A unified account of binary and ternary stress

A unified account of binary and ternary stress

Considerations from Sentani and Finnish

Een unificerende analyse van binaire en ternaire klemtoon

Overwegingen uit het Sentani en Fins

(met een samenvatting in het Nederlands)

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1 Introduction

1.1 Introduction

This thesis is written in the context of metrical theory, and within metrical theory it deals with bounded stress systems. In the literature, the notion of bounded stress is often equated with 'binary alternation' or 'binarity'. However, t*ernary* bounded stress patterns have also been known to exist. This thesis is based on the feeling that to the extent that these ternary patterns have so far been dealt with in the literature, the proposals for explaining ternarity seem to be inadequate.

In the metrical literature several proposals have been made. Two trends clearly emerge: that of 'ternary feet' (Liberman & Prince 1977, Hayes 1981, Levin 1985, 1988, Halle & Vergnaud 1987, Dresher & Lahiri 1991, Hewitt 1992, Rice 1992); and that of 'binary feet', combined with special parsing modes (Hammond 1990, Kager 1994, 1996, Hayes 1995).

The specific goal of this thesis is to account for ternary patterns with the tools provided by metrical theory to account for binary stress patterns. This approach is based on the typological observation that languages with ternary patterns very often combine those ternary patterns with binary patterns. In fact, most languages that show ternary patterns, basically have a binary stress system.

This thesis is written within the framework of Optimality Theory, a theory which assumes that a grammar is the language-specific ranking of universal constraints, and we will see that the constraints introduced and motivated to account for binary patterns can also deal with ternary patterns.

The core of this thesis is formed by the analyses of the stress systems of two languages, Sentani (a Papuan language spoken in Irian Jaya, the eastern most province of Indonesia) and Finnish. The stress systems of both languages combine binary and ternary stress patterns. Their central interest to metrical theory resides in the interactions of factors that produce ternarity in a basically binary system: this has important consequences for the notion of 'bounded stress system'.

In our analysis of the stress systems of Sentani and Finnish, several issues of broader relevance arise, such as the analysis of partial quantity sensitivity; reference to the pure grid versus the bracketed grid; free variation in output patterns; and the notion 'base' in output-output correspondence. These issues are previewed in the sections below, where they are placed in the perspective of metrical theory and Optimality Theory. It will be shown that this thesis contributes to each of these issues.

1.2 Defining ‘binarity’ and ‘ternarity’

In bounded stress systems, the distance between two stressed syllables, or between a stressed syllable and a word edge, is restricted to a limited distance, hence ‘bounded stress’. In most languages with a bounded stress system, the stress system is binary, which means that the basic pattern is binary. In a binary pattern, two stressed syllables, or a stressed syllable and a word edge, are separated by just one unstressed syllable (e.g. Liberman 1975, Liberman & Prince 1977, Prince 1983, Hayes 1981, Kager 1989). This is shown in (1), with the stress patterns from Pintupi in (1a) (Hansen & Hansen 1969) and Warao in (1b) (Osborn 1966).

(1) a. [tʲá.mu.lìm.pa.tʲùŋ.ku] ‘our relation’
b. [e.nà.ho.rò.a.hà.ku.tá.i] ‘the one who caused him to eat’

The terms bounded stress and binary stress are often used interchangeably.

In a minority of cases bounded stress systems permit a larger distance between two stressed syllables, or between a stressed syllable and the word edge. In such cases, the maximal distance is two unstressed syllables, so that stress falls on the third syllable. Hayes (1981) observes that such ternary patterns are more common word-finally (2a) than word-internally (2b). This is related to the observation that stress tends to avoid the right edge of the word. Even less common than a single ternary pattern word-internally is ternary alternation (2c).

In (2a) a ternary pattern extends from the rightmost stress to the right word edge. In (2b) there is a ternary pattern between the two stresses. In (2c) there is ternary alternation, i.e., an interval of two unstressed syllables separating the stresses, as well as the rightmost stress and the right word edge.

(2) a. [$\acute{\sigma}\sigma\underline{\acute{\sigma}\sigma\sigma}$] (Finnish)
b. [$\sigma\underline{\acute{\sigma}\sigma\sigma\acute{\sigma}}\sigma$] (Sentani)
c. [σ́σσσ́σσσ́σσ] (Cayuvava)

This thesis addresses all three kinds of ternarity shown in (2). These patterns have been discussed in the literature, but far from systematically, and not always in connection with one another. To understand the issues at stake better, it is useful to introduce a distinction between a stress system and a stress pattern. A stress system is made up of stress patterns. In this thesis, *bounded stress system* refers to a stress system in which the distance between two stresses syllables, or between a stressed syllable and the word edge is limited to a certain distance, i.e., either one or two unstressed syllables. This includes both binary stress systems and ternary stress systems. A *binary stress system* is a stress system in which the preferred (basic) stress pattern is binary, but in which a ternary pattern occasionally arise. A *ternary stress system* is a stress system in which the preferred (basic) stress pattern is a ternary pattern, but in which binary pattern may occasionally arise. A *binary pattern* is a pattern in which the distance between two stressed syllables or between a stressed syllable and the word edge is limited to maximally one unstressed syllable, as shown in (1). A *ternary pattern* is a pattern in which this distance is two unstressed syllables, either word-internally, word-finally, or in a rhythmically reccurring pattern, as shown in (2).

Most bounded stress systems are binary stress systems, and most ternary patterns occur in binary stress systems. In unbounded stress systems, i.e., stress systems in which the distance between two stressed syllables or between a stressed syllable and the word edge is not limited to a predefined distance, it is, of course, possible that both a binary and a ternary pattern surfaces.

So far, there seems to be very few stress systems that are ternary, i.e., in which the basic pattern is a ternary pattern. Included in this group are almost certainly Chugach, a dialect from the Pacific Yupik Language family (Leer 1985a,b), and Cayuvava, a Bolivian language (Key 1961, 1967). But also Estonian (Hint 1973, Prince 1983) and Winnebago (Hale & White Eagle) are mentioned as languages whose stress systems are possibly ternary. Especially Cayuvava (e.g. Halle & Vergnaud 1987, Levin 1988, Dresher & Lahiri 1991, Hewitt 1992, Rice 1992, Kager 1994, 1996b, Hayes 1995), and Chugach (e.g. Halle 1990, Rice 1992, Kager 1993, Hayes 1995) have received considerable attention in the discussion about ternarity.

It will be shown that these ternary stress systems can be accounted for with tools motivated for the analysis of binary stress systems. Arguments come from the analyses of the stress systems of Sentani and Finnish, which will be given first.

1.3 Sources of ternarity

It is argued in this thesis that Sentani and Finnish are languages with binary stress systems, although several factors may influence stress assignment so that ternary patterns result. In this section, I illustrate for a small number of languages that there are various aspects of stress assignment, that may lead to ternary patterns.

Rather paradoxically, one factor that may cause a ternary pattern to arise, is *foot binarity*. Pintupi, an Australian language (Hansen & Hansen 1967, Hayes 1995), has a trochaic system. Main stress is on the initial syllable, secondary stress is on every other syllable to the right, except when this is the final syllable in the word. Stressing the final syllable creates a degenerate foot, which is avoided by the requirement that feet must be binary. This situation may therefore result in a ternary pattern at the right word edge.

(3) a.	[(σ́σ)(σ̀σ)]	[máɭawàna]	‘through from behind’
b.	[(σ́σ)(<u>σ̀σ)σ</u>]	[púɭiŋkàlatʲu]	‘we (sat) on the hill’

c.	[(σ́σ)(σ̀σ)(σ̀σ)]	[tʲámulìmpatʲùŋku]	‘our relation’
d.	[(σ́σ)(σ̀σ)(σ̀σ)σ]	[tíɭirìŋulàmpatʲu]	‘the fire for our benefit flared up’

In Garawa, also an Australian language (Furby 1974), the orientation of main stress towards the left edge, and that of secondary stress towards the right edge, may result in a ternary pattern. Such edge related factors are also known as *alignment requirements* (McCarthy & Prince 1993). Garawa has a trochaic stress system (McCarthy & Prince 1993, Hayes 1995). Main stress is on the initial syllable, and secondary stress is on every second syllable from the right edge, but not when this is the second syllable from the left.[1] In words with an odd number of syllables this results in a ternary pattern between main stress and the leftmost secondary stress.

(4) a.	[(σ́σ)(σ̀σ)]	[(pún.ja).ɭa]	‘white’
b.	[(σ́σ)σ(σ̀σ)]	[(ká.ma) .ɭa.(ɾì.ɲi)]	‘wrist’
c.	[(σ́σ)(σ̀σ)(σ̀σ)]	[(yá.ka).(là.ka).(làm.pa)]	‘loose’
d.	[(σ́σ)σ(σ̀σ)(σ̀σ)]	[(ŋán.ki).ɾi.(kì.rim).(pà.yi)]	‘fought with boomerangs’

In Garawa, the word must begin with a foot, but on the other hand, feet must also be as much to the right as possible. Obviously, the former requirement is stronger than the latter, resulting in a word-internal ternary pattern in words with an odd number of syllables.

A third source of ternarity is *clash avoidance*. We see this in several languages, among which Manam, an Austronesian language of Papua New Guinea (Lichtenberg 1983). Stress assignment in this language is relatively complicated, but the following three examples illustrate how a ternary pattern appears due to clash avoidance (Halle & Kenstowicz 1991, Buckley 1997).

(5) a.	[L(Ĺ L)][2]	[wa.(bú.bu)]	‘night’
b.	[L(H́)]	[ma.(nám)]	‘Manam Island’
c.	[(H́)LL]	[(ém).be.ʔi]	‘sacred flute’

Like Garawa, and Pintupi, Manam has trochaic feet (Halle & Kenstowicz 1991, Buckley 1997). When the final syllable is light, stress is on the penult (5a), but when the final syllable is heavy, stress is on this final syllable (5b). This indicates that Manam is a quantity sensitive language. Words ending in a sequence: Heavy-Light-Light, have antepenultimate stress (5c). In (5c) stressing both the heavy syllable and the penult would result in a clash (c.f. (6)), which is resolved at the expense of the rightmost foot.

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[1] Furby (1974), McCarthy & Prince (1993), Hayes (1995) distinguish between secondary stress on the penultimate syllable and tertiary stress on every other syllable to the left of secondary stress. This, however, is not relevant for the point illustrated here.

[2] L = light syllable, H = heavy syllable

(6) *[(H̀)(ĹL)]

Clash avoidance thus results in (5c), with stress only on the antepenultimate, heavy syllable, resulting in a word-final ternary pattern.

Another language with words with antepenultimate stress and thus a ternary pattern is Latin (Allen 1973). In Latin, a fourth factor, i.e., *non-finality of stress*, plays a role. For Latin it has been argued that the final syllable is extrametrical (Hayes 1981, 1982, 1995), or that the rightmost foot may not be final in the word (Allen 1973, Prince & Smolensky 1993, Hung 1994, Hayes 1995). Feet in Latin are also trochaic. When the penultimate syllable is heavy, stress is on this penult, but in a sequence of light syllables, the trochaic, non-final foot results in stress on the antepenultimate syllable and a ternary pattern appears at the right edge of the word.

(7) a. [(H́)H] [(cór)pus] 'corps'
b. [L(ĹL)L] [pa(tríci)a] 'Patricia'

A fifth aspect is *quantity sensitivity*. In Finnish, for example, main stress is on the initial syllable, and secondary stress is on every second syllable to the right, counting from the first syllable. But when such a syllable is followed by a heavy syllable, a word-internal ternary pattern appears, i.e., the light syllable is skipped to stress the heavy.

(8) a. [(H́L)(L̀L)L] [(érgo)(nòmi)a] 'ergonomics'
b. [(ĹL)L(H̀L)] [(máte)ma(tìikka)] 'mathematics'

So far, we have only looked at phonological aspects, but also the *morphology* may affect stress assignment. This is a sixth factor that may lead to ternarity. Morphological effects are not uncommon among stress systems. An example is Finnish. Certain suffixes attract stress, in that stress must fall on the syllable immediately preceding the suffix. In words with an odd number of syllables this may result in a ternary pattern word-internally.

(9) a. [(ĹL)(L̀L)] [(áte)(rìa)] 'meal'
b. [(ĹL)L(L̀-LSuf)] [(áte)ri(à-ni)] 'my meal'

We can thus isolate six factors that may affect binary stress assignment in such a way that ternary patterns appear. Of course, none of these factors can be identified as an intrinsic source of ternarity on its own. Rather, it is the interaction of these factors that triggers ternary patterns. For example, clash avoidance does not intrinsically lead to ternarity, but only when it overrides an otherwise perfect binary rhythmic alternation. Perfect binarity manifests itself as a default in contexts in which factors such as edge alignment, non-finality, clash avoidance, quantity sensitivity, etc., are irrelevant. This naturally leads us to the issue of the interaction of metrical factors in a theory of grammar.

1.4 Optimality Theory

As noted in 1.1, the analytical parts of this thesis are couched in the theoretical framework of Optimality Theory (Prince & Smolensky 1993). Optimality Theory is very well suited to account for interaction of principles of metrical theory. Most requirements in a stress system are not absolute. Very often they only express what the preferred pattern is, but other factors may cause another pattern. Prince & Smolensky (1993) describe these situations as "*do something only when*', and "*do something except when*". For example, 'stress is on every other syllable, except when this is the final light syllable in the word', or 'heavy syllables are stressed, except when this results in a clash'.

For rule-based phonology this does not come automatically. Rules assign stress to every other syllable without exception, or to every heavy syllable. In order to account for 'preferences', additional representational or operational tools are needed, such as incorporation, when syllable extrametricality results in a degenerate foot, or repair strategies, such as destressing in clash situations. In Optimality Theory the preferences follow from the constraint hierarchy with strict dominance relations, and minimal violation of constraints. Optimality Theory obviates the need of repair strategies and intermediate levels between input form and output form. An illustration of this is given in the next section, when Quantity sensitivity is discussed. Here I give a very brief outline of Optimality Theory. In Chapter 2 a more detailed description will be given.

In Optimality Theory different potential surface forms ('candidates'), are evaluated by a hierarchy of universal constraints. Constraints come in two types. First, well-formedness constraints, which express surface well-formedness requirements, such as *all syllable have onsets*, or *syllables avoid codas*. The second type of constraints are faithfulness constraints. These constraints require that the output candidate is as close as possible to the input, which means that in the output candidates nothing may be changed with regard to the input. Since all constraints are universal, the grammars for specific languages are due to language-specific rankings. The rankings obey a strict dominance order. The candidate that best satisfies the constraint ranking is selected as the optimal candidate, and is the surface form. In order to 'best' satisfy the constraint ranking, an output form does not need to obey all constraints. The satisfaction of a higher-ranked constraint takes priority over lower-ranked constraints. As a result, the output candidate that best satisfies the constraint ranking may perform very badly on lower-ranked constraints, but it does best for the higher-ranked constraints.

In (10) and (11) evaluation of the candidates is represented in tableaux. The constraints stand in order of domination: left are the highly ranked or undominated constraints, to the right are the lower-ranked constraints. Vertically we find the different output candidates that are evaluated with respect to how well they satisfy the constraints. This is just a way of representing the candidates, but in their order of appearance in the tableaux, there is no hierarchy among the candidates. All are evaluated in parallel, i.e., all are evaluated simultaneously by the hierarchy. Asterisks indicate violations, an exclamation mark means that the violation is fatal. The arrow points at the optimal candidate. Shaded cells indicate that there has been a fatal violation for a constraint ranked higher than these constraints, and that these constraints do not contribute to the selection of the optimal form. This does not mean, however, that they are 'switched off', as can be seen by the violation marks in those cells.

Constraints may be violated, but violation is minimal. It therefore does not need to be fatal if a constraint is violated. There are two circumstances in which violation of a constraint is not fatal. One is when the violation concerns a lowly ranked constraint whose violation is enforced by higher-ranked constraints. A candidate may violate the lower-ranked constraint and still be the optimal candidate (10).

(10) input:	A	B
→ a. Candidate α		*
b. Candidate β	*!	

The other case where a violation is not fatal, is when all candidates have identical violations with respect to a particular constraint, in which case there is a tie. In that case the constraints lower in the hierarchy must make the decision (11).

(11) input:	A	B
→ a. Candidate α	*	
b. Candidate β	*	*!

As pointed out above, constraints are universal. It is the difference in ranking that will give us the different grammars for different languages. For example, in the account of the stress patterns of Finnish and Sentani, it will be shown that for a large part the same constraints interact, but that they are ranked in a different order. On the other hand, also different factors are involved in stress assignment in Finnish and Sentani. As a result, some constraints ranked high in the hierarchy of Finnish are ranked so low in the hierarchy of Sentani that they do not even feature in the tableaux, because they do not play an active role in selecting the optimal candidate. The same holds the other way around.

1.5 Sentani and Finnish

In the discussion of the grammars (constraint rankings) that generate ternary patterns, broader issues will be dealt with, whose relevance extends beyond the analysis of ternary patterns. These issues contribute to the discussion of metrical theory in general. These issues are rhythm and the metrical grid, quantity sensitivity, non-finality of stress, variation or optionality, and the influence of morphology on stress assignment. Empirically, the discussion of these issues is triggered by the analyses of the stress systems of Sentani and Finnish, which form the core of this thesis. Like

English, both languages combine binary and ternary patterns. Both stress systems will be shown to be binary stress systems, with constraint interaction resulting in ternary patterns in various contexts. The reasons for selecting Sentani and Finnish as languages worthy of elaborated analysis are given below.

Sentani is a relatively unknown language. Descriptions by Cowan (1965) and Hartzler (1976) suggest a mixed stress system, with binary and ternary patterns. But the stress data provided by these two descriptions are very restricted. New native speaker data were therefore collected by the author, during a period of fieldwork in Irian Jaya in the Fall of 1994. The newly collected data confirm that Sentani combines binary and ternary patterns.

Different factors trigger ternary patterns in Sentani. First of all, quantity sensitivity effects trigger ternary patterns, such as avoidance of stress on open syllables that end in a schwa, or stressing word-initial and word-final syllables. Furthermore, the combination of non-finality of stress and clash avoidance may also result in a ternary pattern. A third factor, which will also play an important role in the discussion about rhythm and the metrical grid, is that Sentani requires the word to begin and end in a foot, even if this results in a combination of a left-headed and right-headed foot.

In expositions on ternarity, Finnish is very often mentioned. In Finnish ternary patterns appear in a multitude of contexts. Various earlier descriptions (Harms 1964, Carlson 1978, Hanson & Kiparsky 1996) show that Finnish combines binary and ternary stress patterns, just as Sentani. But also the data on Finnish stress available so far, are relatively limited, and the descriptions just mentioned seem to contradict one another at some points. In order to get a better idea of the influence of suffixation on Finnish stress patterns, native speaker data were collected by the author in the Spring of 1996. These data confirm the observations in the descriptions just mentioned, but they also reveal a more complicated interaction than previously assumed between phonology and morphology. Those more complex aspects reside in variation and paradigmatic analogy.

In Finnish a combination of factors may also result in ternary patterns, such as quantity sensitivity (light syllables may be ‘skipped’ to stress an adjacent heavy syllable), non-finality of stress, and avoidance of clash. But equally interesting morphological effects on stress assignment. There are suffixes that may affect the stress pattern in such a way that a ternary pattern surfaces. And perhaps even more interesting is the fact that there is variation in the stress data of Finnish. Especially when we look at the morphological effects we find variation in stress patterns. But we also see variation when we look at the patterns that have a phonological explanation. Whenever there is variation, the choice is between a binary or ternary stress pattern.

The analyses of these two languages below are based on the descriptions mentioned above, but more prominently on the data collected by the author. These analyses trigger the discussion about theoretical aspects of metrical phonology.

1.6 Quantity sensitivity

In both Sentani and Finnish the weight of the syllables, i.e., quantity sensitivity, plays a role in stress assignment, and in both languages quantity sensitivity is one of the factors that may cause a ternary pattern.

In a parametric theory as proposed by Hayes (1995) a language is either quantity sensitive or it is not. If it is quantity sensitive the language can have either an iambic system or a moraic trochaic system. If the language is quantity insensitive, the system uses syllabic trochees. But the quantity sensitivity parameter itself has only two values: quantity sensitive Yes/No. This means that rules either assign stress to all heavy syllables (Yes), or ignore the quantity of the syllables (No). However, when in the output forms of a language not all heavy syllables are stressed, an extra rule is needed to repair the damage. Very often heavy syllables do not receive stress if this would result in a clash. In that case a rule such as *destressing in clash*, removes earlier assigned stresses from some syllables, resulting in at least one extra level in the derivation.

Kager (1992) questions the existence of truly quantity insensitive stress systems, i.e., languages with quantity contrasts that are completely ignored by the phonology. Kager notes that languages which were thought to have quantity insensitive stress systems, seem to be quantity sensitive to at least a certain extent. One of the languages for which he illustrates this is Finnish. It will be shown in this thesis that within the framework of Optimality Theory partial quantity sensitivity can be accounted for by constraint interaction.[3]

The constraint that requires heavy syllables to be stressed is the Weight-to-Stress-Principle (WSP, Prince 1983, 1991). In Optimality Theory in the constraint ranking *X » WSP » Z* constraint X overrules WSP, but Z is overruled by WSP. This ranking will result in a partially quantity sensitive stress system, as explained below.

When X evaluates the output candidates, the requirements by all constraints ranked lower in the hierarchy are not relevant yet. In this example this means that the requirement that heavy syllables must be stressed, is not yet relevant, and thus at this point the evaluation is insensitive to the quantity of the syllables. Satisfaction of X may even induce a violation of WSP.

When the evaluation of X results in a tie, the next constraint in the hierarchy evaluates the candidates. Now the requirements of WSP become relevant. Only candidates that best satisfy WSP, taken into consideration the requirements of X, will ‘survive’ the evaluation, even at the cost of violating Z. And when WSP also results in a tie, finally the requirements of Z become relevant. But the evaluation of this constraint must always take into consideration the requirements of X and weight of the syllables. It may only participate in the evaluation for those candidates that satisfy X and WSP.

[3] This has also been argued by Alber (1997). She shows on the basis of data from German, Finnish and Estonian that quantity sensitivity emerges as a result of constraint interaction. However, we will see in Chapter 5 that her account of Finnish stress is insufficient to account for all stress patterns.

To illustrate this type of situation, let us consider the interaction of three constraints. Constraints that typically conflict are WSP, *CLASH, which requires the avoidance of rhythmic clashes, and PARSE-σ, which requires all syllables to be parsed into a foot. In (12) some of the heavy syllables are not stressed in order to avoid a clash, which means that *CLASH » WSP. The hierarchy first evaluates the candidates with regard *CLASH, regardless of whether heavy syllables are stressed. Satisfaction of *CLASH (12a) results in two violations for WSP.

(12) /H H H H L /	*CLASH	WSP	PARSE-σ
→ a. [(H́H)(H̀ H)L]		**	*
b. [(H́)(H̀)(H̀)(H̀L)]	*!**		

Only when *CLASH is satisfied does the evaluation become sensitive to the weight of syllables. Parsing (13) exhaustively with binary alternation, would result in leaving the heavy syllable unstressed. The ternary pattern in (13a) indicates that heavy syllables must be stressed, and that this is more important than parsing all syllables.

(13) /L L L H L L/	*CLASH	WSP	PARSE-σ
→ a. [(ĹL)L(H̀L)L]			**
b. [(ĹL)(L̀H)(LL)]		*!	
c. [LLL(H́L)L]			***!*

For every ranking X » Y » Z it is the case that the evaluation by X is insensitive to the requirements of Y and Z, because these requirements are not (yet) relevant. X may even induce violations of these constraints. If X is satisfied, or if there is a tie, the following constraint in the hierarchy will evaluate the forms. Only then will the requirements made by Y become relevant, but still not those of Z. What is more, satisfaction of Y may now lead to violations of Z. In other words, the evaluation of output candidates by higher-ranked constraints is insensitive to the requirements of the lower-ranked constraints. Only if higher-ranked constraints have been satisfied (or in the event of a tie) does the evaluation become sensitive to the requirements of lower-ranked constraints.

This property of Optimality Theory, and the fact that constraints may be violated as long as violation is minimal, ensures that Optimality Theory can account for requirements that are not absolute, but whose satisfaction depends on the satisfaction of other, higher-ranked constraints.

It will be argued in this thesis that qantity sensitivity and other previously parametrical factors (e.g. foot form) are best regarded as ‘violable constraints’ in the sense of Optimality Theory. In Sentani, for example, we will see that we need both left-headed and right-headed feet to account for the stress patterns, which will, in turn, play a role in the discussion about rhythm and the metrical grid.

1.7 Rhythm and the metrical grid

An aspect that receives considerable attention in this thesis, especially in the account of Sentani, is rhythmic distribution of stress. The issue under scrutinity here is whether constraints that evaluate rhythmic distribution of stress should refer to foot parsing or to the pure grid. This discussion is triggered by two anti-lapse constraints, both of which refer to parsing stress units into a foot (Kager 1994, Green & Kenstowicz 1995). It will be argued on the basis of data from Sentani that the anti-lapse constraint must refer to the grid, and explicitly avoid reference to parsing the syllables in a foot.

According to Liberman (1975), Liberman & Prince (1977), and Prince (1983) stress is the hierarchical organisation of rhythmic structure. In this rhythmic structure the distance between strong beats may be neither too short, nor too long. When two strong beats are adjacent, there is a so-called *clash*. When the interval between two strong beats is too long, there is a *lapse*. Bounded stress systems tend to avoid both clashes and lapses (Liberman 1975, Liberman & Prince 1977, Prince 1983, Selkirk 1984). In the literature, we find various positions with regard to whether universally the maximal distance between two strong beats is one or two weak beats. Selkirk (1984) proposes the following principle in (14), which consists of an anti-clash provision (14a) and an anti-lapse provision (14b).

(14) *Principle of Rhythmic Alternation*
  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.

According to the second clause of this universal principle, the distance between two strong beats may at most be two adjacent weak beats. However, this anti-lapse provision does *not* state that languages *must* allow for such a sequence of weak beats. It leaves room for a language-specific window: languages either allow maximally two adjacent weak beats, or they allow only one weak beat to intervene two strong beats. In her analysis of English stress, for example, Selkirk proposes an additional, language-specific filter (*anti-lapse filter*), which only allows one weak beat to intervene two strong beats.

In the analysis of Sentani and Finnish stress it will be shown that in these two languages sequences of two adjacent weak beats are allowed. However, none of these languages allows a lapse of three consecutive unstressed syllables, as in the following grid representation:

(15) *		x				x		level 1
	x	x	x	x	x	x	x	level 0

Initially it might be thought that the configuration (15) is intrinsically ill-formed in bounded stress systems, where constraints like PARSE-σ, in combination with FTBIN, will force unparsed syllables to be footed, resulting in a beat on the middle element of this sequence, hence providing for binary alternation.

```
(16)  x      x     x       level 1
     x(x x)(x x)(x  x)  level 0
```

However, as will be shown in Chapter 4 (on Sentani) and Chapter 5 (on Finnish), the complete absence of the rhythmic configuration (15) cannot be explained as the result of interaction of independent metrical constraints. In our analysis of Sentani and Finnish, in which several high-ranked constraints are active in disrupting the basically binary patterns of alternation (see section 1.3), PARSE-σ is ranked too low to prevent the configuration (15) from surfacing. A specific anti-lapse constraint is therefore needed to keep the 'anti-binarity' constraints in check.

This constraint is different from the constraints disrupting the binary pattern in that its high ranking cannot cause a ternary pattern. Rather it serves to limit the interstress interval to at most two syllables, when the interaction of other constraints would otherwise result in a quaternary pattern. For Sentani it will be shown that this constraint in needed to reject a quaternary pattern so that a ternary pattern is correctly chosen as the optimal candidate. But in Finnish this constraint rejects a quaternary pattern, so that a candidate with a binary pattern is chosen as the optimal candidate. So the presence of the anti-lapse constraint in discussions about ternarity is due to the fact that it *allows* for a maximally ternary pattern, and not because it *causes* a ternary pattern.

This having been said, the main question relating to the anti-lapse constraint is this: must this constraint be defined on the pure metrical grid, or must it be phrased in terms of metrical constituency?

In literature based on Optimality Theory, the anti-clash constraint *CLASH is defined on the grid (c.f. Kager 1994, Pater 1995, Alber 1997). This is fully in accordance with the rhythmic character of the notion clash (Liberman (1975, Liberman & Prince 1977, Prince 1983, Selkirk 1984). Analogously, we may now expect that anti-lapse constraints are also defined on the grid. This is the case in Selkirk's anti-lapse provision of her PRA. However, this is not the case in more recent proposals made by Kager (1994) and Green & Kenstowicz (1995).

(17) *PARSE-2* (Kager 1994): One of two adjacent stress units must be parsed by a foot.

(18) *LAPSE* (Green & Kenstowicz 1995): Adjacent unstressed moras or syllables must be separated by a foot boundary.

These two constraints are nearly identical. They do not consider a lapse to be a purely rhythmic ill-formedness, but see it as ill-parsed sequences of stress units.

Therefore, they do not refer exclusively to the grid, but also take metrical structure into account.

As already shown, a sequence of two unstressed syllables is not uncommon in bounded stress systems, but one hardly ever finds a sequence of three unstressed syllables or more. The constraints in (17) and (18) therefore allow for a sequence of two unstressed stress units, either moras or syllables, but disallow a sequence of three unstressed stress units.

(19) a. [(x́ x) x (x́ x)]
b.* [(x́ x) x x (x́ x)]

The configurations of (19) do not make a difference between the proposals of Kager (1994) and Green & Kenstowicz (1995) on the one hand, and Selkirk (1984) on the other. The stress unit appearing between the feet in (19a) does not constitute a lapse under either definition of this notion. And the sequence of two stress units appearing between the feet in (19b) does constitute a lapse for both definitions. In order to make a difference between the two types of proposals, we need to find a language in which both trochaic and iambic feet may occur. This may result in candidates such as (20a) and (20b).

(20) a.* [(x́ x) x (x x́)]
b. [(x x́) x x (x́ x)]

Configuration (20a) constitutes a lapse in Selkirk's definition: there are three adjacent weak beats intervening between the strong beats. However, it is not a lapse for both Kager (1994) and Green & Kenstowicz (1995), since of every two adjacent stress units one is parsed into a foot. Although in principle Sentani is a language which might provide us with examples with the structure in (20a), our data do not contain any such examples.

Fortunately, however, the matter can also be decided on the basis of examples of type (20b). According to Kager (1994) and Green & Kenstowicz (1995), the configuration in (20b) violates their anti-lapse constraints. However, it is *not* a lapse according to Selkirk's definition. Only two weak beats intervene two strong beats. We are now in a position to decide between these proposals: the configuration in (20b) does occur in Sentani, and hence we should reject both Kager's and Green & Kenstowicz's proposals.

(21) [(molò)koxa(wále)] 'I wrote to you'

In Sentani words with six syllables have a ternary pattern. On the basis of the constraint ranking motivated for Sentani (see Chapter 4) the parse is as in (21), leaving the middle two syllables unparsed. Therefore we will follow Selkirk's idea in defining lapse as a purely rhythmic phenomenon, which only looks at the metrical grid.

However, for several reasons which will become clear in Chapter 4, use will be made of a slightly different definition from the anti-lapse provision given by Selkirk. Based on data from both Sentani and Finnish the anti-lapse constraint proposed below will state that a weak beat must be adjacent to a strong beat or a word edge. Reference to how the weak or strong beats must be parsed in a foot, or that they must be separated by a foot boundary is explicitly avoided.

(22) **LAPSE*: A weak beat must be adjacent to a strong beat or to the word edge.

This allows the pattern in (20b), but excludes the patterns in (20a). For more on this issue see Chapter 4, where an extensive analysis of Sentani stress is given.

After the existence of the anti-lapse constraint has been motivated for both Sentani and Finnish, we will see that further interaction of these constraints, especially high-ranked *LAPSE and low-ranked PARSE-σ, may result in a constraint hierarchy that generates ternary patterns as the basic pattern. This means that the interaction of constraints motivated for the analysis of binary stress systems, may also give us a ternary stress system. In Chapter 7 we will see what the crucial rankings are for a stress system to be binary or to be ternary.

1.8 Variation

Variation is inherent to language. In terms of grammars, variation is the phenomenon that two surface forms can be assigned to an identical input form. Variation must be accounted for by the linguistic theory. In a rule-based theory, variation is obtained by optional rule application, i.e., optionally applying rule A results in surface form A, and optionally applying rule B results in surface form B. Of course, optional rule application is not possible in Optimality Theory, but still Optimality Theory provides the means to account for variation.

In Optimality Theory every input-output mapping provides an optimal candidate, which is the output form. This optimal candidate best satisfies the constraint ranking. In order to obtain variation, two different forms must be selected as the optimal candidate. In Optimality Theory this can be obtained if one or more constraints are crucially unranked. When constraints are not ranked with regard to each other, they can be ranked in either order, i.e., A » B and B » A. It is obvious that, when candidates score differently for A and B, different forms will be selected as the optimal candidate, depending on the specific ranking (Kiparsky 1993, Kager 1994, Reynolds 1994, Anttila 1995, 1997).[4]

There is a difference between two constraints that cannot be crucially ranked, and two constraints that are crucially left unranked. For example, when constraint A can never be violated without violating constraint B, even when B can be violated

[4] In essence they all propose that variation is obtained by leaving constraints unranked. I refer the reader to Chapter 2 for an extensive outline and comparison of these proposals.

without violating A, the constraints do not conflict, and one cannot tell what their ranking must be. Either ranking gives the same result, so these constraints are not crucially ranked.

(23a) input	A	B
→ a. candidate α		*
b. candidate β	*!	*

(23b) input	B	A
→ a. candidate α	*	
b. candidate β	*	*!

But in the case of variation, two constraints are obviously in conflict. When A » B, candidate α is selected as the optimal candidate, and when B » A, candidate β will be the optimal candidate. In order to get the two variants, it is crucial that the two constraints are left unranked with regard to each other, so that each can dominate the other, resulting in two variants (Kiparsky 1993).

(24a) input	A	B
→ a. candidate α		*
b. candidate β	*!	

(24b) input	B	A
a. candidate α	*!	
→ b. candidate β		*

Constraints that are crucially not ranked need not be at the same place in the hierarchy, i.e., adjacent in the tableaux. For example, suppose that there is a fixed ranking B » C. It has been established that A must optionally dominate B, but in order to get the other variant, it must optionally also be dominated by C. Then A needs to move down the hierarchy, because the place of C is fixed with regard to B.

(25) a. A » B » C
b. B » A » C
c. B » C » A

When dealing with Finnish, variation will be and issue. The analysis of Finnish is divided into a chapter that analyses the stress patterns that can be accounted for by referring exclusively to the phonology (Chapter 5), and a chapter that analyses the stress patterns that are obviously the result of the influence of morphology (Chapter 6). What we will see is that in both chapters of the analysis we have to deal with variation. And in both cases one variant has a binary pattern, and the other variant has a ternary pattern.

Furthermore, it will be shown that there are constraints that are not ranked at all. In Chapter 5 we will see that the constraint stating that stress may not be final (NONFIN) cannot be ranked. And in Chapter 6, one of the constraints that accounts for the effects of morphology on stress assignment in Finnish can also not be ranked at all. The distance between the highest position of these constraints in the hierarchy (undominated) and their lowest position (below the lowest motivated constraint needed to account for Finnish stress) is quite considerable: five strata.

1.9 Variation and output-output correspondence.

For Finnish it will be shown that some of the stress patterns are the result of copying the stress patterns of nouns with one suffix to related nouns with two suffixes. In order to account for such 'cyclic' processes in Optimality Theory we need a variant of Correspondence Theory, i.e., output-output correspondence. In output-output correspondence, the faithfulness of output candidates is not evaluated with regard to the input, but with regard to how well they match the *base*, which is already an output form, hence *output-output* correspondence.[5] The base, in derivational terms, is the output form at the earlier level of the derivation. In Finnish the stress pattern of the words with one suffix is the base for the stress pattern of the words with two suffixes.

Interestingly, an extra factor in Finnish is that output-output correspondence is combined with variation. Words containing one suffix may show variation, which means that there are two possible output forms, both of which can serve as a base. The two stress patterns of words with one suffix are both copied to the word with two suffixes. And as a result there are also two possible output forms for the words with two suffixes. The question now is: how does output-output correspondence evaluate the forms when there are two possible bases? Are the output forms evaluated with regard to the two bases in the same tableaux (26a), or are there different tableaux per base (26b)?

(26a)
Input < Base 1, Base 2 > Output1,2

(26b) Input — Base 1 — Output 1

Input — Base 2 — Output 2

It will be shown that option (26b) is the correct way in which output-output correspondence evaluates the output candidates with regard to the bases. If we chose option (26a) we would never get variation. As shown above in explaining Optimality

[5] See Chapter 2 for more on Correspondence Theory and output-output correspondence.

Theory, and in showing variation, per tableau there is always only one optimal form. So evaluating the output forms against two bases in the same tableau cannot lead to variation. First this would require the tableau to come up with two optimal candidates, which is against the principles of Optimality Theory. Second, when there are two bases with different stress patterns, each output form has the pattern of either Base 1 or Base 2. In that case one candidate violates the output-output constraints for Base 2, and the other candidate violates the output constraint for Base 1. This will always result in a tie for the output-output constraint, and the other constraints will decide in favour of just one form.

Therefore per tableau only one base is evaluated. This can be illustrated with the abstract examples form Finnish. The examples in (27) are the stress patterns that are the bases, and the examples in (28) are the output forms we want to be selected as optimal.

(27) a. $[(\acute{\sigma}\sigma)(\grave{\sigma}\sigma)+\sigma_S]$ σ_S = syllable that is also a suffix
b. $[(\acute{\sigma}\sigma)\sigma(\grave{\sigma}+\sigma_S)]$

(28) a. $[(\acute{\sigma}\sigma)(\grave{\sigma}\sigma)(+\grave{\sigma}_S+\sigma_S]$
b. $[(\acute{\sigma}\sigma)\sigma(\grave{\sigma}+\sigma_S)+\sigma_S]$

We can insert these patterns in the example of (26b).

(29)	*Input*		*Base*		*Output*
	$/\sigma\sigma\sigma\sigma+\sigma_S+\sigma_S/$	——	$[(\acute{\sigma}\sigma)(\grave{\sigma}\sigma)+\sigma_S]$	——	$[(\acute{\sigma}\sigma)(\grave{\sigma}\sigma)(+\grave{\sigma}_S+\sigma_S]$ [6]
	$/\sigma\sigma\sigma\sigma+\sigma_S+\sigma_S/$	——	$[(\acute{\sigma}\sigma)\sigma(\grave{\sigma}+\sigma_S)]$	——	$[(\acute{\sigma}\sigma)\sigma(\grave{\sigma}+\sigma_S)+\sigma_S]$

1.10 This thesis

This thesis is organised as follows. The next chapter serves as background reading. It will give an overview of the theoretical assumptions, as well as the literature on the aspects dealt with in this thesis, such as metrical representations, ternarity, Optimality Theory, Correspondence Theory, alignment and variation.

The issues discussed briefly above will be discussed below per language. In Chapter 3 and Chapter 4 we will look at Sentani. In Chapter 3 an extensive description of the language will be given, both of phonological and morphological aspects, as far as this is relevant for the understanding of the analysis of the stress patterns in Sentani. This Optimality analysis is given in Chapter 4. In this Chapter special attention will be given to several rhythmic aspects, such as clash and lapse

[6] The stress patterns of the bases and the output cannot be identical. Due to suffixation there is one extra syllable in the output forms, which may result in an extra foot and extra stress. The output-output constraint motivated in Chapter 6 demands that a syllable that is stressed in the base is also stressed in the output form, but not the other way around.

avoidance and non-finality of stress. Sentani gives us information about the definition of an anti-lapse constraint, which must be defined on the pure grid.

Chapter 5 and Chapter 6 are devoted to Finnish. Chapter 5 gives a brief description of several aspects of Finnish phonology and morphology. A description of the stress patterns in Finnish of words without suffixes, or stress patterns without any obvious effect caused by the morphology will be given. This description is followed by an extensive analysis of these phonological generalisations. Again this analysis will result in discussions of certain aspects of the metrical phonology as mentioned above, such as partial quantity sensitivity and variation.

In Chapter 6 the effects of morphology in Finnish are described and accounted for. The analysis of the phonological generalisations serve as the starting point. It will be shown how stress patterns that are the result of morphological effects, and the stress patterns that can be explained purely on the basis of phonological constraints interact, and how the constraints involved are given a place in the constraint hierarchy. Furthermore, it will be shown how the two morphological constraints that influence stress assignment interact with each other, and how output-output correspondence deals with variation, by evaluating only one base at a time.

Chapter 7 summarises the findings of this thesis. Furthermore, we will look at what we could call ‘truly ternary’ stress systems, and show that these are the result of further constraint interaction, using only constraints that were already motivated for binary stress systems. Without invoking special constraints, that specifically refer to ternarity, we will be able to account for the stress patterns of these truly ternary stress systems.

2 Theoretical assumptions

2.1 Introduction

This chapter provides background information on metrical theory and Optimality Theory. First, the representation of stress will be discussed, since this plays a role in the discussion of the analysis of Sentani stress. Second, an overview is given of the literature on ternary stress, and ways in which ternarity has been analysed. Some proposals have extended foot typology with ternary feet (Halle & Vergaud 1987, Levin 1988, Dresher & Lahiri 1991, Hewitt 1992, Rice 1992), whereas other proposals have accounted for these patterns with binary feet, in combination with ternarity specific parsing modes (Hammond, 1990, Kager 1993, 1994, Hayes 1995). Within the latter approach, there is a difference between rule-based versions (Hammond 1990, Hayes 1995, Kager 1993) and an Optimality variant (Kager 1994). A third proposal using binary feet has been given by Ishii (1996), which is an analysis in terms of Optimality Theory, which does not make use of ternarity-specific constraints. Finally, an outline of Optimality Theory and different aspects of this theory, such as Correspondence Theory, output-output correspondence, free variation and optionality, and alignment will be given.

2.2 Metrical representations

According to Liberman (1975) and Liberman & Prince (1977), stress has the following properties which all adequate representations on bounded stress should incorporate. First, *relative prominence*, which means that a syllable is strong with regard to its weak neighbours. Second, *culminativity*, which means that there is only one syllable that is strongest in the word, which is said to bear main stress. Third, stress is *hierarchical*, i.e., there are several levels of stress: primary, secondary, tertiary, and so on (however, many analyses only differentiate between primary and secondary stress). And finally, stress prefers a certain *rhythmic distribution*. In sufficiently long words, we find multiple stresses, which prefer to be distributed at even spacing, i.e., distances between stresses are more or less the same. Among such rhythmic patterns, the binary pattern is most common, that is, a pattern in which stressed and unstressed syllables alternate.

Originally, the properties of stress were represented by a binary branching tree structure, with end nodes at the syllabic level, grouped into metrical feet, which, in turn, were grouped into a word. This tree was combined with a grid structure derived from this tree (Liberman & Prince 1977). This developed into a so-called 'grid-only' representation (Prince 1983, Selkirk 1984), of which (1) is an example.

```
(1)                x     word level:      main stressed syllable
     x      x      x     foot level:      stressed syllables
     x   x  x   x  x x   syllabic level:  potential landing sites for stress
     à   pa là chi có la
```

All syllables are assigned a grid mark, because all syllables can, in principle at least, receive stress. Depending on the specific generalisations of a language, some syllables are more prominent than others, which is expressed by a second level of grid marks. Of these so-called strong beats one bears main stress, expressed by the extra grid mark on word level. This grid structure accounts for the above-mentioned properties of stress, such as: culminativity, rhythmic distribution, hierarchical organisation and relative prominence.

However, certain observations cannot be accounted for by the pure grid, for which it has been argued that an internal structure is needed. Such structures are expressed by groupings of syllables, which are, just like the groupings in the tree structure, called metrical feet. For a complete overview and explanation of the arguments in favour of metrical feet, the reader is referred to Hayes (1995) and Kager (1995). In short these arguments are: stress shift after a stressed vowel has been deleted, in which case stress shift to the right in left-headed feet, and to left in right-headed feet; second, phrasal stress shift (Rhythm Rule); third, certain aspects in the theory of prosodic morphology make use of templates the size of feet, such as reduplication and truncation; fourth, the minimum size of a content word in a language often equals the size of the feet used in that language.

In order to account for these aspects, a grid representation with internal structure was proposed. The representation that is currently used most frequently, is the bracketed grid (Halle & Vergnaud 1987).

```
(2)                 x      word level:      main stress
     (x      x      x   )  foot level:      the heads of the feet
     (x  x)  (x  x)(x  x)  syllabic level:  all syllables grouped into feet
      à  pa   là chi  có la
```

For the sake of brevity, Hayes (1995) conflates the syllabic level and the foot level, which results in the representation in (3), which is merely a notational variant, and not a conceptually different representation.

(3)
```
            x              word level
 (x   .)(x   .) (x   .)    foot level
  à   pa là chi có la
```

Below I will make use of both the pure grid and the bracketed grid. In principle, I assume an internal structure with metrical feet, but for some aspects of the discussion, I explicitly avoid reference to constituent structure, in which case I make use of the pure grid. This will be when discussing rhythmic distribution and clashes and lapses. When referring to aspects that obviously refer to metrical constituent structure, that is, whenever the discussion involves feet, the bracketed grid will be used, in which case I will use the notational variant as used in Hayes (1995).

2.3 Previous analyses of ternarity

The exact shape of feet is the topic of many discussions in the literature about metrical theory. Based on the analysis of bounded stress systems, whose stress patterns are generally binary, it has been argued that feet must be minimally and maximally binary (Prince 1980, McCarthy & Prince 1986, Kager 1989, 1993, Hayes 1995, and many others). But in accounts of ternary stress patterns, the question has been asked whether the foot typology with strictly binary feet should be extended with ternary feet, and if so, what the exact shape of these ternary feet is?

As already mentioned in Chapter 1, there seem to be only very few languages with a truly ternary rhythm, among which Cayuvava. To illustrate and compare different analyses of ternary stress, I will present earlier proposals to account for the stress patterns of this language, using either ternary feet (Halle & Vergnaud 1987, Dresher & Lahiri 1991), or binary feet in combination with a special parsing mode (Hayes 1995, Kager 1994). Both Halle & Vergnaud, Dresher & Lahiri and Hayes make use of a rule-based theory. Halle & Vergnaud analyse Cayuvava with 'flat' ternary feet, i.e., feet without internal structure, while Dresher & Lahiri's ternary feet are internally structured. Hayes, on the other hand, analyses Cayuvava using binary feet and a parsing mode which he calls Weak Local Parsing. Kager (1994) translated the idea of Hayes into an Optimality approach.[1] The stress patterns in Cayuvava are as in (4), (Key 1961, 1967).

(4)

a.	/σ́σ/	éɲe	'tail'
b.	/σ́ σ σ/	šákahe	'stomach'
c.	/σ σ́ σ σ/	kihíbere	'I ran'
d.	/σ σ σ́ σ σ/	ariúuča	'he came already'
e.	/σ σ̀ σ σ σ́ σ σ/	maràhahaéiki	'their blankets'
f.	/σ σ σ̀ σ σ σ́ σ σ/	ikitàparerépeha	'the water is clean'

[1] That Kager (1994) was able to make use of the idea of Hayes (1995) is due to the fact that Hayes' work has been circulating in draft versions as from 1991.

Since different authors use different forms in their examples for Cayuvava, below only abstract examples will be used to illustrate different accounts of Cayuvava. This makes it easier to compare the various methods.

2.3.1 Ternary feet

Halle & Vergnaud (1987) propose to account for stress with three binary parameters for foot form:

(5) Halle & Vernaud 1987 (p. 9-10)

a. Whether or not the head of the constituent is adjacent to one of the constituent boundaries. This parameter determines whether or not a constituent is head-terminal [±HT].
b. Whether or not the head of the constituent is separated from its constituent boundaries by no more than one intervening element. This parameter determines whether or not a constituent is bounded [±BND].
c. And for the [±HT] constituents the third parameter is whether they are left-headed or right-headed.

The combination [-HT] and [+BND] gives a ternary foot, the amphibrach:

```
(6) (. x  .)
    σ σ σ
```

Cayuvava stress results from right-to-left assignment of [+BND], [-HT] feet. The final syllable is assumed to be extrametrical, i.e., invisible for metrical structure.

```
(7a)  (.  x  .)( .  x  .)
       σ σ σ σ σ σ <σ>

(7b)  (x   .)(.  x   .)(.  x  .)
       σ  σ  σ σ σ  σ σ σ <σ>

(7c)  . (.  x  .)(.  x  .)
      σ σ σ σ  σ σ σ <σ>
```

Words consisting of 3*n* + 1 syllables (7a) are straightforward in the analysis of Halle & Vergnaud. After the final syllable has been made extrametrical, there are six syllables which are grouped into two ternary feet, stressing the antepenultimate syllable. An additional assumption is required for words consisting of 3*n* syllables (7b). After extrametricality and ternary feet (assigned from right to left), there are two syllables at the left edge at the word, which are parsed into a binary foot, of which the leftmost syllable is stressed. This foot looks to be [+HT]. But according to

Halle & Vergnaud a [-HT] foot may consist of at least two moras (a defective foot), as long as the distance between the heads of two adjacent feet is two unstressed syllables, hence the left-headedness of this defective foot. Finally, words consisting of 3*n* + 2 syllables are not exhaustively parsed (7c). If the word is exhaustively parsed, the initial syllable would be parsed into a monosyllabic foot, and since, according to Halle & Vergnaud, every foot must have a head, that initial syllable would bear stress. In that case a configuration arises that fails to obey the Recoverability Condition.

(8) *Recoverability Condition*. Given the direction of government of the constituent heads in the grammar, the location of the metrical constituent boundaries must be unambiguously recoverable from the location of the heads, and conversely, the location of the heads must be recoverable from that of the boundaries.

When the initial syllable is stressed, the place of the constituent boundaries cannot be uniquely determined, it may equally well be the result of a binary parse (cf. 9a, 9b).

(9a) (x)(. x .) (. x .)
σ σ σ σ σ σ σ <σ>

(9b) (x .) (x .)(. x .)
σ σ σ σ σ σ σ <σ>

Summing up, Halle & Vergnaud account for ternary patterns in Cayuvava with two parameters [±HT], [±BND] (which form the amphibrach), extrametricality and the Recoverability Condition. But their [-HT] parameter crucially states that the head *need not* be final, rather than that the head *is not* final in the foot, since a binary foot is allowed. Furthermore, the Recoverability Condition only serves one purpose in the work of Halle & Vergnaud, and that is to account for 3*n* + 2 words in Cayuvava (7c), which makes it an ad hoc condition, lacking independent motivation (Elenbaas 1992, Hayes 1995).

Dresher & Lahiri (1991) also assume ternary feet to account for Cayuvava. But, different from Halle & Vergnaud, these feet have an internal constituent structure. Dresher & Lahiri call this the resolved foot, which has a binary head (either on the syllabic or moraic level) and an optional non-head. With *resolved* is meant that two light syllables may take the position of one heavy syllable in the head of the foot. Dresher & Lahiri provide support for this foot from Siever's Law in Gothic, and High Vowel Deletion in Old English. We get a ternary foot in case two light syllables form the head of the foot, and the optional non-head is also present (10a).

(10) a. (x .) b. (x .)
$[\sigma_{\mu}\ \sigma_{\mu}]_{\mathrm{HD}}\ \sigma$ $[\sigma_{\mu\mu}]\ \sigma$

Dresher & Lahiri account for the stress pattern of Cayuvava with the resolved foot as in (10a). Since this language does not have heavy syllables, the head is bisyllabic. Resolved feet are assigned from right to left.

(11) a. ([σ́σ]σ)([σ́σ]σ)
b. σ([σ́σ]σ)([σ́σ]σ)
c. σσ([σ́σ]σ)([σ́σ]σ)

In this analysis, words consisting of 3*n* syllables (11a) are straightforward. Two full ternary feet are assigned. In words consisting of 3*n* + 1 syllables (11b), the initial syllable remains unparsed. There is not sufficient material to form a foot, not even to form a binary head. Words consisting of 3*n* + 2 syllables (11c), however, need an extra step in the derivation. After ternary feet have been assigned, two syllables remain at the left edge of the word. In principle, this is enough material to assign a foot consisting of a binary head, without the optional non-head. But in Cayuvava, the first two syllables in these words do not bear stress. Dresher & Lahiri argue that this is due to clashing heads, of which the leftmost is destressed.

(12a) (***[σ́σ]***)(***[σ́σ]***σ)([σ́σ]σ) → ***σσ***(***[σ́σ]***σ)([σ́σ]σ)

Kager (1996b) discusses two problems for this approach. First, taking two syllables together in a single head is not independently motivated for Cayuvava. Its only motivation is to account for destressing in a situation of clash, when heads are adjacent, as shown in (11). The second problem is that, when destressing of the leftmost head is an option, typologically we expect that in other cases the rightmost head may be destressed. An overlong sequence of unstressed syllables is then expected.

(12b) (***[σ́σ]***)(***[σ́σ]***σ)([σ́σ]σ) → (***[σ́σ]***)***σσ***σ([σ́σ]σ)

Since a non-head may not occur in a foot without a head, destressing of the rightmost head will result in a sequence of four unstressed syllables, of which three are unparsed. This is not attested in bounded stress systems and should be rejected on principled grounds, which the proposal of Dresher & Lahiri is unable to do.

2.3.2 Binary feet

This subsection presents a proposal that accounts for Cayuvava stress with binary feet. It will be shown how Hayes (1995) accounts for these stress patterns in rule-based phonology, using binary feet and the marked setting of the Foot Parsing Locality Parameter, i.e., Weak Local Parsing. Later in this chapter it will be shown how Kager (1994) uses this idea of Weak Local Parsing for a constraint in Optimality Theory.

Hayes provides metrical theory with a foot inventory, which lists the metrical feet with which the bounded stress systems are to be analysed. All these feet are minimally and maximally binary, either at the syllabic or the moraic level.

```
                    (. x)                       (x)
(13a)   Iamb: Form  LX if possible; otherwise form H.

                                (x  .)    (x)
(13b)   Moraic Trochee: Form L L, or H.

                                  (x   .)
(13c)   Syllabic Trochee:  Form (σ σ).
```

The iamb and moraic trochee take the syllable weight into consideration, and these are the feet used for quantity-sensitive stress systems. Since Cayuvava distinguishes between heavy and light syllables, the syllabic trochee is the foot used to analyse Cayuvava. But if the words are exhaustively parsed into syllabic trochees, this will, of course, result in a binary pattern. In order to obtain the ternary pattern, Hayes introduces the *Foot Parsing Locality Parameter*.

(14) *Foot Parsing Locality Parameter:*

a. Strong Local Parsing: When a foot has been constructed, align the window for further parsing at the next unfooted syllable (unmarked value of the parameter).

b. Weak Local Parsing: When a foot has been constructed, align the window for further parsing by skipping over L, where possible (marked value of the parameter).

Weak Local Parsing allows for skipping a single light syllable, resulting in non-adjacent feet. Since Cayuvava does not have heavy syllables, Hayes notes that Cayuvava might equally well be analysed with moraic trochees, since in a language without heavy syllables, these are equivalent to syllabic trochees. With this, he saves the generalisation that parsing skips over a single *light* syllable. In Chugach and Estionian, for which Hayes also demonstrates Weak Local Parsing, the syllable skipped is indeed a single light syllable.

Feet are assigned as follows: the final syllable is extrametrical, syllabic trochees are assigned from right to left, using Weak Local Parsing.

```
(15a)   (x   .)    (x   .)    (x  .)
         σ σ  σ  σ σ   σ σ σ<σ>

(15b)          (x  .)    (x    .)
         σ σ  σ σ  σ σ  σ<σ>
```

```
(15c)     (x  .)  (x  .)
        σ σ  σ σ  σ σ<σ>
```

In (15a) extrametricality and Weak Local Parsing result rather straightforwardly in ternary alternation in words consisting of 3*n* syllables. In (15c), as in any other word consisting of 3*n* + 1 syllables, to the left of the leftmost foot, only a single light syllable remains. This is the syllable to be skipped by Weak Local Parsing, as a result of which left edge of the word is reached, and this is where the parse ends. In words with 3*n* + 2 syllables (15b) to the left of the leftmost feet, two syllables remain, resulting in a double upbeat. Skipping one syllable still leaves one syllable. For Cayuvava it has been argued that it does not allow degenerate feet, which is supported by the word minimum, which is disyllabic. Parsing it into a foot would result in a degenerate foot. The material to the left of the leftmost foot is therefore not parsed, resulting in the double upbeat.

Instead of extending the foot typology with ternary feet, Hayes constrains metrical theory by accounting for ternary stress patterns with strictly binary feet. But this advantage is achieved at the expense of another ternarity-specific mechanism: the Foot Parsing Locality Parameter, with the parametric setting Weak Local Parsing, whose only goal it is to account for ternary stress patterns.

Kager (1994) translates the marked setting of the *Foot Parsing Locality Parameter* in a constraint for Optimality Theory. This is *FTFT, which states that feet must not be adjacent. Although this approach has certain advantages over rule-based accounts this Optimality Theoretic analysis still uses an ad hoc tool to account for ternary patterns. Before Kager's analysis within the framework of Optimality Theory is discussed, first an extensive outline of Optimality Theory will be given in section 2.4, and in section 2.5 I will go into some aspects of alignment. Readers who are familiar with Optimality Theory, may proceed to section 2.6.

2.4 Optimality Theory

In phonological theory as it was known before Optimality Theory was introduced, a surface form (output) was obtained by applying rewrite rules to an underlying form (input). One or more rules applied serially, and in a specific order, yielding the surface form.

These rewrite rules turned out not to be satisfactory, especially not with respect to explanatory adequacy. It became more and more evident that phonological rules often expressed operations that resulted in an output which somehow was more in line with unmarked phonological patterns. However, the rules which performed these operations often do not express express these more harmonic patterns, nor was there any explanation as to why phonological rules would strive for such patterns. Moreover, in specific circumstances it turned out that phonological rules seemed to 'conspire' to output a certain unmarked pattern (Kisseberth 1970). Such conspiracies could not receive a straightforward explanation and had to be dealt with by introducing mixed models (rules-cum-constraints) or so-called Repair-strategies (Paradis 1988). Various phonologists became increasingly aware of this situation, which resulted in grammars in which the more harmonic patterns were defined in terms of surface constraints, which form the core of the grammar. (Prince & Smolensky 1993, Goldsmith 1993).

The structural changes that phonological forms undergo to meet these constraints are considered to be uninteresting in themselves. So we see that the burden of explanation in phonological theory shifted from rules (operations) towards harmonic patterns (constraints).

The central idea of Optimality Theory is that Universal Grammar consists of a set of universal constraints which express requirements on well-formedness of the output. These constraints are ranked in a language-specific order. The highest ranked constraint is the most important one and must be satisfied. The less higher-ranked constraint can only be violated if that violation is necessary to fulfil the requirements of the highest ranked constraints. By this hierarchy, a set of output candidates, which results from a rather uninteresting part of the grammar, the generator, is evaluated. The candidate that fares best on a specific hierarchy, is called the optimal candidate and is the presumed surface form of the input.

(16)

→			[candidate$_1$] →			
→			[candidate$_2$] →			
/input/ →	$\boxed{\textit{Gen}}$	→	[candidate$_3$] →	$\boxed{\textit{Eval}}$	→	[output]
→			[candidate...] →			
→			[candidate$_n$] →			

Optimality Theory has shed light on phonological aspects that had so far remained unexplained, such as the problem of conspiracies, noted above. On the other hand, new data and analyses making use of Optimality Theory have provided further information about Optimality Theory itself.

In this thesis we will see examples of both these aspects. For example, both Sentani and Finnish display partial quantity sensitivity, as explained in Chapter 1. This is a problem for rule-based phonology, in which parameter settings are binary and repair strategies such as destressing in clash are necessary. In Optimality Theory, partial quantity sensitivity follows from constraint interaction. An example of the second type is variation and paradigmatic analogy in Finnish stress, which will be shown to give information about output-output correspondence in Optimality Theory. More specifically, it gives information about what constitutes the base in output-output correspondence, and how Optimality Theory, but more specifically, output-output correspondence deals, with variation (see Chapter 1, and section 2.8 below).

The analyses of Sentani and Finnish are both making use of the theoretical framework of Optimality Theory. Therefore in this chapter an outline will be given of several aspects of Optimality Theory, such as its basic principles and mechanisms (Prince & Smolensky 1993, McCarthy & Prince 1993), Correspondence Theory

(McCarthy & Prince 1994, 1995), output-output correspondence (McCarthy 1995, Benua 1995, 1997), alignment (McCarthy & Prince 1993) and variation in Optimality Theory (Kiparsky 1993, Hammond 1994, Reynolds 1994, Kager 1994, 1997, Anttila 1995, 1997).

As mentioned above, according to Optimality Theory Universal Grammar consists of a set of universal constraints (Con), a generator (Gen) which generates the candidate output forms, and a constraint hierarchy (Eval) which evaluates the candidate output forms with regard to how well they satisfy the constraints. In this section more information will be given about the candidate output forms, the types of constraints, and how the constraints evaluate the candidate forms.

2.4.1 Gen

Gen is a function that generates a set of output candidates. *Gen* is fairly unrestricted and can, in principle, generate an infinite set of logically possible output candidates, given an underlying form. However, according to Prince & Smolensky (1993) Gen is not an empty notion: "*Gen contains information about the representational primitives and their irrevocable relations: for example, that the node σ may dominate a node Onset or a node μ [...], but not vice versa.*" (Prince & Smolensky 1993). That is, the only restriction on Gen is that the output candidates must be made of licit elements from the universal vocabularies of linguistic representation. *Gen* generates all the candidate output forms in a single step. There is no step by step derivation, i.e., feet are not parsed from left-to-right, nor are there repair strategies such as destressing in clash. All candidates are generated at once.

