*Part III*

# Stress

*Chapter 4*

# The Representation of Stress

## 4.1. Introduction

In this chapter I will discuss the representation of stress within the framework of metrical phonology. In sect. 4.2. I will discuss the notion of a **metrical grid**, which was originally introduced by Liberman (1975) and Liberman & Prince (1977). After Kiparsky's (1979) attempt to demonstrate its superfluousness, the grid disappeared from the literature and all attention was focussed on **metrical trees**. Prince (1983), however, defends the opposite position, viz. that trees rather than grids are superfluous. In sect. 4.3.1. grid theory will be compared with tree theory with respect to word stress. In section 4.3.2. I then offer a discussion in which I suggest a possible division of the tasks between tree and grid theory. In sections 4.3.3. and 4.3.4. I provide support for the proposals advanced in section 4.3.2.

The most notable difference between grid and tree theory involves arboreal structure. In section 4.4. I will discuss the need for trees as characterizations of phonological domains, and the need for **feet**. I will argue that tree structure as a characterization of **prosodic domains** forms a necessary part of our theory and that the more limited tree theory proposed in section 4.3.2. comes closer to a characterization of the word prosodic structure than the standard tree theory.

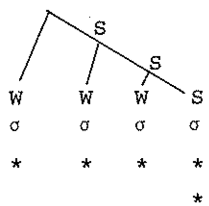
## 4.2. Grids and trees

In Liberman and Prince (1977) (henceforth LP) the string of segments (the "text") is associated with two hierarchical structures: a **metrical tree** and a **metrical grid**. Grids are derived from trees with the aid of a principle that LP term the **Relative Prominence Projection Rule** (RPPR) (p. 316):

(1) **RPPR**
In any constituent on which the strong-weak relation is defined, the designated terminal element of its strong subconstituent is metrically stronger than the designated terminal element of its weak subconstituent.

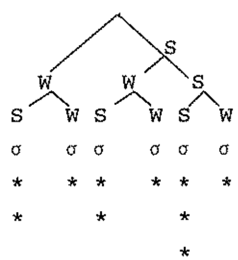
The role of grids is to interpret metrical trees. The grid makes explicit which prominence relations between the terminals are considered to be relevant for a characterization of the stress pattern of a string. In particular the grid makes it possible to characterize intuitive notions such as "rhythmic alternation", "stress clash", etc. in explicit ways, as we will see below. A grid that is in conformity with the RPPR is the one assigned to the tree in (2):

(2)




In a slightly more complex example the RPPR gives us the following tree-grid correspondence:

(3)



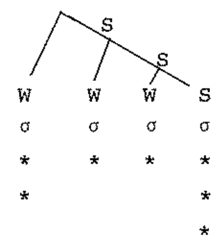

The relation between the string of syllables and the grid can be thought of in terms of autosegmental association. In fact LP's conception of grid-text alignment comes close to being a definition of the autosegmental wellformedness condition (p. 316):



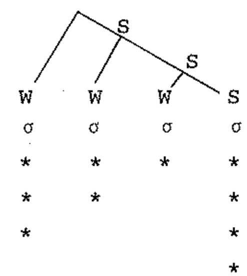
A metrical grid is "aligned" with a linguistic phrase by the previously-mentioned function C, which maps the grid's terminal set one-to-one onto the syllables of the phrase, preserving order. The Relative Prominence Projection Rule (...) is to be interpreted as a wellformedness condition on such alignments.

I will come back to this autosegmental view of the grid in section 4.3.2. The grid in (2) is not the only one that is compatible with the RPPR. In (2) the RPPR does not exclude a difference in relative prominence between the weak syllables. Hence the following grid assignments are all wellformed, i.e. in agreement with the RPPR. These four examples do not exhaust the class of all possible grid assignments that meet this requirement:

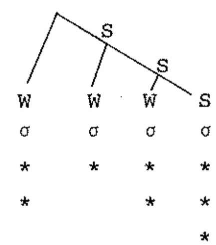
(4) a.



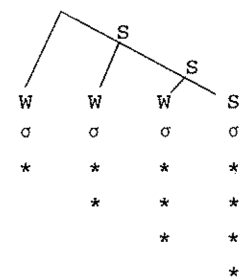

b.




c.




d.



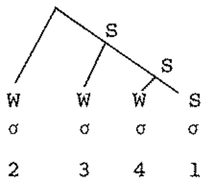

In all trees under (4) the strongest element (the Designated Terminal Element: DTE) has a higher grid column than the other syllables and hence the RPPR is satisfied. The RPPR then allows a number of interpretations for each tree. Prince (1983) refers to the grid in (2) as the **minimal interpretation**. LP mention another algorithm for interpreting trees, one that delivers a string of numbers that is equivalent to the string which results from applying the SPE stress rules. This algorithm is given as (5):

(5) a. Count the number of nodes that dominate the lowest node labelled W

b. The stress number is equal to the result of a. plus 1

For the tree in (6) the algorithm gives the following result:

(6)




LP mention this algorithm but add that the RPPR (which requires, expressed in numerical terms, ØØØ1) should be preferred because the rich differentiation that is present in the SPE-numbers finds no counterpart in natural languages. In this respect then the SPE-algorithm gives too much. Another problem with the SPE-algorithm, especially when applied to longer utterances, is that it does not give the alternating pattern usually found in an utterance of some length. In addition LP point out that a grid, once it is derived from the tree, can be enriched or modified by rules that are more easily formulated as rules that apply to the grid directly. This holds particularly when we are dealing with phrasal stress, where particular syllables must be assigned prominence depending on the "focus structure" of an utterance (cf. LP, p. 323-33Ø).

We can make clearer that the two algorithms are of the same kind by reformulating (4) slightly so that it produces a grid rather than numbers.

(7) a. As above

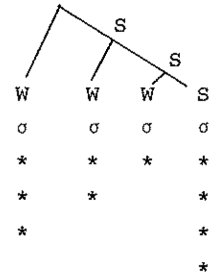
b. Count the number of nodes dominating the terminal having the highest degree of embedding

c. The height of the grid column is equal to the result of b minus the result of a

This algorithm produces exactly one grid:



(8)=(4b)



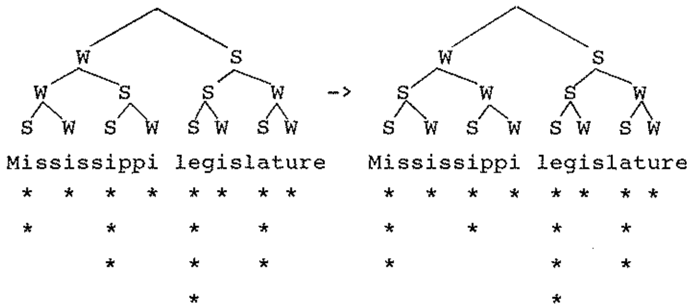

It has been claimed that there is at least one point in favor of the "SPE"-algorithm. The grid that is produced indicates that there is a strong secondary beat on the initial syllable, i.e. the syllable that is furthest away from the syllable carrying the strongest stress. The RPPR gives us this interpretation as one of the possibilities only. But the algorithm also has a few drawbacks. We already mentioned the two objections raised by LP. The disadvantage of not producing an alternating pattern, even within the relatively small domain of words, can be demonstrated clearly with respect to the quadrisyllabic trees that we used as an example. In Dutch four syllable words with final stress (e.g. **fonologie**, 'phonology'), the second syllable is more likely to be reduced than the third. The relative prominence pattern following from the SPE-algorithm, however, predicts the reverse order. Abandoning the SPE-algorithm implies that the initial upbeat (which is not predicted, but only allowed by the RPPR) must be seen as the result of a separate rule that is independent of the rule that assigns main stress.

Let us now look at one particular argument that LP give to substantiate their claim that grids are needed in addition to trees. We have seen that the grid is regarded as an interpretational device. It seems to me, however, that the grid is an **uninterpreted** representation, just like the tree, since nothing is said about the phonetic realization either of the grid or of the tree. The real function of grids in the LP theory is the following. LP argue that grids are necessary to define the notion of a **stress clash** or, to put it in more general terms, to capture the notion of linguistic rhythm. They observe that in certain configurations the relative prominence of words or phrases seems to be adjusted to avoid too small a distance between adjacent stresses. In order to make this precise LP define the following notions in terms of the grid (p. 314):

> Elements are metrically adjacent if they are on the same level and no other elements of that level intervene between them; adjacent elements are metrically alternating, if in the next lower level the elements corresponding to them (if any) are not adjacent; adjacent elements are metrically clashing, if their counterparts one level down are adjacent.

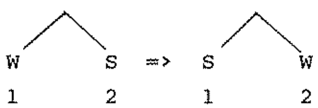
If a clash in the sense just defined arises, a metrical transformation (involving a relabelling operation), **Iambic Reversal** - also known as the **Rhythm Rule** - is performed on the tree. The grid that corresponds to the relabelled tree no longer contains a clash:

(9)




The relabelling rule is formulated as follows:

(1Ø) **Iambic Reversal** (optional) (LP, 319)




**Conditions:**

1. Constituent 2 does not contain the DTE of an intonational phrase (i.e. the syllable which is exclusively dominated by nodes labelled S)
2. Constituent 2 is not an unstressed syllable (i.e. syllables which are exclusively dominated by nodes labelled W)

The crucial role attributed to the grid as part of the phonological representation is to locate environments, defined in terms of the grid, in

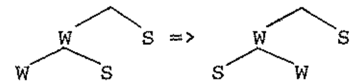


which Iambic Reversal will apply.

The LP theory then uses both trees and grids. A proponent of this **grid-cum-tree** theory is Hayes (1984), who offers a defence of the original LP conception, thus providing an argument against the two alternative theories we are about to discuss.

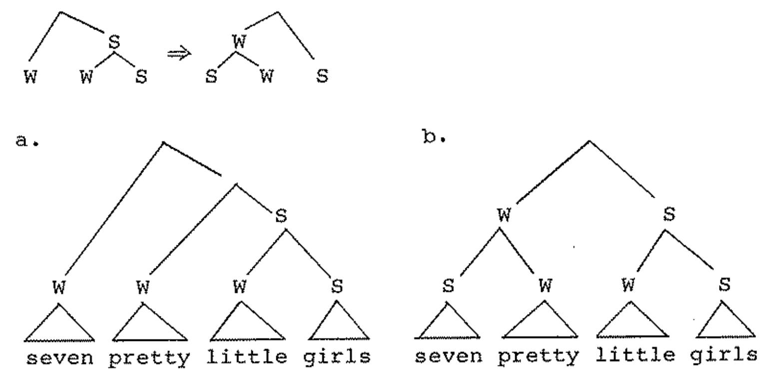
Kiparsky (1979) points out that, strictly speaking, we do not need the grid to find the circumstances under which Iambic Reversal may apply. If we slightly complicate the rule it applies precisely where we want it to apply, without reference to the grid.

