The Rhythmic and Prosodic Organization of Edge Constituents

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by

Henrietta J. Hung

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ABSTRACT

The Rhythmic and Prosodic Organization of Edge Constituents

(A Dissertation Presented to the Faculty of the Graduate School of Arts and Sciences of Brandeis University, Waltham, Massachusetts)

by

Henrietta J. Hung

This thesis addresses **how**, **when** and above all, **why**, do we sometimes negate the rhythmic or quantitative properties of an edge constituent without negating its segmental properties? Considerable insight into the nature of the problem has been provided by Hayes (1979 **et seq**) as well as by Harris (1983) and Inkelas (1989). For Hayes and Harris, the **how** question is solved with a rule which renders the edge constituent invisible just prior to the application of stress rules. For Inkelas, the explanation lies in the mismatch between the domain of phonological rule application and the morphological string. Similarly, Ito (1986) introduces the concept of extraprosodic licensing for edge constituents that are neither prosodically licensed nor deleted. Each of these approaches invoke the phenomenon of unrealized rhythmic and quantitative properties, which I refer to as weak parsing.

This thesis is couched within a framework known as Optimality Theory (Prince and Smolensky 1992, 1993), allowing us to focus on the **when** and the **why** of the problem. The **how** part is left to GEN, the function which takes the input and assigns to it a (possibly infinite) set of candidate analyses. Here this would involve the construction of many different parses, including the weak parse alluded to above. Since weak parsing is in general to be avoided, the **why** question becomes, what is the nature of the higher ranking constraint which can force weak parsing to be in fact optimal? The answer I propose, is a rhythmic constraint, a generalized version of Prince and Smolensky's Nonfinality constraint. Final stress is non-rhythmic, and just in case **Rhythm** dominates **Strict-Parse**, weak parsing effects will be observed. Moreover, the principle of minimal violation provides the necessary means to constrain the **when** aspect of weak parsing. This account is completely compatible with a general theory of prosodic organization and constituent well-formedness: deviations occur only under duress.

In addition to the explanatory aspects of the theoretical analysis, this thesis makes an empirical contribution. The examination of a number of languages that exhibit the phenomenon in question reveals a wide array of effects, for which a typological analysis is given.

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Chapter 1
Introduction

The problem that is addressed in this thesis is **how**, **when** and above all, **why**, do we sometimes negate the rhythmic or quantitative properties of an edge constituent without negating its segmental properties? This is a problem which is standardly in the purview of extrametricality theory, though typically the problem is not phrased in this manner. A great deal of insight into the exact nature of the problem has been provided by Hayes (1979 **et seq**) as well as by Harris (1983) and Inkelas (1989). For Hayes and Harris, the **how** question is solved with an extrametricality rule, which renders the edge constituent invisible just prior to the application of stress rules. For Inkelas, the explanation lies in the mismatch of domains: the lexical prosodic structure, or the domain of phonological rule application, may be but a sub-part of the morphological string. Similarly, Ito (1986) introduces the concept of extraprosodic licensing for edge constituents that are not prosodically licensed and yet not deleted. All of this boils down to the existence of a gray area in which rhythmic and quantitative properties are unrealized.

This thesis is couched within a framework known as Optimality Theory (Prince and Smolensky 1992, 1993), allowing us to focus on the **when** and the **why** of the problem. The **how** part is left to GEN, the function which takes the input and assigns to it a (possibly infinite) set of candidate analyses. In the case at hand, this would involve the construction of many different parses, including the gray area alluded to above, which I refer to as weak parsing. Since weak parsing is in general to be avoided, the **why** question becomes, what is the nature of the higher ranking constraint which can force weak parsing to be in fact optimal? The answer I propose, is a rhythmic constraint, a more general characterization of Prince and Smolensky's Nonfinality constraint. Final stress is non-rhythmic, and just in case **Rhythm** dominates

Strict-Parse, weak parsing effects will be observed. Moreover, the fundamental principle of minimal constraint violation provides the necessary means to constrain the **when** aspect of weak parsing. This account is completely compatible with a general theory of prosodic organization and constituent well-formedness: deviations occur only under duress.

In addition to the explanatory aspects of the theoretical analysis, this thesis attempts to make an empirical contribution. The examination of a number of languages that exhibit the phenomenon in question reveals a wide array of effects, for which a typological analysis is given. The first chapter of this thesis begins with an introduction to the basic principles of Optimality Theory; this is followed by a presentation of the precise theoretical assumptions regarding the definition of rhythmic and prosodic well-formedness.

1.1 Optimality Theory

Optimality Theory or OT (Prince and Smolensky 1991a,b, 1992, 1993) is a specific theory of how an input is matched with its corresponding output. While in the standard theory the output is derived from an input via a context-driven rewrite rule, in OT the output is chosen from a set of candidate parses which is associated with an input.

More precisely, a function GEN takes an input form and assigns to it a (possibly infinite) set of candidate analyses.

(1) GEN ($input_i$) = $\{cand_1, cand_2, \ldots\}$

This set of candidate forms is then submitted in parallel to a hierarchy of constraints for evaluation, and the candidate form which "best satisfies" the hierarchy emerges as the optimal form. The optimal form is the output form, and vice-versa.

(2) Eval $\{cand_1, cand_2, \ldots\} \rightarrow cand_k$ (the output, given $input_i$)

The notion “best satisfaction” has a very specific meaning. Candidates are submitted to the highest constraint on the hierarchy; those which do not satisfy this constraint are eliminated from consideration, allowing the rest to be re-submitted to the next constraint on the hierarchy. This essentially continues until a single candidate remains, emerging as the optimal candidate.

Constraints have a number of properties in this theory. First of all, the set of constraints or CON, is assumed to be part of Universal Grammar. What gives rise to cross-linguistic variation is the manner in which these constraints are ranked. But equally important is the fact that constraints are not at all absolute; rather they are violable, but only minimally so. Consider for example a form A which satisfies the two constraints which make up a hypothetical grammar. In anyone’s view, form A is optimal - how much better can one get? What is interesting is when, given a particular input, the two constraints simply cannot be satisfied. This is known as a CONSTRAINT CONFLICT, and is a fundamental part of any OT analysis. This situation is represented in a constraint tableau, shown in (3). The two constraints, call them X and Y, are shown at the top of the tableau. Along the left are three candidates, A, B, and C. Candidate A satisfies X but not Y, candidate B satisfies Y but not X, and candidate C satisfies neither. Failure to satisfy a constraint, i.e. violation of the constraint, is indicated with an asterisk (*). It is assumed that in this case there is no candidate that satisfies both constraints, otherwise there would be no need for conflict resolution.

(3)	/input$_i$/	Constraint X	Constraint Y
	Candidate A		*
	Candidate B	*	
	Candidate C	*	*

Needless to say, candidate C has no hope given its competitors. The only real candidates worth considering are A and B. So which is optimal? The answer is entirely dependent upon the ranking between

Constraint X and Constraint Y. If X dominates Y, A will be optimal because A satisfies X but B does not. B is eliminated at this stage because a better form exists, namely A. Since there are only two candidates, A emerges as the winner. This is shown in (4), where the double vertical line in the tableau means that the constraint to the left dominates the one to the right, an exclamation mark indicates elimination at that point, and the symbol p points to the optimal form.

(4)		Constraint X	Constraint Y
p	Candidate A		*
	Candidate B	*!	

Alternatively under the reverse ranking, candidate B would emerge as optimal for the same reasons as above.

(5)		Constraint Y	Constraint X
	Candidate A	*!	
p	Candidate B		*

This works the other way too; one can determine the ranking between two constraints knowing that the actual output is also the optimal output form.

In addition to constraint conflict and resolution, a second basic concept of OT is that of MINIMAL VIOLATION. In comparing the absence of an asterisk with the presence of an asterisk, it is easy to choose the better parse. But what if all candidates violate a given constraint? What is important is to look for the candidate which incurs the fewest constraints. If for some reason, all candidates violate Constraint Z exactly on one count, then they tie, and are passed onto the next constraint. The same is true if they all satisfy Constraint Z. If one candidate incurs a single violation of Constraint Z while every other candidate incurs multiple violations of Constraint Z, then this lone candidate must be optimal.

In the preceding paragraphs, the basic principles of OT have been presented. To summarize, they are listed below.

(6) Principles of Optimality Theory

- a. Violability

  Constraints are violable, but violation is minimal.

- b. Ranking

  Constraints are ranked on a language-particular basis; the notion of minimal violation is defined in terms of this ranking.

- c. Inclusiveness

  The constraint hierarchy evaluates a set of candidate analyses that are admitted by very general considerations of structural well-formedness.

- d. Parallelism

  Best-satisfaction of the constraint hierarchy is computed over the whole hierarchy and the whole candidate set. There is no serial derivation.

Note that the entire burden of determining the output from a given input has been shifted to the set of ranked constraints. There is no derivation. An output parse does not have the structure that it does by virtue of structure-building or even structure-changing rules. The parse itself comes from GEN, but it is only one parse among many. But GEN is not completely unconstrained. It is regulated by the following three principles. The implications of the third principle are quite subtle; discussion is postponed until Chapter 4.

(7) Principles Underlying GEN

- a. Freedom of Analysis

  Any amount of structure may be posited.

- b. Containment

No element may be literally removed from the input form. The input form is thus contained in every candidate form.

c. Consistency of Exponence
No changes in the exponence of a phonologically-specified morpheme are permitted.

OT is not without historical precedent. The idea that there was a massive amount of redundancy in rule-based systems is explored in works by Kisseberth (1970), Haiman (1972) and Sommerstein (1974), among others. Parallel developments in the direction of constraint-based systems include Paradis' Theory of Constraints and Repair Strategies (1988 et seq), Archangeli and Pulleyblank's Grounded Phonology (to appear), Goldsmith's Harmonic Phonology (1990, 1991) and Burzio's theory of Metrical Consistency (in press,a,b); the minimalist program for syntax developed by Chomsky (1992) should also be included in this list. For the reader who is interested in recent work in the OT framework, see McCarthy (1993a), McCarthy and Prince (1993a,b) and papers from the Rutgers Optimality Workshop 1 (1993).

Certain areas of phonology have provided an especially fertile ground for the advancement of ideas concerning well-formedness conditions and the larger role that they play. These include the study of syllable structure (Kaye and Lowenstamm 1984, Ito 1986, Singh 1987), the Obligatory Contour Principle (McCarthy 1986, Odden 1986, Yip 1988), and the Minimal Word constraint (McCarthy and Prince 1986, 1990b, Wilkinson 1988, Ito 1991). In each case, it was found that a particular constraint could have widespread and profound ramifications on the rest of the phonology. This idea is taken to its limits in OT, where everything is attributed to constraints and constraint ranking.

Consider now for illustrative purposes the following example. As discussed in Ito (1986, 1989) certain languages appear to have at their disposal a strategy of Stray Epenthesis to handle material that cannot be accomodated within the established limits of the syllable structure.[1] The problem is to account for data of the following sort. In (8a) there is no epenthesis, while in (8b) there is. Suppose this language permits only open syllables.

(8)		Input	Output
	a.	CVCV	CVCV
	b.	CVC	CVCΔ

A context-driven rewrite rule would have to insert a vowel after an unsyllabified consonant, C'.

(9) $\varnothing \rightarrow V \;/\; C' \_\_$

The problem, Ito points out, is that the context of the rule duplicates syllabic well-formedness, but only by sheer coincidence. Moreover, it is also a complete accident that the rule does not apply after a vowel.

Under an OT analysis, there is a constraint which rules out closed syllables. This constraint accounts for the fact that none exist, but it also accounts for the fact that epenthesis occurs where it does. This constraint is given in (10).

(10) **No-Coda**
Syllables are open.

Moreover, there is a general constraint against overparsing. GEN provides all kinds of parses: overparses, underparses, faithful parses. The assumption is that overparsing gives empty nodes which have to be filled in by default features, while underparsing leaves segments unparsed and therefore subject to erasure. The constraint against overparsing is given in (11).

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[1] By far one of the more complicated cases of epenthesis is that of Chukchee. Using a constraint-based analysis Kenstowicz (to appear) succeeds in accounting for many otherwise unexplained effects.

(11) **Fill**

No empty structure.

Given the input /CVCV/ there is no epenthesis because there is nothing to compel a violation of **Fill**. /CVCV/ has a candidate output form which satisfies both constraints regardless of their ranking; this **must** be the optimal form. Epenthesis on the other hand only serves to make matters worse.

Minimal Violation: Do Something Only When Necessary

(12)	/CVCV/	No-Coda	Fill
p	.CV.CV.		
	.CV.CV.Δ		*!

The more interesting case is the one for which there is no candidate that can satisfy both constraints. Candidates associated with an input like /CVC/ violate either one constraint or the other. If there is epenthesis, the coda condition is met but **Fill** is violated. If there is no epenthesis, **Fill** is satisfied but the coda condition must be violated. That the actual output contains an epenthetic segment tells us that **No-Coda** must rank higher than **Fill**, hence the double vertical line.

Constraint Conflict resolved in favor of overparsing

(13)	/CVC/	No-Coda	Fill
p	.CV.CΔ.		*
	.CVC.	*!	

Under the opposite ranking the candidate form without an epenthetic segment would be optimal. Since **Fill** ranks over **No-Coda**, faithfulness is more highly valued in this system.

Constraint Conflict resolved in favor of faithfulness

(14)	/CVC/	Fill	No-Coda
p	.CVC.		*
	.CV.CΔ.	*!	

The arguments that are presented in this thesis are entirely couched within this framework. The main focus will be on the role of **Rhythm**, a constraint which governs the well-formedness of the metrical grid, as outlined in Section 1.2. As a constraint within OT, **Rhythm** is both ranked, and violable. As we will see, a constraint which frequently comes into conflict with **Rhythm** is a constraint I call **Strict-Parse**, which governs the well-formedness aspects of prosodic organization, as outlined in Section 1.3.

1.2 Rhythmic Organization

Following the lead of Prince and Smolensky and having shifted the focus of inquiry onto the motivational aspect behind extrametricality, the claim in this thesis is that extrametricality effects are best understood as being consequences of rhythmic requirements. The proposal made here draws heavily from two principal sources in the literature. The contribution made by the first source regards the observation that final constituents are ignored and the description of the contexts in which this happens. A review is given in the first subsection under **Extrametricality**. The second source of inspiration is the literature regarding the well-formedness conditions which govern the patterns of stress, pioneered by Liberman and Prince (1977). A review is given in the second subsection under **Eurhythmicity**. The proposal itself, given in the third subsection under the heading, **The Rhythmicity Constraint,** is that there is a single rhythmic constraint which rules out both adjacent stresses and final stress. Moreover this constraint is very much like the more familiar constraints such as the OCP or the Minimal Word constraint in that in its interaction with the rest of the grammar, both blocking and triggering effects are observed.