2.4.2 Con

Constraints form the core of Optimality Theory. There are two types of constraints: *well-formedness* constraints and *faithfulness* constraints. The well-formedness constraints are also known as *markedness* constraints. If these constraints are ranked topmost in the hierarchy phonologically unmarked output forms are selected as optimal. Faithfulness constraints require the output to be identical to the input. The interaction of both types of constraints will eventually result in the output form. The degree of markedness of an output form, or how much difference there is between the input and the output depends on the precise interaction of the constraints.

For both types of constraints, the following characteristics hold. First, constraints are *universal.* All languages have the same constraints. It is the ranking of those universal constraints that is language particular, which results in different grammars for different languages.

Second, constraints are *violable*. Constraints may often express conflicting requirements. For example, assume an input, that has the syllable structure CVC. In that case conflicting constraints are, for example, a faithfulness constraint that requires that in the output nothing may be deleted from, nor added to, the input, and a well-formedness constraint which requires that syllables do not have a coda. It is then impossible to satisfy all constraints. One will therefore be satisfied at the cost of violating the other constraints. In this respect, Optimality Theory crucially differs from rule-based phonology, in which constraints and conditions were strict requirements that must be met.

But although violable, violation must be minimal, which means that when more output candidates fail to satisfy the requirements of a constraint, it is the candidate with the fewest violations that best satisfies the constraint. The candidate that best satisfies the constraint ranking, is the output form. This output form is also referred to as the *optimal* candidate. In the next section it is shown how constraints evaluate the candidates and how the optimal form is selected.

2.4.3 Eval

Another part of UG is Eval, a function that is ultimately responsible for selecting the optimal output. Furthermore, as already mentioned, it is the difference in ranking of the constraints that defines different grammars.

Eval operates on the candidate set provided by Gen on the basis of an input form, and selects one, and not more than one candidate as the optimal form. Eval consists of a complete ranking of constraints. A ranking is a fixed order of all constraints of UG. Constraints in a constraint hierarchy are ranked in a *strict dominance order*. Strict dominance means that one constraint takes absolute priority over another constraint, i.e., violation of a higher-ranked is constraint is worse than violation of a lower-ranked constraint. When there are conflicting constraints, violations of lower-ranked constraints may occur only to avoid violation of higher-ranked constraints. Another aspect of strict dominance is *transitivity*. If A strictly dominates B, and B strictly dominates C, then, by transitivity, A also dominates C (A » B, B » C, then A » C).

The evaluation of an input form by a (limited) set of constraints can be demonstrated by a so-called *constraint tableau*, which is a presentational device to demonstrate the ranking of constraints, as well as the satisfaction, versus violation of the constraints by the candidates. Consider (17) below:

(17) /H H H H L L /	*CLASH	WSP	PARSE-σ
→ a. [(H́H)(H̀ H)(ĹL)]		**	*
b. [(H́)(H̀)(H̀)(H̀L)]	*!**		
c. [(H́H)H(H́L)L]		**	**!

All candidates are evaluated by the hierarchy *in parallel*, i.e., they all go through the hierarchy together. The candidates that satisfy the highest ranked constraint, proceed to the next highest ranked constraint, and this is repeated until there is only one candidate left. When there is a tie, the candidates also proceed to the next constraint. Since these are all different candidates, at one point there must be a constraint for which there is no tie. The that candidate best satisfies the constraint hierarchy is the optimal form and is the output form assigned to the input.

Tableau (17) shows how strict dominance works: 17b is rejected due to the violation of high-ranked *CLASH. Candidates (17a) and candidate (17c) proceed. For WSP there is a tie. Both candidates violate the constraint twice. As shown in Chapter 1, in case of a tie, violations are not fatal. The next constraint in the hierarchy (PARSE-σ) now evaluates the two forms, and here there is no tie. Again both candidates violate the constraint, but since violation must be minimal, the candidate with the fewest violations wins. This makes *Candidate a* the optimal candidate.

Due to the strict dominance order, violation of higher-ranked constraints can be fatal, and the outcome of the evaluation on all lower-ranked constraints for this candidate becomes irrelevant. And that is why the optimal candidate may, in principle, have more violations than a candidate that is rejected.

(18) /input/	CONSTR.A	CONSTR.B	CONSTR.C
→ a. candidate α		*	**
b. candidate β	*!		*
c. candidate γ		**!	

In this example, the optimal candidate has overall the most violation marks, but does better on CONSTRAINT A and CONSTRAINT B than *Candidate β* and *Candidate γ.*

A constraint can either be evaluated categorically, or evaluation can be gradient. Categorical constraints are either violated or satisfied. An example of such a constraint is NOCODA: syllables have no coda. This constraint is either violated or satisfied, i.e., a syllable has a coda or it does not. A complex coda violates the constraint just as much as a simple coda, and does not result in multiple violations. Multiple violations only occur when more syllables violate the constraint.

(19)	NOCODA
a. CV.CV	
b. CV.CVC	*
c. CV.CVCC	*
d. CVC.CVC	**

A constraint whose evaluation is gradient can, of course, also be satisfied or violated. But violation may range from a minor violation to a really bad one. Examples of such constraints are some alignment constraints. Suppose we have a constraint that requires the right edge of a the prosodic word to coincide with the right edge of a foot (ALIGN-R (PrWd, R, Ft, R)). For every syllable that separates the right edge of the rightmost foot from the right edge of the word there is a violation, thus violation is gradient.

(20)	ALIGN-R
a. [(σσ)(σσ)(σσ)]	
b. [σ(σσ)(σσ)σ]	*
c. [(σσ)(σσ)σσ]	**
d. [(σσ)σσσσ	****

This discussion about gradient constraints has brought alignment into the discussion. Much more should said about alignment constraints, which form a constraint family, of which all members refer to edges.

2.5 Alignment

Stress is sensitive to prosodic edges. In descriptions of stress we often find that stress is on the first or second syllable from the left/right word edge, and for bounded stress systems, we also find that stress is adjacent to the left/right edge of the foot, etc.

More generally, many phonological and morphological descriptions make reference to edges of constituents. McCarthy & Prince (1993) mention some examples. First, in English, Garawa and Indonesian the normal right-to-left assignment of stress is interrupted word-initially. Second, affixation in Tagalog, in which the affix /*um*/ falls as near to the left edge of the stem as possible, as long as the final consonant of the affix /m/ is not syllabified as a coda. Third, the affix /*ka*/ in Ulwa falls immediately after the head foot of the Word. These, and other aspects that refer to edges, cannot be accounted for in a unified way in rule-based phonology. McCarthy & Prince (1993), however, argue that in Optimality Theory all these different phonological and morphological aspects, can be subsumed under a single family of well-formedness constraints. This family is called Generalized Alignment.

(21) **Generalized Alignment**
Align(Cat1, Edge1, Cat2, Edge 2) = $_{\text{def}}$
∀ Cat1 ∃ Cat2 such that Edge1 of Cat1 and Edge2 of Cat2 coincide
Where:
Cat1, Cat2 ∈ PCat ∪ GCat
Edge1, Edge2 ∈ {Right, Left}

Per alignment constraint the arguments must be specified: PCat and GCat can be a wide range of constituents, both phonological (PCat), morphological and syntactic (GCat). Each specification results in a different constraint from this alignment constraint family. In this dissertation only phonological and morphological categories are specified in alignment constraints, such as head of a foot, foot, prosodic word, affix, etc. The variables for the edges, Right or Left, speak for themselves.

As can be concluded from the definition, the order of the arguments between the brackets is not random. There is a considerable difference between ALIGN (PRWD, L, FT, L) and ALIGN (FT, L, PRWD, L). The first constraint requires the left edge of every prosodic word to coincide with the left edge of a foot, i.e., the prosodic word begins with a foot. Only the distance between the left edge of the word and the left the edge of the leftmost feet is evaluated. Thus in (22a) and (22b) the constraint is satisfied, but not in (22c).

(22) ALIGN(PRWD, L, FT, L)
  a. [(σσ)(σσ)σ]
  b. [(σσ)σ(σσ)]
  c. [σ(σσ)(σσ)]

The second constraint requires the left edge of every foot to coincide with the left edge of a prosodic word. In combination with PARSE-σ, this constraints is the Optimality Theoretic counterpart of directional, left-to-right, foot assignment. It forces all feet to be as much to the left as possible, therefore it is also referred to as ALL-FT-L. This constraint evaluates the distance between the left edge of every foot with regard to the left edge of the word. Every foot in the word that is not at the left edge of the word violates this constraint. And since this alignment constraint is a gradient alignment constraint, for every syllable separating the two edges there is violation mark. This constraint can only be fully satisfied if the prosodic word has only one foot, which is left aligned, as in (23).

(23) ALL-FT-L
  [(σσ)σσσ]

In bounded stress systems, however, we find multiple feet. McCarthy & Prince (1993) observe that this can only be obtained if PARSE-σ dominates ALL-FT-L. In the tableau below, under ALL-FT-L, for every foot a violation mark is given for every syllable that separates the right edge of the foot from the right edge of the word.

(24) input: /σσσσσ/	PARSE-σ	ALL-FT-L
a. [(σσ)σσσ]	**!*	
→ b. [(σσ)(σσ)σ]	*	**
c. [(σσ)σ(σσ)]	*	***!
d. [σ(σσ)(σσ)]	*	* **!*

As shown in this tableau, the only candidate that satisfies the alignment constraint (24a) is rejected as the optimal form, since it violates higher-ranked PARSE-σ. Of all other candidates, the one with fewest violations for ALL-FT-L is chosen as the optimal candidate, which is (24b), with both feet as much to the left as possible.

In Chapter 7 it will be shown that ALL-FT-R/L dominating PARSE-σ in combination with the anti-lapse constraint *LAPSE results in ternary alternation. This brings us back to our discussion of previous proposals to account for ternary stress patterns. Before our discussion of Optimality Theory and Alignment, three rule-based proposals were given. Two of these use ternary feet to account for the stress patterns of Cayuvava (Halle & Vergnaud 1987, Dresher & Lahiri 1991) and one uses binary feet and a special parsing mode (Hayes 1995). Below we discuss a proposal by Kager (1994), who translated the idea of Hayes into an Optimality Theoreric analysis.

2.6 Binary feet and *FTFT

Kager (1994) agrees with the idea of Hayes (1995), that in order to keep metrical theory maximally constrained, the foot typology should not be extended with ternary feet. Kager translates this idea into Optimality Theory. The special parsing mode Weak Local Parsing (WLP) is now the constraint *FTFT, which states that feet must not be adjacent. Contrary to WLP, *FTFT does not specify the distance between feet, it only stipulates that they should not be adjacent to each other. In order to prevent the feet from drifting too far apart, Kager proposes PARSE-2, which was already mentioned in Chapter 1. This constraint requires that of every two stress units, one must be parsed by a foot. According to Kager, the ternary pattern of Cayuvava can be obtained by the ranking *FTFT » PARSE-2 » ALL-FT-R.[2]

From the strictly ternary pattern in Cayuvava, it can be concluded that *FTFT must be undominated in this language. Another highly, though not undominated constraint is $\text{NONFIN}_{\text{FT}}$, which requires that the (rightmost) foot is not final in the word. This constraint accounts for antepenultimate stress.

(25) /σσσσσσσ/ 3*n*	*FTFT	$\text{NONFIN}_{\text{FT}}$	PARSE-2	ALL-FT-R
→a. [(σ́σ)σ(σ́σ)σ]				* ****
b. [σσσ(σ́σ)σ]			*!*	*
c. [σ(σ́σ)σ(σ́σ)]		*!		***
d. [σ(σ́σ)(σ́σ)σ]	*!			* ***
e. [(σ́σ)(σ́σ)(σ́σ)]	*!*	*		** ****
f. [σσ(σ́σ)σσ]			*!*	**

Here, (25a-c) and (25f) obey *FTFT. In (25b,f) there is only one foot, thus it vacuously satisfies the constraint that feet may not be adjacent. As a result, there is a sequence of three unparsed syllables in (25b). This violates PARSE-2, twice. In (25f) there are two sequences of two unparsed syllables, also violating PARSE-2 twice. Candidates (25a) and (25c) do not violate PARSE-2. They both have a ternary rhythm, of which the latter candidate violates $\text{NONFIN}_{\text{FT}}$, hence (25a) is the optimal candidate, with a rhythmic ternary pattern.

[2] Kager (1994) argues that PARSE-2 takes over the function of PARSE-σ. Therefore, we do not find this constraint in the tableaux below.

(26) /σσσσσσσσ/ 3n + 2	*FTFT	NONFIN$_{\text{FT}}$	PARSE-2	ALL-FT-R
→a. [σσ(σ́σ)σ(σ́σ)σ]			*	* ****
b. [σ(σ́σ)σ(σ́σ)σσ]			*	** ****!*
c. [(σ́σ)σ(σ́σ)σ(σ́σ)]		*!		*** ******
d. [(σ́σ)σ(σ́σ)(σ́σ)σ]	*!			* *** ******
e. [(σ́σ)σσ(σ́σ)(σ́σ)]	*!	*	*	** ******

In this example, ALL-FT-R plays a role in selecting the optimal candidate. Candidates (26a) and (26b) satisfy *FTFT and NONFIN$_{\text{FT}}$, and both violate PARSE-2 once. But in (26a) there are fewer violations for ALL-FT-R, since both the rightmost and the leftmost feet are closer to the right than in (26b), upon which ALL-FT-R selects the optimal candidate.

(27) /σσσσσσσ/ 3n + 1	*FTFT	NONFIN$_{\text{FT}}$	PARSE-2	ALL-FT-R
→a. [σ(σ́σ)σ(σ́σ)σ]				* ****
b. [(σ́σ)σ(σ́σ)σσ]			*!	** *****
c. [σσ(σ́σ)σ(σ́σ)]		*!	*	***
d. [(σ́σ)σ(σ́σ)(σ́σ)]	*!	*		** *****

Just as in (25), PARSE-2 selects the optimal candidate in (27). Candidate (27d) violates *FTFT. Penultimate stress in (27c) crucially violates NONFIN$_{\text{FT}}$ and pre-antepenultimate stress crucially violates PARSE-2 (27b), which results in the selection of (27a) with antepenultimate stress.

Contrary to rule-based approaches, this Optimality account of ternary patterns has the advantage that it does not build structures that later have to be deleted, adding an extra layer in the derivation. Furthermore, the constraint *FTFT avoids the additional stipulation of Weak Local Parsing (Hayes 1995), to the effect that only light syllables may be skipped. The amount of material left unparsed between two feet is minimal, which follows from minimal violation of other constraints, such as PARSE-2 and ALL-FT-L. However, just like all other previous proposals, Kager's analysis makes use of a ternarity-specific tool, the constraint *FTFT, whose only motivation is to account for ternary patterns.

As explained in Chapter 1, it will be shown in this thesis that none of these tools are needed to account for ternary patterns. The constraints already needed to account for binary patterns will also be shown to be able to account for Cayuvava. As is always the case in Optimality Theory, the language-specific ranking of constraints will give the grammar for that language. Ishii (1996) has given such an account for Cayuvava, i.e., binary feet, without a foot repulsion constraint such as *FTFT. Instead, he argues that his analysis does not need constraints whose only motivation is to account for ternary patterns. However, his analysis is problematic and does not fit in with the exposition in this section, whose purpose it is to demonstrate how several previous proposals have used ternarity-specific means to account for ternary stress. The analysis proposed by Ishii will therefore be demonstrated in Chapter 7, where a less complex analysis will be proposed that also exclusively makes use of independently motivated constraints. The difference in interpretation of the anti-lapse constraint as explained in Chapter 1 (parsing constraint versus a pure rhythmic constraint) will again play a crucial role.

Now, before turning to the analyses of the stress patterns of Sentani and Finnish and their implications for metrical theory, first other aspects of Optimality Theory will be described and discussed. For the analysis of Finnish we will have to make use of output-output correspondence, a variant of Correspondence Theory, which, in turn, is a subtheory of Optimality Theory.

2.7 Correspondence Theory

There is an identity relation between the input and the output, i.e., the output form is the candidate that best satisfies the constraint hierarchy, given a certain input. Faithfulness constraints, which require the output to be identical to the input, express this relation. Every change in an output candidate with regard to the input violates a faithfulness constraint. Examples of changes are deletion or epenthesis.

In the case of reduplication, this input-output relation does not exist between the output form of the reduplicant and an input form. The reduplicant has a segmentally empty input, while its form is dependent on the output, which it copies, or reduplicates. This output form is called the *base*. The reduplicant is required to be identical to the base. McCarthy & Prince (1993, 1994) call the relation between the base (output form) and the reduplicant (output form) a *correspondence* relation.

McCarthy & Prince (1995) note that relations between a base and its reduplicant, and those between an input and its output, are controlled by the same set of formal considerations. They therefore propose to extend the notion of correspondence, as introduced to account for the relation between a base and its reduplicant, to a more general notion of correspondence, which has resulted in *Correspondence Theory*. Correspondence is a relation that can be described as follows:

(28) *Correspondence* (McCarthy & Prince 1995)
Given two strings S_1 and S_2, **correspondence** is a relation $\Re$ from the elements of S_1 to those of S_2. Elements $\alpha \in S_1$ and $\beta \in S_2$ are referred to as **correspondents** of one another when $\alpha \Re \beta$.

The parallels between input-output faithfulness and between base and reduplicant identity are expressed in the Basic Model in (29).

(29) Basic Model (McCarthy & Prince 1995)

Input:	/Af_{RED} +		Stem/
			$\downarrow\uparrow$ *I-O Faithfulness*
Output:	R	$\leftrightarrow$	B
	B-R Identity		

In this model on the level of Input, we find the segmentally empty input of the reduplicant (Af_{RED}), and the input form for the base (Stem). On the level of Output, we find the reduplicant (R) and the base (B). The vertical arrows express the input-output relation between the stem and the base. The horizontal arrows express the relation between the base and the reduplicant.

There are a few important Faithfulness constraint families in Correspondence Theory, among which: MAXIMALITY, DEPENDENCE and IDENTITY(γF).

(30a) MAXIMALITY (MAX)
Every segment of S_1 has a correspondent in S_2 (no deletion).

(30b) DEPENDENCE (DEP)
Every segment of S_2 has a correspondent in S_1 (no epenthesis).

(30c) IDENTITY (γF) (IDENT(F))
Let α be a segment in S_1 and β be any correspondent of α in S_2. If α is [γF], then β is [γF] (no featural change).

These constraints each have a general schema that can be adapted to input-output faithfulness, base-reduplicant identity, and as we will see in the next section, also to output-output correspondence. In reduplication, input-output faithfulness and base-reduplicant identity each have their own set of constraints. These constraints are separate constraints, and thus they are ranked separately. Moreover, all constraints evaluate the candidates at once. It is not the case that first the output form for the input is selected, which is then the base for the reduplicant, and that a second round of evaluation selects the output form for the reduplicant. Consider the hypothetical example in (31) based on McCarthy & Prince (1995).

(31) /**RED**-tagtag/	MAX-IO	NOCODA	MAX-BR
→ a. **ta.ta**-tag.tag		**	**
b. **tag.ta**-tag.tag		**!*	*
c. **tag.tag**-tag.tag		**!**	
d. **tag.tag**-tag.ta	*!	***	*
e. **tag.ta**-tag.ta	*!	**	

With the ranking in (31a), where MAX-IO dominates NOCODA, and MAX-BR is dominated by NOCODA, the base will be identical to its output. Satisfaction of Max-IO induces violations for NOCODA. But due to its place below NOCODA, this constraint induces two violations of MAX-BR, resulting in incomplete reduplication and a reduplicant that does not have any coda.

2.8 Output-output correspondence

Base-reduplicant identity is a relation between two output forms of which the base, but not the reduplicant, can occur independently. According to Benua (1995, 1997) and McCarthy (1995), a correspondence relation also exists between two morphologically related, freely occurring output forms. In that case, the well-formedness of an output is evaluated with respect to its faithfulness to another output form. The output against which the other output form is evaluated is also called the base.

Within a short period the idea of output-output correspondence has received considerable support, not only in Benua's or McCarthy's work, but also Flemming (1995), Kager (1994, 1996a, to appear), Burzio (1996), Kenstowicz (1995,1996), Steriade (1996), to name only a few. Output-output correspondence has been used to explain several transderivational aspects such as prosodic circumscription, truncation, stem-based affixation 'cyclic' processes.

Output-output correspondence will also be used in in Chapter 6 of this thesis, to account for the way the morphology affects stress assignment in Finnish, in which the stress pattern of complex nouns with two suffixes is based on the stress pattern of complex nouns with one suffix. But to explain how output-output correspondence works, a simplified analysis, based on more detailed analyses by Benua (1995) and Kager (to appear) is given. In the Philadelphia-New York dialect of American English, there is allophonic variation between the front vowel that is tense [E] in closed syllables ending in certain consonants and in open syllables before Class 2 affixes. In open syllables before Class 1 affixes, the vowel is lax [æ].

(32)	*Unaffixed*		*Class 1 Affix*		*Class 2 Affix*	
	pass	[pEs]	passive	[pæ.siv]	passing	[pE.siŋ]

The constraints involved in the analysis of these forms are:

(33)	a.	$*æC]_\sigma$:	No [æ] in closed syllables.
	b.	*TENSE-LOW:	Low vowels are lax.
	c.	IDENT-IO(TENSE):	Let α be a segment in the Input and β be a segment in the Output. If α is [γtense], then β is [γtense].
	d.	IDENT-BA(TENSE):	Let α be a segment in the Base and β be a segment in the Affixed form. If α is [γtense], then β is [γtense].

(34) /pæs/	$*æC]_\sigma$	*TENSE-LOW	IDENT-IO (TENSE)
a. [pæs]	*!		
→b. [pEs]		*	*

The underlying form has a lax vowel. Before a coda this vowel is tense. This indicates that *æC]$_\sigma$ must dominate the other two constraints, which means that this well-formedness constraint dominates the faithfulness constraint.[3]

(35) input:/pæs, iŋ/ base: [pEs]	IDENT-BA (TENSE)	*æC]$_\sigma$	*TENSE-LOW	IDENT-IO (TENSE)
a. [pæ.siŋ]	*!			
→b. [pE.siŋ]			*	*

In (35), because the low vowel is in an open syllable both affixed forms satisfy *æc]$_\sigma$ vacuously. This constraint was responsible for the tense vowel in (34). Now that this constraint is satisfied we would expect *TENSE-LOW and/or IDENT-IO(TENSE) to decide in favour of a lax vowel. However, the output form has a tense vowel. This means that yet another constraint must dominate *TENSE-LOW and IDENT-IO. Benua argues that the tense vowel in (35) is due to output-output correspondence. The phonological information with respect to the tenseness of the low vowel of the output form [pEs] is copied to the output form [pE.siŋ]. The stem [pEs] acts as the base of evaluation of the affixed output candidates. The constraint that evaluates the affixed output candidates is IDENT-BA(tense), which must outrank *TENSE-LOW and IDENT-IO.

In Finnish, Correspondence Theory is also needed to account for certain stress patterns. The phonological information of complex nouns with one suffix, i.e., the stress pattern, is copied to the complex nouns with two suffixes. Interestingly, this copying of the stress pattern is optional, which brings us to variation.

2.9 Variation

This section will describe how Optimality Theory deals with optionality and variation. In Optimality Theory universal constraints and the languages-specific constraint hierarchy can lead to only one optimal form. The constraints are ranked in a hierarchy in strict dominance order. As a result it is impossible that two different candidates score identically in the evaluation. Therefore only one form comes out as the optimal form. How then does Optimality Theory deal with variation? Several proposals have been made to account for variation in Optimality Theory. These proposals will be discussed below.

Hammond (1994) proposes that variation may arise as a result of *incomplete* hierarchies. The hierarchy cannot decide in favour of one candidate or another. Two candidates score equally well for *all* constraints, and therefore the two output forms

[3] Both Benua and Kager argue that input-output faithfulness is ranked very low in the hierarchy and that the well-formedness constraints will always make the decision and that actually *TENSE-LOW also dominates IDENT-IO. This argument is not relevant to illustrate output-output correspondence for these forms and will be ignored here.

are selected as the optimal form. There are two arguments against this way of generating variation. First of all, it goes against the basic assumption of Optimality Theory that, given a constraint ranking, one and only one form is chosen as the optimal candidate. And in line of this argument, in a constraint hierarchy consisting of universal constraints, two different candidates cannot score equally well for all constraints. Constraints are universal, and given two different output candidates, at one point in the hierarchy there must be a constraint for which the two output candidates score differently, as a result of which one candidate is rejected and the other candidate is selected as the optimal candidate.

Other proposals have been made to account for variation in Optimality Theory. Below I will summarise the proposals of Kiparsky (1993), Reynolds (1994) and Anttila (1995, 1997). These proposals share two ideas. First, given a constraint ranking, only one form is selected as optimal. Second, two or more constraints may be left crucially unranked. This combination of selecting only one form as optimal, and leaving constraints crucially unranked will be further explored below.

The possibility of constraints being left unranked was already mentioned by Prince & Smolensky (1993). More specifically, in a grammar there are pairs of constraints that cannot be crucially ranked. Either order will give the same candidate as the optimal output. But according to Prince & Smolenky (1993), allowing this, opens the possibility of constraints that are crucially left unranked. They reject this idea because of lack of evidence to support this view. But this latter idea of crucially leaving two or more of constraints unranked, is exactly what accounts for variation in Optimality Theory (Kiparsky 1993, Kager 1994, Reynolds 1994, Anttila 1995, 1997).

Kiparsky (1993) proposes to account for variation by assuming different, complete constraint hierarchies for one language, each with its own ranking. If two constraints cannot be ranked, the solution is to assume that there are two complete hierarchies, each resulting in their own output. The speaker then chooses between these two hierarchies. If more constraints are not ranked with regard to each other, more complete constraint hierarchies co-exist.

Reynolds (1994) and Anttila (1995,1997) oppose to this that the co-existence of two or more different hierarchies implies the co-existence of two or more different grammars, i.e., a completely ranked hierarchy represents a grammar. Especially when the ranking of several constraints cannot be determined, this implies that there may be a huge number of co-existing grammars.

Instead of multiplying co-existing completely ranked hierarchies, Reynolds and Anttila propose a single constraint hierarchy in which some constraints have a motivated fixed order, but where other constraints may, or even *must* be left unranked. Reynolds calls these unranked constraints *Floating Constraints*, while Anttila calls this principle a *partial ordering*, but the basic concept is the same: a grammar consists of a set of constraints of which some are ranked, and others are not. A *total ordering* (Anttila), or *hard-ordered constraints* (Reynolds) are a special subset. Below I will focus on Reynolds, since it illustrates what will be shown for

Finnish, that there may be a constraint that may both take a high position and a low position in the hierarchy, as well as any position in between.

According to Reynolds (1994), there are always several hard-ordered constraints, but it may be the case that besides these ordered constraints, one constraint is not ranked with regard to these ordered constraints. This is the Floating Constraint.

(36) Floating Constraint

$$\text{CONW} \gg \left\{ \begin{array}{c} \text{.................CONX..................} \\ \\ \text{CONY}_1 \gg \text{CONY}_2 \gg \text{....CONY}_n \end{array} \right\} \gg \text{CONZ}$$

The Floating Constraint CONX is ranked with regard to CONW and CONZ, but it is not ranked with regard to any constraint lying between these two constraints. The Floating Constraint then, is *not* defined with regard to CONW and CONZ, but rather in terms of the subset of ordered constraints with regard to which the Floating Constraint is not ranked. Thus it may be in any position between dominating CONY_1 and being dominated by CONY_n. For Finnish we will see that a Floating Constraint may even be at any position in the hierarchy, i.e., as high as CONW, and as low as CONZ, and still result in only two variants. Constraint interaction of all other constraints prevent unattested candidates from being selected. This will be shown in Chapter 5 for phonological generalisations with regard to non-finality of stress, and in Chapter 6 for patterns which are the result of the effect of morphology. In both cases there is variation, and in both cases several possible constraint rankings result in only two variants, while other (incorrect) variants are rejected by hard-ordered constraints.

At this point it is useful to be explicit about the terminology used. A *grammar* is a *partial order* (Antilla 1995, 1997), in which two or more constraints must or cannot be ranked (*Floating Constraints* (Reynold 1994)). In a partial order, several *total orders* are possible. Each total order corresponds to a *tableau* which demonstrates these total orders. These tableaux need not agree on the output, in which case we have variation. The total number of possible total orders form the *input-output mapping* for a certain input.

(37)

$$\text{Input} \left\langle \begin{array}{lcl} \text{Total Order}_1 & \rightarrow & \text{Output}_1 \\ \text{Total Order}_2 & \rightarrow & \text{Output}_2 \\ \text{Total Order}_3 & \rightarrow & \text{Output}_3 \\ \text{Total Order}_4 & \rightarrow & \text{Output}_4 \\ \text{Total Order}_5 & \rightarrow & \text{Output}_5 \end{array} \right.$$

Al Output forms may be identical, which, for example, is the case when constraints cannot be crucially ranked, in which case every total order gives the same result. The output forms may also be different, which is the case when two or more constraints with conflicting requirements are crucially not ranked. In that case we get variation.

This concludes Chapter 2. We have seen how stress will be represented in the discussion below, using both ‘pure’ grids and bracketed grids. Furthermore, several previous analysis of ternary patterns were given, and for most it can be said that they make use of special tools whose only motivation is to account for ternary patterns, either a ternary foot (e.g. Halle & Vergnaud 1987, Dresher & Lahiri), or a special parsing mode (Hammond 1990, Kager 1994, Hayes 1995).

As a theoretical background to the analyses below, I have summarised the principles and mechanisms of Optimality Theory, as well as some subparts of Optimality Theory, such as Generalized Alignment, Correspondence Theory, output-output correspondence, and how Optimality Theory deals with variation. We will now turn to, the core of this thesis, the analyses of the stress systems of Sentani (Chapters 3 and 4) and Finnish (Chapters 5 and 6).

3 Sentani

3.1 Introduction

As explained in Chapter 1, the primary goal of this thesis is to place ternary patterns in the wider perspective of constraint interactions in bounded stress systems. A description by Cowan (1965) suggests that Sentani has ternary stress patterns, but that it combines those ternary patterns with binary patterns.

(1) "*… a secondary stress affecting the 3rd syllable forward from the main stress, or the 2nd syllable forward if this is closed by a consonant…*" *(Cowan 1965, p. 9).*

(2) a. [habə̀wnokokále] 'I struck him' (C.9)
b. [habə̀wkokawále] 'I have struck thee' (C.9)
c. [habə̀wdokóke] 'he hit me' (C.9)

The description and the data provided by Cowan are sufficient to conclude that Sentani has an interesting stress system, considering the goal of this thesis, but Cowan's are insufficient for an extensive and in-depth analysis. Independent data of Sentani were therefore collected by the author in the autumn of 1994. These data support the observation of Cowan that the Sentani stress system has both binary and ternary patterns. What is more, there are more circumstances in which we find ternary patterns than expected on the basis of the description given by Cowan. This is shown in the examples below, which are examples from my own data.

(3) *Binary*
a. [ikàwalɛ́re] 'for that I give it to you'
b. [kìɲənàsəbónde] 'they all will hand me over'
c. [molòkoxàwalɛ́ne] 'for I wrote to you'

(4) Ternary
a. [nàləkoxále] 'I felt something sharp'
b. [jɛ̀ndəboxéra] 'after we became better'
c. [molòkoxawále] 'I wrote to you'

This and the next chapter are devoted to Sentani. In Chapter 4 an analysis of the stress patterns of Sentani is given. It will be argued that the stress system of Sentani is binary and that constraint interaction relatively frequently results in a ternary pattern. In this chapter a description of some aspects of the phonology and morphology of Sentani that are relevant to the understanding of this thesis as well as an extensive description of the stress patterns in Sentani will be given.

3.2 The language and data

Sentani is a Papuan language spoken in northern Irian Jaya, the eastern most province of Indonesia, and the western half of New Guinea Island. Sentani is spoken on islands in Lake Sentani and on its shores, Southwest of Jayapura, the capital of Irian Jaya. It is related to three other languages: Nafri and Tanah Merah (Cowan 1965) and Nimboran (Anceaux 1965).

Sentani proper has three dialects, West, Central and Eastern Sentani. They are mutually intelligible. This especially holds for the Central and Eastern dialects, from which two the Western dialect is considerably different.

The data used for the analysis of the stress pattern of Sentani were collected by the author during fieldwork in Irian Jaya in the autumn of 1994. Data were collected from both the Eastern and Central dialects, but the majority of the data is from the latter dialect. Speech from two native speakers of the Eastern dialect, and from four native speakers of the Central dialect was recorded. All native speakers were able to read and write in their own language, using the orthography proposed by M. Hartzler (1976, 1987). Three of the native speakers of Central Sentani are involved in extensive research about Central Sentani carried out by Dwight and Margaret Hartzler for the Summer Institute of Linguistics (SIL).

The recordings consist of short utterances, stories and songs. The data were transcribed by the author, but some recordings were also transcribed by four other experienced phonologists. These are the recordings of two native speakers from Central Sentani, who were also involved in the research by SIL. Though aware that the author was doing research about stress, the transcribers were not biased, since they had no background in Sentani, and were left uninformed of the goal of the author's research. These data are analysed below in Chapter 4. First, however, in the remainder of this chapter, some aspects of Sentani are described in sections 3.3 and 3.4, and the stress patterns are described in section 3.5.

3.3 Sentani phonology

In this section, a description of some aspects of the phonology of Sentani will be given. Cowan (1965) and Foley (1986) describe the Eastern Sentani dialect. Hartzler (1976) and the grammar given in the introduction to the *Kamus Sentani-Indonesia-Inggris* (1993) describe the Central dialect. The latter is a Sentani-Indonesian-

English dictionary, henceforth referred to as *Kamus*. For this thesis, my own data collection is the fourth and principal source.

In this section about the phonology of Sentani, the following topics are discussed. First, the vowel and consonant systems of Sentani are described, as well as some forms of allophonic variation. The vowel and consonant systems are simple, but allophonic variation is very rich. This is especially the case for the consonant system. Second, instances of contraction and vowel deletion are described. In Sentani sequences of vowels can occur, albeit infrequently. Especially in verbs, morphophonemic processes are observed when two vowels of adjacent morphemes, either root and suffix, or two suffixes, meet. In that context, contraction occurs. Besides contraction, vowel deletion also occurs between two consonants, which results in consonant clusters. In general consonant clusters are rare in Sentani, due to a restriction on which consonants may occur syllable-finally. A description of vowel harmony is also given. Certain suffixes, optionally, copy the quality of the vowel of one of the adjacent syllable. The description concludes with the syllable structures, and the combination of syllables that may form a phonological word in Sentani.

3.3.1 Phoneme system

It has been observed (Foley 1986) that Papuan languages have a rather restricted vowel system, varying from three to eight phonemic vowels. As such, the seven vowel system of Sentani is one of the more complicated vowel systems.

(5) Sentani Vowels (Cowan 1965, Hartzler 1976, Foley 1986)

	Front					Back
High	i					u
		e		ə[1]	o	
			æ/ε[2]			
Low				a		

[1]According to Cowan (1965), there might be allophonic variation between /ə/ and /ɸ/, but in his examples he only gives /ə/, and not /ɸ/. M. Hartzler (1976) does not refer to such allophonic variation and uses only /ə/ in the relevant cases. Based on the notation of Cowan and Hartzler and the transcription of my own data I will use /ə/ in the relevant examples.

[2] The use of /æ/ versus /ε/ may be due to an interpretation difference, and not so much to a phonological difference between the two dialects. In Dutch, the native language of Cowan, /æ/ is not a phoneme, but /ε/ is. As such the difference between /æ/ versus /ε/ is not distinctive in this language. While in (American) English, the native language of Hartzler, both /æ/ and /ε/ occur as distinctive phonemes. Cowan’s system mentions the phonemes /ε/ and /e/, while Hartzler notes that Central Sentani has a phoneme /æ/ and a phoneme /e/, the latter varies with the allophone /ε/. In my own data (transcribed by several Dutch transcribers) only /ε/ and /e/ are noted as phonemes, just as is the case for Cowan. This points in the direction of a differences between the investigators, more than a phonemic differences. But whatever the reason for these differences, since I have not found minimal pairs that make crucial use of the distinction between /æ/ and /ε/ in the remainder of this work I will follow their transcription, when citing work of either one of the Hartzlers, otherwise /ε/ will be used.

The consonant system of Sentani is also relatively simple. There are only ten consonantal phonemes.

(6) Sentani Consonants (Hartzler 1976, Cowan 1965, Foley 1986)

	labial	labiodental	alveolar	palatal	velar	glottal
plosive	p		t	k		
nasal	m		n			
fricative		f				h
lateral			l			
glide		w		j[3]		

3.3.2 Allophonic variation

The vowel and consonant systems may be relatively simple, but the allophonic variation displayed in Sentani is complex, especially in consonants.

Allophonic variation of vowels is restricted and rather common, such as the tense-lax variation [i]/[I], [e]/[ɛ], [a]/[ɑ], [o]/[ɔ] before continuants, nasals, or consonant clusters.

(7) a.	[kɪŋ]~[kiŋ]	/kin/	'calf (of leg)'	(H.74)[4]
b.	[moxanalɛne]	/moxo-an-a-le-ne/	'because I do it for him'	
c.	[bɔɾowɑnde]	/boro-wo-an-le/	'we heard it'	
d.	[molɔnnəbɔnde]	/molo-nə-nə-bo-n-le/	'he will do/make for me'	

In the underlined syllables we see allophonic variation. These allophonic variations do not affect the stress patterns in Sentani. In other syllables we see examples of vowel contraction, which will be described below in section 3.3.3.

In Sentani the allophonic variation of consonants is much richer than that of the vowels. Most allophonic variations are free variations. Some variations, however, are contextually governed.

For plosives we see quite some allophonic variation. There is aspiration of /k/ and /p/ word-initially. Syllable-initially, aspiration of /t/ occurs, but word-initially it is flapped. Furthermore, we find post-nasal voicing of /k/ and /t/, and for both phonemes intervocalic weakening, or spirantisation is observed. There may be voicing of /p/ intervocalically.

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[3] Orthographically, Cowan and Hartzler differ in representing the palatal glide. Hartzler uses the Indonesian orthography where /y/ represents the palatal glide and /j/ the palatal-alveolar fricative. In Cowan (1965) /j/ represents the palatal glide and /ǧ/ the palatal-alveolar fricative. Below, the International Phonetic Alphabet is followed: /j/ represents the palatal glide and /dʒ/ the palatal-alveolar fricative.

[4] In the examples, (H) refers to Hartzler (1976), (K) refers to the dictionary, and (C) refers to Cowan (1965). When there is no such reference, the data are my own.

- The bilabial plosive /p/ varies with [p^{h}], [b] and [β]. Word-initially, /p/ is aspirated, word-medially, it varies with [b] and [β].

(8) a.	[axoβæ]~[axobæ]	/akopæ/	'friend'	(H.71)
b.	[p$^{(h)}$axa][5]	/paka/	'shoulder'	(H.71)

- /t/ varies with [t^{h}], [d] and [ɾ]. Word-internally, /t/ is aspirated before a front vowel. After a nasal, /t/ is voiced and becomes [d]. Before mid and back vowels, /t/ is flapped, both intervocalically and word-initially

(9) a.	[hot^{h}e]	/hote/	'plate'	(H.71)
b.	[nɛnde]	/nənəte/	'maybe'	(H.71)
c.	[ɾo]	/to/	'person'	(H.71)

- /k/ varies with [k^{h}], [g] and [x]. Word-initially and after /i/, /k/ is aspirated. The [g] is the result of post-nasal voicing, and [x] appears intervocalically, but not after /i/.

(10) a.	[k^{h}ai]	/kai/	'canoe'	(H.71)
b.	[məŋgəi]	/mə nəkei/	'claw'	(H.72)
c.	[joxu]	/joku/	'dog'	(H.72)
d.	[kɛwfik^{h}e]	/kɛ-w-hi-ke/	'he threw away'	(C.3)

For continuants we cannot make a similar generalisation as we made for the plosives.

- /h/ varies with /s/ and /f/. When preceded by /i/, /j/ or a nasal, /h/ is obligatorily realised as [s]. After /u/ or /w/, /h/ is realised as either [s] or [f], varying freely.

(11) a.	[ɛhe]	/ehe/	'yes'	(H.72)
b.	[kɛjsi]	/kɛ-i-hi/	'throw away!'	(C.3)
c.	[kɛwsike]	/kɛ-w-hi-ke/	'he threw away'	(C.3)
d.	[kɛwfike]	idem.	idem.	
e.*	[kɛwhike]	idem.	idem.	

- Nasals display homorganic assimilation, such as regressive assimilation and progressive assimilation of place of articulation. For example:

(12) a. /i/ + /n/ = [iɲ]
b. /n/ + /k/ = [ŋg]
c. /u/ + /n/ = [uŋ]
d. /m/ + /n/ =[nn]

[5] Hartzler (1976) gives examples that illustrate the use of the allophone [p^{h}], but in those examples only [p] is given, hence the use of parentheses.

Word-finally, the place of articulation of all nasals is neutralised. In Sentani, /n/ and /m/ are phonemes, while /ŋ/ is only an allophone of both. Word-finally there is free variation between those three. According to Hartzler (1976), the preferred word-final consonant for Central Sentani is [ŋ], whereas Cowan (1965) notes that the preferred word-final nasal for Central Sentani is [m].

(13)	a.	[maxeiɲa]	/makei-na/	'where'	(H.73)
	b.	[jango]	/janako/	'bush man'	(H.73)
	c.	[wauŋwe]	/waune/	'speak'	(H.73)
	d.	[ən no]	/əm no/	'banana tree trunk'	(C.7)
	e.	[juŋ]~[jun]~[jum]	/jum/	'head'	(H.73)

- /j/ varies with [dʒ]. After /i/ and /j/, the glide becomes an affricate.

(14)	a.	[ohej dʒo]	/ohej jo/	'the village Ohej'	(C.8)
	b.	[oidʒo]	/oijo/	'chicken'	(H.74)

In verb morphology, /l/ has several variants. Indicative verbs usually end in the morpheme /-le/. This morpheme has several possible appearances depending on the preceding vowel or consonant.[6]

3.3.3 Contraction

Compared to consonants, vowels are relatively stable as far as changing their quality is concerned, although we did see the tense-lax variation in (7). But relatively frequently, vowels are subject to contraction. This happens mainly in verbs when two vowels of different morphemes meet. This holds for the vowel of the root as well as for vowels of affixes. In general, it is the case that when two vowels meet, the rightmost vowel will survive, i.e., $V_1 + V_2 \Rightarrow V_2$. But when V_2 is /ə/, the leftmost vowel wins. And when V_1 is /e/ and V_2 is /a/, the result is [ɛ].

(15)	a.	[habonde]	/ho-a-po-n-le/	'we two will kill'	
	b.	[moxommilɛre]	/moko-əm-mi-le-re/	'for he will work for them'	
	c.	[jɛle]	/je-a-le/	'I climb'	(C. 20)

[6] Cowan notes that /l/ also varies with [d] in intervocalic position outside verb morphology. He notes that by non-native speakers of Sentani the intervocalic allophone [d] is often perceived and reproduced as *r*. From this it seems justified to conclude that Cowan's intervocalic [d] is a flap [ɾ]. When comparing Hartzler (1976) and the *Kamus* with Cowan (1965), we see that orthographic *d* in Cowan (1965) is written as *r* in the other works.

a.	odo '	foot' (C.86)	ai.	oro	'foot' (K141)
b.	dami	'snake' (C.77)	bi.	rami	'snake (K.147)
c.	ədə-	'see' (C.8)	ci.	ərə-	'look/see' (H.78)

3.3.4 Vowel deletion

Vowels may be deleted in interconsonantal position, depending on its context. Hartzler notes that when two adjacent open syllables with phonetically identical vowels appear in a word, and one of those vowels stands between a nasal to its left and another nasal, liquid, or stop to its right, this vowel will be deleted. This consonant to the left must be a nasal, since, according to Hartzler, nasals are the only consonants that can occur in coda position. When both vowels meet the criteria for deletion, the leftmost vowel will be deleted.

(16)	a.	[finda lau]	/finida lau/	‘star’	(H.74)
	b.	[jaŋgo]	/janako/	‘bush man’	(H.72)
	c.	[molɔnnəbɔnde]	/molo-nə-nə-bo-n-le/	‘he will do/make for me’	

Cowan (1965) notes a broader range of environments where interconsonantal vowels may be deleted, but this only holds for /ə/. When /ə/ stands between a glide or a nasal to its left and another consonant to its right, there is a tendency to delete this vowel. The consonants to the left of the vowel must be a glide or a nasal, since according to Cowan, these are the only consonants that can occur syllable-finally.

(17)	a.	[anke]	/anə-ke/	‘he ate’	(C.10)
	b.	[dowke]	/dowə-ke/	‘he took’	(C.10)

3.3.5 Vowel harmony

Instead of being contracted or deleted, monosyllabic morphemes that end in a schwa can also harmonise with the vowel quality of one of the adjacent syllables. This is optional, and the few cases found so far are harmony of habitualis /-jə-/ and of the 3 singular object morpheme /-nə-/[7].

(18)	a.	[moxoibojale]	/moko-i-bo-jə-a-le/	‘I am used to make/do something) every time’	(C.29)
	b.	[moxoibojojɛ]	/moko-i-bo-jə-jɛ/	‘you (sg) are used to make (something) every time’c	(C.29)
	c.	[honobobe]~ [honəbobe]	/ho-nə-bo-be/	‘you two slew (something) for him’	(C.34)
	d.	[hoiɲobo]	/ho-i-nə-bo/	‘kill something!’	(C.34)

In (18a) vowel contraction has taken place, but in (18b) the vowel quality of the habitualis morpheme /-jə-/ has assimilated to the preceding morpheme. In (18c) the quality of the object morpheme vowel has assimilated to the vowel quality of either the preceding stem or the following aspect marker. This word shows that vowel harmony is optional. Cowan claims that in (18d) vowel harmony is obligatory, since

[7] See section 3.4 for more information about verb morphology in Sentani.

stress falls on this syllable, and stress on Cə is avoided. However, this is not supported by the data collected by the author in (19).

(19)	a.	[moxònnópo]	/moko-əm-nə-bo/	‘you two will do (it) for him’
	b.	[moxònnə́le]	/moko-ən-nə-le/	‘he will do (it) for him’
	c.	[hojə́le]	/ho-jə-le/	‘he always kills’

In (19a) we see that main stress falls on a syllable that has assimilated, apparently to avoid stressing a Cə syllable, but in (19b,c) main stress falls on a Cə syllable, even though in both cases this could have been avoided by assimilating the vowel of this syllable.

3.3.6 Syllable structure and the phonological word

The syllable structures that occur in Sentani are V, CV, and CVC. Sentani lacks either complex onsets, or complex codas. There seems to be a preference for the core syllable CV. Only a few consonants can occur in syllable-final position, and therefore CVC does not occur very frequently.

There is no agreement between Cowan and Hartzler about the frequency of the occurrence of CVC syllables, since they do not agree about what constitutes a syllable-final consonant. According to Hartzler, the only phoneme that can constitute a syllable-final consonant is a nasal, while Cowan notes that both nasals and glides can be codas. On the other hand, according to Hartzler, vowel sequences occur, while Cowan believes they are rare.

Crucial here are high vowels versus glides. When comparing the sources, we very often find a glide for Eastern Sentani where Central Sentani has a high vowel.

(20)	a.	[daj]	(Eastern dialect)	‘daylight, daytime’	(C.77)
	b.	[awaw]	(idem.)	‘mother’s brother’	(C.76)
	c.	[rai]	(Central dialect)	‘noon’	(K.145)
	d.	[awau]	(idem.)	‘mother’s brother’	(K.17)

Based on my own data, which are mainly from Central Sentani, I tend to follow Hartzler in that there is a high vowel in those positions. But contrary to Hartzler, I conclude that the vowel sequence constitutes a diphthong, and not a sequence of V syllables. That there is a high vowel and not a glide, can be concluded from the morphophonemic change [-le] ~ [-te] in the verb ending. Hartzler (1976) notes that the verb ending [-le] becomes [-te] after a vowel sequence ending in /i/, but that the /i/ is deleted due to other vowel deletion processes (21a). When studying the data, there is no reason to assume that the same deletion process also holds for the glides.

For Eastern Sentani, however, we cannot conclude that there is a high vowel or a glide (i.e., a diphthong or a VC sequence), since it seems that in Eastern Sentani the [-le]~[-te] alternation does not occur. Cowan mentions the [-le]~[-de]~[-be]

alternation, but in the cases where Hartzler writes *i* and Cowan *j*, the morpheme /-le/ changes into [-de] and *j* is not deleted (21b).

(21) a.	[əxate]	/ə-kə-ai-le/	'they went'	(H.26)
b.	[məxəjde]	/mə-kə-əi-le/	'they two came'	(C.29)

The phonological word in Sentani consists of a single syllable or any combination of the syllables just mentioned. This means that the phonological word can even consist of a single vowel. Due to the preference of the core syllable, however, consonant clusters do not occur very frequently and if they do, they are often the result of interconsonantal vowel deletion. As a result of morpheme concatenation we also see geminates appear.

(22) a.	[jaŋgo]	/janako/	'bush man'	(H.73)
b.	[fiŋgi]	/finiki/	'thick'	(H.74)
c.	[wənnəle]	/wə-ən-nə-le/	'he will tell him'	
d.	[moxommile]	/moxo-ən-mi-le/	'he will do/work for them'	

To sum up, this section on Sentani phonology has provided an overview of phonological information relevant to understand the outline of the morphology, and the analysis of stress in Sentani. We have discussed the phoneme system in Sentani, the kinds of allophonic variation that occur, where and when vowel contraction and vowel deletion takes place, what possible syllables there are in Sentani, and how the phonological word is formed. For a more detailed description of Sentani phonology the reader is referred to Cowan (1965) and Hartzler (1976).

3.4 Sentani verbal morphology

In this section, an outline of the verbal morphology of Sentani will be given. For this outline, the sources are again Cowan (1965), D. Hartzler (1976), M. Hartzler (1976), Kamus (1993) and my own data.

The morphology of nouns is limited in Sentani, while the verbal morphology is rich. Since only relatively long words are informative about secondary stress, and since nouns are relatively short, this work will concentrate on verbs and therefore only the verbal morphology will be discussed.

Sometimes it is difficult to identify the morphemes, because of the contraction of vowels that takes place, or the reordering of morphemes. No attempt is made to fully analyse and describe the verbal morphology of Sentani. In order to get more in-depth insight into the morphology of Sentani, the reader is referred to Cowan (1965) and Hartzler (1976).

Sentani is an agglutinative language, and as a result, the verbal morphology is very rich, i.e., there are many affixes that can be added to the verb. But besides its richness, the verbal morphology of Sentani is also very complex. For example, the form of the subject affixes depends on the tense, and the form of the object affixes depends on both the number of the subject and the tense of the verb. Furthermore, there seem to be complex rules that determine the order of the morphemes in the verb. There is a basic order for the morphemes in the verb, but almost all morphemes are subject to reordering, depending on other affixes in the word. Verbs that consist of one or two roots with their own inflection are even more complex.

For a correct understanding of the analysis of the stress pattern of Sentani it is not essential to fully understand which morphemes change places and when. consequently the outline presented below only gives the reader a basic idea of what is going on in the verbal morphology of Sentani, so that one understands the underlying structure given in the examples throughout the remainder of this chapter and in the next chapter.

3.4.1 Basic order

The basic order of morphemes in verbs is as in (23) (cf. *Kamus*):

(23) *Verb structure, basic order*
Root - Tense/Aspect - Subject pers/nr - Object pers/nr - Verb Ending (Mood)

(24) [ərannəle]	/ərə-∅-an-nə-le/	'we all see him'
	see-present-1spl [8]-3osg-indicative (ind)	

The actual order of the suffixes depends on a combination of factors, including subject number, tense and aspect. Because of obligatory inflection, it is impossible to give examples of verbs using only the root and the relevant morpheme, so the examples will always include several affixes, which may not always be immediately relevant to the discussion.

3.4.2 Subject

Verbs in Sentani are marked for subject person and number by a single suffix. Sentani makes a distinction between singular, dual and plural.

(25) Subject morphemes[9]

singular	*dual*	*plural*
1 -a-	1 -ən-	1 -an-
2 -ɛ-	2 -eu-	2 -au-
3 -∅-	3 -ei-	3 -ai-

[8] *ssg* = subject singular, *sdu* = subject dual, *spl* = subject plural.
osg = object singular, *odu* = object dual, *opl* = object plural.

[9] With subject 2du/pl and 3du/pl we find the same difference between Cowan (1965) and Hartzler (1976) with regard to i/j versus u/w as discussed in section (3.2.5). Unless I explicitly cite Cowan, I will follow Hartzler's transcription.

These subject suffixes are used in the present, imperfect and past tense.

(26) a.	[ərale]	/ərə-***a***-le/	‘I see’
		see-1ssg-indicative	
b.	[ərarɛ]	/ərə-ar-***ɛ***/	‘you see me’
		see-1osg-2ssg	
c.	[ərəle]	/ərə-***ø***-le/	‘he sees’
		see-3ssg-indicative	
d.	[borowande]	/boro-wo-***an***-ne-le/	‘we have all heard it’
		hear-imp.-1spl-3osg-indicative	

3.4.3 Tense

Cowan and Hartzler differentiate four tenses in Sentani: present, past, imperfect and future tense.

Present tense. The least complicated of the tenses is the present tense. The past, imperfect and future tenses all come with a specific affix. The present tense can be recognised by the absence of such a affix.

(27) *Present tense: no tense marker*

a.	[əranale]	/ərə-an-a-le/	‘I see it/him’
		see-3osg-1ssg-indicative	
b.	[ərale]	/ərə-a-le	‘I see’
		see-1ssg-indicative	
c.	[moxanale]	/moxo-an-a-le/	‘I do/make (it) for him’
		do/make-3osg-1ssg-indicative	

Past tense. The past tense affix is /-kə-/. The best way to identify the root of the verb is to look at the form that expresses past tense whose subject is first person singular. The root is the morpheme immediately preceding the past tense suffix.

(28) Past tense: /-kə-/

a.	[ərəxanale]	/ərə-kə-an-a-le/	‘I saw it/him’
		see-past-3osg-1ssg-indicative	
b.	[ərəxale]	/ərə-kə-a-le/	‘I saw (it)’
		see-past-1ssg-indicative	

Imperfect. The suffix for imperfect is /-wo-/. Again the final vowel of this suffix may be subject to contraction.

(29) Imperfect: /-wo-/

a.	[məwale]	/mə-wo-a-le/	‘I have come’
		come-imperfect-1ssg-indicative	

b.	[borowande]	/boro-wo-an-ne-le/ hear-imperfect-3spl-3osg-indicative	'we pl. have heard it'
c.	[məwole]	/mə-wo-le/ come-imperfect-indicative	'he has come'

Future. Above it was shown that the past tense and imperfect have separate suffixes for tense and subject. The present tense has no suffix (i.e., a zero-affix). The future tense is marked by a single combined subject/tense marker. This subject/tense marker is different from the subject suffixes for the other tenses.

(30) Combined future tense/subject marker

singular	*dual*	*plural*
1 -re-	1 -a-	1 -ma-
2 -eu-	2 -∅-	2 -əm-
3 -ən-	3 -nei-	3 -nai-

Furthermore, the future tense has a future marker, a nasal, before the final suffix, the verb ending, but this future marker is not obligatory and depends on the presence of an aspect marker.

(31) a.	[aneumakonde]	/anə-u-***ma***-ko-***n***-le/ eat-[...[10]] -1pl/fut-aspect-fut.-ind.	'we all shall eat'	(H.24)
b.	[əmale]	/ə-***ma***-le/ go-1pl/fut-ind.	'we all shall go'	(H.24)

3.4.4 Object

The verb is also marked for the object. As was the case for the subject, the object also distinguishes between dual and plural. The suffixes denoting the object express both the direct and the indirect object, the interpretation depending on its context.

(32) [moxanale]	/moko-***an***-a-le make-3osg-1ssg-ind.	'I make (it) for him'

The form of the object suffixes depends on subject person and number, and on tense. The non-future tenses 1ssg and 2ssg have other object suffixes than the non-future tenses 3ssg-3spl. The object suffixes in the future tense are the same as for the non-future tense 3ssg-3spl.

[10] The exact meaning of this morpheme remains uncertain (see section 3.4.5)

(33) Object suffix when non-future and 1 subject-singular/2 subject singular:

singular	*dual*	*plural*
1 -ar-	1 -am-	1 -am-
2 -au-	2 -b-	2 -am-
3 -an-	3 -ame-	3 -ame-

(34) Object suffix when non-future 3 subject-singular - 3 subject-plural, or future tense:[11]

singular	*dual*	*plural*
1 -rə-	1 -mə-	1 -mə-
2 -ei-	2 -ə-	2 -əm-
3 -nə-	3 -mi-	3 -mi-

Not only is the suffix different when 1ssg and 2ssg are used, the subject and object also change places in the verb.

(35) a.	[əraræ]	/ərə-***ar***-ɛ/ see-1osg-2ssg	'you see me'	(H.28)
b.	[əramæle]	/ərə-***ame***-a-le/ /see-3opl-1ssg-indicative	'I see them'	(H.28)
c.	[əraimi]	/ərə-ai-***mi***/ see-3spl-3opl	'they see them'	(H.29)
d.	[ərəxaimi]	/ərə-kə-ai-***mi***/ see-past-3spl-3opl	'they saw them'	(H.30)

3.4.5 Aspect

Another verbal suffix is the suffix denoting aspect. Cowan observes four different aspect markers in what he calls secondary verbs (as opposed to primary verbs that do not contain an aspect marker). These four types of aspect markers are:

- directive aspect; expresses direction in both space and time:
  /-mə-/, /-ə-/, /-ho-/ ([-so-, -fo-]), /-o-/, /-me-/, /-di-/
- objective aspect: expresses action of the verb with regard to the object:
  /-ko-/, /-hi-/ ([-si-, -fi-]), /-ha-/ ([-sa-, -fa-])
- medial aspect: expresses the action of the verb with regard to the subject
  /-bo-/
- reflexive:
  /-nu-/

[11] Under certain conditions -nə- may be -nən- or -nəm-, and -mi- maybe -mim-or -min- and -ə(m)- (2du/pl) or -məm-. See Cowan (1965) for details.

In verbs with an aspect suffix and a singular subject we find /-u-/ or /-w-/ between the root and the aspect suffix. The exact meaning of this morpheme or discontinuous part of the aspect suffix remains unclear.

(36)	a.	[dilowdəhonde]	/dilo-***w***-də-ho-n-le/	‘I shall dive over/across’
	b.	[hineumiboxera]	/hine-***u***-mi-bo-kə-le-ra/	‘so that he honoured them’

3.4.6 Mood

The most frequently found mood in Sentani is the indicative. This is marked by the verb final suffix /-le/, which can have several appearances depending on the preceding vowel or consonant, as described above in (10).

(37)	a.	/-le/ → [-le]/ V__	[məxale]	/mə-kə-a-le/	‘I came’
	b.	/-le/ → [-de]/ n __	[məxənde]	/mə-kə-ən-le/	‘we two came’
	c.	/-le/ → [-be]/{m, u} __	[məxaube]	/mə-kə-au-le/	‘you all came’
	d.	/-le/ → [-te]/ Vi __	[məxate]	/mə-kə-ai-le/	‘they all came’

When the verb is in the past tense, and the past tense suffix immediately precedes the indicative, the two suffixes are contracted: /-kə/ + /-le/ = [-ke].

(38)	a.	[beukoxe]	/be-u-ko-kə-le/	‘it floated’
	b.	[halukoxe]	/halu-ko-kə-le /	‘it is bailed out (from canoe)’
	c.	[haxomiboxe]	/hako-mo-bo-kə-le /	‘he obeyed/followed them’

3.4.7 Habitualis

The suffix that expresses a continuous or repetitive event is the discontinuous habitualis suffix: /...i...jə.../.

(39)	a.	[moxoiməjəle]	/moko-***i***-mə-***jə***-le/ do-hab-1odu-hab-ind	‘he always does for us two’
	b.	[moxoipojanale]	/moko-***i***-bo-***jə***-an-a-le/ do-hab-aspect-hab-3osg-1ssg-ind	‘I always do it for him’

3.4.8 Verb serialisation

One type of verb that is very complex is that consisting of two roots with individual inflection. The entire verb ends in an indicative marker. This suggests that this type of verb should be considered to be a single complex verbs, and not a phrase. The meaning of the compound verb may either be a series of events expressed by the two roots (40a), or it may have a single meaning (40b).

(40) a. [məxɛnəxəwoyɛ] /***mə***-kə-ɛ#***nəkə***-wo-(j)ɛ/ 'you came and lived here'
come-past-2ssg-stay/live-imp-2sg
b. [əxanəxəwale] /***ə***-kə-a#***nəkə***-wo-a-le/ 'I started living/dwelling on'
go-past-1ssg-stay/live-imp-1ssg-ind

3.4.9 Modality

There are a few morphemes that express the actor's desire or intention to perform the event expressed by the verb.

(41) a. /-ne/
b. /-na/
c. /-re/
d. /-ra/

The data are too limited to give a conclusive analysis of the exact meaning of these morphemes. In the verb they appear to the right of the indicative marker.

(42) a.	[rowəndɛre]	/rou-ən-le-***re***/	'so that he will take'
b.	[ufəndɛra]	/u-rə-ən-le-***ra***/	'after I will talk to him'
c.	[moxanalɛne]	/moko-an-a-le-***ne***/	'because I do (it) for him'
d.	[nolonnəna/	/nolonnə-***na***/	'because half'

The above outline of the morphology of Sentani has shown that the language has a rather complex verb system. The verb is inflected for mood, tense, aspect, subject and object. The exact forms of the morphemes that belong to the various topics depend on the form of other morphemes. With the help of the outline just given, the reader should now be able to understand the morphology and structure of the verbs given in the examples below.

