Junko & Armin Mester. 2012b. (Un)accentedness and the Perfect Prosodic Word. Ms., UC Santa Cruz.

Itô, Junko & Armin Mester. 2013 Prosodic subcategories in Japanese. *Lingua* 124, 20–40

Jacobson, Steven. 1985. Siberian Yupik and Central Yupik prosody. In Michael Krauss (ed.), *Yupik Eskimo prosodic systems: descriptive and* *comparative studies*, 25–46. Fairbanks, AK: Alaska Native Language Center, University of Alaska.

Jensen, John. 2000. Against ambisyllabicity. *Phonology* 17, 187–235.

Jurgec, Peter. 2010. *Feature spreading 2.0: a unified theory of assimilation*. Doctoral Dissertation, University of Tromsø.

Kabak, Bariş & Anthi Revithiadou. 2009. An interface approach to prosodic word recursion. In Janet Grijzenhout & Bariş Kabak (eds.), *Phonological domains: universals and deviations,* , 105–34. Berlin: Mouton de Gruyter.

Kager, René. 1989. *A metrical theory of stress and destressing in English and Dutch*. Dordrecht: Foris.

Kager, René. 1993. Alternatives to the iambic-trochaic law. *Natural Language & Linguistic Theory* 11, 381–432.

Kager, René. 1994. Ternary rhythm in alignment theory. Ms., University of Utrecht. Available as ROA-35 from the Rutgers Optimality Archive.

Kager, René. 1996a. Stem disyllabicity in Guugu Yimidhirr. In Marina Nespor & Norval Smith (eds.), *Dam Phonology: HIL Phonology Paper II*, 59-101. Den Haag: Holland Institute of Generative Linguistics: Holland Institute of Generative Linguistics.

Kager, René. 1996b. On affix allomorphy and syllable counting. In Ursula Kleinhenz (ed.), *Interfaces in phonology*, 155–71. Berlin: Akademie Verlag.

Kager, René. 1999. *Optimality theory*. Cambridge University Press.

Kager, René. 2001. Rhythmic directionality by positional licensing. Paper presented at Fifth HIL Phonology Conference, University of Potsdam.

Kager, René. 2004. Rhythm, locality and non-gradient alignment. Paper presented at the Third North-American Phonology Conference, Concordia University, 22 May 2004.

Kager, René. 2005. The factorial typology of rhythmic licensing constraints. *Phonological Studies* 5, 47–155.

Kager, René. 2012. Stress in windows: Language typology and factorial typology. *Lingua* 122, 1454–93.

Kahn, Daniel. 1976. *Syllable-based generalizations in English phonology*. Doctoral dissertation, MIT, Cambridge [Distributed by the Indiana University Linguistics Club, Bloomington, Indiana].

Keating, Patricia, Taehong Cho, Cécile Fougeron & Chai-Shune Hsu 2003. Domain-initial articulatory strengthening in four languages. In John Local, Richard Ogden & Rosalind Temple (eds.), *Phonetic interpretation: Papers in laboratory phonology*, vol. 6, 145–63. Cambridge, UK: Cambridge University Press.

Kenstowicz, Michael. 1993. Evidence for metrical constituency. In Kenneth Hale & Samuel J. Keyser (eds.), *The view from Building 20: Essays in linguistics in honor of Sylvain Bromberger*, 257–73. Cambridge, MA: MIT Press.

Kenstowicz, Michael. 1995. Cyclic vs. non-cyclic constraint evaluation. *Phonology* 12, 397–436.

Kenstowicz, Michael 1997. Quality-sensitive stress. *Rivista di Linguistica* 9, 157–88. Reprinted in 2004 in *Optimality Theory in Phonology: A reader*, ed. John J. McCarthy. Oxford: Blackwell. 191–201.

Key, Harold. 1961. Phonotactics of Cayuvava. *International Journal of American Linguistics* 27, 143–50.

Key, Harold H. 1967. *Morphology of Cayuvava*. The Hague: Mouton.