1.2.1 Extrametricality

Lest it be forgotten, the most important thing about the subtheory of extrametricality is that it allows us to maintain a restricted theory of what constitutes a possible foot. In addition, it eliminates the need for labelling based on branching and provides an account for deviant criteria for syllable weight in final position. These findings are primarily attributed to Hayes (1979 et seq), Prince (1983) and Harris (1983). The subtheory itself accounts for the observation that final constituents do not always contribute to the overall stress pattern, and is itself made up of a rule plus a number of principles which restrict its application. According to Hayes (1991:47) the extrametricality rule "designates a particular prosodic constituent as invisible for the purposes of creating metrical structure; the rules analyze the form as if the extrametrical entity were not there." The extrametricality rule has the following format, where X is a constituent at the edge of some domain D.

(1) $X \rightarrow \langle X \rangle \ / \ \_\_ \ ]_D$

The restrictions on extrametricality given in Hayes (1991:47) are repeated below.

(2) a. Constituency
Only constituents (e.g. segment, mora, syllable, foot, phonological word) may be marked as extrametrical.
b. Peripherality
A constituent may be extrametrical only if it is at the designated edge (left or right) of its domain.
c. Edge markedness
The unmarked edge for extrametricality is the right edge.
d. Nonexhaustivity
An extrametricality rule is blocked if it would render the entire domain of the stress rules extrametrical.

And what of the fate of the extrametrical constituent? In Hayes (1981) extrametrical elements are adjoined as weak members of the next higher constituent, thereby guaranteeing that they in fact surface as weak. In Hayes (1991) however, the notion of Stray Adjunction as originally conceived of by Liberman and Prince (1977) is rejected; instead, it is assumed that surface representations permit the appearance of stray elements.

Extrametricality allows for a superior account of otherwise anomalous phenomena like the antepenultimacy of stress in Latin (Hayes 1980) or Spanish (Harris 1983), for the so-called stress shift facts of Hopi (Hayes 1982), and for the final weight demotion effects of Arabic (McCarthy 1979), English (Hayes 1980, Borowsky 1989, Davis 1987) and Estonian (Prince 1980).[2] Its implications for learnability are explored in Dresher and Kaye (1990). And it has been used to explain the behavior of certain morphemes (Archangeli 1984/5, 1985 for Yawelamani, and Nanni 1977 for English), of tonal phenomena (Poser 1984, Pulleyblank 1983), and of initial onsetless syllables (Davis 1988). The bottom line in all these cases is that certain syllables simply avoid prominence. Although Poser (1986) and Inkelas (1989) discuss some other phenomena which are completely unrelated to stress or accent, the focus of this thesis will be on the avoidance of stress, specifically in final position. The analyses presented in this thesis rely heavily upon earlier work done on individual languages in which the existence of final stresslessness effects were recognized and brought to our attention.

1.2.2 Eurhythmicity

A second subtheory of metrical phonology that this thesis crucially depends on is the theory of rhythmic well-formedness. The very idea

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[2] A conceptual alternative to extrametricality is its dual, catalexis. According to Kiparsky (1992) catalexis allows metrical theory to be formulated in simpler and more restrictive way. Catalexis itself involves the addition (rather than the subtraction) of an empty consituent at the edge of a prosodic domain.

In Burzio's (in press,a,b) “stress-checking” approach, stress rules are dispensed with entirely, including that of extrametricality. Instead, foot size is partly dependent upon word prosody in the sense that the more prominent portions of the word invoke feet of a larger size. Since English word prosody is right-dominant with main stress on a final foot, that foot will tend to be larger.

that stress is based upon the notion of rhythm, and not upon a multi-valued vocalic feature as in the SPE framework (Chomsky and Halle 1968), is due to Liberman (1975) and Liberman and Prince (1977). Stress, it was observed, behaves in a manner which is completely different from say, voicing or backness, which are typical linguistic features. Rather stress is more like music; stress may be defined in terms of linguistic rhythm, not unlike the description of musical rhythm given in Jackendoff and Lerdahl (1982) and Lerdahl and Jackendoff (1983).

The power of the metrical grid as the purest form of representation is fully explored in Prince (1983). The metrical grid consists of an abstract array of x-marks arranged in rows and columns, where the height of a column represents the relative prominence of the stress-bearing unit and the rows represent a series of strong and weak beats. The grid is either projected from a metrical tree as in Liberman and Prince, or independently derived, as in Prince (1983).

While in music patterns are typically alternating and evenly subdivided into strong and weak beats, in language things are not so clean since the grid has to respond to demands imposed by the relative strength of syllables, words, phrases, etc. according to the rules of the language. Nevertheless, there is a certain aspiration to the state of music: "when infelicities in grid form appear in the normal course of linguistic concatenation, it is often the case that various steps are taken to remedy them. A clear example is the Rhythm Rule of English, which readjusts certain otherwise expected patterns of prominence when they would result in a nonalternating or 'clashing' grid" (Prince 1983:21). In the example below, the phrasal stress pattern does not involve the straightforward concatenation of two lexical stress patterns. (The highest grid mark comes from the rule that strengthens the second member of a phrasal collocation.) Instead, the application of the Rhythm Rule causes a leftward shift in stress.

```
(3)   a.         x            b.    x
             x   x                  x   x

             fourteen               women
```

```
c.             x
         x     x
         x  x  x  x

         fourteen  women
```

The idea here is that the Rhythm Rule applies just in case it creates a more eurhythmic output.

The theory of rhythm can be seen as being made up of two parts, the first part being constrained by the second part. The first part demands that a grid be maximally organized, or filled; the second part demands that there be no adjacent or clashing grid marks. Together they give rise to the perfectly alternating grid.

```
(4)            x                 x
         x     x     x           x     x
      x  x  x  x  x  x  x  x  x  x  x
```

Prince's exact definition of clash is as follows: two grid marks clash if they are adjacent (in the strict sense) on level n, and if there are no intervening grid marks on level n-1. Consider for example the grid that would result from straight concatenation of **fourteen** and **women**, where a clash is indicated by a series of dashes.

```
(5)         x
         x - - x
      x  x  x  x

      fourtèen  wómen
```

The problem here occurs at the second level, where there are two grid marks which are both adjacent and which lack an intervening grid mark between them on the next level down. Clash is similarly created at the highest level in the example in (6).

```
(6)   x - - - - - x
      x           x
      x     x     x
```

Although subsequent modifications have been proposed regarding the precise definition of what is good and what is bad (Selkirk 1984a, Hayes

1884), the case for eurhythmy as a principle governing the patterns of stress remains strong.[3] Hayes (1984) for example proposes that there are degrees of eurhythmy; his alternative to the stress clash theory is the rhythmic interval theory in which the spacing of stressed appears to strive for a target interval of around four syllables. More specifically, a metrical grid is considered eurhythmic when it contains a row of marks spaced as close as possible to four syllables apart, with greater divergence implying greater dysrhythmy.

(7) Quadrisyllabic Rule (Hayes 1984)
A metrical grid is eurhythmic when it contains a row of marks spaced about four syllables apart.

The theory proposed by Selkirk (1984a) is less radically different from the stress clash theory. In her view there are two parts to the story; an avoidance of clash and an avoidance of lapse. Together, these constrain applications of Beat Movement, Beat Addition, and Beat Deletion.

(8) The Principle of Rhythmic Alternation (Selkirk 1984a:52)
a. Every strong position on a metrical level n should be followed by at least one weak position on that level.
b. Any weak position on a metrical level n may be preceded by at most one weak position on that level.

1.2.3 The Rhythmicity Constraint

Of particular interest to the enterprise at hand is Selkirk's statement of the anti-clash provision. The constraint that I propose in order to rule out both clash and final stress on the same rhythmic grounds is one which demands that a stressed element be followed by an unstressed element. Prince's definition of what is not rhythmic requires a pair of clashing stresses, and therefore cannot capture the similarity between a

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3 Studies exploring the role of eurhythmy in determining phrasal stress patterns include, French (Dell 1984), Polish (Hayes and Puppel 1985, Rubach and Booij 1985), Dutch (Kager and Visch 1988) and Italian (Nespor and Vogel 1989).

stressed element which precedes another stressed element, and one which precedes a word-boundary. Although I do not think her intention was to do so, Selkirk's definition rules out final stress. The definition I propose to account for rhythmicity in the grid is given in (9).

(9) **Rhythm**:

Every grid mark x at level n + 1 (where n ≥ 1) must be followed by a beat of height n such that there is no beat of height greater than n which intervenes.

Examples are given in (9a-h), where starred grid marks are those that violate **Rhythm** as it is defined above. Grid marks at level 1 do not count.

```
a.      x       x
    x   x   x   x   x

b.  x
    x       x
    x   x   x   x

c.  x
    x           x
    x   x   x   x   x

d.  x*      x*
    x       x
    x   x   x   x

e.  x*      x
    x       x       x
    x   x   x   x   x   x

f.      x       x*
    x   x   x   x

g.  x
    x*  x
    x   x   x

h.          x*
        x*  x*
    x   x   x
```

Note that **Rhythm** and the anti-clash constraint both regard the grids in (9a-e) in much the same way. The crucial difference between the two constraints however is that **Rhythm** is fundamentally asymmetrical in nature. This can be clearly seen in (9f) where final stress constitutes a violation of **Rhythm** but not of anti-clash, as well as in the contrast in well-formedness between (9g) and (9h).

At this point, I will outline a number of assumptions that are being made for this particular analysis. First of all, the focus here is on the nature of lexical stress, rather than of phrasal stress. Secondly, the fundamental source of s/w (strong/weak) relations is the prosodic organization, i.e. relative prominence is derived from the basic properties of syllable and foot structure. These relations are in turn directly mapped onto the metrical grid: stress-bearing units must absolutely project a grid mark at the lowest level;[4] heavy syllables and foot-heads project a grid mark at the next level under compulsion from the principle of Weight-to-Stress (Prince 1990). A single foot-head is then promoted to main stress in accordance with the conditions laid out by the language in question. Third, the grid itself is subject to some (eu)rhythmic constraint of the type discussed above, which essentially demands strict alternation. In the theory proposed here, strict alternation includes not only the avoidance of internal clash, but also the nonfinality of stress. And fourth, what is really interesting is when there is a conflict; if grid well-formedness is more important, then a candidate which is imperfectly parsed will be optimal. In this view, imperfect or weak parsing is due to the demands of rhythmicity, and not to a rule of extrametricality.

The notion that extrametricality effects should be viewed as nonfinality effects in the first place is due to Prince and Smolensky (1993:Chapter 4). Earlier hints of nonfinality may be found in Hyman (1977) who observes that penultimate stress is at least as natural as final stress, which he sets out to explain. He notes that while on the one hand

4 In accordance with Kager's (1993:393) Rhythmic Uniformity Hypothesis, which states that in every stress system there is a match between rhythmic units (in terms of which clash and lapse are defined) and parsing units (type of stressable element, i.e. syllable or mora).

stress has a demarcative function, namely to signal a word-boundary, phonetically it is more natural to realize this in terms of a falling pitch prominence (HL) over two syllables. The idea is that stress is better perceived by contrast with what follows, rather than what precedes. According to Hyman (1977:46) nonfinal stress accomplishes two things: (i) phonetically, the fall from H to L is enhanced, and (ii) conceptually, the culmination of prominence is enhanced by virtue of the fact that a syllable lacking stress follows. And in Kisseberth (1993) the nonfinality of a high-tone is related to the Obligatory Contour Principle; the interpretation here seems to be also that H must be followed by L at the end of the domain.

In any case, extrametricality should be viewed as final stresslessness, and final stresslessness should in turn be viewed as rhythmically desirable. Moreover what rules out final stress also rules out internal clash. There are at least three places in the literature where internal destressing is likened to extrametricality. The first is in Hayes (1991:91-92) who discusses a specific type of extrametricality which he calls **extrametricality in clash**. He proposes that the rule of extrametricality may be sometimes triggered by the appearance of a stressed syllable in the left environment. Consider the following example from Turkish (for more on the stress of the Turkish toponym see Kaisse 1985). As shown on the left, placing a foot-head on /ka/ produces a clash with the preceding heavy syllable. The extrametricality rule applies to render the final foot invisible, thereby removing the offending grid mark.

```
(10)  (x          )        (x          )
      (x)  <(x   .)>       (x)
      an    ka   ra   →    an    ka   ra
```

The second is Hammond (1990) who analyses word-internal ternary alternations and word-final ternary alternations in the same way. Thus the ternary system of Cayuvava is analysed in terms of trochaic feet plus extrametricality, where peripherality is relativized to the foot. The third is Idsardi (1992) whose theory focusses on the placement of certain constituent boundaries. Parentheses should not appear too close together nor they should appear too close to the edge of the form. The first case thus achieves clash avoidance, while the second case achieves edge avoidance.

As we will see in looking at the individual languages, one of the biggest problems that is associated with the rule-based approach is that extrametricality effects are not uniform, either within a language, or across languages. Prince and Smolensky point to the fact that, attached to every rule of extrametricality is a condition of Nonexhaustivity: the rule does not apply if it would otherwise render the entire string extrametrical. Consider the case of Latin, where final syllables are extrametrical, and yet monosyllables are stressed. In OT terms, monosyllabic words give rise to a constraint conflict since monosyllables cannot respect culminativity and **Nonfinality** at the same time. That monosyllables are stressed means that **Nonfinality** is dominated by a higher constraint such as the independently attested **MinWd** constraint which essentially demands that a lexical word have sufficient metrical structure. The so-called Nonexhaustivity effect can therefore be shown to be derivable from the domination of **MinWd** constraint over **Nonfinality**. The interesting case is the monosyllabic word, because this is the case that produces a constraint conflict. That the conflict is resolved in favor of **MinWd** establishes the crucial ranking relation, shown below.

Nonexhaustivity (Prince and Smolensky 1993)

(11)	/mens/ ‘mind’	MinWd	Nonfinality
p	(méns)		*
	mens	*!	