3.5 Sentani stress

As already mentioned above, Sentani has an interesting stress system, since it combines several stress patterns. In Sentani we find words with ternary patterns, binary patterns and stress clashes. In this section, the placement of main and secondary stress is described. These descriptions form the input for the analysis of the stress patterns in Chapter 4. In order to be able to give an analysis of the stress system we have to look for generalisations in the placement of main and secondary stress. In the subsections below we look in more detail at the stress patterns of Sentani. We will see what the position of main stress is and what the possible landing sites for secondary stress are.

3.5.1 Main stress

If the final syllable is light, main stress falls on the penultimate syllable.

(43)	a.	[hojə́le]	/ho-jə-le/	‘he always kills’
	b.	[fomále]	/fo-ma-le/	‘we all will go across’
	c.	[moxànále]	/moko-an-a-le/	‘I do (it) for him’
	d.	[ahùnəkóxe]	/ahunə-ko-kə-le/	‘he tied together’
	e.	[jaròmaxónde]	/jaro-ma-ko-n-le/	‘we all will take (it)’
	f.	[molòkoxàwalɛ́ne]	/molo-ko-kə-aw-a-le-ne/	‘for I wrote to you’

If the final syllable is heavy, main stress will fall on this final syllable. Closed syllables and diphthongs are heavy, open syllables are light.

(44)	a.	[ɾàmbún]		‘good’
	b.	[ànnuwáu]		‘place’
	c.	[əràmám]		‘food’
	d.	[omòxojéi]	/ə-moko-jə-i/	‘not do’

As already mentioned in the section 3.3, only nasals can fill coda positions and only diphthongs may form a branching nucleus. Only a few word-final suffixes end in a nasal or a diphthong. Inflected verbs mostly end in CV, as a result of which final heavy syllables are relatively rare. Nevertheless, all words ending in heavy syllables are stressed in my data.

3.5.2 Secondary stress

In principle, secondary stress seems to be on the second syllable, and in sufficiently long words on every other even-numbered syllable.

(45)	a.	[moxànále]	/moko-an-a-le/	‘I do (it) for him’
	b.	[haxòmibóxe]	/hako-mi-bo-kə-le/	‘he followed them’
	c.	[molòkoxàwalɛ́ne]	/molo-ko-kə-aw-a-lɛ-ne/	‘because I wrote to you’
	d.	[xəlàrəmìkoxále]	/kəlarə-mi-ko-kə-a-le/	‘I separated them’

Like main stress, secondary stress is quantity sensitive. If the initial syllable is heavy, secondary stress is on this first syllable.

(46)	a.	[ɾàmbún]		‘good’
	b.	[ànnuwáu]		‘place’
	c.	[nàndólo]		‘current (water)’
	d.	[ràisixáte]	/ra-ai-hi-kə-ai-le/	‘they put down’

Other cases in which we see initial stress is when the initial syllable is a CV syllable, while the second syllable is an open syllable ending in schwa. In (47) we see minimal pairs with regard to syllable structure, i.e., all syllables are open, but they differ in vowel quality. What we see is that stress has ‘shifted’ to the left, to avoid stressing the open syllable ending in schwa.

(47) a.	[moxànále]	/molo-kə-an-a-le/	‘I do (it) for him’
ai.	[àxəláne]	/axəla-ne/	‘in the forest’
b.	[ikàwalɛ́re]	/i-kə-aw-a-le-re/	‘for that I give it to you’
bi.	[xànəmikóxe]	/kanə-mi-ko-kə-le]	‘he called them’

Due to the fact that the initial syllables are stressed, the stress pattern is ternary (47bi,bii). In (48) stress is also on the initial syllable to avoid stress on the schwa, but here the word is sufficiently long to assign an additional secondary stress, resulting in an alternating pattern, starting from the initial syllable.

(48) a.	[kìɲənàsəbónde]	/kiɲə-nai-rə-bo-n-le/	‘they all will hand me over’
b.	[fèiɲəbòxawále]	/feiɲə-bo-kə-aw-a-le/	‘I washed you’

The examples in (47) show that there is a difference between full vowels and schwa. Full vowels are more easily stressed than schwa-syllables, but this does not mean that schwa cannot be stressed. Even main stress can be on schwa (43a, 49b). And if both the first and the second syllable end in schwa, secondary stress is on the second syllable, analogous to words beginning with a CVCV-sequence (where V is a full vowel). Compare (47a) with (49).

(49) a.	[ənə̀tɛ́re]	/ə-nei-le-re/	‘they two will go’
b.	[ələ̀jə́le]	/ələ-jə-le/	‘he always talks’

Closed syllables with a schwa, however, behave like other closed syllables. In (50) they are stressed, just like other word-initial closed syllables. Compare (46c,d) with (50).

(50) a.	[nə̀ŋhíke]	/nə-u-nə-hi-kə-le/	‘he pushed it away’
b.	[wə̀nnə́le]	/wə-ən-nə-le/	‘he will tell him’
c.	[ufə̀ndɛ́re]	/u-rə-ən-le-re/	‘after I will talk to him’
d.	[rowə̀ndɛ́re]	/rou-ən-le-re/	‘after he will take’

Heavy syllables do not receive stress under all circumstances. In the following examples, heavy syllables do not receive stress.

(51) a.	[xəlɛ̀waimíle]	/kələ-u-wo-ai-mi-le/	‘they taught him’
b.	[hilɛ̀mbondɛ́re]	/hilə-əm-bo-n-le-re/	‘for he will calm down’
c.	[nobɛ̀nnɛŋgondɛ́re]	/nobə-ən-nə-ko-n-le-re/	‘for he will come near to it’

In the analysis presented in the next chapter it will be argued that these heavy syllables remain unstressed because of clash avoidance. But even though from these examples we might conclude that Sentani avoids stress clashes altogether, they do occur, as the examples below show.

(52)	a.	[ɾàmbún]		'good'
	b.	[nàndólo]		'current (water)'
	c.	[moxànále]	/molo-kə-an-a-le/	'I do (it) for him'
	d.	[ələ̀jə́le]	/ələ-jə-le/	'he always talks'
	e.	[molàigóxe]	/molo-ai-ko-kə-le/	'they all wrote'
	f.	[molònasəhàndéra]	/molo-nai-re-ho-an-le-re/	'after they will bury me'
	g.	[əxàikɛləwàimíle]	/ə-ko-ai-kə-ələ-wo-ai-mi-le/	'they went and taught them'

It will be argued that the examples in (52a-e) respect the requirement that words must begin and end with a foot. In (52a), both heavy syllables have their own monosyllabic foot. In (52b), the initial syllable has its own monosyllabic foot, while the final two syllables form a binary left-headed foot. Examples (52c-e) all have two binary feet, a right-headed initial foot and a left-headed final foot.

In (52f,g), the words are sufficiently long for an extra secondary stress. In (46c) we saw a binary pattern, without a clash. Here we see a ternary pattern with a clash. For (52f,g) it will be argued that this clash results from a complex interaction of several constraints that hold for Sentani stress, such as avoidance of stressing an open syllable ending in schwa, avoidance of final stress, as well as restricting the sequence of unstressed syllables, i.e., avoidance of a metrical lapse.

Overlong sequences of unstressed syllables (i.e., lapses) are avoided in Sentani. The maximum number of adjacent unstressed syllables is two. This is an observation that holds for almost all bounded stress systems, and which will be accounted for in the next chapter. In the examples given above, several words have a ternary pattern. They are brought together in (53).

(53)	a.	[xànəmikóxe]	'he called them'
	b.	[nàləkoxále]	'I felt something sharp'
	c.	[nobɛ̀nnɛŋgondɛ́re]	'for he came near to it'
	d.	[molòkoxawále]	'I wrote to you'
	e.	[əxàimoxowáte]	'they went and worked'
	f .	[molònasəhàndéra]	'after they will bury me'
	g.	[əxàikɛləwàimíle]	'they went and taught them'

The ternary patterns in the words in (53) are caused by different causes factors. Interaction of different requirements force the binary pattern to be disturbed, resulting in either a clash (52) or a ternary pattern (53). In sum, when we look at the stress patterns, it seems that the stress system of Sentani has many contradictions. There seem to be patterns that are arguably the result of quantity sensitivity, avoidance of final stress, stress clashes and stressing open syllables ending in schwa. But, on the other hand, we also see patterns with unstressed heavy syllables, as well as with final stress, stress clashes and stress on open syllables that end in schwa. As will be shown in the next chapter, these apparent contradictions can well be accounted for by Optimality Theory.

4 The analysis of Sentani Stress

4.1 Introduction

In the previous chapter we saw a description of several aspects of Sentani. Sections 3.2 to 3.4 served as background information allowing a full understanding of the analysis of the stress system of Sentani. The description of the stress patterns in Sentani was given in section 3.5. There it was shown that Sentani combines binary and ternary stress patterns. Furthermore, it seems that there are quite a few contradictions in the stress patterns. Heavy syllables attract stress as shown in (44) and (46), but it was also shown that, apparently in order to avoid a clash, not all heavy syllables receive stress (51). But then again clashes do occur, even in words consisting of only light syllables (45a) and (49). And finally it was shown that stress shifted to the left to a syllable with a full vowel, to avoid stressing a syllable ending in schwa (47), while it was also shown that schwa can receive stress (49a,b), what is more, schwa can even receive main stress (49b).

In the present chapter these stress patterns will be analysed metrically in the framework of Optimality Theory. We will see that the stress system of Sentani is a binary stress system, i.e., the basic pattern is binary. The ternary patterns in the output forms are the result of constraint interaction. None of the relevant constraints are specifically introduced or motivated to account for ternary patterns.

As already noted in Chapter 1, when analysing the stress pattern of Sentani, several issues, of which the relevance exceeds the discussion of ternarity, will be touched upon. We will see that the anti-lapse constraint should refer to the pure grid and not include reference to feet or foot boundaries, unlike anti-lapse constraints proposed in Optimality Theory literature so far (Kager 1994, Green & Kenstowicz 1995). Another issue is non-finality of stress. Non-finality of stress holds for final light syllables, but not for final heavy syllables. I propose that, due to a relatively low ranking of WSP, final stress on heavy syllables in Sentani is the result of non-finality of stress on the final mora. So far, in the literature, extrametricality (Hayes 1995) or non-finality constraints (Prince & Smolensky 1993), refer to the two prosodic categories syllable and foot. Considering the prosodic hierarchy (Selkirk 1980), it is an interesting result to see that we can complete this range with the mora, resulting in a non-finality constraint family NONFIN$_{\mu}$, NONFIN$_{\sigma}$, NONFIN$_{FT}$.

Related to non-finality of stress is Hung's (1994) proposal that clash avoidance and non-finality of stress can be united. In both cases, a strong beat is followed by a weak beat. She therefore proposes to account for both phenomena as actually being one and the same phenomenon, and thus with a single constraint. However, it will be shown that the constraints that avoid clashes (*CLASH) and final stress (NONFIN) in Sentani are ranked in crucially different positions in the hierarchy. This means that the requirements made by the two constraints are not the same, and therefore cannot be accounted for by a single constraint. Support for the different rankings of *CLASH and NONFIN also comes from Asheninca Campa (Payne, Payne & Santos 1982, Payne 1990).

Finally, the last rhythmic aspect that receives attention is avoidance of edges in general. Van de Vijver (1998) proposes a constraint *EDGEMOST. This constraints requires stress to avoid edges. It crucially does not differentiate between the left and right edge of the word. When analysing Sentani we will see that a difference is made between avoidance of stress at the left or the right edge.

In this chapter, the stress system of Sentani is analysed step by step. The issues just mentioned will be addressed in the course of the analysis. First words with light syllables are dealt with. Then I continue with the analysis of words with heavy syllables, involving quantity sensitivity. After a constraint ranking for Sentani ahs been established, the proposals by Hung (1994) and Van de Vijver (1998) are discussed and it will be shown how they fail to account for the data of Sentani.

4.2 Binary right-headed feet

On the basis of the analyses of bounded stress systems, of which most languages have binary stress patterns, the notion that feet must be strictly binary has received widespread support (e.g. McCarthy & Prince 1986, 1995, Prince 1980, 1990 Kager 1989, 1993). As already mentioned above, the analyses of ternary patterns, and thus those of Sentani and Finnish, make use of strictly binary feet. It is shown below that it is not necessary to introduce a ternary foot.

The binarity of feet is expressed by Hayes (1995) by means of the foot inventory, where all possible feet are listed. These feet are all binary at some level of analysis, either the mora or the syllable. In Optimality Theory, there is no such fixed list of feet. The shape of the foot is determined by a set of constraints. The requirement of binarity is expressed by the constraint FTBIN.

(1) *FTBIN*: Feet are binary at some level of analysis (μ, σ) (Prince & Smolenksy 1993).

In Sentani FTBIN is considered to be undominated. It will be shown that in Sentani all optimal forms have feet that are binary, either at syllabic or moraic level. In section 4.6 we will see the motivation for the high ranking of FTBIN. The requirements of this constraint must always be met. Every candidate with a foot that is larger or smaller is rejected.

Besides the fact that feet in Sentani are binary, it is also argued that in Sentani feet are basically right-headed. That is, Sentani is analysed with iambic feet, although trochees arise under specific conditions. The stress pattern of words with light syllables and no schwa are as in (2).

(2) a.	[σ́σ]	[bóhi]	'next'
b.	[σσ́σ]	[walóbo]	'spirit'
c.	[σσ̀σ́σ]	[fomàlɛ́re]	'for we will go across'
d.	[σσ̀σσ́σ]	[haxòmibóxe]	'he obeyed them'
e.	[σσ̀σσσ́σ]	[molòkoxawále]	'I wrote to you'
f.	[σσ̀σσ̀σσ́σ]	[molòkoxàwalɛ́ne]	'because I wrote to you'

Main stress is on the penultimate syllable, and secondary stress is on the second syllable. In sufficiently long words, secondary stress is on every even syllable (2f). Except for bisyllabic words, none of the words has stress on edge-adjacent syllables. On the basis of these stress patterns, it is hard to see whether Sentani has a trochaic or an iambic stress system. Except for disyllabic words, which have a trochaic pattern, all stress patterns are symmetrical. It will, however be argued that Sentani is best analysed as a language with an iambic stress system that occasionally allows for trochees under duress.

The arguments in favour of an iambic system are indirect. Sentani stress appears to be quantity sensitive, but it does not have vowel lengthening or a vowel length distinction, which is otherwise typical for iambic systems (Hayes 1995).[1] And on the basis of the stress patterns in (2) it is not immediately clear that Sentani has an iambic stress system. In a way, the arguments are not so much in favour of the iamb, but rather against the trochee. In an account of Sentani using trochaic feet, a constraint must be invoked which is disfavoured in most metrical frameworks, i.e., left extrametricality or left edge avoidance. This approach, which is taken by Van de Vijver (1998), is shown not to be tenable.

The stress patterns that are crucial in the argument are (2c,e). Both words have an even number of syllables. Main stress is on the penultimate syllable, and secondary stress is on the second syllable. In (2c) there is a stress clash in the stress pattern, and in (2e) there is a ternary stress pattern. Despite the even number of syllables, stress at the edges is avoided.

When assuming trochaic feet, an unstressed final syllable should follow automatically, but, on the other hand, one expects initial stress.

[1] In monosyllabic content words there is a vowel length contrast.

/a/	'voice, word'	/ɾo/	'egg'	/ja/	'rain'
/a:/	'down'	/ɾo:/	'man'	/ja:/	'day'

This points in the direction of subminimal feet and a possible violation of FTBIN. However, it will be argued that in the polysyllabic words of Sentani there are no degenerate feet and that FTBIN is undominated.

(3) a. [(σ̀σ)(σ́σ)]
b. [(σ̀σ)(σ̀σ)(σ́σ)]

If iambic feet are assumed, an unstressed initial syllable follows automatically. However, due to the right-headedness of the iamb, we now expect a final stress.

(4) a. [(σσ̀)(σσ́)]
b. [(σσ̀)(σσ̀)(σσ́)]

However, it has been observed (Hayes 1982, 1995) that stress systems in general seem to prefer to avoid final stress. For trochees this follows automatically from their left-headedness. But even in iambic systems, where final stress is expected because of the right-headed foot, rather often stress is not on the final syllable. This asymmetry between left and right edges is expressed by extrametricality in rule-based phonology (Hayes 1982, 1995), or by NONFIN, the constraint that requires stress to avoid the final constituent (Prince & Smolensky 1993). One of the properties of extrametricality is that the default edge is the right edge. And NONFIN speaks for itself, it refers to the final constituent.[2]

Trochaic systems, on the other hand, do not avoid initial stress in the same way as iambic systems avoid final stress, what is more, trochaic systems in fact favour initial stress. Stress on the second syllable in (2c,e) in a trochaic system would require initial extrametricality, or avoidance of the left edge, which is a device ruled out in most metrical frameworks (Hayes 1982, 1995).

On the basis of this observation, I choose to analyse Sentani as a language with an iambic stress system. Stress on the second syllable follows automatically because of the right-headedness of the foot. Stress on the penultimate syllable is the result of the rather common avoidance of final stress. In four-syllable words, the avoidance of final stress induces a stress clash. For words of six syllables the sequence of two unstressed syllables will be argued to be the result of the interaction of avoidance of final stress and avoidance of clash.

The constraint that will be used to express that feet are right-headed in Sentani is FTFORM.

(5) *FTFORM=IAMB*: The metrical foot is the iamb (Hayes 1995, Prince & Smolensky 1993 (RHTYPE=I/T))

In the following sections, an analysis of the Sentani stress patterns as described in section 3.5 of the previous chapter is developed, starting from the assumption that the language has an iambic stress system.

[2] See Buckley (1994) for a possible counter example in Kashaya, a language that seems to avoid initial stress.

4.3 NONFIN » FTFORM » *CLASH

In this section, we consider the interaction of FTFORM with two other constraints. We will see that in order to avoid final stress, the requirements of FTFORM (=IAMB) are violated, i.e., a left-headed foot may appear in the output form. On the other hand, we find clashes in Sentani that can, in principle, be solved by violating FTFORM. From the fact that clashes occur that remain unsolved, it may be concluded that FTFORM must be ranked between NONFIN and *CLASH.

The interaction of FTFORM with NONFIN and *CLASH forms the basis in the argument against a proposal made by Hung (1994), who argues that avoidance of clash and avoidance of final stress are actually two instantiations of one and the same phenomenon, which can be accounted for by a single constraint (see section 4.9).

4.3.1 NONFIN » FTFORM

As already noted, iambic stress systems tend to avoid final stress. This can be seen, for example, in bisyllabic words of languages with an iambic stress system. Avoidance of final stress may result in a trochaic pattern in those bisyllabic words. This is what we see in Sentani.

(6)	a.	[bóhi]	‘next’
	b.	[bɛ́xo]	‘evil’
	c.	[xóle]	‘he is playing’

Examples of other languages are Asheninca Campa (the Apurucayali dialect of an Peruan language, Payne, Payne & Santos 1982, Payne 1990) and Yidin^{y} (an Australian language spoken in Queensland, Dixon 1977)

(7)	a.	Ashininca Campa	[síma]	‘fish’
	b.	Yidin^{y}	[wúRu]	‘spear handle’

These trochaic patterns are problematic in rule-based phonology if foot binarity is assumed. As already mentioned at the beginning of the previous section, according to Hayes’s foot inventory, feet must be binary. Extrametricality of the final syllable makes this syllable invisible for stress rules, and it may therefore not be parsed into a foot. This results in an initial degenerate foot, which is undesirable, and which needs to be repaired by incorporating the unparsed syllable to form a binary foot.

(8) Incorporation

```
             (x)        (x  .)
σ<σ> →  (σ́)<σ>→ (σ́σ)
```

But in Optimality Theory, the trochaic pattern is precisely what is predicted if the constraint that prevents final stress is ranked higher than FTFORM (Prince &

Smolensky 1993). The constraint against stress on the final constituent has already been mentioned a few times. This is the constraint NONFIN. Prince & Smolensky define it as follows:

(9) *NONFIN*: The head of a prosodic word must not be word-final (Prince & Smolensky 1993).

NONFIN as defined in (9) demands that *main stress* is not on the final syllable or foot in the word. In Sentani main stress is oriented towards the right edge, so here it does indeed concern main stress. In Finnish, however, main stress is on the initial syllable. But in this language, secondary stress avoids final stress. Therefore, NONFIN is here interpreted in a more general way, i.e., *stress* is not final in the word, which may be either main or secondary stress.

(10) *NONFIN*: Stress may not be final in the word.

At this point in the analysis of Sentani, NONFIN requires that stress is not on the final syllable.

The difference with extrametricality is that NONFIN is a well-formedness constraint. It is concerned with the well-formedness of the stress peak. It requires that stress is not final, regardless of whether the final constituent is part of a foot or not. For example, if in a particular language NONFIN requires that final syllables remain unstressed, this syllable may be part of a word-final trochee. All that counts is that stress is not on the final syllable.

(11) ….$(\acute{\sigma}\sigma)]_{PrWd}$

In rule-based phonology using extrametricality, the final syllable has become invisible for metrical structure and may not be part of a foot. As noted by Prince & Smolensky (1993), the advantage of Optimality Theory is that the trochee for disyllabic words in an iambic system simply emerges under constraint interaction. There are no extra levels in the derivation, and the final syllable does not need to be incorporated. The crucial ranking is NONFIN » FTFORM.

(12) /bohi/ ‘next’	FTBIN	NONFIN	FTFORM
→ a. [(bóhi)]			*
b. [(bohí)]		*!	
c. [(bó)hi]	*!		

4.3.2 FTFORM » *CLASH

Another constraint that interacts with FTFORM in Sentani is the constraint that requires adjacent strong beats be avoided. This requirement was first observed by Liberman & Prince (1977) and is here referred to as *CLASH.

(13) **CLASH*: Between two strong beats of level n, at least one weak beat on level n - 1 must intervene.

For Sentani, this constraint must be interpreted as “no adjacent stressed syllables.” This constraint is dominated by FTFORM. Arguments for this ranking, once more, derive from words with four light syllables, which have the stress pattern as in (14).

(14) a. [(moxà)(nále)] /moxo-an-a-le/ ‘I do it for him’
b. [(faxò)(góxe)] /fako-ko-kə-le/ ‘it floated’
c. [(fomà)(lɛ́re)] /fo-ma-le-re/ ‘for we will go across’

Just as in bisyllabic words, here the final foot is a trochee. This induces a clash. This clash could in principle be resolved if the initial foot is also a trochee. However, that would result in an extra violation of FTFORM. That this clash remains unresolved, indicates that FTFORM » *CLASH.

(15) /fomalɛre/ ‘for we will go across’	NONFIN	FTFORM	*CLASH
→ a. [(fomà)(lɛ́re)]		*	*
b. [(fòma)(lɛ́re)]		**!	
c. [(fomà)(lɛré)]	*!		

With the ranking NONFIN » FTFORM established above, we arrive at the ranking as in (16), with NONFIN and *CLASH crucially ranked in a different position with regard to FTFORM.

(16) NONFIN » FTFORM » *CLASH.

Hung (1994) proposed to generalise over NONFIN and *CLASH. She argued that the requirements by both constraints can be united into the single requirement that in bounded stress systems strong beats must be followed by weak beats, for which she proposed the constraint RHYTHM. But the ranking in (16), with NONFIN and *CLASH crucially ranked in a different position with regard to FTFORM, shows that it is impossible to collapse both constraints into one constraint. In section 4.9 a more detailed outline of Hung (1994) is given and the problems that arise in her analysis.

4.4 PARSE-σ

In bounded stress systems, which are characterised by feet of limited size, sufficiently long words have multiple feet. In rule-based phonology feet are assigned iteratively either from left to right, or from right to left. However, in Optimality Theory we can no longer make use of such derivational notions as ‘iterative foot parsing'. Multiple feet are the result of a constraint that requires that as many syllables as possible are parsed into feet.[3]

(17) *PARSE-σ*: A syllable must be parsed into a foot (Halle & Vergnaud 1987 (Exhaustivity Condition), Prince & Smolensky 1993).

On the basis of the stress patterns of longer words in Sentani, it will be argued that PARSE-σ is ranked relatively low in the hierarchy in this language.

So far, we have only seen forms in which PARSE-σ was fully satisfied, i.e., words consisting of two or four syllables which were exhaustively parsed. In words with an odd number of syllables, at least one syllable must remain unparsed to prevent a violation of FTBIN. This means that PARSE-σ must be dominated by FTBIN. But there are also long words with an even number of syllables, that have syllables that remain unparsed. This cannot be due to FTBIN, because in principle a word consisting of an even number of syllables can be parsed exhaustively into binary feet. Obviously, other constraints must dominate PARSE-σ. Words consisting of six light syllables provide arguments for this.

(18) a.	[molòkoxawále]	/molo-ko-kə-aw-a-le/	'wrote to you'
b.	[himàloŋəbóxe]	/himalo-eu-nə-bo-kə-le/	'he straightened it out'
c.	[məxànəxəwále]	/məkə-a-nəkə-wo-a-le/	'I came and lived here'
d.	[əjə̀rəwamɛ́le]	/ə-i-ərə-wo-amə-a-le/	'I always see them'

These words have a ternary pattern: main stress is on the penultimate syllable and there is only one instance of secondary stress, which is on the second syllable. This means that these words contain no more than two binary feet, leaving two syllables unparsed. On what grounds is the exhaustive parse excluded? Consider the following exhaustive parses, and their respective constraint violations.

(19)	NONFIN	FTFORM	*CLASH	PARSE-σ
a. [(molò)(koxà)(walé)]	*	✓	✓	✓
b. [(molò)(koxà)(wále)]	✓	*	*	✓
c. [(molò)(kòxa)(wále)]	✓	**	*	✓
d. [(mòlo)(kòxa)(wále)]	✓	***	✓	✓

If the word is exhaustively parsed using iambic feet, NONFIN is violated (21a). If stress on the final syllable is avoided, this either leads to a violation of both FTFORM and *CLASH (21b,c), or a severe violation of FTFORM (21d). The ternary pattern of the six syllable words has no stress on the final syllable, neither has it a stress clash. Hence, PARSE-σ must be dominated by *CLASH. The ranking of NONFIN » FTFORM

[3] Directionality (e.g. left-to-right or right-to-left parsing) is regulated by other constraints. We will discuss these in Chapter 5, when analysing Finnish.

» *CLASH has already been motivated in previous sections, and this means that by transitivity PARSE-σ must be dominated by all three constraints (when A » B and B » C, then A » C). This means that PARSE-σ takes the lowest position in the ranking we have established so far.

(20) FTBIN, NONFIN » FTFORM » *CLASH » PARSE-σ

Now observe that the two feet in the ternary pattern can be arranged in different ways:

(21) a. [(σσ̀)σ(σσ́)σ]
b. [σ(σ̀σ)σ(σ́σ)]
c. [σ(σ̀σ)(σσ́)σ]
d. [(σσ̀)σσ(σ́σ)]

Based on the ranking so far, (21a) is chosen as the optimal candidate.

(22) /molokoxawale/ 'I wrote to you'	NONFIN	FTFORM	*CLASH	PARSE-σ
→ a. [(molò)ko(xawá)le]				**
b. [mo(lòko)xa(wále)]		*!*		**
c. [mo(lòko)(xawá)le]		*!		**
d. [(molò)koxa(wále)]		*!		**

However, below it is argued that the actual output in Sentani is parsed as in (21d, 22d). In the following section it is shown that two constraints from the alignment constraint family outrank FTFORM, as a result of which (21d, 22d) is chosen as the optimal candidate.

4.5 Alignment

In order to motivate the two alignment constraints, we need to look at four syllable words, as well as three-syllable words. On the basis of the ranking motivated for these words, we will see that (21d, 22d) is indeed the optimal form.

When looking back at the four-syllable words (15), we see that these words are exhaustively parsed at the cost of a violation of FTFORM and *CLASH. But we have just established that PARSE-σ is ranked below both these constraints. Why then is there an exhaustive parse for this word? Candidate (25b) does not violate any of the constraints ranked above PARSE-σ.

(23) /fomalɛre/ 'for we will go across'	NONFIN	FTFORM	*CLASH	PARSE-σ
a. [(fomà)(lɛ́re)]		*!	*	
→ b.* [fo(malɛ́)re]				**

That the optimal candidate in words with four syllables is parsed with a word-initial iamb and a word-final trochee is due to the requirement that in Sentani the prosodic word begins and ends with a foot. This is expressed by the alignment constraints in (26).

(24) a. *ALIGN-L*: ALIGN-L (PrWd, L, Ft, L). The left edge of a PrWd must coincide with the left edge of a foot (McCarthy & Prince 1993b).

b. *ALIGN-R*: ALIGN-R (PrWd, R, Ft, R). The right edge of a PrWd must coincide with the right edge of a foot (McCarthy & Prince 1993b).

When we look at the stress pattern of Sentani in (2) at the beginning of this chapter, we observe that main stress never falls further from the right edge than the penultimate syllable, and secondary stress never further from the left edge than the second syllable. This strongly suggests that the alignments constraints are ranked in a high position in the hierarchy. Since stress does not fall on peripheral elements, and even seems to avoid them, the alignment constraints do not demand that the left and right edge of the word coincide with the left and right edge of a stressed syllable, but rather they require that the left edge of the word aligns with the left edge of a foot, and that in turn the right edge of the word aligns with the right edge of a foot.

In four-syllable words there are two feet, satisfying both ALIGN-L and ALIGN-R at the cost of a violation of FTFORM and *CLASH. This means that in Sentani it is more important for the word to begin and end with a foot than it is to have a 'wrong' foot and a clash. This indicates that both alignment constraints must be ranked higher than FTFORM and *CLASH.

(25) /fomalɛre/ 'for we will go across'	ALIGN-R	ALIGN-L	FT-FORM	*CLASH	PARSE-σ
→ a. [(fomà)(lɛ́re)]			*	*	
b. [fo(malɛ́)re]	*!	*			**
c. [(fomá)lɛre]	*!*				**
d. [foma(lɛ́re)]		*!*	*		**

When we add the two alignment constraints to tableau (23) repeated here as (26), we see that due to ALIGN-R » FTFORM the six-syllable words end in a final trochee.

(26) /molokoxawale/ 'I wrote to you'	NONFIN	ALIGN-R	ALIGN-L	FT-FORM	*CLASH	PARSE-σ
a. [(molò)ko(xawá)le]		*!				**
b. [mo(lòko)xa(wále)]			*!	**		**
c. [mo(lòko)(xawá)le]		*!	*	*		**
→ d. [(molò)koxa(wále)]				*		**
e. [(molò)(koxà)(walé)]	*!					
f. [(molò)(koxà)(wàle)]				*	*!	
g. [(molò)(koxá)wale		*!*				**

ALIGN-L nor ALIGN-R conflicts with NONFIN. ALIGN-L and NONFIN refer to different edges. ALIGN-R does not conflict with NONFIN either, because all ALIGN-R says is that the word must end in a foot, regardless of whether the final foot is left-headed or right-headed. Therefore, at this moment, the ranking between the two alignment constraints and NONFIN cannot yet be established. And on the basis of the examples used so far, ALIGN-L and ALIGN-R cannot be ranked with respect to each other either. However, below it is shown that on the basis of trisyllabic words and words with an open syllable ending in a schwa a ranking can be established between ALIGN-R and ALIGN-L, and it turns out that ALIGN-R dominates ALIGN-L.

4.6 *(C)ə́

As shown in section 3.5 and in Chapter 1, in Sentani /ə/ can receive both main and secondary stress (section 3.5 cf. (43a) and (49b)), but still it seems that Sentani tries to avoid stressing this vowel in open syllables.

(27) a.	[σσ̀σ́σ]	[fomàlɛ́re]	'for we will go across'
ai.	[σ̀əσ́σ]	[àxəláne]	'to the forest'
b.	[σσ̀σσ́σ]	[haxòmibóxe]	'he obeyed them'
bi.	[σ̀əσσ́σ]	[xànəmikóxe]	'he called them'
c.	[σσ̀σσσ́σ]	[molòkoxawále]	'I wrote to you'
ci.	[σ̀əσ̀σσ́σ]	[kìɲənàsəbónde]	'they all will hand me over'

In words that begin with a sequence of a syllable ending in a full vowel followed by a syllable ending in schwa ([CV.Cə...), stress seems to 'shift' to the left to avoid stressing the schwa. A constraint that expresses the requirement to avoid stress on a schwa is proposed by Cohn & McCarthy (1994), i.e., NONHEAD-ə. This constraint forbids stressing /ə/ altogether, regardless of whether the syllable is open or closed. However, in Sentani we cannot use this constraint. Closed syllables with /ə/ behave like other closed syllables, since stress on these syllables is not avoided. I therefore propose a constraint that only refers to open syllables ending in schwa.

(28) **(C)ə́*: Avoid stressing open syllables ending in a schwa.[4]

Initial stress in words that begin with [CV.Cə... indicates that *(C)ə́ must dominate FTFORM.

(29) /axəlane/ 'in the forest'	*(C)ə́	FTFORM
→ a. [(àxə)(láne)]		**
b. [(axə̀)(láne)]	*!	*

Interestingly, we do not see the same kind of behaviour at the right edge of the word. When the penultimate syllable has a schwa, and the final syllable has a full vowel, stress does not fall on the final syllable to avoid stressing the schwa. Sentani strongly bans stress on final light syllables. This demonstrates that NONFIN dominates *(C)ə́.

(30) /hoxoməxe/ 'while coming he picked/gathered'	NONFIN	*(C)ə́
→ a. [(hoxò)(mə́xe)]		*
b. [(hoxò)(məxé)]	*!	

In words that begin with a sequence of Cə-syllables, stress is on the second syllable, just as in words with no schwa. Apparently, it is more important to have a foot at the left edge of the word than it is to satisfy *(C)ə́. This means that ALIGN-L dominates *(C)ə́. And since we have already seen that *(C)ə́ dominates FTFORM, this confirms the earlier established ranking of ALIGN-L dominating FTFORM (27), because when ALIGN-L » *(C)ə́, and *(C)ə́ » FTFORM, then by transitivity ALIGN-L » FTFORM.

(31) /ənətɛre/ 'they two will come'	ALIGN-L	*(C)ə́	FTFORM
→ a. [(ənə̀)(tɛ́re)]		*	*
b. [(ə̀nə)(tɛ́re)]		*	**!
c. [ənə(tɛ́re)]	*!*		

Now that the constraint *(C)ə́ has been introduced, and its interaction with ALIGN-L motivated, we will see how it helps to establish the ranking between ALIGN-L and ALIGN-R. In words with three syllables that begin with a [CV.Cə... sequence, stress

[4] The difference between heavy syllables with /ə/ and light syllables with /ə/ cannot be reduced to an interaction between NONHEAD-ə and WSP. Closed syllables with /ə/ receive stress. This would indicate that WSP must dominate NONHEAD-ə. However, in section 4.8 below it will be shown that WSP is ranked below *CLASH, which by transitivity is ranked below the constraint that requires stress to avoid /ə/. As a result, in assuming the relevance of constraint NONHEAD-ə in words like [*nalə̀ŋhíke*] 'he stumbled over it'; [*ufə̀ndɛ́re*] 'after I will talk to him'; [*rowə̀mməmbéna*] 'if you (will) bring it here', stress is expected on the initial syllable, just as in open syllables.

does not shift to the left. The penultimate syllable, which is a Cə syllable, receives main stress, just as in words with full vowels.

(32) a. [walóbo] 'spirit'
b. [hojə́le] /ho-jə-le/ 'he always kills'

At this point in the analysis, ALIGN-L and ALIGN-R are still not ranked with respect to each other. As a result, in words with full vowels, FTFORM decides in favour of a parsing with an initial iamb.

(33) /walobo/ 'spirit'	ALIGN-L	ALIGN-R	*(C)ə́	FTFORM
→ a. [(waló)bo]	*			
b. [wa(lóbo)]		*		*!

A violation for either ALIGN-L or ALIGN-R is not decisive. The constraint FTFORM rejects the candidate with a word-final trochee, and the candidate with a word-initial iamb is chosen as the optimal candidate.

But if we evaluate candidates for form (32b), it turns out that the wrong candidate is chosen as optimal. As noted above, with ALIGN-L and ALIGN-R in the same high position in the hierarchy, a violation of these constraints is not decisive between (34a) and (34b,c). The first constraint down in the hierarchy now evaluates the forms, which is *(C)ə́. This constraint was vacuously satisfied in (33), and therefore FTFORM could make the decision. But in (34) *(C)ə́ will reject the candidate with stress on the schwa, incorrectly selecting the candidate with initial stress as the optimal candidate (34c).

(34) /hojəle/ 'he always kills'	ALIGN-L	ALIGN-R	*(C)ə́	FTFORM
a. [ho(jə́le)]	*		*!	*
b. [(hojə́)le]		*	*!	
→ c.*[(hójə)le]		*		*

If ALIGN-L dominates ALIGN-R, the same incorrect candidate is chosen. ALIGN-L rejects (34a), there is a tie for ALIGN-R, and *(C)ə́ rejects (34b). Again this leaves (34c) as the optimal candidate. However, if ALIGN-R dominates ALIGN-L, the candidates with a foot at the left edge all crucially violate ALIGN-R, and for this reason they are all rejected (35b,c). Now, the actual output is chosen as the optimal candidate (35a), which does indeed violate the lower-ranked constraints ALIGN-L and *(C)ə́.

(35) /hojəle/ ‘he always kills’	ALIGN-R	ALIGN-L	*(C)ə́	FTFORM
→ a. [ho(jə́le)]		*	*	*
b. [(hojə́)le]	*!		*	
c. [(hójə)le]	*!			*

The parsing of words with three syllables with full vowels is analogous to the parsing of words with schwa. Due to the ranking ALIGN-R » ALIGN-L we see that the output form has a trochee at the right edge of the prosodic word (compare (33) with (36) below).

(36) /walobo/ ‘spirit’	ALIGN-R	ALIGN-L	*(C)ə́	FTFORM
→ a. [wa(lóbo)]		*		*
b. [waló)bo]	*!			
c. [(wálo)bo]	*!			*

And these examples also provide evidence for the high ranking of FTBIN assumed so far. In candidates with a word-initial, degenerate foot, ALIGN-L would be satisfied at the cost of a violation of the lower-ranked constraint *CLASH. This is what we have seen in words consisting of four syllables. That we do not find secondary stress on the initial syllable is due to FTBIN.

(37) /walobo/ ‘spirit’	FTBIN	ALIGN-R	ALIGN-L	FT-FORM	*CLASH
→ a. [wa(lóbo)]			*	*	
b. [(waló)bo]		*!			
c. [(wálo)bo]		*!		*	
d. [(wà)(lóbo)]	*!				*

Now that we have establishinged the constraint ranking between ALIGN-L and ALIGN-R as well as *(C)ə́, we arrive at the following constraint ranking:

(38)

FTBIN, ALIGN-R, NONFIN
ALIGN-L
*(C)ə́
FTFORM
*CLASH
PARSE-σ

The constraint ranking is based on the subrankings in (39).

(39) a. FTBIN » ALIGN-L [σ(σ́σ)] > [(σ̀)(σ́σ)] [wa(lóbo)]
b. ALIGN-R » ALIGN-L [σ(ə́σ)] > [(σ́ə)σ] [ho(jə́le)]
c. ALIGN-L » *(C)ə́ [(əə̀)(σ́σ)] > [əə(σ́σ)] [(ənə̀)(tɛ́re)]
d. NONFIN » *(C)ə́ [(σσ̀)(ə́σ)] > [(σσ̀)(əσ́)] [(hoxò)(mə́xe)]
e. NONFIN » FTFORM [(σ́σ)] > [(σσ́)] [(bóhi)]
f. *(C)ə́ » FTFORM [(σ̀ə)(σ́σ)] > [(σə̀)(σ́σ)] [(àxə)(láne)]
g. FTFORM » *CLASH [(σσ̀)(σ́σ)] > [(σ̀σ)(σ́σ)] [(fomà)(lɛ́re)]
h. *CLASH » PARSE-σ [(σσ̀)σσ(σ́σ)] > [(σσ̀)(σσ̀)(σ́σ)] [(molò)koxa(wále)]

This constraint ranking already accounts for some of the ternary patterns. We saw why words with six light syllables have a ternary pattern. And even though we have not seen an example of it, the ternary pattern of words with five light syllables that begin with a [CV.Cə... sequence can now also be accounted for.

(40) /xanəmikoxe/ 'he called them'	ALIGN-R	ALIGN-L	*(C)ə́	FT-FORM	*CLASH	PARSE-σ
→ a. [(xànə)mi(kóxe)]				**		*
b. [(xanə̀)mi(kóxe)]			*!	*		*
c. [xa(nəmì)(kóxe)]		*!		*	*	*
d. [(xànə)(mikó)xe]	*!			*		*
e. [xanəmik(kóxe)]		*!**		*		***

However, there are a few patterns that can still not be accounted for. Among these are some other words with a ternary pattern. We will see that due to the relatively low ranking of PARSE-σ, the current constraint ranking selects an ill-formed candidate with a sequence of three unstressed syllables as the optimal candidate. This is not in conformity with the actual output. Obviously a constraint ranked higher in the hierarchy must prevent this overlong sequence of unstressed syllables, which is called a rhythmic lapse. We will look at two anti-lapse constraints that have already been proposed in the literature to limit the interstress interval: PARSE-2 (Kager 1994) and LAPSE (Green & Kenstowicz 1995). It will be shown that those constraints do not produce the correct results, so an alternative is offered.

4.7 PARSE-2 and LAPSE versus *LAPSE

With the constraint ranking given above, including PARSE-σ low in the hierarchy, we cannot account for the stress pattern of the examples in (41) below. The constraint ranking fails to select the actual output as the optimal candidate.

(41) a. [molònasəhàndéra] 'they will go and bury me'
b. [əxàikɛləwàimíle] 'they went and taught them'

(42) /molonasəhandera/ 'after they will bury me'	*(C)ə́	FtForm	*Clash	Parse-σ
→ a.*[(molò)nasəhan(déra)]		*		***
b. [(molò)na(səhàn)(déra)]		*	*!	*
c. [(molò)(nàsə)han(déra)]		**!	*	*
d. [(molò)(nasə̀)han(déra)]	*!	*		*

The constraint ranking given above incorrectly selects (42a) as the optimal candidate, whereas (42b) is the actual output form. If we compare (42a) with (42b), the fatal violation turns out to be the violation of *Clash. Apparently a constraint that is ranked at least above *Clash is needed to arrive at the actual output.

The crucial difference between the candidate that is chosen as the optimal candidate, and the one we want to be the optimal candidate is the sequence of three unstressed syllables in the first candidate. Due to its ranking so low in the hierarchy, Parse-σ cannot reject the candidate with this overlong sequence of unstressed syllables.

In the literature on bounded stress systems we find that a pattern with a binary alternation is the preferred one (e.g. Liberman 1975, Liberman & Prince 1977, Prince 1980). There are two ways in which stress patterns may deviate from this binary alternation, either by two stresses that are too close, i.e., adjacent, in which case there is a clash, or by stresses that are too far apart. We find that in bounded stress systems two adjacent unstressed syllables are not exceptional, but that stress patterns with an interstress interval of more than two adjacent unstressed syllables are rare. If the distance is more than two unstressed syllables, there is a rhythmic lapse (Selkirk 1984).

The preference for a binary alternation means that in bounded stress systems, rhythmic clashes and rhythmic lapses are avoided whenever possible. Selkirk subsumes this under a universal Principle of Rhythmic Alternation (PRA), which consists of an anti-clash and an anti-lapse provision. Both provisions are defined on the grid.

(43) *Principle of Rhythmic Alternation*
  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.

In the literature we find all anti-clash constraints defined on the grid, just as the anti-clash provision. Kager (1994), for example, defines *Clash as follows:

(44) **Clash*: No adjacent strong beats on the grid (Kager 1994).

The anti-lapse constraints that we find in the Optimality Theory literature, on the other hand, are defined referring both to the metrical grid, and to constituent structure, i.e., feet. These constraints are PARSE-2 (Kager 1994) and LAPSE (Green & Kenstowicz 1995). They are given in (17) and (18) in Chapter 1, and repeated below.

(45) *PARSE-2*: One of two adjacent stress units must be parsed by a foot. (Kager 1994)

(46) *LAPSE*: Adjacent unstressed moras or syllables must be separated by a foot boundary (Green & Kenstowicz 1995).

Just as the anti-lapse provision, both constraints are intended to limit the sequence of unstressed stress units to at most two. These constraints work for the forms in (43) and select the correct form as the optimal candidate. But we can also observe that due to the reference to feet, these constraints turn out to be too strong on the one hand, and too weak on the other. First, let us see how they work for (43).

Since the anti-lapse constraints are nearly identical, I concentrate on only one, i.e., PARSE-2. As noted above, this constraint must outrank *CLASH in order to select the actual output (42b) as the optimal one. Since in none of the words in Sentani the interstress interval is more than two syllables, this constraint has an undominated position in the hierarchy.

(47) /molonasəhandera/ 'after they will bury me'	PARSE-2	*Cə́	FT-FORM	*CLASH	PARSE-σ
→ a. [(molò)na(səhàn)(déra)][5]			*	*	*
b. [(molò)(nàsə)han(déra)]			**!	*	*
c. [(molò)(nasə̀)han(déra)]		*!	*		*
d. [(molò)nasəhan(déra)]	*!*		*		***

That we see two violation marks for PARSE-2 is due to the fact that the sequence /nasə/ violates the constraint, as well as the sequence /səhan/. For both sequences it holds that neither of the syllables is parsed into a foot.

However, when we now turn back to the word with six syllables, we see that the optimal candidate violates PARSE-2. The optimal candidate has two adjacent unparsed syllables, which is excluded by PARSE-2. Still we do not find a lapse as described by Selkirk (1984), since in this example the sequence of unstressed syllables is exactly two, just as is the case in (47a).

[5] Stressing the heavy syllable is not due to WSP, because as will be shown in the next section, *CLASH dominates WSP. Besides, I predict that if we replace the heavy syllable with light syllables, the problem and solution would have been the same. However, such words have not been attested in my data. I consider this to be an accidental gap.

(48) /molokoxawale/ 'I wrote to you'	PARSE-2	NON FIN	FT-FORM	*CLASH	PARSE-σ
a. [(molò)koxa(wále)]	*!		*		**
→ b.* [(molò)(koxà)(wále)]			*	*!	
c. [(mòlo)(koxá)(wále)]			**!	*	**
d. [(molò)(kòxa)(wále)]			**!	*	
e. [(mòlo)(kòxa)(wále)]			**!*		
f. [(molò)(koxà)(walé)]		*!			

What seems to be the problem with PARSE-2 is that it is formulated as a constraint that refers both to the grid and to parsing stress units into a foot. Avoidance of lapse is a rhythmic phenomenon. The problem as shown in (48) can be avoided if the anti-lapse constraint is defined as a constraint that refers strictly to the grid, just as *CLASH. In Chapter 1 (section 1.7), an anti-lapse constraint was formulated, that refers to the grid. This constraint is repeated in (49).

(49) **LAPSE*: A weak beat must be adjacent to a strong beat or to the word edge.

The formulation is different from the anti-lapse provision in the PRA (43b). In the anti-lapse provision it is trivial why a weak beat is preceded by at most one weak beat. Furthermore, the definition avoids counting. *LAPSE states how strong and weak elements are distributed among the word. It does not refer to the number of elements that may intervene, which is trivial and does not explain anything. By the formulation given in (49), the distance between two stresses, or stress and the word edge is limited on more principled grounds, i.e., it is a local constraint. In (50) predictions made by PARSE-2 and by *LAPSE are compared.

(50)	*PARSE-2*	**LAPSE*
a. [(σ́σ)σσ(σ́σ)]	*	*
b. [(σ́σ)σ(σ́σ)]	✓	✓
c. [(σ́σ)σ(σσ́)]	✓	*
d. [(σσ́)σσ(σ́σ)]	*	✓

Some of the configurations are rejected or accepted by both anti-lapse constraints (50a,b), but there are two configurations for which *LAPSE makes the correct predictions, while PARSE-2 does not. One of the configurations is (50d), which is what we saw already above in (48a). But PARSE-2 also allows for a configuration that it is supposed to ban, i.e., three adjacent unstressed syllables (50c). Note that in both (50c) and (50d) there are two types of feet, both an iamb and a trochee. This is exactly what we see in Sentani, i.e., both feet can appear in one output form. What (50) shows is that PARSE-2 is too strong, as a result of which it rejects (50d), but this constraint is also too weak, as a result of which it allows for (50c), which is a configuration it is supposed to prevent from occurring in output forms.

If we replace Parse-2 with *Lapse, (cf. (51)) we still select the correct output as the optimal candidate as in (47).

(51) /molonasəhandera/ 'after they will bury me'	*Lapse	*Cə́	Ft-Form	*Clash	Parse-σ
→ a. [(molò)na(səhàn)(déra)]			*	*	*
b. [(molò)(nàsə)han(déra)]			**!	*	*
c. [(molò)(nasə̀)han(déra)]		*!	*		*
d. [(molò)nasəhan(déra)]	*!		*		***

Different from the two violations of Parse-2, the constraint *Lapse is violated only once, since only /sə/ is not adjacent to a strong syllable.

And in (52) we now also select the correct output as the optimal candidate output for (48).

(52) /molokoxawale/ 'I wrote to you'	*Lapse	NonFin	Ft-Form	*Clash	Parse-σ
→ a. [(molò)koxa(wále)]			*		**
b. [(molò)(koxà)(wále)]			*	*!	
c. [(mòlo)(koxá)(wále)]			**!	*	
d. [(molò)(kòxa)(wále)]			**!	*	
e. [(mòlo)(kòxa)(wále)]			**!*		
f. [(molò)(koxà)(walé)]		*!			

Candidate (52a) does not violate the anti-lapse constraint and is selected as optimal.

With the discussion about *Lapse and its motivated undominated place in the hierarchy, we get the ranking as in (53).

(53) FtBin, Align-R, NonFin, *Lapse

Align-L

*(C)ə́

FtForm

*Clash

Parse-σ

In sections 4.2 to 4.7, the stress pattern of words with light syllables have been accounted for. An inventory of constraints has been made, and their ranking in the hierarchy has been established, which is shown (53).

In the sections below, we will have a closer look at the stress patterns of words with heavy syllables. We will see that it appears as if there is a ranking paradox between WSP and NonFin, but by having a closer look at NonFin, we can solve this ranking paradox. Furthermore, this discussion will give information about the prosodic level at which NONFIN operates.

4.8 Quantity sensitivity

This section introduces heavy syllables into the discussion of Sentani stress. Sentani appears to have a quantity-sensitive stress system. The strongest evidence for quantity sensitivity is that word-initially and word-finally closed syllables and syllables with diphthongs are stressed, as can be seen in (54).

(54)	a.	[fomàlɛ́re]	'for we will go across'
	ai.	[ràisixáte]	'they all put down'
	aii.	[omòxojéi]	'not do'
	b.	[walóbo]	'spirit'
	bi.	[bèukóxe]	'it floated'
	bii.	[əràmám]	'food'

In this section, we concentrate on the stress pattern of words with final heavy syllables, since these are the interesting cases. In our analysis of these stress patterns we will see that we can only account for these patterns by having a closer look at the prosodic level of one of the constraints discussed above: NONFIN. It will be shown that the only way to account for the stress pattern is by interpreting NONFIN on the moraic level.

The fact that heavy syllables attract stress suggests the presence of a constraint that forces stress on heavy syllables. Prince (1990) proposes a principle that accounts for stress on heavy syllables. This principle can be looked upon as a constraint in OT.

(55) *WEIGHT-TO-STRESS-PRINCIPLE (WSP)* A heavy syllable must be prominent in foot structure and on the grid.

So far, we have worked on the simplifying assumption that Sentani avoids final stress. However, heavy syllables in final position receive main stress, violating the so far undominated constraint NONFIN. This result might simply be achieved by WSP dominating NONFIN, as shown in (56).

(56) /omoxojei/ 'not do'	WSP	NONFIN
→ a. [(omò)(xojéi)]		*
b. [(omò)(xójei)]	*!	

However, this ranking cannot be maintained. The interaction between WSP and *CLASH is problematic. If WSP dominates NONFIN, by transitivity it also dominates all constraints ranked below NONFIN and crucially also *CLASH. If we consider words with heavy syllables word-internally, we see that heavy syllables in medial position can be unstressed.

(57) a.	[xəlɛ̀<u>wai</u>míle]	‘they taught him’
b.	[ənàij<u>ɛm</u>bónde]	‘the all will go for you two’
c.	[ikìlənàij<u>ɛŋ</u>gómbe]	‘we will capture you all’
d.	[ənàsəmò<u>lon</u>sánde]	‘they will go and bury me’

If they are stressed, the underlined heavy syllables would induce a clash. From the fact that those syllables remain unstressed to avoid the clash, we can conclude that *CLASH must dominate WSP.

(58) /xəlɛwaimile/ ‘they taught him’	*CLASH	WSP
→ a. [(xəlɛ̀)wai(míle)]		*
b. [(xəlɛ̀)(wài)(míle)]	*!*	

In (58) WSP dominates NONFIN, and in (60) *CLASH dominates WSP. By transitivity, NONFIN must dominate *CLASH (52). This gives a ranking paradox.

(59) ***WSP*** » NONFIN » *CLASH » ***WSP***

We cannot solve this paradox by downgrading NONFIN in the hierarchy so that it is dominated by WSP, because then it would, also by transitivity, be dominated by *CLASH, and that would lead to the selection of the wrong candidate in (60).

(60) /axojole/ ‘it always goes down’	*CLASH	NONFIN
a. [(axò)(jóle)]	*!	
→ b.* [(axò)(jolé)]		*

In order to find the solution to this ranking paradox, I propose to have a closer look at the internal structure of heavy syllables and at NONFIN. At the moraic level, heavy syllables are considered to be binary (Prince 1983, Hyman 1985, Hayes 1989). Furthermore, heavy syllables appear to behave trochaically as a result of their falling prominence in the case of long vowels, or declining prominence in the case of closed syllables and diphthongs (Prince 1983, Kager 1993).

```
(61)   (x  .)
        μ  μ
         \ /
          σ
```

This means that in the case of a final heavy syllable, an unstressed mora separates the edge of the domain and the rightmost stress.

(62) ....µ́ µ]#
\ /
σ

Now, we may actually question the assumption that NONFIN is violated when a final heavy syllable receives stress. I propose that in order to account for the data of Sentani, non-finality should be interpreted with respect to moraic rhythm.

(63) NONFIN
a ...µ́ µ$]_{\mathrm{PrWd}}$ ai ...µ́ µ$]_{\mathrm{PrWd}}$
| | \/
σ́ σ σ́

This interpretation is supported by the functional motivation for non-finality as proposed by Hyman (1977). According to Bolinger (1958) the most important perceptual cue for stress is pitch change. Hyman in turn suggests that pitch *fall* is a more basic strategy in realization of stress than a pitch *rise*. And as Hyman states, penultimate stress 'feeds into' the falling pitch, which can account for the observed preference of avoiding final stress. A final heavy syllable still provides the space for a falling intonation contour over the final two moras, while stress on a final light syllable, a single mora, does not.

We can now solve the ranking paradox. Under the interpretation just proposed, the stressed final heavy syllable violates both NONFIN and satisfies WSP. And since NONFIN is not violated when a final heavy syllable is stressed, it can dominate WSP, and the paradox is solved.

(64) /omoxojei/ 'not do'	NONFIN$_{\mu}$	WSP
→ a. [(omò)(xojéi)]		
b. [(omò)(xójei)]		*!

This is an interesting result. The mora is a member of the prosodic hierarchy (Selkirk 1980).

(65) Prosodic Word
|
Foot
|
σ
|
µ

In the literature, extrametricality (in rule-based phonology, Hayes 1995), but also non-finality (in Optimality Theory, Prince & Smolensky 1993) only refer to feet and syllables. Hayes even explicitly excludes mora extrametricality since extrametricality means that the final mora is invisible for metrical structure and thus it remains unparsed. This implies that a foot boundary may occur syllable internally, which is ruled out universally by syllable integrity.

(66) …µ)<µ>

σ

But since NonFin focusses on the wellformedness of the stress-peak, and not on the parsability of the final constituent, NonFin$_{\mu}$ can be satisfied, even if this mora is parsed into a foot. We do not get the undesirable result of a foot boundary syllable-internally. With NonFin$_{\mu}$ we can now fill the gap in the prosodic hierarchy of the NonFin constraint family, with NonFin$_{\mu}$, NonFin$_{\sigma}$ and NonFin$_{Ft}$. For Sentani this gives us the constraint ranking as in (67).

(67)

FtBin, Align-R, NonFin$_{\mu}$, *Lapse

Align-L

*(C)ə́

FtForm

*Clash

WSP, Parse-σ

This concludes the analysis of the stress patterns of Sentani as described in section 3.5 of the previous chapter. What we have seen is that Sentani has a binary stress system, which is analysed with strictly binary feet. The preferred pattern is a binary pattern as can be seen in words consisting of five or seven light syllables. In those words, a binary alternation is possible without explicitly having to avoid final stress or clashes. Constraint interaction, such as avoidance of final stress, of clashes and of stress on an open syllable with schwa, may result in ternary patterns.

Below we will turn to analyses as proposed by Hung (1994) and Van de Vijver (1998). We will see that they fail to account for Sentani stress.

4.9 Alternative analyses

In this section I look into two earlier proposals for stress assignment, rhythm and edge related phenomena, i.e., Hung (1994) and Van de Vijver (1998).

Hung observes, following Liberman (1975), Liberman & Prince (1977), Prince (1980), among others, that stress is a rhythmic phenomenon, and that bounded stress systems prefer to have an alternating stress pattern. In order to achieve this, stress systems generally avoid stress clashes and final stress. Hung claims that avoidance of clash and non-finality of stress are actually identical. Both demand that a strong beat be followed by a weak beat. And since both are the same, Hung proposes that they should be accounted for by a single constraint, which she calls RHYTHM and which is defined as referring to the grid. We will see below that this constraint cannot account for the stress pattern of Sentani, and that the constraint RHYTHM needs to be split up again into two separate constraints. Furthermore, her analysis runs into trouble when accounting for non-finality effects of trochaic systems.

The other work we look at is Van de Vijver (1998). Van de Vijver claims that iambic feet are not primitives in UG, but are the result of constraint interaction. To be more specific, iambic feet are the result of the interaction between the constraint TROCHEE, which demands that all feet are trochaic, and *EDGEMOST, which is a rhythmic constraint demanding that stress is not adjacent to the edge of a word. According to Van de Vijver, this constraint crucially does not differentiate between the left edge and the right edge of the word. Based again on the data of Sentani we will see that the constraint *EDGEMOST makes the wrong predictions for Sentani. That *EDGEMOST does not differentiate between the left and the right edge is problematic when accounting for Sentani stress.

4.9.1 Hung 1994

Hung (1994) follows Prince & Smolensky (1993) in assuming that extrametricality effects should be viewed as non-finality effects. Furthermore, she claims that extrametricality effects are best understood as consequences of rhythmic requirements. More specifically, extrametricality should be viewed as final stresslessness, a rhythmically desirable property. It is her claim that what rules out final stress also rules out internal clashes, and as such both phenomena can be accounted for by a single constraint RHYTHM.

(68) *RHYTHM*: Every grid mark *x* at level $n + 1$ (where $n \geq 1$) must be followed by a beat of height *n* such that there is no beat of height greater than *n* which intervenes. (Hung 1994 p. 15).

This constraint rules out both clashes and final stress by demanding that every strong beat be followed by a weak beat, word-internally as well as word-finally. Hung makes use of the pure metrical grid, as a result, RHYTHM does not work on the bottom level, but only on level 1 and higher.

(69)	a.*	x	x			b. *	x			x	level 1
	x	x	x	x			x	x	x	x	level 0

Example (69a) violates RHYTHM, because word-internally the leftmost strong beat is not followed by a weak beat, and (69b) violates this constraint because the final strong beat is not followed by a weak beat. According to Hung, this constraint seems to be specifically active in iambic systems, and less in trochaic systems, since, due to their left-headedness non-finality is automatically satisfied in trochaic systems.

For Sentani, being an iambic language, it is interesting to test Hung's hypothesis. What we see is that this language provides evidence against accounting for both clash avoidance and non-finality of stress with one single constraint. The interaction of RHYTHM with the constraint FTFORM in four-syllable words is crucial in this respect.

Hung (1994) describes several iambic languages of which she proposes a subtypology, based on the way these languages treat bisyllabic words. In this subtypology, the ranking of ALIGN-R, FTFORM and RHYTHM plays an important role. She distinguishes three subtypes. We briefly discuss examples of all three.

First, in Negev Bedouin Arabic (Blanc 1970), bisyllabic words have final stress. This can be described by the ranking ALIGN-R, FTFORM » RHYTHM.

(70) /bina/ 'he built'	ALIGN-R	FTFORM	RHYTHM
→ a. [(biná)]			*
b. [(bína)]		*!	
c. [(bí:)na]	*!		

Second, Hixkaryana, an Amerindian language spoken in Brazil (Derbyshire 1979), makes use of a lengthening process to satisfy RHYTHM. The first syllable is lengthened and a heavy monosyllabic foot can be formed on this first syllable.[6] This does not give information about the ranking of FTFORM and RHYTHM, because both are satisfied.

(71) /kana/ 'fish'	FTFORM	RHYTHM	ALIGN-R
→ a. [(ká:)na]			*
b. [(kaná)]		*!	
c. [(kána)]	*!		

Finally, in Ashininca Campa (Payne & Santos 1982 and Payne 1990) and Yidin^y (Dixon 1977) stress shifts to the first syllable, and a bisyllabic trochee can be formed in order to satisfy non-finality, violating FTFORM. The ranking for these languages is therefore ALIGN-R, RHYTHM » FTFORM.