Kim, Michael Jinhwa. 1997. Tonal Predictability from Metrical Structure in Northern Tepehuan. In Brian Agbayani & Sze-Wing Tang (eds.), *Proceedings of the 15th West Coast Conference on Formal Linguistics (WCCFL 15)*, 257–71. Stanford, CA: CSLI Publications.

Kiparsky, Paul. 1979. Metrical structure assignment is cyclic. *Linguistic Inquiry* 10, 421–41.

Kiparsky, Paul. 2000. Opacity and cyclicity. In Nancy A. Ritter (ed.), *A review of Optimality Theory. Special issue, The Linguistic Review 17 (2-4)*, 351–67.

Koepcke, Michael. 1995. Die Klassifikation der schwachen Makulina in der deutschen Gegenwartssprache. *Zeitschrift für Sprachwissenschaft* 14, 159–80.

Köhnlein, Björn. 2011. *Rule Reversal Revisited: Synchrony and diachrony of tone and prosodic structure in the Franconian dialect of Arzbach*. Doctoral Dissertation, LOT, Utrecht.

Krämer, Martin. 2009a. *The Phonology of Italian*. Oxford: Oxford University Press.

Krämer, Martin. 2009b. When Romans lose their heads. Paper presented at CUNY Conference on the foot, CUNY Graduate Center, New York City. Available online at http://www.hum.uit.no/a/kraemer/cuny-headless-mk.pdf.

Kristoffersen, Gjert. 2008. Level stress in North Germanic. *Journal of Germanic Linguistics* 20, 87–159.

Kubozono, Haruo. 1988. *The organization of Japanese prosody*. Doctoral Dissertation, University of Edinburgh. [Published by Kurosio Publishers, Tokyo, 1993].

Kubozono, Haruo. 2005. Focus and intonation in Japanese: Does focus trigger pitch reset?. In Shinichiro Ishihara, Michaela Schmitz & Anne Schwarz (eds.), *Interdisciplinary Studies on Information Structure (Working Papers of the Sonderforschungsbereich 632)*. Potsdam: Universitätsverlag Potsdam.

Kwon, Soohyun. 2013. Against an asymmetry between initial and final extrametricality. Paper presented at the *21st Manchester Phonology Meeting*, University of Manchester, UK.

Labrune, Laurence. 2012. Questioning the universality of the syllable: evidence from Japanese. *Phonology* 29, 113–52.

Ladd, D. Robert. 1986. Intonational phrasing: the case for recursive prosodic structure. *Phonology* 3, 311–40.
Ladd, D. Robert. 1988. Declination "reset" and the hierarchical organization of utterances. *The Journal of the Acoustical Society of America* 84, 530–44.
Ladd, D. Robert. 1996/2008. *Intonational phonology*. Cambridge, UK: Cambridge University Press.
Leer, Jeff. 1985a. Prosody in Alutiiq. In Michael Krauss (ed.), *Yupik Eskimo prosodic systems: descriptive and comparative studies*, 77–134. Fairbanks, AK: Alaska Native Language Center, University of Alaska.
Leer, Jeff. 1985b. Evolution of prosody in the Yupik languages. In Michael Krauss (ed.), *Yupik Eskimo prosodic systems: descriptive and comparative studies*, 135–58. Fairbanks, AK: Alaska Native Language Center, University of Alaska.
Leer, Jeff. 1985c. Toward a metrical interpretation of Yupik prosody. In Michael Krauss (ed.), *Yupik Eskimo prosodic systems: descriptive and comparative studies*, 159–73. Fairbanks, AK: Alaska Native Language Center, University of Alaska.
Levelt, Willem J. M., Ardi Roelofs & Antje S. Meyer. 1999. A theory of lexical access in speech production. *Behavioral and Brain Sciences* 22, 1–38.
Levin, Juliette. 1985. *Evidence for ternary feet and implications for a metrical theory of stress rules*. Ms., University of Texas at Austin.
Levin, Juliette. 1988. Generating ternary feet. *Texas Linguistic Forum 29*, 97–113.
Liberman, Mark. 1975. *The intonational system of English*. Doctoral Dissertation, MIT.
Liberman, Mark & Alan Prince. 1977. On stress and linguistic rhythm. *Linguistic Inquiry* 8, 249–336.
Loos, Eugene. 1999. Pano. In Robert M. W. Dixon & Alexandra Aikhenvald (eds.), *The Amazonian languages*. Cambridge: Cambridge University Press.
Lorentz, Ove. 1990. Overlength: the case of Lappish. Paper presented at *UC Santa Cruz Colloquium*.
Martínez-Paricio, Violeta. 2012. Superfeet as recursion. In Nathan Arnett & Ryan Bennett (eds.), *Proceedings of the 30th West Coast Conference on Formal Linguistics (WCCFL 30)*, 259–69. Somerville, MA: Cascadilla Proceedings Project. Available online at http://www.lingref.com/, document #2823.
Martínez-Paricio, Violeta & René Kager. 2013. Non-intervention constraints and the binary-to-ternary rhythmic continuum. Paper presented at the *21st Manchester Phonology Meeting*, University of Manchester, UK. Handout available online at https://sites.google.com/site/violetamartinezparicio/mpm21.pdf?attredirects=0&d=1.