(11)

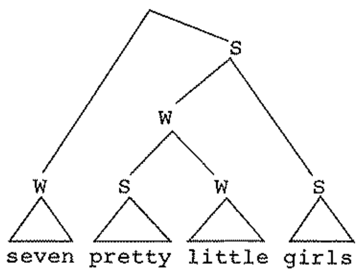


Kiparsky's proposal allows us to eliminate grids from the theory, or at least to reduce their interest, leading to a **tree-only** theory. A recent defence of the tree-only approach can be found in Giegerich (1983). Giegerich completes the argument in favor of a tree-only theory by arguing that we do not need the grid to account for rhythmic phenomena. He argues that these phenomena can be accounted for in terms of other metrical transformations, rules that restructure the underlying prosodic constituent structure. Instead of producing rhythmic patterns by adding beats to the grid and leaving the constituent structure as it is, Giegerich proposes to modify the tree structure, by a series of metrical transformations, which perform operations of the following kind (p. 299). The rule **W-pairing** changes (12a) into either (12b) or (12c):

(12) **W-Pairing**



c.




In Giegerich's model the set of metrical transformations maps a prosodic tree that is a copy of the syntactic tree plus S/W labelling onto a surface tree that expresses the surface rhythmical pattern of an expression.

A different route is also possible, however. Prince (1983) raises the question whether trees rather than grids should be abandoned. His position is supported in Selkirk (1984). Offering the counterpart of Kiparsky's argument, both attempt to show that the Rhythm Rule can be formulated entirely in terms of the grid. The rule that Selkirk proposes roughly is as follows:

```
(13)        * *      *   *
          * * * --> * * *
```

Prince chooses an even simpler formulation:

(14) Move *

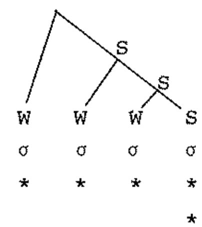
To produce the prominence pattern, including main stress, an alternating pattern or an initial beat Prince introduces rules that add beats to the grid directly without intervention of the trees. To a certain extent this was also allowed in LP's standard theory. The major difference between the theory offered by Prince and the standard theory offered by LP is that the strongest stress, too, results from adding a beat to the grid, both at the level of words and at the level of phrasal stress.

Prince's point of departure is that the RPPR gives us a satisfactory interpretation of metrical trees (p. 24):

> Grid (9a) [our 2a, repeated here as 15] is distinguished by being **minimal** in the obvious way: it has less structure than any other interpretation of the tree [w w w s]. The RPPR can be supplemented with a natural principle of minimality to pick out (9a) as fundamental. Divergences from the 'flattest' interpretation will arise from subtle variations of emphasis consistent with overall s/w- structure (...), as well as from the pressures of eurhythmicity and phrasal demarcation. For example, in a [w w w s] tree like (9a) the first **w** is often felt to be more strongly stressed than the others. This fact might be recorded as a supplementary principle of prosodic realization, based on constituent structure and linear order, distinct from the primary interpretation of the stress pattern imposed by the metrical tree.



(15)




Prince then observes the following (p. 25):

> Because the grid carries over so little of the information in the tree, there is another, more direct route to the match-up. We can deal just with **terminals** according to a rule like this: "in any constituent C, the rightmost terminal is strongest".

To put it in more formal and general terms (p. 25):

> **End rule.** In a constituent C, the leftmost/rightmost terminal in C is associated to a stronger grid position than any other terminal in C.

It is undoubtedly true that the End Rule gives us the same information about relative prominence as the tree + RPPR. The question whether one of the hierarchical structures is superfluous is therefore legitimate. In the next section I will discuss the alternative theories in more detail, limiting myself to discussing the two theories with respect to word stress systems.

### 4.3. A comparison of grid and tree theory

In this section I will offer a discussion of the types of word stress systems that I know of, analyzed in both tree theory and grid theory. This discussion serves two purposes. Firstly it is my intention to show that both theories actually have the same descriptive coverage. Not only, however, do both theories succeed in accounting for the known variety, they also make use of a highly comparable "machinery", to an extent that one is tempted to speak of "notational variants" (ignoring the issue of constituency). The second goal of this discussion is to provide the appropriate background for the proposals that will be put forward in section 4.3.2. concerning the relation between main stress assignment and alternating stress assignment.

#### 4.3.1. Word stress systems

Within the metrical theory of stress a particular stress system is characterized by specifying a universally defined set of parameters. Two fundamental parameters involve the shape of feet. First the head of a foot may or may not be allowed to branch. If no branching is allowed the feet are said to be **bounded**; otherwise they are called **unbounded**. Secondly the terminal nodes may or may not be sensitive to properties of the syllables they dominate. If the non-head terminals are restricted to positions where they dominate a light syllable, feet are said to be **quantity sensitive**. In addition it may be required that the head terminal does not dominate a light syllable. I will call such feet **quantity determined**. The logical possibilities for stress systems according to these parameters are then the following:



(16) **Types of feet**

| | |
|---|---|
| quantity insensitive | unbounded |
| | bounded |
| quantity sensitive | unbounded |
| | bounded |
| quantity determined | unbounded |
| | bounded |

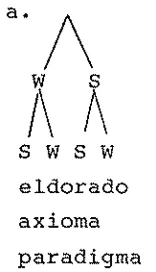
Other important parameters involve the directionality of foot assignment, labelling (SW or WS) and the (non)-iterativity of foot assignment.

In the following subsections I will systematically discuss the various types of systems. I will refer to languages that are cited in the literature, for illustrative purposes. I must add that the claims made in the literature about the stress systems of the various languages have been accepted without question. My sources have been Garde (1968), Hyman (1977), Greenberg and Kaschube (1978) and Hayes (1981). The purpose of this section is to point out how the various stress systems that have been mentioned in the literature are dealt with in tree theory (as developed in Hayes 1981) and grid theory (as developed in Prince 1983).

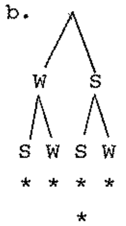
##### 4.3.1.1. Quantity insensitive systems: bounded

In metrical theory the alternating pattern that is present in a Dutch word like **eldorado** is generated in the tree theory by assigning bounded left dominant feet. Feet in turn are gathered in a word tree:

(17) a.




b.



The corresponding grid (cf. 17b) is derived from the tree according to the RPPR. To generate alternating patterns of this type directly Prince introduces as a primitive the **Perfect Grid** (PG):

```
(18)       *    *    *    *
        *  *  *  *  *  *  *  *  *
```

Prince assumes that the PG can be "associated" with the string of syllables from Left-to-Right (LR) or from Right-to-Left (RL), either starting with a Peak (pk) or a Trough (tr). The grid is organized in a maximal way. Maximality implies that "lapses", i.e. sequences of two equally strong positions, are avoided. Apart from the "no lapse" requirement the perfect grid is also subject to a "no clash" requirement, although Prince ends up saying that this second requirement is not absolute. The two parameters (direction and peak/trough priority, henceforth referred to as the dominance-parameter) allow four types of systems:

```
(19)    a. LR;tr
                    *     *     *
                 *  *  *  *  *  *
              #  σ  σ  σ  σ  σ  σ  ...#

        b. LR;pk
                 *     *     *
                 *  *  *  *  *  *
              #  σ  σ  σ  σ  σ  σ  ...#

        c. RL;tr
                    *     *     *
                    *  *  *  *  *  *
              # ... σ  σ  σ  σ  σ  σ  #

        d. RL;pk
                       *     *     *
                    *  *  *  *  *  *
              # ... σ  σ  σ  σ  σ  σ  #
```

Hayes (1981) reports that all four types are attested. We can generate all the elementary stress systems that are binary and quantity insensitive if we apply the End Rule (ER) to such "perfect" grids. The ER can apply



initially (I) or finally (F):

```
(2Ø)  a.  3  *                    b.                *
          2  *     *     *                *     *     *
          1  *  *  *  *  *  *          *  *  *  *  *  *
             σ  σ  σ  σ  σ  σ          σ  σ  σ  σ  σ  σ
```

The two systems just given are generated by the following stress rules:

```
(21)     a.  PG(LR;pk)          b.  PG(LR;tr)
             ER(I)                  ER(F)
```

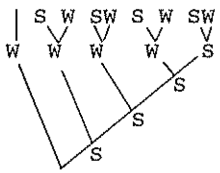
As a principle, the ER applies to the highest grid level, although we will see below that Prince makes use of the possibility of restricting the application of the ER to the second grid level.

The ER promotes a peripheral unit within a domain D to the most prominent unit of D. Prince proposes to label levels in the grid with names that correspond to the domain with respect to which the rules that build the grid are applied. So in (2Øa) level 1 is called the syllable level, because at that level a grid mark is added to each syllable. Level 3 is called the word level because at that level a beat is added to the most prominent unit of the word. Level 2 is called the foot level, although in this case, Prince claims, the name for this level cannot be derived from a domain that is independently defined as a morpho-syntactic or prosodic constituent.

So far we notice little difference between tree and grid theory except for the obvious fact that trees provide more information than grids, viz. the grouping of units into constituents.

An advantage of grid theory that Prince does not mention is that tree theoretical analyses must often be supplemented by rules that "destress" monosyllabic feet. An example of this can be found in Hayes' analysis of stress in **Warao**. In **Warao** stress falls on the penultimate syllable. Every other syllable to the left of the main stress bears a secondary stress. In words with an uneven number of syllables this leads to an initial monosyllabic foot:

(22) enahoroahakutai




However, initial syllables of words with an uneven number of syllables are not reported to be stressed. To account for this Hayes formulates the following destressing rule:

(23)
```
                       W
      F  ->   Ø   /   _|_
```

The important point is that in the theory that Hayes proposes the presence of a foot implies stress, even if the foot is degenerate, i.e. monosyllabic. Hence, Hayes (and others as well) implicitly assumes a partly non-relational interpretation of the trees, that is different from the RPPR. In the grid-only approach we do not get an initial beat to begin with:

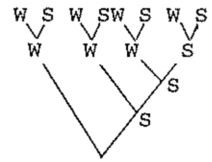
(24)
```
enahoroahakutai
* * * ** * * **
  *   *   *  *
             *
```

In this respect the standard tree-cum-grid theory is more successful than the tree-only theory. The grid produced in (24) is exactly the one we get by using the RPPR to derive a grid from the tree produced in (22). Of course in (24) the grid can be produced without intervention of tree structure. The point Prince makes is that the grid-only theory is simpler in a straightforward way and should therefore be preferred, especially when we attach no importance to the grouping of syllables and feet into constituents.

A possible hint that constituency is not always taken seriously comes from the following example. Given the device of extrametricality there is a way to avoid the destressing rule for **Warao**, as is pointed out in Halle (1982). If we mark the final syllable in **Warao** as extrametrical and assign **right** dominant feet instead of left dominant feet no clashing of stresses is produced at the beginning of words with an odd number of syllables:



(25) enahoroahakuta(i)




It is noteworthy that the ease with which Halle changes the metrical structure from that in (22) to that in (25) demonstrates that the particular grouping of syllables into feet seems to be of little importance. In any case, since no arguments are provided by either Hayes or Halle for one particular grouping Prince's proposal gains credibility.

To show how the system works in a slightly more complicated case I will give Prince's treatment of **Hawaiian** stress. The data (deliberately simplified by Prince) are as follows:

(26) **Hawaiian stress** (Prince 1983, 49-51)
Main stress: final if the final syllable has a long vowel, penultimate otherwise
Sec. stress: alternating to the left
Extra: uneven syllabled words have an initial ternary foot

(27)
```
                               -->                 *
* * * * * * (*)   ER(F)  * * * * * * *
σ σ σ σ σ σ              σ σ σ σ σ σ σ

-->     *              *        -->      *          *    *
ER(I)   * * * * * * *           PG(RL)*  * * * * * *
        σ σ σ σ σ σ σ                    σ σ σ σ σ σ σ

                 *
-->     *        *     *
EF(F)   * * * * * * *
        σ σ σ σ σ σ σ
```

Note that in the input the final syllable is marked as extrametrical. The rule of PG can only assign one grid mark because the second one would clash with the initial mark: PG creates no clash, although Prince will ultimately regard this as a parameter (cf. below).