(72) a. Ashininca Campa [(síma)] 'fish'
b. Yidin^y [(wúRu)] 'spear handle'

[6] Recall that FTBIN can be satisfied at the moraic level.

(73) /sima/ 'fish'	ALIGN-R	RHYTHM	FTFORM
→ a. [(síma)]			*
b. [(simá)]		*!	
c. [(sí:)ma]	*!		

In the languages just described we see that RHYTHM is either ranked at the same position as FTFORM (Hixkaryana), or dominated by FTFORM (Negev Bedouin Arabic), or that it dominates FTFORM (Ashininca Campa, Yidin^y).

When considering the stress pattern of Sentani, at first sight it seems as if Sentani belongs to the third group, that of Ashininca Campa and Yidin^y, where RHYTHM dominates FTFORM. Just as those two languages, Sentani has an iambic stress system with a trochaic pattern for bisyllabic words.

(74) /bohi/ 'next'	ALIGN-R	RHTYHM	FTFORM
→ a. [(bóhi)]			*
b. [(bohí)]		*!	
c. [(bó:)hi]	*!		

However, we encounter problems with the four-syllable words in Sentani when using RHYTHM. As in the examples given above, the ranking of the constraint RHYTHM with regard to FTFORM plays a crucial role. With these two constraints we predict the violations for iambic stress systems as in (75).

(75)	RHYTHM	FTFORM
a. [(σσ̀)(σσ́)]	*	✓
b. [(σ̀σ)(σ́σ)]	✓	**
c. [(σσ̀)(σ́σ)]	*	*
d. [(σ̀σ)(σσ́)]	*	*

If FTFORM » RHYTHM, we predict (75a), and if FTFORM » RHYTHM, we predict (75b), but there is no ranking of the two constraints that predicts a form as in (75c), while this is exactly the form we see in Sentani.[7]

(76) a.	[moxànále]	/molo-kə-an-a-le/	'I do (it) for him'
b.	[faxòbóxe]	/fako-bo-kə-le/	'it floated'
c.	[fomàlɛ́re]	/fo-ma-le-re/	'for we will go across'

[7] This pattern also occurs in Southern Paiute and Ashininca Campa. Hung realises that these patterns are a problem for her theory and therefore she argues against P&S and states that these patterns do not occur in these languages. For Ashininca Campa she argues that these patterns must be the result of prominence effects, and not stress. For Southern Paiute, she argues that the (ws)(sw) parsing should be interpreted as a (ws)(ww) parsing, so that the clash is not present in the output form. However, none of these strategies are possible for Sentani.

As already explained above, in Sentani FTFORM is violated to avoid final stress, which points in the direction of RHYTHM » FTFORM. But in four syllable words we see that FTFORM is not violated to avoid a clash, which would be the result of FTFORM » RHYTHM. We therefore have a ranking paradox.

Apparently the rhythmic demands at the word edge are stronger than those applicable word-internally. This shows that we have to abandon the idea that both can be collapsed into a single constraint RHYTHM. The only way to resolve this ranking paradox is by using two different constraints, one referring to clash avoidance (*CLASH) and one referring to non-finality of stress (NONFIN). In the constraint hierarchy these two constraints must be crucially ranked in different positions with regard to FTFORM. Now we get the tableaux as already given in (15), repeated below.

(77) /fomalɛre/ 'for we will go across'	NONFIN	FTFORM	*CLASH
→ a. [(fomà)(lɛ́re)]		*	*
b. [(fòma)(lɛ́re)]		**!	
c. [(fomà)(lɛré)]	*!		

What we see here, and what I already observed in the previous section, is that word-internal rhythm behaves differently from word-final rhythm, and therefore these phenomena cannot be accounted for by one single constraint.

The difference between word-internal rhythm and word-final rhythm can also be illustrated by the observation that in Sentani *CLASH and *LAPSE evaluate at the syllabic level, while NONFIN evaluates at the moraic level. This makes it even more difficult to treat both as the same.

Hung also encounters problems with non-finality effects in trochaic languages. She treats clash avoidance and non-finality of stress as one and the same phenomenon, and uses the pure metrical grid for both. This does not seem to be too problematic when accounting for penultimate stress in iambic systems, but Hung runs into problems when dealing with non-finality effects of the stress pattern of Classical Latin, which has a trochaic stress system.

Trochaic systems are expected to avoid final stress automatically due to their left-headedness. Still, these languages display non-finality effects. Latin, for example, has antepenultimate stress if the penult is light, and penultimate stress if the penult is heavy, regardless of the weight of the final syllable, which never receives stress, unless the word is monosyllabic. In this language, it is not the syllable bearing main stress that may not be final in the word, but it is the foot with the main-stressed syllable that may not be final. In order to account for this, Hung needs to posit an extra layer in the grid structure to distinguish the unstressed unfooted syllables from the unstressed footed syllables.

```
(78)  a.       x                b.  x              c.     x
               x                     x x                  x    x
            x(  x ) x              ( x  x)x           x(  x    x ) x
          re (féc)tus              spátula            pa  trí  ci   a
```

This solution is problematic and ad hoc. The first problem lies in the extra layer in the grid. According to Hung, it has been assumed in metrical theory that in some languages a footed unstressed syllable is stronger than an unfooted unstressed syllable (Russian, Alderete 1995), and in other languages it is the other way around (Dutch, Kager 1989). This can be expressed by assuming two constraints: one that says that footed unstressed syllables are stronger, and one constraint that limits the number of layers. But she does not give examples of these constraints and a comparison of languages with conflicting violations for these constraints. But even if it is true that languages differ in this respect, then in her proposal this extra layer must be restricted to trochaic languages. Assuming an extra layer in iambic systems would result in a severe violation of RHYTHM, and undermine the central claim of her thesis.

```
(79)      x
       x  x
     x (x  x) x
     σ σ  σ σ
```

In this iambic system, the leftmost strong beat at level 2 (*n + 1*) is not followed by a weak beat at level *n*, and for the strong beat in the rightmost column there is not weak beat at level *n* for level 3 (*n+1*) either. So this is a severe violation of RHYTHM. This leads to an asymmetry between trochaic and iambic systems, which has actually nothing to do with iambic or trochaic rhythm, but only serves to account for the fact that in a language as Latin main stress is on the rightmost non-final foot.

The other problem is that even descending grid structures violate RHYTHM. In (78a), the highest grid mark is not followed by a mark on level *n*, but by a mark on level *n-1*. This is the same violation of RHYTHM as a two-layer column word-finally. In (78b,c), the marks of the extra layer are followed by a grid mark on that same level, which is also a violation of RHYTHM. Hung therefore needs to refine her definition of RHYTHM by not only looking at the grid marks that are bad, but also at the good marks. The good marks need to be in different columns. This suddenly makes RHYTHM a constraints that evaluates gradiently.

(80) *Hung (1994)*

```
   a.    x               b.    x
         x*  x                 x        x*
         x   x   x             x    x   x
```

In both examples of (80) there is one grid mark that violates RHYTHM. According to Hung, a decision can be made by looking at the distribution of the good grid marks. In (80a) there are two good grid marks, the topmost grid mark in the first column, and the topmost grid mark in the second column. This then is a better situation than (80b), where the two good grid marks are both in one and the same column, which is the leftmost column.

Clearly, the non-finality effects of a trochaic language as Latin, in which the foot may not be final, are problematic for Hung. The extra foot layer in the grid is not motivated empirically, but depends on whether an iambic or a trochaic stress system displays non-finality effects. Furthermore, it is necessary to relativise RHYTHM. Together with the arguments given on the basis of the stress patterns of Sentani, Ashininca Campa and Southern Paiute, there is enough evidence that clash (and lapse) avoidance seems to behave differently from non-finality effects. We obviously need different constraints, which also evaluate differently. It has been argued that clash avoidance and lapse avoidance must crucially refer to the pure grid. For NONFIN this is problematic. If we interpret NONFIN with reference to the metrical grid and constituent structure, as we have done so far, $\text{NONFIN}_{\text{FT}}$ will account for the non-finality effects in Latin. Whenever the right edge of the prosodic word coincides with the right edge of a foot, this constraint is violated. In this case we avoid the ranking paradox as shown above in (77), as well as the ad hoc and unmotivated asymmetry between iambic and trochaic languages with regard to the difference between the prominence of unfooted versus footed unstressed syllables, which only serves to save RHYTHM.

In the next section we deal with another metrical analysis that addresses edge adjacent elements. Here the problem is not so much the difference in behaviour between word-internal rhythm and word-final rhythm, but rather, the difference between the left edge and the right edge.

4.9.2 Van de Vijver 1998

Essential in the work of Van de Vijver (1998) is that he denies the existence of iambic feet as primitives of UG. He claims that these rightheaded feet are the result of constraint interaction. He proposes to account for the stress patterns of iambic stress systems by means of the constraint interaction of *EDGEMOST and TROCHEE.

(81) *TROCHEE:* Within a foot, every ‘x’ is followed by a ‘.’.

(82) **EDGEMOST:* Edge-adjacent elements must not be prominent.

The constraint *EDGEMOST is symmetrical, it explicitly does not refer to the left or the right edge. Van de Vijver motivates this by the fact that iambic languages seem to avoid both initial and final stress. This can be achieved by the ranking *EDGEMOST » TROCHEE. If *EDGEMOST dominates TROCHEE, stress will be pushed away from both edges, and due to the lower position of TROCHEE, this can result in iambic feet. The idea that iambic feet arise under constraint interaction explains why relatively many iambic stress systems, among which Sentani, have a trochaic pattern in disyllabic words. In bisyllabic words *EDGEMOST will be violated by either an iamb or a trochee, and due to the constraint TROCHEE, initial stress appears.

(83) /σσ/	*EDGEMOST	TROCHEE
→ a. [(σ́σ)]	*	
b. [(σσ́)]	*	*!

*EDGEMOST must be interpreted in the same way as NONFIN in the sense that, for example, in case *EDGEMOST holds for a syllable, the syllable may be part of a foot, as long as it is not adjacent to an edge.

It will be shown below that four-syllable words in Sentani, where the penultimate syllable ends in schwa, are problematic for this approach. This is exactly due to the fact that *EDGEMOST does not differentiate between the left and the right edge of a word. First let us see what patterns we predict with the constraints *EDGEMOST and TROCHEE.

(84)	*EDGEMOST	TROCHEE
a. [(σσ̀)(σ́σ)]	✓	*
b. [(σ̀σ)(σ́σ)]	*	✓
c. [(σσ̀)(σσ́)]	*	**
d. [(σ̀σ)(σσ́)]	*	*

The constraint ranking proposed by Van de Vijver (1998) to account for iambic stress patterns, i.e., *EDGEMOST » TROCHEE, results in pattern (84a), a pattern that we see frequently in Sentani (85a). However things go wrong when we try to account for words with syllables that end in a schwa (85b,c).

(85) a. [fomàlɛ́re] ‘for we will go accross’
b. [àxəláne] ‘in the forest’
c. [hoxòmə́xe] ‘while coming he picked/gathered’

As we have already seen above, when the second syllable ends in a schwa (87b), stress shifts to the left to land on the initial syllable. But when the third syllable ends in a schwa (85c) stress does not move to the final syllable. Since *EDGEMOST does not differentiate between the left or the right edge, initial stress is predicted to be as bad as final stress, and therefore only the form with a word-internal clash is selected as the optimal candidate. In order to get the output of (85b) *EDGEMOST must be dominated by *(C)ə́.

(86) /axəlane/ ‘in the forest’	*(C)ə́	*EDGEMOST	TROCHEE
→ a. [(àxə)(láne)]		*	
b. [(axə̀)(láne)]	*!		*

However, in order to get the output of (85c), the constraint *EDGEMOST must dominate *(C)ə́.

(87) /hoxoməxe/ 'while coming, he picked/gathered'	*EDGEMOST	*(C)ə́	TROCHEE
→ a. [(hoxò)(mə́xe)]		*	*
b. [(hoxò)(məxé)]	*!		**

Now we have a ranking paradox. The only way to resolve this ranking paradox is by invoking a constraint that differentiates between the left and the right edge, and this constraint should outrank *EDGEMOST in (89). NONFIN does exactly this. We have seen that in Sentani, NONFIN is undominated, and as such it outranks *EDGEMOST. However, by invoking NONFIN, *EDGEMOST loses an important part of its explanatory power. The only reason why we need *EDGEMOST now is to avoid initial stress, which is characteristic of iambic stress systems. This can also be obtained when we simply assume FTFORM = IAMB. The constraint ranking NONFIN » *(C)ə́ » FTFORM results in a trochaic pattern in bisyllabic words, and accounts for the avoidance of stressing the schwa syllable word-initially, but not word-finally, and this is the constraint ranking that is given above in (69) for the stress pattern of Sentani.

4.10 Conclusion

In this chapter we have seen that the key aspect of Sentani stress is that even though it has both binary and ternary patterns, the stress system of Sentani is binary. The stress system can be accounted for by using binary iambic feet, with trochaic feet under duress, due to NONFIN » *(C)ə́. Without invoking constraints that specifically refer to ternarity, constraint interaction results in either binary patterns or ternary patterns. The constraints that we saw return most often when a word has a ternary pattern are NONFIN, FTFORM and *(C)ə́.

The analysis of Sentani also showed that the rhythmic distribution of stresses should be accounted for by the rhythmic constraints *CLASH and *LAPSE, which refer to the pure grid. We already saw this in the literature for *CLASH, but the anti-lapse constraints we found in the literature so far referred to both the grid and to feet or foot boundaries. These constraints are PARSE-2 (Kager 1994) and LAPSE (Green & Kenstowicz 1995). As a result, they failed to account for the stress pattern of Sentani. Not only did those constraints rule out forms in Sentani that actually did not have a rhythmic lapse, but in principle, they also allow for a long rhythmic lapse (an interstress interval of three adjacent unstressed stress units), without violating the constraints. Both blocking a pattern that occurs in Sentani, and allowing for a pattern that is highly undesirable in bounded stress systems, is due to the combination of iambic and trochaic foot. The question arose whether anti-lapse constraints should refer to metrical structure, or be defined on the grid. Sentani gave us the opportunity to decide on the matter, since due to constraint interaction in Sentani, we do find a combination of both an iamb and a trochee in one single word. With the purely rhythmic definition as proposed in Chapter 1 and section 4.7 of this chapter, we can account for the data in Sentani. Due to the reference to the pure grid the anti-lapse constraint does not allow for a rhythmic lapse without violating the constraint.

In order to account for the stresslessness of final light syllables and the stressed final heavy syllables, we concluded that the NONFIN constraint needs to refer to the mora. Prince & Smolensky (1993) already propose a NONFIN constraint that refers to the syllable or the foot. To this we can now add the mora, a natural extension, given the prosodic hierarchy (Selkirk 1980). This resulted in a constraint family on the three prosodic levels foot, syllable and mora.

Furthermore, we saw that Hung (1994) tried to collapse clash avoidance and non-finality of stress into one constraint. But we saw that for Sentani the demands for clash avoidance and non-finality were not the same. We had to use different constraints. Not only are they crucially ranked in different positions in the hierarchy for Sentani, they also evaluate on different prosodic levels. Clash evaluates at the syllabic level, while NONFIN evaluates at the moraic level.

That there seems to be a difference between avoidance of clash and non-finality of stress also became apparent from Hung's analysis of non-finality effects in a trochaic system such as Latin. Being a trochaic language, on the syllabic level non-finality comes naturally, but Latin shows non-finality of the foot as well. This could only be accounted for by introducing an extra layer on the grid, which is awkwardly restricted to trochaic systems. And even then Hung had to redefine RHYTHM.

Not only does there seem to be a difference between word-internal rhythm and non-finality of stress, there is also a difference between the left and the right edge of the word. This was originally mentioned as the edge markedness restriction on extrametricality. The constraint *EDGEMOST proposed in Van de Vijver (1998) crucially makes no difference between the two edges. Data of Sentani have shown, however, that this language does indeed make a difference between the two edges, so that the demands to avoid final stress are stronger than the demands to avoid initial stress. We therefore still needed a constraint expressing this difference, reducing the use of *EDGEMOST to the left edge of the word, for which we could simply use the constraint FTFORM = IAMB.

This concludes the chapter about Sentani. In the next chapter we will see an extensive description of the stress patterns of Finnish. Just as Sentani, this language has frequent ternary patterns, which we will also analyse in an Optimality analysis. And as is the case for Sentani, it will be shown that Finnish has a binary stress system. Its basic stress pattern is binary, but constraint interaction may cause ternary patterns to surface.

Other aspects that Finnish shares with Sentani are its use of *LAPSE, to rule out overlong sequences of unstressed and unparsed syllables, partial quantity sensitivity and avoidance of final stress.

5 Finnish Stress: the phonological pattern

5.1 Introduction

Another language that is known to exhibit ternary patterns is Finnish. As explained in Chapter 1, the goal of this thesis is to keep the metrical theory as restricted as possible, and to account for ternary patterns by the means already available, such as the ones used to account for binary stress. Binary stress systems account for the majority of bounded stress systems, and have received considerable attention in the literature about metrical phonology.

Carlson (1978) and Hanson & Kiparsky (1996) have described Finnish as a language with both ternary and binary stress patterns. In the previous chapter it was shown that the stress system of Sentani, which also combines binary and ternary patterns, was accounted for by binary feet. Constraint interaction resulted in the binary and ternary patterns. We did not need to refer to ternary feet, or to introduce constraints that were specifically motivated to account for ternary patterns, such as a constraint that triggers a parsing mode, for example , the *FTFT constraint proposed by Kager (1994). In this and the next chapter it will be shown that, just as for Sentani, we can also account for the stress system of Finnish with binary feet. Again, the interaction between constraints that are known from the analyses of binary stress systems give us both the binary and ternary patterns. We do not need constraints specifically designed for ternarity.

In Finnish some of the ternary patterns are phonological, but some of the ternary patterns are the result of the interaction between phonology and morphology. There are two 'phonological' circumstances in which ternary patterns arise. First, main stress is always on the initial syllable. In a string of light syllables, secondary stress is on every odd-numbered syllable, except when this is the final syllable of the word. This results in a ternary pattern word-finally (X́XL̀LL). Second, when the odd-numbered syllable is followed by a heavy syllable, stress will fall on the heavy syllable (X́XLH̀L). But this latter ternary pattern is optional when the heavy syllable is the final syllable in the word (X́XLH̀-X́XL̀H). In Finnish (C)V syllables are light, and (C)VV, (C)VC, (C)VVC syllables are heavy.

(1) a.	[érgonòmia]	‘ergonomics (Nom)’
b.	[púhelimèltani]	‘my telephone (Abl)’
c.	[mérkonomìn] - [mérkonòmin]	‘a degree in economics (Gen)’

However, ternary patterns also appear word-internally when there are no heavy syllables. These ternary patterns seem to be the result of certain suffixes. Carlson (1978) and Hanson & Kiparsky (1996) observe that when a case marker or possessive suffix is attached to the word, stress may shift to the right and land on the syllable preceding the suffix. This may result in a ternary pattern. Data collected by the author confirm that stress shifts to the right when these suffixes are used.

(2) a.	[áterìa]		‘meal (Nom)’
b.	[áteriàna]	/ateria-na/	‘meal (Ess)’
c.	[áteriàni]	/ateria-ni/	‘meal (Nom 1SG)’
d.	[áteriànani]	/ateria-na-ni/	‘meal (Ess 1SG)’

The newly collected data show that the interaction between phonology and morphology is more complicated than the earlier descriptions show us. First, the stress shift which depends on the presence of a suffix is optional (3a-b). Second, we find binary stress patterns with secondary stress on an odd numbered light syllable preceding a heavy syllable. According to the phonology, this would trigger a ternary pattern. Again this is optional (3c,d).

(3) a.	[áterìana]	[áteriàna]	/ateria-na/	‘meal (Ess)’
b.	[áterìanàni]	[áteriànani]	/ateria-na-ni/	‘meal (Ess 1SG)’
c.	[áterìanànsa]	[áteriànansa]	/ateria-na-nsa/	‘meal (Ess 3SG)’
d.	[périjänä̀mme]	[périjä̀nämme]	/perijä-nämme/	‘inheritor (Ess 2PL)’

In this chapter first a description of several aspects of Finnish phonology and morphology will be given, followed by an extensive description of Finnish stress. This description is restricted to stress patterns that can be obtained by strictly applying phonological constraints. This chapter concludes with wan Optimality account fo these phonological generalisations. Chapter 6, focuses on the description and analysis of the stress patterns in which the morphology plays a role in stress placement.

The descriptions of the phonology and morphology are based on Harms (1960, 1964), the Standard Finnish Dictionary: Finnish-English/English-Finnish (Aino Wuolle 1978), Carlson (1978), Schot-Saikku (1992), Karlsson (1984), Hanson & Kiparsky (1996). The description of the stress patterns are based on Carlson (1978), Hanson & Kiparsky (1996), but also to a large extent on data collected by the author in the spring of 1996.[1]

[1] Carlson = C, Hanson & Kiparsky = H&K, Schot-Saikku = S-S, Standard Finnish Dictionary = SFD.

5.2 The Data

Carlson (1978) and Hanson & Kiparsky (1996) have described Finnish stress. Both sources mention the influence of the morphology on the stress pattern. Despite the relatively extensive description by Carlson, I felt that the data were still too restricted for the purpose of an in-depth analysis, especially with regard to the effects of the morphology on the stress pattern. In the spring of 1996 I collected new data of the Finnish language by recording some short utterances of three native speakers of Finnish. All of them were speakers of standard Finnish.[2] At the time the data were collected, all three speakers were in their first year of a stay in the Netherlands as exchange students. It is assumed that this did not fundamentally affect the use and competence of their own language.

The recordings were transcribed by three phonologists/phoneticians of the Utrecht Institute of Linguistics OTS. None of these three researchers were native speakers of Finnish. They were also all involved in transcribing the recordings of Sentani. They almost always agreed on the perception of the stress patterns as produced by all three speakers. In the autumn of 1996, these transcriptions were then looked at by two other native speakers of Finnish, both linguists and experts in the field of metrical phonology. They agreed that the patterns in my data were all possible stress patterns in Finnish. These data form the basis for the description and analysis of the Finnish stress pattern given below.

The new data confirm the descriptions by Carlson (1978) and Hanson & Kiparsky (1996), especially with regard to the phonological patterns. In addition they also show patterns that are not mentioned in these works. Of special interest is the variation related to the influence of the morphology.

It has already been mentioned that morphology may affect stress placement. Carlson (1978) observes that main stress is on the initial syllable and every other syllable, resulting in a binary pattern. "*Clearly, feet are counted from left to right, giving preference to binary feet, where there is no overriding reason not to do so*" (Carlson 1978, p. 9). However, he argues that when there is a case marker or a possessive suffix, there is a stress shift to the right that results in a ternary pattern. There are two circumstances in which stress shifts occur. First, when the suffix closes the previous syllable, and as such creates a heavy syllable. Second, and more importantly, when the suffix does not close the preceding syllable, and thus does not become a heavy syllable. In these cases, the stress shift occurs according to what Carlson calls a "*quite regular paradigmatic analogy*" (Carlson 1978, p14). In both cases, a ternary pattern appears.

[2] Finnish has quite a few dialects. Originally Standard Finnish was the predominant dialect of the Helsinki area. In general it can be said that Standard Finnish is the variant of the language used in schools, in the media, and formal situations.

(4) a.	[óttamiàmme]	/otta-ma-i-a-**mme**/	(C.13)
		‘take’-participle-plural-partative-1plural	
b.	[óttamiàni]	/otta-ma-i-a-**ni**/	(C.13)
		‘take’-participle-plural-partative-1singular	
c.	[óhittavàlta]	/ohitta-va-**lta**/	(C.13)
		‘pass’-participle-ablative	
d.	[óhittavàna]	/ohitta-va-**na**/	(C.13)
		‘pass’-participle-essive	

Hanson & Kiparsky (1996) offer a different description of the effects of suffixes on the stress pattern. They agree with Carslon that the regular stress pattern for Finnish is a binary pattern. They also observe that case markers and possessive suffixes influence the stress pattern. Under certain circumstances, these suffixes require stress on the syllable that immediately precedes them, and this requirement may lead to a ternary pattern. Hanson & Kiparsky call this the *preaccenting* property of case markers and possessive suffixes. According to Hanson & Kiparsky, the appearance of a ternary pattern depends on the number of suffixes. Only one such preaccenting suffix may lead to a ternary pattern, but when there are two such suffixes, the regular phonological (i.e., binary) pattern reappears.

(5) a.	[kómppanià-na]	‘as a company (Ess)’	(H&K 307)
b.	[kómppanìa-nà-ni]	‘as my company (Ess 1SG)’	(H&K 307)

As already indicated in the introduction of this chapter, my data show that the situation is more complicated. I also found that both the case markers and the possessive suffixes affect the stress pattern in the way described by Carlson and Hanson & Kiparsky. However, contrary to the observation by Hanson & Kiparsky, the preaccenting property is visible not only when there is a single suffix, but also when both are attached to the noun. Thus, in the case of two suffixes, there can be either a binary or a ternary pattern, as evidenced by the data in (6).

(6) a.	[áterìana]	[áteriàna]	/ateria-na/	‘meal (Ess)’
b.	[áterìanàni]	[áteriànani]	/ateria-na-ni/	‘meal (Ess1SG)’
c.	[púhelìmeni]	[púhelimèni]	/puhelime-ni/	‘telephone (Nom 1SG)’
d.	[púhelìmenàni]	[púhelimènani]	/puhelime-na-ni	‘telephone (Ess 1SG)’

And there is still variation when the case endings and/or possessive suffixes result in a closed syllable. This even results in a stress pattern in which a light syllable preceding a heavy syllable is stressed. This contradicts the observation about stress shift by Carlson (1978).

(7) a.	[áterìanànsa]	[áteriànansa]	/ateria-na-nsa/	‘meal (Ess 3SG)’
b.	[érgonòmianànsa]	[érgonòmiànansa]	/ergonomia-na-nsa/	‘ergonomics (Ess 3SG)’

The variation in my data, as shown in (6) and (7), is the result of the speech produced by three native speakers. The utterances consist of stems to which suffixes were attached. The suffixes had different forms, but most were of the form (C)V or CCV. Either a single suffix, or combinations of suffixes, were attached to stems, which themselves were of different length and/or of different syllable structures. None of the utterances were repeated, but in the data morphological and syllable structures reccurred several times. The items were offered at random, i.e., from a paradigm of complex nouns (for example, as in (6) and (7)), the items were spread among other items of other paradigms, to prevent the speakers from falling into a rhythmic cadence. The speakers produced all the utterances only once. The variation is the result of either two of the speakers producing the binary pattern and the other ternary, or vice versa. All speakers showed variation, i.e., at one stage a speaker produced a binary pattern, and at another stage a word with comparable morphological and syllabic structure was produced with a ternary pattern. This was true for all the speakers. In general, it was observed that of the three speakers, one speaker tended towards a binary pattern, one towards a ternary pattern and one had no obvious preference. But despite these tendencies, all speakers produced both binary and ternary patterns for words with comparable morphological and syllabic structure.

The stress patterns that are phonological are accounted for below. The analysis resembles that of Hanson & Kiparsky (1996) and Alber (1997), especially since the data did not reveal any unexpected phonological patterns. In the next chapter, the morphological patterns are accounted for. However, before giving a detailed description and an Optimality account of the stress patterns of Finnish, I first give a brief outline of several aspects of Finnish phonology and morphology. These help to understand the description and analysis of Finnish stress.

5.3 Phonology

In this section I provide an outline of some aspects of Finnish phonology. The outline covers only these aspects that are thought to be relevant for the understanding of Finnish stress. This outline is based on Karlsson (1984), Keyser & Kiparsky (1984) and Schot-Saikku (1992). And, as was the case for Sentani, data collected by the author help to illustrate the observations.

5.3.1 Vowels and Consonants

Finnish has eight vocalic phonemes.

(8) i, y, u, e, o, a, ø (orthographic: ö), ɛ (orthographic: ä)

	Front				Back
High	i	y			u
		e	ø	o	
		ɛ			
Low			a		

It has thirteen consonantal phonemes.

(9) p, t, d, k, g, s, h, v, j, l, r, m, n.

	labial	labiodental	alveolar	palatal	velar	glottal
plosive	p		t, d		k, g	
nasal	m		n			
trill			r			
fricative		v	s	j		h
lateral			l			

5.3.2 Syllable structure

As already mentioned in the chapter on Sentani, I follow Hayes (1995) in assuming that in stress languages the syllable constitutes the stress-bearing unit. Finnish has the syllable structures as shown in (10).

(10)	a.	(C)V	a.su.a	'to live'	(S-S. 14)
	b.	(C)VV	pyy.tää	'to ask'	(SFD. 289)
	c.	(C)VC	vil.kas	'busy'	(SFD. 451)
	d.	(C)VVC	py.sä.koin.tiin	'parking'	
	e.	(C)VCC	telk.kä	'golden eye'	(SFD 382)

Finnish has no complex onsets, neither word-initially, nor word-internally. Only some recent loanwords, which have not been assimilated to Finnish phonology, may have word-initial complex onsets.[3]

(11)	a.	struk.tuu.ri	'structure'	(S-S. 15)
	b.	pre.si.dent.ti	'president'	(S-S. 15)

Word-finally, there are no complex codas. Complex codas occur only word-internally. Those word-internal codas involve long geminates, i.e., the rightmost consonant in a coda is usually a long consonant, which also serves as the onset of the following syllable (10e, 11b). Word-internally we frequently find consonant clusters that consist of a single coda consonant and a single onset (10c) consonant.

[3] The analysis of these recent loanwords are ignored in this thesis since the stress pattern in those words may not have been assimilated to the Finnish stress patterns.

The nucleus of a CVV or CVVC syllable can be either a long vowel or a diphthong (12b,d). Finnish has 18 diphthongs.

(12) a. ai, äi, oi, öi, ei, ui, yi
b. au, eu, iu, ou
c. ey, iy, äy, öy
d. ie, uo, yö

All other vowel combinations are separated by a syllable boundary.

(13)	a.	suo.me.a	'the Finnish language'	(S-S. 15)
	b.	lau.an.tai	'Saturday'	(S-S. 15)

5.3.3 Word minimum

The word minimum in Finnish is bimoraic. Lexical words consist of at least CVV or CVCV.

(14)	a.	puu	'tree'	(SFD. 284)
	b.	puhe	'speech'	(SFD. 277)

Words of more than one syllable always combine syllables that take into consideration the restriction on complex onsets and complex codas just described.

5.3.4 Length of vowels and consonants

The length of both vowels and consonants is a distinctive feature in Finnish.[4]

(15)	a.	itä	- itää		'east'	- 'sprout'	
	b.	latu	- laatu		'skiing trace'	- 'quality'	
	c.	kiitää	- kiittää		'to speed'	- 'to thank'	
	d.	kuka	- kukka		'who'	- 'flower'	
	e.	kato	- kaato	- katto	'failure of crops'	- 'fall'	- 'roof'
	f.	tili	- tiili	- tilli	'bill'	- 'tile'	- 'dill'

5.3.5 Consonant gradation

For consonants, the distinctiveness of length is also shown in the process of consonant gradation. This is a process in which the length or the quality of consonants changes under the influence of the morphology. Consonants go from a strong grade to a weak grade. There are several ways in which consonant gradation

[4] These pairs were brought to my attention by one of the native speakers. For an analysis of length in Finnish, see Harrikari (1998).

manifests itself: long consonants become short, short consonants assimilate, change in quality, or are deleted. Especially when long consonants become short, or short consonants are deleted, consonant gradation can affect the weight of the syllables. And since Finnish seems to have a quantity sensitive stress system, this may have influence on the placement of stress.

Consonant gradation is restricted to the consonants /k/, /p/ and /t/. The exact nature of consonant gradation depends on the left environment of these consonants. Below we only see examples of shortening, assimilation and deletion.[5]

(16) Karlsson (p. 38-39)

Long consonants			
a. pp - p	kaappi	kaapi-ssa	'bookcase'
b. kk - k	kukka	kuka-n	'flower'
c. tt - t	matto	mato-lla	'carpet'
Short consonants			
d. Vp - v	tupa	tuva-ssa	'cabin, hut'
e. Vt - d	katu	kadu-lla	'alley'
f. ht - hd	lähte-	lähde-n	'to leave'
g. k - ø	jalka	jala-n	'foot, leg'
/k,t,p/ after nasals and laterals			
h. mp - mm	ampu-	ammu-mme	'to discharge'
i. nt - nn	ranta	ranna-lla	'beach'
j. nk - ng	kenkä	kengä-n	'shoe'
k. lt - ll	kulta	kulla-n	'gold'
l. rt - rr	parta	parra-ssa	'beard'
Special cases for /k/			
m. lke - lje	polke-	polje-n	'to pedal'
n. rke - rje	särke-	särje-n	'to break'
o. hke - hje	rohkene/t	rohjet-a	'brave'
p. k - v	puku	puvu-n	'clothes, dress'

In nouns, case endings trigger consonant gradation, while person endings do the same for verbs. The suffixes that trigger consonant gradation consist either of a single consonant (-C), or of two consonants followed by a vowel (-CCV). In both cases the preceding syllable will be closed. All other case endings or person endings do not trigger consonant gradation. This is illustrated in (17) below.

(17) Karlson (p. 41)

a. [katon]	/katto-n/	'roof (Gen)'
b. [katolla]	/katto-lla/	'roof (Adess)'

[5] For a more detailed account of consonant gradation see Bye (1996).

c. [kattona]	/katto-na/	'roof (Elat)'
d. [kattoon]	/katto-Vn/[6]	'roof (Ill)'

The examples in (17) show consonant gradation versus the lack of it in single noun stems. In (17a), the suffix is a single consonant and consonant gradation takes place, /-*tt*-/ becomes weak [-*t*-]. In (17b), there is also consonant gradation. Here consonant gradation is triggered by the -CCV case marker. In the other two examples (17c,d), there is no consonant gradation, since neither of the case markers meets the requirements. In (17c), the suffix is -CV, and in (17d) the suffix lengthens the vowel, and is followed by a consonant (-VC).

In (18) the application of consonant gradation is distinctive. In (18a,b) the ending /-*ista*/ is not a case ending and therefore it does not trigger consonant gradation, while in (18ci,di), the plural affix is followed by the elative case marker /-*sta*/, which does trigger consonant gradation (18).[7]

(18) a.	[somerikkoista]	somerikko-ista	'like pebbles'
b.	[somerikoista]	somerikko-i-sta	'pebbles (Elat)'
c.	[ruttoista]	rutto-ista	'like the plague'
d.	[rutoista]	rutto-i-sta	'the plagues (Elat)'

In sum, this overview of possible syllables and syllable combinations in Finnish shows that the occurrence of consonant clusters is restricted to word-internal position. The word minimum in Finnish is either a heavy syllable or two light syllables. Vowel length and consonant length are distinctive. Consonant gradation is a productive process that affects the quality or length of the consonants.

Since it has been observed that the place of secondary stress in Finnish is also partly determined by an interaction between phonology and morphology, I continue by looking at some aspects of Finnish morphology.

5.4 Morphology

This thesis ananlyzes in greater depth the observations made by Carlson (1978), Hanson & Kiparsky (1996), and the observations based on the newly collected data about secondary stress. It seeks to find an explanation for the way morphology affects the stress patterns in Finnish. An overview of the structure of morphologically complex nouns in Finnish is therefore given below.

This section only serves to explain the basic properties of complex nouns in Finnish. It is beyond the scope of this work to give a detailed description of all that can be said about complex nouns in Finnish. For an extensive description of the

[6] Vn = Illative lengthens the vowel.

[7] These pairs were brought to my attention by one of the native speakers.

complex nouns, the reader is referred to the descriptions of the grammar of Finnish, such as Sulkala & Karjalainen (1992) or Karlsson (1984).

5.4.1 Complex nouns

Finnish, like Sentani, is an agglutinative language. Each noun or verb can, in principle, occur with a sequence of suffixes. The form of the noun is as follows:

(19) Root- (+ plural) (+ case ending) (+ possessive suffix)

All morphemes in (19) are bound morphemes. The root is a bound morpheme that cannot occur on its own. The root is that part of the noun that precedes the suffixes denoting either plural, case or possessive. The nominative singular has no overt case ending and is called the 'basic form'. The basic form and the root can be segmentally identical, but they can also be different. In inflected nouns, the root can be identified by looking at the genitive. The part of the word that precedes the genitive case marker /-n/ is the root.

(20)	*Basic Form*	*Root + -n (Gen)*	
	a. [ateria]	[ateria-n]	'meal'
	b. [tarjotin]	[tarjottimen]	'tray'
	c. [hammas]	[hampaa-n]	'tooth'

When suffixes are added to the root, the right edge of the root may change. The way it changes depends on the declination. Nouns are grouped in four types of declination. This grouping is based on the right edge of the basic form and how the root deviates segmentally from the basic form. The surface form of the complex noun depends on the type of declination to which the noun belongs.[8]

The nominative plural is formed by adding /-t-/ to the stem. Cases other than the nominative have /-i-/ added between the root and the case ending. This may result in a change of the root-final vowel or in a diphthong, depending on the declination.

(21)	a. [ateria] (Nom sg)	[ateriat] (Nom pl)	[aterioi-ssa] (Ess pl)
	b. [tarjotin] (Nom sg)	[tarjottimet] (Nom pl)	[tarjottimi-ssa] (Ess pl)
	c. [hammas] (Nom sg)	[hampaat] (Nom pl)	[hampaissa] (Ess pl)

As mentioned above, case markers may affect the stress pattern. The case markers attach to the plural affix, or directly to the root.

[8] For a detailed description of the declinations, I refer the reader to Karlsson (1984). Whenever this is relevant, both the basic form and stem will be given.

(22)	a.	nominative	ø (sg.), -t (pl.)	ateria	'meal'
	b.	genitive	-n (sg), -en, -den/-tten (pl)[9]	ateria-n	
	c.	partitive	-a, -ta	ateria-a	
	d.	inessive	-ssa	ateria-ssa	
	e.	elative	-sta	ateria-sta	
	f.	illative	-Vn, -seen, -siin (sg) -hVn, -hin (pl)	ateria-an	
	g.	adessive	-lla	ateria-lla	
	h.	ablative	-lta	ateria-lta	
	i.	allative	-lle	ateria-lle	
	j.	essive	-na	ateria-na	
	k.	translative	-ksi	ateria-ksi	
	l.	accusative	-t (pronouns only)	kuka-t	'who'

The case endings can in turn be followed by a possessive suffix. Those suffixes express to whom the noun belongs.

(23)	a.	1 sg	-ni	ateria-lla-ni	'meal (Adess 1SG)'
	b.	2 sg	-si	ateria-lla-si	'meal (Adess 2SG)'
	c.	3 sg/pl	-nsa	ateria-lla-nsa	'meal (Adess 3SG/PL)'
	d.	1 pl	-mme	ateria-lla-mme	'meal (Adess 1PL)'
	e.	2 pl	-nne	ateria-lla-nne	'meal (Adess 2PL)'

When the noun is in the nominative, the possessive suffix attaches directly to the root.

(24)	BASE		ROOT	Root + poss	
	a.	ateria	ateria-	ateria-ni	'meal (Nom 1SG)'
	b.	tarjotin	tarjottime-	tarjottime-ni	'tray (Nom 1SG)'

This, in short, is how complex nouns appear. It is beyond the scope of this thesis to explain when exactly which case marker or possessive suffix is used. For this, I refer the reader to other descriptions and grammars of the Finnish language. To understand the analysis of Finnish stress it is sufficient to know which components form a complex noun, and the place in the nouns of the case markers and possessive suffixes. These are the suffixes that play a role in the placement of secondary stress. For nouns, all the relevant suffixes were given, as well as their place in the complex noun. The following section gives a detailed description of the stress patterns. These stress patterns are the patterns that can be explained by using strictly phonological constraints. The next chapter deals with the stress patterns that are affected by the morphology.

[9] The choice of the genitive suffix is very complex. See for an analysis Anttila (1997).

5.5 Stress patterns of Finnish

In the stress system of Finnish we find both binary as ternary patterns. This chapter concentrates on stress patterns that are based on phonological factors. Below, an extensive description of these stress patterns of Finnish is given.

5.5.1 Main stress

In Finnish, the place of main stress is fixed. Main stress is on the initial syllable. Finnish has a quantity-sensitive stress system. Heavy syllables attract stress. CV is light, CVV, CVC, and CVVC are heavy. But regardless of the weight of the initial syllable, and that of the second syllable, main stress is on the initial syllable.

(25)	a.	[áterìa]	[ĹLL̀L]	‘meal (Nom)’
	b.	[jä́rjestèlmä]	[H́HH̀L]	‘system (Nom)’
	c.	[érgonòmia]	[H́LL̀LL]	‘ergonomics (Nom)’
	d.	[rávintòla]	[ĹHL̀L]	‘restaurant (Nom)’

Most remarkable is (25d), which has stress on the initial light syllable, while the second syllable is heavy. In Finnish, the second syllable never receives stress. There is an undominated constraint that forces the prosodic word to begin with main stress.

5.5.2 Secondary stress

Giving generalisations for the distribution of secondary stress is far more complicated than for main stress. This is, among other factors, due to variation.

In words consisting of a sequence of light syllables, stress falls on every odd-numbered syllable, resulting in a binary pattern.

(26)	a.	[mä́kä]		‘hill (Nom)’
	b.	[répeä̀mä]		‘crack, rupture (Nom)’
	c.	[púhelìmenàni]	/puhelime-na-ni/	‘telephone (Ess 1SG)’

In Finnish final light syllables are never stressed. Thus when the odd numbered syllable is the final syllable in the word, this syllable will not be stressed, resulting in a ternary pattern word-finally.

(27)	a.	[périjä]		‘inheritor (Nom)’
	b.	[érgonòmia][10]		‘ergonomics (Nom)’
	c.	[púhelìmena]	/puhelime-na/	‘telephone (Ess)’

[10] The description here concentrates on words consisting of a sequence of light syllables. As already described, in Finnish, stress is always on the initial syllable, and therefore *ergonomia* with an initial heavy syllable can serve in the examples here.

When introducing heavy syllables, things become more complicated. When an odd-numbered light syllable is followed by a heavy syllable, the light syllable is skipped and the heavy syllable is stressed. This results in a ternary pattern word-internally.

(28)	a.	[mátematìikka]		'mathematics (Nom)'
	b.	[púhelimìstani]	/puhelime-i-sta-ni /	'telephones (Elat 1SG)'
	c.	[rákastajàttariànsa]	/rakastajattare-i-a-nsa/	'mistresses (Part 3SG)'

In long words the 'regular' stress pattern resumes the binary count after this heavy syllable. As a result even-numbered syllables may be stressed.

(29)	a.	[rákastajàttarèna]	/rakastajattare-na/	'mistress (Ess)'
	b.	[páimentolàisiàni]	/paimentolaise-i-a-ni/	'nomads (Part 1SG)'

However, when, in a configuration comparable to that of (28), the heavy syllable is the final syllable in the word, stress on this final heavy syllable is optional.

(30)	a.	[rávintolàt]	[rávintòlat]	'restaurants (Nom)'
	b.	[mérkonomìn]	[mérkonòmin]	'degree in economics (Gen)'

In general in Finnish, stressing the final heavy syllable is optional. According to Hanson & Kiparsky the generalisation with regard to final heavy syllables is that *"[f]inal syllables not preceded by a stressed syllable are stressed optionally if they are heavy"* (Hanson & Kiparsky p. 301). Note that the unstressed syllable preceding the heavy syllable can be either light (30) or heavy, as in (31a). The observation by Hanson & Kiparsky also captures (31b), where secondary stress is either on the antepenultemate and the final syllable, or only on the antepenultimate syllable. Finally, the observation rules out stress on the final syllable in (31c). Stress on the third, heavy syllable is obligatory, and as a result the final syllable is preceded by a stressed syllable and cannot receive stress itself.

(31)	a.	[kúningàs]	[kúningas]	'king (Nom)'
	b.	[káinostèlijàt]	[káinostèlijat]	'shy people (Nom)'
	c.	[síirtolàinen]	* [síirtolainèn]	'emigrant (Nom)'

Examples (28)-(31) show that Finnish has a quantity-sensitive stress system. When an odd-numbered light syllable is followed by a heavy syllable, stress is on this heavy syllable, resulting in a ternary pattern, while in a sequence of light syllables, stress is just on every odd-numbered syllable, displaying a binary pattern. Moreover, when the final syllable is heavy, this heavy syllable is optionally stressed when preceded by an unstressed syllable, while final light syllables never receive stress.

(32)		Heavy syllables[11]		Light syllables
	a.	[X́XLH̀L]		[X́XL̀LL]
	b.	[X́XLH̀]	~[X́XL̀H]	[X́XL̀L]
	c.	[X́XH̀]	~[X́XH]	[X́XL]
	d.	[X́XL̀LH̀]	~[X́XL̀LH]	[X́XL̀LL]

Also, word-internally, heavy syllables do not always receive stress. We already saw that main stress is always on the initial syllable and that the second syllable is never stressed, even when it is heavy.

(33)	a.	[rávintòla]	[ĹHL̀L]	'restaurant (Nom)'
	b.	[lä́hettilä̀stä]	[ĹHLH̀L]	'envoy (Part)'

In Finnish there is an absolute ban on clashes. In the examples below, stressing all heavy syllables would result in clashes. Therefore, of adjacent heavy syllables, only one is stressed, so that the stress pattern is binary.

(34)	a.	[jä́rjestèlmä]	[H́HH̀L]	'system (Nom)'
	b.	[énsimmä̀isellä]	[H́HH̀HL]	'first (Nom)'

The resumption of the stress pattern on odd-numbered syllables after a stressed syllable is another indication of clash avoidance. From the regular stress pattern with initial main stress and stress on every odd-numbered syllable, we may conclude that the binary foot of Finnish is the trochee. A heavy syllable may in principle form a monosyllabic foot, except when such a trochee immediately adjacent to a stressed heavy syllable would create a clash.

(35)	a.	[(váati)(màtto)(màna)]	*[(váati)(màt)(tòma)na]	'modest (Ess)'
	b.	[(síirto)(làisi)(àni)]	*[(síirto)(lài)(sìa)ni]	'emigrant (Part 1SG)'

(36)	a.	[(rákas)ta(jàtta)(rèna)]	*[(rákas)ta(jàt)(tàre)na]	'mistress (Ess)'
	b.	[(páimen)to(làisi)(àni)]	*[(páimen)to(lài)(sìa)ni]	'nomads (Part 1SG)'

This description of Finnish stress patterns, shows that the patterns above can be accounted for by applying only phonological constraints. To recapitulate, we saw that main stress is always on the initial syllable.

(37) a. [ĹL...
b. [ĹH...
c. [H́L...
d. [H́H...

[11] X = any syllable, H = heavy syllable, L = light syllable.
The initial and second syllable are represented by the letter X, because stress is always on the initial syllable and never on the second syllable, regardless of the weight of either syllable.

A light syllable receives secondary stress when it is the odd-numbered syllable counted from the main stress or another stressed syllable, resulting in a binary pattern.

(38) a. [X́XL̀L]
b. [X́XL̀LL̀L]
c. [X́XLH̀LL̀L]

But when this odd-numbered syllable is the final syllable in the word, it never receives stress.

(39) a. [X́XL]
b. [X́XL̀LL]

When an odd-numbered light syllable counted from main stress or another secondary stress is followed by a heavy syllable, the light syllable is skipped and the heavy syllable is stressed, resulting in a ternary pattern.

(40) a. [X́XLH̀L]
b. [X́XLH̀LLH̀L]
c. [X́XLH̀LL]

Of adjacent heavy syllables, only one is stressed, and in a sequence of heavy syllables, the pattern is binary.

(41) a. [H́HH̀L]
b. [H́HH̀HL]

Word-final heavy syllables are optionally stressed when preceded by an unstressed syllable, or else stress is on the penultimate or antepenultimate syllable.

(42) a.	[X́XH̀]	or [X́XH]
b.	[X́XLH̀]	or [X́XL̀H]
c.	[X́XL̀LH̀]	or [X́XL̀LH]
d.	[X́XH̀H]	but not *[X́XHH̀]

These patterns are accounted for below. Alignment of main stress, avoidance of clash, foot binarity, syllable quantity and avoidance of final stress seem to be the determining factors for the position of secondary stress in Finnish.

5.6 The analysis of Finnish stress: the phonological patterns

In this section, an analysis of the stress patterns described above is given. Just as was the case for Sentani, this analysis is expressed within the theoretical framework of Optimality Theory. Finnish stress has been by Carlson (1978), Kiparsky (1991), Hanson (1992), Kager (1992) and Kenstowicz (1994). Analyses using Optimality Theory were given by Hanson & Kiparsky (1996) and Alber (1997). In several respects, my analysis resembles the analyses of Hanson & Kiparsky and Alber, but it also provides crucial improvements with regard to these analyses. The analyses of Hanson & Kiparsky and that of Alber are discussed at the end of this chapter.

As has been shown above, Finnish combines both binary and ternary stress patterns. These patterns are accounted for by using binary feet. We do not need to extend metrical phonology with ternary feet or any other special device to account for the ternary patterns. Using binary feet and constraint interaction result in both binary or ternary patterns.

This section concentrates on the analysis of the stress patterns that are based on phonological factors. There are three circumstances in which a ternary pattern appears. First, a ternary pattern arises word-internally, if an odd-numbered light syllable counted from main stress or another stressed syllable, is followed by a heavy syllable. In that case the heavy syllable receives stress (*X́XLH̀X*). Second, we may find a ternary pattern word-finally. Light syllables never receive stress when they are the final syllable in the word. If a final light syllable is the second syllable to the right of main stress or another stressed syllable, a ternary pattern appears (*X́XL̀LL*). Third, optionally avoiding stress on a word-final heavy syllable may optionally result in a ternary pattern (*X́XH̀*) versus (*X́XH*).

In this section, it is shown that, in order to account for the ternary patterns word-internally, the constraint that seems most obvious for this purpose, WSP, does not suffice to predict all word-internal ternary patterns. Another constraint is therefore introduced that can account for the word-internal ternary patterns just described. WSP however, plays a role when accounting for the stress patterns affected by morphological factors, as will be shown in the next chapter.

The word-final ternary pattern in a sequence of light syllables is due to the requirement that feet must be binary at either the moraic or trochaic level.

Of course optionality with regard to stressing the final heavy syllable is also accounted for. It is shown that the constraint NONFIN is not ranked with regard to two constraints, meaning that NONFIN can dominate either of these constraints and that these constraints can each dominate NONFIN.

The issues just mentioned are addressed in the course of the analysis of the stress patterns in Finnish. Main stress is analysed first, then words consisting of a sequence of light syllables, I continue by looking at words with heavy syllables word-internally, before turning to the variation in words with heavy syllables word-finally. Each time a constraint is introduced and its ranking established, I check the consequences of introducing this constraint on earlier motivated constraint rankings.

5.6.1 Main stress

Main stress is on the first syllable. This means that there is an undominated constraint, which either forces the prosodic word to begin with a foot or with the head of the prosodic word. This requirement can be expressed by an alignment constraint. This may be either an alignment constraint that forces the left edge of the prosodic word to coincide with the left edge of a foot, or an alignment constraint that demands that the prosodic word begins with the syllable which is the head of the prosodic word.

Hanson & Kiparsky (1996) propose the first option, i.e., the word begins with a foot. But in that case, one needs two other requirements in order to get main stress on the initial syllable, first we need FTFORM=TROCHEE, and second this constraint must be undominated. However, following Alber (1997), in this thesis, the choice is made for the alignment constraint that demands that the word begins with the head of the prosodic word.

(43) *ALIGN-HD*: ALIGN (PrWd, L, Head, L). Align the left edge of the prosodic word with the left edge of the head of the prosodic word (McCarthy & Prince 1993).

5.6.2 Light syllables

The stress pattern in words that consist of a sequence of light syllables is binary. From the observation that main stress is on the initial syllable and secondary stress on every other syllable to the right, it may be concluded that the foot must be a left-headed foot: a trochee. This constraint is undominated in Finnish.

(44) *FTFORM=TROCHEE*: The metrical foot is the trochee (Hayes 1995, Prince & Smolensky 1993 (RHTYPE=T)).

(45) a.	[(mấkä)]		‘hill (Nom)’
b.	[(péri)jä]		‘inheritor (Nom)’
c.	[(áte)(rìa)]		‘meal (Nom)’
d.	[(púhe)(lìme)na]	/puhelime-na/	‘telephone (Ess)’
e.	[(púhe)(lìme)(nàni)]	/puhelime-na-ni/	‘telephone (Ess 1SG)’

The word minimum in Finnish is bimoraic, i.e., either CVV or CVCV. This indicates that in Finnish feet must be binary at least at the moraic level, but in the next chapter it will be shown that this also holds for the syllabic level.

(46) *FTBIN*: Feet must be binary at some level of analysis. (Hayes 1995, Kager 1989, Prince & Smolensky 1993).

Anticipating on the arguments given in Chapter 6, the feet used here for the analysis of the phonological generalisations are: (H́L), (H́H), (Ĺ H) all binary at the syllabic level; (Ĺ L) binary at both the syllabic and moraic level; (H́) binary at the moraic level.

When analysing the stress patterns it will be shown that the three constraints just mentioned (ALIGN-HD, FTFORM, FTBIN) are not violated. From this it seems that these constraints are undominated. Below more constraints will be introduced and their place in the hierarchy determined. It will be shown that most of the constraints below however, are dominated.

Finnish has a bounded stress system. This means that as many syllables as possible are parsed into feet. The constraint PARSE-σ demands that all syllables be parsed into feet.

(47) *PARSE-σ*: a syllable must be parsed by a foot (Halle & Vergnaud 1987 (Exhaustivity Condition), Prince & Smolensky 1993).

This constraint cannot be undominated. In words with an odd number of syllables, at least one syllable will remain unparsed. Parsing all syllables would violate FTBIN.

(48) /ergonomia/ 'ergonomics (Nom)'	FTBIN	PARSE-σ
→ a. [(érgo)(nòmi)a]		*
b. [(érgo)(nòmi)(à)]	*!	

The strictly binary alternation indicates that feet prefer to be as much to the left as possible.

(49) *ALL-FT-L*: ALIGN (Ft, L, PrWd, L). The left edge of the foot must coincide with the left edge of the prosodic word (McCarthy & Prince 1993).

As McCarthy & Prince have shown, ALL-FT-L can only be satisfied if the word has one foot at the left edge of the word. In longer words, Finnish has multiple feet. This can only be obtained if PARSE-σ dominates ALL-FT-L.

(50) /ergonomia/[12] 'ergonomics (Nom)'	ALIGN-HD	FTFORM	FTBIN	PARSE-σ	ALL-FT-L
→ a. [(érgo)(nòmi)a]				*	**
b.[(érgo)no(mìa)]				*	***!
c. [(érgo)nomia]				**!*	

These two constraints replace what in rule based phonology would have been iterative Left-to-Right parsing. In (50c) there is only one foot, satisfying ALL-FT-L, but severely violating higher-ranked PARSE-σ. The candidates (50a) and (50b) would

[12] See footnote 9.

score the same for PARSE-σ, both one violation, hence the crucial ranking for ALL-FT-L for (50b).

With the constraint ranking in (51) we can obtain the binary stress pattern of the words in (26) and (27).

(51) ALIGN-HD, FTBIN, FTFORM » PARSE-σ » ALL-FT-L

However, Finnish has a quantity-sensitive stress system, which means that there are words in which heavy syllables attract stress, and which consequently cause the deviations from the binary alternating patterns, as was described in section 4.5. It was also shown that heavy syllables do not always receive stress. This makes the Finnish stress system a partially quantity-sensitive stress system. In cases where higher-ranked constraints block the stressing of heavy syllables, the stress system is 'quantity-insensitive'. In those cases where the constraint that demands stress on the heavy syllable dominates lower-ranked constraints, the stress system is quantity sensitive. In the next section, we will see which constraints are involved in the analysis of the phonological of words with heavy syllables.

5.6.3 Heavy syllables

In section 5.5, it was described how heavy syllables attract stress, leading to ternary stress patterns.

(52) a.	[mátematìikka]		'mathematics (Nom)'
b.	[púhelimìstani]	/puhelime-i-sta-ni/	'telephones (Elat 1SG)'
c.	[páimentolàisiàni]	/paimentolaise-i-a-ni/	'nomads (Part 1SG)'

This means that there must be a constraint that requires stress on heavy syllables must play an active role in the evaluation of the candidates. A constraint already known from the literature in the field of metrical theory is WSP.

(53) *WEIGHT-TO-STRESS-PRINCIPLE (WSP)*: A heavy syllable must be prominent in foot structure and on the grid (Prince 1983, 1990).

This constraint must dominate PARSE-σ, as can be seen in words consisting of six syllables. A ternary pattern implies that the word is not exhaustively parsed.

(54) /puhelimistani/ ' telephone (Elat 1SG)'	WSP	PARSE-σ
→ a. [(púhe)li(mìsta)ni]		**
b. [(púhe)(lìmis)(tàni)]	*!	

We already saw that PARSE-σ dominates ALL-FT-L (50). WSP dominates PARSE-σ (55), and by transitivity it also dominates ALL-FT-L.

(55) /matematiikka/ ‘mathematics (Nom)’	WSP	PARSE-σ	ALL-FT-L
→ a. [(máte)ma(tìikka)]		*	***
b. [(máte)(màtiik)ka]	*!	*	**

In this example, PARSE-σ does not play a role, because both candidates have one violation mark for this constraint. The candidate that has most violation marks for ALL-FT-L is the optimal candidate due to higher-ranked WSP.

Even though the description of the stress patterns shows that heavy syllables attract stress, not all heavy syllables are stressed. When the initial syllable is light and the second syllable is heavy, main stress will be on the first, light syllable. The second syllable is never stressed. This means that ALIGN-HD dominates WSP.

(56) /räjähde/ ‘explosive (Nom)’	ALIGN-HD	WSP
→ a. [(rä́jäh)de]		*
b. [rä(jä́hde)]	*!	

Another context in which quantity sensitivity is inhibited is in sequences of heavy syllables. In (57), stressing all heavy syllables would result in stress clashes. Finnish strictly disallows stress clashes. Of adjacent heavy syllables only one is stressed.

(57) a. [káupunki] ‘capital (Nom)’
b. [jä́rjestèlmät] ‘systems (Nom)’
c. [énsimmä̀isellä] ‘first (Adess)’
d. [jä́rjestèlmänä] ‘system (Ess)’

This indicates that the constraint *CLASH dominates WSP. The absolute ban on clashes indicates that this constraint is also undominated in Finnish.

(58) **CLASH*: No adjacent strong beats on the grid (Liberman & Prince 1977, Prince 1983, Selkirk 1984, Kager 1994).

(59) /kaupunki/ ‘capital (Nom)’	ALIGN-HD	*CLASH	WSP	PARSE-σ	ALL-FT-L
→ a. [(káupun)ki]			*	*	
b. [(káu)punki]			*	**!	
c. [(káu)(pùnki)]		*!			*
d. [kau(púnki)]	*!		*	*	*

So far, the analysis has resulted in the following ranking:

(60) ALIGN-HD, FTBIN, FTFORM, *CLASH » WSP » PARSE-σ » ALL-FT-L

This ranking, not only accounts for the binary patterns in words with light syllables, but also accounts for the lack of stress on the second syllable in words that begin with [LH... Furthermore, it accounts for the observation that of adjacent heavy syllables only one is stressed, and it explains the ternary patterns in (52).

However, there are ternary patterns, comparable to those in (52), that (60) cannot be accounted for. Here, (60) will select the wrong candidate as the optimal one.

(61)	a.	[áteriàstanne]	/ateria-sta-nne/	'meal (Elat 3PL)'
	b.	[mátematìikkaamme]	/matematiikka-a-mme/	'mathematics (Part 2PL)'
	c.	[púhelimìstansa]	/phulime-i-sta-nsa/	'telephone (Elat 3PL)'
	d.	[páimentolàisella]	/paimentolaise-lla/	'nomad (Adess)'

The constraint ranking in (60) will incorrectly select the candidate with the binary pattern as the optimal candidate.

(62) /paimentolaisella/ 'nomad (Adess)'	*CLASH	WSP	PARSE-σ	ALL-FT-L
a. [(páimen)to(làisel)la]		**	*!*	***
→ b.* [(páimen)(tòlai)(sèlla)]		**		** ****
c. [(pái)(mèn)to(lài)(sèlla)]	*!*		*	* *** *****

Candidates (62a,b) have identical violations for WSP. The violations of this constraint are therefore not decisive. The violations for a constraint lower in the hierarchy, PARSE-σ, are crucial. The actual output violates this constraint twice, while the output which is incorrectly selected as optimal is exhaustively parsed. In order to prevent (62b) from being chosen as the optimal output, a different constraint ranked higher than PARSE-σ must be added to the hierarchy.

Another constraint that comes to mind is the STRESS-TO-WEIGHT PRINCIPLE (SWP) (Myers 1987), a constraint that differs from WSP in that the latter demands that a heavy syllable be stressed, while SWP demands that a light syllable remains unstressed. In other words, an unstressed heavy syllable violates WSP and a stressed light syllable violates SWP.

(63) /paimentolaisella/ 'nomad (Adess)'	*CLASH	WSP	SWP	PARSE-σ	ALL-FT-L
→ a. [(páimen)to(làisel)la]		**		**	***
b. [(páimen)(tòlai)(sèlla)]		**	*!		** ****
c. [(pái)(mèn)to(lài)(sèlla)]	*!*			*	* *** *****

Now the correct output is selected as the optimal candidate. However, because of its ranking above PARSE-σ it selects the wrong candidate in the tableau below, while we would have no problem selecting the right candidate without SWP.