Mascaró, Joan. 1996/2004. External allomorphy as emergence of the unmarked. In Jacques Durand & Bernard Laks (eds.), *Current trends in phonology: Models and methods*, 473–83. Salford, Manchester: University of Salford, European Studies Research Institute. Reprinted in 2004 in *Optimality Theory in Phonology: A reader*, ed. John J. McCarthy, 513–522. Oxford: Blackwell.

Mascaró, Joan. 2007. External allomorphy and lexical representation. *Linguistic Inquiry* 38, 715–35.

McCarthy, John J. 1979. *Formal problems in Semitic phonology and morphology*. Doctoral dissertation, MIT [Distributed by the Indiana University Linguistics Club, Bloomington, Indiana].

McCarthy, John J. 1982. Prosodic structure and expletive infixation. *Language* 58, 574-90.

McCarthy, John J. 2002. *A thematic guide to optimality theory*. Cambridge: Cambridge University Press.

McCarthy, John J. 2003. OT constraints are categorical. *Phonology* 20, 75–138.

McCarthy, John J. 2008. The serial interaction of stress and syncope. *Natural Language and Linguistic Theory* 26, 499–546.

McCarthy, John J. & Alan Prince. 1986/1996. *Prosodic morphology*. Ms., University of Massachusetts, Amherst and Brandeis University, Waltham, Mass. [Annotated version 1996, issued as Technical report no. 32, Rutgers Center for Cognitive Science].

McCarthy, John J. & Alan Prince. 1994. The emergence of the unmarked: Optimality in prosodic morphology. *Proceedings of the North East Linguistic Society*, vol. 24, 333–79. Amherst: University of Massachusetts.

McCarthy, John J. & Alan Prince. 1995. Faithfulness and Reduplicative Identity. In Jill Beckman, Suzanne Urbanczyk & Laura Walsh Dickey (eds.), *University of Massachusetts Occasional Papers in Linguistics 18: Papers in Optimality* 249–384.

McCarthy, John J. & Alan Prince. 1999. Faithfulness and Identity in Prosodic Morphology. In René Kager, Harry van der Hulst & Wim Zonneveld (eds.), *The prosody-morphology interface*, 218–309. Cambridge: Cambridge University Press

McCartney, Steven 2003. *Ternarity through binarity*. Doctoral Dissertation, University of Texas, Austin.

McCawley, James 1968. *The Phonological Component of a Grammar of Japanese*. The Hague: Mouton.

McGarrity, Laura W. 2003. *Constraints on patterns of primary and secondary stress*. Doctoral Dissertation, Indiana University.

Melinger, Alissa. 2002. Foot Structure and Accent in Seneca. *International Journal of American Linguistics* 68, 287–315.