The particular problem posed by incorporating Nonexhaustivity is that it clearly duplicates **MinWd**. It has been established that **MinWd** has all sorts of blocking and triggering effects in the grammar; for example, it triggers epenthesis in Choctaw as shown by Lombardi & McCarthy (1991), while it blocks apocope in Lardil as shown by Wilkinson (1988). This can be accounted for by ranking **MinWd** over **Fill** in Choctaw, shown below (or over **No-V#** in Lardil, see Prince and Smolensky (1993:Chapter 7)). Augmentation then is viewed purely as an effect of ranking **MinWd** over **Fill**. Note that since violation is always minimal, a larger word such as **pisa** 'to see' which can satisfy **MinWd** and **Fill** at the same time, will not produce such an effect.

Augmentation in Choctaw

(12)	/bi/ 'to kill'	MinWd	Fill
p	(Δbi)		*
	(bi)	*!	

In much the same way that **MinWd** has been shown to have a role in the grammar of a given language, it will be shown here that **Rhythm**, as a constraint of OT, is ranked and violable, and therefore capable of interacting with other constraints in the grammar. The array of empirical facts will then be shown to be entirely derivable from specific rankings of **Rhythm** within a grammar.

The idea that eurhythmic principles may provide an explanation to otherwise unexplainable effects started out in Liberman and Prince and has continued with recent work including Kager (1993), Zoll (1992) and Kenstowicz and Rubach (1987). Kager for example sets out to deduce the iambic/trochaic asymmetry from the sonority asymmetry in bimoraic syllables, showing that there a number of quantitative processes which are guided by principles of eurhythmy, while Zoll and Kenstowicz and Rubach discuss quantitative effects of the Slovak Rhythmic Law. This kind of approach is not unlike the more familiar studies in which vowel length alternations are linked to conditions on metrical structure (Myers 1987, Burzio 1992).

1.3 Prosodic Organization

While the basic spirit of the Strict Layer Hypothesis (Selkirk 1984a:26) is generally accepted as a guiding principle for prosodic organization, the degree to which it should be satisfied is far less clear. This issue is examined in depth by Ito and Mester (1992) who essentially conclude that the stronger version of maximal parsing, “parse everything” should give way to a weaker version, namely “parse everything parsable.” In other words, the requirement to parse elements into well-formed constituents outweighs the requirement to parse every element. As a result, surface forms with loose or unfooted syllables abound. This is referred to as the theory of Weak Layering. Implicit in the theory is the possibility for an element to be unparsed; under the principle of Prosodic Licensing, this entails deletion (Ito 1986).

The present claim is that GEN provides exactly three states in which a phonological node can appear: it can be strictly parsed, or to use the preferred metaphor of syntacticians, properly mothered; it can be unparsed, or orphaned; or it can be weakly parsed, or improperly mothered. As a concept, weak parsing already exists. However, under the present treatment, weak parsing is simply a possibility supplied by GEN, which means that we need to have a very precise notion of what the representations look like in order to evaluate their well-formedness. A more specific theory of weak parsing will therefore be developed in this thesis, the ultimate goal being to show that weak parsing may be forced not only by requirements that prosodic constituents be well-formed, as demonstrated by Ito and Mester (1992), but also by rhythmic requirements, as described in the previous section.

1.3.1 Strict Parsing, or Proper Motherhood

The principle of Prosodic Licensing (Ito 1986) requires that all phonological units belong to higher prosodic structure.

(1) Prosodic Licensing (Ito 1986:2)
All phonological units must be prosodically licensed, i.e. belong to higher prosodic structure (modulo extraprosodicity).

More specifically, segments must belong to syllables, syllables to metrical feet, and metrical feet to phonological words or phrases. Thus as Ito shows, Prosodic Licensing ensures that a phonological string be exhaustively syllabified. Conversely, unsyllabified segments are subject to Stray Erasure (see for example Steriade 1982); in Ito's view, deletion is the result of not being properly licensed.

Despite the explicit statement that all prosodic constituents are subject to licensing, Ito's discussion is basically limited to the licensing of segments. It is therefore natural to ask how the notion of licensing applies to the other categories. A broader conception of prosodic organization is assumed by Selkirk's Strict Layer Hypothesis, which demands that every prosodic constituent be exhaustively dominated by a constituent of the immediately superordinate type.

(2) Strict Layer Hypothesis (Selkirk 1984a:26)
A category of level **i** in the hierarchy immediately dominates a (sequence of) categories of level **i-1**.

The hierarchy referred to in the definition of Strict Layering is the Prosodic Hierarchy (Selkirk 1980 et seq, Nespor and Vogel 1986, McCarthy and Prince 1986), given below.

(3) The Prosodic Hierarchy

PrWd
F
σ
μ

Suppose we take Selkirk's proposal very seriously, and state it in the form of an OT-type constraint.

(4) **Strict Parse:** (First Statement)
A node must be parsed according to the SLH.

This means that all segments must be dominated either by a mora or by the syllable (depending if it is moraic or not), a mora must be dominated by the syllable, the syllable by the foot, and the foot by the PrWd. The complete set of strictly parsed nodes would therefore be as shown in (5). (Note that only the daughter nodes are being evaluated!)

(5) Constituents Satisfying **Strict-Parse**

```
μ/σ        σ        F        PrWd
 |         |        |         |
Rt         μ        σ         F
```

In the ideal case, all nodes in question are strictly parsed or properly mothered. However, the **Strict-Parse** constraint, being a constraint within OT, is both violable and ranked. This means that while **Strict-Parse** may be minimally violated, it is not always unviolated.

1.3.2 Unparsed Elements, or Orphans

The theory of Prosodic Licensing, as originally conceived, allows for two possible scenarios. A node is either prosodically licensed or it is not. Failure to be licensed entails deletion, or to put it less drastically, failure to be realized.

In languages like Diola Fogny, Lardil and Attic Greek, conditions on syllable structure must be met; as a result, certain segments may not be syllabifiable in certain contexts and therefore are deleted. In Lardil, for example, the fact that only apical coronals are permitted in coda position leads Ito to posit the following (positive) condition.

(6) Lardil Coda Condition (Ito 1986:89)

```
If        C ]σ
          |
Then      [+cor,-bk]
```

The existence of such a condition provides an explanation as to why the output of underlying strings like /waNalk/ ‘boomerang’ and /Naluk/ ‘story’ is [waNal] and [Nalu], respectively. (Evidence for the presence of an underlying /k/ comes from forms containing vowel-initial suffixes.) The loss of the final consonant is not due to a general rule of consonant deletion. Rather, given this specific condition on syllable structure, there is no way to syllabify the final /k/ in either case. Since the final /k/ cannot be syllabified, it is stray erased, and we get the surface forms [waNal] and [Nalu]. In an OT-based framework these effects are derived by ranking the Coda Condition over the faithfulness constraint, **Parse**.

I will assume that stray erasure is applicable to all nodes, and not only to segments. Thus if a syllable is not part of any higher structure, it cannot be realized. Unparsed nodes are orphans in the sense that they lack a mother node entirely. I shall assume that while unparsed nodes violate **Parse**, they (vacuously) satisfy **Strict-Parse**, which as it is phrased in (7) imposes strict layering requirements only upon mothered nodes. **Parse**, given in (8), is essentially the same as Ito's Prosodic Licensing.

(7) **Strict-Parse:** (Second Statement)
If a node is parsed, it must be parsed according to the SLH.

(8) **Parse:** (First Statement)
A node must be part of a Prosodic Word.

The full set of orphans is given in (9) where the effect of having an unparsed root is the loss of a segment, and the effect of having an unparsed mora is vowel shortening.

(9) Constituents violating **Parse**

Rt μ σ F

The three states in which a node can appear are defined as follows. A properly mothered node satisfies both **Parse** and **Strict-Parse**, an orphan satisfies only **Strict-Parse**, and an improperly mothered node (discussed below) satisfies only **Parse**. The fourth logical possibility, a case which violates both constraints is excluded.[5]

---

[5] If there are two constraints and three possibilities, the fourth non-occurring possibility must be the one which violates the two constraints, otherwise we would expect situations in which the fourth possibility is optimal.

(10)

	Parse	Strict-Parse
Proper Motherhood	√	√
Orphans	*	√
Improper Motherhood	√	*

Proper motherhood is clearly always optimal. However if the two constraints cannot be simultaneously satisfied, the outcome will depend on the ranking between them. If **Parse** is ranked over **Strict-Parse**, then the language will choose weak parsing over deletion. If the ranking is reversed, then deletion will be favored over weak parsing.

1.3.3 Weak Parsing, or Improper Motherhood

In the standard theory, extrametrical constituents are in some sense banished to a gray area between the intrametrical and the realm beyond the word boundary. These constituents are segmentally present and yet their rhythmic or quantitative properties are ignored by virtue of an extrametricality rule which applies just prior to the rules of stress. At the end of the derivation however, they are returned via Stray Adjunction (Hayes 1982:235). This account reflects the dual nature of these constituents: while segmentally present, they are rhythmically absent.

In Ito (1986:3), the gray area between being parsed and not being parsed is attributed to Extraprosodicity. Extraprosodicity as a licensing mechanism is considered similar to Prosodic Licensing, except that its role is to take care of edges of well-defined domains. Final syllables which are excluded by metrical rules, as well as initial complex onsets and final complex codas are assumed to be licensed in this way. While Ito focuses on the conditions of syllabification and how they differ in word-final versus word-internal position, it appears that the intention was to treat final extrametrical syllables as falling under this gray concept of Extraprosodic Licensing.

What is extraprosodic for Ito is outside the rule domain for Inkelas (1989). In her theory, there is a mismatch between the lexical prosodic structure, i.e. the domain of phonological rule application and the morphological structure. Again we find this notion of being neither here nor there.

And as Ito and Mester (1992) observe from the facts of Japanese word clippings, an all-or-nothing type theory of prosodic organization is empirically inadequate. For one thing, it is not at all the case that syllables can only exist as parts of feet. The basic idea behind their theory of Weak Layering is that maximal parsing is not absolute, and that a particular structure is optimal to the extent that it is maximally parsed. The gray area is absolutely necessary.

The theory pursued here is similar in spirit to each of these theories in that it acknowledges the existence of a gray area in which the constituent is present in one respect, but absent in another. A fundamental difference in the theory here, however, is that this gray area is supplied by GEN, and that it may or may not be optimal. Since GEN provides each input with such a wide variety of candidate parses, one must have a very specific characterization of weak parsing. In the sections which follow, I introduce some key technical refinements, of which there are basically three parts. First, **Parse** is restated in more local terms, and adjunction to either the syllable or the Prosodic Word is allowed. Second, there is the idea that weak parsing must be constrained so that nodes are not freely attached to just any higher node; this is accomplished by imposing a gradient definition on **Strict-Parse**. Third, it is proposed that that weakly parsed constituents are actually different from strictly parsed constituents and orphans in that although they are segmentally well-formed, they are rhythmically or quantitatively defective. This last property is particularly relevant in the evaluation of the rhythmic well-formedness of the structure. Recall that the ultimate goal here is to show that weak parsing may result under pressure from a higher-ranking rhythmic constraint.

1.3.3.1 The first part of the theory has to do with what is allowed by GEN. Following McCarthy and Prince (1993b) I assume that the mora is not really part of the Prosodic Hierarchy. McCarthy and Prince show that the skeletal-level units, i.e. the mora and the root node, do not behave in the same way as true prosodic constituents with respect to alignment phenomena. This suggests that we have two separate domains of organization, as shown below, where the truly prosodic constituents are distinguished from the subsyllabic constituents.

(11) Prosodic Hierarchy — Syllable-Internal Hierarchy

Prosodic Hierarchy	Syllable-Internal Hierarchy
PrWd	σ
F	μ
σ	Rt

Ito and Mester (1992:32) also hint at such a distinction in their discussion of Hierarchical Locality, a constraint under which binarity at the moraic level is not visible from the PrWd-level. The special status of the mora is also alluded to in their principle of Mora Confinement (1992:11), which specifically says that a mora can only be licensed by a syllable. So while a syllable can be parsed by the PrWd, it is not the case that a mora can be parsed by a foot.

As a result, we can revise our statement of **Parse** to ensure that a constituent is part of the appropriate domain.

(12) **Parse** (Final Statement)
Subsyllabic constituents must be part of the syllable;
Prosodic constituents must be part of the Prosodic Word.

The main reason for making the distinction in (11) here is to force a more local interpretation of weak parsing. This means that we must allow for the possibility of adjunction to the highest node of each domain, namely to the syllable and to the PrWd, if we are to provide a means by which a root node, mora or foot is to be weakly parsed. How else would a foot be parsed and yet not strictly parsed? I therefore assume GEN permits the following adjunction structures, where subsyllabic constituents are adjoined to the highest node of their domain, and prosodic constituents are adjoined to the highest node of theirs. Each of these constituents is considered improperly mothered since they satisfy **Parse** but violate **Strict-Parse**.

(13) Adjoined Constituents satisfying **Parse**

```
σ'          σ'          PrWd'       PrWd'
|           |           |           |
Rt          μ           σ           F
```

It should be noted that in each case, σ' and PrWd' also dominate a σ or PrWd node respectively, if the principle of Proper Headedness is to be maintained.

(14) Proper Headedness (Ito and Mester 1992:12)
Every (nonterminal) prosodic category of level **i** must have a head, that is, it must immediately dominate s category of level **i-1**.

The special property of adjunction is that adjunction is by definition possible only at word edges, which explains why weak parsing is so common at word edges. We return to the importance of this issue in Section 1.3.3.4.

The revised, stricter definition of **Parse** eliminates a number of representations. The following structures, for example, are interpreted as containing unparsed constituents.[6]

(15) Constituents violating **Parse**

```
PrWd        F           PrWd        F
|           |           |           |
Rt          Rt          μ           μ
```

1.3.3.2 The second part of the theory has to do with minimal violation. I assume that a node is weakly parsed if it is neither

6 Contra Booij and Rubach (1990), extrasyllabic consonants are not attached to the PrWd, but adjoined to the syllable.

strictly parsed nor unparsed. This gives us exactly five possibilities in which **Parse** is satisfied but **Strict-Parse** is not, as shown in (16).