(64) /järjestelmistäni/ 'system (Elat 1SG)'	*CLASH	WSP	SWP	PARSE-σ	ALL-FT-L
a. [(jä́rjes)(tèlmis)(tä̀ni)]		**	*!		** ****
→ b. *[(jä́rjes)tel(mìstä)ni]		**		**	***
c. [(jä́r)(jès)(tèl)(mìs)(tä̀ni)]	*!***				* ** *** ****

Clearly, invoking SWP solves one problem, only to creates another, and it does not seem to be the solution here. This constraint does not play an active role in selecting the optimal candidate in Finnish, and unless it is relevant for the argument, from now on SWP is excluded from tableaux and constraint rankings, as these only illustrate the relevant constraints in Finnish.

5.6.4 Resolved foot

In what follows it transpires that eventually there is no motivation to apply WSP either. In order to account for the stress patterns in (63, 64), another constraint must be introduced. Due to this constraint, we lose the motivation for WSP. In (63b) the second foot has a stressed light syllable, followed by an unstressed heavy syllable: (ĹH). This makes a bad trochee, since the light syllable is stressed while the heavy syllable is left unstressed. This trochee is known in the literature as the 'resolved trochee' (Allen 1973, Dresher & Lahiri 1991, Hanson & Kiparsky 1996). Instead of WSP or SWP, which both failed to select the correct candidates as the optimal form, it seems that we need a constraint that dictates the avoidance of this resolved foot.

(65) *(ĹH): Avoid the resolved foot (Hanson & Kiparsky).[13]

With this constraint ranked above PARSE-σ we select the actual output forms as the optimal candidates in (66) and (67). In (66), we avoid the problem that the first and second candidate score equally for WSP, as a result of which PARSE-σ selects the optimal candidate (63). By crucially ranking *(ĹH) above PARSE-σ, the second candidate is rejected, and the correct candidate is chosen as the optimal form.

(66) /paimentolaisella/ 'nomads (Adess)'	*CLASH	*(ĹH)	WSP	PARSE-σ	ALL-FT-L
→ a. [(páimen)to(làisel)la]			**	**	***
b. [(páimen)(tòlai)(sèlla)]		*!	**		** ****
c. [(pái)(mèn)to(lài)(sèl)la]	*!*			**	* *** *****

In (67), using *(ĹH) avoids the problem of SWP, which rejects the first candidate because it has a stressed light syllable (64).

[13] This constraint has been proposed by Hanson & Kiparsky (1996), but since their work is about poetic meter they have given it the name EUPODY: avoid resolution. Note that *(ĹH) is the local conjunction (Prince & Smolenksy 1993) of SWP and WSP, within the domain of the foot.

(67) /järjestelmistäni/ ‘system (Elat 1SG)’	*CLASH	*(ĹH)	WSP	PARSE-σ	ALL-FT-L
→ a. [(jä́rjes)(tèlmis)(tä̀ni)]			**		** ****
b. [(jä́rjes)tel(mìstä)ni]			**	*!*	***
c. [(jä́r)(jès)(tèl)(mìs)(tä̀ni)]	*!***			**	* ** *** ****

Above, we have motivated that *(ĹH) must dominate PARSE-σ. But it must in turn be dominated by ALIGN-HD. Main stress is always on the initial syllable, and in words that begin with a [LH... sequence, the initial foot must be [(ĹH)..., which is due to FTBIN.

(68) /räjähde/ ‘explosive (Nom)’	ALIGN-HD	*(ĹH)	WSP
→ a. [(rä́jäh)de]		*	*
b. [rä(jä́hde)]	*!		

We do not know what the ranking is of *(ĹH) with regard to WSP, the constraint that failed to select the form with the ternary pattern in (62). WSP can be violated without violating *(ĹH), but *(ĹH) cannot be violated without violating WSP (69). Whatever the ranking of these two constraints, the result is the same.

(69)	WSP	*(ĹH)
[(káupun)ki]	*	✓
[(rávin)(tòla)]	*	*
[(páimen)to(làisel)la]	**	✓

WSP was initially motivated for the ternary patterns in the words in (70). But these words can also be accounted for by *(ĹH).

(70) a. [(máte)ma(tìikka)] ‘mathematics (Nom)’
b. [(púhe)li(mìsta)ni] /puhelime-i-sta-ni/ ‘telephones (Elat 1SG)’
c. [(páimen)to(làisi)(àni)] /paimentolaise-i-a-ni/ ‘nomads (Part 1SG)’

(71) /matematiikka/ ‘mathematics (Nom)’	*(ĹH)	PARSE-σ	ALL-FT-L
→ a. [(máte)ma(tíikka)]		*	***
b. [(máte)(màtiik)ka]	*!	*	**

(72) /puhelimistani/ ‘telephones (Elat 1SG)’	*(ĹH)	PARSE-σ
→ a. [(púhe)li(mìsta)ni]		**
b. [(púhe)(lìmis)(tàni)]	*!	

(73) /paimentolaisiani/ ‘nomads (Elat 1SG)’	*(ĹH)	PARSE-σ	ALL-FT-L
→ a. [(páimen)to(làisi)(àni)]		*	*** *****
b. [(páimen)(tòlai)(sìa)ni]	*!	*	** ****

The motivation for WSP has now disappeared. At this point in the analysis all we know is that if WSP is motivated, it must be dominated by ALIGN-HD and *CLASH. When analysing the stress patterns influenced by the morphology in the next chapter, we will see that we do indeed need WSP. For the remainder of the analysis of the phonological generalisations, WSP is left out of the constraint rankings, for these only show the constraint whose active role can be motivated.

(74) ALIGN-HD, FTBIN, FTFORM, *CLASH
|
*(ĹH)
|
PARSE-σ
|
ALL-FT-L

5.6.5 Final heavy syllables

So far we have only looked at words with heavy syllables word-internally. But heavy syllables also occur as the final syllable of the word. When word-finally a heavy syllable is preceded by an unstressed syllable the heavy syllable optionally receives stress, else stress is on the penultimate or antepenultimate syllable.

(75) a.	[kúningàs]	[kúningas]	‘king (Nom)’
b.	[rávintolàt]	[rávintòlat]	‘restaurants (Nom)’
c.	[káinostèlijàt]	[káinostèlijat]	‘shy people (Nom)’

For these patterns we do not need WSP, not even for (75a). The matter is resolved with PARSE-σ. In the previous chapter, in our analysis of the stress patterns in Sentani, we saw that the constraint that demands stress not to be final is NONFIN. The fact that not only the light, but also the heavy syllable can remain unstressed means that NONFIN evaluates at the syllabic level. Compare this with Sentani in which final light syllables never receive stress, while the final heavy syllable may receive stress.

(76) *NONFIN*: Stress may not be final in the word.

Variation arises when two (or more) conflicting constraints are crucially left unranked with regard to each other (A » B and B » A) (Kiparsky 1993, Kager 1994, Reynolds 1994, Anttila 1995, 1997). For Finnish, we will see that NONFIN is not ranked with regard to two constraints, namely PARSE-σ and *(ĹH).

In (77) the candidate with final stress is parsed exhaustively, while the candidate with penultimate stress has one unparsed syllable. Variation results when NONFIN and PARSE-σ are not ranked.

(77a) /kuningas/ ‘king (Nom)’	NONFIN	PARSE-σ
→ a. [(kúnin)gas]		*
b. [(kúnin)(gàs)]	*!	

(77b) /kuningas/ ‘king (Nom)’	PARSE-σ	NONFIN
a. [(kúnin)gas]	*!	
→ b. [(kúnin)(gàs)]		*

But the interaction between NONFIN and PARSE-σ does not result in variation in the tableaux below. The candidates either violate NONFIN and PARSE-σ, or they satisfy the two constraints. This always results in the selection of the candidate with stress on the penultimate syllable.

(78a) /ravintolat/ ‘restaurants (Nom)’	NONFIN	PARSE-σ
→ a. [(rávin)(tòlat)]		
b. [(rávin)to(làt)]	*!	*

(78b) /ravintolat/ ‘restaurants (Nom)’	PARSE-σ	NONFIN
→ a. [(rávin)(tòlat)]		
b. [(rávin)to(làt)]	*!	*

The candidate that is chosen as the optimal one in both tableaux has a (ĹH) foot, which suggests that *(ĹH) again plays a role. If *(ĹH) dominates NONFIN we get final stress, and when NONFIN dominates *(ĹH) we get penultimate stress. When these two constraints are not ranked with regard to each other, we get variation.[14]

(79a) /ravintolat/ ‘restaurants (Nom)’	*(ĹH)	NONFIN	PARSE-σ
→ a. [(rávin)(tòlat)]	*!		
b. [(rávin)to(làt)]		*	*

[14] A third candidate would be [*(rávin)tolat*]. With these constraints and constraint rankings, this candidate would win. In the next section, we will see how this candidate will be rejected. Therefore, we need to introduce a constraint not yet used in the analysis of Finnish. In this section we concentrate on NONFIN. This constraint remains necessary anyway, even after the introduction of ‘the other constraint’.

(79b) /ravintolat/ 'restaurants (Nom)'	NONFIN	*(Ĺ H)	PARSE-σ
→ a. [(rávin)(tòlat)]		*	
b. [(rávin)to(làt)]	*!		*

We argued above that *(ĹH) must dominate PARSE-σ to get the ternary pattern in the examples of (61). This ranking must be fixed in order to preserve the obligatory ternary patterns. That is to say, despite the possible rankings PARSE-σ » NONFIN and NONFIN » *(ĹH), we must exclude the ranking PARSE-σ » *(ĹH). We have the fixed ranking *(ĹH) » PARSE-σ. NONFIN may be at any position ranging from dominating *(ĹH) up to being dominated by PARSE-σ, but it leaves the fixed rankings unaffected.

(80) a. ***NONFIN*** » *(ĹH) » PARSE-σ
b. *(ĹH) » ***NONFIN*** » PARSE-σ
c. *(ĹH) » PARSE-σ » ***NONFIN***

With these three rankings we can also explain the variation for *[káinostèlijàt]-[káinostèlijat]*.

(81) /kainostelijat/ 'shy people (Nom)'	NONFIN	*(ĹH)	PARSE-σ	ALL-FT-L
→ a. [(káinos)(tèli)jat]			*	**
b. [(káinos)(tèli)(jàt)]	*!			** ****
c. [(káinos)te(lìjat)]		*!	*	***
d. [(káinos)telijat]			**!*	

(81b) /kainostelijat/ 'shy people (Nom)'	*(ĹH)	NONFIN	PARSE-σ	ALL-FT-L
→ a. [(káinos)(tèli)jat]			*	**
b. [(káinos)(tèli)(jàt)]		*!		** ****
c. [(káinos)te(lìjat)]	*!		*	***
d. [(káinos)telijat]			**!*	

(81c) /kainostelijat/ 'shy people (Nom)'	*(ĹH)	PARSE-σ	NONFIN	ALL-FT-L
a. [(káinos)(tèli)jat]		*!		**
→ b. [(káinos)(tèli)(jàt)]			*	** ****
c. [(káinos)te(lìjat)]	*!	*		***
d. [(káinos)telijat]		*!**		

When NONFIN dominates PARSE-σ (81a,b), the candidate with stress on the antepenultimate syllables wins, regardless of the ranking of NONFIN and *(ĹH). As soon as PARSE-σ dominates NONFIN (81c), the deciding constraint is *(ĹH), which must always dominate PARSE-σ.

This all means that in the constraint hierarchy NONFIN is not ranked with respect to *(ĹH) and PARSE-σ. It can both dominate *(ĹH), and be dominated by PARSE-σ. In order to indicate that NONFIN is in fact a dominated constraint, it is ranked under the dominated constraints, but it is left 'floating', i.e., not ranked with respect to all other constraints.

(82) ALIGN-HD, FTBIN, FTFORM, *CLASH

*(ĹH) NONFIN

PARSE-σ

ALL-FT-L

In our discussion of the two possible stress patterns of words with the structure [XXLH], one candidate was left out of the tableaux, i.e., [*(rávin)tolat*]. Now that the need for *(ĹH) is motivated, together with its ranking above PARSE-σ, this candidate is problematic for the analysis developed so far. This candidate does not violate NONFIN, nor *(ĹH). As a result, we fail to select the candidate with penultimate stress, in addition, we predict the wrong candidate to be the optimal candidate.

(83a) /ravintolat/ 'restaurants (Nom)'	NONFIN	*(ĹH)	PARSE-σ
a. [(rávin)to(làt)]	*!	*	*
b. [(rávin)(tòlat)]		**!	
→ c. * [(rávin)tolat]		*	**

(83b) /ravintolat/ 'restaurants (Nom)'	*(ĹH)	NONFIN	PARSE-σ
a. [(rávin)to(làt)]	*	*!	*
b. [(rávin)(tòlat)]	**!		
→ c. * [(rávin)tolat]	*		**

(83c) /ravintolat/ 'restaurants (Nom)'	*(ĹH)	PARSE-σ	NONFIN
→ a. [(rávin)to(làt)]	*	*	*
b. [(rávin)(tòlat)]	**!		
c. [(rávin)tolat]	*	**!	

When NONFIN is dominated by PARSE-σ (and hence automatically dominated by *(ĹH)), the candidate with final stress is chosen (83c). In all other cases the candidate with stress only on the initial syllable is incorrectly chosen as the optimal candidate (83a,b).

This means that yet another constraint must be added to the hierarchy. This is a constraint that has received considerable attention in the analysis of Sentani, but has not yet been mentioned in the analysis of Finnish. This is *LAPSE.

5.6.6 *LAPSE revisited

In the previous chapter *LAPSE was introduced to ensure the selection of the candidate with an interstress interval of two syllables rather than the candidate with an interstress interval of three syllables. It was argued that the latter violated *LAPSE, because not all unstressed syllables were adjacent to a stressed syllable.

(84) *LAPSE: A weak beat must be adjacent to a strong beat or the word edge.

The candidate *[(rávin)tolat]* has three adjacent unstressed syllables, and thus violates *LAPSE. When *LAPSE dominates PARSE-σ, this candidate is rejected.

(85a) /ravintolat/ ‘restaurants (Nom)’	*LAPSE	NONFIN	*(ĹH)	PARSE-σ
a. [(rávin)to(làt)]		*!	*	*
→ b. [(rávin)(tòlat)]			**	
c. [(rávin)tolat]	*!		*	**

(85b) /ravintolat/ ‘restaurants (Nom)’	*LAPSE	*(ĹH)	NONFIN	PARSE-σ
→ a. [(rávin)to(làt)]		*	*	*
b. [(rávin)(tòlat)]		**!		
c. [(rávin)tolat]	*!	*		**

(85c) /ravintolat/ ‘restaurants (Nom)’	*LAPSE	*(ĹH)	PARSE-σ	NONFIN
→ a. [(rávin)to(làt)]		*	*	*
b. [(rávin)(tòlat)]		**!		
c. [(rávin)tolat]	*!	*	**	

Just as in Sentani, *LAPSE is necessary to restrict the sequence of unstressed and unparsed syllables. In (86b) it results in a ternary pattern, while in (86a) *LAPSE results in a binary pattern. As was noted in Chapter 1, *LAPSE is not a constraint whose high ranking causes ternary pattern, but it restricts the sequence of unstressed and unparsed syllables in rankings where PARSE-σ ranked too low to do so. In

Sentani, we only saw how *LAPSE resulted in a ternary pattern, but in Finnish, we see that *LAPSE allows for a maximally ternary pattern (86b), although, as a result of interaction with other constraints, it may also result in a binary pattern (86a).

*LAPSE, as introduced in Chapter 4 and repeated in (84), actually states that an unstressed syllable must be adjacent to a stressed syllable or the word edge. So far the latter part of the definition, i.e., adjacency to a word edge, has not been shown to be necessary. In Sentani, we only meant to exclude word-internal lapses and in the examples of the third candidate in (85a-c), the syllable *-to-* is not adjacent to a stressed syllable, neither to the left nor the right, which rules out this candidate. But we do need the formulation as in (84) to allow for two adjacent unstressed syllables word-finally. Words with five or seven syllables, (cf. [*érgonòmia*], [*érgonòmiànani*]\) end in two unstressed syllables. As discussed in Chapter 4, two adjacent unstressed syllables are not considered a rhythmic lapse. In (86a), the final syllable is not adjacent to a stressed syllable, but it is, however, adjacent to the word edge and therefore this form does not violate *LAPSE and is chosen as the optimal candidate.

(86) /ergonomia/ ‘ergonomics (Nom)’	*LAPSE	PARSE-σ	ALL-FT-L
→ a. [(érgo)(nòmi)a]		*	**
b.*[(érgo)no(mìa)]		*	***!

With *LAPSE dominating PARSE-σ, it seems as if the motivations for the ranking *(ĹH) » PARSE-σ, or even the motivations for the constraint PARSE-σ itself, have disappeared. In (85), [*(rávin)tolat*] was rejected by *LAPSE, and not by PARSE-σ. When we replace PARSE-σ with *LAPSE in (50), we correctly also select [*(áte)(rìa)*] as the optimal candidate, as shown in (87).

(87) /ateria/ ‘meal (Nom)’	*LAPSE	ALL-FT-L
→ a. [(áte)(rìa)]		**
b. [(áte)ria]	*!*	

However, PARSE-σ is still needed. In (88) both candidates satisfy *LAPSE and it is because of the ranking PARSE-σ » ALL-FT-L that the binary pattern is correctly chosen as the optimal form.

(88) /ergonomiana/ ‘ergonomics (Ess)’	*LAPSE	PARSE-σ	ALL-FT-L
→ a. [(érgo)(nòmi)(àna)]			** ****
b. [(érgo)no(mìa)na]		*!*	***

And also the motivation for the strict ranking *(ĹH) » PARSE-σ is still in tact. Neither of the candidates in (89) violate *LAPSE, and therefore it is still the ranking

*(ĹH) » PARSE-σ that correctly selects the candidate with the binary pattern as the optimal candidate.

(89) /paimentolaisella/ ‘nomads (Adess)’	*LAPSE	*(ĹH)	PARSE-σ	ALL-FT-L
→ a. [(páimen)to(làisel)la]			**	***
b. [(páimen)(tòlai)(sèlla)]		*!		** ****

In Finnish there are no stress patterns with more than two adjacent unstressed syllables. *LAPSE is therefore considered undominated. This concludes the analysis of the phonological stress patterns of Finnish. The constraint rankings we have established so far are as in (90).

(90) ALIGN-HD, FTBIN, FTFORM, *CLASH, *LAPSE

*(ĹH) NONFIN

PARSE-σ

ALL-FT-L

(91) *Strict dominance order*

a.	ALIGN-HD » *(ĹH)	[(ĹH)L] > [L(H́L)]	[(rä́jäh)de]
b.	*CLASH » PARSE-σ	[(H́H)L] > [(H́)(H̀L)]	[(káupun)ki]
c.	FTBIN » PARSE-σ	[(X́X)(L̀L)L] > [(X́X)(L̀L)(L̀)]	[(érgo)(nòmi)a]
d.	*(ĹH) » PARSE-σ	[(X́X)L(H̀H)L] > [(X́X)(L̀H)(H̀L)]	[(páimen)to(làisel)la]
e.	*(ĹH) » ALL-FT-L	[(X́X)L(H̀L)] > [(X́X)(L̀H)L]	[(máte)ma(tìikka)]
f.	*LAPSE » *(ĹH)	[(X́X)(L̀H)] > [(X́X)LH]	[(rávin)(tòlat)]
g.	PARSE-σ » ALL-FT-L	[(X́X)(L̀L)(L̀L)] > [(X́X)L(L̀L)L]	[(érgo)(nòmi)(àna)]

(92) *Variation*

a.	NONFIN » *(ĹH)	[(X́X)(L̀H)]	[(rávin)(tòlat)
b.	*(ĹH) » NONFIN	[(X́X)L(H̀)]	[(rávin)to(làt)]
c.	NONFIN » PARSE-σ	[(X́X)H]	[(kúnin)gas]
d.	PARSE-σ » NONFIN	[(X́X)(H̀)]	[(kúnin)(gàs)]

5.7 Hanson & Kiparsky (1996) and Alber (1997)

As mentioned at the beginning of this chapter, two other Optimality analyses of Finnish stress are given by Hanson & Kiparsky (1996) and Alber (1997). These two analyses are restricted to phonological generalisations, and disregard morphological aspects. Alber (1997) even abstracts away from optionality with regard to the stressing of final heavy syllables. My analysis, as presented above, resembles the analyses by Hanson & Kiparsky (1996), but in particular the one proposed by Alber (1997). However, it is shown that these analyses fail to account for the phonological generalisations as described in section 5.5.

5.7.1 Hanson & Kiparsky (1996)

The analysis of Hanson & Kiparsky is largely based on the data of Carlson (1978), who assumes the following generalisations: main stress is on the initial syllable; binary patterns are preferred for secondary stress, but a light syllable is skipped to stress an adjacent heavy syllable, and when this heavy syllable is the final syllable of the word, stressing this heavy syllable is optional; final light syllables are never stressed, but heavy syllables are optionally stressed when preceded by an unstressed syllable; adjacent syllables are never stressed. For the analysis of these generalisations Hanson & Kiparsky make use of following constraints:

(93)	ALIGNMENT:	Align left edge of word with foot boundary
	*CLASH:	Avoid clashes
	FTBIN:	Feet are strictly binary
	FTFORM:	Moraic trochee with resolution[15]
	NONFIN:	Final syllables are not stressed
	EUPODY:	No resolution, i.e., avoid (ĹH) foot
	EURHYTHMY:	Alternating syllables are stressed

The ranking Hanson & Kiparsky propose is as in (94).

(94) *CLASH, FTBIN, FTFORM, ALIGNMENT » NONFIN - EURHYTHMY » EUPODY

*CLASH, FTBIN, FTFORM and ALIGNMENT are considered to be undominated, when not necessary, they do not appear in their tableaux,. Hanson & Kiparsky mention that NONFIN optionally dominates EURHYTHMY to account for optional final stress on heavy syllables. In (95), we find the tableaux given by Hanson & Kiparksy (1996).

(95) Hanson & Kiparsky (1996 p. 306)[16]

candidates	ALIGNMENT	EURHYTHMY	EUPODY
→ a. [(káar)tuva]		*	
ai. [kaar(tuva)]	*!		
→ b. [(lúmot)(tùi)hin]			*
bi. [lu(mót)tui(hìn)]	*!		
bii. [(lúmot)tui(hìn)]		*!	*(17)

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[15] By moraic trochee, Hanson & Kiparsky mean the moraic trochee as proposed by Hayes (1995) in his foot inventory, to which the resolved foot is added: (H́), (ĹL), (ĹH).

[16] Stress marks are added by the author for the purpose of clarification.

[17] Hanson & Kiparsky have omitted the violation mark here (see their tableau page 306).

candidates	ALIGNMENT	EURHYTHMY	EUPODY
→ c. [(ópet)ta(màs)sa]		*	*
ci. [o(pét)ta(màs)sa]	*!		
cii. [(ópet)(tàmas)sa]		*	**!

We find a few familiar names in the list of constraints mentioned in (93) and a few unfamiliar ones. Unfamiliar are the names of the constraints EUPODY and EURTHYTHMY. The constraint EUPODY says that resolution must be avoided, which is actually the same as stating that the resolved foot must be avoided, i.e., this constraint does the same work as our constraint *(ĹH).

EURHYTHMY is a special constraint, for which there is no counterpart in my analysis given above. It expresses the preference for binary alternation, and it seems to do the work of three constraints proposed in the analysis above, i.e., *LAPSE, PARSE-σ and ALL-FT-L. The very fact that this constraint seems to do the work for all three constraints just mentioned is the reason why the analysis proposed by Hanson & Kiparsky fails to account for the phonological generalisations under discussion. In the analysis above, the three constraints *LAPSE, PARSE-σ and ALL-FT-L all have different places in the hierarchy. Motivations were given for the different places in the hierarchy of these constraints. When one constraint takes over the function of three constraints that have crucially different places in the hierarchy, the analysis can be expected to fail to account for all patterns, which is indeed what happens.

We can show this by comparing the ranking of EUPODY and EURHYTHMY with *(ĹH) and PARSE-σ. I argue above that the constraint militating against the resolved foot *(ĹH) must dominate PARSE-σ. In the analysis of Hanson and Kiparsky, on the other hand, EURHYTHMY dominates EUPODY, which is actually the reversed ranking of the one motivated above. As a result, the wrong candidate is chosen as the optimal candidate in the tableau below.

(96) /XXLHHL/	EURHYTHMY	EUPODY
a. [(X́X)L(H̀)HL]	*!*	
→ b.* [(X́X)(L̀H)(H̀)L]		*

This abstract example is the analysis of *páimentolàisella*. In (66) it was argued that *(ĹH) must dominate PARSE-σ to select the correct form as the optimal candidate. In the analysis of Hanson & Kiparsky, the actual pattern cannot be selected, because the constraint that requires a binary pattern dominates the constraint that states that the resolved foot must be avoided. As a result a candidate with a binary pattern always wins. I will return to Hanson & Kiparsky when discussing the morphological influences on stress, but let us now turn to another Optimality analysis of Finnish.

5.7.2 Alber 1997

My analysis above resembles the analysis of Finnish stress by Alber (1997), in which she predicts most patterns correctly. But again, it is the analysis of the patterns such as [*páimentolàisella*] that poses a problem for her analysis. Alber abstracts away from optionality and avoidance of final stress. The constraint ranking she proposes is the one in (97) (Alber 1997, p. 30).

(97) FTBIN, TROCH, *CLASH, LEFTMOST
    | |
    WSP   ITL
    |
    PARSE-σ
    |
    ALL-FT-L

According to Alber (1997) the foot typology of Finnish is determined by the Iambic/Trochaic Law (ITL). This constraint demands that trochaic feet are even (LL, HH, H), and thus it militates against both (ĹH) and (H́L). However, Alber recognizes that the (ĹH) foot is needed, to account for main stress on the initial syllable, when this syllable is light, and the second is heavy. This can be obtained by a constraint which requires main stress on the initial syllable, which must dominate ITL. In the analysis of Alber this is LEFTMOST. On the basis of the phonological generalisations in Finnish, it is impossible to determine whether H́L is parsed as (H́)L or (H́L). Alber lets the ITL decide against (H́L). In her ranking, there is no constraint that dominates ITL that allows for (H́L).

In the analysis of Alber, ITL functions in a way as our *(ĹH) (or Hanson & Kiparsky's EUPODY). With ITL militating against both (H́L) and (ĹH) feet, according to Alber, the ranking of ITL with regard to PARSE-σ cannot be determined. But when the ranking of ITL and PARSE-σ cannot be established, they are not crucially ranked, and we expect either ranking to give the same result. But we see in the tableau below that when PARSE-σ dominates ITL the binary pattern would be selected as the optimal candidate, while we know that the actual output has a ternary pattern.

(98) /XXLHHL/	WSP	PARSE-σ	ITL
a. [(X́X)L(H̀H)L]	*	*!*	
→ b. *[(X́X)(L̀H)(H̀L)]	*		*
c. [(X́X)L(H̀)HL]	*	*!**	

Here we see that the ranking of ITL with regard to PARSE-σ can indeed be determined. Since ITL functions similarly to *(ĹH), the forms in (61)/(98) give the motivation for the ranking of ITL with regard to PARSE-σ, and, of course ITL must dominate PARSE-σ, comparable to the ranking *(ĹH) » PARSE-σ argued for in the analysis above.

(99) /XXLHHL/	WSP	ITL	PARSE-σ
→ a.[(X́X)L(H̀H)L]	*		**
b.[(X́X)(L̀H)(H̀L)]	*	*!	
c.[(X́X)L(H̀)HL]	*		***!

In my analysis, I have argued that it is the ranking of WSP that cannot be determined. This means that WSP can actually be left out of the tableaux. We can apply this to the example of Alber (1997).

Alber (1997, p. 33)

(100) candidates	WSP	ITL	PARSE-σ	ALL-FT-L
→ a. [(vális)tu(màt)tomi(àn)ne]			***	*** ******
b. [(vális)(tùmat)(tòmi)(àn)ne]	*!	*!	*	** **** ******

When we replace WSP by ITL, the tableau given by Alber still selects the same optimal candidate, and it can now also account for the problematic forms in (63). Therefore, even though the foot typology used by Alber for Finnish is not the same as the one used in the analysis I propose (which crucially allows (H́L), which will be argued for in the next chapter), nor the one proposed by Hanson & Kiparsky, the argument still holds that ITL crucially dominates PARSE-σ and that it is WSP that must be floating under LEFTMOST which actually results in the constraint ranking I propose in (90).

(101) *Repaired constraint ranking of Alber 1997*

FTBIN, TROCH, *CLASH, LEFTMOST

ITL **WSP**

PARSE-σ

ALL-FT-L

5.8 Conclusion

In this chapter, the stress patterns of Finnish were described and analysed. The stress patterns we have seen so far were accounted for by referring strictly to phonological constraints. Just as for Sentani the task was to account for both the binary and ternary patterns without expanding the metrical theory with specific ternarity tools, such as ternary feet or parsing modes. Just as Sentani, the stress system of Finnish is binary, i.e., the basic stress pattern is binary. Constraint interaction gave us both binary and ternary patterns.

In Finnish there are three circumstances under which ternary patterns arise. First, when the binary count would stress a final light syllable. In Finnish final light syllables are never stressed, which may result in a ternary pattern word-finally [*(X́XL̀LL)*]. Second, when a light syllable is followed by a heavy syllable this heavy syllable is stressed [*X́XLH̀L*], resulting in a ternary pattern word-internally. But this latter ternary pattern is optional when the heavy syllable is final [*X́XLH̀*]-[*X́XL̀H*]. And third, also due to optionally stressing the final heavy syllable, a ternary pattern may occur word-finally [*X́XH̀*]-[*X́XH̀*].

These word-internal ternary patterns indicate that Finnish has a quantity-sensitive stress system. However, accounting for the stress patterns with such ternary patterns by WSP failed. The constraint *(ĹH) dominating PARSE-σ was needed to reject the candidate with the binary pattern (68). And since the ranking between *(ĹH) and WSP could not be established, the motivation for WSP disappeared and it was removed from the hierarchy (76).

Due to *(ĹH) crucially dominating PARSE-σ it could happen that [*X́XLH*] was incorrectly selected as the optimal candidate (83). That was where *LAPSE came into play. In Sentani *LAPSE was introduced to prevent an overly long sequence of unstressed syllables (i.e., three adjacent unstressed syllables) from occurring. There, *LAPSE reduced the distance to two adjacent unstressed syllables. In (85) we saw that when *LAPSE dominates both NONFIN and *(ĹH), the stress patterns which were selected as optimal either had a ternary pattern as in (85b,c), or a binary pattern as in (85a). From these examples we can conclude that *LAPSE is not a specific ternarity tool. *LAPSE functions to reduce the distance between two stressed syllables. Its definition in (84) allows for an interstress interval of *at most* two unstressed syllables, which implies that it may also be used to reduce the interstress interval to just one unstressed syllable.

Furthermore, we saw seen that variation can be obtained when two or more constraints are crucially left unranked, i.e., when they can dominate each other. If *LAPSE dominates NONFIN and *(ĹH), the two patterns of [*X́XLH̀*]-[*X́XL̀H*] can be obtained by leaving *(ĹH) and NONFIN unranked (85). The two stress patterns [*X́XH̀*]-[*X́XH*] can be obtained by leaving NONFIN and PARSE-σ unranked (77). We saw that even though NONFIN is not ranked with regard to *(ĹH), nor with regard to PARSE-σ, this does not mean that *(ĹH) and PARSE-σ are also no longer ranked with regard to each other. NONFIN can be crucially left unranked with respect to both constraints, without affecting the motivated ranking *(ĹH) » PARSE-σ (80). This resulted in the constraint ranking in (90) with NONFIN floating under the undominated constraints. This constraint ranking will play a role in the analysis of the nouns in which morphology interacts with phonology in stress assignment. When these patterns are analysed, we will see that WSP is indeed needed in Finnish, and we will also find further motivations for the foot typology assumed so far, which includes (H́L).

6 Finnish stress: the morphological pattern

6.1 Introduction

The previous chapter provided an Optimality analysis of Finnish word stress. The occurrence of both binary and ternary stress patterns could be explained by referring exclusively to phonological factors and hence only using phonological constraints. Examples of factors that affect stress assignment in such a way that ternary patterns occur, are quantity sensitivity, avoidance of clashes and lapses, and non-finality of stress.

In order to analyse secondary stress correctly, we had to examine relatively long words. In spite of their length, some of those words were mono-morphemic, although most of them were morphologically complex. However, no attention was actually paid to this morphological structure. All stress patterns described in Chapter 5 can be predicted by the phonological constraints and the hierarchy given in Chapter 5. The current chapter however, is explicitly concerned with the influence exerted by two classes of stress-attracting suffixes on the stress patterns of Finnish.

As noted earlier, Carlson (1978) and Hanson & Kiparsky (1996) observe that in nouns both case markers and possessive suffixes may cause ternary stress patterns in words consisting of sequences of light syllables. These patterns are not found in words without these suffixes, and cannot be selected as optimal by the constraint ranking in Chapter 5. Moreover, in my own data, additional stress patterns were found in words with case markers and possessive suffixes that also cannot be predicted by the constraint hierarchy in Chapter 5. Furthermore, the influence of the two types of suffixes is optional. What we will see is that some words with these suffixes have just one stress pattern, which can be predicted by the constraint hierarchy presented in Chapter 5. For other words, two stress patterns are possible: one that can be predicted by the phonology, and one that cannot. Thus, besides the optional stress on the final heavy syllable, as discussed in the previous chapter (section 5.6.2), these suffixes form the second source for variation in the Finnish stress system. The stress patterns that can be predicted by the constraint ranking in Chapter 5, are referred to as the *phonological patterns* and the patterns that are the result of the influence of the morphology will be referred to as the *morphological patterns*. This chapter is concerned with the analysis of the morphological patterns.

It is obvious that in order to account for patterns sensitive to the morphology, that are not predicted by the constraint hierarchy of Chapter 5, other constraints must be introduced. These constraints are given a place in the hierarchy without affecting the already motivated rankings of Chapter 5. Consider the examples in (1).

(1) a.	[(áte)(rìa)na]	[(áte)ri(àna)]	/ateria-na/	‘meal (Ess)’
b.	[(áte)(rìa)(nànsa)]	[(áte)ri(ànan)sa]	/ateria-na-nsa/	‘meal (Ess 3SG)’
c.	[(péri)jä(nằmme)	[(péri)(jằnäm)me]	/perijä-nä-mme/	‘inheritor (Ess 2PL)’

The patterns in the first column of (1a-c) are the phonological patterns. In (1b,c), this results in stressing the heavy syllable. The patterns in the second column are the patterns we must account for in this chapter. First, we need to account for the word-internal ternary pattern in a word consisting of light syllables (1a). There are no factors such as clash avoidance, non-finality of stress or quantity sensitivity involved here. Second, we need to account for the ternary pattern in (1b), in which the only heavy syllable in the word is left unstressed. Third, in (1c) we see that the phonology predicts a ternary pattern due to quantity sensitivity, and in the middle column we see a binary pattern in which, just as in (1b), the only heavy syllable is not stressed.

When comparing the two patterns in (1a), we see that, in the phonological pattern, one syllable separates the right edge of the foot from the right edge of the word. In the morphological pattern, the word ends in a foot, i.e., the right edge of the foot and the word coincide. An alignment constraint that demands that words with a case marker or a possessive suffix end in a foot accounts for this difference: ALIGN-$\mathrm{R_{SFX}}$.

(2) *ALIGN-R_{SFX}*: ALIGN-R (PRWDSFX, R, FT, R). Align the right edge of the prosodic word with the right edge of a foot, for a case or possessive suffix.

Carlson and Hanson & Kiparsky call these suffixes ‘preaccenting’. This characteristic of the suffix is expressed by ALIGN-$\mathrm{R_{SFX}}$. As shown in Chapter 5, in Finnish feet are trochaic, i.e., the left member of the foot is strong and the right member weak. When there is a preaccenting suffix, the syllable preceding it must be stressed, and thus be the strong member, i.e., the left member of the trochaic foot. The suffix itself must be the weak member of the foot, i.e., the right member of the foot. This is obtained when the right edge of the foot aligns with the right edge of the word, as the example with a word-internal ternary pattern in (1a) shows.

In the binary pattern of (1b), the word already ends in a foot, satisfying the alignment constraint, and therefore this constraint cannot account for the variant with the ternary pattern in (1b), which does not end in a foot. The same holds for (1c). The phonological ternary pattern ends in a foot, satisfying ALIGN-$\mathrm{R_{SFX}}$, while the morphological binary pattern does not. An important observation is that the complex word *aterianansa* has both a case marker and a possessive suffix, but *ateriana* has only the case marker. It is argued that ternary pattern of (1b) is the result of the paradigmatic analogy with the ternary pattern of (1a). And below, we see that paradigmatic analogy also accounts for the binary pattern of (1c). It is argued that there is a constraint that demands that the stress pattern of the output form with one suffix must recur in the stress pattern of the output form with two suffixes. In Optimality Theory this is accounted for by output-output correspondence (McCarthy 1995, Benua 1995). The constraint that selects the optimal candidate is STRESSMAX (McCarthy & Prince 1995, Alderete 1995, Kager 1996b).[1]

(3) *STRESSMAX (B/O)*: Let α be a segment in B and β be its correspondent in O. If α is stressed in B, then β is stressed in O.

STRESSMAX requires that a syllable that is stressed in the output form that serves as the *base* (the related complex noun with one suffix) must also be stressed in the output. For every stress in the base, which has a correspondent in the output candidate that is not stressed, STRESSMAX is violated. For the ternary pattern in (1b) the output form with a word-internal ternary pattern of (1a) is the base.

Before explaining the two constraints in detail and how they evaluate the candidates, I first give a detailed description of the stress patterns of complex nouns.

6.2 Morphology and secondary stress

Carlson (1978) and Hanson & Kiparsky (1996) both mention the effect of case markers and possessive suffixes may have on secondary stress in nouns. My own data support the observations by Carlson and Hanson & Kiparsky that these suffixes can have considerable influence on the stress pattern of the word they are part of. However, my data paint a more complex picture than given in these descriptions.

Carlson notes that due to their -CCV shape, the majority of the case markers and the possessive suffixes close the preceding syllables. As a result, they can create an environment in which a light third syllable is skipped in favour of stress on the following heavy syllable, creating the configuration X́XLH̀L (cf. (40) in Chapter 5). This is the stress pattern that also follows from the ranking in Chapter 5. Carlson observes that, as a result, stress precedes the suffix.

(4) a. [óttamiàmme] /otta-ma-i-**a**-**mme**/ (C. 13)
‘take’-participle-plural-partitive-1pl

b. [óhittavàlta] /ohitta-va-**lta**/ (C. 13)
‘pass’-participle-ablative

In the words with a case marker or possessive suffix that does not close the preceding syllable (because it has a -CV shape) secondary stress still shifts to the right to fall on the syllable preceding the suffix. According to Carlson, these suffixes

[1] See Chapter 2 for more on Correspondence Theory and output-output correspondence.

preserve the ternary stress pattern by *paradigmatic analogy* with the words with -CCV suffixes (Carlson 1978, p. 14).

(5) a. [óttamiàni] /otta-ma-i-a-ni/ (C. 13)
'take'-participle-plural-partitive-possessive 1SG
b. [óhittavàna] /ohitta-va-na/ (C.13)
'pass'-participle-essive

Furthermore, Carlson notes that this stress shift only occurs when the syllable that is skipped is light. A heavy syllable is not skipped to stress the syllable that precedes the suffix.

(6) a. [sáatavìstani] /saatava-i-sta-ni/ (C.14)
b. *[sáatavistàni] 'balance'-plural-elative-possessive 1SG

In my analysis below, paradigmatic analogy does indeed play a role in explaining the morphological patterns, but in this thesis paradigmatic analogy is interpreted differently from Carlson. This difference is best explained using terminology that refers to a derivational approach. For Carlson, paradigmatic analogy is an analogy of morphologically related words on the *same* level of derivation. In both (4a) and (5a) the complex words each have two relevant suffixes, and the stress pattern of (5a) is analogous to (4a). Similarly in (4b) and (5b), there is only one such relevant suffix, and the pattern in (5b) is analogous to the pattern in (4b). In my analysis these patterns are considered to be the result of preaccentuation, and accounted for by ALIGN-R_{SFX}. That is, they are the winning candidates, because they satisfy ALIGN-R_{SFX}. According to the interpretation presented in this thesis, these patterns are not due to paradigmatic analogy.

(7) a. [(ótta)mi(àni)]
b. [(óhit)ta(vàna)]

Below we see that we still need the notion of paradigmatic analogy to account for the data in (1b,c), illustrated in (8). However, to this end, the notion paradigmatic analogy is interpreted as analogy between morphologically related words on *different* levels of the derivation. That is, the pattern of a complex form with two suffixes is analogous to the stress pattern of the complex form with only one suffix.

(8) a. [(áte)(rìa)na] → [(áte)(rìa)(nànsa)]
b. [(áte)ri(àna)] → [(áte)ri(ànan)sa]
c. [(péri)(jȁnä)] → [(péri)(jȁnäm)me]

Below, I describe in detail the stress patterns of the complex nouns with a case marker and/or a possessive suffix as they appear in the data available. The description will first concentrate on complex nouns with one suffix, and then proceed to complex nouns with two suffixes.

The discussion proceeds from words with short roots to words with longer roots. It is shown that variation only occurs in complex words of five syllables or more. Complex nouns of up to four syllables have only one stress pattern, which confirms the undominated status of constraints such as FTBIN, ALIGN-HD, *CLASH and *LAPSE, as motivated in Chapter 5.

6.2.1 One suffix

A case suffix and a possessive suffix can each attach directly to the root (cf. (19) Chapter 5). Both the case suffix and the possessive suffix can be either CV or CCV. In (9) below, the root is monosyllabic. When one suffix is attached to this root, the resulting complex noun consists of only two syllables. This never results in variation, because main stress is always on the initial syllable, and final open syllables are never stressed. In this pattern the preaccenting requirement of the suffix is trivially satisfied.

(9) Root + -CV or Root + -CCV

a.	[(púuni)]	/puu-ni/	'tree (Nom 1SG)'
b.	[(púusta)]	/puu-sta/	'tree (Elat)'

When the root consists of two syllables, as in the examples in (10), stress is again only on the initial syllable.

(10) Root + -CV or Root + -CCV

a.	[(kénkä)nä]	/kenkä-nä/	'shoe (Ess)'
b.	[(kéngäl)tä]	/kenkä-ltä/	'shoe (Abl)'

This confirms the undominated status of *CLASH and ALIGN-HD. If stress was assigned to the syllable preceding the suffix (i.e., to the second syllable), this would result in either a stress clash with main stress [*(kén)(kä̀nä)*], or a unstressed initial syllable and a stressed second syllable [*ken(kä́nä)*]. As mentioned before, in Finnish there are no clashes and main stress is always on the initial syllable. Here, regular phonology overrules preaccentuation.

When we look at a root with three syllables, we see that there is still only one possible stress pattern in the resulting four-syllable complex noun.

(11) Root + -CV or Root + -CCV

a.	[(péri)(jä̀nä)]	/perijä-nä/	'inheritor (Ess)'
b.	[(péri)(jä̀nsä)]	/perijä-nsä/	'inheritor (Nom 3SG)'
c.	[(kúnin)(kàani)]	/kuninkaa-ni/	'king (Nom 1SG)'
d.	[(kúnin)(kàansa)]	/kuninkaa-nsa/	'king (Nom 3SG)'

A binary pattern satisfies the undominated constraints and at the same time stresses the syllable preceding the suffix, again trivially satisfying preaccentuation.

The influence of case markers and possessive suffixes, and the variation mentioned above, appear only when a suffix is added to a four-syllable root, resulting in a complex noun consisting of five syllables. In those words, two stress patterns are possible, without violating the undominated constraints.

(12) Root + -CV

a.	[(áte)(rìa)na]	[(áte)ri(àna)]	/ateria-na/	'meal (Ess)'
b.	[(kúnnal)(lìse)ni]	[(kúnnal)li(sèni)]	/kunnallise-ni/	'council (Nom 1SG)'

In (12), a -CV suffix is added to a four-syllable root. The stress pattern which can be expected on the basis of Chapter 5 is a ternary pattern word-finally, but we also find a ternary pattern word-internally. We argue that this is due to the requirement that when there is a case marker or possessive suffix, the prosodic word must end in a foot (ALIGN-R_{SFX} in (3)). The variation just shown must be related to the case marker and possessive suffix. Nominatives, which do not have an overt case marker, only have one stress pattern when they end in a string of light syllables.

(13)

a.	[(érgo)(nòmi)a]	*[(érgo)no(mìa)]	'ergonomics (Nom)'
b.	[(ópis)(kèli)ja]	*[(ópis)ke(lìja)]	'student (Nom)'
c.	[(káinos)(tèli)ja]	*[(káinos)te(lìja)]	'a shy person (Nom)'

In (14), a -CCV suffix is added to a four-syllable root. There are two patterns, one with a word-final ternary pattern, which is the phonological pattern, and another with a word-internal ternary pattern, and a word-final foot.

(14) Root + -CCV

a.	[(óhjel)(mòinnis)sa]	[(óhjel)moin(nìssa)]	/ohjelmointi-ssa/ 'programming (Iness)'
b.	[(súku)(làisel)la]	[(súku)lai(sèlla)]	/sukulaise-lla/ 'relative (Adess)'

However, such variation never occurs in complex nouns derived from a four-syllable root: compare (12) and (14) with (15) and (16).

(15) Root + -CCV

a.	[(áte)ri(àsta)]	*[(áte)(rìas)ta]	/ateria-sta/ 'meal (Elat)'
b.	[(kúnnal)li(sèlla)]	*[(kúnnal)(lìsel)la]	/kunnalise-lla/ 'council (Adess)'

(16) Root + -CV

a. [(óhjel)(mòinti)a]	*[(óhjel)moin(tìa)]	/ohjelmointi-a/ 'programming (Part)'
b. [(énsim)(mä̀ise)nä]	*[(énsim)mäi(sèna)]	/ensimmäise-nä/ 'punishment (Ess)'

In (12), we saw that a -CV suffix attached to *ateria-* and *kunnalise-* results in variation. In (15), however, we see that when a -CCV suffix is attached to the same root, there is no variation. Surprisingly, the examples in (14) and (16) are the mirror image of this. In (14) a -CCV suffix is added to *ohjelmointi-* and *ensimmäise-*, which results in variation, but a -CV suffix attached to the same roots in (16) results in only one stress pattern. Let us consider the syllable structures of these complex nouns to see what causes this paradox.

(17) Root + -CV (= *12*)

a. [(X́ X)(Ĺ L) L]	[(áte)(rìa)na]	'meal (Ess)'
b. [(X́ X) L (L̀ L)]	[(áte)ri(àna)]	

(18) Root + -CCV (= *14*)

a. [(X́ X)(H̀ H) L]	[(óhjel)(mòinnis)sa]	'programming (Iness)'
b. [(X́ X) H (H̀ L)]	[(óhjel)moin(nìssa)]	

(19) Root + -CCV (= *15*)

a. [(X́ X) L (H̀ L)]	[(áte)ri(àsta)]	'meal (Elat)'
b.* [(X́ X)(L̀ H) L]	* [(áte)(rìas)ta]	

(20) Root + -(C)V (= *16*)

a. [(X́ X)(H̀ L) L]	[(óhjel)(mòinti)a]	'programming (Part)'
b.* [(X́ X) H (L̀ L)]	* [(óhjel)moin(tìa)]	

We see that in cases where there is variation, stress 'shifts' to the right from a light syllable to the adjacent light syllable (17), or from a heavy syllable to the adjacent heavy syllable (18). But when the third and fourth syllable do not have the same weight, there is no variation. When the third syllable is light and the fourth is heavy, stress is on the heavy fourth syllable (19). This is the expected pattern, predicted by the constraint ranking in Chapter 5. In these patterns the word also ends in a foot, satisfying the alignment requirement. In addition, when the third syllable is heavy and the fourth syllable is light, there is no variation either (20). Stress is on the third syllable (20). This is also the stress pattern predicted by the constraint ranking given in Chapter 5. Here, no pattern occurs in which the word ends in a foot. Obviously, in the analysis of these words, quantity sensitivity plays an important role. On the basis of the stress patterns in (20), it may be concluded that quantity sensitivity requirements overrule the requirement that the word ends in a foot.

The longest roots in the data consist of five syllables. When a suffix is added to these roots, the resulting complex nouns display only one stress pattern each.

(21)	a. [(érgo)(nòmi)(àna)]	/ergonomia-na/	‘ergonomics (Nom 1SG)’
	b. [(érgo)(nòmi)(àssa)]	/ergonomia-ssa/	‘ergonomics (Iness)’
	c. [(máte)ma(tìikka)ni]	/matematiikka-ni/	‘mathematics (Nom 1SG)’
	d. [(máte)ma(tìikkan)sa]	/matematiikka-nsa/	‘mathematics (Nom 3SG)’

The patterns in (21) are those we predict on the basis of the constraint ranking of Chapter 5. In (21a,b), the binary pattern stresses the syllable preceding the suffix, trivially satisfying the preaccenting requirement, just as the two and four-syllable words. In (21b), the consistent binary pattern also results in stressing the heavy syllable.

In (21c) and (21d) we see a ternary pattern, which is due to the heavy fourth syllable. Stress is not on the syllable preceding the suffix and the word does not end in a foot (cf. (22)). As was noted earlier, for the five-syllable examples of (20), quantity sensitivity plays a role in blocking preaccentuation.

(22)	a.*[(máte)(màtiik)(kàni)]	/matematiikka-ni/	‘mathematics (Nom 1SG)’
	b.*[(máte)(màtiik)(kànsa)]	/matematiikka-nsa/	‘mathematics (Nom 3SG)’

To sum up the description of stress patterns of complex nouns in which one suffix is attached to the root: although both case markers and possessive suffixes can optionally trigger stress on the syllable preceding the suffix, the variation is restricted. There is variation in complex nouns that consist of five syllables. In shorter words, variation would either mean violating the undominated constraints, or the preaccenting requirement had already been satisfied. However, even in the five-syllable words, variation is restricted. There is only variation when, in both patterns, stress is on a syllable of the *same weight*, either light (17) or heavy (18). When the third and fourth syllable are not of the same weight, there is only one stress pattern, with stress on the heavy syllable, resulting in either a ternary (19), or binary pattern word-internally (20). We now proceed to the description of the words with two suffixes.

6.2.2 Two suffixes

Combining two preaccenting suffixes leads to further complications. In complex nouns with two suffixes, variation is not restricted to words consisting of five syllables. Variation is also found in complex nouns of six and seven syllables. In shorter words, however, there is still no variation, which again confirms the undominated status of constraints such as ALIGN-HD, *CLASH and FTBIN. Just as in the previous section, we proceed from short roots to longer ones. And since we look at complex nouns with two suffixes, all four combinations of -CV and -CCV suffixes are considered.

When two suffixes are attached to a one syllable root, there is no variation. There is only main stress on the initial syllable. Any other pattern would violate ALIGN-HD, or *CLASH or FTBIN.

(23) [X́XL]

a.	[(púulta)ni]	/puu-lta-ni/	‘tree (Abl 1SG)’
b.	[(púultan)sa]	/puu-lta-nsa/	‘tree (Abl 3SG)’

There is also no variation when both suffixes are attached to a two syllable root. Again, any other pattern will result in a violation of undominated constraints.

(24) [X́XL̀L]
[(kénkä)(nä̀ni)] /kenkä-nä-ni/ ‘shoe (Ess1SG)’

(25) [X́XH̀L]
[(kénkä)(nä̀mme)] /kenkä-nä-mme/ ‘shoe (Ess1PL)’

When both suffixes attach to a three-syllable root, there is variation. As before, variation appears when the complex noun consists of at least five syllables.

(26) Root + -CV-CV = [X́XL̀LL] or [X́XLL̀L]

a.	[(péri)(jä̀nä)ni]	[(péri)jä(nä̀ni)]	/perijä-nä-ni/ ‘inheritor (Ess1SG)’
b.	[(ávai)(mìna)ni]	[(ávai)mi(nàni)]	/avaime-i-na-ni/[2] ‘keys (Ess1SG)’

(27) Root + -CV-CCV = [X́XLH̀L] or [X́XL̀HL]

a.	[(péri)jä(nä̀mme)]	[(péri)(jä̀näm)me]	/perijä-nä-mme/ ‘inheritor (Ess1PL)’
b.	[(káupun)ki(àmme)]	[(káupun)(kìam)me]	/kaupunki-a-mme/ ‘capital (Part1PL)’

(28) Root + -CCV-CV = [X́XH̀LL] **but not** [X́XHL̀L]

a.	[(péri)(jä̀stä)ni]	*[(péri)jäs(tä̀ni)]	/perijä-stä-ni/ ‘inheritor (Elat 1SG)’
b.	[(ávai)(mìsta)ni]	*[(ávai)mis(tàni)]	/avaime-i-sta-ni/ ‘keys (Elat1SG)’

[2] Here we see three suffixes: one *-i-* is the plural affix. The plural suffix does not affect the stress pattern here.

(29) Root + -CCV-CCV = [X́XH̀HL] or [X́XHH̀L]

a. [(péri)(jä̀stän)ne] [(péri)jäs(tä̀nne)] /perijä-stä-nsä/
'inheritor (Elat1SG)'

b. [(ávai)(mìstan)sa] [(ávai)mi(stànsa)] /avaime-i-sta-nsa/
'keys (Elat1SG)'

In (26), (27) and (29) there is variation, but this is not the case in (28), in which the sequence of the form -CCV-CV is added to the root. When we compare these examples with those of the previous section, we expect the variation in (26) and (29), in which stress 'shifts' from a light syllable to an adjacent light syllable (26), or from a heavy syllable to an adjacent heavy syllable (29). We may also expect that variation is blocked in (28), since variation would mean a stress on a light syllable, which fails to stress the heavy syllable. However, the variation in (27) is not expected. The ranking in Chapter 5 predicts a word-internal ternary pattern with secondary stress on the heavy syllable. In that case the word ends in a foot, also satisfying the alignment requirement. What we see here is a binary pattern, which must leave the one and only heavy syllable in the word unstressed (27a). Furthermore, a syllable separates the right edge of the foot and the right edge of the word. This indicates that ALIGN-R_{SFX} cannot account for this binary variant, and that other factors are at work in words with two suffixes than in words with only one suffix. In order to find out what causes the binary pattern of (27), more complex nouns with both types of suffixes must be drawn into the discussion.

In the examples above, the root ends in a light syllable. Below, the root ends in a heavy syllable. The stress patterns of (30) and (32) are the same as in (28) and those of (31) and (33) are the same as in (29).

(30) Root + -CV-CV = [X́XH̀LL] **but not** [X́XHL̀L]
[(kúnin)(kàana)ni] *[(kúnin)kaa(nàni)] /kuninkaa-na-ni/
'king (Ess1SG)'

(31) Root + -CV-CCV = [X́XH̀HL] or [X́XHH̀L]
[(kúnin)(kàanan)sa] [(kúnin)(kaanàn)sa] /kuninkaa-na-nsa/
'king (Ess 3SG)'

(32) Root + -CCV-CV = [X́XH̀LL] **but not** [X́XHL̀L]
[(kúnin)(kàakse)ni] *[(kúnin)kaak(sèni)] /kuninkaa-kse-ni/
'king (Transl 1SG)'

(33) Root + -CCV-CCV = [X́XH̀HL] or [X́XHH̀L]
[(kúnin)(kàaksen)ne] [(kúnin)kaak(sènne)] /kuninkaa-kse-nne/
'king (Transl 2PL)'

The root ends in a heavy syllable, hence it does not make a difference whether the first suffix is -CV or -CCV: the third syllable is always heavy. There is only variation when -CV-CCV or -CCV-CCV are attached to the word. In both cases, the result is a configuration [XXHHL]. In these words, stress ‘shifts’ from a heavy syllable to the adjacent heavy syllable, as found earlier in (18). When either -CV-CV or -CCV-CV are attached to the root, a word appears with the configuration [XXHLL]. In these words, variation would mean shifting stress from a heavy syllable onto a light syllable. As expected from (20), variation does not occur.

Below, both suffixes are attached to a four-syllable root. The resulting complex nouns consisting of six syllables are of great interest, because they provide clues about what causes the different stress patterns.

(34) Root + -CV-CV = [X́XL̀LL̀L] or [X́XLL̀LL]

a.	[(áte)(rìa)(nàni)]	[(áte)ri(àna)ni]	/ateria-na-ni/ ‘meal (Ess 1SG)’
b.	[(púhe)(lìme)(nàni)]	[(púhe)li(mèna)ni]	/puhelime-na-ni/ ‘telephone (Ess 1SG)’

(35) Root + -CV-CCV = [X́XL̀LH̀L] or [X́XLL̀HL]

a.	[(áte)(rìa)(nànsa)]	[(áte)ri(ànan)sa]	/ateria-na-nsa/ ‘meal (Ess 3SG)’
b.	[(púhe)(lìme)(nàmme)]	[(púhe)li(mènam)me]	/puhelime-na-mme/ ‘telephone (Ess 1PL)’

(36) Root + -CCV-CV = [X́XLH̀LL] **but not** [X́XL̀HL̀L]

a.	[(áte)ri(àsta)ni]	*[(áte)(rìas)(tàni)]	/ateria-sta-ni/ ‘meal (Elat 1SG)’
b.	[(púhe)li(mèlta)ni]	*[(púhe)(lìmel)(tàni)]	/puhelime-lta-ni/ ‘telephone (Abl 1PL)’

(37) Root + -CCV-CCV = [X́XLH̀HL] **but not** [X́XL̀HH̀L]

a.	[(áte)ri(àstan)ne]	*[(áte)(rìas)(tànne)]	/ateria-sta-nne/ ‘meal (Elat 3PL)’
b.	[(púhe)li(mèstan)sa]	*[(púhe)(lìmes)(tànsa)]	/puhelime-sta-nsa/ ‘telephone (Elat 3SG)’

When both suffixes are attached to a four-syllable root ending in two light syllables, there is variation when the sequence of suffixes begins with -CV (i.e., -CV-CV and -CV-CCV, see examples (34), (35)). But when the sequence begins with -CCV (i.e., -CCV-CV and -CCV-CCV, see examples (36), (37)) there is no variation. The variation in (35), in which -CV-CCV is attached to the root, is especially unexpected. In a binary pattern, i.e., the phonological pattern, the heavy syllable is stressed and the word ends in a foot (cf. (21b)). In the ternary pattern, the heavy syllable is not stressed and the word does not end in a foot. Again, this indicates that ALIGN-R$_{\text{SFX}}$ cannot explain the morphological pattern.

We argue that the variation (34,35) or lack thereof in (36,37), can be explained by looking at morphologically related words with one suffix. In words with the same root, but only one suffix, there is analogous variation in forms with a -CV suffix as in (12: *áterìana-áterìàna*), but not so in forms with a -CCV suffix, as in (15: *áteriàsta*-**áterìasta*). The variation and lack thereof in five-syllable forms with one suffix explain why there is variation in six-syllable forms with two suffixes to which -CV -(C)CV is added (i.e., beginning with a -CV suffix), and also why there is no variation in words to which -CCV-(C)CV is added (i.e., beginning with a -CCV suffix). The stress pattern of the words with two suffixes is analogous to the stress pattern of the related words with one suffix. Below in section 6.4, this is explained by output-output correspondence, and the constraint introduced in (3): STRESSMAX.

The four-syllable roots below have a different syllable structure than the ones just described. Above the roots ended in a sequence of light syllables (XXLL-), whereas below, the roots end in a sequence of a heavy and a light syllable (XXHL-).

(38) Root + -CV-CV = [X́XH̀LL̀L] **but not** [X́XHL̀LL]

a. [(óhjel)(mòinti)(àni)] *[(óhjel)moin(tìa)ni] /ohjelmointi-a-ni/ 'programming (Part 1SG)'

b. [(súku)(làisi)(àni)] *[(súku)lai(sìa)ni] /sukulaise-i-a-ni/ 'relatives (Part 1SG)'

(39) Root + -CV-CCV = [X́XH̀LH̀L] **but not** [X́XHL̀HL]

a. [(óhjel)(mòinti)(ànsa)] *[(óhjel)moin(tìan)sa] /ohjelmointi-a-nsa/ 'programming (Part 3SG)'

b. [(súku)(làisi)(nànne)] *[(súku)lai(sìnan)ne] /sukulaise-i-na-nne/ 'relatives (Ess 3PL)'

(40) Root + -CCV-CV = [X́XH̀HL̀L] or [X́XHH̀LL]

[(súku)(làisel)(làni)] [(súku)lai(sèlla)ni] /sukulaise-lla-ni/ 'relative (Adess 1SG)'

(41) Root + -CCV-CCV = [X́XH̀HH̀L] or [X́XHH̀HL]

[(súku)(làisel)(lànsa)] [(súku)lai(sèllan)sa] /sukulaise-lla-nsa/ 'relative (Adess 3SG)'

When -CV-(C)CV is attached to the root, there is no variation, as shown in (38) and (39), conforming exactly to what we have come to expect now. In the previous section, we saw that when a single -CV suffix is attached to these roots, quantity sensitivity blocks variation in these words (cf. (16) and (20)), and therefore paradigmatic analogy does not predict variation. Neither could the alignment constraint cause variation, because the binary forms of the words in (38) and (39) already end in a foot. Turning now to (40) and (41), we see that the root plus a single -CCV suffix has two variants (cf. (14) and (18)). We expect variation from paradigmatic analogy regardless of whether -CCV-CV or -CCV-CCV is attached.

The examples of (40) and (41) do indeed show this variation. In short, all forms in (38)-(41) are indeed as expected.

Finally, we look at the stress patterns of complex nouns where both suffixes attach to a five-syllable root. We first consider a sequence of two -CV-CV suffixes attached to a root, which itself ends in a sequence of light syllables.