Stated in full the stress system of **Hawaiian** requires the following rules:

(28) a. EM(F;M)
b. ER(F;F)
c. PG(RL;tr)
d. ER(I;F)
e. ER(F;W)

To familiarize ourselves with P.'s notation let me spell out what is meant here:

a. mark as **E**xtra**M**etrical the **F**inal **M**ora
b. **E**nd **R**ule applies adding a grid mark word **F**inally at the **F**oot level
c. **P**erfect **G**ridding applies from **R**ight to **L**eft, **tr**ough first
d. **E**nd **R**ule applies adding a grid mark **I**nitially at the **F**oot level
e. **E**nd **R**ule applies adding a grid mark **F**inally at the **W**ord level

Prince is the first to note that the given grid based account of Hawaiian stress is somewhat cumbersome. He mentions a few alternatives, but he does not make a definite choice. Firstly, it will strike the reader as somewhat inelegant that the End Rule must be stated three times. An obvious alternative would be to apply first the ER(I), then PG(RL;tr), without using extrametricality, and finally ER(F). An even more promising alternative is to apply the ER(F) as the first rule, promoting the final syllable to the word level directly. Then we apply the ER(I), adding a foot level beat. Since PG is subject to the "no clash/no lapse" requirement nothing needs to be said now beyond saying that "there is perfect gridding". If we furthermore assume that the rhythmic wave always starts at the edge where main stress is assigned we have eliminated the two PG parameters (dominance and direction). Prince considers this possibility, but rejects it for reasons that I will mention shortly hereafter. In section 4.3.2. I will argue in favor of this "main stress first" theory, however.

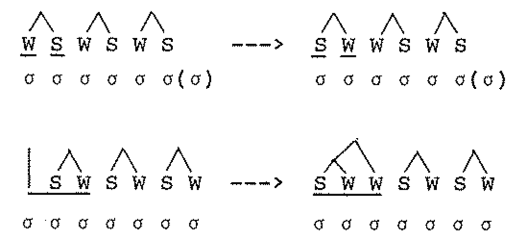
When compared to the system of **Warao**, the novelty shown by the Hawaiian system is the presence of an initial beat. Prince points out that one can find many more examples of this kind. Instead of using foot-level ER(I), he suggests the possibility of adding a rule **Move *** to the system, applying after all the other rules, whichever of the alternatives we choose.



(30)
```
  *   *   *          *    *   *
* * * * * * *  =>  * * * * * * *
σ σ σ σ σ σ σ      σ σ σ σ σ σ σ
```

Either way of characterizing the initial beat requires an extra statement. Tree theory (with or without grids) fares neither better nor worse on this point. In a tree based account we need a relabelling rule or a defooting rule depending on the way in which we group syllables into feet:

(31)




Apparently both theories have to say something extra if alternating stress deviates from a strict binary pattern.

A third example that illustrates Prince's framework is stress in **winnebago.**

(32) **Winnebago stress** (Hayes 1981, 68)
Main stress: third syllable from the left
Sec. stress: alternating rightward

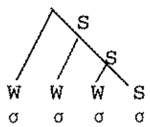
(33)
```
          # (*) * * * * * * *
                σ σ σ σ σ σ σ σ

                    *   *   *
PG(LR;tr)       * * * * * * * *
                σ σ σ σ σ σ σ σ

                    *
                    *   *   *
ER(I)           * * * * * * * *
                σ σ σ σ σ σ σ σ
```

This system, as Prince points out, shows that we cannot do without the dominance parameter. We need both extrametricality and the dominance parameter to account for stress located on the third-from-edge syllable. Given the limited "window" of end rules there is no other way in which we can get a main stress that is three syllables away from the word boundary.

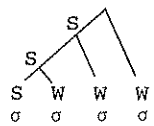
#### 4.3.1.2. Quantity insensitive systems: unbounded

As Hayes (1981) observes, a language having final or initial stress, without having secondary stresses, can be described in terms of an elementary right branching or left branching tree. Languages with simple penultimate or "peninitial" stress use the same trees and extrametricality as well:

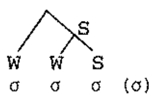
(34) **Final**



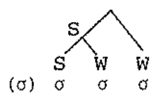

**Initial**




**Penultimate**




**Postinitial**




We must note that there are at least two other ways to describe the systems with penultimate or postinitial stress in arboreal terms. We can make use of a special labelling rule that is sensitive to branching:

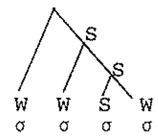
(35) **Lexical Category Prominence Rule (LCPR)**
Label the right node strong iff it branches

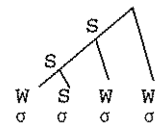
This labelling rule is proposed by LP in their analysis of the English stress system. Given this rule a branching node will always be labelled S. Only if two sister nodes are both non-branching is an option possible. If the rest of the tree is labelled WS the unmarked case is to label the left sister W and the right sister S. The LCPR expresses the second logical possibility, the marked option according to Hayes 1981, chapter 3.

A second alternative involves assigning feet **non-iteratively**, i.e. we might assign a left dominant bounded foot at the right edge to account for stress on the penultimate syllable and a right dominant foot at the left edge to account for peninitial stress. A word tree combines the peripheral foot and other syllables of the word:

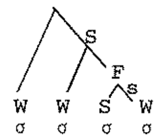


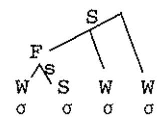
(36) **LCPR**




**Non-iterative foot**




As for antepenultimate systems (without secondary stress) at least two descriptions are possible. Either we use a non-iterative foot cum extrametricality or we assign no feet at all and combine the descriptive power of extrametricality and the LCPR.

The various descriptive possibilities that are available for the systems just mentioned only involve differences at the level of constituent structure. Grid theory characterizes the first four systems mentioned (final/initial and penultimate/postinitial syllable) with the end rule and extrametricality. For the antepenultimate type of system it would be necessary to say that perfect gridding can apply non-iteratively, just like foot assignment, which leads to the fact that grid theory makes also available two descriptions for the penult/second syllable type of system. The extra power present in the tree theory is found in the presence of the special labelling rule, the LCPR.

Prince argues against the LCPR. Within arboreal theory it can be dispensed with, he claims. As we have seen here the near-peripheral stresses caused by the LCPR can also be explained in other ways, i.e. by using feet with a labelling that is the opposite of the word tree labelling or by using extrametricality. Stress on the third syllable can be handled by combining these two devices.

Apart from the question whether the LCPR is necessary or not we must realize that the grid-only theory is not so restricted that we could not mimick the result of the LCPR. In passing we mentioned the fact that it may be necessary to assume rules that move *'s around. It seems to me that "move *" can do what the LCPR does and even more. Consider the following example.

We want to describe near-peripheral stress. After application of the end rule we now apply "move *":

(37) Move *

```
                *           *
      *  *  *  *  *  *  =>  *  *  *  *  *  *  *
      σ  σ  σ  σ  σ  σ      σ  σ  σ  σ  σ  σ  σ

             *                 *
      *  *  *  *  *  *  =>  *  *  *  *  *  *  *
      σ  σ  σ  σ  σ  σ      σ  σ  σ  σ  σ  σ  σ
```

In this type of analysis we must stipulate that movement is restricted in the sense that the star cannot be moved beyond the near-peripheral syllable. It seems to me that the LCPR represents a more restricted type of mechanism, because its "local" effect derives from the fact that trees are uniformly branching. The possibility of moving stars around opens the door for a wide range of analyses for every stress system we can think of, existing or not. Here then lies a potential piece of machinery that differentiates the two theories. If the LCPR can be shown to be needed (crucially, not as one of the descriptive possibilities) a problem arises for grid theory because it is forced to allow a mechanism of unlimited descriptive power and must be complemented by a theory of "domains" and "landing sites". But if the LCPR is not proved to be necessary the special labelling rule (in fact any kind of labelling rule) can be eliminated from tree theory and both theories are again "notational variants" (ignoring the constituency issue). In chapter 5 two metrical analyses of Dutch stress are discussed, one of which uses the LCPR.

**4.3.1.3. Quantity sensitive systems: bounded**

In quantity sensitive systems the internal make-up of syllables influences stress assignment. Prince proposes to account for the difference between heavy and light syllables in terms of the grid. The proposal is that a heavy syllable is associated to a grid column of two asterisks. In addition a heavy syllable may or may not be associated to **two** grid positions. In this way it is possible to create a three way contrast:



(38) **Superheavy** **Heavy** **Light**

```
      Superheavy    Heavy    Light
         *            *
         * *          *        *
```

The distinction between heavy and superheavy syllables is the result of a parameter that Prince calls **mora sluicing**. The assumption is that all heavy syllables are associated to two grid positions and that the second mora may be "parenthesized".

As an example of a Q-sensitive binary system Prince gives a grid-only analysis of stress in **Tübatulabal**:

(39) **Tübatulabal stress** (Hayes 1981, 56,60; Prince 1983, 63-67)
All stressed syllables are equally strong
Stress is on: final syllables
long vowels
certain morphemes
alternating rightward

**Tübatulabal** is claimed to lack a syllable bearing main stress. Consider the following two examples:

(40) (a) (b)

```
(a)                          (b)
                *                  *
  *  *  *  *  *  *            *  *  *  *  *  *  *
  ti ka pi ga na yin          a  na ni i  ni ni mut
```

The extra mark in the first word is lexical, i.e. it is brought in by the morpheme **piganá**, while that in the second word results from a heavy syllable: the two underlined **i**'s form one syllable. The surface prominence pattern results from applying PG(RL,pk):

(41)

```
          *     *     *  *        *     *     *     *
PG(RL)    *  *  *  *  *  *        *  *  * *   *  *  *
          σ  σ  σ  σ  σ  σ        σ  σ   σ    σ  σ  σ
```

In full the stress rule is as follows:

(42) QS([+voc])
PG(RL;pk;FCO)

Two new abbreviations occur here. QS means that the system is Quantity **S**ensitive (hence heavy syllables are represented as bipositional with their first beat strong) and the addition of [+voc] means that morae must be vocalic. PG is specified as **F**orward **C**lash **O**verride, i.e. PG may produce a clash. To illustrate what this means take the following example. PG is specified as (LR;tr). In (43a) application is blocked because adding a mark to the grid would produce a clash. In (43b) application is not blocked, despite the clash:

(43) a. **No FCO**

```
                 PG
      *         -x->      *
    * * * ...           * * * ...
    σ σ σ               σ σ σ
```

b. **FCO**

```
                 PG
      *          ->     * *
    * * * ...           * * * ...
    σ σ σ               σ σ σ
```

Turning to the examples from **Tülatulabal** we see that in the first example a beat is added to the final syllable producing a clash with the beat on the penultimate syllable. In the second example a beat is added to the antepenultimate syllable although the ante-antepenultimate syllable is heavy. In both cases then PG produces a clash.