(16) Constituents violating **Strict-Parse**

```
PrWd      PrWd'     σ'        σ'        PrWd'
|         |         |         |         |
σ         σ         μ         Rt        F
```

Note however that the syllable can be weakly parsed in one of two ways. I would like to propose that weak parsing must be further constrained to eliminate the possibility of adjoining the syllable to the PrWd and that this may be accomplished if we assume a gradient version of **Strict-Parse**, along the lines of Prince and Smolensky's **Edgemostness** Constraint (1993:29).

(17) **Strict-Parse** (Final Statement)
A parsed node must be parsed by a higher node, such that the number of levels skipped is minimal.

The idea is essentially that if a proper mother is not available, one looks to the next node up (within its domain) for mothering. In the example below, three structures are compared: a syllable mothered by a foot, a syllable mothered by the PrWd, and a syllable adjoined to the PrWd. The symbol ">" means "better satisfies the constraint hierachy than".

```
(18)  a.   F     >    b.   PrWd      >    c.   PrWd'
           |               |                   |
           σ               σ                   σ
```

In each case the syllable is part of its appropriate domain, satisfying **Parse**. The three cases differ however with respect to the degree to which **Strict-Parse** is respected. In (18a), the syllable satisfies **Strict-Parse** because no intermediate levels are skipped, in (18b) exactly one level is skipped, that of F, while in (18c) two levels are skipped, F and PrWd. While (18b) may be chosen over (18a) under pressure from say **Foot-Binarity**, it will never be the case that (18c) is chosen over (18b). The structure in (18c) simply incurs more violations than necessary. This is parallel to the arguments raised in the discussion of how to constrain epenthesis (Prince and Smolensky 1993:24-26), namely, by assuming that violation is always minimal.

We are thus left with the following complete set of weakly parsed nodes where in each case the number of skipped levels is exactly one.

(19) Constituents minimally violating **Strict-Parse**

```
σ'          σ'          PrWd        PrWd'
|           |           |           |
Rt          μ           σ           F
```

1.3.3.3 The third part of the theory has to do with establishing the properties of weakly parsed constituents. While unparsed elements are segmentally unrealized and strictly parsed elements are both segmentally and rhythmically or quantitatively present, weakly parsed elements are segmentally present, but rhythmically or quantitatively absent. These properties are crucial when it comes to evaluating the rhythmic well-formedness of a structure.

Recall that **Rhythm** demands that a stressed syllable be followed by a stressless syllable. Implicit in this requirement is that final syllables not be stressed. If **Rhythm** dominates **Strict-Parse**, then we will observe weak parsing effects at the end of the word.

Given that **Strict-Parse** is always minimally violated, the complete set of weakly parsed nodes that actually occur under rhythmic pressure is repeated below. In each case the number of skipped levels is exactly one. I shall explain each one in turn.

(20)

```
σ'          σ'          PrWd        PrWd'
|           |           |           |
Rt          μ           σ           F
```

Under rhythmic pressure a consonantal root may be weakly parsed as in (21a), where it is adjoined to the syllable (two notational variants are given). I assume that in a language where codas are moraic, (21b) is independently ruled out on the grounds of a Weight-by-Position type principle, which requires that a consonant be moraic when it is in coda position (Hayes 1989a), i.e. inside a syllable. The overall result is that a post-vocalic consonant does not contribute any syllable weight; therefore, by the principle of Weight-to-Stress, the syllable is neither heavy nor inherently stressed.[7]

---

7 Another type of consonant extrametricality is the type exemplified by Kamaiurá (Everett and Seki 1985). In this language, syllables are strictly open except word-finally, where a single consonant can occur. This is standardly analysed with a maximal CV syllable and final consonant extrametricality (Borowsky 1986, Ito 1986, 1989). McCarthy and Prince (1993b:44) offer an OT-based analysis which makes use of the notion of alignment. Their idea is that the ban on codas i.e. **No-Coda** is not absolute, and can be dominated by an align-type constraint which demands that the right edge of the morphological stem be aligned with the right edge of the syllable, namely **Align-R**. Any faithfulness violation would lead to a misalignment of the edges, given the hypothesis known as Consistency of Exponence (McCarthy and Prince 1993a), which essentially says that epenthetic elements have no morphological affiliation.

Consonant Extrametricality under Alignment

<table>
<tr><th></th><th></th><th>Align-R</th><th>»</th><th>No-Coda</th></tr>
<tr><td>p</td><td>.a.pot.|</td><td></td><td></td><td>*</td></tr>
<tr><td></td><td>.a.po.<t>|</td><td>*!</td><td></td><td></td></tr>
<tr><td></td><td>.a.po.t|Δ.</td><td>*!</td><td></td><td></td></tr>
</table>

McCarthy and Prince (1993b:45) add in a footnote that it is also possible that the final /t/ is parsed directly by PrWd, i.e. an appendix of the type described by Booij and Rubach (1990). The dominating **Align-R** constraint would then demand that the right edge of the stem coincide with the right edge of the PrWd, forcing a violation of **No-Appendix**, which prohibits appendices (cf. Sherer 1994). This would be compatible with the analysis presented here, where the Kamaiurá facts are accounted for by ranking **No-Coda** over **Strict-Parse**.

Consonant Extrametricality under Weak Parsing

<table>
<tr><th></th><th></th><th>No-Coda</th><th>»</th><th>Strict-Parse</th></tr>
<tr><td>p</td><td>{a}{{po}t}</td><td></td><td></td><td>*</td></tr>
<tr><td></td><td>{a} {pot}</td><td>*!</td><td></td><td></td></tr>
</table>

(21) Weakly Parsed Consonant = Weightless Consonant

a. σ'
|
C

= $\}_{\sigma}$ C $\}_{\sigma'}$

b.* σ
|
C

Similarly, under rhythmic pressure a mora may be weakly parsed, as in (22). Since an adjoined mora is a weightless mora, the result is shortening.

(22) Weakly Parsed Mora = Weightless Mora

σ'
|
μ

= $\}_{\sigma}$ μ $\}_{\sigma'}$

An unfooted syllable is parsed by the PrWd, as is standardly assumed. The most obvious case in which this kind of weak parsing arises is under pressure from the higher ranking constraint of **Foot-Binarity**. Note that this is the only case of weak parsing that does not involve adjunction. This means that it is not at all limited to word-edges, as we will see in the following section.

(23) Weakly Parsed Syllable = Loose Syllable

PrWd
|
σ

= $)_{F}$ σ $]_{PrWd}$

Finally the weakly parsed foot must be adjoined to the PrWd. An adjoined foot is a headless foot, which under rhythmic pressure may be optimal.[8]

---

8 This notion of weak parsing as optimal is echoed in a paper by Spaelti (1993) who proposes a constraint Weaken-Edge (P-Cat). The statement of this constraint is, "the right periphery of P-Cat should be empty," suggesting that the optimal edge may be the one which contains the least amount of structure. An example he gives of weakening is the result of ranking Weaken-Edge over Weight-by-Position.

(24) Weakly Parsed Foot = Headless Foot

PrWd'
|
F

= $]_{PrWd}$ F $]_{PrWd'}$

1.3.3.4 In this section I address the fact that weak parsing is so much more common word-finally than word-internally. The sole exception is the weak parsing of syllables, which occurs word-internally all the time. Loose syllables resulting from pressure under **Foot-Binarity**, or ternary alternations such as those found in Cayuvava (Hayes 1991; Hammond 1992) provide the perfect example.[9]

While the theories of Extrametricality and Nonfinality have the peripherality aspect built into them, the theory proposed here does quite the opposite. The claim here is that Nonfinality effects can be attributed to more general rhythmic effects, such that the appearance of stress on a final syllable is treated on a par with a clash configuration. The question then is, why is it that alleviation of final stress is so much more common than alleviation of clash? In Axininca Campa, for example, final long vowels are shortened, but long vowels which precede other long vowels do not. The answer has to do with the nature of adjunction: adjunction by definition can only appear at the edges of domains.[10]

The theory presented here gives two ways to represent vowel shortening. Either a mora is unparsed, violating **Parse**, or it is weakly parsed, violating **Strict-Parse**.

(25a) ***Parse**
$\{ \mu \}_{\sigma} \; \mu$

(25b) ***Strict-Parse**
$\{\{ \mu \}_{\sigma} \, \mu \}_{\sigma'}$

9 Interestingly Hayes refers to the loose syllables as "weakly parsed", while Hammond analyses them on a par with extrametrical syllables. The idea here is that these are all one and the same.

10 Unfortunately it is not entirely clear why adjunction to a **syllable** should be restricted to the edge of a **PrWd**.

The first can take place anywhere in the word. The second involves adjunction and can therefore only take place at the edge of the word. If the constraint-ranking of the language is such that **Rhythm** dominates **Strict-Parse**, but not **Parse**, as shown in (26), then one would expect that while **Rhythm** can force weak parsing, it cannot force non-parsing.

(26) **Parse** » **Rhythm** » **Strict-Parse**

Weightless consonants, weightless moras, and headless feet may all be derived from adjunction structures and are therefore limited to the word-edge. Loose syllables are slightly different. As pointed out earlier, syllables are the only constituents that when weakly parsed, never involve adjunction. So even when other weakly parsed constituents are disallowed word-internally, loose syllables may appear there.

1.3.4 Constraint Family Dispersion

This term, due to Ito, Mester and Padgett (1993) refers to the fact that a broad constraint can be split up into smaller subconstraints. The example they cite is the family SonVoi (sonorants must be voiced) which can apparently be split into NasVoi and ApproxVoi/VocVoi with some Faithfulness constraint intervening.

This means that in principle, a constraint such as **Parse** could in fact be made up of at least five subconstraints - Parse-Foot, Parse-Syllable, Parse-Mora, Parse-Root, Parse-Features. Further differentiation between [+cons] Rt and [-cons] Rt should also be possible. These subconstraints in turn should be able to interact freely with all the other constraints, creating a very complicated grammar.

The view that will be taken in this thesis is that "dispersion" does not take place until there is absolute evidence for it (this applies to both the linguist and the language-learner). In other words, I assume that the default case is one where Parse-X, X a phonological node, consists of an unranked block of constraints which interacts as a whole with the rest of the grammar. If a higher constraint such as No-Coda dominates

Parse-X, then the only relevant candidate will be the one which has an unparsed Root. Unparsing a foot for example will not result in the satisfaction of the coda constraint. Given such a situation, there is no immediate need to posit a separate **Parse-C** constraint.

If on the other hand it turns out that two (or more) subconstraints interact with the higher constraint, and one of them makes the wrong predictions, then dispersion is needed. In Yidiñ for example, we will see that **Strict-Parse** (syllable) can only be satisfied by violating **Parse-V** and crucially not **Parse-C**. **Parse-C** must be picked out and put aside as unviolated. Similarly we find that **Strict-Parse-Syllable** and **Strict-Parse-Consonant** must be distinguished, and moreover that the former dominates the latter. A third case, again from Yidiñ, is that an insertion analysis of the vowel-zero alternation facts requires that the violated **Parse** constraint be of the form **Parse-Features**, crucially excluding the possibility of violating **Parse-Root**.

1.4 Thesis Overview

Having laid out the basic concepts of rhythmic and prosodic organization, we are now ready to examine some real data to see how **Rhythm** interacts with other constraints in the grammar to produce a variety of effects that are otherwise unexplained.

The thesis contains six more chapters (for a total of seven). The first four chapters each represent one type of iambic system within a four-way typology, based on the ranking of **Rhythm** with respect to **Strict-Parse** and **FtForm**. While a violation of **Strict-Parse** produces weak parsing effects, a violation of **FtForm** gives rise to trochaic parsing effects. The proposed typology is shown below:

(i) **Rhythm** dominates **Strict-Parse**, but not **FtForm** (Chapter 2)
(ii) **Rhythm** dominates both (Chapter 3)
(iii) **Rhythm** dominates **FtForm**, but not **Strict-Parse** (Chapter 4)
(iv) **Rhythm** dominates neither (Chapter 5)

In Chapter 2 we take a close look at Negev Bedouin Arabic and Hixkaryana, and conclude that despite certain surface differences, the two languages are alike with respect to the rankings of **Rhythm**, **Strict-Parse** and **FtForm**. Cayuga also appears to fit into this language type.

In Chapter 3 the focus is on Axininca Campa, where, in addition to weak parsing effects, trochaic parsing effects turn up in a number of situations. The second part of the chapter presents a brief overview of a number of languages which potentially fit into the same category.

In Chapter 4 the focus is on Yidiñ, where trochaic parsing can be optimal under rhythmic pressure, but weak parsing cannot be. Further complications to the system are attributed to the presence of other constraints which interact with **Strict-Parse** and **FtForm**.

In Chapter 5 we examine three languages which appear to lack the types of weak/trochaic parsing effects seen so far. Nevertheless Ojibwa, Creek and Araucanian exhibit other kinds of rhythmic effects, which is to be expected given that **Rhythm** is nevertheless present in the hierarchy of constraints.

In Chapter 6, we shift our attention to the role of **Rhythm** in trochaic systems. Since **Rhythm** does not interact with trochaic **FtForm** in the same way as it does with iambic **FtForm**, we are left with a simpler typology: either **Rhythm** does not dominate **Strict-Parse**, as in Fijian, or it does, as in Cairene Arabic and Latin. The focus of this chapter is on these two languages: while the analysis is generally straightforward, the analysis of Latin reveals two particularly interesting properties - the first is related to the antepenultimacy of stress, the second to the fact that final long vowels may be unstressed.

And finally Chapter 7 wraps things up, with special attention paid to the typological implications of this thesis.

Chapter 2[*]

Rhythmicity and Weak Parsing

The three iambic languages that will be examined in this chapter, Negev Bedouin Arabic, Hixkaryana and Cayuga, exemplify systems in which final stresslessness is more important than having a perfect parse. In terms of constraint domination, it will be shown that in these languages, **Rhythm** dominates **Strict-Parse** but not **Iambic Foot-Form**. As a result, we find word-final weak parsing, but never trochaic footing.

2.1 Negev Bedouin Arabic

According to the primary source consulted, Blanc (1970), this dialect of Arabic is spoken "by the semi-nomadic tent dwellers of the Negev, as represented chiefly by the speech of the Zulla:m."

2.1.1 The Stress Patterns

The metrical interpretation of the stress facts described in Blanc (1970) is due to Hayes (1991:189). Judging solely from the stress patterns in (1) and (2), Negev Bedouin Arabic looks just like the other Arabic dialects.

First of all, final superheavy syllables (CVVC, CVCC) are always stressed.