(42) Root + -CV-CV = [X́XL̀LL̀LL] or [X́XL̀LLL̀L]
[(érgo)(nòmi)(àna)ni] [(érgo)(nòmi)a(nàni)] /ergonomia-na-ni/
'ergonomics (Ess 1SG)'

Given what was said earlier about paradigmatic analogy between forms with one suffix and those with two suffixes, variation is not expected in these words. In the previous section we saw that these roots with only a single suffix did not allow variation (21a). Thus, when a second suffix is added, variation is not expected on the basis of paradigmatic analogy. Nevertheless, there are two patterns in (42), and the key to this behaviour resides in their odd number of syllables, which means they can be compared to five-syllable forms. The binary pattern is actually predicted by both the phonology and paradigmatic analogy. However, the binary form does not end in a foot. The requirement for the word to end in a foot causes the variant in which the ternary pattern is sandwiched between the two secondary stresses.

When the suffix sequence attached to the nouns is -CV-CCV, variation is also found, as shown in (43).

(43) Root + -CV-CCV = [X́XL̀LLH̀L] or [X́XL̀LL̀HL]
[(érgo)(nòmi)a(nànsa)] [(érgo)(nòmi)(ànan)sa] /ergonomia-na-nsa/
'ergonomics (Ess 3SG)'

The ternary pattern is expected from the 'phonological' constraint ranking of Chapter 5. This form also ends in a foot, obeying the alignment requirement of ALIGN-R_{SFX}. But here, the binary pattern that stresses the light syllable preceding the heavy syllable is the result of paradigmatic analogy with the stress pattern of its root plus one suffix (cf. 21a). Here the 'phonological' constraints and preaccentuation each predict the ternary pattern, while the binary pattern is predicted by paradigmatic analogy. Now consider a -CCV-CV sequence attached to the root.

(44) Root + -CCV-CV = [X́XL̀LH̀LL] but not [X́XL̀LHL̀L]
[(érgo)(nòmi)(àlle)ni] *[(érgo)(nòmi)al(lèni)] /ergonomia-lle-ni/
'ergonomics (Allat 1SG)'

We can now understand why there is no variation in (44). This binary stress pattern is predicted by the constraint ranking of Chapter 5. Furthermore, in (21b) we saw that the root /ergonomia-/ with a single -CCV suffix shows no variation. On the basis of paradigmatic analogy with this form, we again expect the binary pattern as in (44). The binary form in (44) does not end in a foot. However, as was noted above, the alignment requirement is blocked by quantity sensitivity. In order for the foot to be word-final in (44), stress must shift onto the penultimate light syllable, leaving the antepenultimate heavy syllable unstressed.

For the word in (45), in which -CCV-CCV is attached to the root, variation is also expected.

(45) Root + -CCV-CCV = [X́XL̀LH̀HL] (or [X́XL̀LHH̀L])
[(érgo)(nòmi)(àllen)ne] [(érgo)(nòmi)al(lènne)] /ergonomia-lle-nne/
‘ergonomics (Allat.3PL)’

However, the data that I collected do not show any variation. We can expect variation when we compare this word with a complex noun that has a three-syllable root to which -CCV-CCV is added. As shown in (27) and again in (46a,b) these words show variation. Example (46c) is the stress pattern of (45), and (46d) is the stress pattern we expect, but which was not found in the data, hence the question mark.

(46)	a.	[(péri)(àstan)ne]	X́ X H̀ H L
	b.	[(péri)as(tànne)]	X́ X H H̀ L
	c.	[(érgo)(nòmi)(àllen)ne]	X́ X X̀ X H̀ H L
	d.	?[(érgo)(nòmi)al(lènne)]	X́ X X̀ X H H̀ L

There is reason to believe that this is an accidental gap. Note that in words with a root of the type /ergonomia-/, stress is always on the first and third syllable (13). When counting from the third syllable, we can compare the final five syllables in the seven-syllable complex nouns with the five-syllable complex noun. There is variation in (46a,b), but this variation is absent from (46c,d). However, based on comparison with (46a,b), we do expect variation. In all other respects, the complex nouns derived from a three-syllable root, and those derived from a five-syllable root are the same. It is therefore assumed that the lack of variation in (46c,d) must be considered to be an accidental gap.

We now turn to roots that have a different syllable structure, from the five-syllable root considered above. Here the root ends in a sequence of a heavy and a light syllable. This difference is crucial to the possible stress patterns in complex nouns with two suffixes. In (47), all combinations of suffixes are given.

(47)	a.	[(máte)ma(tìikka)(nàni)]	/matematiikka-na-ni/	‘mathematics (Ess 1SG)’
	b.	[(máte)ma(tìikka)(nànne)]	/matematiikka-na-nne/	‘mathematics (Ess 2PL)’
	c.	[(máte)ma(tìikas)(sàni)]	/matematiikka-ssa-ni/	‘mathematics (Iness 1SG)’
	d.	[(máte)ma(tìikas)(sànne)]	/matematiikka-ssa-nne/	‘mathematics (Iness 3PL)

Variation does not occur in any of the complex seven-syllable. This is exactly what we would expect. When only one suffix was attached to this root, there was only one stress pattern (21c,d). Thus paradigmatic analogy predicts only one stress pattern when a second syllable is attached. All the words in (47) end in a foot, so the alignment requirement is met. And finally, these patterns are the patterns predicted by the constraint ranking of Chapter 5.

This concludes the description of the complex nouns. First the stress patterns of words with a single suffix attached to the root were discussed. Variation only occurs in complex nouns of five syllables or more, and even then only when the stress shifts to a syllable of the same weight. The crucial difference between the binary pattern and the ternary pattern is whether all feet are as much to the left as possible, or whether the word ends in a foot. The requirement that stress is on the syllable preceding the suffix is expressed by an alignment constraint which requires that the word ends in a foot, is sensitive to the weight of the syllables, and may be blocked when it fails to stress a heavy syllable (17-20).

Much more variation was found for words with both a case marker and a possessive suffix. Only complex nouns with very short roots do not show any variation, because that would result in violating constraints for which it has been motivated that they are undominated in Finnish. But with roots of three syllables or more, resulting in complex nouns of five syllables or more, there is considerable variation.

This variation may again in part be due to the requirement that the word ends in a foot, i.e., ALIGN-R_{SFX} (cf. (26), (29) and (42)). But even stress patterns that can be predicted by the constraint ranking of Chapter 5, and where the word ends in foot, could still have a ternary variant. In this variant it may even be the case that the only heavy syllable remains unstressed, even when it is preceded by a light syllable, and should be stressed according to the phonological factors as shown in the previous chapter (cf. (27), (35) and (43)). These additional stress patterns are the result of paradigmatic analogy with the stress pattern of morphologically related words with the same root, but a single suffix. This paradigmatic analogy is expressed by STRESSMAX.

The requirement made by ALIGN-R_{SFX} respects quantity sensitivity, that is, it may be blocked when it fails to stress a heavy syllable. Apparently STRESSMAX does not respect quantity sensitivity, since satisfying this constraint may even lead to leaving the only heavy syllable in a word unstressed. The Optimality analysis below will focus on this difference. The analysis will proceed analogous to the description, that is, the patterns of complex nouns with a single suffix will first be dealt with, then the stress patterns of words with two suffixes will be accounted for.

6.3 Ranking ALIGN-R_{SFX}

Above, a detailed description of the stress patterns of complex nouns with case and possessive suffixes was given. In this and the next section these stress patterns will be accounted for within the framework of Optimality Theory. It will be shown how two constraints, ALIGN-R$_{\text{SFX}}$ and STRESSMAX, introduced in section 6.1, interact with the constraints motivated in Chapter 5 to account for the stress patterns of words with the possessive and case suffixes. This section concentrates on the analysis of complex nouns whose stress pattern is the result of the requirements of ALIGN-R$_{\text{SFX}}$. The interaction of this constraint with other constraints is initially best explained when looking at words with only one suffix. When a second suffix is attached, the interaction is more complicated due to paradigmatic analogy. This section therefore will concentrate on complex nouns with only one suffix, but in later sections it will become clear that the requirements of ALIGN-R$_{\text{SFX}}$ are not restricted to complex nouns with a single suffix.

As shown in section 6.2.1, when one suffix is attached to the root, there is variation in the stress patterns of the five-syllable words, but not in all (17-20). Below (17) and (19) are repeated.

(48) a. [(áte)(rìa)na] [(áte)ri(àna)] ‘meal (Ess)’
b. [(áte)ri(àsta)] * [(áte)(rìas)ta] ‘meal (Elat)’

There is variation when a -CV suffix is attached to the root in (48a), but there is no variation when a -CCV is attached, as in (48b).

In the examples in (18) and (20), repeated in (49), the reverse situation occurs. When a -CCV suffix is attached to the root, there is variation, but there is no variation in the case of (49b), where a -CV suffix is attached.

(49) a. [(óhjel)(mòinnis)sa] [(óhjel)moin(nìssa)] ‘programming (Iness)’
b. [(óhjel)(mòinti)a] * [(óhjel)moin(tìa)] ‘programming (Part)’

In (48) and (49) there is variation when in both variants stress is on a syllable of the same weight (50a,b), but not when stress will be on either a heavy or a light syllable (50c,d). In the latter cases, stress is always on the heavy syllable.

(50) a. [(X́X)(L̀L)L] - [(X́X)L(L̀L)]
b. [(X́X)(H̀H)L] - [(X́X)H(H̀L)]
c. [(X́X)L(H̀L)] - *[(X́X)(L̀H)L]
d. [(X́X)(H̀L)L] - *[(X́X)H(L̀L)]

Let us now try to account for this generalisation by constraint ranking. In (50a,b) there are two patterns, i.e., there is variation. In one pattern, the two feet are as much to the left as possible, as a result of which one syllable separates the right edge of the foot from the right edge of the word. In the other pattern, the word ends in a foot, so that the right edges of the foot and word coincide. But the rightmost foot is not as much to the left as it can be. From this, it is can be concluded that variation is the result of interaction between ALL-FT-L, which is motivated in Chapter 5 (cf. (49)

Chapter 5), and an alignment constraint which demands that the word ends in a foot. This constraint was introduced in (2), and is repeated below in (51).

(51) *ALIGN-R$_{SFX}$*: ALIGN-R (PRWDSFX, R, FT, R). Align the right edge of the prosodic word with the right edge of a foot, for a case or possessive suffix.

This alignment constraint must be restricted to complex nouns that end in a case marker or possessive suffix, since it is only in words with these suffixes that we find this stress pattern. Words without suffixes (cf. (13)), or with suffixes other than a case marker or possessive suffix, do not show variation. For example, category-changing suffixes as *-la*, *-ja*, *-ma* attached to the root, do not have this pattern. When *-ja* is attached to a verb (*-ja* changes the verb into a noun), there is no variation in the resulting noun.

(52)	opiskella		'to study'
	[(ópis)(kèli)-ja]	*[(ópis)ke(lì-ja)]	'student (Nom)'

ALIGN-R$_{SFX}$ obviously conflicts with ALL-FT-L. As explained in Chapter 2, variation is obtained when two constraints are crucially left unranked (Kiparsky (1993, Kager 1994, Reynolds 1994, Anttila 1995, 1997). This means that they can dominate each other (A » B and B » A). When ALL-FT-L dominates ALIGN-R$_{SFX}$, the pattern in the left column of (50a) is selected as optimal. When, on the other hand, ALIGN-R$_{SFX}$ dominates ALL-FT-L, the other pattern is selected. This results in the following two tableaux.

(53a) ALL-FT-L » ALIGN-R$_{SFX}$

/ateria-na/ 'meal (Ess)'	ALL-FT-L	ALIGN-R$_{SFX}$
→ a. [(áte)(rìa)na]	**	*
b. [(áte)ri(àna)]	***!	

(53b) ALIGN-R$_{SFX}$ » ALL-FT-L

/ateria-na/ 'meal (Ess)'	ALIGN-R$_{SFX}$	ALL-FT-L
a. [(áte)(rìa)-na]	*!	**
→ b. [(áte)ri(à-na)]		***

On the basis of these two constraints, variation is also expected in (50c,d). However, we do not see any variation. This lack of variation must be the result of another constraint, which dominates both ALL-FT-L and ALIGN-R$_{SFX}$. This constraint must dominate ALL-FT-L to prevent the pattern with a word-final ternary pattern from being selected as optimal in (50c), and it must also dominate ALIGN-R$_{SFX}$ to prevent the selection of the word with the word-internal ternary pattern in (50d). From the fact that there is no variation when one of the two patterns fails to stress the heavy syllable, but stresses a light instead, it can be concluded that a quantity sensitivity constraint, which requires heavy syllables to be stressed, must outrank both alignment constraints. In Chapter 5 it was motivated that this constraint is *(ĹH). Ranking this constraint above the pair ALIGN-R_{SFX} and ALL-FT-L seems to produce the correct results.

(54a) *(ĹH) » ALL-FT-L » ALIGN-R_{SFX},

/ateria-sta / ‘meal (Elat)’	*(ĹH)	ALL-FT-L	ALIGN-R_{SFX}
→ a. [(áte)ri(àsta)]		***	
b. [(áte)(rìas)ta]	*!	**	*

(54b) *(ĹH) » ALIGN-R_{SFX} » ALL-FT-L

/ateria-sta / ‘meal (Elat)’	*(ĹH)	ALIGN-R_{SFX}	ALL-FT-L
→ a. [(áte)ri(àsta)]			***
b. [(áte)(rìas)ta]	*!	*	**

However, as shown in (55), *(ĹH) is not sufficient to prevent variation in the form (50d), since this constraint is irrelevant here.

(55a) *(ĹH) » ALL-FT-L » ALIGN-R_{SFX},

/ohjelmointi-a/ ‘programming (Part)’	*(ĹH)	ALL-FT-L	ALIGN-R_{SFX}
→ a. [(óhjel)(mòinti)a]		**	*
b. [(óhjel)moin(tìa)]		***!	

(55b) *(ĹH) » ALIGN-R_{SFX} » ALL-FT-L

/ohjelmointi-a/ ‘programming (Part)’	*(ĹH)	ALIGN-R_{SFX}	ALL-FT-L
a. [(óhjel)(mòinti)a]		*!	**
→ b. *[(óhjel)moin(tìa)]			***

Neither of the candidates violate *(ĹH). As a result, the two possible rankings of ALL-FT-L and ALIGN-R_{SFX} give variation. It seems that yet another constraint must dominate ALIGN-R_{SFX} and ALL-FT-L. This constraint can only be WSP. In Chapter 5 it was already noted that, after *(ĹH) was introduced, there was no motivation for WSP when accounting for the phonological patterns (72)-(75). However, it was also announced that, in order to account for the influence of the morphology on stress assignment, WSP is needed after all. Here we are finally in the position to present evidence for this claim. WSP will account for the stress pattern in (50d).

(56a) WSP » ALL-FT-L, ALIGN-R_{SFX}

/ohjelmointi-a/ ‘programming (Part)’	WSP	ALL-FT-L	ALIGN-R_{SFX}
→ a. [(óhjel)(mòinti)a]	*	**	*
b. [(óhjel)moin(tìa)]	**!	***	

(56b) WSP » ALIGN-R_{SFX}, ALL-FT-L

/ohjelmointi-a/ ‘programming (Part)	WSP	ALIGN-R_{SFX}	ALL-FT-L
→ a. [(óhjel)(mòinti)a]	*	*	**
b. [(óhjel)moin(tìa)]	**!		***

In (50b) there are also heavy syllables, but neither WSP, nor *(Ĺ H) block variation. *(ĹH) does not block variation, because neither output candidates violate the constraint. WSP does not block variation, because both output candidates have two violations for WSP, which means that there is a tie for this constraint. As a result, the two rankings of ALL-FT-L and ALIGN-R_{SFX} give the variation as shown in (57).

(57a) *(ĹH), WSP » ALL-FT-L » ALIGN-R_{SFX}

/ohjelmointi-ssa/ ‘programming (Iness)’	*(ĹH)	WSP	ALL-FT-L	ALIGN-R_{SFX}
→ a. [(óhjel)(mòinnis)sa]		**	**	*
b. [(óhjel)moin(nìssa)]		**	***!	

(57b) *(ĹH), WSP » ALIGN-R_{SFX} » ALL-FT-L

/ohjelmointi-ssa/ ‘programming (Iness)’	*(ĹH)	WSP	ALIGN-R_{SFX}	ALL-FT-L
a. [(óhjel)(mòinni-s)sa]		**	*!	**
→ b. [(óhjel)moin(nì-ssa)]		**		***

As was shown in Chapter 5, WSP and *(ĹH) *cannot* be crucially ranked with regard to each other (cf. (71) in the previous chapter). In this chapter we saw that, in order to get variation, ALIGN-R_{SFX} and ALL-FT-L *must* crucially not be ranked with regard to each other. Both alignment constraints must be dominated by *(ĹH) and WSP. This explains why there is variation in (50a,b), where there is a tie for both *(ĹH) and WSP (57). This also explains the lack of variation in (50c,d). In (50c), both *(ĹH) and WSP are violated by one of the candidates, and in (50d), WSP is violated by one of the candidates.

We now know how to account for the stress patterns of complex five-syllable nouns with one suffix. These are the only words in which variation occurs. Now let us see what blocks variation in words that are either shorter or longer than five syllables.

We have just established that both *(ĹH) and WSP must dominate ALIGN-R$_{SFX}$ and ALL-FT-L. However, in Chapter 5 it was motivated that *(ĹH) and WSP, in turn, must be dominated by a series of undominated constraints, among which FTBIN, *CLASH and ALIGN-HD. These undominated constraints block the variation in words that are shorter than five syllables.

Complex nouns consisting of a monosyllabic root and a single suffix end up as a disyllabic word (9). The word is parsed in a single foot. With main stress on the initial syllable, all undominated constraints are satisfied, as is ALL-FT-L, and stress is also on the syllable preceding the suffix, satisfying ALIGN-R$_{SFX}$.

If the root consists of two syllables, the addition of a suffix results in a complex noun of three syllables. For such three-syllable nouns in principle more ways of parsing are possible than for disyllabic complex nouns. But undominated ALIGN-HD and *CLASH block variation.

(58) /kenkänä/ 'shoe (Ess)'	ALIGN-HD	*CLASH	WSP	ALIGN-R$_{SFX}$	ALL-FT-L
→ a. [(kénkä)nä]				*	
b. [(kén)(kȁnä)]		*!			*
c. [ken(ka̋nä)]	*!		*		*

For complex nouns consisting of four syllables (11), the best parse is one with two feet. As explained in Chapter 5, due to undominated *LAPSE and ALIGN-HD, the candidate with one foot is rejected. If -CV is attached to the root, only (59a) can surface.

(59) /perijänä/ 'inheritor (Ess)'	ALIGN-HD	*LAPSE	PARSE-σ	ALL-FT-L	ALIGN-R$_{SFX}$
→ a. [(péri)(jȁnä)]				**	
b. [(péri)jänä]		*!	**		**
c. [pe(ríjä)nä]	*!		**	*	*

If a -CCV suffix is added, for the same reasons, only the output form with a binary pattern is chosen.

(60) /perijänsä/ 'inheritor (Nom 3SG)'	ALIGN-HD	*LAPSE	WSP	PARSE-σ	ALL-FT-L	ALIGN-R$_{SFX}$
→ a. [(péri)(jȁnsä)]					**	
b. [(péri)jänsä]		*!	*	**		**
c. [pe(rìjän)sa]	*!		*	**	*	*

So far we have seen the analysis of words shorter than the five-syllable complex nouns. No variation is possible due to constraints motivated in the previous chapter, which all dominate ALL-FT-L and/or ALIGN-R$_{SFX}$. The same holds for longer words, i.e., the six-syllable complex nouns.

In complex nouns with a single suffix, resulting in a six-syllable word, PARSE-σ and ALIGN-R$_{SFX}$ apply pressure in the same direction, the binary parse. And due to the motivated ranking PARSE-σ » ALL-FT-L, even if ALL-FT-L dominates ALIGN-R$_{SFX}$, PARSE-σ is already crucially violated. If ALIGN-R$_{SFX}$ dominates ALL-FT-L, PARSE-σ and ALIGN-R$_{SFX}$ are both satisfied, so only the binary pattern can surface.[3]

(61a) ALL-FT-L » ALIGN-R$_{SFX}$

/ergonomiana / ‘ergonomics (Ess)’	PARSE-σ	ALL-FT-L	ALIGN-R$_{SFX}$
→ a. [(érgo)(nòmi)(àna)]		** ****	
b. [(érgo)no(mìa)na]	*!*	***	*

(61b) ALIGN-R$_{SFX}$ » ALL-FT-L

/ergonomiana / ‘ergonomics (Ess)’	PARSE-σ	ALIGN-R$_{SFX}$	ALL-FT-L
→ a. [(érgo)(nòmi)(àna)]			** ****
b. [(érgo)no(mìa)na]	*!*	*	***

And for the examples in (21b) it holds that *(ĹH) also works in the same direction as PARSE-σ and ALIGN-R$_{SFX}$, i.e., even when PARSE-σ is dominated, a binary pattern results.

(62) /ergonomiassa / ‘ergonomics (Iness)’	*(ĹH)	PARSE-σ	ALL-FT-L	ALIGN-R$_{SFX}$
→ a. [(érgo)(nòmi)(àssa)]			** ****	
b. [(érgo)no(mìas)sa]	*!	**	***	*

But due to the ranking *(ĹH) » PARSE-σ, for (21c,d) the ternary pattern is selected as optimal. Here *(ĹH) functions as a ‘ternarity’ constraint.

(63) /matematiikkani/ ‘mathematics (Nom 1SG)’	*(ĹH)	PARSE-σ	ALL-FT-L	ALIGN-R$_{SFX}$
→ a. [(máte)ma(tìikka)ni]		**	***	*
b. [(máte)(màtiik)(kàni)]	*!		** ****	

[3] Throughout the analysis of complex nouns it has proven impossible to establish a ranking between ALIGN-R$_{SFX}$ and PARSE-σ. This means that they are not crucially ranked. For the sake of convenience, in all tableaux below PARSE-σ dominates ALIGN-R$_{SFX}$.

(64) /matematiikkansa/ ‘mathematics (Nom 3SG)’	*(ĹH)	PARSE-σ	ALL-FT-L	ALIGN-R$_{SFX}$
→ a. [(máte)ma(tìikkan)sa]		**	***	*
b. [(máte)(màtiik)(kànsa)]	*!		** ****	

Summing up the analysis of the stress patterns of complex nouns with a single suffix, we saw that only in (48a) and (49a) there is variation. This can be explained by crucially leaving ALL-FT-L and ALIGN-R$_{SFX}$ unranked. This means that each can dominate the other. Due to conflicting violations, two different patterns can be selected as the optimal form.

The position of ALIGN-R$_{SFX}$ is relatively low in the hierarchy. In (48a) and (49a), for all the constraints dominating the alignment constraints there is a tie. But for all other words with one suffix there is no tie for the higher-ranked constraints. *CLASH or ALIGN-HD prevent variation from occurring in (10), as shown in (58). The motivation for WSP in the hierarchy was given, and we saw that *(ĹH) and/or WSP block variation in (48b), and in (60), (62)-(64). PARSE-σ ensures that the binary pattern is chosen for (11) and (21a,b), as shown in (59) and (61). In those cases where we do not see variation, the phonological constraints select the phonological pattern. Whenever there is variation, one of the patterns is the phonological pattern, while the other pattern is the result of the preaccenting requirement of the suffix, expressed by ALIGN-R$_{SFX}$. In the diagram below, WSP is at the same level as *(ĹH). ALIGN-R$_{SFX}$ is dominated by *(ĹH). But ALIGN-R$_{SFX}$ *cannot* be ranked with regard to PARSE-σ and *must not* be ranked with regard with ALL-FT-L, hence its floating position under *(ĹH) and WSP.

(65) ALIGN-HD, FTBIN, FTFORM, *CLASH, *LAPSE

*(ĹH), WSP NONFIN

PARSE-σ ALIGN-R$_{SFX}$

ALL-FT-L

Below we will turn to the stress patterns of words with both a case marker and a possessive suffix. As described above, there is much more variation in the stress patterns of complex nouns when both these two suffixes are attached to the noun. The ranking of Chapter 5, ALIGN-R$_{SFX}$ and paradigmatic analogy all play a role.

6.4 Paradigmatic analogy and output-output correspondence

ALIGN-R$_{SFX}$ and its place in the hierarchy of Chapter 5 cannot account for all the stress patterns of words with a case marker or possessive suffix in Finnish, especially not when there are two suffixes. The patterns in the middle column in (66) are still problematic, since these are neither ‘phonological’ patterns nor patterns ending in a foot.

(66)	a.	[(péri)jä(nä̀mme)]	[(péri)(jä̀näm)me]	/perijä-nä-mme/
	b.	[(áte)(rìa)(nàni)]	[(áte)ri(àna)ni]	/ateria-na-ni/
	c.	[(áte)(rìa)(nànsa)]	[(áte)ri(ànan)sa]	/ateria-na-nsa/
	d.	[(érgo)(nòmi)a(nànsa)]	[(érgo)(nòmi)(ànan)sa]	/ergonomia-na-nsa/

All patterns in the left column are predicted by the ‘phonological’ constraint ranking of Chapter 5. They have stress on the heavy syllables, or they are exhaustively parsed into binary feet, and all words end in a foot, also satisfying ALIGN-R_{SFX}. What then causes the patterns in the middle column?

All words in (66) have two suffixes, and in sections 6.1 and 6.2 above it was already indicated that these stress patterns would be accounted for by paradigmatic analogy of these forms with complex nouns with a single suffix. Consider (67).

(67)	a.	[(áte)(rìa)na]	[(áte)(rìa)(nàni)]	/ateria-na-ni/
			[(áte)(rìa)(nànsa)]	/ateria-na-nsa/
	b.	[(áte)ri(àna)]	[(áte)ri(àna)ni]	
			[(áte)ri(ànan)sa]	

In (53) it was shown how the two stress patterns for *ateriana* were obtained. In related nouns with two suffixes, we see both stress patterns reappear. To express the relation between morphologically related output forms in Optimality Theory, McCarthy (1995) and Benua (1995) propose output-output correspondence, an extension of Correspondence Theory (McCarthy & Prince 1995), which was originally proposed to account for the relation between a Base and a Reduplicant.

As was explained in Chapter 2, output-output correspondence can account for ‘cyclic’ effects as may be observed in (67), where phonological information of one output form (i.e., the stress pattern) is copied to another output form. In output-output correspondence, the faithfulness constraints evaluate the output candidates with regard to how well they match another output form. This latter output form is the *base*. In derivational terminology, the base would be the previous level in the derivation. Below we compare the stress patterns of the candidates of complex nouns with two suffixes with the stress patterns of morphologically related complex nouns with one suffix. The complex nouns with one suffix are considered to be the *base*.

There are different ways in which an output form can differ from the base. For example, a segment may be added or deleted. As explained in Chapter 2, the constraints that prohibit this are Maximality and Dependence constraints. Maximality forbids deletion, whereas Dependence forbids adding segments. In order to be able to analyse the stress patterns of Finnish, the correspondence constraint that plays an important role is a Maximality constraint. The constraint was introduced in (3) and is repeated below in (68). The constraint has a format similar to constraints proposed by Kager (1996a), who, in turn, based his constraints on Alderete (1995), who was the first to apply Correspondence Theory to stress.

(68) *STRESSMAX (B/O)*: Let α be a segment in B and β be its correspondent in O. If α is stressed in B, then β is stressed in O.

STRESSMAX evaluates as follows: it adds a violation for every stressed syllable in the base which has an unstressed correspondent in the output form. Below we will see how STRESSMAX is ranked with respect to the other constraints.

6.4.1 Ranking STRESSMAX

In this section it will be shown how and when STRESSMAX works, what exactly the base is, what the place of STRESSMAX is in the hierarchy of Chapter 5, and how it interacts with the constraint discussed in the previous section, i.e., ALIGN-R_{SFX}.

The first problem we are confronted with is that for some affixed nouns with one suffix, which are considered to be the base, there are two possible stress patterns, hence two possible bases. The question is: what exactly is the base? Do both output forms together constitute one single base against which the candidates are evaluated, resulting in two possible output forms (69a), or are the two output forms each the base in different output-output mappings, in which case each evaluation leads to a different stress pattern (69b)? Recall (26) in Chapter 1, repeated below in (69).

(69a) Input — Base 1 / Base 2 — Output 1, 2

(69b) Input — Base 1 — Output 1

Input — Base 2 — Output 2

Based on the data of Finnish and the way STRESSMAX is defined above, it will be shown that for Finnish (69b) is the correct way in which output-output correspondence constraints evaluate output candidates with regard to the two bases. The two stress patterns of affixed nouns with one suffix cannot together form a 'dual' base. First, according to Optimality Theory, per evaluation there is always just one candidate that is chosen as the optimal candidate. We never expect two different patterns to appear as optimal in one single evaluation. Second, and this confirms the former remark, when both bases appear together in one evaluation, there will be a tie for STRESSMAX, 'neutralising' this constraint. Below, (70a) violates STRESSMAX for the base with the ternary pattern, and candidate (70b) violates STRESSMAX for the base with the binary pattern. Now the phonology (i.e., PARSE-σ), will decide in favour of the binary pattern.

(70) Input: ateria-na-ni Base: [(áte)(rìa)-na], [(áte)ri(àna)]	STRESS MAX	PARSE-σ	ALIGN-R$_{SFX}$	ALL-FT-L
→ a. [(áte)(rìa)(nàni)]	*			** ****
b. [(áte)ri(àna)ni]	*	*!*	*	***

When there is only one base per tableau, STRESSMAX is not neutralised. In (71a) STRESSMAX is violated by the ternary pattern, and the binary pattern is selected.

(71a) STRESSMAX » PARSE-σ

Input: ateria-na-ni Base: [(áte)(rìa)-na]	STRESS MAX	PARSE-σ	ALIGN-R$_{SFX}$	ALL-FT-L
→ a. [(áte)(rìa)(nàni)]				** ****
b. [(áte)ri(àna)ni]	*!	**	*	***

Since PARSE-σ and ALIGN-R$_{SFX}$ are violated for the candidate with the ternary pattern, the ranking of STRESSMAX with regard to these constraints cannot yet be established. But the ranking can be established when the base has a ternary pattern. For the ternary pattern to be selected in (71b) STRESSMAX must dominate PARSE-σ.

(71b) STRESSMAX » PARSE-σ

Input: ateria-na-ni Base:[(áte)ri(à-na)]	STRESS MAX	PARSE-σ	ALIGN-R$_{SFX}$	ALL-FT-L
a. [(áte)(rìa)(nàni)]	*!			** ****
→ b. [(áte)ri(àna)ni]		**	*	***

Now let us turn to the two stress patterns for *aterianansa*. If the base has a binary pattern, STRESSMAX, *(ĹH) and PARSE-σ are all violated for the ternary pattern in (72a), and the binary pattern is chosen. When the base has a ternary pattern, in order for the output candidate with the ternary pattern to be selected as optimal, STRESSMAX must be ranked above *(ĹH), cf. (72b). The ranking of *(ĹH) » PARSE-σ has already been motivated in Chapter 5 (cf. (70)-(73) in that chapter).

(72a) STRESSMAX » *(ĹH)

Input: ateria-na-nsa Base: [(áte)(rìa)-na]	STRESS MAX	*(ĹH)	PARSE-σ	ALIGN-R$_{SFX}$	ALL-FT-L
→ a. [(áte)(rìa)(nànsa)]					** ****
b. [(áte)ri(ànan)sa]	*!	*	**	*	***

(72b) STRESSMAX » *(ĹH)

Input: ateria-na-nsa Base:[(áte)ri(à-na)]	STRESS MAX	*(ĹH)	PARSE-σ	ALIGN-R$_{SFX}$	ALL-FT-L
a. [(áte)(rìa)(nànsa)]	*!				** ****
→ b. [(áte)ri(ànan)sa]		*	**	*	***

In (71) and (72), the two different stress patterns for *aterianani* and *aterianansa* are obtained from two bases with different stress patterns, and STRESSMAX dominating *(ĹH) and PARSE-σ. The lack of two different bases explains why for the nouns with two suffixes in (73) there is no variation.

(73) a. [(áte)ri(àsta)] [(áte)ri(àsta)ni] /ateria-sta-ni/
*[(áte)(rìas)(tàni)]

b. [(áte)ri(àsta)] [(áte)ri(àstan)ne] /ateria-sta-nne/
*[(áte)(rìas)(tànne)]

That the complex noun with one suffix can only have one stress pattern, was explained in the previous section (cf.(54)). Since there is only one stress pattern, there is only one base, and therefore highly ranked STRESSMAX can only select the ternary pattern.

(74) Input: ateria-sta-ni Base:[(áte)ri(à-sta)]	STRESS MAX	*(ĹH)	PARSE-σ
a. [(áte)(rìas)(tàni)]	*!	*	
→ b. [(áte)ri(àsta)ni]			**

(75) Input: ateria-sta-nne Base:[(áte)ri(à-sta)]	STRESS MAX	*(ĹH)	PARSE-σ
a. [(áte)(rìas)(tànne)]	*!	*	
→ b. [(áte)ri(àstan)ne]			**

STRESSMAX can also account for the binary pattern of (66a,d), with stress on the light syllable preceding a heavy syllable. We now know that, due to STRESSMAX » *(ĹH), an output form with a (ĹH) trochee may be chosen as the optimal candidate. Since the patterns of (66a) and (66b) behave identically, only the evaluation for (66a) is given.

(76) STRESSMAX » *(ĹH)

Input: perijä-nä-mme Base: [(péri)(jȁ-nä)]	STRESS MAX	*(ĹH)	PARSE-σ
→ a. [(péri)(jȁnäm)me]		*	*
b. [(péri)jä(nȁmme)]	*!		*

However, the analysis above is still not sufficient to account for all patterns in (66). Consider (77).

(77) a. [(péri)(jȁnä)] [(péri)(jȁnä)ni]
[(péri)jä(nȁni)]

b. [(péri)(jä̀nä)] [(péri)(jä̀näm)me]
[(péri)jä(nä̀mme)]

We no longer seem to be able to select the stress pattern [*(péri)jä(nä̀mme)*\. This pattern strictly obeys the phonology: a ternary pattern with stress on the heavy syllable, due to the strict dominance order of *(ĹH) dominating ALIGN-R$_{SFX}$ (cf. (65)). However, now that we have argued that STRESSMAX » *(ĹH), the binary pattern with a (ĹH) trochee is chosen. Thus, in order to select this pattern, STRESSMAX must be dominated by *(ĹH). This means that we need two rankings. Based on the two patterns in (77b), we must conclude that STRESSMAX and *(ĹH) must indeed crucially be left unranked. Besides STRESSMAX » *(ĹH) in (76), we also have *(ĹH) » STRESSMAX, as in (78).

(78) *(ĹH) » STRESSMAX

Input: perijä-nä-mme Base:[(péri)(jä̀-nä)]	*(ĹH)	STRESS MAX	PARSE-σ
a. [(péri)(jä̀näm)me]	*!		*
→ b. [(péri)jä(nä̀mme)]		*	*

Surprisingly, this still cannot account for the variation in (77a). In these words there are no heavy syllables. *(ĹH) does not play a role, and the conclusion that STRESSMAX and *(ĹH) are left unranked does therefore not make any difference for these two patterns. The binary pattern is the pattern we expect, in any case, on the basis of the phonology (PARSE-σ » ALL-FT-L » ALIGN-R$_{SFX}$), but it can also be chosen by highly ranked STRESSMAX.

(79) STRESSMAX » PARSE-σ » ALL-FT-L » ALIGN-R$_{SFX}$

Input: perijä-nä-ni Base:[(péri)(jä̀-nä)]	STRESS MAX	PARSE-σ	ALL-FT-L	ALIGN-R$_{SFX}$
→ a.[(péri)(jä̀nä)ni]		*	**	*
b.[(péri)jä(nä̀ni)]	*!	*	***	

However, in order to obtain the ternary pattern, STRESSMAX must be demoted even further and be dominated by ALIGN-R$_{SFX}$. We know that ALIGN-R$_{SFX}$ and ALL-FT-L are not ranked with respect to each other, and thus that they may dominate each other. To select the ternary pattern, we need the ranking ALIGN-R$_{SFX}$ » ALL-FT-L, STRESSMAX.

(80) PARSE-σ » ALIGN-R$_{SFX}$ » ALL-FT-L, STRESSMAX

Input: perijä-nä-ni Base:[(péri)(jä̀-nä)]	PARSE-σ	ALIGN-R$_{SFX}$	ALL-FT-L	STRESS MAX
a. [(péri)(jä̀nä)ni]	*	*!	**	
→ b. [(péri)jä(nä̀ni)]	*		***	*

What consequences does the floating ranking of StressMax have for earlier analyses? If we look back at (77), we see that when StressMax dominates *(ĹH), the binary pattern with a (LH) trochee is chosen, but as soon as *(ĹH) dominates StressMax, the ternary pattern with stress on the heavy syllable is chosen. Due to the motivated high ranking of *(ĹH), which, by transitivity, dominates Align-R$_{SFX}$ and All-Ft-L (see (90) in Chapter 5), any position lower than *(ĹH) will result in the same ternary pattern. Even when StressMax is ranked at the bottom of the hierarchy established so far, only attested output forms will be chosen as optimal. We find that floating StressMax has no negative side effects of overgeneration. This conclusion will be strengthened by the discussion below.

Let us now return to the stress patterns of (67) and the evaluations (71) and (72), as well as the stress patterns in (73) and the evaluations (74) and (75). The patterns are repeated below in (81) and (82).

(81)	a.	[(áte)(rìa)na]	[(áte)(rìa)(nàni)]	/ateria-na-ni/
			[(áte)(rìa)(nànsa)]	/ateria-na-nsa/
	b.	[(áte)ri(àna)]	[(áte)ri(àna)ni]	
			[(áte)ri(ànan)sa]	
(82)	a.	[(áte)ri(àsta)]	[(áte)ri(àsta)ni]	/ateria-sta-ni/
			* [(áte)(rìas)(tàni)]	
	b.	[(áte)ri(àsta)]	[(áte)ri(àstan)ne]	/ateria-sta-nne/
			* [(áte)(rìas)(tànne)]	

The variation in (81), and the lack thereof in (82), was explained by the fact that for (81) there were two different bases, as a result of which high ranked StressMax selected either a binary pattern as in (81a), or a ternary pattern as in (81b). In (82), on the other hand, there is only one base, and highly ranked StressMax could correctly only select the ternary pattern. Now that we know StressMax may also be ranked at the bottom of the hierarchy, even below All-Ft-L and/or Align-R$_{SFX}$, this should not result in selecting patterns that are not attested in the data in these cases.

With respect to tableaux (71a,b) we observe that as soon as StressMax is dominated by Parse-σ, this phonological constraint chooses the binary pattern. Due to Parse-σ, any position of StressMax lower in the hierarchy does not make a difference. This means that the ternary pattern is chosen only when the base has a ternary pattern, and StressMax dominates Parse-σ, which is (71b). Any other ranking results in the binary pattern, and only attested patterns are chosen as optimal.

In the tableaux of (72), the same line of reasoning holds, but now with regard to *(ĹH). As soon as StressMax is dominated by *(ĹH), the binary pattern with stress on the heavy syllable is chosen by this phonological constraint, and due to its relatively high ranking, any other position of StressMax lower in the hierarchy than *(ĹH) does not make a difference. Again only the ternary pattern with a (ĹH) trochee can be selected if the base has a ternary pattern, and STRESSMAX dominates *(ĹH), which is (72b). Any other ranking for STRESSMAX just gives the binary pattern, and again we see that only attested patterns are chosen as optimal.

For (82a,b) only one pattern is possible for the complex nouns with two suffixes. It was argued that this was the result of highly-ranked STRESSMAX. Demoting STRESSMAX may not result in variation. When we look at tableaux (74) and (75), we see that one candidate violates both STRESSMAX and *(ĹH), while the other satisfies both. Thus, whenever STRESSMAX is dominated by *(ĹH), the latter constraint will still select the actual patterns as the optimal candidates. In (71) and (72), as well as in (74) and (75), whenever STRESSMAX is lowered in the hierarchy, still only stress patterns that actually occur in the language are selected as the optimal candidates. This is thanks to the phonological constraints and their rankings as motivated in Chapter 5. Thus far we have shown that floating STRESSMAX produces no negative side-effects for forms that were already dealt with. There are, however, still a few patterns of words with two suffixes that still need some attention.

(83) a. [(péri)(jȁstä)] [(péri)(jȁstä)ni]
* [(péri)jäs(tȁni)]

b. [(péri)(jȁstä)] [(péri)(jȁstän)ne]
[(péri)jäs(tȁnne)]

So far, whenever quantity sensitivity played a role, we always looked at the interaction of *(ĹH) with STRESSMAX. As was noted in the previous section, *(ĹH) alone is not sufficient. There are patterns for which we needed WSP (56). The same conclusion is valid for the patterns in (83). With WSP we can account for the patterns in (83).

(84a) STRESSMAX » WSP

Input: perijä-stä-ni Base: [(péri)(jȁstä)]	STRESS MAX	WSP	PARSE-σ	ALIGN-R$_{SFX}$	ALL-FT-L
→ a. [(péri)(jȁstä)ni]			*	*	**
b. [(péri)jäs(tȁni)]	*!	*	*		***

(84b) WSP » STRESSMAX

Input: perijä-stä-ni Base: [(péri)(jȁstä)]	WSP	STRESS MAX	PARSE-σ	ALIGN-R$_{SFX}$	ALL-FT-L
→ a. [(péri)(jȁstä)ni]			*	*	**
b. [(péri)jäs(tȁni)]	*!	*	*		***

STRESSMAX and WSP both have one violation mark for the candidate with the ternary pattern. Just as is the case in (74) and (75) with *(ĹH), regardless of the place of STRESSMAX, the binary pattern is always chosen as the optimal candidate. By analogous mechanisms, the ternary pattern is always chosen in (85).

(85a) STRESSMAX » ALIGN-R$_{SFX}$.

Input: perijä-stä-nne Base:[(péri)(jȁstä)]	STRESS MAX	WSP	PARSE-σ	ALIGN-R$_{SFX}$	ALL-FT-L
→ a. [(péri)(jȁstän)ne]		*	*	*	**
b. [(péri)jäs(tȁnne]	*!	*	*		***

(85b) ALIGN-R$_{SFX}$ » STRESSMAX

Input: perijä-stä-nne Base:[(péri)(jȁstä)]	WSP	PARSE-σ	ALIGN-R$_{SFX}$	ALL-FT-L	STRESS MAX
→ a. [(péri)(jȁstän)ni]	*	*	*!	**	
b. [(péri)jäs(tȁnne]	*	*		***	*

Both candidates violate WSP once, which causes the difference compared to (84). Due to this tie, WSP cannot decide in favour of any of the two patterns, nor can PARSE-σ, for which there is also a tie. In these cases ALIGN-R$_{SFX}$ will give us the ternary pattern. Just as in (80), in order for the ternary pattern to be selected as optimal, the crucial ranking is ALIGN-R$_{SFX}$ » ALL-FT-L, STRESSMAX.

With this final aspect, we can account for all patterns described in Chapter 5 and the present chapter. In Chapter 5, a constraint ranking was proposed that can account for all the phonological patterns. In this chapter, two additional constraints have been introduced to account for the effects of morphology on stress assignment. These constraints are ALIGN-R$_{SFX}$ and STRESSMAX. Due to the mutual interaction of these two constraints, and what is more, the interaction of these constraints with the constraint ranking of Chapter 5, all patterns described in this and the previous chapter can be accounted for.

A fixed ranking for STRESSMAX cannot be established. It is therefore not an undominated constraint, in the constraint ranking below. STRESSMAX is placed next to NONFIN, for which it was also impossible to establish a fixed position in the hierarchy.

(86) ALIGN-HD, FTBIN, FTFORM, *CLASH, *LAPSE

*(Ĺ H), WSP NONFIN, STRESSMAX

PARSE-σ ALIGN-R$_{SFX}$

ALL-FT-L

However, one question remains, which will be formulated below. ALIGN-R$_{SFX}$ was initially introduced to account for stress patterns with one suffix, but we saw that it is also actively involved in selecting output forms when the complex noun has two suffixes. STRESSMAX, on the other hand, has only been discussed in connection with these latter types of complex nouns. The question now is: is STRESSMAX also actively involved in selecting complex nouns with one suffix? Since STRESSMAX is part of the constraint hierarchy, it is, in principle, also part in the evaluation of the nouns with one suffix. In the next section I will argue that STRESSMAX, although part of the constraint hierarchy, is not actively involved in selecting the stress patterns of complex nouns with one suffix. This inactivity is due to purely morphological factors.

6.4.2 Root, stem and base

STRESSMAX evaluates output candidates against a base, which is also an output form. We saw that when the candidate is a complex nouns with two suffixes, the base is a complex noun with only one suffix. The stress pattern of the base must be copied in the stress pattern of the optimal candidate. When looked at in a derivational way, words with one suffix 'precede' words with two suffixes.

The specific question we must raise here is whether non-suffixed forms ever function as the base for a single-suffixed word. For this we turn to nominatives. Nominatives have no overt case marker, and they are freely occurring words, and thus they have a stress pattern. The stress patterns of these nominatives have been accounted for in Chapter 5 in our analysis of phonological generalisations. These free-standing output forms seem, in principle, able to serve as the base for stress patterns of complex nouns with one suffix, since they recur in the affixed form. The binary pattern would then be selected by STRESSMAX and the ternary pattern by ALIGN-R_{SFX}, where this constraint must dominate STRESSMAX and ALL-FT-L (87)-(89).

(87) a. [(áte)(rìa)] 'meal (Nom)'
b. [(óhjel)(mòinti)] 'programming (Nom)'
c. [(érgo)(nòmi)a] 'ergonomincs (Nom)'
d. [(máte)ma(tìikka)] 'mathematics (Nom)'

(88) a. [(áte)(rìa)] - *STRESSMAX* - [(áte)(rìa)na] - *STRESSMAX* - [(áte)(rìa)(nàni)]
b. [(áte)(rìa)] - *ALIGN-R_{SFX}* - [(áte)ri(àna)] - *STRESSMAX* - [(áte)ri(àna)ni]

(89a) STRESSMAX » ALIGN-R_{SFX}, ALL-FT-L

Input: ateria-na Base: [(áte)(rìa)]	STRESS MAX	PARSE-σ	ALIGN-R_{SFX}	ALL-FT-L
→ a. [(áte)(rìa)na]		*	*	**
b. [(áte)ri(àna)]	*!	*		***

(89b) ALIGN-R_{SFX} » ALL-FT-L, STRESSMAX

Input: ateria-na Base: [(áte)(rìa)]	PARSE-σ	ALIGN-R_{SFX}	ALL-FT-L	STRESS MAX
a. [(áte)(rìa)-na]	*	*!	**	
→ b. [(áte)ri(à-na)]	*		***	*

Now consider the fact that STRESSMAX makes the wrong prediction for the example below, which has a -CCV suffix. As explained in (54), this affixed form has only one stress pattern, which is [*(áte)ri(àsta)*]. But it has been shown above, that STRESSMAX may optionally dominate WSP and *(ĹH). In that position, it incorrectly selects as the optimal candidate the pattern with stress on the light syllable preceding the heavy syllable.

(90) [(áte)(rìa)] — *STRESSMAX* — * [(áte)(rìas)ta]
[(áte)(rìa)] — **(ĹH)* — [(áte)ri(àsta)]

(91a) STRESSMAX » *(ĹH)

Input: ateria-sta Base: [(áte)(rìa)]	STRESS MAX	*(ĹH)	PARSE-σ	ALIGN-R_{SFX}	ALL-FT-L
→a.*[(áte)(rìas)ta]		*	*	*	**
b. [(áte)ri(àsta)]	*!		*		***

(91b) *(ĹH) » STRESSMAX

Input: ateria-sta Base: [(áte)(rìa)]	*(ĹH)	STRESS MAX	PARSE-σ	ALIGN-R_{SFX}	ALL-FT-L
a. [(áte)(rìa-s)ta]	*!		*	*	**
→ b. [(áte)ri(à-sta)]		*	*		***

The lack of variation in (90) may imply two things: either there is a constraint that dominates STRESSMAX, or STRESSMAX does not take part in the evaluation here for some reason, which can only be that there is no base. I will argue that the latter is what prevents *[*(áte)(rìas)ta*] from being selected as optimal.

In Chapter 5, when describing the morphology of complex nouns, it was explained that the noun consists of a root (which is a bound form), to which suffixes are attached (cf. (19) in Chapter 5).

(92) puhelin (Nom) /puhelime-/

[(púhe)(lìme)na]	[(púhe)(lìme)(nàni)]	[(púhe)(lìme)(nànsa)]
[(púhe)li(mèna)]	[(púhe)li(mèna)ni]	[(púhe)li(mènan)sa]
[(púhe)li(mèsta)]	[(púhe)li(mèsta)ni]	[(púhe)li(mèstan)ne]
* [(púhe)(lìmes)ta]	* [(púhe)(lìmes)(tàni)]	* [(púhe)(lìmes)(tànne)]

(93) ateria (Nom) /ateria-/

[(áte)(rìa)na]	[(áte)(rìa)(nàni)]	[(áte)(rìa)(nànsa)]
[(áte)ri(àna)]	[(áte)ri(àna)ni]	[(áte)ri(ànan)sa]
[(áte)ri(àsta)]	[(áte)ri(àsta)ni]	[(áte)ri(àstan)sa]
*[(áte)(rìas)ta]	* [(áte)(rìas)(tàni)]	* [(áte)(rìas)(tànsa)]

For the forms in (92), the root differs from the nominative. In (92) the stem is *puhelin*. This stem has only three syllables. The root /*puhelime-*/, on the other hand, consists of four light syllables. The stress patterns we find for the affixed forms (92) are identical to the stress patterns in (93), where the root /*ateria*-/ and nominative [áterìa] are segmentally identical, and also consist of four light syllables.

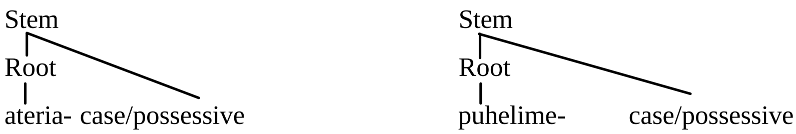
Below it is argued that although the nominative in (93) is segmentally identical to the root that precedes the suffixes, both case markers and possessive suffixes attach to the root /*ateria*-/, which, being a bound form, can not occur as a free stem, and hence cannot serve a base. Support comes from the declinations in Finnish.

The shape of the root preceding the suffixes depends on the right edge of the so-called 'basic form' (not to be confused with 'base'). The basic form is the nominative. Depending on the segments at the right edge of the basic form, stem allomorphy results in a root which may in various ways differ from the basic form, or may be identical to the basic form.

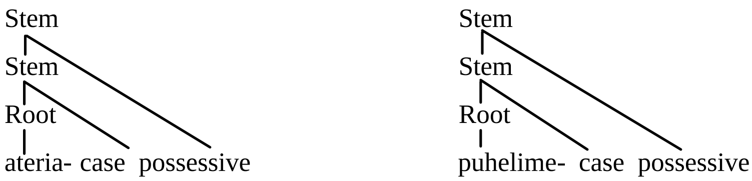
(94)	Basic Form	Plural	Genitive	Partitive	Other Case (Adess)	
a.	rivi	rivi-t	rivi-n	rivi-ä	rivi-llä	'row'
b.	nimi	nime-t	nime-n	nime-ä	nime-llä	'name'
c.	uusi	uude-t	uude-n	uut-ta	uude-lla	'one'
d.	sisar	sisare-t	sisare-n	sisar-ta	sisare-lla	'sister'
e.	nainen	naise-t	naise-n	nais-ta	naise-lla	'woman'

Without going into the details of root/stem allomorphy in Finnish, which is beyond the scope of this thesis, (94) shows that the root very often differs from the basic form. This list is not exhaustive, but there are obviously various ways in which the basic form and the root differ in shape. Whenever the root and the basic form differ segmentally, it is obvious that STRESSMAX cannot evaluate the affixed form with respect to he base. This is because there is no output form that reappears in the affixed form, i.e., there is no base. Analogous to these cases, it is assumed that, whenever the suffix is attached to a form that is segmentally identical to the basic form, the suffix is still attached to the root, which is not an output form and hence cannot serve as a base. This is shown for /*ateria*-/ and /*puhelime*-/ below.

(95)



(96)



These structures demonstrate why STRESSMAX does not perform any evaluation when the complex noun has only one suffix. The output forms are of the category stem, but they are derived from roots, whereas only stems can be a base. Thus even when STRESSMAX outranks *(Ĺ H), we still obtain the stress pattern with stress on the heavy syllable.

(97) Input: /puhelime-nsa/ Base: ---	STRESS MAX	*(ĹH)	PARSE-σ	ALL-FT-L	ALIGN-R_{SFX}
→a. [(púhe)li(mènsa)]		*!	*	**	*
b. [(púhe)(lìmens)a]			*	***	

(98) Input: /ateria-sta/ Base: ---	STRESS MAX	*(ĹH)	PARSE-σ	ALL-FT-L	ALIGN-R_{SFX}
→ a. [(áter)ri(àsta)]		*!	*	**	*
b. [(áter)(rìas)ta]			*	***	

This concludes the analysis of how morphology may affect stress assignment in Finnish. Below the analysis of Finnish stress is summarised and its most important features are discussed.

6.5 Conclusion

We have now reached the end of the analysis of Finnish stress. In this chapter and the previous one, the phonological and morphological stress patterns in Finnish nouns have been accounted for. Chapter 5 focused on the phonological generalisations, while in this chapter we have concentrated on the effects of morphology on stress patterns.

The analysis of the phonological generalisations set forth in Chapter 5 has served as the background against which the patterns that are affected by the morphology were analysed. Two classes of suffixes have been observed to affect stress patterns in Finnish considerably. These are case markers and possessive suffixes. When these suffixes are added to the root, stress patterns may appear that cannot be explained by the constraints and their rankings given in Chapter 5, which were only sufficient to account for phonological generalisations.

Carlson (1978) first observed that when a -CCV suffix is added, the resulting ternary pattern is due to the heavy syllable attracting stress. He also noted that when a -CV suffix is added to the root, the stress pattern may still be ternary, 'analogous' to the -CCV suffixes, so that the syllable preceding the suffix is stressed. Above this was explained by means of preaccentuation, i.e., by ALIGN-R_{SFX}, rather than by paradigm uniformity, as Carlson explains it.

Hanson & Kiparsky (1996) also argued that case markers and possessive suffixes are preaccenting suffixes that require stress to fall on the syllable preceding the suffix. This can eventually lead to a ternary pattern. However, they observed that when a second suffix is added to the root, the phonology decides in favour of the phonology and a binary pattern reappears. In this chapter this phenomenon has been accounted for by ‘Phonology’ » STRESSMAX. In other words, STRESSMAX and ALIGN-R$_{SFX}$ are ranked at the bottom of the hierarchy, in which case the phonological constraints select the optimal candidate.

The data I collected in the spring of 1996 showed that the interaction between phonology and morphology is much more complicated than observed by earlier researchers. First, contrary to the observation made by Hanson & Kiparsky (1996), when there are two preaccenting suffixes, there may still be a ternary pattern ([*(púhe)li(mèna)ni*], [*(áte)ri(ànani)*]). Second, when there is a heavy syllable that follows a light syllable, the heavy syllable does not always receive stress when the two suffixes are both attached to the root ([*(áte)ri(ànan)sa*], [*(péri)(jä̀näm)me*]).

Furthermore, I have established that the influence of morphology is optional. Whenever morphological factors affect the stress pattern there is always also a dual pattern that can be predicted by the phonology. That means that the constraints responsible for the effect of the unexpected stress patterns apply optionally, which means that they are crucially left unranked (Kiparsky 1993, Kager 1994, Reynold 1994, Anttila 1995, 1997).

Two morphology-sensitive constraints have been introduced to account for these stress patterns. When one suffix is added to a noun, the constraint that accounts for the influence of the morphology is an alignment constraint that requires the prosodic word to end in a foot, ALIGN-R$_{SFX}$ (2). This constraint expresses the preaccenting requirement for the suffixes, relating it to the right word edge. Stress must be on the syllable preceding this suffix. The suffix is word-final, so by making it the right member of the final foot, which is left-headed, stress precedes the suffix.

Effects of ALIGN-R$_{SFX}$ are inhibited by the phonology. ALIGN-R$_{SFX}$ only affects the stress pattern if candidates score equally for the quantitative sensitivity constraints WSP and *(ĹH). Hence, ALIGN-R$_{SFX}$ may make stress ‘shift’ only from a heavy to another heavy syllable, or from a light to another light syllable, but not from a heavy syllable to a light syllable (50). The third constraint with which it interacts is ALL-FT-L. Because there is variation, ALIGN-R$_{SFX}$ and ALL-FT-L are crucially not ranked with regard to each other. That is, ALIGN-R$_{SFX}$ may dominate ALL-FT-L, and ALL-FT-L may in turn dominate ALIGN-R$_{SFX}$.

When two suffixes are added to the root, ALIGN-R$_{SFX}$ is not sufficient to account for all stress patterns with these two suffixes. Therefore output-output correspondence (McCarthy 1995, Benua 1995) was introduced in the discussion. The stress pattern of the complex noun with one suffix serve as the base against which the stress patterns of words with two suffixes are evaluated.

The constraint that evaluates the candidates is STRESSMAX (3). This constraint requires stress in the base to return in the optimal candidate. Every time a syllable in the output candidate does not have stress on the syllable that has stress in the base, STRESSMAX is violated.

In words with two suffixes, a heavy syllable is expected to get stress according to the phonology. However, in these complex nouns the heavy syllable can be left without stress. This means that STRESSMAX must optionally be ranked above *(Ĺ́H) and WSP. But again, since all these patterns are optional, STRESSMAX may also optionally be ranked lower in the hierarchy. It has been shown above that STRESSMAX must even optionally be dominated by ALIGN-$R_{SFX,}$ which can, in turn, be ranked at the bottom of the hierarchy (80).

After ALIGN-R_{SFX} and STRESSMAX were added to the hierarchy of Chapter 5, this ranking (86) can account for the variation attested, but it also correctly blocks variation where it is not attested.

Finally, I have argued that STRESSMAX can only apply to words with a base. For some nouns the root to which the suffixes are attached is segmentally identical to the nominative. This suggests that output-output correspondence can also apply between the nominative and the complex noun with one suffix. But I have argued that the leftmost suffix always attaches to the root, which is a bound form. A bound form does not occur as a free word, hence has no stress, and hence there is no base against which the form with one suffix can be evaluated. This view is supported by words that do not have a nominative that is identical to the root. These words obviously have no output against which the complex noun with one suffix can be evaluated, but we still see the same kind of stress patterns and the same kind of variation. Nouns that have a nominative that happens to be identical to the root are treated analogously with nouns that do not have a nominative identical to the root.

To sum up, we have seen that when there is a long string of light syllables and no suffixes, the stress pattern prefers to be binary. In the previous chapter we saw how phonological patterns could force an output form with a ternary pattern, such as quantity sensitivity, clash avoidance, foot binarity and non-finality of stress. In this chapter, we have seen how 'preaccenting' suffixes could result in a ternary pattern, which, by paradigmatic analogy could even result in a ternary pattern in which a heavy syllable is not stressed, even if the phonology would predict stress on this heavy syllable. Even more, we have also seen that when the phonology predicts a ternary pattern, due to quantity sensitivity, paradigmatic analogy results in a binary pattern, ignoring the heavy syllable.

From this we can conclude that Finnish, like Sentani, has a binary stress system, in which ternary patterns may occur, due to a wide range of factors.

In the section chapter we will look at Cayuvava, Chugach and Estonian, languages for which it has been argued that they have 'truly' ternary systems. It will be shown that the interaction of constraints already motivated for Sentani and Finnish, especially the interaction of PARSE-σ, ALL-FT-L/R and *LAPSE will account for the systematic ternary alternation in those languages.

7 Conclusion

7.1 Introduction

As explained in Chapter 1, the goal of this thesis is to account for both ternary patterns in binary stress systems, and ‘truly’ ternary stress systems without ternarity-specific tools, such as ternary feet (Halle & Vergnaud 1987, Levin 1988, Dresher & Lahiri 1991, Hewitt 1992, Rice 1992), binary feet in combination with a special parsing mode (Hammond 1990, Hayes 1995) or a constraint of which the only motivation is to account for ternary stress patterns, such as *FTFT (Kager 1994).

The analyses of Sentani and Finnish serve as illustrations of the first part of that goal, i.e., accounting for ternary patterns in binary stress systems. Both languages have stress systems in which ternary patterns occur rather frequently, but these ternary patterns are combined with binary patterns. The analyses of these languages have shown that their stress systems are binary. That is, the basic pattern of both languages is binary, which can be seen in sufficiently long words consisting of light syllables. In those cases we see a strictly binary pattern appear. Constraint interaction resulted in ternary patterns. Constraints whose requirements, in interaction with the requirements of other constraints, result in ternary patterns are rather common in the analyses of bounded stress systems, and have not been specifically introduced and motivated to account for ternarity in Sentani or Finnish. Let us illustrate these points by means of the following data, all of which have been discussed in previous chapters.