It is not beyond doubt that we need this marked option of FCO. In the case of adding a beat next to heavy syllables there is no clash since the second mora of the heavy syllable intervenes. There would not be mora sluicing in **Tübatulabal**. Only the assignment of a PG to the left of the pregiven stress in the first word produces a clash. It is tempting to suggest that PG **never** produces a clash, and that what we have here is an application of the ER(F). The fact that this final "main stress" is not more prominent than another stressed syllable should then be seen as a matter of phonetic interpretation or by complicating the ER: ER(F;F).

One case that Prince uses as crucial evidence in favor of the parameter FCO is the stress system of **Passamaquoddy.** The stress system of **Passamaquoddy** is described by Stowell (1979). The basic data are the following:



(44) **Passamaquoddy stress** (Hayes 1981, 55,71-2)

a. penultimate syllables with a full vowel get main stress
b. if the penultimate syllable contains a reduced vowel and the antepenult a full vowel the latter gets main stress
c. if both the penultimate and antepenultimate syllable have a reduced vowel that one is mainstressed that is separated by an odd number of syllables from the rightmost full vowel or, if there is no full vowel, from the left word boundary.

Full vowels are i, e, a and u and only the schwa counts as reduced. Stowell represents the difference between full and reduced vowels in terms of nucleus structure. Full vowels correspond to a branching nucleus and the schwa to a nonbranching nucleus. The key to Stowell's treatment of this stress system is the fact that feet (WS, Q-sensitive) iterate from the left, whereas main stress is located to the right. Of course the final syllable is marked as extrametrical. Here are some of the data that Stowell accounts for:

(45)
a. àkənutəmákən "story"
b. kətəwèhkanénnul "we use them"
c. lùhkewínəwək "workers"
d. sákəmak "chiefs"
e. èləkiləkə́pən "he was big"
f. mèkənutəsə́pənik "those who must have been chosen"
g. wəməsənə́mənəl "he gets them"
h. ətələsə́kwe "he's checking traps"
i. màtəyaqàsəkəníke "he is heard walking in the grass"
j. wəmə̀kəsèwalək̀ìkwehtáhal "he gave him a black eye"

These expressions are associated to the following grids:

(46) a.

```
                      *
   *                  *
   *        *         *
   **   *   **   *    **   (*)
   a    ə   u    ə    a     ə
```

```
b.                *
             *    *
         ⊛   *    *    *    *
     *   *   **   **   **   (**)
     ə   ə   e    a    e    u
```

```
c.          *
     *      *
     *   *  *
     **  ** **  *  (*)
     u   e  i   ə  ə
```

```
d.   *
     *      *
     **  *  (**)
     a   ə  a
```

```
e.                *
     *            *
     *     *      *
     **  * **  *  *  (*)
     e   ə i   ə  ə  ə
```

```
f.                *
     *            *
     *     *      *      *
     **  * **  *  *  *  (**)
     e   ə u   ə  ə  ə   i
```

```
g.             *
          *    *
      *   *  *  *  *  (*)
      ə   ə  ə  ə  ə   ə
```

```
h.          *
        *   *   *
     *  *  *  *  (**)
     ə  ə  ə  ə   e
```



```
i.                          *
     *          *           *
     *      *   *       ⊛   *     *
     **  *  **  **  *   *   **   (**)
     a   ə  a   a   ə   ə   i     e
```

```
j.                                 *
             *            *        *
         *   *    *       *    *   *     *
     *   *   *   **   **  *   **   **   **   (**)
     ə   ə   ə   e    a   ə   i    e    a     a
```

As we can see, **two** layers of rhythmic structure have been added, one filling up the rhythmless space between heavy syllables and the other one grouping "feet" from right to left. The clashing beats have been encircled. The present system has several interesting properties to which I will turn in the discussion offered in section 4.3.2. The main reason for discussing it here was to observe that Perfect Gridding, operating from left-to-right, produces a clash in examples b. and i. Prince (p.7Ø) therefore points out that the rule has to be marked as FCO since in these examples a star is placed immediately before a heavy syllable. Compare this to the **Hawaiian** system discussed earlier where PG failed to apply if a beat clashed with the "initial beat".

This system shows also, as Prince (p. 8Ø) observes, that the **trough** that meets the SD of PG(LR;tr) is not the weak beat of a heavy syllable, but the beat of a following light syllable. Were this not the case then the star laid down by PG in example i would have been on c rather than d:

(47)

```
         ab c d ef
         *      *
     ... ** * * ** ...
         a  ə ə i
```

PG applies to the string cd and not to bc. The pattern of secondary stresses in **Passamaquoddy** shows then two significant properties of PG. In full the grid based account looks like this:

(48) EM(F;Syll)
QS([voc])
PG(LR;tr)
PG(RL;pk)
ER(F;Wd)

Prince discusses other similar systems in some detail (**Creek**, **Cairene Arabic**) that also have quantity sensitive bounded feet and shows that his grid-only theory is capable of generating these systems as well. I refer to his article for some discussion of the tree theoretical accounts of these systems.

Before proceeding with the other types of stress systems let me draw attention to a third interesting property of the system of **Passamaquoddy**. The position of the **final** main stress in this language is determined by counting syllables from left-to-right. Both **Creek** and **Cairene Arabic** have this property too. As in the system of **Passamaquoddy** main stress in **Creek** falls on the last syllable in the word that is separated from a preceding heavy syllable or word boundary (if there are no heavies) by an even number of syllables. In **Cairene Arabic** the rule is the same except for the fact that the number of syllables must be odd. The reason for calling attention to this fact is that in by far the majority of stress systems that I know of main stress is located at the edge where PG (or foot assignment) starts. Consider again **Warao**. In this language PG runs from **left** to right and main stress is also located at the **left** edge. In section 4.3.3. I will argue that this is not accidental, but rather something that our theory must explain.

**4.3.1.4. Quantity sensitive systems: unbounded**

In Q-sensitive systems all heavy syllables are already gridded at the foot level. As no additional alternating stress is reported we must assume that such systems simply lack the rule of Perfect Gridding.

There appear to be two important subtypes of quantity sensitive unbounded systems ('E' means edge, '-E' means opposite edge):

(49) a. **E/-E**

Main stress falls on the **last heavy** or on the **first** syllable (if there are no heavies)

Main stress falls on the **first heavy** or on the **last** syllable (id.)



b. **E/E**

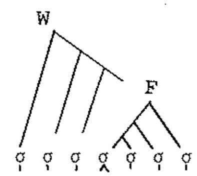
Main stress falls on the **last heavy** or on the **last** syllable (id.)

Main stress falls on the **first heavy** or on the **first** syllable (id.)

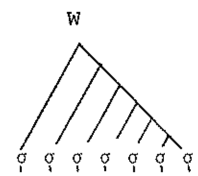
Hayes (1981) reports that for each type several cases have been attested. Let us look somewhat closer at these two types. The characteristic property of type (49a) is that the words that lack heavy syllables are stressed at "the other side": stress the **last** heavy of the word or the **first** syllable of the word. One of the crucial contributions of the arboreal theory has been that such systems and systems where the default case is precisely reversed (type b: E/E) could be handled by simply postulating constraints on the positions that the head of the foot may occupy.

To handle the E/E case we assume that the head of the unbounded foot **must** dominate a heavy syllable. Above we called this type of foot **quantity-determined**. To pick out the final heavy as locus for main stress we must furthermore assume that the word tree is rightbranching (case 5Øa below). When there is no heavy syllable in the word, we cannot place a foot in that word; there will only be a word tree (case 5Øb):

(5Ø) a.

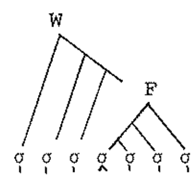



b.

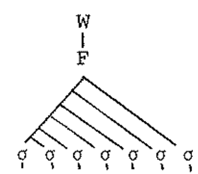



"σ̬" indicates a heavy syllable, "σ" a light one. To handle the E/-E case we do not require that the head of the foot dominates a heavy syllable, i.e. the head terminal is free. Hence if a word has no heavies the whole word will be dominated by one foot:

(51) a.




b.




Prince says that it will come as a "mild shock" that grid theory cannot make "simple" statements about these two cases. Let us go through the two systems. E/E is relatively simple:

(52) QS
ER(F;F)
ER(F;wd)

This rule can be simplified if we assume that the ER will always apply to the highest grid level, unless we explicitly demand otherwise. This reduces (47b) to:

(53) QS
ER(F)

The 'mild shock' comes when we consider the E/-E case:

(54) QS
ER(I;F)
ER(F;wd)

To derive the default (initial) stress, Prince assumes that the first syllable will always get a strong beat. The analysis is indeed suspect. One could argue that the order of the two statements is incorrect, i.e. we should not assign the first syllable a foot level beat **in each case**, but only if heavies are absent, i.e. the initial stress must be assigned by a "default rule" that only comes into action if there is no heavy syllable in the word.

In a standard SPE type of description the E/-E type required the use of essential variables (the Q-variable):

(55) $\sigma \rightarrow \acute{\sigma}$ / $-$ Q#

where Q is a maximal sequence of syllables not containing a heavy syllable

In the other type of case (E/E) a different type of variable must be used:



(56) $\sigma \rightarrow \acute{\sigma}$ / $-$X#

where X does not contain a heavy syllable

Instead of giving a somewhat suspect treatment of the last/first type Prince could have used the Q-variable in the formulation of his end rule, but he did not.

Halle (1982), granting the claim that the various word stress systems can be characterized by assigning grids to words directly, without the intermediate step of creating a metrical tree, also observes that for some systems this will entail that rules must make use of **essential** variables. Halle then says (p. 2):

> Thus, we now face the question as to whether anything has been gained by eliminating metrical trees if this elimination forces us to introduce variables, which are devices of great descriptive power. In fact, it would appear that metrical trees are considerably more restricted descriptive devices than variables and should, on those grounds alone, be preferred to variables.

By avoiding the use of essential variables Prince bypasses Halle's argument, but despite this it is clear that in accounting for this type of systems grid theory does not count as a clear improvement. The last/first type necessitates adding an extra parameter in tree theory (quantity determined feet), but it creates some "pressure" to adjust the grid theory as well. Prince is forced to introduce a category of end rules that introduce **foot** level beats, which are only taken into account if there are no other foot level beats (due to heavy syllables).

In the next section I will discuss the last group of stress systems: **limited stress systems**. In such systems stress falls on the peripheral (final or first) or near-peripheral syllable (penult or second). This type is interesting because it leads us to propose that grid theory must make use of a **domain parameter**, which brings the two competing theories again one step closer.

### 4.3.1.5. Limited stress systems and syllable weight

In a number of stress systems stress vacillates between the peripheral and near-peripheral syllable, depending on the weight of either both or one of the syllables involved. In this section I will show how such systems are or can be handled in both theories.

In the previous section we have seen two types of bounded Q-sensitive feet. In one type the dominant terminal could dominate a light or a heavy syllable (i.e. the terminal node is free), in the other type the dominant node had to dominate a heavy syllable. One will recall that these two possibilities implied different **default** options for words containing no heavy syllables. It appears that both unbounded systems have a "local" counterpart. I will start with the first type, i.e. the local counterpart of the type of stress system where the default option leads to stress at the opposite end of the word.