(1)	as̲í:l	'pure-bred'
	Ganamá:t	'(several individual) sheep'
	balHáyl	'strongly, much'
	mislimí:n	'muslims'
	ho:Dallá:k	'those'
	gahawatí:h	'my coffee'

[*] Constraints given in boldface are the ones defined and used here; constraints given in italics are ones which have been replaced or redefined.

And in the absence of such a syllable, a heavy penult (CVC, CVV) is stressed.

(2)	ábda	'having priority'
	Ganámna	'our sheep'
	Himú:lih	'clan'
	xalláyna	'I/we left'
	Sayyá?kuw	'he sent you (masc. pl.)'
	gahawítna	'our coffee'
	taHatá:niy	'lower'
	arrabá:bah	'the raba:bah'
	baSSibríyyih	'stringed instrument'[11]

The stress patterns in (3), though not typical of all Arabic dialects, is commonly associated with that of Palestinian Arabic, where main stress is said to fall on the penultimate foot (as analysed in Hayes 1987, for example).

(3)	áttifag	'to agree'
	astáfhamah	'he queried him'

In the remaining cases however, Negev Bedouin Arabic diverges sharply from the other Arabic dialects. While the data presented thus far is equally well-suited to either an iambic or a trochaic analysis, the stress patterns in (4) and (5) absolutely demand an iambic analysis.

As shown in (4), disyllabic words whose initial syllable is light (CV) exhibit final stress.

(4)	biná	'he built'
	jimál	'camel'
	guwíy	'strong'
	adúw	'enemy'

11 Thanks to John McCarthy for providing this gloss.

Otherwise, stress falls on the penult or the antepenult, whichever is separated by a single light syllable from the nearest preceding heavy syllable, or in the absence of such a syllable, from the beginning of the word.

(5) a9áma 'blind'
gaháwah 'coffee'
ankitálaw 'they were killed'
zalámatak 'your man'

As pointed out by Hayes (1991), the forms in (4) look overtly like iambs, and those in (5) are best suited to a left to right iambic analysis. Moreover, there is an extrametricality effect, since main stress falls on a non-final foot. Hayes claims that this is due to a foot extrametricality rule which precedes the assignment of main stress which is accomplished by End Rule (Right). Like all extrametricality rules, this rule is subject to the Peripherality Condition, which only allows peripheral elements to be extrametrical.

(6) /zalamatak/
(zala)(matak)
(zala) <(matak)>
(zalá)
(zalá)(matak)

Hayes notes further that when there is only one foot, foot extrametricality is blocked by the Nonexhaustivity condition; as a result, in cases like (4), the word consists of a single iambic foot.

(7) /bina/
*<(bina)>
(biná)

Having established the crucial generalizations regarding the stress patterns of Negev Bedouin Arabic, let us now examine the facts from the point of view of Optimality Theory.

2.1.2 The Foot Structure

The Negev Bedouin Arabic facts which are of particular interest here are those which distinguish it from the other dialects of Arabic. Together with Bedouin Hijazi Arabic (McCarthy 1993), Negev Bedouin Arabic differs from all of the dialects described in the literature in that it is not a fundamentally trochaic system.

It has been determined that the universal inventory of feet includes the (quantity-insensitive) syllabic trochee, the (quantity-sensitive) moraic trochee, and the (quantity-sensitive) iambic foot (McCarthy and Prince 1986 **et seq**, Hayes 1987, Prince 1990). The possible expansions of each foot type are those which respect Foot-Binarity (Prince 1976 **et seq**), Foot Headedness (Hayes 1980, Halle and Vergnaud 1987), and the Weight-to-Stress Principle (Prince 1990, cf. Hayes' weak-nodes-don't-branch). These are given in (8), where L is light, H is heavy, and o is a syllable. The head of the foot is underlined.

(8)	Syllabic trochee	(o o)
	Moraic trochee	(LL), (H)
	Iambic foot	(LL), (LH), (H)

That heavy syllables are mentioned at all in the description of Negev Bedouin Arabic indicates that it is a quantity-sensitive system. Heavy syllables, here CVV and CVC, attract stress in (1) and (2), and heavy syllables interrupt the left to right count in (5). This means that the foot cannot be a syllabic trochee. And while the patterns in (1)-(3) are amenable to either an iambic or a trochaic analysis, those in (4) and (5) clearly point to the iambic nature of Negev Bedouin Arabic. There are essentially two analyses available to the words in (4): either the two syllables form a binary, right-headed foot as in (9a), or the final syllable forms a degenerate foot, leaving the initial syllable unfooted, as in (9b).

(9) [biná]

a. (biná)

b. bi(ná)

The evidence for degenerate feet has been very weak, and I will assume throughout this work that the constraint against degenerate feet is undominated.[12]

(10) **Foot-Binarity**:

Feet are binary at some level of analysis.

Another constraint which I will assume to be undominated provides the basis of quantity-sensitivity: it essentially forbids the appearance of a heavy syllable in weak position.

(11) **Weight-to-Stress**:

A heavy syllable is stressed.

The words in (5) must also be given an iambic analysis if they are to receive a uniform treatment. As shown in (12), a left to right iambic analysis, along with some statement about the penultimate foot receiving main stress, makes the right predictions. A right to left trochaic analysis would work for (12a-c) giving penultimate stress, but would fail to account for the antepenultimacy of stress in (12d).

(12) a. (a9á)ma

b. (gahá)(wah)

c. (an)(kitá)(law)

d. (zalá)(matak)

---

12 But see Kager's (1993) analysis of Tübatulabal where it is proposed that degenerate feet occur when exhaustivity cannot be met in other, less marked, ways without violating his rhythmic filters. Pressure towards exhaustivity outweighs avoidance of degenerate feet, even when this produces syllable-level clashes.

This analysis can be extended to the other patterns as well.

(13) (así:l)
(Gana)(má:t)

(áb)da
(Ganám)na

(át)(tifag)
(as)(táf)(hamah)

This establishes the iambic nature of the system at hand, and I encode this in terms of the following headedness constraint on foot-form (compare to Prince and Smolensky's **RhType**, 1993:54).

(14) **Foot-Form**:
If there is a head, it is on the right.

The wording of this statement is intentional. It implies that a headless foot vacuously satisfies the constraint, which as we will see, is crucial.

2.1.3 The Nonfinality of Stress

Another interesting property of Negev Bedouin Arabic is the extent to which final constituents are skipped over for the purposes of stress assignment.

2.1.3.1 In (15), a final constituent is ignored: the real surprise is that in final position, neither a CVC syllable nor a syllable with even parity gets stress, as shown in (15a). Final stresslessness in (15b) is also worthy of our attention.

(15) a. (zalá)(matak)
(gahá)(wah)
b. (a9á)ma

On the other hand, as the data in (16) show, stress can be final given the right circumstances, namely in disyllabic words whose first syllable is light, and words ending in a superheavy syllable.

(16) a. (biná)

(jimál)

b. (as̲í:l)

According to Blanc (1970:15) we also find final weakening effects: "… final **iy** and **uw** denote actual diphthongs that are regularly heard as such when stressed and in pause, though they may be replaced by [i] and [u] otherwise." My interpretation of this is given in (17). I assume that the phenomenon effectively involves vowel shortening in (17b) and that the surface glide of the diphthong in (17a) is derived.

(17) a.	guwíy	'strong'	/i:/	→ [iy]
b.	taHatá:niy	'lower'	/i:/	→ [i]

2.1.3.2 Nonparticipation of the final constituent has been generally attributed to the theory of Extrametricality, where in a given language a final constituent X is marked extrametrical prior to the rules of stress assignment (Hayes 1982a **et seq**, Harris 1983, Prince 1983). This theory has been critical in our understanding of stress systems, allowing us to dispense with such undesirable notions as word-final ternary feet, and labelling based on branchingness (Prince 1983).

(18) Extrametricality:

X → <X> / __ $]_D$

The principal claim of this thesis however is that the nonparticipation of the final constituent is better understood in terms of an output constraint, as suggested by Prince and Smolensky (1993:Chapter 4), who refer to the constraint as **Nonfinality**. A simplified version is given here.

(19) Nonfinality:
Stress is not final.

A secondary claim of this thesis is that **Nonfinality** is a rhythmically-motivated constraint. The idea is that final stresslessness is due to a more general constraint which governs the alternating pattern on the grid and which I call **Rhythm**. The schematic content of this constraint is given in (20).

(20) **Rhythm**:
Every x at level n+1 ($n \geq 1$) must be followed by a beat of height n.

```
Ex.     x
        x   x
```

What this constraint says is that a stressed element must be followed by an unstressed element; word-internally, this is violated in contexts of clash, word-finally this is violated in contexts of final stress. In the examples below, the offending grid marks are starred.

```
(21)          x*  x
          x   x   x   x

(22)          x       x*
          x   x   x   x
```

If **Rhythm** were satisfied fully, we would get the perfect grid described in Prince (1983).

```
(23)      x       x       x       x       x
      x   x   x   x   x   x   x   x   x   x   x
```

Under this view, avoidance of final stress and avoidance of clash are given a uniform analysis. The reason the former is more readily "remedied" has to do with the fact that adjunction structures are available at word-edges but not word-internally.

2.1.3.3 The nonfinality effect demonstrated by the form in (15b), **a9áma**, is usually not interpreted as such, but rather as the result of left to right parsing. However, as McCarthy and Prince (1993:152-3) demonstrate, the left to right directionality aspect which is so common to iambic systems need not be stipulated, but rather can be viewed as a consequence of satisfying **Nonfinality**.[13] The issue of directionality emerges in the parsing of odd-numbered strings of light syllables into iambic feet, where left-to-right parsing is crucially distinguished from right-to-left parsing with regards to final stresslessness. As shown in (24), the former satisfies **Nonfinality** but the latter does not.

(24) /o o o o o/

L to R (o ó) (o ó) o

R to L o (o ó) (o ó)

McCarthy and Prince's argument is as follows: since **Foot-Binarity** must be satisfied, there is no way to avoid positing a loose, i.e. unfooted, syllable given an odd-numbered string of light syllables. This is the kind of weak parsing forced by higher demands on constituent well-formedness, of the type discussed in Ito and Mester (1992). The relevant aspect of the definition of S**trict-Parse** for the time being is that all syllables should be footed.

(25)	/a9ama/	FtBin	Strict-Parse
p	(a 9a) ma		*
	(a 9a)(ma)	*!	

However, as far as **Nonfinality** is concerned the location of the loose syllable is critical. In the tableau in (26), three candidates are evaluated with respect to **Foot-Form** and **Nonfinality**. Candidates A and

---

13 The handful of exceptions include Weri (Boxwell and Boxwell 1968), Tübatulabal (Voegelin 1935) and Aklan (Hayes 1980), none of which make a clear case for right to left footing, or iambic footing for that matter. For instance, Kager (1991) analyses Tübatulabal as having R to L moraic trochees.

B both have iambic feet, but differ with respect to the location of the loose syllable. Candidates A and C both avoid final stress, but differ with respect to foot type. Clearly the optimal form is form A since it satisfies both constraints, regardless of the ranking between them.

Left to Right Directionality

(26)	/a9ama/	FtForm	NonFin
p	(a 9á) ma		
	a (9a má)		*
	a (9á ma)	*	

Under this view, directionality in iambic systems need not be specified; it falls out directly from the existence of a **Nonfinality** constraint in the grammar.[14]

2.1.4 The Dominance of Rhythm

The goal of this section is to explain two things: first, to account for the array of final stresslessness effects in Negev Bedouin Arabic and second, to explain why internal clash is not "alleviated" to the same degree final stress is. The basic idea behind the answer to the first question is that final stresslessness effects are observed when there is a conflict between **Rhythm** and some lower-ranking constraint. As a dominating constraint, **Rhythm** can force a lower-ranking constraint to be violated. The answer to the second question has to do with the nature of prosodic adjunction, a representation that is inherently limited to the edges of domains.

2.1.4.1 That a constituent behaves as if it were segmentally present and yet absent for the purposes of rhythm and quantity tells us that it must be weakly parsed, or improperly mothered. Most theories recognize the necessity of a three-way distinction with respect to parsing states

---

14 But see Kager (1993) who provides a very different explanation for the markedness of leftward iambic systems which derives from his theory of directional parsing and the rhythmic filters.

(Hayes' extrametricality, Ito's extraprosodicity, Inkelas' mismatched domains); here the three are referred to as strict parsing, weak parsing and non-parsing. The function GEN makes each one available in the form of a candidate parse and the actual output is the one deemed optimal in the eyes of the hierarchy of constraints. That we observe weak parsing effects in Negev Bedouin Arabic means that a higher ranking constraint must demand them. This constraint I contend is **Rhythm**.

In order to evaluate the three parsing states, I have established two constraints which govern the way in which constituents are organized. The first of these, **Strict-Parse**, demands that a parsed node be properly mothered, according to the Strict Layer Hypothesis of Selkirk (1984). The second constraint, **Parse**, demands that a node be associated with the appropriate domain (cf. Ito's Prosodic Licensing).

(27) **Strict-Parse**

A parsed node must be parsed by a higher node, such that the number of levels skipped is minimal.

(28) **Parse**

Subsyllabic constituents (Rt, μ) must be part of the syllable; Prosodic constituents (σ, F) must be part of the PrWd.

The system is set up in such a way that a properly mothered constituent satisfies both **Parse** and **Strict-Parse**, hence establishing the golden ideal. Improperly mothered constituents satisfy **Parse** alone; orphaned constituents violate **Parse** but vacuously satisfy **Strict-Parse**. The fourth logical possibility involves the violation of both constraints, but never surfaces. Thus we have the following three parsing states.

(29)

		Parse	**Strict-Parse**
Proper Mo.	Strictly Parsed	√	√
Improper	Weakly	√	*
Orphan	Un-	*	√

If **Rhythm** dominates **Parse**, we would expect outright deletion effects; however if **Rhythm** dominates **Strict-Parse**, we would expect weak parsing effects, which is the case here.

The statements of **Strict-Parse** and **Parse** are such that the theory of weak parsing is severely constrained. Given the implicit assumption of locality in the statement of **Parse**, the following structures are considered ill-formed. (The nodes which are being evaluated are given in so-called "outline" form.)

(30) Unparsed Constituents

```
PrWd        PrWd        F        F
|           |           |        |
μ           Rt          μ        Rt
```

Assuming the possibility of adjunction to either the syllable or the PrWd provides the necessary means of weak parsing, which crucially violates **Strict-Parse**, but not **Parse**.