Mellander, Evan W. 2003. (HL)-creating processes in a theory of foot structure. *The Linguistic Review* 20, 243–80.

Mester, Armin. 1994. The quantitative trochee in Latin. *Natural Language and Linguistic Theory* 12, 1–61.

Michael, Lev. in press. The interaction of tone and stress in the prosodic system of Iquito (Zaparoan, Peru). *Amerindia* 36. Prepublished version available online at: http://www.cabeceras.org/ldm_publications/l_michael_Amerindia_Iquito_tone_and_stress.pdf

Michelson, Karin. 1988. *A Comparative Study of Lake-Iroquoian Accent* (Studies in Natural Language and Linguistic Theory). New York: Springer-Verlag.

Morén, Bruce. 1999/2001. *Distinctiveness, coercion, and sonority: a unified theory of weight*. London, New York: Routledge. Available as ROA-349 from the Rutgers Optimality Archive.

Morén, Bruce. 2007. *Substance-free prosody*. Ms., University of Tromsø.

Morén-Duolljá, Bruce. 2013. The prosody of Swedish underived nouns: No lexical tones required. *Nordlyd* 40, 196–248.

Myers, Scott. 1987. Vowel shortening in English. *Natural Language and Linguistic Theory* 5, 485–518.

Nash, David. 1979. Yidiny stress: a metrical account. Paper presented at CUNY Forum 7/8, 112– 130.

Nespor, Marina & Irene Vogel. 1982. Prosodic domains of external sandhi rules. In Harry van der Hulst & Norval Smith (eds.), *The Structure of Phonological Representation*, vol. 1, 224 – 55. Dordrech: Foris.

Nespor, Marina & Irene Vogel. 1986. *Prosodic phonology*. Dordrecht: Foris Publications. Reprinted in 2008 by Mouton de Gruyter.

Odden, David. 1999. Typological issues in tone and stress in Bantu. In Shigeki Kaji (ed.), *Proceedings of the symposium Cross-linguistic studies of tonal phenomena: tonogenesis, typology, and related topics*, 187–215. Tokyo: Institute for Languages and Cultures of Asia and Africa.

Oostendorp, Marc van. 1995. *Vowel quality and syllable projection*. Doctoral Dissertation, University of Tilburg.

Oostendorp, Marc van. 2003. Ambisyllabicity and fricative voicing in West Germanic dialects. *The syllable in Optimality Theory*, 304–37. Cambridge: Cambridge University Press.

Parker, Steve. 1994. Coda epenthesis in Huariapano. *International Journal of American Linguistics* 60, 95–119.

Paster, Mary E. 2006. *Phonological conditions on affixation*. Doctoral Dissertation, University of California, Berkeley.

Pearce, Mary. 2006. The interaction between metrical structure and tone in Kera. *Phonology* 23, 259–86.

Pedersen, Pia R. 1973. An instrumental investigation of the Danish stød. *Annual Report of the Institute of Phonetics 7*, 195–234. Copenhagen: University of Copenhagen

Penny, Ralph. 1969. *El habla pasiega: ensayo de dialectología montañesa*. London: Tamesis.

Peperkamp, Sharon. 1997. *Prosodic Words*, vol. 34. The Hague: Holland Academic Graphics HIL dissertations.

Pierrehumbert, Janet & Mary Beckman. 1988. *Japanese tone structure*. Cambridge, MA: MIT Press.

Pierrehumbert, Janet & David Talkin. 1992. Lenition of/h/and glottal stop. *Papers in laboratory phonology II: Gesture, segment, prosody*, 90-117.

Piggott, Glyne L. 1995. Epenthesis and syllable weight. *Natural Language and Linguistic Theory* 13, 283-326.

Poser, William J. 1984. *The Phonetics and Phonology of Tone and Intonation in Japanese*. Doctoral Dissertation, MIT.

Prince, Alan. 1976. *Applying stress*. Ms., Amherst: University of Massachusetts.

Prince, Alan. 1980. A metrical theory for Estonian quantity. *Linguistic Inquiry* 11, 511–62.