(57) **Rotuman stress**
Stress is final if the final syllable is heavy, prefinal otherwise

**Latin stress**
Stress is penultimate if the penultimate is heavy, antepenultimate otherwise

**Ossetic stress** (Hayes 1981, 78-79)
Stress is initial if the first syllable is heavy, on the second syllable otherwise

**Rotuman** and **Latin** are of the type "last heavy or first", whereas Ossetic is of the type "first heavy or last". To make this explicit we could reformulate the two cases as follows:

(58) **Latin**
Stress falls on the last heavy or the first syllable, **considering only the final two syllables**

**Ossetic**
Stress falls on the first heavy or the last syllable, **considering only the first two syllables**

The crucial difference as compared with for example **Eastern Cheremis** is that the choice for "last" or "first" is limited to the two final syllables (in **Latin** the real final syllable is extrametrical). In tree theory such systems are accounted for by assigning bounded feet non-iteratively. Consider **Rotuman** as an example:

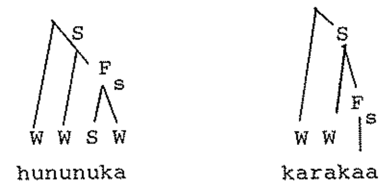


(59)

| | |
|---|---|
| tā́ka | "lie down" |
| hununū́ka | "grasp for breath" |
| marṓo | "to be taut" |
| karakā́a | "snore" |

(6Ø) a. Assign a left dominant Q-sensitive foot at the right edge (non-iterative)
b. Word tree is right dominant (labelled WS)

(61)




In the grid-only theory I can think of the following way to handle cases like **Rotuman** or **Latin**. Either we stipulate that only the final two syllables may be considered and assume a rule of the form ER(I;F) or we apply PG non-iteratively, peak first. In both alternatives the ER(F) completes the analysis. Clearly there is little difference in effect between non-iterative PG and an ER applying to a domain of two syllables.

The point that is really relevant here is that the equivalence between the unbounded systems discussed in the previous section and the bounded systems discussed here can only be brought to the surface in the grid only theory by adding a domain parameter to the theory. This parameter has two values: the two peripheral syllables or the whole word. It needs little emphasizing that such a parameter is highly comparable to the bounded-unbounded parameter in the tree theory.

On the assumption then that only the final two syllables are taken into account the stress system of **Rotuman** can be derived as follows (assuming a monopositional representation of heavy syllables):

```
(62)        a.    *        b.  *          c.  * *       d.
             ...*  *#       ...*  *#       ...*  *#      ...*  *#
                σ  σ           σ  σ           σ  σ          σ  σ

   ER(F;wd)       *            *                *             *
   ER(F;F)        *            *              * *             *
                * *          * *              * *           * *
                σ σ          σ σ              σ σ           σ σ
```

Let us now consider the local counterpart of the E/E type of system. In this case the weight of both peripheral syllables matters:

(63) **Yapese stress** (Hayes 1981, 65)
Stress is prefinal if the final syllable is light and the penultimate heavy, final otherwise

**Malayalam stress** (Hayes 1981, 66)
Stress is post-initial if the first syllable is light and the second heavy, initial otherwise

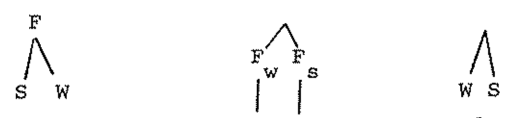
In tree theory the device employed to handle these cases is similar to that employed for the unbounded "last, last" and "first, first" cases, i.e. a foot whose head **must** dominate a heavy syllable. This can be made clearer if we again reformulate the above statements:

(64) **Yapese stress**
Stress the final **heavy** syllable or the final syllable (if there is no heavy), **considering only the final two syllables.**

**Malayalam stress**
Stress the **first** heavy syllable or the first syllable (if there is no heavy), **considering only the first two syllables.**

Comparing this with (42b) we realize that **Yapese** is the bounded counterpart of **Acuacatec Mayan**, whereas **Malayalam** is the bounded counterpart of **Khalkha Mongolian.**

Let us consider the tree treatment of **Yapese:** at the right edge of the word we assign a leftdominant Q-determined foot (i.e. a foot whose head must dominate a heavy syllable). Feet are gathered in a right dominant word tree:

(65)



a. saalap    b. magpaa    c. pa?ag

Since the dominant node must branch no foot can be assigned to the third word. The word tree produces final stress. In **Malayalam** we get the reverse: we assign a left dominant Q-sensitive foot at the left edge. The word tree is left dominant.



Of the limited stress systems that we discuss in this section Prince only mentions **Malayalam,** for which he suggests the use of two end rules, i.e. ER(I;F) and ER(I;Wd). Had Prince considered the Latin/Rotuman type of case, he would have realized that using two end rules necessitates a domain parameter, limiting the domain of application to two peripheral syllables. In **Malayalam** the four possible cases at the beginning of the word come out as follows:

```
(66)      a.   *        b.  *          c.  * *         d.
             #* *...      #* *...        #* *...         #* *...
              σ σ          σ σ            σ σ             σ σ

ER(I;wd)       *            *              *               *
ER(I;F)        *            *              * *             *
              * *          * *            * *             * *
              σ σ          σ σ            σ σ             σ σ
```

The ER(I;F) cannot assign the star to the first case where the word starts with a light-heavy syllable sequence and therefore ER(I;wd) will stress the second syllable. The same type of approach can also be used in cases where "retraction" occurs at the right edge. In that case we arrive at the following analysis for **Yapese:**

(67) i. ER(F;F)
ER(F;wd)

```
  ii. a.   *        b.  *          c.  * *         d.
        ...* *#      ...* *#        ...* *#         ...* *#
           σ σ          σ σ            σ σ             σ σ

ER(F;wd)   *            *                *               *
ER(F;F)    *            *              * *               *
          * *          * *            * *             * *
          σ σ          σ σ            σ σ             σ σ
```

The following table makes explicit the similarities between the local and non-local QS systems:

(68)

| | **last/first** | **last/last** |
|---|---|---|
| **non-loc.** | ER(I;F) | ER(F;F) |
| | ER(F;wd) | ER(F;wd) |
| **local** | ER(I;F) | ER(F;F) |
| | ER(F;wd) | ER(F;wd) |

Let us now consider a **third** type of peripheral stress system:

(69) **Type three**
Stress is near-peripheral if the near-peripheral syllable is heavy, peripheral otherwise

We find this type both in the word-initial and the word-final variety:

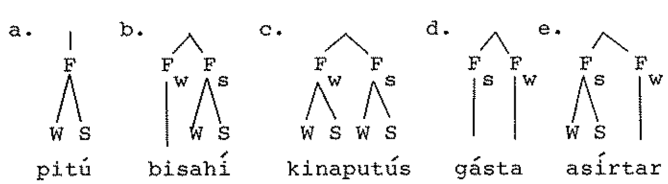
(70) **Creek stress, Aklan stress**
Stress is prefinal if the prefinal syllable is heavy, otherwise stress is final

**Capanahua stress**
Stress is on the second syllable if it is heavy, otherwise stress is initial

In **Aklan** and **Creek** we only get a penultimate stress if the penult is heavy (closed). The **Aklan** stress system is described by Hayes (1981). To account for this type Hayes employs the LCPR. Given this labelling rule the **Aklan** system can be generated as follows:

(71) a. assign right dominant Q-sensitive binary feet, RL
b. assign a right dominant word tree, LCPR

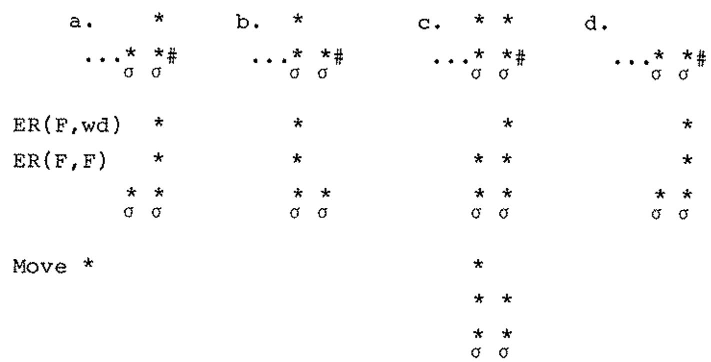
Consider the following examples, taken from Hayes (1981, chapter 2):

(72)



In examples d and e it is not possible to combine the two peripheral syllables into one foot, because the penultimate syllable is heavy (i.e. closed); it cannot be the weak daughter of a foot. Another possible analysis would be to say that the two peripheral syllables are always combined into one foot that is labelled by the LCPR (left node is strong iff it branches). In fact this is the type of analysis that Hayes proposes for the mirror image case in **Capanahua**.

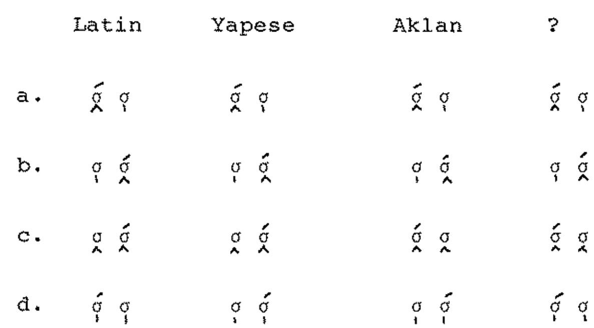
A grid theoretic account of this type of system must be as follows. After application of an ER(F) we apply a rule of the form "move *" (cf. Halle 1982):



(73)



In section 4.3.1.2. we noted that tree theory can resort to a special labelling rule, the LCPR, and that the counterpart of this LCPR in grid theory would be "move *". It now appears to be the case that adding "move *" to grid theory was not just a remote possibility. To describe this third type of limited stress system such a movement rule is required.

So far we have seen three types of limited Q-sensitive systems in this section. Before ending this survey of stress systems I want to raise the question whether a fourth type occurs as well, and if so, what consequences that will have for our two competing theories:

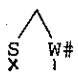
(74)


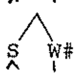

Case d is the (so far) unattested type. Notice what the three attested types have in common. If there is a difference in syllable weight the heavier syllable always bears main stress (case a and b). However, when the syllables are of equal weight we find three out of the four logically possible systems (case c and d). Grid theory has no problems in generating the fourth type of system:

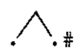
```
(75)      ER(I,F)
          ER(F,Wd)
          move *

(76)      a.     *        b.  *          c.  * *        d.
             ...* *#       ...* *#         ...* *#        ...* *#
                σ σ           σ σ             σ σ            σ σ

     ER(F,wd)    *             *                 *               *
     ER(I,F)     *             *              *  *               *
               * *           * *              *  *             * *
               σ σ           σ σ              σ σ              σ σ

     move *                                   *
                                              * *
                                              * *
                                              σ σ
```

It is interesting that tree theory offers no means to characterize this type of system. If we accept the second analysis suggested for **Aklan**, this theory offers only three possibilities:

(77)


i.e. Quantity-sensitive foot


i.e. Quantity-determined foot.


i.e. Foot labelled by the LCPR (i.e. left node strong iff it branches)

These three possibilities correspond exactly with the attested cases.

The question of the "missing fourth type" will be taken up in chapter 5 where I analyze the stress system of Dutch. I will propose two analyses which both suggest that Dutch represents the fourth type. The type of foot that is required for Dutch deviates from the three types in (77) in that the weak daughter(s) are allowed to contain both light and heavy syllables.