(31) Adjoined Constituents

```
σ'          σ'          PrWd'    PrWd'
|           |           |        |
μ           Rt          σ        F
```

However, given a gradient definition of **Strict-Parse**, a syllable that is weakly parsed by the PrWd will always be chosen over a syllable that is weakly parsed by adjoining to the PrWd. The set of weakly parsed constituents that minimally violate **Strict-Parse** is therefore as follows.

```
(32) a.  σ'    b.  σ'    c.  PrWd  d.  PrWd'
         |         |         |         |
         Rt        μ         σ         F
```

These weakly parsed constituents are characterized by the fact that they are rhythmically or quantitatively defective; a weakly parsed C is a weightless C, a weakly parsed μ is a weightless μ, a weakly parsed syllable is a loose syllable, and a weakly parsed foot is a headless foot.

And since adjunction is by definition limited to the edges of a domain, weak parsing of root nodes, moras and feet (but not syllables) is restricted to the edges of words.

2.1.4.2 This is just what we need to explain the Negev Bedouin Arabic facts. As (33a) shows, a final consonant may be present but not contribute to the weight of the syllable. And as (33b) shows, a final foot may be present but not have a head.

(33) a. (gahá) wah cf. (a9á) ma

b. (zalá)(matak)

These cases present a situation of conflict for **Rhythm** and **Strict-Parse**, and as shown in the tableau below, **Rhythm** must be the dominant constraint. With no adjunction structure, the final CVC would be fully syllabified, it would be heavy and therefore it would also be stressed.

Weak Parsing of a Final Consonant …

(34)	/gahawah/	Rhythm	Strict-Parse
p	… $\{\{wa\}_{\sigma}\ h\}_{\sigma'}$		*
	… $\{wah\}_{\sigma}$	*!	

Clearly **Parse** must in turn dominate **Strict-Parse**, otherwise we would expect to get deletion.

… Not Deletion.

(35)	/gahawah/	Parse	Strict-Parse
p	… $\{\{wa\}_{\sigma}\ h\}_{\sigma'}$		*
	… $\{wa\}_{\sigma}$ h	*!	

Just as it may be optimal to adjoin final consonants, it may be optimal to adjoin terminal feet. A terminal foot is a foot whose right boundary coincides with the right edge of a word; crucially it is not however the only foot in the word (I refer to this as a solitary foot). This gets us the effect of final foot extrametricality: an adjoined foot is present in the segmental sense, but crucially absent in the rhythmic sense. In other words, an adjoined foot is a headless foot.

Weak Parsing of a Terminal Foot

(36)	/zalamatak/	Rhythm	Strict-Parse
p	…]$_{p}$ (matak)]$_{p'}$		*
	… (matak)]$_{p}$	*!	

Let us now take a closer look at the structure of a final CVC sequence, in say **gaháwah**. I assume that the final consonant /h/ is adjoined to the syllable, without any intervening mora, as shown below.

(37) Weightless Consonant

… { { w a }$_{\sigma}$ h }$_{\sigma'}$

I assume further that no mora is possible in this configuration and that codaic (positional) moras are only licensed in a particular context, say, within a syllable. This is not to say that a mora may not be adjoined to the syllable. In a case of final vowel shortening such as **taHatá:ni<:>**, I assume the representation given in (38).

(38) Weightless Mora

… { {n i }$_{\sigma}$ μ }$_{\sigma'}$

In this case, both moras are lexical. The second mora, by virtue of being adjoined to the syllable, makes no contribution to the weight of the syllable. The reason for not simply deleting the mora, i.e. satisfying **Strict-Parse** but violating **Parse** instead as in (39), is that such deweighting effects are apparently restricted to the edges of words. The fact that adjunction is restricted to word-edges accounts then for this asymmetry. Deletion on the other hand does not distinguish between internal and edge contexts.

(39) Unparsed Mora
… { n i }$_{\sigma}$ μ

This is true of Negev Bedouin Arabic and as we shall see, Axininca Campa as well. In a word like [xalláyna] for example there is no evidence that the initial syllable is light even though a light syllable would give a more rhythmic output.

Word-internal demotion, with no access to adjunction, would have to resort instead to violations of **Parse**. Assuming that **Rhythm** dominates **Strict-Parse** but not **Parse** provides an explanation to internal/edge asymmetric behavior. Ranking **Parse** over **Rhythm** forces the representation in (38).

Another thing about final shortening: the reason the final long vowel does not remain long has to do not only with **Rhythm**, but also with **Weight-to-Stress**. In principle, there is a candidate form in which both moras are part of the syllable itself and yet the syllable is unstressed. Although **Rhythm** is satisfied without adjunction, the highly ranked **Weight-to-Stress** is violated, and therefore the parse cannot be optimal.

Weak Parsing of a Final Mora

(40)	/taHata:ni:/	WSP	Rhythm	Strict-Parse
p	… {ni}$_{\sigma}$: }$_{\sigma'}$			*
	… {ní:}$_{\sigma}$		*!	
	… {ni:}$_{\sigma}$	*!		

This point, that final shortening is inextricably tied to final stresslessness by **Weight-to-Stress**, will be elaborated upon in the discussion of Axininca Campa.

Adjunction is also a way of getting around the constraints on syllable size. In Negev Bedouin Arabic, the so-called superheavy syllables, i.e. syllables of the shape CVVC and CVCC, exist word-finally only. Elsewhere, syllables are maximally bimoraic. It seems plausible to say that **Bimoraicity** also dominates **Strict-Parse**, the result being the adjunction of final consonants.

(41)	/… CVCC/	Bi-μ	Strict-Parse
p	… $\{CVC\}_{\sigma}$ C$\}_{\sigma'}$		*
	… $\{CVCC\}_{\sigma}$	*!	

McCarthy and Prince (1990b:15) relate the appearance of these extrasyllabic consonants to the possibility of having incomplete syllables at the periphery of words. These syllables are assumed to consist solely of a moraic consonant (a coda) or a non-moraic consonant (an onset). The restriction of these incomplete syllables to the edges of domains is accomplished by their Contiguity Constraint, which states that syllabic well-formedness is enforced only over contiguous strings of subsyllabic domains. This constraint, assumed to be universal, is roughly analogous to the analysis here, where adjunction does the work of restricting such effects to the edges of domains.

2.1.4.3 In this section it was argued that the traditional terms extrametrical, extraprosodic, and extrasyllabic simply refer to elements that are weakly parsed. Like empty nodes, adjunction is provided by GEN but must be constrained. As a result adjunction occurs only under duress. In the cases discussed here the pressure can come from either rhythmic requirements or constraints on syllable structure: the domination of **Rhythm** or **Bimoraicity** over **Strict-Parse** leads to situations where adjunction is in fact optimal. Moreover the ranking of

Parse over **Strict-Parse** ensures that deletion does not occur. Since adjunction is not available beyond the edges of words, no demotion effects are observed word-internally in this language.

2.1.5 The Finality of Stress

In this section I present those cases where final stresslessness is ignored, i.e. where stress is indeed final. There are two such cases, words which coincide exactly with a single foot (I refer to these as solitary feet), and words ending in a superheavy syllable. This being an iambic language, possible solitary feet include LL, LH and H.[15]

(42)	LL	LH	H
	biná 'he built'	jimál 'camel'	xúbz 'bread'

As in Latin, monosyllables exist, and they are stressed. This, as explained above, is due to the dominance of **Minimality** over **Nonfinality**.

Final superheavies are also stressed, no matter what. As we will see in the following section this has to do largely with the importance of the faithfulness constraints.

(43) Ganamá:t '(several individual) sheep'

The question before us now is not how do we derive these facts but how do we show that they are optimal.

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15 All monosyllabic words contain superheavy syllables. There are no CVX words. In McCarthy and Prince (1990a:253) the explanation is that final consonants must be extrametrical and therefore cannot provide the mora necessary for minimality requirements. In contrast, the view here is that a consonant is only weakly parsed under some dominating constraint. So what is the constraint that chooses CVXC over CVX? The only suggestion I have is that there may be a Word-Binarity effect here, similar to the one discussed in Ito and Mester (1992) which accounts for why Japanese word-clippings are typically "1 and 1/2 feet". Perhaps Word-Binarity forces a different analysis of **solitary** superheavies such that they are in fact disyllabic.

2.1.6 The Recession of Rhythm

Having established those constraints which are dominated by **Rhythm**, we now examine the constraints which themselves dominate **Rhythm**. These are the constraints that potentially force a violation of **Rhythm**, given the appropriate context.

In the case of solitary feet, minimality plays a crucial role. A more precise definition of minimality according to McCarthy and Prince (1986 **et seq**) is as follows: to be well-formed, a lexical word must contain a prosodic word, which in turn, given Proper Headedness, must contain a foot. The foot itself, being subject to requirements of binarity, forces the lexical word to contain at least two moras if the system is quantity-sensitive, or two syllables if the system is quantity-insensitive. Thus minimality is made up of two parts: **Lx=Pr**, and **FtBin**. For simplicity I will refer to the minimality constraint as **Lx=Pr**.

(44) **Lx=Pr:**

A lexical word must contain a well-formed prosodic word.

The superordinacy of this constraint means that every lexical word must be assigned some sort of metrical structure; as a result, it is not possible to use the adjunction strategy available to terminal feet. Clearly, a solitary foot cannot be adjoined because it has nothing to adjoin to. Nor can it be adjoined to an empty prosodic word. Consider the following representations, which are clearly ill-formed with respect to the constraints outlined directly above.

(45) a. $[\ (o\ o)_F\ ]_{PrWd'}$

b. $[\ [\ \ ]_{PrWd}\ (o\ o)_F\ ]_{PrWd'}$

So while **Rhythm** may indeed dominate **Strict-Parse** in the grammar of Negev Bedouin Arabic, a higher ranking **Lx=Pr** bars the possibility of adjunction in the cases of solitary feet.

There are still other conceivable ways of avoiding final stress. In fact, two of the three candidates that will be shown to be suboptimal here actually emerge as optimal in other languages. One candidate to consider avoids final stress but contains a non-binary foot, as shown in (46). That this does not surface means that **FtBin** is ranked higher than **Rhythm**. Actually it is unlikely that this can ever be the optimal output.

(46)	/bina/	FtBin	Rhythm
p	(biná)		*
	(bí)na	*!	

A second candidate worthy of consideration is one which is overparsed, as shown in (47). An additional mora is provided to sustain an iambic foot and satisfy **Rhythm**. As we will see in Section 2.2 of this chapter this is precisely what we get in Hixkaryana. In Negev Bedouin Arabic however, this is not what we get, indicating that **Fill** too is ranked higher than **Rhythm**.

(47)	/bina/	Fill	Rhythm
p	(biná)		*
	(bí:)na	*!	

The third possibility is to parse the solitary foot in a trochaic fashion in order to satisfy **Rhythm**. As we will see in Chapter 3, this is observed in languages such as Axininca Campa, Hopi, and Choctaw, among others. Here however it is clear that iambic parsing is optimal and that **FtForm** is also ranked above **Rhythm**.

(48)	/bina/	FtForm	Rhythm
p	(biná)		*
	(bína)	*!	

That final superheavies are always stressed, despite **Rhythm**, tells us that there are other constraints which dominate **Rhythm**. As shown earlier, the superheavy syllable involves the adjunction of the final consonant so that **Bimoraicity** is met. We already know that **Fill** dominates **Rhythm** (47) so it comes as no surprise that epenthesis does not occur, even though this would render the stressed syllable non-final.

(49)	/Ganama:t/	Fill	Rhythm
p	(Gana)(ma:t)		*
	(Gana)(ma:)tΔ	*!	

Clearly **Parse** must also dominate **Rhythm**; otherwise, we might expect to find deletion of final consonants, as shown in (50).

(50)	/balHayl/	Parse	Rhythm
p	(bal)(Háyl)		*
	(bál)Ha<y><l>	**!	

And finally it must be that **Weight-to-Stress** dominates **Rhythm**, otherwise we would get cases of unstressed superheavies.

(51)	/balHayl/	WSP	Rhythm
p	(bal)(Háyl)		*
	(bál)Hayl	*!	

The analysis presented here treats final superheavies not as sequences of heavy plus light or degenerate syllables (Aoun 1979, Selkirk 1981), but as single heavy syllables with an adjoined consonant. This is not unlike McCarthy's (1979) analysis of Cairene or Hayes' view that the final consonant is unsyllabified until after the stress rules apply.

There is another important difference between this analysis and the standard approach. Under my analysis, stress is final; adjunction of the final consonant is due to pressure from **Bimoraicity** and faithfulness. On the other hand, the role of the final consonant is far more defined under the standard approach, where its presence crucially protects the rightmost heavy syllable from being final and hence from being made extrametrical. Under the standard approach, demotion is impossible because of non-peripherality; here demotion is impossible because of faithfulness.

2.1.7 Summary and Conclusions

The stress facts of Negev Bedouin Arabic have led me to postulate the following Hasse diagram as a partial representation of the grammar of the language. There are six constraints which dominate **Rhythm**; these are shown on the top line. The number below each one corresponds to the tableau in which the ranking of that constraint above **Rhythm** was established. There is one constraint which is dominated by **Rhythm**; this is shown on the bottom line. The numbers above it correspond to the tableaus in which the ranking of that constraint below **Rhythm** was established.

(52) A Partial Grammar for Negev Bedouin Arabic

```
FtBin     Fill        FtForm     Lx=Pr     Parse     WSP
(46)\     \(47,49)    |(48)      /         /(50)     /(51)
                      |
                      Rhythm
                      | (34,36)
                      Strict-Parse
```

We see then that the only way to avoid final stress is to posit an adjunction structure. Final stresslessness cannot be achieved by positing degenerate feet, empty nodes, trochaic footing, subminimal words, deletion or ignoring weight-to-stress.

Assuming a constraint of the **Edgemost**-type, defined in terms of the right edge of the word, the stress patterns described at the beginning of this section can be reinterpreted in terms of the constraint hierarchy shown above.

(a) **Stress a superheavy -** A superheavy syllable cannot be demoted given the ranking of **Parse** and **Fill** over **Rhythm**. Nor can it be unstressed given the **WSP**. Moreover it is the rightmost head.

(b) **Stress a heavy penult -** A heavy penult poses no conflict. By the **WSP** it must be the head of a foot, and it satisfies both **Edgemost** and **Rhythm**.