Prince, Alan. 1983. Relating to the grid. *Linguistic Inquiry* 14, 19–100.

Prince, Alan. 1985. Improving tree theory. *Berkeley Linguistic Society* (BLS) 11, 471–90.

Prince, Alan. 1991. Quantitative consequences of rhythmic organization. In Karen Deaton, Manuela Noske & Michael Ziolkowski (eds.), *Papers from the parasession on the syllable in phonetics and phonology*, vol. 26 (2), 355–98. Chicago: Chicago Linguistics Society.

Prince, Alan & Paul Smolensky. 1993/2004. *Optimality theory: Constraint Interaction in Generative Grammar*. Malden, MA: Blackwell. Available as ROA-537 from the Rutgers Optimality Archive.

Pruitt, Kathryn. 2010. Serialism and locality in constraint-based metrical parsing. *Phonology* 27, 481–526.

Raffelsiefen, Renate. 1999. Diagnostics for prosodic words revisited: The case of historically prefixed words in English. In T. Alanand Hall & Ursula Kleinhenz (eds.), *Studies on the phonological word*, 133–201. Amsterdam: John Benjamins.

Revithiadou, Anthi. 2004. The iambic/trochaic law revisited: lengthening and shortening in trochaic systems. In Boban Arsenijevic, Noureddine Elouazizi, Martin Salzmann & Mark de Vos (eds.), *Leiden papers in Linguistics*, vol. 1.1, 37–62.

Riad, Tomas. 1992. *Structures in Germanic prosody: a diachronic study with special reference to the Nordic languages*. Doctoral Dissertation, Stockholm University.

Rice, Curt. 1988. Stress assignment in the Chugach dialect of Alutiiq. In Diane Brentari, Gary Larson & Lynn MacLeod (eds.), *Proceedings of the Chicago Linguistic Society* (24), 304–15. Chicago: Chicago Linguistics Society.

Rice, Curt. 1992. *Binarity and ternarity in metrical theory: Parametric extensions*. Doctoral Dissertation. University of Texas, Austin.

Rice, Curt. 2006a As proud the head with heavy feet: Restrictions on structure are in Gen. Paper presented at OCP-4, Rhodes
Rice, Curt. 2006b. Norwegian stress and quantity: Implications of loanwords. *Lingua* 116, 1171-94.
Rice, Curt. 2007. The roles of GEN and CON in modeling ternary rhythm. In Sylvia Blaho, Patrik Bye & Martin Krämer (eds.), *Freedom of analysis?* , 233–55. Berlin: Walter de Gruyter.
Rice, Curt. 2008. A momentary lapse of reason. Paper presented at OCP-5, Toulouse.
Rice, Curt. 2011. Ternary rhythm. In Marc van Oostendorp, Colin J. Ewen, Elizabeth Hume & Keren D. Rice (eds.), *The Blackwell companion to phonology*, vol. 5, 1228–44. Malden, MA: Blackwell.
Riggle, Jason. 2004. *Generation, recognition, and learning in finite state Optimality Theory*. Doctoral Dissertation, University of California, Los Angeles.
Rosenthall, Samuel. 1994. *Vowel/glide alternation in a theory of constraint interaction*. Doctoral Dissertation, University of Massachusetts, Amherst.
Rosenthall, Samuel & Harry van der Hulst. 1999. Weight-by-Position by Position. *Natural Language and Linguistic Theory* 17, 499–540.
Rubach, Jerzy & Geert. E. Booij. 2001. Allomorphy in Optimality Theory: Polish iotation. *Language* 77, 26–60.
Sapir, Edward. 1930. Southern Paiute: a Shoshonean Language. *Proceedings of the American Academy of Arts and Sciences*, vol. 65, 1–296. American Academy of Arts & Sciences.
Schiering, René, Balthasar Bickel & Kristine Hildebrandt. 2010. The prosodic word is not universal, but emergent. *Journal of Linguistics* 46, 657–709.
Schreuder, Maartje. 2006. *Prosodic Processes in Language and Music*. Doctoral Dissertation, Groningen Dissertations in Linguistics (GRODIL) 60, University of Groningen
Schreuder, Maartje, Dicky Gilbers & Hugo Quené. 2009. Recursion in phonology. *Lingua* 119, 1243–52.
Selkirk, Elisabeth O. 1978a. On prosodic structure and its relation to syntactic structure. In Thorstein Fretheim (ed.), *Nordic Prosody*, 111–40. Trondheim TAPIR.
Selkirk, Elisabeth O. 1978b. The French Foot: On the Status of 'Mute' e *Journal of French Linguistics* 1.
Selkirk, Elisabeth O. 1980. The role of prosodic categories in English word stress. *Linguistic Inquiry* 11, 563–605.
Selkirk, Elisabeth O. 1981. On the nature of phonological representation. In John M. Anderson, John Laver & Terry Myers (eds.), *The cognitive representation of speech*, 379–88. Amsterdam: North Holland Publishing Company.
Selkirk, Elisabeth O. 1984. *Phonology and syntax: the relation between sound and structure*. Cambridge, MA: MIT Press.