### 4.3.2 A conclusion and a proposal

In the previous sections we have seen that both the grid and the tree theory are capable of accounting for the variety of stress systems and that both face the problem that some systems can be generated in more than one way. We have also seen that Prince (p. 20) may have been somewhat too optimistic in saying that a theory has emerged that is "significantly simpler" than the arboreal theory. It has been made clear here that applying grid theory to the full range of attested cases forces one to add more and more machinery until one ends up in a situation in which there is an almost perfect one-to-one correspondence between the grid and tree theory:



(78)

| Tree theory | Grid theory |
|---|---|
| Foot assignment | Perfect Gridding |
| -direction:LR/RL | -direction:LR/RL |
| -dominance:SW/WS | -dominance:pk/tr |
| -Quantity Sensitive:Yes/No | -QS:Y/N |
| -Quantity determined:Y/N | -Foot level end rule |
| -shape:bounded/unbounded | -domain:bounded/unbounded |
| Word Tree | End Rule |
| -branching:left/right | -Edge:I/F |
| -labelling:uniform/LCPR | -Move * |
| Extrametricality | Extrametricality |

We have seen that in a few cases the theories make slightly different predictions, but this is only the case if we disregard the fact that both theories can be slightly adjusted here or there to eliminate or add empirical claims. I think that the conclusion is justified that the single discriminating property is the absence or presence of a detailed word internal prosodic structure:

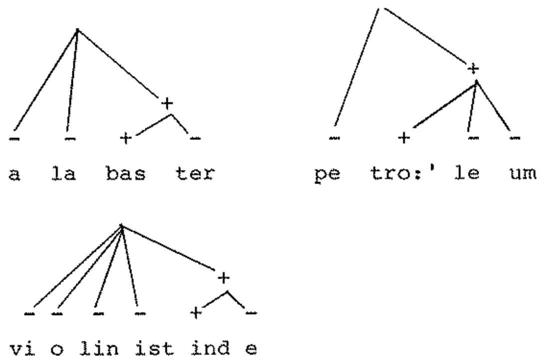
(79) **Tree theory** **Grid theory**

I have assumed here that, although Prince makes no use of foot assignment or uniformly branching trees, it is not his intention to deny the existence of the prosodic hierarchy as distinct from the morpho-syntactic hierarchy. Now the two structures embody two rather extreme views and we must not exclude the possibility that an intermediate position may turn out to be preferable to either of the two positions considered so far.

Rischel (1982, 2Ø1) presents such an intermediate position:

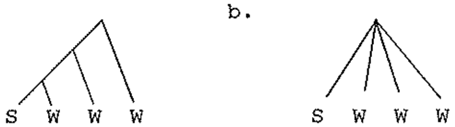
> [...], there seems to be more of a break between **the pretonic part and the remainder** than between the posttonic part and the syllables preceding it; this appears in that it is possible to hesitate between the (last) pretonic syllable and the stress-syllable rather than elsewhere, and that there may be an extremely sharp intonational break here. I therefore venture to suggest a hierarchical arrangement as follows, [...]

(8Ø)



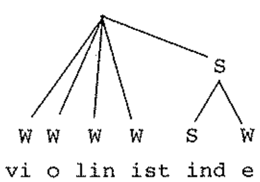

The examples are from Danish. Leben (1982) offers suggestions that are similar in certain respects. He argues that there are no compelling reasons for assuming that prosodic constituent structure is binary branching. His proposal is to replace structures as in (81a) with structures as in (81b):

(81) a. b.




If Leben's proposal is adopted the word **violinistinde** could be represented as follows:

(82)






In Halle and Clements (1983), finally, the same approach is found. They assume no labelling whatsoever. Instead the leftmost or rightmost daughter is dominated by a branch that ends in a dot, thus indicating that a particular syllable is the **head** of a constituent. Clearly, there is no significant difference between using + and -, S and W or any other conceivable way to indicate that within a particular constituent one daughter is the head, i.e. the strongest element. It is furthermore irrelevant to ask whether we are going to call multiple branching structures "metrical" or "autosegmental". The important point is that there is some plausibility in Rischel's proposal to differentiate main stress, expressed in terms of a labelled constituent structure, and other, more detailed aspects of the prominence pattern of words.

In chapter 1 I pointed out that standard metrical theory is based on two fundamental ideas. The first idea is that prominence relations are expressed in terms of a SW labelling imposed on a constituent structure, and the second idea is that the constituent structure is binary branching. The two ideas are logically independent. We can say then that in the proposals advanced by Rischel and Leben only one of the fundamental ideas behind standard metrical theory is dropped. Rischel goes one step further than Leben, however, and also questions the use of constituent structure (i.e. feet) to characterize non-primary stresses (p. 2Ø1):

> If some syllables among the unstressed ones are felt to be more prominent than others, this is probably ascribable to two factors, viz. (1) that each syllable has an inherent degree of prominence, which is a function of its phonological make-up (closed syllables having more prominence than open syllables, and syllables with a full vowel more prominence than syllables with schwa), and (2) that the pitch contour associated with a full stress [...] supplies each syllable with a tone level ($F_o$ level) which contributes to the impression of more prominence or less prominence. I have not considered it useful to build such considerations into the assignment of hierarchical structure to a clustering of zero-syllables around a full-stress syllable (and my model therefore comes to look somewhat different from those proposed for English in recent work such as Liberman and Prince 1977 and Selkirk 198Ø).

Rischel does not mention the natural tendency to assign a rhythmic structure as a possible (third) factor. It seems to me that rhythmic structure is an important factor, and both impressionistic and phonetic evidence (involving Swedish data) will be discussed in section 4.3.4.2. We can still agree with Rischel, however, and argue that this rhythmic structure too does not have to be expressed in the constituent structure.

The interesting aspect of structures like (80) and (82) is that a fruitful partnership between arboreal theory and grid theory is emerging here. The implication of assuming structures as in (80) and (82) is that main stress is characterized in terms of a labelled constituent structure and that as a consequence secondary accents must be characterized differently. I propose the following theory of stress assignment.

I will assume that main stress arises by assigning a **foot** at one of the edges of a word. Since the sole goal is to assign main stress, foot assignment need never be an **iterative rule**. To distinguish the foot assigned by a non-iterative stress rule from feet in standard metrical theory, I will refer to the former as a **stress foot**. As a general convention we may adopt Rischel's proposal that syllables outside the stress foot are combined as equal sisters of the stress foot into a constituent labelled (prosodic) word. Part of this general convention would be that the labelling of the word tree is always such that the stress foot is S (or +). This is no different from a convention proposed by Liberman and Prince (1977) and Hayes (1981) in connection to the **Stray Syllable Adjunction Rule**. In Hayes' proposal too, syllables that are adjoined to existing structure by means of this rule are always weak. The resulting arboreal theory is considerably simpler and more constrained than standard metrical theory, yet it makes use of some of the important parameters that have been proved to be useful. In particular it takes over the array of foot types that were discussed at the end of the previous section (plus their mirror image cases), with one difference: feet that contain more than two syllable need not be binary branching.

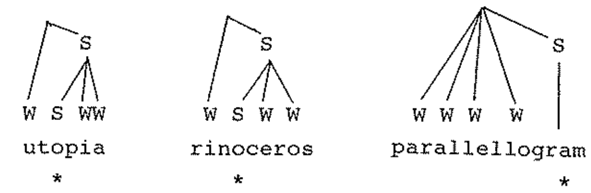
As in the standard LP theory a grid is projected from the tree, although the projection rule is even more trivial than the RPPR:

(83) Assign an asterisk to the strongest daughter of the stress foot

Leaving out the first grid level as somewhat redundant the following Dutch words have been assigned prosodic structure according to our (still rudimentary) tree-cum-grid theory:

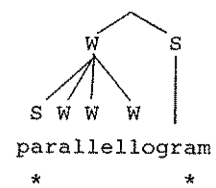


(83)




It has been observed many times that in languages having final stress, the initial syllable of a word, if separated by at least one syllable from the main stressed syllable, bears a strong secondary stress. This is also the case in Dutch. Proceeding on the assumption that such a strong secondary stress is not present in all languages that have final stress, let us see how we might differentiate between languages with and languages without an initial beat. We might say that in languages of the former type syllables outside the stress foot are gathered in a second foot that is a sister of the (main stress) foot. I will use the term **antipole stress foot** for this second foot, which, I emphasize, does not result from iterative application of the stress rule, but by means of a separate convention. Since Dutch has an initial beat of the type referred to the structure of **parallellogram** could be represented as in (84):

(84)




A limited tree structure of this type has the advantage that it expresses adequately the fact that longer words have two suitable locations for anchoring pitch accents. This is the case both in Dutch and in English. I do not want to pursue this topic in great detail, but it is interesting to devote some attention to it in order to motivate a constituent structure as in (84). I quote Bolinger (1981,26) here:

> [...] it is not necessary - or even accurate - to insist that "primary" is more prominent than "secondary" [...]. To show this we need only demonstrate that the "pronunciation" of a word constitutes an intonational pattern, and that pattern is its citation form.

With "secondary" Bolinger refers to the strongest non-primary stress, located, in English, at the beginning of the word. Bolinger points out that in English answering a question leads to an intonational pattern that he expresses as follows (p. 26):

Q: Where did you go?
Bos
went
A: I to
ton

He continues:

> Similarly a citation form is an answer to a question: **What word did you use?** or **How do you say this word?**, and the same question-answering contour is used, with the high second peak:

poe ga a
On Al ten
omato le At u
ia tion tion

In Bolinger's view the syllable carrying main stress is simply that syllable which is associated to the highest pitch peak present in the intonational pattern that is characteristic of the citation form.

> If prominence is defined in intonational terms, we have here the simplest explanation of why the full syllable at the cutoff point has been called "more prominent". The analyst reads into the lexical representation of word prosody the intonation of the citation form that is ringing in his ear. (p.28)

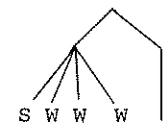
There are cases, however, where the syllable with the so-called secondary accent is the most prominent syllable of the word. Bolinger mentions examples where isolated words receive the highest pitch peak on the first syllable and also mentions the familiar cases of "stress shift" found in phrases of the type **thírteen men** or **ácademic discipline**. If we take the two syllables that have been associated to a grid mark as equal then it is more appropriate to speak of selection rather than shift:



> In **things academic** versus **ácademic things** the difference is not so much a shift as a SELECTION. Counting leftward beginning with the cutoff point there are two long syllables, two positions that can bear an accent, and the one is chosen that is more convenient for the pitch turn.

If Bolinger is right and a correct analysis of so-called shifts involves selection then it may be better to represent the structure in (84) without the higher level labelling:

(85)




parallellogram
*          *

A possible objection to a structure like in (84) or (85) might be that it does not do justice to the "rhythmic structure" of the word **parallellogram** that is claimed to have a strong beat on its third syllable. I would like to argue that the presence of a beat on the third syllable does not force us to abandon our restricted arboreal theory. I propose that the rhythmic structure for which tree theory has introduced iterative foot assignment and grid theory the perfect grid is represented separately from those aspects of the rhythmic structure that in the present proposal have been characterized in terms of a labelled constituent structure. I suggest that the alternation of strong and weak syllables is characterized by a "rhythmic melody" that is placed on a separate tier (Prince suggests the term rhythmic melody). An argument in favor of this proposal is the fact that rhythmic beats are not suitable locations for placing a pitch accent. The following example illustrates this point. In the phrase **Apalachicola falls** it is claimed (e.g. in Hayes 1984) that the main stress can shift back due to a stress clash (employing current terminology). It cannot shift back to the third syllable, however. The only possible landing site is the first syllable.