(c) **Stress a heavy antepenult -** The implication here is that the last two syllables are light. These two can form a binary foot, but **Rhythm** forces a violation of **Strict-Parse**, resulting in a headless foot. The rightmost head is therefore the heavy antepenult.

(d) **If the word is disyllabic, the first of which is light, stress the final -** The two syllables must form a binary, right-headed foot, regardless of **Rhythm**.

(e) **If the final three syllables are light, stress the antepenult or the penult, whichever is separated by an odd number of light syllables from the rightmost heavy syllable, or in the absence of such a syllable, from the left edge of the word -** The parse takes place from left to right, since this will always be rhythmically optimal. Heavy syllables force counting to begin anew, due to demands of **Iambic FtForm** and the **WSP**. If there is no terminal foot, i.e. parsing is not exhaustive, the rightmost head will be the penult, and all is well. If there is a terminal foot, it must be adjoined under rhythmic pressure, and hence the rightmost head is the antepenult.

2.2 Hixkaryana

Hixkaryana is a Carib language spoken in Brazil and described in Derbyshire (1979, 1985). It is of interest here because of the fundamental similarities it shares with Negev Bedouin Arabic with respect to final stresslessness. Most notably, the system is such that while it may be optimal to have weak parsing under rhythmic duress, it can never be optimal to have a trochaic parse.

2.2.1 The Basic Patterns of Alternation

The prominential facts described in Derbyshire (1979:184, 1985) received their first metrical interpretation in Hayes (1991:169-172). What is interesting about Hixkaryana is its pattern of alternating short and long vowels. The facts are as follows: in a string of CV syllables, vowels in even-numbered (counting from the left), non-final syllables are lengthened. (An underlined /i/ is a barred /i/.)

(1)	/torono/	to	ro:	no			‘small bird’
		1	2	3			
	/atxowowo/	a	txo:	wo	wo		‘wind’
		1	2	3	4		
	/akmatari̲/	ak	ma	ta:	ri̲		‘branch’
			1	2	3		
	/tohkurihona/	toh	ku	ri:	ho	na	‘to Tohkurye’
			1	2	3	4	

That lengthening is derived and not underlying is confirmed by the fact that a morpheme such as **hona** ‘to’ gives rise to different surface realizations depending on where it appears in the larger morphological domain.

(2) /owto hona/ ‘to the village’

ow to ho: na

/tohkurye hona haxaha/ ‘finally to Tohkurye’

toh ku ri: ho na: ha xa: ha

/tohkurye hona/ ‘to Tohkurye’

toh ku ri: ho na

A particularly interesting thing is what happens to words which are made up of two light syllables: according to Derbyshire, the initial vowel of these words is lengthened.

(3)	/kana/	ka:na	‘fish’
	/kwaya/	kwa:ya	‘red and green macaw’

/tuna/	tu:na	‘water’

As Hayes points out, Hixkaryana does not have a length contrast in its vowel inventory. However it is clear that it is a quantity-sensitive language: the data in (1) and (2) demonstrate that CVC syllables must be heavy since they interrupt the left to right parity count. Moreover, the vowels of CVC syllables themselves never lengthen.

(4)	/baSme/	baSme	‘silver-beaked tanager’
	/arko/	arko	‘take it’
	/fotwo/	fotwo	‘species of banana’

A further point worth noting regards the distribution of syllable types: in final position, neither CVV nor CVC is observed on the surface.

2.2.2 Iambicity

Hayes (1991) interprets the patterns of alternation as indicative of the presence of metrical structure, or more specifically, of iambic foot structure. The left to right, even-numbered strong, with heavy syllables forcing counting to begin anew, is typical of iambic systems in general. Moreover, lengthening of stressed vowels in light syllables is characteristic of iambicity, in that it creates canonical LH iambs.[16] Recall Hayes' (1985) paper on the iambic-trochaic law, where he observes that iambic rhythm typically involves a durational contrast while trochaic rhythm involves an intensity contrast. As we will see in the following chapter, Choctaw also exhibits this iambic lengthening effect.

There are two issues that must be addressed in this section. The first involves being able to correctly predict the location of metrical heads within a word. The second calls for a concrete account of the lengthening phenomenon.

16 But see Kager (1993) for a very different view of iambic lengthening where moraic iambs expand into rhythmically well-formed surface feet, taking into account (a) the mora prominence contour in long vowels, and (b) the anti-lapse filter.

2.2.2.1 An analysis which assumes the basic constraints of foot structure, described in the previous section and repeated below, makes the correct predictions regarding the location of metrical heads.

(5) **Foot-Binarity**:
Feet are binary at some level of analysis.

(6) **Foot-Form**:
If there is a head, it is on the right.

(7) **Weight-to-Stress**:
A heavy syllable is stressed.

The perfect alternation observed in strings of light syllables is accounted for by **Foot-Binarity**: feet are made up of two syllables, one unstressed, one stressed. That the stressed syllable is always the even-numbered syllable follows from **Foot-Form**: iambic feet are right-headed. The **WSP** accounts for the departure from perfect alternation that heavy syllables bring. An initial heavy syllable must be a head, it cannot be footed with a following light syllable, so it is parsed as its own foot, where binarity is met at the level of the mora. As explained in the previous section, left to right directionality may be viewed as a consequence of **Nonfinality**, and need not be independently stipulated. The effect is that loose syllables are always final. Thus in each of the following examples, each and every one of the three constraints listed above is met (including **Nonfinality**), so there is no doubt that these parses are optimal.

(8) (to ró) no
(ák) (ma tá) ri
(báS) ma

(9) /naknyohyatxkenano/ 'they were burning it'
(nák) (nyóh) (yátx) (ke ná) no

(10) /nemokotono/ 'it fell'

(ne mó) (ko tó) no

2.2.2.2 Having located the metrical heads, we now have to address the phenomenon of lengthening. The problem of the behavior of the final syllable will be addressed in the following section.

In purely prosodic terms, lengthening involves the addition of a mora. For Hayes, lengthening may be stated as a segmental rule which reinforces the durational contrast which is fundamental to the nature of iambic rhythm. The rule inserts a mora in the context of an iambic foot, as shown below.

(11) Iambic Lengthening (Hayes 1991:170)

```
                      (σ   σ́)
                       |   | \
ø    →    μ    /       μ   μ ___
```

The structural change of this rewrite rule inserts a mora, while the context of this rule restates the notion that iambic rhythm involves a durational contrast.

From an OT point of view however, insertion need not be tied to iambic rhythm.[17] Rather, mora "insertion" is a possibility provided by GEN and constrained by the faithfulness constraint **Fill**.

---

[17] Crowhurst (1992:58) states the iambic lengthening rule as an operation on the metrical head, and expresses lengthening as mora insertion followed by the spread of vowel features. Her rule is given below. Unlike Hayes, the requirement for her rule is there be a monomoraic head; any link to iambicity is not made explicit.

```
H          H
|          |\
μ    →     μ μ
|          |/
σ          σ
```

(12) **Fill**:

No empty nodes.

Generally speaking the optimal form is the form which satisfies **Fill**, i.e. which contains no empty prosodic nodes. However, if the conditions are right, a **Fill** violation may be forced, giving the effect of augmentation, epenthesis, or lengthening. Some examples are given below.

Augmentation in Kameyama Japanese

(13)	/ka/ 'mosquito'	MinWd	Fill
p	kaΔ		*
	ka	*!	

Epenthesis in Ponapean

(14)	/kitik-men/ 'rat'	No-Coda	Fill
p	.ki.ti.kΔ.men.		*
	.ki.tik.men.	*!	

The durational character of iambic rhythm on the other hand is a separate issue with a separate niche in the grammar. Its effects are observed in cases where it dominates another constraint, such as **Fill**. So what motivates lengthening in Hixkaryana? It is important to note that the converse of the **WSP** does not hold true: so while it is the case that heavy syllables are stressed, it is certainly not the case that stressed syllables must be heavy. To explain the **Fill** violations observed in Hixkaryana, I call upon Prince's (1990) account of iambic lengthening, which is based upon the notion that in an iambic system a LH foot is preferred over a LL foot. The idea is that the two differ with respect to a fundamental requirement of iambic quantity, namely, that in a rhythmic unit (W S), |S| > |W|, preferably (Prince 1990:359).

(15) **Iambic Quantity**:

In a rhythmic unit (W S), S is heavy.

Note that this constraint is contigent upon iambic footing, i.e. upon the satisfaction of (Iambic) **Foot-Form**. Moreover its effects can only be observed if it dominates some faithfulness constraint, in this case, **Fill**.[18]

Iambic Lengthening in Hixkaryana

(16)	/torono/	IQ	Fill
p	(to ro:) no		*
	(to ro) no	*!	

Given a LL foot, it is clear that **IQ** and **Fill** cannot be simultaneously satisfied. That the optimal form contains an empty prosodic node establishes the ranking of **IQ** over **Fill**. Thus iambicity is tied to lengthening only in so far as the two constraints interact.

In summary, there are four constraints which govern the size and the shape of the foot in Hixkaryana. The only crucial ranking established thus far is that of **IQ** over **Fill**, which accounts for the observed lengthening effects. Up till this point no surface violations of **FtBin**, **FtForm**, **WSP**, or **IQ** have been observed. In other words, there has been no evidence so far for degenerate feet, trochaic feet, heavy syllables in weak position, or LL right-headed feet.

(17) **FtBin** **FtForm** **WSP** **IQ**

| (16)

Fill

18 Domination of **IQ** over **Parse**, would give the following situation: /CV CV CV .../ → [.CV.CVC. <V> …].

2.2.3 Nonfinality Effects

The phrase which appears in Derbyshire's description "except where the syllable is word-final (p.184)" is the first clue that final stresslessness is at work in this language. The fact is that final syllables are always light. First of all, in an odd-numbered string of light syllables, the final syllable is always loose. In other words, an effect of having left to right directionality is that in such strings, the final syllable can never be the head. As mentioned before, McCarthy and Prince (1993a) were the first to relate directionality to nonfinality.

(18) (to ró) no
     (ak) (ma tá) r<u>i</u>
     (baS) me
     (ow) (to hó) na

Secondly, in an even-numbered string of light syllables, the vowel of the final syllable remains short, even though by parity, it is expected to lengthen. This particular problem is addressed by both Hayes and Crowhurst, as we shall see.

(19)	atxo:wowo	*atxo:wowo:
	tohkuri:ho na	*tohkuri:hona:

The same is true of words made up of two light syllables: not only does the second syllable not lengthen, but the first one does! This problem was also first brought to light by Hayes.

(20)	/kana/	ka:na	*kana:	*kana
	/tuna/	tu:na	*tuna:	*tuna

And finally, there are no words ending in CVC, even though there are plenty of CVC syllables word-internally. This too, I think, should be looked at as a nonfinality effect, since CVC is indeed heavy in this language.

(21) baS.me *me.baS
fot.wo *wo.fot

2.2.4 The Dominance of Rhythm

The analysis that will be proposed here to account for the nonfinality effects described above is essentially that **Nonfinality**, or more specifically **Rhythm**, is unviolated in this language. Specific nonfinality effects are attributed to the dominance of **Rhythm** over individual constraints. Only the directionality effect noted above is independent of ranking. As was shown in 2.1.3.3 of this chapter, left to right directionality follows from minimal violation of **Rhythm**.

The remainder of this section is divided into three parts to deal with the data in (19), (20) and (21) respectively.

2.2.4.1 The first question that must be addressed is, what happens when there is an even-numbered string of light syllables at the end of the word? The standard view, expressed by Hayes (1991) and Crowhurst (1992) is that the inertia or the non-participation of the final syllable is due to its extrametrical status.[19] The final syllable is rendered extrametrical by virtue of a rule such as the one given in (22).

(22) Extrametricality

$\sigma \rightarrow \langle\sigma\rangle$ / __ $]_{PhonWd}$

This rule prevents final syllables from receiving metrical prominence, and hence from being lengthened.

Inertia under OT however is viewed as satisfying general rhythmic demands on patterns of stress.

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19 For Kiparsky (1992:17) this is an instance of quantitative neutralization. A catalectic final mora, by making the final vowel long, renders it ineligible for iambic lengthening.

(23) **Rhythm**:
x
x x

Both the rule-based approach and the OT-based approach ensure that a final syllable is not a metrical head. The real difference between the two has to do with the status attributed to the penultimate syllable. Consider the following word, which contains a terminal sequence of four light syllables /…kurihona/. The vowel of the second light syllable is the only one that is lengthened.

(24) /tohkurihona/ tohkuri:hona

Hayes notes the absence of monosyllabic content words in the language and takes it to mean that degenerate feet are therefore disallowed. As a result, forms such as (24) will end in two loose, i.e. unfooted, syllables: the final one is extrametrical, and the penult has "insufficient bulk on its own to form a foot."

(25) (toh) (ku ri) ho <na>

Crowhurst takes a similar view, emphasizing the fact that the penultimate syllable is not itself lengthened. She attributes this to the (parameterized) fact that although in this language subminimal heads may be augmented (hence lengthening), subminimal feet cannot be. Subminimal feet are subsequently defooted, leaving two unfooted syllables at the end of the word.

Under the theory of weak parsing presented here, there is an alternative structure to consider. Instead of two weakly parsed syllables, shown in (26b), one can posit a single weakly parsed foot, as shown in (26a). Weak parsing is local and not inherited, a point that is made in McCarthy (1993b) as well.

(26) a. $[\ [\ (o\ o)_F\ ]_{PrWd}\ (o\ o)_{F*}\ ]_{PrWd'}$

b. $[\ (o\ o)_F\ o*\ o*\ ]_{PrWd}$

The structure in (26a) contains a single violation of **Strict-Parse**: the only improperly mothered node is F*. In contrast, the structure in (26b) contains two improperly mothered nodes, o* and o*. Since violation is always minimal, I will take (26a) as the correct representation of a terminal string of light syllables. More specifically, this is a case in which the terminal foot is adjoined to the Prosodic Word; as in Negev Bedouin Arabic, an adjoined structure may be optimal under rhythmic duress.

(28)	/o o o o/	Rhythm	Strict-Parse
p	[[(o ó)]$_P$ (o o)]$_{P'}$		*
	[(o ó) (o ó)]$_P$	*!	