Selkirk, Elisabeth O. 1986. On derived domains in sentence phonology. *Phonology Yearbook* 3, 371–405.

Selkirk, Elisabeth O. 1996. The prosodic structure of function words. In James L. Morgan & Katherine Demuth (eds.), *Signal to syntax: Prosodic bootstrapping from speech to grammar in early acquisition*, 187– 213. Mahwah, NJ: Lawrence Erlbaum Associates. Also in Jill Beckman, Laura Walsh Dickey & Suzanne Urbanczyk (eds.), *Papers in Optimality Theory* 18. Amherst, MA: GLSA.

Selkirk, Elisabeth O. 2000. The interaction of constraints on prosodic phrasing. In Merle Home (ed.), *Prosody: Theory and Experiments*, 231–62. Dordrecht: Kluwer.

Selkirk, Elisabeth O. 2011. The syntax-phonology interface. In John Goldsmith, Jason Riggle & Alan Yu (eds.), *Handbook of phonological theory Blackwell Handbooks in Linguistics Series*, 435–84. Malden MA: Wiley-Blackwell 2nd edn.

Selkirk, Elisabeth O. & Koichi Tateishi. 1988. Constraints on minor phrase formation in Japanese. *Papers from the 24th Annual Regional Meeting of the Chicago Linguistic Society*, 316-36. Chicago: Chicago: Chicago Linguistic Society.

Sherer, Tim. 1994. *Prosodic phonotactics*. Doctoral Dissertations, University of Massachusetts, Amherst.

Shimoji, Michinori. 2009. Foot and rhythmic structure in Irabu Ryukyuan. *Journal of the Linguistic Society of Japan* 135, 85–122.

Shinya, Takahito, Elisabeth O. Selkirk & Shigeto Kawahara. 2004. Rhythmic boost and recursive minor phrase in Japanese. *Proceedings of the second international conference on speech prosody*, 345–8.

Smith, Jennifer L. 2005. *Phonological augmentation in prominent positions*. New York, London: Routledge.

Smith, Norval. 1999. A preliminary account of some aspects of Leurbost Gaelic syllable structure. In Harry van der Hulst & Nancy Ritter (eds.), *The syllable: views and facts* 577–630. Berlin: Mouton de Gruyter.

Steriade, Donca. 1994. *Positional neutralization.* Ms., University of California, Los Angeles.

Thompson, Anie 2010. Interactions between footing, accent, and lengthening in Seneca. Paper presented at *LASC (Linguistics at Santa Cruz)*, University of California, Santa Cruz.

Thorsen, Nina G. 1974. Acoustical and perceptual properties of the Danish stød. *ARIPUC 8*, 207–13. Copenhagen.

Titterington, Jill, Alison Henry, Martin Krämer & Joe G. Toner & Mike Stevenson. 2006. An investigation of weak syllable processing in deaf children with cochlear implants. *Clinical linguistics and phonetics* 20, 249–69.