The proposal to separate two aspects of the rhythmic structure conforms to the view expressed by Bolinger, who argues in favor of separating what he calls **accentual rhythm** and **syllabic rhythm.** Accentual rhythm involves the tendency to avoid situations in which syllables associated to a pitch accent are too close to each other. Syllabic rhythm involves an alternation of strong and weak syllables. This syllabic rhythm may be due to intrinsic properties of the syllables (such as the quality of the vowel or another property that determines syllable weight) or to an extrinsic rhythmic pattern (i.e. a perfect grid) or both.

In this section I have advanced two proposals. The first proposal is to separate two components that together make up the prominence pattern of utterances and the second proposal is to deal with the one in terms of a labelled constituent structure and the other in terms of a rhythmic melody.

The two proposals are logically independent, i.e. it would be possible to separate the two components and maintain at the same time that both aspects of the prominence pattern are jointly characterized by either a grid or a tree structure.

In the next two sections I will give additional support to the view that main stress assignment (and possibly assignment of the strongest secondary stress) must be separated from the assignment of alternating stress. Then I will return to the issue of constituent structure.

### 4.3.3. The main stress first theory

In this section I want to reconsider certain aspects of the analyses that have been offered in section 4.3.1. I will propose that a certain redundancy present in the analyses leads to the conclusion that we must alter our view of the relation between main stress and alternating stress surrounding it.

An appropriate starting point will be to consider in detail the view on characterizing rhythmic structure that was discussed at the end of the preceding section. Instead of building the grid going through the word from left to right or from right to left I will regard the perfect grid as a pregiven autosegmental melody, i.e. a rhythmic melody. Stress systems of the type we discussed in section 4.3.1.1. (bounded, Q-insensitive) could then be generated as follows:

(86) **Warao**

Initial Stress Association Rule (ISAR):

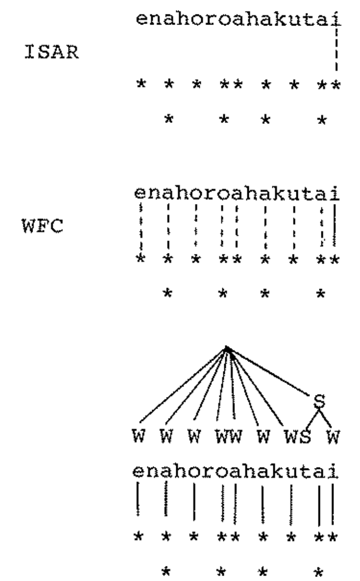
Associate the last Stress Bearing Unit with a trough

After application of this ISAR the Wellformedness Condition (WFC) applies thus completing the derivation. The reader will notice that the present alternative comes very close to the way in which tone patterns are associated to words in tone languages (cf. chapter 1). Indeed, I think that



what we have here is more than suggestive terminology.

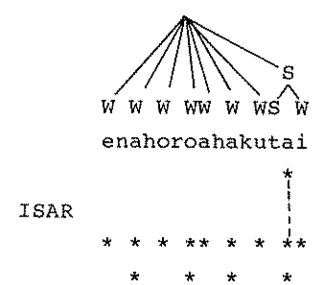
(87)




Main stress has been accounted for by assigning a binary SW foot at the right edge and a multiple branching word tree labelled W*S.

The description just given contains a redundancy, however. The fact that the ISAR and the Main Stress Rule refer to the same edge suggests a simpler analysis. Suppose the first move is to apply the main stress rule, assigning (via the tree) a star to the penultimate syllable. The rhythmic melody is then associated by another type of ISAR that requires that the star is linked first, to a peak on the melodic tier. Again the WFC completes the association between melody and text:

(88)



```
            enahoroahakutai
            | | | || | | *|
      WFC   | | | || | | ||
            | | | || | | ||
            * * * ** * * **

              *   *  *   *
```

It seems to me that the relative ordering of first assigning main stress and then the rhythmic melody is attractive, not only because it eliminates the redundancy, but also because it reveals quite straightforwardly to what extent pitch-accent systems and stress-accent systems are the same. The difference between the two arises because in the former type of system a **tonal** melody is anchored to the star (as, for example, in Japanese), whereas in the latter type a **rhythmic** melody is anchored to the star.

Let us now look at "standard" tree and grid theory. In both grid and tree theory main stress arises by assigning a peripheral foot head status in the word tree or by adding an extra beat to the first assigned perfect grid. In other words, we first assign "alternating stresses" and then promote one of them to "primary stress". The above discussion suggests another way of looking at alternating stresses, viz. making them dependent on the main stress. Garde (1968, 53) speaks about alternating stresses (of the kind we are considering here) as "écho de l'accent". Here I want to take this metaphor seriously and propose that much can be gained if we say that alternating stress results simply as a "by-product" of main stress. To speak in grid terminology: Perfect Gridding is determined by the End Rule. In section 4.3.1.1. I mentioned this conception of the relation between main stress and alternating stress, referring to it as the main-stress-first-theory. In this section I will explore the possibilities and problems that cross our path if we adopt it.

Let us observe that, with a few exceptions (**Passamaquoddy, Creek, Cairene Arabic, Garawa**), systems with alternating stress (with PG) locate the main stress at the edge where iteration of PG starts. So if PG goes from left to right the ER applies word initially and vice versa. If we take this to be the unmarked case, it should be reflected in the formulation of our rules.

To take the simplest example first, let us look at the stress system of **Maranungku**. Here main stress is located on the first syllable and counting from that syllable rightward a secondary stress falls on every other syllable. In standard grid theory (as in standard tree theory) we first assign alternating stress and on the basis of this we determine the main stress. Suppose that we reverse the order and first assign main stress to



the first syllable and, based on this, then determine alternating stresses. Under this proposal alternating stresses can properly be called **echos** of the main stress.

Above we saw that this proposal easily translates into an autosegmental grid theory. Of course the order in which main stress and alternating stress is assigned can also be reversed if we adopt Prince's view in which the grid is built up, bottom-to-top. Within this approach **Maranungku** would have the following analysis:

(89) a. End Rule (I;wd)
b. Perfect Gridding

If we assign main stress first we must assume that the ER (which is our main stress rule) as formulated will promote the final stress-bearing unit directly to the word level:

(90)

```
                  *
                  *
      * * * * * * *
      σ σ σ σ σ σ σ
```

Another way to obtain the same result is to say that the end rule is formulated as ER(I) and simply adds one beat and that this beat survives perfect gridding by a general convention:

(91)

```
                      ER(F)                    * PG
      * * * * * * *    =>     * * * * * * *  =>
      σ σ σ σ σ σ σ           σ σ σ σ σ σ σ

                  *
      *   *   *   *
      * * * * * * *
      σ σ σ σ σ σ σ
```

In the approach Prince takes PG must be specified for at least two parameters (direction, dominance). Selkirk (1984) follows Prince in this respect. Adopting the main stress first theory proposed here it is obvious that a PG rule, whose parameters have not been specified, cannot apply before the ER has applied, just as the echo can only come after and never before your coin hits the bottom of the well. I suggest here that (unless specified otherwise) PG will always move away from the main stress and, since no clash will be produced, that it will lead to a trough on the syllable next to the main stressed syllable. If sufficient syllables both precede and follow the main stress PG may go in two directions, as seems to be the case in **Cahuilla**, referred to by Prince as being problematical for a standard grid theory.

The following rules generate the stress systems with peripheral stress discussed in sect. 4.3.1.1.-2.:

(92)
a. ER(F) + PG
b. ER(I) + PG
c. ER(F) + EM + PG
d. ER(I) + EM + PG
e. ER(F)
d. ER(I)
e. ER(I) + EM
f. ER(F) + EM

Recall that EM stands for 'extrametricality. The first four (+PG) correspond to the insensitive bounded systems, whereas the latter four correspond to the insensitive unbounded systems, i.e. those that do not have alternating stress.

Let us now investigate how this extremely simple approach can be extended to handle all the other stress systems, without losing its attractiveness. I will discuss here the cases of **Hawaiian**, **Garawa**, **Winnebago**, **Passamaquoddy** and **Tübatulabal**.

I will first consider the **Hawaiian** stress system. Recall that this system was like elementary systems with two additional properties. The main stress is penultimate, rather than final and in words with five or more syllables the initial syllable has a secondary stress. Let us assume that the final syllable is extrametrical. How are we going to generate the beat at the left edge? Prince's solution was to formulate another ER, operating before PG. After that PG, moving away from main stress, fills in the rhythmic space without creating a clash:

(93)

```
                                                 *
                    *               *            *
*   *   *   *   *   *  (*)   =>    *   *   *   *   *   *   *   =>
σ   σ   σ   σ   σ   σ           σ   σ   σ   σ   σ   σ   σ
```

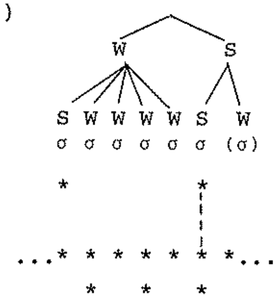


```
                    *
*                   *
*         *         *
*   *   *   *   *   *   *
σ   σ   σ   σ   σ   σ   σ
```

The difference between **Hawaiian** and **Maranungku** is then that the latter lacks an ER, which causes what I called in the previous section an **antipole** stress.

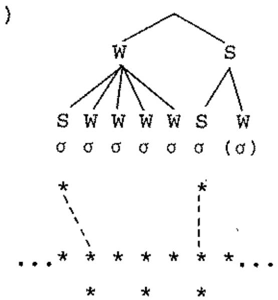
In the previous section I have suggested that the presence of an antipole stress can be accounted for by assuming that syllables outside the stress foot are gathered into a second foot. The rhythmic structure of Hawaiian words is accounted for by associating a rhythmic melody to the final main stress:

(94)



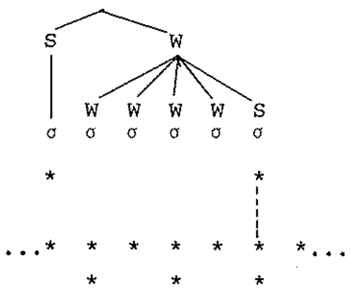

It is not evident that we must prevent a peak from associating to the second syllable. We might adopt as a matter of convention that stresses corresponding to trees are always stronger than strong beats on the rhythmic melody. Another possibility would be to say that the ISAR requires that each syllable that is the head of a foot must be associated to a peak:

(95)



**Garawa** has initial main stress and a prefinal secondary stress. In addition there is an alternating pattern. As described in Hayes (1981) the leftmost foot is ternary if there is an even number of syllables between the main stress and the prefinal secondary stress. We can explain this pattern by assuming that the rhythmic melody is associated first to the secondary stress:

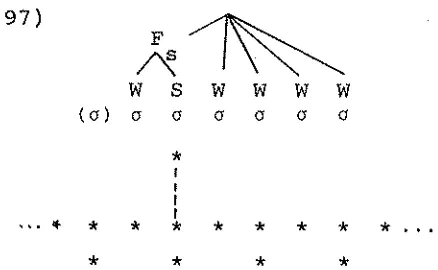
(96)



The stress system of **Garawa** is special (and perhaps suspect) because the ISAR refers to the strongest syllable of the weak foot instead of referring to the strongest syllable of the strong foot.