Crucially, the adjoined foot is a headless foot. Recall that an adjoined structure is considered present for the purposes of the segmental phonology, but absent for the purposes of quantity and rhythm. A headless foot then vacuously satisfies **Foot-Form**, which says that if there is a head, it is on the right. Similarly a headless foot satisfies **Iambic Quantity** as well, since this constraint is a constraint on right-headed feet. Note that violating **IQ** does not entail satisfaction of **Rhythm**, since the head is still metrically strong. The following tableau compares an adjoined foot to an iambic foot whose head is not lengthened.

(29)	/… o o #/	FtForm	Rhythm	IQ
p	…]$_P$ (o o)]$_{P'}$			
	… (o ó)]$_P$		*!	*

Thus the only constraint violated by the structure containing an adjoined foot is **Strict-Parse**, but this is necessary under the domination of **Rhythm**, as shown in (28).

In this section a terminal sequence of two light syllable is analysed as an adjoined foot, rather than as a sequence of two unfooted syllables. In this respect, Hixkaryana is no different from Negev Bedouin Arabic in its treatment of so-called terminal feet. In both languages, this follows from the ranking of **Rhythm** over **Strict-Parse**.

(30) **Rhythm**
| (28)
Strict-Parse

2.2.4.2 The realization of an underlying sequence of exactly two light syllables however is quite different in the two languages. Recall that in Negev Bedouin Arabic, LL words surfaced with final stress, as in **biná**. In Hixkaryana on the other hand, the initial syllable undergoes lengthening, indicating that it must be the metrical head.

(31) /tuna/ tu:na 'water'

As with Negev Bedouin Arabic, the adjunction option available to terminal feet is simply not available to solitary feet, given the demands of **Lx-Pr**, or minimal word constraints.

While it is clear that the initial syllable containing a long vowel must be the metrical head of the word, it would be a mistake to say that it is lengthened because it is the metrical head. A rule-based approach essentially does this, but this might lead one to propose that there is such a thing as trochaic lengthening, that LL is parsed as a trochee, and that the lengthening rule applies to the metrical head to give an HL trochee. There has been a lot of evidence that this is undesirable, and that the trochee is in fact an even constituent (Hayes 1985, 1987, Prince 1990, Mester 1994).

A rule-based approach also allows one to take the view that augmentation is of a degenerate foot, which is Hayes' view. In accordance with the rest of the grammar a final syllable is extrametrical, leaving too little material to sustain a foot. As Hayes reasons, the impossibility of degenerate feet combined with the need to have metrical structure leads to augmentation under the form of lengthening.

(32) tu <na>
(tu:) na

My analysis is very much a formalization of Hayes' intuition. According to Hayes, disyllabic words whose first syllable is light give rise to a situation which he calls the **Unstressable Word Syndrome** since there are three principles in conflict, namely foot well-formedness, extrametricality and culminativity. Optimality Theory provides just the right machinery to formally capture these intuitions. Under OT, the form **tu:na** must be the optimal candidate since this is what is observed. From this point of view, we can evaluate its strengths and weaknesses. On the plus side, **Rhythm** and **Foot-Form** are met, since we have a perfectly well-formed iambic foot in non-final position. **Iambic Quantity** is also vacuously met. The only minuses are an empty mora, in violation of **Fill**, and a loose syllable, in violation of **Strict-Parse**.

(33)
```
             PrWd
          /            \
         F              |
         σ              σ
         μ    μ         μ
    t    u         n    a
```

As Hayes rightly noted, words of the shape /L σ/ give rise to a constraint conflict: there is no single candidate which can satisfy (Iambic) **Foot-Form**, **Rhythm** and **Fill** at the same time. Taking minimal violation into consideration, three candidate forms are worth entertaining, each one violating exactly one of the three constraints. The first is of course the one which violates **Fill**, but not **Rhythm** or **Foot-Form**. This augmented parse is the actual output. The second violates **Rhythm**, but satisfies **Foot-Form** and **Fill**. That the iambic (unaugmented) parse does not surface in Hixkaryana means that **Rhythm** must dominate **Fill**. Note however that the imabic parse is what we get in Negev Bedouin Arabic.

(34)	/tuna/	Rhythm	Fill
p	(tu:) na		*
	(tu ná)	*!	

The third candidate violates **Foot-Form**, but satisfies **Rhythm** and **Fill**. That this form does not surface means that **Foot-Form** must dominate **Fill** as well. However, as we will see, the trochaic parse is in fact the optimal parse in Axininca Campa.

(35)	/tuna/	FtForm	Fill
p	(tu:) na		*
	(tú na)	*!	

And since it has been established that **Rhythm** dominates **Strict-Parse** (30) it comes as no surprise that the actual output should contain a loose syllable.

Under the analysis presented here, initial lengthening is viewed as an augmentation effect, necessary for the satisfaction of higher ranking constraints such as **Foot-Form** and **Rhythm**.[20] Just as Hayes noted, this is distinct from Iambic Lengthening (16).

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20 Michael Kenstowicz tells me that according to Andrew Spencer, Altujor exhibits a similar effect. In this language which is related to Chukchee, /C∂CVC/ becomes C∂C<u>V</u>C∂ (the underlined V is stressed). Apparently, **Nonfinality** is met at the cost of **Fill**.

Initial Lengthening in Hixkaryana

(36)	/tuna/	Rhythm	FtForm	Fill
p	(tu:) na			*
	(tú na)		*!	
	(tu ná)	*!		

Notice that in Hixkaryana, neither **Rhythm** nor **Foot-Form** is ever violated on the surface. In other words there are no cases of trochaic parsing, nor of final stress. This is confirmed by the fact that the smallest word in the language is of the shape HL.

In this section, it was established that in addition to **IQ**, **Rhythm** and **FtForm** also dominate **Fill**. This gives the two types of lengthening in Hixkaryana: iambic lengthening and initial lengthening.

(37) **Rhythm** **FtForm**
(34) \ / (35)
Fill

2.2.4.3 The absence of CVC syllables word-finally in output forms is quite remarkable given that they occur word-internally, and therefore merits some discussion. The question regarding the nature of the input is a more difficult one and looks to be an instance of what Prince and Smolensky (1993:51) call Stampean occultation in the sense that the possible input /…CVC/ is hidden and therefore inaccessible.

However it cannot be denied that the absence of word-final CVC sequences on the surface underscores the importance of final stresslessness and of strict parsing in this language. This suggests that some faithfulness constraint must be dominated by **Rhythm** as well as by **Strict-Parse**, and that given an input ending in a consonant, one would expect a violation of faithfulness to result under duress.

The perfect external source of evidence would be found in borrowings; unfortunately all loanwords referred to in Derbyshire are from Portuguese and all already end in vowels (such as **soldado**, 'soldier'). However all is not lost as we can look to the partial grammar that has been determined for Hixkaryana. Since it has already been established that **Rhythm** dominates **Fill** (34), one would expect that a source word ending in a consonant would surface with an epenthetic vowel. That consonant adjunction is not available to get around final stresslessness tells us that **Strict-Parse** also dominates **Fill**.

Parsing a stem-final consonant

(38)	/… CVC/	Rhythm	Strict-Parse	Fill
p	$\{CV\}_\sigma$ $\{C\Delta\}_\sigma$			*
	$\{\{CV\}_\sigma$ $C\}_{\sigma'}$		*!	
	$\{CVC\}_\sigma$	*!		

2.2.5 Summary and Conclusions

In Hixkaryana, three constraints, **Rhythm**, **FtForm**, and **IQ** are undominated. **Strict-Parse** and **Fill** are the dominated constraints, as shown in the Hasse diagram below, where vertical lines indicate dominance relations.

```
(39)  Rhythm     FtForm      IQ
           \         |         /
              Strict-Parse
                     | (38)
                   Fill
```

The major observable effects of such a grammar are (i) final stresslessness is always met, as is iambicity, and (ii) nonfinality effects take the form of weak parsing and overparsing.

All things being equal, an overparsed structure is chosen over an adjoined structure, so that given a /…CVC/ input, we get an epenthetic vowel and not an adjoined consonant. Note however that in the case of the terminal foot, we get adjunction, and not an epenthetic loose syllable.

(40)	/… o o/	Rhythm	Strict-Parse	Fill
	…]$_P$ (o o)]$_{P'}$		*	
*p	… (o ó) Δ]$_P$			*

What this means is that the definition of **Fill** here should be strictly limited to empty moras or nuclei.

(41) **Fill** (Revised Statement):
No empty moras.

To complete this section on Hixkaryana, I return to the stress patterns described at the outset and provide a reinterpretation of each one under the rankings established here.

(a) **In a string of CV syllables, vowels in even-numbered, non-final syllables are lengthened –** Iambic lengthening is a result of ranking of **Iambic Quantity** over **Fill**. Lengthening, or overparsing, may be optimal given the demands of the more highly ranked constraint which demands that iambic feet be durationally uneven. The additional fact that only vowels in non-final syllables are lengthened is attributed to the ranking of **Rhythm** over **Strict-Parse**. This means that it is optimal for terminal feet to be adjoined, i.e. headless, since they would otherwise incur final stress.

(b) **In words made up of two light syllables, the vowel of the initial syllable is lengthened –** Initial lengthening is a result of ranking

Rhythm and **FtForm** over **Fill**. Here lengthening occurs given the demands of final stresslessness and iambicity. The augmented parse is the optimal form since it is both rhythmically and iambically well-formed.

2.3 Cayuga

The following discussion of Cayuga, a Northern Iroquoian language, is modeled closely after the analysis given in Kager (1993:422-425), which is in turn based upon work done by Foster (1982), Michelson (1988) and Benger (1984).[21] The analysis presented here, although extremely sketchy, suggests that Cayuga is like Negev Bedouin Arabic and Hixkaryana in that terminal feet are weakly parsed and solitary feet are iambically parsed.[22]

The data paradigm given in Kager is repeated below. Underlined vowels indicate nasalization.

(1)	a.	/hoyane?/	hoyá:ne?	‘chief’
	b.	/e̲he̲natowat/	e̲hè̲nató:wat	‘they will hunt’
	c.	/teyakotkwe̲h/	teyákotkwe̲h	‘she's dancing’
	d.	/tewakatawe̲nye?/	tewàkatáwe̲nye?	‘I'm moving about’
	e.	/akekaha?/	akékaha?	‘my eye’
	f.	/akye̲tho?/	akyé̲:tho?	‘I planted it’
	g.	/te̲katawe̲nye?/	te̲kàtawé̲:nye?	‘I'll move about’
	h.	/e̲katato̲kw?eto̲nye̲?/	e̲kàtatò̲kw?etó̲:nye̲?	
			‘I'll make some people for myself’	
	i.	/he̲natowas/	he̲nà:tó:was	‘they're hunting’
	j.	/akekho̲ni?/	akè:khó̲:ni?	‘I cooked a meal’

There are essentially three lengthening rules in operation here.

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21 The other members of this language group are Tuscarora, Mohawk, Oneida, Onondaga (Chafe 1970, 1973) and Seneca (Chafe 1967, Stowell 1979). Prince (1983:82-87) also provides some discussion on these languages.

22 Many thanks to Carrie Dyck for helping me out on the facts over electronic mail. I assume all responsibility for any errors or overeager interpretations.

(i) The first is **Open Penult Lengthening** (OPL) which says that an open penult is long and has main stress. This is a remnant of the Proto-Northern-Iroquoian accent rule, and following Foster and Michelson I assume that it applies before the left to right iambic stress rule. This applies in the data in (a,b,i,j).

(ii) The second is **Penult Main Stress Lengthening** (PMSL) which applies to words with closed penults. Main stress appears on the rightmost, non-final, even-numbered syllable (c,d,f,g,h), which is lengthened if it is penultimate (f,g,h).

(iii) And third, **Pre-Tonic Lengthening** (PTL) applies to the rightmost vowel bearing secondary stress, if this vowel directly precedes the main stress. Secondary stresses are on even numbered syllables going from left to right. This can be seen in (i,j).

Consider first the set of words containing an open penult. Assuming that the OPL has already applied, the iambic stress rule applies in the following manner. Main stress falls on the rightmost foot-head, which is underlined.

(2)	a.	(ho	yaa)	ne?						yáa
	b.	(e	he)	(na	too)	wat				tóo
	i.	(he	na)	(too)	was					tóo
	j.	(a	kek)	(hoo)	ni?					hóo

Consider next the set of words with closed penults which have even parity. The PMSL rule applies to the rightmost foot-head, which is underlined in the data below.

(3)	f.	(ak	yet)	ho?						yé:t
	g.	(te	ka)	(ta	wen)	ye?				wé:n
	h.	(e	ka)	(ta	tok)	(w?e	ton)	ye?		tó:n

And finally consider the set of words with closed penults which have odd parity. The PMS part of the PMSL rule applies to the rightmost non-final foot-head, giving antepenultimate stress.

(4)	c.	(te	ya)	(kot	kweh)			yá
	d.	(te	wa)	(ka	ta)	(weh	nye?)	tá

The data show that when there is a loose syllable, the rightmost foot receives main stress, as in (2) and (3). When there is a terminal foot however, as in (4), it appears that this foot is headless.

The next step is to look at the stress patterns on disyllables. Are they trochaic or iambic? It seems like most words which are disyllabic have an initial long vowel, as the following examples from Dyck (1993) indicate.

(5)	a.	thó:hah	'almost'
	b.	ó:neh	'now'

Moreover, Carrie Dyck (p.c.) citing Mithun and Henry (1982) gives a form in which there is a prothetic vowel which is lengthened.

(6)	/s-h-e?/	í:she?	'he is going back'

Cases like these look a lot like the initial lengthening cases of Hixkaryana, where a **Fill** violation was necessary for the sake of **Rhythm** and **FtForm**. There are however other complicating factors. For one, Cayuga imposes strict conditions on lengthening, resulting in cases where the initial syllable of a disyllabic word may end up being unstressed and unlengthened. Examples of such overriding conditions on lengthening are as follows: (i) do not lengthen when the syllable ends with an [h], [?], or an [s] if the [s] is followed by another C (although it is okay to lengthen if [s] is intervocalic; (ii) do not lengthen if the syllable in question is odd-numbered (counting from the beginning of the word) and followed by a consonant cluster of any kind.

Thus a word like **kahnih** 'it barks, it's a barker' the initial vowel is neither stressed nor lengthened, but devoiced. This is because it is in an odd-numbered syllable which is closed by a laryngeal. In either case, the solitary foot always seems to be iambic.