(1) Sentani: binary pattern

a.	[bóhi]	‘next’
b.	[walóbo]	‘spirit’
c.	[haxòmibóxe]	‘he obeyed/followed them’
d.	[molòkoxàwalɛ́ne]	‘because I wrote to you’

(2) Sentani: ternary pattern

a.	[xànəmikóxe]	‘he called them’	*(C)ə́ » FTFORM
b.	[jɛ̀ndeboxéra]	‘after we became better’	ALIGN-L/R + WSP
c.	[molòkoxawále]	‘I wrote to you’	*CLASH + NONFIN
d.	[molònasəhàndéra]	‘after they will bury me’	*CLASH + *(C)ə́

(3) Finnish: binary pattern

a.	[áterìa]	'meal (Nom)'
b.	[érgonòmiàna]	'ergonomics (Ess)'
c.	[rávintòlat]	'restaurants (Nom)'

(4) Finnish: ternary pattern

a.	[périjä]	'inheritor (Nom)'	FTBIN
b.	[kúningas]	'king (Nom)'	NONFIN
c.	[mátematìikka]	'mathematics (Nom)'	*(Ĺ H)
d.	[káupunkiàmme]	'city (Part 2PL)	*CLASH + *(Ĺ H)
e.	[áteriàna]	'meal (Ess)'	ALIGN-R_{SFX}
f.	[áteriànani]	'meal (Ess 1SG)'	STRESSMAX

Words consisting of six light syllables, with a ternary pattern (2c, 4f) indicate that PARSE-σ must be ranked relatively low in the hierarchies of both languages, or else one would expect an exhaustive parse with main stress and two occurrences of secondary stress. However, this conclusion presents a paradox, which can be illustrated by cases such as (2d) and (3c). With PARSE-σ ranked relatively low, in some cases the higher-ranked constraints predict overlong sequences of unstressed syllables: *[*(molò)nasəhan(déra)*] (cf. (44), section 4.7) and *[*(rávin)tolat*] (cf. (83) section 5.6.5). Therefore, in order to prevent such overlong sequences of unstressed syllables (i.e., a rhythmic lapse), from occurring, it has proven necessary to assume an anti-lapse constraint which restricts the interstress interval. Such a constraint had already been proposed in earlier analyses, and has not been newly introduced in this thesis only to account for the stress patterns of Sentani or Finnish.

Even though anti-lapse constraints are typically associated with discussions about ternary rhythm (Selkirk 1984, Kager 1994, Green & Kenstowicz 1995, Ishii 1996), it has been shown that the anti-lapse constraint allows for a ternary pattern, but that its requirements do not result in a ternary pattern, as do all constraints mentioned in (2) and (4). When the combined requirements of other constraints would select a candidate with a rhythmic lapse (i.e., an overlong sequence of unstressed syllables) as optimal, the anti-lapse constraint makes sure that the distance between two strong beats, or between a strong beat and the word edge, is restricted to *at most* two weak beats. As shown for Finnish in section 5.6.5, the highly-ranked constraint *LAPSE ensures that a pattern with a quaternary pattern is rejected *[*(rávin)tolat*]. Lower-ranked constraints decide between a binary or a ternary pattern [*(rávin)to(làt)*]-[*(rávin)(tòlat)*].

The anti-lapse constraint assumed in this thesis is *LAPSE, and was presented in section 1.7 and section 4.7.

(5) **LAPSE*: A weak beat must be adjacent to a strong beat or to the word edge.

In the literature on Optimality Theory and rhythmic lapses, two anti-lapse constraints had already been proposed. Both constraints are parsing constraints, i.e., both constraints refer to stress units being parsed into a foot. These almost identical constraints are PARSE-2 (Kager 1994) and LAPSE (Green & Kenstowicz 1995). It has been shown that due to the reference to metrical structure, these constraints are both too strong and too weak. Too strong in that they reject specific stress patterns whose interstress interval is only two weak beats, and too strong in that it allows specific stress patterns whose interstress interval is three weak beats (cf. (19, 20) section 1.7 and (52) section 4.7).

The data of Sentani have presented arguments in favour of defining the anti-lapse constraint as a rhythmic constraint, referring exclusively to the grid, an idea originally proposed by means of the Principle of Rhythmic Alternation (PRA) by Selkirk (1984). The definition proposed in this thesis, however, is different from the anti-lapse provision of the PRA of Selkirk. As explained in Chapter 4, the definition proposed in (5) is a more principled definition in that it avoids counting, i.e., *LAPSE does not refer to the number of weak beats that may be adjacent to one another. Rather it refers to adjacent strong beats and to the word edge. As is shown below, the analysis of Cayuvava supports the rhythmic interpretation of *LAPSE. High-ranked *LAPSE and low-ranked PARSE-σ provide the key to the analysis of 'truly' ternary systems, i.e., systems in which the basic stress pattern is ternary, such as that of Chugach (a dialect of the Alutiiq Language, also referred to as the Pacific Yupik language (Leer 1985a,b)) and Cayuvava (a Bolivian language (Key 1965, 1967)).

In the following sections we first discuss a proposal by Ishii (1996) to account for ternary systems without ternarity-specific tools. It will be shown that, although his analysis is in the spirit of my thesis, the realisation of his analysis is rather complicated, and makes use of constraints for which the only motivation is to account for the ternary pattern in words consisting of eight syllables in Cayuvava. I therefore present an alternative analysis, which is an improvement of Ishii's analysis, in that it accounts for ternary patterns with fewer constraints, all of which are common and well-motivated constraints the metrical theory, and whose validity has already been demonstrated above.

After having accounted for the ternary systems of Chugach and Cayuvava, I will turn to the analyses of Sentani and Finnish, recapitulate these analyses, summarise the implications these analyses have for metrical theory, and suggest points for further research.

7.2 Ternary systems

7.2.1 An earlier proposal

Ishii (1996) argues that, in order to account for the ternary stress systems of Chugach and Cayuvava, it is not necessary to invoke a foot repulsion constraint, such as *FTFT, as was proposed by Kager (1994). *FTFT is a constraint for which the only motivation lies in the analysis of ternary stress. Ternary stress systems, Ishii argues, can be accounted for by principles of alignment and parsing. Two alignment constraints that both refer to opposite edges cause, what Ishii calls, a *push/pull* effect. Together with an anti-lapse constraint, this push/pull effect results in a ternary pattern.

The anti-lapse constraint used by Ishii, is called *LAPSE. This is *not* the same anti-lapse constraint presented in Chapter 1 and Chapter 4 of this thesis. Ishii's anti-lapse constraint is actually the constraint PARSE-2 as proposed by Kager (1994) (cf. (17) section 1.7 and (47) section 4.7). PARSE-2 is a parsing constraint, whose disadvantages have already been pointed out in sections 1.7 and 4.7.

The alignment constraints used by Ishii are: ALIGN(PRWD, X, FT, X), i.e., the left/right edge of every prosodic word must coincide with the left/right edge of a foot; ALIGN(FT, Y, PRWD, Y), i.e., the right/left edge of every foot must coincide with the right/left edge of a prosodic word. The latter constraint is, as we have seen in the analysis of Finnish, also referred to as ALL-FT-Y. Furthermore, he argues that the anti-lapse constraint, which is dominated in the proposal by Kager (1994) by *FTFT, can remain undominated in his analysis. However, while this idea seems to work well for Chugach, the analysis is unsatisfactory when accounting for Cayuvava. Below, Ishii's analysis of Chugach is given, after which we proceed to the analysis of Cayuvava.

In his analysis of Chugach (Leer 1985a,b), Ishii concentrates on stress patterns with light syllables only. The stress patterns and parsings he aims to predict are the following:

(6) a.	[(σσ́)σ]	[(atá)ka]	'my father'
b.	[(σσ́)(σσ́)]	[(akú)(tamék)]	'kind of foot (Abl) (*akutaq*)'
c.	[(σσ́)σ(σσ́)]	[(atú)qu(nikí)]	'if he (refl) uses them'
d.	[(σσ́)σ(σσ́)σ]	[(pisú)qu(taqú)ni]	'if he (refl) is going to hunt'
d.	[(σσ́)σ(σσ́)(σσ́)]	[(maŋár)su(qutá)(quní)]	'if he (refl) is going to hunt porpoise'

For the analysis of these stress patterns, Ishii assumes two constraints to be undominated, i.e., FTFORM=Iambic and FTBIN. These constraints are left out of the tableaux. Other relevant constraints are:

(7) a. *LAPSE
b. ALIGN (PRWD, L, FT, L), i.e., ALIGN-L
c. ALIGN (FT, R, PRWD, R), i.e., ALL-FT-R
d. PARSE-σ

The Left-to-Right orientation of the stress pattern in Chugach isdue to the push/pull effect of ALIGN-L and ALL-FT-R. ALIGN-L ensures that the word begins with a foot, ALL-FT-R pulls the feet towards the right, and *LAPSE prevents overlong sequences of unstressed syllables from occurring. The crucial ranking is ALIGN-L, *LAPSE »

ALL-FT-R » PARSE-σ. To get a ternary pattern with only two feet, ALL-FT-R must dominate PARSE-σ. This rules out (8b). Candidates (8d) and (8e) both have fewer violation marks for ALL-FT-R than (8a), but (8d) violates *LAPSE and (8e) violates ALIGN-L, and by ranking both above ALL-FT-R, (8c) is also rejected and (8a) is chosen as the optimal candidate. With these motivated rankings we get all stress patterns as given in (6) (cf. (9)-(12)).

(8) /σσσσσσ/ 3*n*	ALIGN-L	*LAPSE	ALL-FT-R	PARSE-σ
→ a. [(σσ́)σ(σσ́)σ]			* ****	**
b. [(σσ́)(σσ́)(σσ́)]			** ****!	
c. [(σσ́)(σσ́)σσ]		*!	** ****	**
d. [(σσ́)σσ(σσ́)]		*!	****	**
e. [σ(σσ́)σ(σσ́)]	*!		***	**

With these motivated we can obtain all the stress patterns as given in (6).

(9) /σσσσσσσ/ 3*n* + 1	ALIGN-L	*LAPSE	ALL-FT-R	PARSE-σ
→ a. [(σσ́)σ(σσ́)(σσ́)]			** *****	*
b. [(σσ́)(σσ́)σ(σσ́)]			*** *****!	*
c. [(σσ́)σ(σσ́)σσ]		*!	** *****	***
d. [(σσ́)σσ(σσ́)σ]		*!	******	***
e. [σ(σσ́)(σσ́)(σσ́)]	*!		** ****	*

(10) /σσσ/ 3*n*	ALIGN-L	*LAPSE	ALL-FT-R	PARSE-σ
→ a. [(σσ́)σ]			*	*
b. [σ(σσ́)]	*!			*

(11) /σσσσ/ 3*n* + 1	ALIGN-L	*LAPSE	ALL-FT-R	PARSE-σ
→ a. [(σσ́)(σσ́)]			**	
b. [(σσ́)σσ]		*!	**	**
c. [σ(σσ́)σ]	*!		*	**

(12) /σσσσσ/ 3*n* + 2	ALIGN-L	*LAPSE	ALL-FT-R	PARSE-σ
→ a. [(σσ́)σ(σσ́)]			***	*
b. [(σσ́)(σσ́)σ]			****!	*
c. [(σσ́)σσσ]		*!*	***	***
d. [σ(σσ́)(σσ́)]	*!		**	*

This analysis of Chugach by Ishii (1996) seems to be a satisfactory result. It selects the correct candidates as optimal, without having to use ternary feet or a 'ternarity' constraint such as *FTFT. However, when Ishii tries to analyse stress in Cayuvava, problems arise, as will be shown below. Recall from Chapter 2, the stress patterns of Cayuvava.

(13) a.	[(σ́σ)σ]	[šákahe]	‘stomach’
b.	[σ(σ́σ)σ]	[kihíbere]	‘I ran’
c.	[σσ(σ́σ)σ]	[ariúuča]	‘he came already’
d.	[σ(σ̀σ)σ(σ́σ)σ]	[maràhahaéiki]	‘their blankets’
e.	[σσ(σ̀σ)σ(σ́σ)σ]	[ikitàparerépeha]	‘the water is clean’
f.	[(σ̀σ)σ(σ̀σ)σ(σ́σ)σ]	[čàadiròboβurúruče]	‘ninety-nine (first digit)’
g.	[σ(σ̀σ)σ(σ̀σ)σ(σ́σ)σ]	[medàručečèirohíiɲe]	‘fifteen each (sec. digit)’
h.	[σσ(σ̀σ)σ(σ̀σ)σ(σ́σ)σ]	[čaadàirobòirohíiɲe]	‘ninety-nine (sec. digit)’

Without going into the discussion of non-finality, Ishii assumes an undominated constraint to cause the rightmost foot to be non-final (i.e., NONFIN$_{\text{FT}}$). Furthermore, he assumes an undominated constraint that allows extra-syllabic segments to occur only at the right edge of the word. These constraints are left out of the tableaux below. Other relevant constraints are:

(14) Constraints:

FTFORM=TROCHEE:	Feet are left-headed: undominated.
FTBIN:	Feet are binary at the syllabic level: undominated.
ALIGN-PRWD-FT-R:	The word ends in a foot (ALIGN-R).
ALIGN-PRWD-σ-L:	The word must begin with a syllable (ALIGN-σ-L).
ALL-FT-L :	All feet must be as much to the left as possible.
*LAPSE:	Of every two stress units one must be parsed into a foot.
NON-ALIGN-L:	The word does not begin with a foot (NON-ALIGN).
PARSE-σ:	All syllables must be parsed into a foot.
PARSE-SEG:	Segments must be parsed into a syllable.

According to Ishii, the Right-to-Left orientation of the stress pattern of Cayuvava is expressed by ALIGN- R » ALL-FT-L. The crucial ranking to get the ternary pattern is *LAPSE, ALIGN-R » ALL-FT-L » PARSE-σ. Obviously, NONFIN must dominate ALIGN-R, as a result of which none of the candidates has a word-final foot. Below, the arguments of Ishii will be exemplified with words of six, seven and eight syllables.

(15) /σσσσσσ/ 3*n*	ALIGN-R	*LAPSE	ALL-FT-L	PARSE-σ
→ a. [(σ́σ)σ(σ́σ)σ]	*		***	**
b. [σ(σ́σ)(σ́σ)σ]	*		****!	**
c. [(σ́σ)(σ́σ)σσ]	**!	*	**	**

In (15) ALIGN-R prevents the candidate with the two feet as much to the left as possible (15c) from being selected as the optimal candidate. The active involvement of ALL-FT-L in selecting the optimal candidate is motivated by the selection of (15a) and not (15b). This tableau does not motivate the ranking of *LAPSE » ALL-FT-L. ALIGN-R and *LAPSE reject the same candidate, i.e., (15c). Nor does this tableau motivate the ranking of ALL-FT-L above PARSE-σ. Candidates (15a) and (15b) both violate PARSE-σ twice, and therefore, regardless of the ranking of these two constraints, (15a) will be selected because of fewer violations for ALL-FT-L. Now consider (16).

(16) /σσσσσσσ/ 3*n* + 1	ALIGN-R	*LAPSE	ALL-FT-L	PARSE-σ
→ a. [σ(σ́σ)σ(σ́σ)σ]	*		* ****	***
b. [(σ́σ)(σ́σ)(σ́σ)σ]	*		** ****!	*
c. [(σ́σ)σσ(σ́σ)σ]	*	*!	****	***
d. [σσ(σ́σ)(σ́σ)σ]	*	*!	** ****	***

In (16) we see the relevance of *LAPSE. *LAPSE rejects the candidate with fewest violations of ALL-FT-L (16c). In this example, we also find motivations for ALL-FT-L dominating PARSE-σ. Candidates (16a) and (16b) both violate ALIGN-R once, and neither candidates violate *LAPSE. It is the word with the word-internal ternary pattern (i.e., with only two feet) that is selected, while the word-internal binary pattern (i.e., with three feet) is rejected. This is due to ALL-FT-L » PARSE-σ.

So far, the analysis of Cayuvava seems rather straightforward, similar to the analysis of Chugach. But, as will be shown below, the words consisting of 3*n* +2 syllables are problematic for Ishii. As we saw above in (14), a whole range of constraints was mentioned. Some of these constraints are motivated solely on the basis of the analysis of these 3*n* + 2 syllable words. This has to do with the interpretation of the anti-lapse constraint as a parsing constraint, which causes Ishii to assume extra-syllabic segments at the left edge of the word. In addition, the use of ALIGN-R is not satisfactory, as a result of which Ishii needs to invoke the constraint NON-ALIGN-L.

(17) /σσσσσσσσ/ 3*n* + 2	*LAPSE	ALL-FT-L	NON ALIGN	ALIGN-σ	PARSE-SEG	PARSE-σ
→ a. [CVσ(σ́σ)σ(σ́σ)σ]		** *****		CV	*	***
b. [(σ́σ)(σ́σ)σ(σ́σ)σ]		** *****	*!			
c. [σσ(σ́σ)σ(σ́σ)σ]	*!	** *****				***
d. [(σ́σ)σ(σ́σ)(σ́σ)σ]		*** *****!	*			**

In most analyses we find (17c) as the output form, with two unparsed, unstressed syllables. Since Ishii interprets *LAPSE as PARSE-2, the double upbeat (i.e., the two word-initial unstressed syllables) is a violation of this constraint. Ishii wishes to keep this constraint undominated, and in order to keep this constraint undominated, he suggests that if there are extra-syllabic segments at the left edge of a word, the lapse is solved, i.e., only one syllable remains unparsed. The battle is now between (17a) and (17b). Neither of these two candidates violate *LAPSE.

Both (17a) and (17b) do equally badly on ALL-FT-L (extra-syllabic CV apparently counts as one prosodic unit when measuring the violations for ALL-FT-L). In the other tableaux above we saw that PARSE-σ came directly under ALL-FT-L. Here, that would mean that (17b), with a word-initial binary pattern, would incorrectly be selected as the optimal candidate, and therefore Ishii proposes a constraint that rejects word-initial feet: NON-ALIGN-L. This constraint must outrank PARSE-σ. Words with six syllables, however, have a word-initial foot (15). By ranking NON-ALIGN-L below ALL-FT-L, words with six syllables still begin with a foot.

(18) /σσσσσσ/ 3*n*	ALL-FT-L	NONALIGN	PARSE-σ
→ a. [(σ́σ)σ(σ́σ)σ]	***	*	**
b. [σ(σ́σ)(σ́σ)σ]	* ***!		**

Constraints such as ALIGN-PRWD-L-σ and PARSE-SEG ensure that in words with seven syllables the word begins with a visible syllable, and not with extra-syllabic segments. In (19b) the word begins with extra-syllabic segments, while in (19a) the word begins with a visible syllable. Apparently, although motivated for the words in (17), words preferably begin with a visible syllable whenever possible. The constraints ALIGN-σ and PARSE-SEG are violated by (19b) and due to their ranking above PARSE-σ candidate, (19a) is chosen as optimal.

(19) /σσσσσσσ/ 3*n* + 1	ALL-FT-L	NON-ALIGN	ALIGN-σ	PARSE-SEG	PARSE-σ
→ a. [σ(σ́σ)σ(σ́σ)σ]	* ****				***
b. [CV(σ́σ)σ(σ́σ)σ]	* ****		CV!	*	**

This analysis is problematic for the following reasons. The solution with extra-syllabic segments to account for words with a double upbeat is an ad hoc solution which has no other motivation than to account for the double upbeat in words with 3*n* + 2 syllables. In fact, the problem starts with the interpretation of *LAPSE as a parsing constraint. Due to this interpretation, a double upbeat, leaving two syllables unparsed word-initially, is a violation of this constraint. This forces Ishii to assume extra-syllabic segments in words with a double upbeat, because the alternative, satisfying the anti-lapse constraint by parsing these syllables into a foot, does not give the right result either. It incorrectly predicts a binary pattern word-initially, for which NON-ALIGN-L needs to be invoked. As explained in Chapter 4, in the discussion of Van de Vijver (1998), stress systems generally do not systematically avoid initial stress in the same way they avoid final stress, especially not trochaic stress systems. We would therefore like to avoid a constraint which does exactly require this, and instead, let constraint interaction result in non-initial stress.

It is shown below that with the rhythmic interpretation of *LAPSE as in (5), and without a 'non-initiality' constraint, constraint interaction can account for the double upbeat in words consisting of $3n + 2$ syllables in Cayuvava, while still avoiding special ternarity constraints.

7.2.2 An alternative analysis

In order to account for Cayuvava without running into the problems Ishii's analysis ran into, we can still make use of the idea that that there is a push/pull effect by using alignment constraints that refer to opposite edges. But instead of having this push/pull effect follow ALIGN(from PRWD, X, FT, X) and ALL-FT-Y, I will argue that this is the result of the interaction between ALL-FT-X and ALL-FT-Y.

Extra-syllabic segments can be avoided when interpreting *LAPSE as a rhythmic constraint, in which case two word-initial unparsed syllables do not violate *LAPSE. Crucially, *LAPSE is a symmetrical constraint. It allows two adjacent unstressed syllables, regardless of whether they are parsed or not, and regardless of their position in the word (i.e., either word-initially, word-internally, or word-finally).

The other problematic aspect of Ishii's analysis, the non-alignment constraint, can be avoided by using ALL-FT-R. For Cayuvava, the crucial ranking is *LAPSE » ALL-FT-L » ALL-FT-R » PARSE-σ. Let us first look at the problematic words, i.e., words consisting of $3n + 2$ syllables.

(20) /σσσσσσσσ/ $3n + 2$	*LAPSE	ALL-FT-L	ALL-FT-R	PARSE-σ
→ a. [σσ(σ́σ)σ(σ́σ)σ]		** *****	* ****	****
b. [(σ́σ)(σ́σ)σ(σ́σ)σ]		** *****	* **** *!*****	**
c. [(σ́σ)σ(σ́σ)(σ́σ)σ]		*** *****!	* *** ******	**
d. [σ(σ́σ)(σ́σ)(σ́σ)σ]		* *** ****!*	* *** *****	**
e. [(σ́σ)σ(σ́σ)σ(σ́σ)]		*** *****!*	*** ******	**
f. [σ(σ́σ)σσ(σ́σ)σ]	*!	* *****	* *****	****
g. [σ(σ́σ)σ(σ́σ)σσ]	*!	* ****	** *****	****

Candidates (20f) and (20g) violate *LAPSE and are therefore rejected, despite their fewer violations for ALL-FT-L, which, in turn, rejects candidates (20c-e). The constraint ALL-FT-R then rejects (20b). Since (20b) has one extra foot at the left edge, it does worse for ALL-FT-R. We now get (20a) as the optimal candidate, with only two feet, leaving four syllables unparsed.

Furthermore, non-finality of the rightmost foot follows from the constraints given here. We do not need NONFIN$_{FT}$, which was assumed in an earlier analysis of Cayuvava (Kager 1994). A word-final foot always pulls the rightmost feet further to the right, resulting in an extra violation of ALL-FT-L. Due to the relative high ranking of ALL-FT-L, such extra violations are fatal.

Let us now look at words with $3n + 1$ and $3n$ syllables. In (21) the word has seven ($3n + 1$) syllables.

(21) /σσσσσσσ/ 3*n* + 1	*LAPSE	ALL-FT-L	ALL-FT-R	PARSE-σ
→ a. [σ(σ́σ)σ(σ́σ)σ]		* ****	* ****	***
b. [(σ́σ)(σ́σ)(σ́σ)σ]		** ****!	* *** *****	*
c. [(σ́σ)σσ(σ́σ)σ]	*!	****	* *****	***
d. [(σ́σ)(σ́σ)σσσ]	*!*	**	*** *****	***
e. [σσ(σ́σ)(σ́σ)σ]		** ****!	* ***	***
f. [σσ(σ́σ)σ(σ́σ)]		** ****!*	* ***	***

The candidates with fewest violations for ALL-FT-L in (21) are rejected by *LAPSE (21c,d). Candidate (21f) has a word-final foot, as a result of which the two feet have even more violations for ALL-FT-L than the three feet of (21b). Candidates (21b,e) score identically for ALL-FT-L, but both have more violations than (21a), which is selected as the optimal candidate. In (20) above, candidates (20a,b) score equally for ALL-FT-L, and the ranking of this constraint above ALL-FT-R was therefore not motivated, only that invoking ALL-FT-R could select the optimal candidate. In (21) it can seen that ALL-FT-L must indeed dominate ALL-FT-R, else (21e) would be selected as optimal.

(22) /σσσσσσ/ 3*n*	*LAPSE	ALL-FT-L	ALL-FT-R	PARSE-σ
→ a. [(σ́σ)σ(σ́σ)σ]		***	* *****	**
b. [σ(σ́σ)(σ́σ)σ]		* ***!	* ***	**
c. [(σ́σ)(σ́σ)(σ́σ)]		** **!**	** ****	
d. [(σ́σ)(σ́σ)σσ]	*!	**	** ****	**

In (22), the motivated ranking *LAPSE » ALL-FT-L » ALL-FT-R » PARSE-σ selects (22a). When we try this analysis with words with even more syllables (and thus more feet), and even more violations for ALL-FT-L and ALL-FT-R, we still only select the actual output as the optimal candidates.[1]

(23) /σσσσσσσσσσσ/ 3*n* + 2	ALL-FT-L	ALL-FT-R
→ a. [σσ(σ́σ)σ(σ́σ)σ(σ́σ)σ]	15[2]	12
b. [(σ́σ)(σ́σ)σ(σ́σ)σ(σ́σ)σ]	15	21!
c. [(σ́σ)σ(σ́σ)(σ́σ)σ(σ́σ)σ]	16!	20
d. [σ(σ́σ)(σ́σ)(σ́σ)σ(σ́σ)σ]	17!	19
e. [(σ́σ)σ(σ́σ)σ(σ́σ)(σ́σ)σ]	19!	19
f. [σ(σ́σ)(σ́σ)σ(σ́σ)(σ́σ)σ]	18!	18
g. [σ(σ́σ)σ(σ́σ)(σ́σ)(σ́σ)σ]	19!	17
h. [σσ(σ́σ)(σ́σ)(σ́σ)(σ́σ)σ]	20!	16
i. [(σ́σ)(σ́σ)(σ́σ)(σ́σ)(σ́σ)σ]	20!	25

[1] In the schemata below, there are no candidates with word-final feet, knowing that this will only result in more violations of ALL-FT-L and thus rejection by this constraint. All candidates satisfy *LAPSE.

[2] The numbers refer to the total number of syllables that separate the edges of the feet from the word edges.

In (23), just as for the eight-syllable words, the two candidates with fewest violations for ALL-FT-L score identically for this constraint. Due to the extra word-initial foot, ALL-FT-R selects (23a).

(24) /σσσσσσσσσσ/ 3*n* + 1	ALL-FT-L	ALL-FT-R
→ a. [σ(σ́σ)σ(σ́σ)σ(σ́σ)σ]	12	12
b. [(σ́σ)(σ́σ)(σ́σ)σ(σ́σ)σ]	13!	13
c. [(σ́σ)(σ́σ)σ(σ́σ)(σ́σ)σ]	14!	18
d. [(σ́σ)σ(σ́σ)(σ́σ)(σ́σ)σ]	15!	17
e. [σ(σ́σ)(σ́σ)(σ́σ)(σ́σ)σ]	16!	16

(25) /σσσσσσσσσ/ 3*n*	ALL-FT-L	ALL-FT-R
→ a. [(σ́σ)σ(σ́σ)σ(σ́σ)σ]	9	12
b. [σ(σ́σ)σ(σ́σ)(σ́σ)σ]	11!	10
c. [σσ(σ́σ)(σ́σ)(σ́σ)σ]	16!	9
d. [(σ́σ)(σ́σ)(σ́σ)(σ́σ)σ]	20!	16

In both (24) and (25), ALL-FT-L » ALL-FT-R already decides in favour of one candidate.

Above, we have seen how to account for the ternary stress system of Cayuvava, without needing to refer to ternarity-specific constraints, and without the extra complications Ishii (1996) introduced to account for 3*n* + 2 words. More specifically, our account has the following advantages. First, besides the analysis of Sentani, the analysis of Cayuvava above also provides support for the interpretation of *LAPSE as a rhythmic constraint.

Thanks to ALL-FT-L, ranked relatively high in the hierarchy, we do not need to invoke NONFIN. A word-final foot violates ALL-FT-L more severely than a non-final foot. Invoking a constraint such as NON-ALIGN-L can be avoided by ALL-FT-R. Words with an extra foot at the left edge violate ALL-FT-R more severely than words with to unfooted syllables word-initially.

And with the interaction of ALL-FT-L and ALL-FT-R, ALIGN-R is not needed to account for the push/pull effect, as suggested by Ishii (1996). According to Ishii, the ternary pattern of Cayuvava followed from the push/pull effect of ALIGN-R versus ALL-FT-L. However, in none of the examples given by Ishii do we find ALIGN-R. But even if we assume that ALIGN-R is indeed active in Cayuvava, ALIGN-R only evaluates the distance between the right edge of the word and the right edge of the rightmost foot, and it can therefore not reject a candidate which, compared to its competitor, has an extra foot at the left edge of the word.

ALL-FT-R, on the other hand, evaluates the distance between the right edge of the word and the right edge of all feet, and as such it is sensitive to the number of feet. Since only the rightmost foot satisfies this constraint, every extra foot means extra violations of this constraint. The interaction of ALL-FT-L » ALL-FT-R, both ranked between higher-ranked *LAPSE and lower-ranked PARSE-σ, resulted in the ternary patterns.

This is a good result, and typical of Optimality Theory. Two constraints with obviously conflicting requirements are both actively involved in selecting the optimal candidates in the stress system of Cayuvava. We now still have to look for the consequences of the analysis just given for Chugach.

The analysis of Chugach by Ishii was not problematic, and his analysis fits with my analysis. According to my analysis, ALL-FT-L would be the constraint that must interact with ALL-FT-R. But for Chugach, ALIGN-L is well-motivated, and all words begin with a foot. And contrary to Cayuvava, in Chugach we see an extra foot and a binary pattern when two syllables are left over at the word edge. This means that ALL-FT-L must be dominated by PARSE-σ, as a result of which ALL-FT-L is never actively involved in selecting the optimal form, in which case we get exactly the analysis as proposed by Ishii.

In (26a,b) we see words consisting of 3*n* + 1 syllables. These examples show why ALL-FT-L must be ranked below PARSE-σ. Chugach, just like Cayuvava, is a language with a ternary system, i.e., the preferred pattern is ternary. Given this ternarity, it parses as many syllables as possible into a foot. In Chugach, this may result in the occurrence of word-final binary patterns in an otherwise ternary stress system. If ALL-FT-L is ranked immediately below ALL-FT-R, ALL-FT-L would decide in favour of a word-final ternary pattern, which is not the actual output. Therefore, in order to get a word-final binary pattern, PARSE-σ must dominate ALL-FT-L.

(26a) /σσσσ/ 3*n* + 1	ALIGN-L	*LAPSE	ALL-FT-R	PARSE-σ	ALL-FT-L
→ a. [(σσ́)(σσ́)]			**		**
b. [(σσ́)σσ]			**	*!*	
c. [σ(σσ́)σ]	*!		*	**	*

(26b) /σσσσσσσ/ 3*n* + 1	ALIGN-L	*LAPSE	ALL-FT-R	PARSE-σ	ALL-FT-L
→ a. [(σσ́)σ(σσ́)(σ́σ)]			** *****	*	*** *****
b. [(σσ́)σ(σσ́)σσ]			** *****	**!*	***

This concludes the analysis of the ternary stress systems of Chugach and Cayuvava. We have seen that it is possible to analyse these ternary stress systems with constraints *not* motivated specifically for ternarity. All constraints are independently motivated. The interaction of these constraints results either in a ternary pattern in binary stress systems (as shown in Chapters 4 to 6), or in and ternary stress systems, as shown above.

7.2.3 Factorial typology

What we have seen in the previous chapters, and the sections above is that constraints that play a crucial role in the analysis of ternary stress are *LAPSE, ALL-FT-X and PARSE-σ. *LAPSE is undominated, while ALL-FT-X and PARSE-σ change places to get either a binary or ternary stress system. In principle, these three constraints allow for six possible rankings (3x2x1).

(27) a. ALL-FT-X » PARSE-σ » *LAPSE
b. ALL-FT-X » *LAPSE » PARSE-σ
c. PARSE-σ » *LAPSE » ALL-FT-X
d. PARSE-σ » ALL-FT-X » *LAPSE
e. *LAPSE » PARSE-σ » ALL-FT-X
f. *LAPSE » ALL-FT-X » PARSE-σ

The rankings of (27a,b) resulted in unbounded stress systems, with feet either at the left or the right edge of the word, depending on the value of X, and stress in a two-syllable window from the left or right edge of the word, depending on whether the foot is left-headed or right-headed (feet are assumed to be strictly binary).

(28) /σσσσσσσσ/	ALL-FT-L
→ a. [(σ́σ)σσσσσσ]	✓
b. [(σ́σ)σ(σ́σ)σ(σ́σ)]	*!** ******
c. [(σ́σ)(σ́σ)(σ́σ)(σ́σ)]	*!* **** ******

The rankings of (27c,d), on the other hand, require the word to be exhaustively parsed, and which results in strictly binary systems.

(29) /σσσσσσσσ/	PARSE-σ
→ a. [(σ́σ)(σ́σ)(σ́σ)(σ́σ)]	✓
b. [(σ́σ)σ(σ́σ)σ(σ́σ)]	*!*
c. [(σ́σ)σσσσσσ]	*!*****

And finally, the rankings of (27e,f) are the rankings discussed throughout this thesis, either resulting in a binary stress system (27e) or a ternary stress system (27f).

As we have seen above, the binary systems of Sentani and Finnish also include ternary patterns, due to constraints being ranked between *LAPSE and PARSE-σ, for example, *(C)ə́ in Sentani, or *(Ĺ H) in Finnish.

(30) a. [(σ̀ə)σ(σ́σ)] (Sentani) *LAPSE » *(Cə́) » PARSE-σ
b. [(σ́σ)L(H̀σ)] (Finnish) *LAPSE » *(ĹH) » PARSE-σ

Let us call this 'ternarity-inducing' constraint Y. We now have an interaction of four constraints, i.e., *LAPSE, Y, PARSE-σ, ALL-FT-X. If four constraints interact, there are twenty-four combinatory possibilities (4x3x2x1). We may now ask ourselves what systems and what patterns we predict on the basis of these rankings.

If ALL-FT-X or PARSE-σ are undominated, we still predict either unbounded stress system, or strictly binary stress systems, as in (28) and (29). And we know that if *LAPSE is undominated, the difference between a binary system and a ternary system is the difference in ranking of PARSE-σ » ALL-FT-X for a binary system, versus ALL-FT-X » PARSE-σ for a ternary system. Consider the rankings that result in a binary system.

(31) a. *LAPSE » PARSE-σ » ALL-FT-X » Y
b. *LAPSE » PARSE-σ » Y » ALL-FT-X
c. *LAPSE » Y » PARSE-σ » ALL-FT-X

As long as PARSE-σ immediately follows *LAPSE in the hierarchy, the stress system is strictly binary (31a,b). Only in the event that another (a fourth) constraint dominates PARSE-σ, we may get a ternary pattern (31c), as has already been shown in (30a,b).

For ternary systems, i.e., *LAPSE » ALL-FT-X » PARSE-σ, there is no ranking that always results in strict ternarity. Whether or not the system is strictly ternary depends on the nature of Y.

(32) a. *LAPSE » ALL-FT-X » PARSE-σ » Y
b. *LAPSE » ALL-FT-X » Y » PARSE-σ
c. *LAPSE » Y » ALL-FT-X » PARSE-σ

Cayuvava is a system with strict ternarity. In Cayuvava the value for X in ALL-FT-X is L. But despite ALL-FT-L dominating PARSE-σ, we need another constraint (i.e., constraint Y dominating PARSE-σ (32b)), in order to select [σσ(σ́σ)σ(σ́σ)σ] and not *[(σ́σ)(σ́σ)σ(σ́σ)σ] as the optimal candidate. For Cayuvava constraint Y is an alignment constraint (i.e., ALL-FT-R (20)), and its ranking above PARSE-σ make patterns with fewer feet better candidates.

So far we have considered only patterns in ternary systems without quantity sensitivity. But we can imagine a pattern in which the first syllable is heavy, and Y is WSP. In that case [(H́σ)(σ́σ)σ(σ́σ)σ] would be selected, with a word-initial binary pattern, and not the strictly ternary alternation [Hσ(σ́σ)σ(σ́σ)σ]. Thus, with the same ranking, but with different constraints for Y, the result is either a strictly ternary system (Y=ALL-FT-R) or a ternary system with a binary pattern (Y=WSP).

Chugach is a language in which the ternary system combines ternary patterns with binary patterns. In this language, the value for X in ALL-FT-X is R. Here Y may be L (ALL-FT-L), but ALL-FT-L was dominated by PARSE-σ, as demonstrated in (26), which is the ranking of (32a), resulting in a binary pattern word-finally (i.e., [(σσ́)σ(σσ́)(σσ́)] but not [(σσ́)σ(σσ́)σσ], cf. (26b)).

And when the ranking is as in (32c), we can again imagine that, if Y is WSP, in words with six syllables, a binary pattern emerges with three feet, even if this means a severe violation of, say, ALL-FT-L. Consider (33).

(33) /σσσσσσσσ/	WSP	ALL-FT-L
→ a. [(H́σ)(H́σ)(H́σ)]		** ****
b. [(H́σ)H(σ́H)σ]	*!*	***

The most complicated situation, however, is that in which Y is the undominated constraint. Again there are six possible rankings.

(34) a. Y » *LAPSE » PARSE-σ » ALL-FT-X
b. Y » *LAPSE » ALL-FT-X » PARSE-σ
c. Y » PARSE-σ » ALL-FT-X » *LAPSE
d. Y » PARSE-σ » *LAPSE » ALL-FT-X
e. Y » ALL-FT-X » PARSE-σ » *LAPSE
f. Y » ALL-FT-X » *LAPSE » PARSE-σ

Depending on the nature of Y, we predict either bounded or unbounded stress systems. Suppose Y is again an alignment constraint, say, ALL-FT-Z, then we get, of course, an unbounded stress system. As shown above in (28), undominated ALL-FT-Z always results in unbounded stress systems. If Y is WSP, the rankings (33e,f) will result in unbounded stress systems of which every heavy syllable is stressed. These are instantiated, for example, by Malayalam (Mohanan 1986).

(35) /σσσσσσσσ/	WSP	ALL-FT-L
→ a. [(σ́σ)σ(H́σ)σσσσ]		***
b. [(σ́σ)σHσσσσ]	*!	
c. [(σ́σ)σ(H́σ)σ(σ́σ)]		*** *!*****
d. [(σ́σ)(H́σ)(σ́σ)(σ́σ)]		** **!** ******

When Y is WSP, the rankings in (34a-d) result in bounded stress systems, with stress on every heavy syllable. For (34a,c,d) the systems are binary, due to the ranking PARSE-σ » ALL-FT-X.

(36) /σσσσσσσσ/	WSP	*LAPSE	PARSE-σ	ALL-FT-L
→ a. [(σ́σ)σ(H́σ)(σ́σ)σ]			**	*** ****
b. [(σ́σ)(σ́H)(σ́σ)(σ́σ)]	*!			** **** ******
c. [(σ́σ)σ(H́σ)σ(σ́σ)]			**	*** *****!*

Ranking (34b) will give a ternary system, with a possible binary pattern to satisfy WSP (37a).

(37) /σσσσσσσσ/	WSP	*LAPSE	ALL-FT-L	PARSE-σ
→ a. [(σ́σ)(H́σ)σ(σ́σ)σ]			** *****	**
b. [(σ́σ)H(σ́σ)σ(σ́σ)]	*!		** **** ******	**
c. [(σ́σ)(H́σ)(σ́σ)(σ́σ)]			** **** **!****	

However, a constraint that prohibits stress on a certain syllable may cause an overlong sequence of unstressed syllables in an otherwise bounded stress system. Consider the hypothetical form (38).

(38) /ələjəjəlɛne/

If Y is *(C)ə́, this may result in a final foot with a word-inital sequence of four unstressed syllables.

(39) [ələjəjə(lɛ́ne)]

But given the rankings of (34a-d), in words with six syllables, without such ə-syllables, *LAPSE and PARSE-σ will result in words with maximally ternary patterns. *(C)ə́ » *LAPSE, PARSE-σ » ALL-FT-X, for example, will give a binary stress system, with a binary pattern, for example as in (40).

(40) [(òlo)(jàja)(lɛ́ne)]

In bounded stress systems, the pattern in (39) is highly disfavoured, but it is a pattern that may result under constraint interaction of the four constraints under consideration. That we hardly ever find these patterns is the result of the fact that we have painted a rather simplified picture. In most stress systems, more constraints play a role than just four, of which the interaction would rule out a pattern as in (39). But the fact remains that *in principle* such a pattern is possible.

The only way to avoid those patterns from being selected as optimal is by putting constraints on constraint interaction, such as universally undominated constraints, as has tentatively been proposed by Prince & Smolensky (1993) with regard to FTBIN. Answering the question whether there are constraints on constraint rankings is in fact worth another dissertation, and beyond the scope of this thesis.

That factorial typology shows that patterns are predicted that are disfavoured in bounded stress systems does in no way undermine the goal of this thesis, i.e., showing that both binary and ternary stress systems can be analysed by means of constraint interaction. Ternary stress systems follow from constraints that are, motivated for binary stress systems. That is to say, we do not need ternarity-specific tools to get such ternary systems. And even invoking ternarity-specific tools would not rescue us in factorial typology or preventing overlong sequences of unstressed syllables. There would only be an extra constraint that has to be taken into consideration, resulting in many more combinatory possibilities, i.e., a total of one hundred and twenty (5x4x3x2x1).

This concludes the discussion about ternarity. In the remainder of this chapter the analyses of Sentani and Finnish will be recapitulated, and aspects that came up in analysing these stress systems will be summarised, as well as their implications for metrical theory.

7.3 Sentani

As noted above, the analysis of Sentani has shown that Sentani has a binary stress system in which ternary patterns may occur (i.e., a constraint intervenes between *LAPSE and PARSE-σ cf. (31)). In (2) it was shown that the interaction of the requirements of several different constraints may result in a ternary pattern in Sentani, such as *(C)ə́, ALIGN-L, WSP, *CLASH and NONFIN. As shown, none of these constraints, inherently require the stress pattern to be ternary. The analysis of the stress system of Sentani has provided several interesting aspects that are not directly related to the discussion of ternarity, some of which deserve special attention.

7.3.1 *LAPSE

First, Sentani provided evidence that the anti-lapse constraint must be interpreted as a rhythmic constraint, exclusively referring to the grid, rather than as as a parsing constraint that refers to metrical constituent structure, as did PARSE-2 (Kager 1994) and LAPSE (Green & Kenstowicz 1995). Evidence for this could be obtained by looking at configurations in which both a left-headed and a right-headed foot appear (cf. (19) section 1.7 and (52) section 4.7). Sentani is a language in which this may occur. Words consisting of light syllables are parsed with a word-initial iamb and a word-final trochee [*(molò)koxa(wále)*], violating the anti-lapse constraints PARSE-2 and LAPSE, while actually no rhythmic lapse occurs. In the spirit of the anti-lapse provision of the Principle of Rhythmic Alternation as proposed by Selkirk (1984), the anti-lapse constraint *LAPSE, as presented in Chapters 1 and 4, must therefore be a rhythmic constraint, referring to the grid. *LAPSE is formulated differently from the anti-lapse provision, so that it is a local constraint, and so that counting of stress units is avoided. Above, in the present chapter, we have seen that Cayuvava confirms this interpretation of *LAPSE (19).

7.3.2 X » FTFORM » Y

Words with both an iamb and a trochee are also interesting in that they show the advantage of Optimality Theory over parametric, rule-based phonology. As noted in Chapter 1, most requirements in metrical systems are not absolute. This is problematic for rule-based phonology. Once the parameter is set, rules assign either left-headed or right-headed feet. In order to get both type of feet in one word, words first need to be parsed into feet with their heads either only left or only right in the foot, and subsequently, the metrical structure over one of the feet must be erased and a new structure must be built, resulting in two extra layers in the derivation. In Optimality Theory, this simply follows from constraint interaction, i.e., X » FTFORM » Y.

7.3.3 NONFIN-Family

Third, when accounting for stress on final heavy syllables, and the lack of stress on final light syllables, it was concluded that this must be a case of NONFIN evaluating at the moraic level (cf. (65) section 4.8). According to extrametricality in rule-based phonology, the stress unit considered to be extrametrical is invisible for metrical structure and may not be part of a foot (Hayes 1982, 1995). As a result, assuming mora-extrametricality could, in the case of a heavy syllable, result in a syllable internal foot-boundary, which is ruled out universally by syllable integrity. NONFIN is different from extrametricality. It is only concerned with the well-formedness of the stress peak, and not with whether the stress unit involved is parsed into a foot or not. It is therefore possible to include NONFIN$_{\mu}$ in the NONFIN constraint family, in addition to already proposed NONFIN$_{\sigma}$ and NONFIN$_{FT}$ (Prince & Smolensky 1993), which is a good result, considering the prosodic hierarchy proposed by Selkirk (1980).

7.3.4 RHYTHM

Finally, we saw that NONFIN and *CLASH are crucially ranked in different places in the hierarchy, especially with regard to FTFORM. In words with four syllables [*(fomà)(lɛ́re)*] avoidance of final stress results in a violation of FTFORM=IAMB, while the resulting clash is not solved by violating FTFORM once more (cf. (16) and (17) in section 4.3.2). These stress patterns form the argument against the proposal by Hung (1994) that non-finality of stress and clash avoidance are actually one and the same phenomenon (i.e., a strong beat must be followed by a weak beat), which should be accounted for by a single constraint: RHYTHM.

7.3.5 Pure grid versus bracketed grid

In general, the analysis of Sentani has triggered an extensive discussion about the rhythmic distribution of strong and weak beats. The largest part of the discussion about rhythm refers to the pure grid. The question now rises whether this means that we are back to the pure grid as proposed by Prince (1983) and Selkirk (1984), now that we have seen that PARSE-σ is often ranked very low in the hierarchy, and particularly low in the hierarchy of Sentani.

I think there are reasons to believe we still need feet. First, in our discussion of the proposal by Hung, we saw how her argument ran into trouble when accounting for NONFIN$_{FT}$ in trochaic systems when referring exclusively to the grid. Second, if we do not have feet, we also lose the constraint FTFORM (i.e., left-headedness and right-headedness of feet), which is used to account for the typological differences between iambic and trochaic systems, as observed by Hayes (1985, 1987, 1995). It seems, however, an interesting question for further research, to see what possibilities there are to account for those aspects on the pure grid.

7.4 Finnish

The analysis of Finnish, just like that of Sentani, showed that Finnish, too, has a binary stress system, and that constraint interaction may result in ternary patterns (i.e., one or more constraints intervening between *LAPSE and PARSE-σ). The constraints that may result in a ternary pattern are partly the same as for Sentani, but partly completely different (4). Again, we find constraints such as *CLASH and NONFIN. New constraints that induced ternary patterns in Finnish are *(Ĺ H) and FTBIN, as well as the 'morphological' constraints ALIGN-R_{SFX} and STRESSMAX.

The analysis of Finnish was divided into two parts. Some of the stress patterns of Finnish can be accounted for by referring exclusively to phonological aspects, but there are also stress patterns that are the result of the influence of morphological aspects.

7.4.1 Phonology

First, in Chapter 5, the phonological patterns were accounted for. This analysis resembles the analysis given by Hanson & Kiparsky (1996), but even more the one provided by Alber (1997). A crucial difference is that due to a lack of relevant data, Alber ranked WSP, under the undominated constraints, but above PARSE-σ, while she could not rank the constraint ITL, which, in her analysis, functions as the *(ĹH) constraint in my analysis (cf. (97) in section 5.7.2). However, on the basis of forms such as those given in (61) in section 5.6.3, it has been shown that it is ITL (or *(ĹH)) that must be ranked between the undominated constraints and PARSE-σ, while WSP cannot be ranked. What is more, on the basis of the phonological patterns, the presence of WSP cannot even be motivated at all.

7.4.2 Morphology

The analysis of words whose stress patterns are obviously the result of morphological effects (Chapter 6) is very interesting. Two classes of suffixes (case marker and possessive suffix) have been observed to affect stress assignment (Carlson 1978, Hanson & Kiparsky 1996). Carlson observed that stress shifts to the right when either of these suffixes, or even both these suffixes, are attached to the word to precede the suffix. If the suffix closes the preceding syllable (-CCV), this stress shift is what we expect, due to quantity sensitivity. But if the suffix does not close the preceding syllable (-CV), Carlson argues that the stress shift is due to *paradigmatic analogy* to the -CCV suffixes (cf. (4) and (5) in section 6.2).

The Finnish data I collected confirm the stress patterns as given by Carlson (1978) and Hanson & Kiparsky (1996), but as has already been explained above, they paint a rather more complicated picture, and interestingly the effects created by the two suffixes turns out to be optional. Whenever we find a pattern that is the result of the presence of one or both suffixes, we also find a pattern that is the result of the phonology.

7.4.3 Preaccentuation

When accounting for stress patterns, that are cause by morphological effects, we saw that, when a single suffix is attached, *preaccentuation* can be accounted for by ALIGN-R$_{SFX}$, which requires the suffixed prosodic word to end in a foot (section 6.3). This constraint was given a place in the hierarchy motivated in Chapter 5. In order to get variation when attested (i.e., in words of five syllables), ALIGN-R$_{SFX}$ is crucially not ranked with regard to ALL-FT-L, (Kiparsky 1993, Kager 1994, Reynolds 1994, Anttila 1995). ALIGN-R$_{SFX}$, however, is restricted by quantity sensitivity, and ranked below *(Ĺ́H), as a result of which we find variation in (48a) and (49a), but not in (48b) and (49b).

7.4.4 Output-output correspondence

The analysis of stress patterns of words with two suffixes was very complicated. It was argued that the stress patterns in (66) in section 6.4 were the result of 'copying' the stress pattern of the word with one suffix to the word with two suffixes. This *paradigmatic analogy* is different from the interpretation offered by Carlson (1978). Carlson interprets paradigmatic analogy as analogy between morphologically related forms at 'the same level of the derivation', while in the analysis proposed in Chapter 6, paradigmatic analogy is interpreted as analogy between morphologically related words at 'different levels of the derivation'.

As explained in Chapter 2 and Chapter 6, such analogies can be accounted for by output-output correspondence, where the candidates are evaluated with regard to how well they match a certain *base*, not an input. For words with two suffixes, the base is the complex word with one suffix (67). In the case of Finnish stress, the faithfulness constraint that plays a role is STRESSMAX, which requires that a syllable that is stressed in the base, must also be stressed in the output.

7.4.5 The base

If there are two possible stress patterns for words with one suffix, we need to know, what it is exactly that constitutes the base in such cases. We saw that if there are two possible bases, there may only be one base per tableau, otherwise we get a tie (69)-(71). And if there are two different bases, the variation in the two bases is retrieved in the two different stress patterns of the complex forms with two suffixes.

7.4.6 The interaction of phonology, ALIGN-R$_{SFX}$ and STRESSMAX

Contrary to ALIGN-R$_{SFX}$, STRESSMAX is not restricted by *(Ĺ́H), with regard to which it is crucially left unranked (72). And interestingly, in words with two suffixes, ALIGN-R$_{SFX}$ may still trigger a ternary pattern. This means that STRESSMAX must also crucially be left unranked with respect to ALIGN-R$_{SFX}$ (79, 80). The motivated high ranking of *(Ĺ́H) and the motivated low ranking of ALIGN-R$_{SFX}$ and STRESSMAX being crucially left unranked with regard to both these constraints, means that STRESSMAX is not ranked at all. This makes STRESSMAX a *Floating Constraint* (Reynolds 1994). What we saw was that, no matter where STRESSMAX is ranked in the hierarchy, a candidate is always selected that is attested in the data, and there are either two possible output forms (i.e., variation between two output forms), or just one output form (i.e., no variation). If there is variation, one of the patterns is the pattern that can be predicted by the phonology, while the other is the result of one of the morphological constraints. If there is no variation, the pattern that is selected in all tableaux is the phonological pattern.

As explained in the previous chapter (section 6.4.1), the fact that maximally two variants may be selected is due to the interaction of the phonology, ALIGN-R_{SFX} and STRESSMAX. First, all three co-operate in selecting one and the same candidate, which, for example, is the case in the tableaux (71a) and (72a). Second, the phonology and ALIGN-R_{SFX} co-operate, while STRESSMAX predicts another pattern, as can be seen in (71b) and (72b). With the ternary base, STRESSMAX, predicts a ternary output, but as soon as STRESSMAX is demoted in the hierarchy, both *(Ĺ H) or PARSE-σ and ALIGN-R_{SFX} select the binary pattern. Third, STRESSMAX selects one pattern, ALIGN-R_{SFX} selects the other pattern, while the phonology does not make a difference, i.e., there is a tie for the phonological constraints (85a,b). But due to the undominated phonological constraints, one of the patterns can always also be predicted by the phonology.

7.4.7 Stems and roots

Finally, in Finnish we find nominatives which do not have an overt case marker, whose output is segmentally identical to the root. This suggests that output-output correspondence may also apply to words with a single suffix. As shown, this results in predicting output forms that are not attested in the data (e.g. *[*(áte)(rìas)ta*] (cf. (90) section 6.4.2)). Analogous to nominatives that are not identical to the root (94), and for which there is no base for words with one suffix, it was argued that even if the nominative is segmentally identical to the root, the suffixes attach to the root (95), and hence STRESSMAX cannot take part in the evaluation.

7.4.8 Further research

The question that has not yet been answered in this thesis, but which is a very interesting question, refers to section 7.4.6. This question is the following: although STRESSMAX may take any position in the hierarchy, there are still maximally two possible variants given a certain input. Is it a coincidence of Finnish that the interaction of the phonology, STRESSMAX and ALIGN-R_{SFX} only results in two variants, or is this the result of the organisation of Optimality Theory? In order to answer this question, we need to look at more languages that have variation of various kinds.

7.5 Conclusion

In concluding this thesis. We have seen how we can account for ternary patterns in binary systems, and for truly ternary stress systems, without the use of ternarity-specific means.

Strictly binary stress systems are obtained by the ranking *LAPSE, PARSE-σ » ALL-FT-X. Sentani and Finnish both have binary stress systems. Ternary patterns result from constraint interaction, particularly when a constraint intervenes between *LAPSE and PARSE-σ, i.e., *LAPSE » Y » PARSE-σ » ALL-FT-X.

As have shown in Chapters 3, 4, 5 and 6, none of the constraints used for the analyses of both languages, are constraints for which the motivation is accounting for ternarity. All constraints are independently motivated.

The analyses of the stress systems of Sentani and Finnish have provided the key for the analysis of ternary stress systems such as those found in Chugach and Cayuvava. As shown in sections 7.2 and 7.3, ternary stress systems are the result of the ranking *LAPSE » ALL-FT-X » PARSE-σ. In both languages, this ranking, in combination with alignment constraints, results in correct analyses of the relevant stress systems. In Cayuvava, ALL-FT-L and ALL-FT-R dominating PARSE-σ results in strict ternarity. In Chugach ALIGN-L is undominated, and PARSE-σ is dominated by ALL-FT-R, but it dominates ALL-FT-L. This results in a ternary system with binary patterns word-finally in words consisting of 3*n* + 1 syllables.

The interaction of *LAPSE, ALIGN-X/Y, ALL-FT-Y/X, and PARSE-σ not only resulted in a unified account of binary and ternary stress systems, but it also contributed to keeping the metrical theory restricted. This became obvious when analysing the ternary stress systems of Chugach and Cayuvava. The constraint *FTFT as proposed by Kager 1994 turned out to be unnecessary, and neither did we need the constraints NONALIGN-L, ALIGN-L-σ, PARSE-SEG as proposed by Ishii to account for Cayuvava.

References

Alber, Birgit (1997) ‘Quantity Sensitivity as Constraint Interaction’, in G.E. Booij and J. van de Weijer (eds.) *Phonology in Progress-Progress in Phonology, HIL phonology papers III*. Holland Academic Graphics, The Hague (1-45).

Alderete, John (1995) Faithfulness to prosodic heads, Ms., University of Massachusetts, Amherst.

Allen, W. Sidney (1973) *Accent and Rhythm: Prosodic Features of Latin and Greek: A Study in Theory and Reconstruction*. Cambridge University Press, Cambridge UK.

Anceaux, J. (1965) *The Nimboran Language*. Koninklijk Instituut voor Taal- Land- en Volkenkunde (KITLV) 44.

Anttila, Arto (1995) ‘Deriving Variation from Grammar: A study of Finnish Genitives’, Ms., Stanford University.

Anttila, Arto (1997) *Variation in Finnish Phonology and Morphology*. Doctoral Dissertation, Stanford University.

Anttila, Arto and Young-mee Yu Cho (1996) ‘Variation and Change in Optimality Theory’, Ms., Stanford University.

Benua, Laura (1995) ‘Identity Effects in Morphological Truncation’, in J. Beckman, L. Walsh & S. Urbanzyck (eds) *UMOP* 18 (77-136).

Benua, Laura (1997) *Transderivational identity: phonological relations between words*. Doctoral dissertation, University of Massachusetts, Amherst.

Blanc, Haim (1970) ‘The Arabic Dialect of the Negev Bedouins’. *Proceedings of the Israel Academy of Sciences and Humanities* IV.7, 112-150.

Bolinger, D.L. (1958) ‘A theory of pitch-accent in English’. *Word* 14, 109-149.

Buckley, Eugene (1994) *Theoretical Aspects of Kashaya Phonology and Morphology*. Doctoral Dissertation, Stanford University, CSLI publications.

Burzio (1994) *Principles of English stress*. Cambridge University Press, Cambridge.

Bye, Patrick (1996) *Correspondence in the prosodic hierarchy and the grid: case studies in overlength and level stress*. Cand Philol. Thesis, University of Tromsø.

Carlson, Lauri. (1978) 'Word Stress in Finnish', Ms., Department of Linguistics MIT, Cambridge Massachusetts.

Cohn, Abigail & John McCarthy (1994) 'Alignment and parallelism in Indonesian phonology', Ms., Cornell University, Ithaca, New York & University of Massachusetts, Amherst.

Cowan, Hendrik K.J. (1965) *Grammar of the Sentani Language*. Koninklijk Instituut voor Taal- Land- en Volkenkunde (KITLV) 47.

Derbyshire, Desmond C. (1979) 'Hixkaryana', in *Lingua Descriptive Studies* 1, Amsterdam.

Dixon, R.M.W. (1977) *A grammar of Yidin^y*. Cambridge, Cambridge University Press.

Dresher, B. Elan and Aditi Lahiri (1991) 'The Germanic Foot: Metrical Coherence in Old English', in *Linguistic Inquiry* 22 (251-286).

Elenbaas, Nine (1992) 'Een vergelijking van twee ternaire analyses, getoetst aan het Sentani', Master's thesis, Utrecht University.

Elenbaas, Nine (1996) 'Ternary rhythm in Sentani', in C. Cremers & Marcel den Dikken (eds.) *Linguistics in the Netherlands* 1996. John Benjamin, Amsterdam (61-72).

Elenbaas, Nine (1996) 'Heavy syllables and rhythm in Sentani', in J. Don, B. Schouten, W. Zonneveld (eds.) OTS Yearbook 1995. LEd, Utrecht (27-40).

Flemming, E. (1995) *Auditory Representations in Phonology*. Doctoral Dissertation University of California, Los Angeles.

Foley William A. (1984) *The Papuan Languages of New Guinea*. Cambridge University Press, Cambridge.

Furby, Christine (1974) 'Garawa Phonology', *Pacific Linguistics*, Series A, Australian National University, Canberra.

Goldsmith, John (1993) 'Harmonic phonology', in J. Goldsmith (ed.) *The last phonological rule: reflections on constraints and derivations*. Chicago University Press, Chicago.

Green, Thomas & Michael Kenstowicz (1995) 'The Lapse Constraint', Ms., MIT.

Hale, Kenneth & Josie White Eagle (1985) 'A note on Winnebago Metrical Structure', *International Journal of American Linguistics* 51, 427-429.

Halle, Morris (1990) 'Respecting Metrical Structure', *Natural Language and Linguistic Theory* 8, 149-176.

Halle, Morris & Jean-Roger Vergnaud (1987) *An Essay on Stress*, MIT Press, Cambridge Massachusetts.

Halle, Morris & Micheal Kenstowicz (1991) 'The Free Element Condition and Cyclic Versus Noncyclic Stress' in *Linguistic Inquiry* 22, 457-501.

Hammond, Michael (1990) 'Deriving Ternarity', Ms., University of Arizona, Tucson.

Hammond, Michael (1994) An OT account of variability in Walmatjarri stress, Ms., University of Arizona, Tucson.

Hansen, Kenneth & L.E. Hansen (1969) 'Pintupi Phonology', *Oceanic Linguistics* 8, 153-170.

Hanson, K. (1992) *Resolution in modern meters*. Doctoral dissertation, Stanford University.

Hanson, K. and P. Kiparsky (1996) 'A Parametric Theory of Poetic Meter', *Language* 72/2, 287-335.

Harms, Robert T. (1960) *Stress and Juncture in Finnish*, Uralic and Altaic Studies 1. Indiana University.

Harm, Robert T. (1964) *Finnish Structural Sketch*, Uralic and Altaic Studies 42. Indiana University Bloomington. (Mouton, Dordrecht).

Harrikari, Heli (1998) 'Epenthesis as Evidence of Geminate Integrity in Finnish', *Prepublications and Internal Communications* 3. Department of General Linguistics, University of Helsinki.

Harrikari, Heli (1998) 'At-will spoonerisms and vowel length in Finnish' *Prepublications and Internal Communications* 3. Department of General Linguistics, University of Helsinki.

Hartzler, Dwight (1976) 'Verb Structure of Central Sentani', *Irian* 5/2, Abepura, Indonesia.

Hartzler, Margaret (1976) 'Central Sentani Phonology', *Irian* 5/2, Abepura, Indonesia.

Hartzler, Margaret (1987) 'A brief Phonology of the Sentani Language', *Afeu* IV (30-37).

Hayes, Bruce (1981) *Metrical Theory of Stress Rules*, Doctoral Dissertation (1980), MIT, Cambride, Massachusetts. Published in 1985, New York: Garland Press.

Hayes, Bruce (1982) ‘Extrametricality and English stress’, *Linguistic Inquiry* 13, 227-276.

Hayes, Bruce (1985) ‘Iambic and Trochaic Rhythm in Stress Rules’, *Berkeley Linguistic Society* 13, 429-446.