Trubetzkoy, Nikolai S. 1939. *Grundzüge der phonologie*. English translation by Christiane A. M. Baltaxe published in 1969 as Principles of Phonology. Berkeley and Los Angeles: University of California Press.

Truckenbrodt, Hubert. 1999. On the relation between syntactic phrases and phonological phrases. 30, 219–55.

Tyhurst, James 1987. Accent shift in Seminole nouns. In Pamela Munro (ed.), *Muskogean linguistics. UCLA Occasional Papers in Linguistics*, vol. 6, 161–70.

Ussishkin, Adam 2000. *The emergence of fixed prosody*. Doctoral Dissertation, University of California, Santa Cruz.

Vaysman, Olga. 2009. *Segmental alternations and metrical theory*. Doctoral Dissertation, MIT.

Vijver, Ruben van de. 1998. *The iambic issue: iambs as a result of constraint interaction*. The Hague: Holland Academic Graphics.

Wagner, Michael. 2005. *Prosody and Recursion* Doctoral Dissertation, Massachusetts Institute of Techonology.

Wagner, Michael. 2010. Prosody and recursion in coordinate structures and beyond. *Natural Language and Linguistic Theory* 28, 183–237.

Walker, Rachel. 2005. Weak triggers in vowel harmony. *Natural Language and Linguistic Theory* 23, 917–89.

Walker, Rachel. 2011. *Vowel patterns in language* (130). Cambridge University Press.

Whitgott, M. 1982. *Segmental evidence for phonological constituents*. Doctoral Dissertation, University of Tilburg.

Wiese, Richard. 1996. *The Phonology of German*. Oxford: Clarendon Press.

Woodbury, Anthony C. 1987. Meaningful phonological processes: a consideration of Central Alaskan Yupik Eskimo prosody. *Language*, 685-740.

Yip, Moira J. 1980. *The tonal phonology of Chinese*. Doctoral Dissertation, MIT.

Yip, Moira J. 2001 The complex interaction of tone and prominence. *Proceedings of NELS*, vol. 31, 531–45.

Yip, Moira J. 2002. *Tone*. Cambridge, UK: Cambridge University Press.

Yu, Alan C. L. 2003. *The morphology and phonology of infixation*. Doctoral Dissertation, University of California, Berkeley. Available at http://home.uchicago.edu/~aclyu/dissertation.html:

Yu, Alan C. L. 2004. Reduplication in Homeric infixation. *Proceedings of NELS*, vol. 34, 619–33.

Zec, Draga. 1988. *Sonority Constraints on Prosodic Structure*. Doctoral Disseartation, University of California, Stanford.

Zec, Draga. 1999. Footed tones and tonal feet: rhythmic constituency in a pitch accent language. *Phonology* 16, 225–64.

Zec, Draga. 2003. Prosodic weight. In Caroline Féry & Ruben van de Vijver (eds.), *The syllable in optimality theory*, 123–43. Cambridge, UK: Cambridge University Press.

Zoll, Cheryl. 1996. *Parsing below the segment in a constraint-based framework*. Doctoral Dissertation, University of California, Berkeley.

Zoll, Cheryl. 1998/2004. Positional asymmetries and licensing. In John J. McCarthy (ed.), *Optimality Theory in Phonology: A Reader*, 365–78. Oxford: Blackwell [Available as ROA-282 from the Rutgers Optimality Archive].

Zoll, Cheryl. 2004. Ternarity vs. final exclusion: a synthesis. Ms., MIT. Not consulted.

Zonneveld, Wim, Mieke Trommelen, Michael Jessen, Curt Rice, Gösta Bruce, Kristjan Árnason. 1999. Word-stress in West-Germanic and North-Germanic languages. In Harry van der Hulst (ed.), *Word prosodic systems in the languages of Europe*, 477–603. Berlin & New York: Mouton de Gruyter.

ISBN xxx-xx-xxxx-xxx-x