Hayes, Bruce (1987) ‘A Revised Parametric Metrical Theory’, *North Eastern Linguistic Society* 17, 472-489.

Hayes, Bruce (1989) ‘Compensatory Lengthening in Moraic Phonology’, *Linguistic Inquiry* 20, 253-306.

Hayes, Bruce (1995) *Metrical Stress Theory: Principles and Case Studies*. University of Chicago press, Chicago.

Hewitt, Mark S. (1992) *Vertical Maximization and Metrical Theory*. Doctoral Dissertation, Brandeis University, Waltham, Massachusetts.

Hint, Mati (1973) *Eesti keele sonafonoloogia I*. Tallinn, Estonia: Eesti NSV Teaduste Akadeemia.

Hyman, Larry (1977) ‘On the nature of linguistic stress’, *Studies in Stress and Accent*, Southern California Occasional Papers in Linguistics 4, Dept. of Linguistics, University of Souther California, Los Angeles.

Hyman, Larry (1985) *A theory of phonological weight.* Foris, Dordrecht.

Hung, Henrietta (1994) *The Prosodic Organization of Edge Constituents: An Optimality Theoretic Account.* Doctoral Dissertation, Brandeis University, Massachusetts.

Idsardi, William (1992) *The computation of prosody*. Doctoral dissertation, MIT.

Ishii, Toru (1996) ‘An optimality-theoretic approach to ternary stress systems’. In Agbayani, Brian & Naomi Harada (eds.) UCIWPL 2, *Proceedings of the South Western Optimality Theory Workshop (SWOT II)*, 95-111.

Kager, René (1989) *A Metrical Theory of Stress and Destressing in English and Dutch*, Doctoral Dissertation, Utrecht University.

Kager, René (1992) ‘Are there any truly quantity insensitive systems? In L.A. Buszard-Welcher, L. Lee & W. Weigel (eds.) *Proceedings of the Berkeley Linguistic Society* 18, 123-132.

Kager, René (1993) ‘Alternatives to the Iambic/Trochaic Law’, in *Natural Language and Linguistic Theory* 11, 381-432.

Kager, René (1994) ‘Ternary Rhythm in Alignment Theory’, Ms., Utrecht University.

Kager, René (1996a) ‘Stem Stress and Peak Correspondence in Dutch’, UiL-OTS Working Paper, Utrecht University, Utrecht.

Kager, René (1996b) ‘Ternary Rhythm in Alignment Theory’, Ms., Utrecht University. Completely revised version of Kager (1994).

Kager, René (to appear) *Optimality Theory. A textbook.*

Karlsson, F. (1984) *Finnische Grammatik*. Helmut Buske Verlag, Hamburg.

Kenstowicz, M (1995) ‘Cyclic versus Noncyclic Constraint Evaluation’ in Carnie, A. and H. Harley, T. Bures (eds.) MIT Working Papers in Linguistics 21.

Kenstowicz, M. (1996) ‘Base-Identity and Uniform Exponence: Alternatives to Cyclicity’. In: Durand, J. & B. Laks (eds.) *Current trends in phonology models and methods.* CNRS Parix X, and University of Salford. University of Salford Publications, 363-393.

Keyser, S.J. and P. Kiparsky (1984) Syllable Structure in Finnish Phonology, in: Aronoff, Mark and Richard T. Oehrle (eds.) *Language and Sound Structure, studies in phonology*. MIT Cambridge Massachusetts.

Key, Harold (1961) ‘Fonotacticas del Cayuvava’ *International Journal of American Linguistics* 27, 143-150.

Key, Harold (1967) *Morphology of Cayuvava*. Janua Linguarum, Series Practica LIII, Mouton, The Hague.

Kisseberth, Charles (1970) ‘On the functional unity of phonological rules’, *Linguistic Inquiry* 1, 291-306.

Kiparsky, Paul (1991) ‘Catalexis’, Ms., Stanford University, Stanford and Wissenschaftskolleg zu Berlin.

Kiparsky, Paul (1993) ‘Variable Rules’, handout distributed at Rutgers Optimality Workshop 1.

Leer, Jeff (1985a) ‘Prosody in Alutiiq (The Koniag and Chugach dialects of Alaskan Yupik)’, in Michael Kraus (ed.) *Yupik Eskimo Prosodic Systems: Descriptive and Comparative Studies*, Alaska Native Language Center, Fairbanks.

Leer, Jeff (1985b) ‘Towards a Metrical Interpretation of Yupik Prosody’, in Michael Kraus (ed.) *Yupik Eskimo Prosodic Systems: Descriptive and Comparative Studies*, Alaska Native Language Center, Fairbanks.

Levin, Juliette (1985) ‘Evidence for Ternary Feet, and Implications for a Metrical Theory of Stress Rules’, Ms., University of Texas, Austin.

Levin , Juliette (1988) ‘Generating Ternary Feet’, *Texas Linguistic Forum* 29, 97-113.

Liberman, Mark (1975) *The intonational system of English*, Doctoral dissertation, MIT.

Liberman, Mark & Alan Prince (1977) 'On stress and linguistic rhythm' *Linguistic Inquiry* 8, 249-336.

McCarthy, John (1995) Extensions of faithfulness: Rotuman revisited, Ms., University of Massachusetts, Amherst.

McCarthy, John & Alan Prince (1986) 'Prosodic Morphology', Ms., University of Massachusetts, Amherst and Brandeis University.

McCarthy, John & Alan Prince (1993a) 'Generalized Alignment' In: Booij G.E. & J. van Marle (eds.) *Yearbook of Morphology* 1993. Kluwer, Dordrecht, 79-153.

McCarthy, John & Alan Prince (1993b) 'Prosodic Morphology I': constraint interaction and satisfaction, Ms., University of Massachusetts, Amherst & Rutgers University.

McCarthy, John & Alan Prince (1994a) 'Emergence of the Unmarked: Optimality in Prosodic Morphology. In: Gonzàlez, M. (ed.) *Proceedings of the North East Linguistic Society* 24, 333-379.

McCarthy, John & Alan Prince (1995) 'Faithfulness and reduplicative identity: In: Beckman, J. L. Walsh & S. Urbanczyk (eds.) *UMOP* 18, 249-384.

McCartney, Steven (1998) 'Finnish Stress in Optimality Theory', Ms., University of Texas, Austin.

Mehue, Chris & Gad Monim (1990) *Buyaka Obo Yoku Næi Rilime*. Universitas Cenderawasih and Summer Institute of Linguistics.

Mehue, Chris, M. Hartzler & D. Hartzler (1993) *Kamus Sentani-Indonesia-Inggris*. Summer Institute of Linguistics.

Mester, Armin (1994) 'The quantitative trochee in Latin', *Natural Language and Linguistic Theory* 12, 1-61.

Myers, Scott (1987) 'Vowel shortening in English', *Natural Language and Linguistic Theory* 5, 485-518.

Osborn, Henry (1966) 'Warao I; phonology and morphophonemics', *International Journal of American Linguistics* 32, 108-123.

Pater, Joe (1995) 'On the Nonuniformity of Weight-to-Stress and Stress Preservation effects in English', Ms., McGill University.

Paradis, Carole (1988) 'On constraints and repair strategies', *The Linguistic Review* 6, 71-97.

Payne, D.L., J.K. Payne, and J.S. Santos (1982) *Morfologia, Fonologia Y Fonetica Del Asheninca del Apurucayali*. Series Linguistica Peruana 18, Instituto Lingüístico de Verano, Yarinacocha, Pucallpa, Perú.

Payne, J.K. (1990) 'Asheninca Stress Patterns', in Doris L. Payne, ed., *Amozonian Linguistics*, University of Texas Press, Austin, 185-209.

Prince, Alan (1980) 'A metrical theory for Estonian quantity' *Linguistic Inquiry* 11, 511-562.

Prince, Alan (1983) 'Relating to the grid', *Linguistic Inquiry* 14, 19-100.

Prince, Alan (1990) 'Quantitative consequences of rhythmic organization', in Ziolkowski, M., M. Noske & K. Deaton (eds.) *Papers from the Chicago Linguistic Society* 26/2, 355-398.

Prince, Alan & Paul Smolensky (1993) 'Optimality Theory: constraint interaction in generative grammar', Ms., Rutgers University, New Brunswick & University of Colorado, Boulder.

Reynolds William (1994) *Variation and phonological theory*. Doctoral dissertation, University of Pennsylvania, Philadelphia.

Rice, Curt (1992) *Binarity and Ternarity in Metrical Theory: Parametric Extensions*. Doctoral Dissertation, University of Texas, Austin.

Rice, Curt (1993) 'A note on ternary stress in Sentani', *Working Papers in Linguistics* 17, University of Trondheim.

Schot-Saikku, P. (1992) *Basiscursus Fins 1 en 2*, Dick Coutinho, Muiderberg.

Selkirk, Elizabeth O. (1980), The role of prosodic categories in English word stress, *Linguistic Inquiry* 11, 563-605.

Selkirk, Elizabeth O. (1984) *Phonology and Syntax, The Relation between Sound and Structure*, MIT press, Cambridge, Massachusetts.

Steriade, Donca (1996) 'Paradigm uniformity and the phonetic-phonology boundary', Paper presented at the 5th Conference in Laboratory Phonology, Evanston, Illinois, July 1996.

Vijver, Ruben van de (1998) *The Iambic Issue: Iambs as the Result of Constraint Interaction*, Doctoral Dissertation, HIL, Vrije Universiteit Amsterdam.

Appendix A: Sentani

The data of Sentani are arranged according number of syllables and syllable structure. Closed syllables and syllables ending in a diphtongh are heavh, syllables ending in an open vowel, including schwa are light. For more information about the morphological structure of the data the reader is referred to the outline given in Chapter 3.

Two syllables

L L

bɛ́xo	'evil/bad'
bóhi	'next'
xóle	'he is playing'

H H

ɾàmbún	'goods'

L H

àháu	'far'

H L

ə́nde	'he will go'
jéiɲe	'you give him'
réufi	'side/half'
wéuŋe	'he tells him'

Three syllables

L L L

əlɛ́le	'he tells'
ənáte	'they all will go'
ərə́le	'I will go/he sees'
bewóle	'he resisted'
bohínə	'next to'
fomále	'we will go across'

hojə́le	'he always kills'
kitə́le	'he goes up'
moxóle	'he does'
məwále	'I have come'
məwóle	'he has come'
məxále	'I came'
nanə́mə	'all'
nəxáte	'they sit/live'
walóbo	'spirit'
xanále	'we play it'
xojə́le	'he (always) does'
xolɛ́ne	'because he is playing'

H L L

bèukóxe	'it floated'
jèufə́le	'you must give to me'
nə̀ŋhíke	'he pushed it away'
nàndólo	'current (water)'
ɾàuŋgə́le	'together with me'
ɾàuŋgóle	'he blew it'
wə̀nnə́le	'he will tell him'
xàigóxe	'they answered'
xèiɲə́hi	'you throw it away'

L H L

hapónde	'we two will kill/slaughter'
nolónne	'half'
ɾowə́ndə	'he will take'
ufə́nde	'I will talk to him'

H L H

ànnuwáu	'place'

L L H

əràmám	'food'

Four syllables

L L L L

ələ̀jə́le	'he always talks'
ənə̀tɛ́re	'they two will go'
ərànále	'I see it'
ərə̀xále	'I saw'
ahɛ̀kóxe	'he closed'
axòjóle	'it always goes down'

bahɛ̀kóxe	'it became dark'
faxògóxe	'it floated'
fomàlɛ́re	'for we will go across'
halùkóxe	'it is bailed out (from canoe)'
hoxòmə́xe	'while coming he picked/gathered'
ikòwáte	'they always play'
mahɛ̀kóxe	'he attacked blindly/blind with fury'
molòkóxe	'he made a division'
moxànále	'I do it for him'
xanàlə́be	'for we play it (game)'
bɛ̀ŋəkóxe	'he sought it'
àxəláne	'in the forest'
L L L H	
omòxojéi̯	'not do'
L L H L	
boròwánde	'we heard it'
L H L L	
alɛ̀ukóxe	'he stepped on it'
bojànnə́le	'we all always hit him'
buxùŋhíke	'he came back/returned'
fənèiŋhíke	'he smoothed it/he slipped'
fomàugóxe	'it became light'
honòiɲə́hí	'you jump on it'
honòiɲóxo	'you store it (food)'
isèigómi	'he carried knowledge over to them'
kulàibóse	'for opening'
molàigóxe	'they wrote'
moxòiɲópo	'you do for him'
moxòmmíle	'he will do/work for them'
moxònnə́le	'you all will do (it) for him'
moxònnópo	'you all will do for him'
nolònnə́na	'because half'
nalə̀ŋhíke	'he stumbled over it'
nanə̀mmə́nə	'all of it'
osèigóxe	'he is aware'
rowə̀ndɛ́re	'so that he will take'
ufə̀ndɛ́ra	'after I will talk to him'
wabèikóxe	'they two stayed late'
xəlɛ̀mmíle	'he will teach/learn them'
xalɛ̀ŋháxe	'he made him brave'

H L L L	
ɛ̀nnəhóxe	'we fastened/tied him'
ɾàuŋgolɛ́ne	'because it blew'
ànnuwáufe	'to the place'
ràisixáte	'they put down'
wànnəxóxe	'we tell him'
xàikoxáte	'they all play'
xòimejáte	'while playing they go'
L H H L	
bɛnèikónde	'they two will trade/change'
enàisónde	'they will go fighting'
hɛnàibónde	'they will build it'
hilɛ̀mbónde	'he will calm down'
xonàikónde	'they will play'

Five syllables

L L L L L	
əjə̀ləwóle	'he always talks'
ələ̀koxɛ́ne	'because he said'
ənə̀tɛrɛ́ne	'because they two will go'
ərə̀xanále	'I saw it/him'
fərə̀ŋəxóxe	'she lost her pregnancy
əjànəwáte	'they always eat'
ənàtərɛ́ne	'because they all will go'
ahùnəkóxe	'he told a parable'
həbɛ̀ləmə́xe	'he runs down/he went'
həbɛ̀ləxə́fe	'he attacked me'
halùkoxɛ́ne	'because it is bailed out (from canoe)'
haxòmibóxe	'he obeyed/followed them'
haxòropópe	'I will obey you two'
hilòŋəbóxe	'he remained the same'
ijàxawáte	'they always explain/clarify'
ikàwalɛ́re	'for that I give it to you'
isùwəwóle	'he always tells'
jaròŋəbóxe	'he is afraid of it'
jəwànəkóxə	'he drowned'
mɛkùləfáxe	'he went and collapsed'
molòŋəxóxe	'he swept/planted'
molòkoxɛ́ne	'because he made a division'
moxànalɛ́ne	'because I do it for him'
rəbɛ̀ləkóxe	'he was bruised'

xəràləfáxe	'it bloomed'
xelɛ̀ŋəbóxe	'he showed it to him'
xelɛ̀fəbóxe	'he showed to me'
xobùŋəkóxe	'he chew betelnut'
bɛ̀ŋəkoxéra	'after he sought it/looked for it'
nàləkoxále	'I felt something sharp'
wɛ̀ŋəkoxále	'I told to him'
xànəmikóxe	'he called them'
L L L H L	
ərə̀hərə́nde	'I will go and die'
jaròmaxónde	'we will take (it)'
xəlɛ̀rəhínde	'I will dig out'
xolòrəxónde	'I will lay it down orderly'
L L H L L	
xelɛ̀waimíle	'they taught them'
L H L L L	
akòibojóle	'it always goes down'
bulèiɲəxóxe	'they always mock at him'
fəlèifixále	'I tasted (it)'
hɛrèijəgóxe	'he spread it'
hərèijɛwə́xe	'he sowed'
hajèiɲəkóxe	'they let him go'
hawàimijə́xe	'they went tell them'
isèijəkóxe	'he carried knowledge over'
jaròibojóŋe	'he is always afraid'
jawɛ̀nnəhópe	'you two will be taken by him'
moxàiɲəxóxe	'they did it for him'
moxòiməjə́le	'he always does do (it) for us two'
moxòmmilɛ́re	'for he will do/work for them'
moxònnəbópe	'you two will do it for him'
moxònnəmə́le	'he will do it for us'
nahɛ̀ŋxoxále	'I turned it around'
ojèibojáte	'they always have a quarrel'
ɾəlèiɲəxóxe	'they suffered from it'
ɾoràikoxáte	'they are having a war'
H L L L L	
jɛ̀ndəboxɛ́ra	'after we became better (after being ill)'

L H H L L	
bɛnèikondɛ́re	'so that they two will trade/change'
fənèiyuŋhíke	'he slipped on it'
hɛnàibondɛ́re	'for they will build it'
hilɛ̀mbondɛ́re	'for he (will) calm(s) down'
rowə̀mməmbéna	'if you (will) bring it here'
uŋàibondɛ́re	'so that they will prepare'
xonàikondéna	'because they played'
L L H H L	
əmə̀ləŋgómbe	'you all will go will tell'
jaxàrəmbónde	'I will clarify'
məmànɛŋgónde	'we all will come and eat it'
moxòmambónde	'we all will do/make for you all'
moxòrəmbónde	'I will do/make for you all'
orùləmbónde	'we will enter'
L H H H L	
ənàijɛmbónde	'they all will go for you two'
nobɛ̀nnɛŋgónde	'he will come near to it'
L H L H L	
alɛ̀nnəxónde	'he gives a massage with his feet'
molònnəbónde	'he will greet him'
moxònsəbónde	'he will do/make for me'

Six syllables

L L L L L	
əxànəxəwále	'I started living, dwelling on'
əjə̀rəwamɛ́le	'I always see them'
ahùnəŋəbóxe	'he accused him'
ahùnəgoxéra	'after he tied together
fərə̀ŋəxoxɛ́be	'after she lost her pregnancy
həràwəŋəbóxe	'he suppressed it'
həràwəmikále	'I pushed us two down'
hilòŋəboxɛ́ne	'because he remained the same'
himàloŋəbóxe	'he straightened it out'
jalɛ̀ŋəboxále	'I have improved it'
məxànəxəwále	'I came and lived here'
məxɛ̀nəxəwójɛ	'you came and lived here'
molòkoxawále	'I wrote to you'
moxòyəgoxéte	'they two did it for you'
ɾəlɛ̀ŋəxoxále	'I set it on fire'

L L L L H L	
ikìləmaxónde	'we will catch/capture (many)'
molònasəhánde	'they all will bury me'
moxòrəmibónde	'I will do it for them'
kìɲənàsəbónde	'they all will hand me over'
L L L H L L	
xəlɛ̀rəhindɛ́re	'for I will dig out'
xolòrəxondɛ́re	'so that I will lay it down orderly'
L L H L L L	
bulɛ̀rɛnnəbópe	'you two will be released by him'
enàsondərɛ́ne	'because they will go fighting'
hàbəlèiməjə́le	'he runs-he comes'
L H L L L L L	
ələ̀mboxamále	'I chose you all'
əxàimoxowàte	'they went and worked/did'
bulèiɲəxoxɛ́be	'they always mock at him'
hinèumiboxéra	'so that he honoured them'
isèijəkoxɛ́ne	'because he carried knowledge 0ver'
məxàiɲəxəwáte	'they came and lived here'
moxàiɲəxoxɛ́ne	'because they did (it) for him'
moxòipojanále	'I aways do it for him'
ɾijèumihikále	'I asked them'
xəlɛ̀mmilərɛ́ne	'because he will teach/learn them'
H L L L L L	
èisənànəwóle	'he always refuses'
fèiɲəbòxawále	'I washed you'
L L L H H L	
əhə̀raweibói̯ɲe	'because not suppressed'
əmàjaroŋgónde	'we will go and take (it)'
ahùnəmambóndə	'we will accuse him'
həbɛ̀lənaikónde	'they will chase'
ikìlɛnàibónde	'they all will capture (him)'
ikìlənaijɛ́mbe	'they will capture you'
moxònəjɛ̀mbómbe	'they two will do it for you all'
orùləmambónde	'we will be submitted'

L L H H L L

jaxàrəmbondɛ́re	'for I will clarify'
hàrənàikondɛ́re	'for they will laugh'
kìɲənàijɛmbómbe	'we will hand you all over'

L H H L L L

fənèijuŋhikɛ́ne	'because he slipped on it'
hərèijeikojáte	'they all always fall'

L H L H L L

alɛ̀nnəxondɛ́re	'so that he gives a massage with his feet'

L H H H L L

nobɛ̀nnɛŋgondɛ́re	'for he will come near to it'

L H H L H L

hərèijəmmijə́mbe	'you all will spread around for them'
xəlèijəŋgoxə́mbe	'you all taught you all (yourself)'

L H L L H L

məxànnəxəwánde	'we all came and lived here'
məxàunəxəwáuge	'you all came and lived here'

L L H L H L

moxòjɛmboxə́mbe	'they two did it for you all'
moxàjɛmboxə́mbe	'we all did it for you all'

Seven syllables

L L L L L L L

molòkoxàwalɛ́ne	'because I wrote to you'
ɾəlɛ̀ŋəxòxalébe	'for I set it on fire'
xəlàrəmìkoxále	'I separated them'

L L L L H H L

ənàsəmòlonsánde	'they will go and bury me'
ikìlənàijɛŋgómbe	'we will capture you all'

L L L L H L L

molònasəhàndéra	'after they will bury me'
xànərəmìjəndɛ́re	'for I can go call them'

L H L L L L L

moxònnəbòpərɛ́ne	'because you two will do it for him'

L L L H H L L ikìlənàijɛmbɛ́ne	'because they will capture you'
L L H H L L L ənàijɛmbòndərɛ́na	'because they all will go for you two'
L H L L H L L əxàikɛləwàimíle	'they went and taught them'
L H L H L L L molònnəbòndərɛ́na	'because he will greet him'

Appendix B: Finnish

The data of Finnish are arranged according number of syllables and syllable structure, where CV is light, all other syllables are heavy, i.e. CVC, CVV, CVVC, CVCC. When there is variation, the left column is the 'phonological' stress pattern and the right column is the 'morphological' stress pattern. Since stress is always on the first syllable and since the second syllable never receives stress, the first and second syllable are represented as X́ X. For an overview of the case markers and possessive suffixes, the reader is referred to Chapter 5.

Two syllables

H L

kénkä	'shoe (Nom)'
púuni	'tree (Nom 1SG)'
púusta	'tree (Elat)
mä́kä	'hill (Nom)'

H H

kéngät	'shoes (Nom)'
púiden	'tree (Gen)'

Three syllables

X X L

kénkänä	'shoe (Ess)'
mä́kinä	'hill (Ess)'
périjä	'inheritor (Nom)'
púultani	'tress (Abl 1SG)'

X X L

káupunki	'capital (Nom)'
kéngältä	'shoe (Abl)'
púultansa	'tree (Abl 3SG)'
rä́jähde	'explosive (Nom)'

X X H

ávaimèt		'keys (Nom)'
káupungìt		'capitals (Nom)'
káupunkìen		'capitals (Gen)'
kúningàs	kúningas	'king (Nom)'
périjä̀t		'inheritors (Nom)'
tárjotìn	tárjotin	'tray (Nom)'

Four syllables

X X L L

áterìa	'meal (Nom)'
hámmastàni	'toot (Part 1SG)'
káupunkèja	'capitals (Part)'
káupunkìna	'capitals (Ess)'
kénkänä̀ni	'shoe (Ess !SG)'
mä́kinä̀ni	'hill (Ess 1SG)'
mérkonòmi	'degree in economics (Nom)'
périjä̀nä	'inheritor (Ess)'
pýrkyrìä	'careerist (Part)'
pýrkyrìni	'careerist (Nom 1SG)
rávintòla	'restaurant (Nom)'
répeä̀mä	'crack, rupture (Nom)'

X X H L

ávaimèeni	'key (Ill 1SG)'
hámmastànne	'tooth (Part 2PL)'
jä́rjestèlmä	'system (Nom)'
káupungìssa	'capital (Iness)'
káupunkìnne	'capital (Nom 2PL)'
kénkänä̀mme	'shoe (Ess 2PL)'
kúninkàani	'king (Nom 1SG)'
kúninkàansa	'king (Nom 3SG)
mä́kinä̀mme	'hill (Ess 1PL)'
óhjelmòinti	'programming (Nom)'
périjä̀nsä	'inheritor (Nom 3SG)'
périjä̀sta	'inheritor (Elat)
púhelìnta	'telephone (Part)'
pýrkyrìnsä	'careerist (Nom 3SG)'
pýrkyrìstä	'careerist (Elat)'
tárjotìnta	'tray (Part)'

X X L H

áteriàa		'meal (Part)'
kúnnallinèn	kúnnallìnen	'council (Nom)'
kúnnallisèen		'council (Ill)'
lä́hettilä̀s		'envoy (Nom)'
mérkonomìn	mérkonòmin	'degree in economics (Gen)'
púhelimèt		'telephones (Nom)'
rávintolàt	rávintòlat	'restaurants (Nom)'

X X H H

jä́rjestèlmää		'system (Part)'
jä́rjestèlmät		'systems (Nom)'
kúnnallìsten		'councils (Gen)'
óhjelmòintiin		'programming (Ill)'
périjö̀itten		'inheritors (Gen)'
púhelìnten		'telephone (Gen)'
síirtolàinen		'emigrant (Nom)'
síirtolàiset		'emigrants (Nom)'
súkulàinen		'relative (Nom)'
tárjotìnten		'trays (Gen)'

Five syllables

X X L L L

áterìani	áteriàni	'meal (Nom 1SG)'
áterìana	áteriàna	'meal (Ess)
ávaimìnani	ávaiminàni	'keys (Ess 1SG)'
érgonòmia		'ergonomics (Nom)'
káinostèlija		'a shy person (Nom)'
káupunkìani	káupunkiàni	'capital (Part 1SG)'
káupunkìnani	káupunkinàni	'capital (Ess 1SG)
kúnnallìsena	kúnnallisèna	'council (Ess)'
kúnnallìseni	kúnnallisèni	'council (Nom 1SG)
kúnnallìsia		'council(Part)
kúnnallìsina	kúnnallisìna	'councils (Ess)'
mérkonòmia		'degree in economics (Part)'
mérkonòmina		'degree in economics (Ess)
mérkonòmini		'degree in economics (Nom 1SG)
ópiskèlija		'student (Nom)'
périjä̀näni	périjänä̀ni	'inheritor (Ess 1SG)'
púhelìmena	púhelimèna	'telephone (Ess)'
púhelìmeni	púhelimèni	'telephone (Nom 1SG)'
púhelìmina	púhelimìna	'telephones (Ess)'
rávintòlana	rávintolàna	'restaurant (Ess)'

rávintòlani	rávintolàni	'restaurant (Nom 1SG)
tárjottìmena	tárjottimèna	'tray (Ess)'
tárjottìmina	tárjottimìna	'trays (Ess)'

X X L H L

áteriàksi		'meal (Transl)'
áteriàsta		meal (Elat)
ávaimenànsa		'key (Ess 3SG)'
ávaimiànne		'keys (Part 2PL)'
káupunkiàmme	káupunkìamme	'capital (Part 1PL)'
kúnnallisèlla		'council (Adess)'
kúnnallisèmme		'council (Nom 1PL)
lä́hettilä̀stä		'envoy (Elat)
mátematìikka		'mathematics (Nom)'
mérkonomìlla		'degree in economics (Adess)'
mérkonomìnne		'degree in economics (Nom 2PL)
périjänä̀mme	périjä̀nämme	'inheritor (Ess 2PL)'
púhelimèlle		'degree in economics(All)'
púhelimènsa		'degree in economics (Nom 3SG)
púhelimèsta		'degree in economics (Elat 3SG)
pýrkyriä̀mme		'careerist (Part 1PL)'
rávintolàlla		'restaurant (Adess)'
rávintolànsa		'restaurant (Nom 3SG)
tárjottimèlta		'tray (All)'
tárjottimèmme		'tray (Nom 1PL)

X X H L L

ávaimìstani		'keys (Elat 1SG)'
énsimmä̀isenä		'punishment (Ess)'
jä́rjestèlmänä		'system (Ess)'
káupungìllani		'capital (Adess 1SG)'
kúninkàakseni		'king (Transl 1SG)'
kúninkàanani		'king (Ess 1SG)'
kúnnallìstani		'council (Part 1SG)'
óhjelmòintia		'programming (Part)'
óhjelmòintina		'programming (Ess)
pákinòitsija		'columnist (Nom)'
périjä̀stäni		'inheritor (Elat 1SG)'
púhelìntani		'telephone (Part 1SG)'
síirtolàiseni		'emigrant (Nom 1SG)'
súkulàisena		'relative (Ess)'
súkulàistani		'relative (Part 1SG)

X X H H L

ávaimìstansa	ávaimistànsa	'keys (Elat 3SG)'
ávaimèstamme	ávaimestàmme	'key (Part 1PL)'
énsimmä̀isella		'first (Adess)'
jä́rjestèlmäksi		'system (Transl)'
jä́rjestèlmänsä		'system (Nom 3SG)'
káupungèissanne		'capitals (Iness 2PL)'
káupungìllansa		capital (Adess 3SG)'
kúninkàaksenne	kúninkaaksènne	'king (Transl 2PL)'
kúninkàanansa		'king (Ess 3SG)'
kúnnallìstamme	kúnnallistàmme	'council (Part 1PL)'
kúnnallìstansa	kúnnallistànsa	'council (Part 3SG)'
óhjelmòinnissa	óhjelmoinnìssa	'programming (Iness)'
óhjelmòintiinne	óhjelmointìinne	'programming (Ill 2PL)'
périjä̀stänne	périjästä̀nne	'inheritor (Elat 2PL)'
púhelìntamme	púhelintàmme	'inheritor (Part 1PL)'
síirtolàisemme	síirtolaisèmme	'emigrant (Nom 1PL)'
síirtolàisensa		'emigrant (Nom 3SG)'
súkulàisella	súkulaisèlla	'relative (Adess)'
súkulàisenne	súkulaisènne	'relative (Nom 2PL)'
súkulàisista	súkulaisìsta	'relatives (Elat)'

X X L L H

érgonòmiàt	érgonòmiat	'ergonomics (Nom plural)'
káinostèlijàt	káinostèlijat	'shy people (Nom)'
ópiskèlijàa		'student (Part)'
ópiskèlijàan		'student (Ill)'

X X L H H

áteriòiden		'meals (Gen)'
mátematìikat		'mathematics (Nom plural)'
mátematìikkaa		'mathematics (Nom singular)'
páimentolàinen		'nomad (Nom)'
páimentolàisen		'nomad (Gen)'
rávintolòihin		'restaurants (Ill)'
rávintolòitten		'restaurants (Gen)'

X X H L H

pákinòitsijàan		'columnist (Ill)'
pákinòitsijàt		'columnists (Nom)

Six syllables

X X L L L L

áterìanàni	áteriànani	'meal (Ess 1SG)'
érgonòmiàna		'ergonomics (Ess)'
káinostèlijàna		'shy person (Ess)'
káinostèlijàni		'shy person (Nom 1SG)'
kúnnallìsenàni	kúnnallisènani	'council (Ess 1SG)'
kúnnallìsiàni		'councils (Part 1SG)'
kúnnallìsinàni	kúnnallisìnani	'councils (Ess 1SG)'
mérkonòmiàni		'degree in economics (Part 1SG)'
mérkonòminàni		'degree in economics (Ess 1SG)'
ópiskèlijàni		'student (Nom 1SG)'
púhelìmenàni	púhelimènani	'telephone (Ess 1SG)'
púhelìmiàni		'telephone (Part 1SG)'
púhelìminàni		'telephone (Ess 1SG)'
rávintòlanàni	rávintolànani	'restaurant (Ess 1SG)'
tárjottìmenàni	tárjottimènani	'tray (Ess 1SG)'
tárjottìmiàni		'trays (Part 1SG)'
tárjottìminàni		'trays (Ess 1SG)'

X X L L H L

áterìanànsa	áteriànansa	'meal (Ess 3SG)'
érgonòmiàssa		'ergonomics (Iness)'
káinostèlijàksi		'shy person (Transl)'
káinostèlijànsa		'shy person (Nom 3SG)'
kúnnallìsenànsa	kúnnallisènansa	'council (Ess 3SG)'
kúnnallìsiànsa		'councils (Part 3SG)'
kúnnallìsinànsa	kúnnallisìnansa	'councils (Ess 3SG)'
mérkonòmiàmme		'degree in economics (Part 1PL)'
mérkonòminàmme		'degree in economics (Ess 1PL)'
ópiskèlijànsa		'student (Nom 3SG)'
ópiskèlijàksi		'student (Transl)'
púhelìmenàmme	púhelimènamme	'telephone (Ess 1PL)'
ràkastàjatàrta		'mistress (Part)'
rávintòlanàmme	rávintolànamme	'restaurant (Ess 1PL)'
tárjottìmenànne	tárjottimènanne	'tray (Ess 2PL)'
tárjottìmiànsa		'trays (Part 3SG)'
tárjottìminànsa		'trays (Ess 3SG)'

X X L H L L

áteriàstani		'meal (Elat 1SG)'
kúnnallisìstani		'council (Elat 1SG)'
mátematìikkani		'mathematics (Nom 1SG)'
mérkonomèissani		'degree in economics (Iness 1SG)'

mérkonomìkseni	'degree in ecomomics (Transl-1PL)'
páimentolàisena	'nomdad (Ess)'
páimentolàiseni	'nomad (Nom 1SG)'
páimentolàistani	'nomad (Part 1SG)'
púhelimèltani	'telephone (Abl 1SG)'
púhelimèstani	'telephone (Elat 1SG)'
rávintolàssani	'restaurant (Iness 1SG)'
tárjottimèkseni	'tray (Transl 1SG)'

X X L H H L

áteriàstanne	'meal (Elat 2PL)'
kúnnallisìstamme	'councils (Elat 1PL)'
mátematìikkaamme	'mathematics (Part 1PL)'
mátematìikkaani	'mathematics (Part 1SG)'
mátematìikkansa	'mathematics (Nom 3SG)'
páimentolàisella	'nomad (Adess)'
páimentolàisemme	'nomad (Nom 1PL)'
púhelimèstansa	'telephone (Elat 3SG)'
rávintolòitamme	'restaurants (Part 1PL)'
tárjottimèksensa	'tray (Transl 3SG)'

X X H L L L

énsimmä̀isenä̀ni	'first (Ess 1SG)'
óhjelmòintiàni	'programming (Part 1SG)'
pákinòitsijàna	'columnist (Ess)'
rángaistùksenàni	'punishment (Ess 1SG)'
rángaistùksinàni	'punishments (Ess 1SG)'
síirtolàisiàni	'emigrants (Part 1SG)'
váatimàttomàna	'modest (Ess)'

X X H L H L

óhjelmòintiànsa	'programming (Part 3SG)'
pákinòitsijàansa	'columnist (Part 3SG)'
pákinòitsijàlta	'columnist (Abl)'
síirtolàisiànsa	'emigrants (Part SG)'
súkulàisinànne	'relatives (Ess 2PL)'
váatimàttomàani	'modest (Ill 1SG)'
váatimàttomàansa	'modest (Ill 3SG)'
váatimàttomàlta	'modest (Abl)'

X X H H L L

énsimmä̀iseltä̀ni	'first (Abl 1SG)'
jä́rjestèlmällèni	'system (All 1SG)'
jä́rjestèlmistä̀ni	'systems (Ess 1SG)'

óhjelmòinnistàni		'programming (Elat 1SG)'
rángaistùksessàni		'punishment (Iness 1SG)'
súkulàisellàni	súkulaisèllani	'relative (Adess 1SG)'

X X H H H L

énsimmä̀iseltä̀nne		'first (Abl 2PL)'
jä̀rjestèlmällènne		'system (All 2PL)'
jä́rjestèlmistä̀nne		'systems (Ess 2PL)'
óhjelmòinnistànsa		'programming (Elat 3SG)'
rángaistùksessànsa		'punishment (Iness 3SG)'
súkulàisellànsa	súkulaisèllansa	'relative (Adess 3SG)'

X X L H L H

rákastajàttarèen		'mistress (Ill)'
rákastajàttaret		'mistresses (Nom)'

X X L L H H

érgonòmiòiden		'ergonomics (Gen plural)'
káinostèlijòitten		'shy people (Gen)'
ópiskèlijòiden		'students (Gen)'

X X H L H H

pákinòitsijòiden		'columnists (Gen)'
pákinòitsijòihin		'columnists (Ill)'

Seven syllables

X X L L L L L

érgonòmiànani	érgonòmianàni	'ergonomics (Ess 1SG)'
káinostèlijànani		'shy person (Ess 1SG)'
ópiskèlijànani	ópiskèlijanàni	'student (Ess 1SG)'

X X L L L H L

érgonòmiànansa	érgonòmianànsa	'ergonomics (Ess 3SG)'
káinostèlijànanne	káinostèlijanànne	'shy person (Ess 2PL)'
ópiskèlijànamme	ópiskèlijanàmme	'student (Ess 1PL)'

X X L L H L L

érgonòmiàlleni		'ergonomics (All 1SG)'
káinostèlijàstani		'shy person (Elat 1SG)'
ópiskèlijàllani		'student (Adess 1SG)'
rákastàjatàrtani		'mistress (Part 1SG)'

X X L L H H L

érgonòmiàllenne	'ergonomics (All 2PL)'
káinostèlijàstansa	'shy person (Elat 3SG)'
ópiskèlijàllamme	'student (Adess 1PL)'
rákastàjatàrtansa	'mistress (Part 3SG)'

X X L H H L L

mátematìikassàni	'mathematics (Ill 1SG)'
páimentolàiseksèni	'nomad (Transl 1SG)'
páimentolàisillàni	nomads (Adess 1SG)'

X X L H H H L

mátematìikassànne	'mathematics (Ill 2PL)'
páimentolàiseksènne	'nomad (Transl 2PL)'
páimentolàisillàmme	'nomads (Adess-PL-1PL)'

X X L H L L L

mátematìikkanàni	'mathematics (Ess 1SG)'
páimentolàisiàni	'nomads (Part 1SG)'
rákastajàttarèna	'mistress (Ess)'
rákastajàttarèni	'mistress (Nom 1SG)'

X X L H L H L

mátematìikkanànne	'mathematics (Ess 2PL)'
páimentolàisiànsa	'nomads (Part 3SG)'
rákastajàttarèlta	'mistress (Abl)'
rákastajàttarìssa	'mistress (Iness)'

X X H L H L L

pákinòitsijàlleni	'columnist (All 1SG)'
pákinòitsijòitani	'columnists (Part 1SG)'
váatimàttomàkseni	'modest (Transl 1SG)'

X X H L H H L

pákinòitsijàllemme	'columnist (All 1PL)'
pákinòitsijòittenne	'columnists (Gen 2PL)'
váatimàttomàksenne	'modest (Transl 3SG)'

X X H L L L L

pákinòitsijànani	pákinòitsijanàni	'columnist (Ess 1SG)'
váatimàttomànani	váatimàttomanàni	'modest (Ess 1SG)'
váattimàttomìani	váatimàttomiàni	'modest (Part 1SG plural)'
váatimàttomìnani	váattimàttominàni	'modest (Ess 1SG plural)'

X X H L L H L

pákinòitsijanànne	pákinòitsijànanne	'columnist (Ess 2PL)'
váatimàttomanàmme	váatimàttomànamme	'modest (Ess 1PL)'
váatimàttomiànsa		'modest (Part-PL-3SG)'
váatimàttominànsa		'modest (Ess 3SG)'

Eight syllables

X X L H L L L L

rákastajàttarènani	rákastajàttarenàni	'mistress (Ess 1SG)'
rákastajàttarìani	rákastajàttariàni	'mistresses (Part 1SG)'

X X L H L L H L

rákastajàttariànsa		'mistresses (Part 3SG)'
rákastajàttarenànsa		'mistress (Ess 3SG)'

X X L H L H L L

rákastajàttarèstani		'mistress (Elat 1SG)'

X X L H L H H L

rákastajàttarèstanne	rákastajàttarestànne	'mistress (Elat 2PL)'

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Nederlandse samenvatting
(Summary in Dutch)

Veel talen kennen het verschijnsel klemtoon. Dit boek concentreert zich op talen met een gebonden klemtoonsysteem. Dit zijn klemtoonsystemen waar klemtoon op een beperkte afstand van de woordgrens of een andere beklemtoonde lettergreep ligt. Binnen gebonden klemtoonsystemen kunnen twee groepen onderscheiden worden. In de eerste plaats de binaire klemtoonsystemen. In deze systemen ligt klemtoon op iedere tweede lettergreep vanaf de woordgrens of een andere beklemtoonde lettergreep [σ́σσ́σσ́σ]. De andere groep gebonden klemtoonsystemen zijn ternaire klemtoonsystemen. In deze systemen ligt klemtoon op iedere derde lettergreep van de woordgrens of een andere beklemtoonde lettergreep [σ́σσσ́σσσ́σσ].

Veruit de meeste talen met een gebonden klemtoonsysteem hebben een binair systeem. Het Pintupi, een Australische taal, en Warao, een Venezuelaanse taal, zijn voorbeelden van talen met een dergelijk binair systeem. Slechts een kleine hoeveelheid talen lijkt een ternair systeem te hebben, waaronder het Cayuvava, een Boliviaanse taal, en het Chugach, een dialect van het Yupik, gesproken in Alaska.

Doel van deze dissertatie is het op unificerende wijze analyseren van beide typen gebonden klemtoonsystemen. Daar de meeste gebonden klemtoonsystemen binair zijn, ligt de nadruk binnen de metrische theorie op de analyse van deze systemen. Binnen deze analyses ligt de nadruk op het groeperen van woorden in binaire metrische voeten, de jambe (σσ́) en de trochee (σ́σ). In dit boek wordt aangetoond dat het, in tegenstelling tot eerdere voorstellen, niet nodig is om de metrische theorie uit te breiden met middelen die specifiek als doel hebben het analyseren van ternaire klemtoonsystemen.

Een voorbeeld van een dergelijke ternariteit specifieke oplossing is het uitbreiden van de voettypologie met ternaire voeten, zoals de amfibrachys [(σσ́σ)] als voorgesteld door Halle & Vergnaud (1987), of een intern gestructureerde voet [([σ́σ]σ)], zoals is voorgesteld door, onder andere, Dresher & Lahiri (1991). Een andere oplossing is het gebruik van slechts binaire metrische voeten, en deze gepaard laten gaan met een speciale manier om lettergrepen in die binaire voeten te groeperen. Zo kan een woord in binaire voeten worden gegroepeerd, terwijl er tussen iedere voet een losse lettergreep moet zitten [(σ́σ)σ(σ́σ)σ]. Dit is voorgesteld door Hammond (1994), Kager (1994) en Hayes (1995).

Het zal blijken dat deze oplossingen niet nodig zijn, sterker nog, ze zijn ongewenst, daar zij geen verdere onafhankelijke evidentie hebben. De enige motivatie voor deze oplossingen is het analyseren van de ternaire systemen.

Aangetoond zal worden dat de bestanddelen die worden gebruikt voor de analyse van binaire klemtoonsystemen ook kunnen worden gebruikt voor de analyse van ternaire systemen. Hierbij wordt gebruik gemaakt van ‘Optimaliteitstheorie’ (Prince & Smolensky 1993).

In Optimaliteitstheory worden verschillende mogelijke oppervlakte vormen, in dit geval de klemtoonpatronen, geëvalueerd door universeel geldende condities, dat wil zeggen dat deze condities voor alle talen gelden. Deze condities zijn echter per taal gerangschikt naar belangrijkheid. De belangrijkste conditie, waaraan altijd moet worden voldaan, staat bovenaan, de mindere belangrijke condities, welke geschonden mogen worden om aan belangrijkere condities te kunnen voldoen, staan onderaan (Conditie a » Conditie b » … » Conditie n). De verschillen tussen talen zijn het gevolg van de taalspecifieke rangschikking van deze condities.

Binnen binaire systemen is het niet altijd het geval dat het klemtoonpatroon strikt binair is. Verschillende condities kunnen dermate hoog gerangschikt staan, dat ondanks de voorkeur voor een binair patroon in deze systemen, de oppervlaktevorm incidenteel een lokaal ternair patroon heeft. Bijvoorbeeld, in een woord worden lettergrepen gegroepeerd in één van twee typen binaire metrische voeten. De ene type voet is de jambe. In de jambe ligt het hoofd van de voet, dat wil zeggen de beklemtoonde lettergreep, rechts ($\sigma\acute{\sigma}$). In de trochee, de ander type metrische voet, ligt het hoofd van de voet links ($\acute{\sigma}\sigma$). Over het algemeen worden binnen gebonden klemtoonsystemen metrische voeten die kleiner zijn dan twee lettergrepen (subminimale voeten) vermeden. Indien een woord bestaat uit een oneven aantal lettergrepen kan dit plaatselijk aan de rand van het woord een ternair patroon tot gevolg hebben, zoals bijvoorbeeld in het Pintupi. In het Pintupi is het systeem in principe binair. Wanneer, na het van links naar rechts groeperen van de lettergrepen in trocheeën, aan de rechterzijde van het woord één lettergreep overblijft, verschijnt daar, als gevolg van het vermijden van subminimale voeten, een ternair patroon $[(\acute{\sigma}\sigma)(\grave{\sigma}\sigma)(\underline{\grave{\sigma}\sigma)\sigma}]$.

Een tweede factor die een ternair patroon tot gevolg kan hebben is zwaartegevoeligheid. Niet alle lettergrepen in een taal hebben dezelfde opbouw. Sommige lettergrepen bestaan slechts uit een klinker (V), eventueel voorafgegaan door een medeklinker (C), dus (CV). Andere lettergrepen hebben meer klinkers (CVV), en/of één of meer medeklinkers aan het eind van de lettergreep (CVC, CVVC, CVCC, CVVCC). Talen waar het verschil in lettergrepen van invloed is op klemtoontoekenning worden zwaartegevoelig genoemd. Grofweg maken talen onderscheid tussen CV lettergrepen, die licht zijn, versus de andere lettergrepen, die zwaar zijn. Zware lettergrepen trekken klemtoon aan, en dit kan ten koste gaan van klemtoon op de lichte lettergrepen. In het Fins ligt hoofdklemtoon op de eerste lettergreep, en bijklemtoon op ieder tweede lettergreep naar rechts $[\acute{\sigma}\sigma\grave{\sigma}\sigma\grave{\sigma}\sigma]$. Echter, wanneer zo’n tweede lettergreep licht is (L) en onmiddellijk gevolgd wordt door een zware lettergreep (H), dan wordt deze zware lettergreep beklemtoond en niet de lichte lettergreep, met een woordintern ternair patroon als gevolg $[(\underline{\acute{L}L)L(\grave{H}}L)L]$.

Een derde factor heeft te maken met condities die eisen dat de grens van de metrische voeten en die van de woorden samenvallen. In Garawa, bijvoorbeeld, strijden twee van dergelijk eisen met elkaar. Enerzijds is er in het Garawa een conditie hoog gerangschikt, die eist dat het woord begint met een voet. Anderzijds is er een conditie, die eist dat alle voeten zo ver mogelijk naar rechts in het woord moeten staan. In woorden met een oneven aantal lettergrepen zien we dat het resultaat van de wisselwerking van deze twee condities is dat er een woordintern ternair patroon ontstaat [(σ́σ)σ(σ̀σ)(σ̀σ)]. Enerzijds begint het woord met een voet, maar anderzijds staan de overige twee voeten allebei zoveel mogelijk rechts in het woord.

Een vierde factor is het vermijden van klemtoon op aangrenzende lettergrepen. Wanneer twee aangrenzende lettergrepen beklemtoond zijn, spreken we van een ritmische clash [σ̀σ́]. Een ritmische clash kan ontstaan wanneer een taal zwaartegevoelig is, en de twee aangrenzende zware lettergrepen worden beklemtoond [(H́)(H̀)]. Maar vaak wordt een clash vermeden. Zo ook in het Manam. Het Manam is een zwaartegevoelig systeem dat gebruikt maakt van trocheeën. Wanneer het groeperen van de lettergrepen in trocheeën, en het beklemtonen van zware lettergrepen zou resulteren in een clash, krijgt één van de twee betrokken lettergrepen geen klemtoon, wat kan leiden tot een ternair patroon. In het Manam vinden we dus niet *[(H̀)(ĹL)], maar [(H́)LL], met een ternair patroon op het woordeinde.

Zo zijn er meer verschillende condities op te sommen die door hun hoge rangschikking, al dan niet in combinatie met andere condities, een ternair patroon tot gevolg kunnen hebben, zonder dat deze condities zelf direct ternariteit eisen. Wanneer we kijken naar woorden met een even aantal lettergrepen, bijvoorbeeld een woord met zes lettergrepen, dan zien we dat minstens één conditie die resulteert in een ternair patroon, zwaarder weegt, dat wil zeggen hoger gerangschikt staan, dan de conditie die eist dat alle lettergrepen in metrische voeten moeten worden gegroepeerd. Een woord met zes lettergrepen en een ternair patroon heeft slecht twee binaire voeten, terwijl in principe drie binaire voeten mogelijk zijn, zie bijvoorbeeld het voorbeeld uit het Fins hierboven, of het Sentani waar woorden met zes lettergrepen het volgende patroon hebben: [(σσ̀)σσ(σ́σ)].

De lage rangschikking van de groeperingsconditie zou, in principe, tot gevolg kunnen hebben het optimale klemtoonpatroon een patroon is waarin de afstand tussen twee beklemtoonde lettergrepen drie onbeklemtoonde lettergrepen is. Dit is een ritmische 'lapse', en ongewenst binnen gebonden klemtoonsystemen. In het Sentani staat de groeperingsconditie inderdaad zo laag in de rangschikking dat een patroon zou kunnen worden geselecteerd met een dergelijk ongewenst patroon. Dit zou, tot gevolg kunnen hebben dat een patroon als [(molò)nasəhan(déra)] 'nadat zij mij hebben begraven' gekozen zou kunnen worden, terwijl het echte patroon [(molò)na(səhàn)(déra)] is. Er moet dus een anti-lapse conditie zijn, die boven de ternariteit-bevorderende condities staat, en als resultaat heeft dat de rangschikking het gewenste patroon selecteert.

In Hoofdstuk 1 zien we twee voorbeelden uit de literatuur van dergelijke anti-lapse condities, namelijk PARSE-2 (Kager 1994) en LAPSE (Green & Kenstowicz 1995). Aangetoond wordt dat de formuleringen van deze condities problematisch zijn. Deze anti-lapse condities verwijzen naar het in metrische voeten groeperen van lettergrepen, namelijk van ieder twee onbeklemtoonde lettergrepen moet er ten minste één in metrische voet staan, dus [(σ́σ)σ(σ́σ)] is goed, maar [(σ́σ)σσ(σ́σ)] is fout. Op deze manier wordt een ternair patroon toegestaan, maar een patroon met drie onbeklemtoonde lettergrepen naast elkaar wordt niet toegestaan. Echter, volgens deze condities is [(σ́σ)σ(σσ́)] ook goed, terwijl [(σσ́)σσ(σ́σ)] fout is. In het eerste voorbeeld staan drie onbeklemtoonde lettergrepen op een rij staan, en dit wordt binnen de metrische theorie gezien beschouwd als een metrische lapse (Selkirk 1984), terwijl in het tweede voorbeeld, wat volgens de anti-lapse condities fout is, er slechts twee onbeklemtoonde lettergrepen naast elkaar staan. Deze 'mismatch' is het gevolg van het feit dat bij de formulering van de anti-lapse condities door Kager en Green& Kenstowicz geen rekening is gehouden met het feit dat er in een taal twee verschillende metrische voeten mogen voorkomen, namelijk een jambe én een trochee. Dit is echter precies wat we vinden in het Sentani: [(molò)koxa(wále)] 'ik schrijf naar jou'.

Ik beargumenteer dat de anti-lapse conditie een ritmische conditie moet zijn, die verwijst naar de afwisseling van sterke en zware lettergrepen, zonder enige uitspraak te doen over het al dan niet in een voet staan van de lettergrepen. De formulering die ik voorstel is dat een zwakke (dat wil zeggen onbeklemtoonde) lettergreep naast een sterke (beklemtoonde) lettergreep moet staan, of naast een woordgrens. Dus in [(molò)koxa(wále)] staat de zwakke lettergreep /*ko*/ naast de sterke lettergreep /*lo*/, en staat de zwakke lettergreep /*xa*/ naast de sterke lettergreep /*wa*/. Deze anti-lapse conditie speelt een belangrijke rol in de analyse van ternaire systemen.

In Hoofdstuk 2 wordt verder ingegaan op de theoretische aspecten binnen de metrische theorie, de fonologie in het algemeen en Optimaliteitstheorie. Zo wordt een overzicht gegeven van de metrische representaties en een overzicht van eerdere analyses van ternaire systemen. Tevens vinden we in Hoofdstuk 2, een samenvatting van de Optimaliteitstheorie, en een korte samenvatting van verschillende subtheorieën binnen Optimaliteitstheorie, waaronder Correspondentietheorie. Verder wordt, in verband met de analyse van het Fins, ingegaan op verschillende voorstellen over hoe Optimaliteitstheorie omgaat met variatie in een taal. In het Fins vinden we namelijk dat bepaalde woorden twee mogelijke klemtoonpatronen hebben.

Het argument dat het mogelijk is om met dezelfde middelen binaire en ternaire klemtoonsystemen te analyseren wordt gesteund door de analyses van, onder andere, de klemtoonsystemen van het Sentani en het Fins. Beide talen hebben een binair klemtoonsysteem, maar in beide talen vinden we frequent ternaire patronen, zodanig dat aanvankelijk werd vermoed dat deze talen behoorden tot de talen met een ternair klemtoonsysteem. In Hoofdstuk 3 wordt een uitgebreide beschrijving gegeven van diverse aspecten van de fonologie en de morfologie van het Sentani, voorzover deze relevant zijn voor de analyse van het klemtoonsysteem. In de laatste sectie van Hoofdstuk 3 worden de klemtoonpatronen van het Sentani beschreven.

Deze klemtoonpatronen worden, met gebruikmaking van Optimaliteitstheorie, geanalyseerd in Hoofdstuk 4. Niet alleen wordt in dit hoofdstuk het klemtoonsysteem van het Sentani geanalyseerd, en uitgebreid benadrukt dat het noodzakelijk is voor het Sentani om gebruik te maken van een ritmische anti-lapse conditie, er worden tevens eerdere metrische analyses besproken (Hung 1994, Van de Vijver 1998), en getoond dat deze analyses om verschillende redenen ontoereikend zijn voor de analyse van het Sentani. In deze discussie speelt het verschil tussen ritme-verschijnselen aan de randen van het woord versus woordintern ritme een belangrijke rol.

In Hoofdstuk 5 en Hoofdstuk 6 wordt het klemtoonsysteem van het Fins geanalyseerd. In het Fins wordt klemtoontoekenning beïnvloed door de morfologie, maar alleen in woorden met bepaalde uitgangen voor naamval en voor bepaalde uitgangen voor persoon. Daarbij komt dat er in het Fins klemtoon variatie is. In die gevallen waar het klemtoonpatroon het gevolg is van de invloed van de morfologie, zien we dat daarnaast ook een klemtoonpatroon is voor dat woord, welke het gevolg is van het toepassen van slechts de fonologische condities. Hoofdstuk 5 analyseert deze ‘fonologische’ klemtoonpatronen. In dit hoofdstuk vinden we onafhankelijke evidentie voor de anti-lapse conditie, waar het een rol speelt in het selecteren van een binair patroon.

Hoofdstuk 6 richt zich op de ‘morfologische’ patronen in het Fins. De invloed van de morfologie kan, onder andere, worden verklaard door ‘paradigmatische analogie’. Dit wil zeggen dat het klemtoonpatroon van een woord moet lijken op het klemtoonpatroon van een morfologisch verwant woord uit hetzelfde paradigma [áterìana]-[áterìanàni]. Voor de Optimaliteitsanalyse van paradigmatische analogie wordt Correspondentietheorie gebruikt, een subtheorie van Optimaliteitstheorie. In Corrrespondentietheorie (McCarthy & Prince 1993, Benua 1995, 1997, McCarthy 1995) wordt bij de evaluatie van de mogelijke klemtoonpatronen ook gekeken naar in hoeverre het klemtoonpatroon van de betreffende oppervlakte vorm lijkt op dat van een morfologische verwante vorm, welke de *basis* wordt genoemd.

Zoals boven gemeld, komt in het Fins ook variatie voor. In Optimaliteitstheorie krijgen we variatie wanneer twee of meer condities niet ten opzichte van elkaar gerangschikt zijn (Kiparsky 1993, Kager 1994, Reynolds 1994, Anttila 1995, 1997). De een mag de ander domineren en vice versa (A » B en B » A). Wanneer conditie A boven conditie B gerangschikt staat, is conditie A belangrijker en wordt het ene patroon geselecteerd, maar wanneer conditie B boven conditie A gerangschikt staat wordt het andere patroon geselecteerd.

Er zijn twee condities die door hun optionele hoge rangschikking de morfologische patronen tot gevolg hebben. Hoewel ze daarmee tot op zekere hoogte de fonologische condities domineren, zijn er altijd bepaalde fonologische condities die daar weer boven staan, waardoor er, bijvoorbeeld, nooit een patroon ontstaat met een andere voet dan een binaire voet, of met een sequentie van drie of meer onbeklemtoonde lettergrepen.

Hoofdstuk 7 tenslotte, laat zien dat het mogelijk is de ternaire systemen van het Chugach en het Cayuvava volledig te analyseren met condities die voor de analyses van het Sentani, Fins en andere binaire systemen zijn geïntroduceerd. Door het op de voor de betreffende taal specifieke manier rangschikken van deze condities worden de juiste klemtoonpatronen geselecteerd in het Chugach of Cayuvava, zonder gebruikmaking van ternariteit-specifieke middelen. Hierbij wordt gebruik gemaakt van een idee van Ishii (1996).

Ishii laat zien dat een paar condities een belangrijke rol spelen, namelijk de anti-lapse conditie PARSE-2, de groeperingsconditie PARSE-σ, en de condities die verwijzen naar woord- en voetgrenzen. ALIGN-X eist dat aan de woordrand een voet staat. ALL-FT-Y eist dat de voeten zoveel mogelijk links, dan wel rechts in het woord moeten staan. De ternaire systemen zijn volgens Ishii het gevolg van de wisselwerking tussen deze twee condities, die ieder naar tegengestelde woordgrenzen verwijzen (Chugach: ALIGN-L en ALL-FT-R, Cayuvava: ALIGN-R en ALL-FT-L). Op deze manier worden de voeten twee kanten opgetrokken, en ontstaat er een ternair patroon. Dit kan alleen wanneer PARSE-2 hoog staat, en PARSE-σ laag, dus PARSE-2, ALIGN-X » ALL-FT-Y » PARSE-σ.

Met name de analyse van het Cayuvava is problematisch voor Ishii, aangezien hij uitgaat van PARSE-2 van Kager (1994, 1996a), een anti-lapse constraint die verwijst naar het groeperen van lettergrepen in metrische voeten. In het Cayuvava is het klemtoonpatroon voor woorden met acht lettergrepen [σσ(σ́σ)σ(σ́σ)σ]. Aan het begin van het woord staan twee lettergrepen niet in een voet, wat een schending inhoudt van PARSE-2. Om deze vorm toch te krijgen, moet Ishii uitgaan van een ingewikkelde constructie met extra-syllabische segmenten. Deze ingewikkelde constructie kan vermeden worden als, zoals reeds beargumenteerd voor het Sentani, een ritmische interpretatie van de anti-lapse constraint wordt aangenomen.

Verder is de wisselwerking tussen ALIGN-R en ALL-FT-L niet afdoende voor Cayuvava wanneer de keuze gemaakt moet worden tussen [σσ(σ́σ)σ(σ́σ)σ] en [(σ́σ)(σ́σ)σ(σ́σ)σ], waardoor Ishii een extra conditie in moet voeren die woord-initiële voeten verbied. Dit kan vermeden worden wanneer we in plaats van ALIGN-R, ALL-FT-R toepassen. Voor ALL-FT-R maakt, in tegenstelling tot ALIGN-R, het aantal voeten wel verschil, en wordt de vorm gekozen met de twee woord-interne voeten.

Op deze wijze kunnen we dus de ternaire systemen analyseren, zonder dat we condities in moeten voeren die specifiek betrekking hebben op ternaire systemen. De anti-lapse conditie is nodig om bepaalde klemtoonpatronen in de binaire systemen van het Sentani en Fins te analyseren, PARSE-σ is een conditie die aan de basis staat van de analyse van binaire klemtoonsystemen, en ook de grenscondities als ALIGN-X en ALL-FT-Y komen we veelvuldig in binaire klemtoonsystemen tegen.

Tenslotte, de factoriële typologie van deze condities levert zowel ongebonden als gebonden systemen op. Binnen die gebonden systemen resulteren deze condities in binaire systemen of ternaire systemen, maar er is geen ranking die een kwartaire alternantie oplevert, wat strookt met de taaltypologische kennis. Voorzover bekend, zijn er wel talen beschreven die onder bepaalde omstandigheden een lokaal kwartair patroon hebben, maar zijn er geen talen die een kwartair systeem hebben. Mijn theorie is dus niet alleen unificerend, maar ook zeer restrictief.

Curriculum Vitae

Nine Elenbaas was born on January 24, 1967. She completed her high school education at R.S.G. Wijdschild, in Gorinchem, where she graduated in 1986. She then started her university studies musicology at Utrecht University, for which she received her propaedeutics in 1988. She continued her studies at the Linguistics Department, studying General Linguistics, with emphasis on Phonology and Morphology. She obtained her Masters Degree in 1992.

From 1992 to 1993 she was the management assistant of the managing director of Het Gemeenschappelijk Kolenbureau voor Elektriciteitsproductiebedrijven (GKE). From 1993 to 1998 she was employed by the Research Institute of Language and Speech (UiL-OTS) as a graduate student (AIO) in phonology, where she carried out research in the field of metrical phonology.