Prince notes that **Winnebago** is problematical for a theory in which PG is "subservient to the ER and rather characterless", filling out "those portions of the grid that the End Rule cannot reach, in an entirely predictable way" (p. 51), in short the theory we are defending here. The reason is that main stress is located on the third syllable. In Prince's conception of the End Rule we can reach at most the second syllable, with the help of extrametricality. Things are different, however, in the theory of end rules (i.e. stress rules) that I have adopted. End rules in my view are foot assignment rules, feet being bounded or unbounded. We can therefore reach the third syllable by marking the first syllable extrametrical and assigning a bounded WS foot, quantity insensitive:

(97)

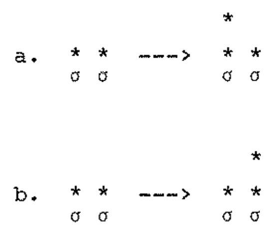




The implicit claim behind the present proposal is that alternating stress in all the examples given is a mere **phonetic** phenomenon, completely determined by the main stress. The question might be raised whether alternating stress assignment cannot also be a rule of the phonology proper, ordered at an earlier level. Without even considering the implications one would expect such a situation to be possible. Phenomena that are phonetic ("low-level") in one language may be phonological in others. This is a very common state of affairs.

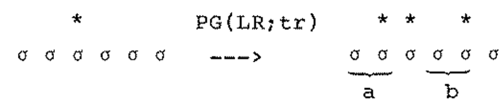
Suitable candidates are cases where the location of the main stress depends on counting syllables from the word edge that is opposite to the main stress location. I would like to argue that in such cases application of alternating stress assignment has gained the status of an iterative phonological rule, whose structural description is limited to two grid positions:

(98) **phonological PG**



An important consequence of this proposal is that the systems of **Passamaquoddy**, **Creek** and **Cairene Arabic** can thus be handled without assuming **FCO**. And since these languages provided the crucial evidence for that parameter it can be dispensed with altogether. Take the system of **Passamaquoddy** as an example:

(99)

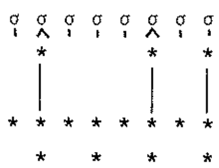


It is not necessary to say that PG(LR,tr) is FCO, because PG is an iterative rule whose SD is limited to two positions. In the schematic example given above, it finds two such substrings, a and b. The rule, applying to the first two grid positions cannot see the third position, which happens to be heavy. Note furthermore that assuming a heavy syllable to be monopositional circumvents the problem that it would otherwise not be clear why the second application disregards the alleged second grid position of the heavy syllable. **Mora sluicing** is unnecessary. The second layer of perfect gridding in **Passamaquoddy** is of a phonetic nature. Here we find no clashes. There is only an alternating pattern moving away from the main stress. **Passamaquoddy** is a language that has both **phonetic** and **phonological** gridding.

The interaction between heavy syllable stressing and assignment of alternating stress can also be handled within the present proposal. Consider the case of **Tübatulabal.** The stress system of this language requires the following set of rules:

(100) a. Assign main stress to the final syllable
b. Assign stress to every heavy syllable
c. Associate the rhythmic melody peak-to-peak

(101)



The difference between phonological and phonetic gridding lies in the fact that the second really produces ideal rhythm. That phonetic gridding serves the "laws of eurhythmy" better than phonological gridding is not different from the phenomenon that lower-level rules generally serve the "laws of pronunciation and perception" much better than phonological rules proper. I emphasize that the distinction between phonetic and phonological gridding is by no means an unsurprising move. To make this clear I will briefly discuss the completely parallel case of syllable weight.

There is presumably no language in which all syllables are precisely the same in terms of length, intensity, sonority or whatever phonetic property that may be intrinsically connected to stressing. In such languages, we might say, syllable weight is a phonetic phenomenon, taken into account after stress has applied. However, in a language in which syllable weight does count for stress purposes syllable weight has been "phonologized", which means that the phonetic rules that spell out syllable weight are now ordered before the stress rules. All this simply involves the wellknown phenomenon of **phonologization.** What I have proposed above boils down then to the (perhaps trivial) claim that imposing a rhythmical pattern on words is a phonetic property that has, in some languages, been phonologized.



I realize that the proposals advanced in this section are programmatic and in need of further elaboration. The point that I want to make here is that main stress assignment must take priority over alternating stress assignment. It has furthermore been suggested that such a move allows us to combine (a slightly modified) metrical and autosegmental theory in an interesting way. In the next section I want to support the priority of main stress assignment with a quite simple argument, involving the treatment of free stress systems.

### 4.3.4. Fixed stress and secondary stress

#### 4.3.4.1. Introduction

So far we have discussed stress systems in which the location of main stress was predictable on phonological grounds. Systems like these are called **fixed stress systems.** Opposed to fixed systems are **free stress systems.** In the latter type of system the location of the main stress is not predictable on phonological grounds and must therefore be regarded as lexical or morphological information. Lexical information means that certain segments or morphemes are provided with a stress mark in the lexicon.

It is known, however, that in most of the so-called fixed stress systems certain irregularities occur, whereas in systems that have been described as free subregularities can be discerned in many cases. It is therefore impossible to draw a sharp line between fixed and free systems, not least because the status of being irregular is itself dependent on the analysis. Within the SPE framework it is for example possible, if not required, to establish phonological regularities by giving forms that appear as exceptions at the surface a different underlying representation to which a regular phonological rule may apply. Stress rules refer to specific lexical items, affixes, word classes or other non-phonological information only as a last resource, i.e. in those cases where any phonological generalization requires the analyst to assume underlying representations that are completely ad hoc. Within this framework then the dichotomy between fixed and free stress systems appears in a different way. Fixed stress systems have stress rules that are "surface true", i.e. that express generalizations about the surface representation of the words of the language. Typically such rules refer to phonological properties, such as edges of prosodic domains, syllable weight properties and the like. Free stress systems, on the other hand, have rules that refer to abstract representations, i.e. to phonological properties that are subject to transformation in the subsequent derivation or to non-phonological features.

Within the framework of lexical phonology the distinction between "late" and "early" stress rules has been given a clear status. The fact that early rules are often restricted to apply in words derived by particular classes of affixes is no longer attributed to abstract phonological properties of these affixes, but rather to a classification of affixes. In this sense lexical phonology meets some of the objections that have been raised against the SPE "phonologism", though some argue that even the generalizations made within one morphological level are not really of a phonological nature and should refer to classes of affixes directly (e.g. Strauss 1982). I will not go into this issue here. Within lexical phonology early rules are referred to as cyclic (or lexical) and late rules are referred to as post-cyclic (or post-lexical).

In this section I will demonstrate that the main stress first theory, proposed in the preceding section, finds support in the fact that the system of secondary stresses in free and fixed stress systems is completely governed by the same rules.

A second issue that I wish to discuss is related to the first. In the previous sections we have seen many stress systems in which secondary stresses (except for the antipole secondary stress) are determined on phonological grounds:

(102) a. location of main (or antipole) stress
b. syllable weight

I will investigate in this section whether the rules that assign secondary stress in fixed stress systems are sufficient to account for secondary stress in free stress systems.

For those who are familiar with the literature on "cyclic stress rules" the obvious answer will be **no**. A certain syllable of a morphologically complex word may carry a secondary stress because the "same syllable" of a related word from which the complex word is (indirectly) derived carries main stress. Since such secondary stresses cannot be predicted on phonological grounds alone, they support the view that among non-primary stresses the distinction between fixed and free exists too. This brings the number of non-primary (or secondary) stress types to **three** (ignoring the antipole secondary stress):



(103) **Secondary stress types**

a. Sec. stress due to **syllable weight**
b. Sec. stress due to **echo**
c. Sec. stress due to **cyclicity**

It is logically possible that all three types play a role in one and the same language. In fact in most analyses of English stress it has been claimed that English is such a language. Recall that although echo stresses are determined on phonological grounds a language having free stress can still have echo stresses. This is so because the reference point for echo stressing (i.e. the main stress or antipole stress) is a phonological property, no matter how this reference point is determined.

It would a priori not be unreasonable to suppose that cyclic stress can only occur in free stress systems, i.e. that a necessary (though not sufficient) condition for the presence of all three types of secondary stresses, and in particular the presence of cyclic stresses, is that the language in question has free (i.e. lexical) stress. This is not a point of logic, but an empirical claim. I will return to this point in more detail in the following section, but here I will try to indicate why the relation between free stress and cyclic stress should exist at all.

Suppose that a language has fixed stress. Within the model of lexical phonology rules that assign stress will apply at the post-cyclical level in such a language. It is assumed in this model that at that point information about word internal morphological structure is no longer "visible". Suppose now that in such a language cyclic stresses must be assigned. To be able to do this we must be able to see whether a certain word has a smaller part that can be equated to another word in order to carry over stress information from the latter to the former. But this boils down to restoring the word internal grammatical structure and this nullifies the claim that postcyclic rules are "blind" to word internal structure. In other words we lose the possibility of postulating a severe restriction on the way in which different components of the grammar interact, viz. the constraint that the maximal domain of a component A, the cyclic component, which directly feeds into a component B is the minimal domain for B, the non-cyclic component.

On the other hand, if a language has free stress this means that morphemes form part of complex words **with** their stress properties, either because they are idiosyncratic properties of the morphemes or because they are assigned by lexical rules. At the postcyclical level complex words will therefore already contain their cyclic stress, as well as their main stress. Postlexical stress rules in such a language can assign prosodic structure and a rhythmic melody.

In the next section I will discuss secondary stress in Italian. The system of secondary stress in Italian has recently been described in some detail in Vogel & Scalise (1982). The purpose of giving a reanalysis here is not to criticize their analysis which is carried out in a standard segmental framework. The purpose is rather to study the interaction of echo and cyclic stress and to show how the facts that Vogel & Scalise describe are handled in a different framework, i.e. the (revised) tree-cum-grid theory.

### 4.3.4.2. Secondary stress in Italian

Vogel and Scalise hold the view that main stress in underived words is a lexical property (p. 214):

> It is generally agreed that primary stress is not predictable in Italian, at least on the basis of purely phonological criteria, given such minimal (or near minimal) pairs as **áncora** 'anchor'/**ancóra** 'again', **párlo** 'I speak'/**parló** 'he spoke' and **dútttile** 'ductible'/ **sottíle** 'thin'.

The placement of main stress in Italian is, despite the facts just mentioned, governed by a number of regularities that make it possible to arrive at a rule-based analysis of Italian stress. This is not inconsistent with Vogel and Scalise's view, because the rules that assign stress would be lexical in the sense of Kiparsky (1982, 1983) and Mohanan (1982). Hence, although rule-governed, stress can still be seen as a lexical property because the stress rules are lexical. In line with the proposals in the foregoing sections I assume that main stress assignment involves creating word internal prosodic structure and the projection of a degenerate grid. If main stress assignment is a lexical rule, I will assume that on each subsequent cycle the word internal prosodic structure assigned on the previous cycle is erased, while the grid that was projected remains.

The focus here is not on main stress, however, but on secondary stress. We will see that the placement of secondary stress in Italian is predictable by the same kind of rules that were motivated in the previous sections. Such a state of affairs strongly suggests that the "main stress first" approach that I discussed in the previous section is correct. We can say that the difference between fixed and free stress systems is caused by a difference in the way main stress is established, i.e. cyclic or post-cyclic. Once the



location of main stress has been determined, the derivation in both types of systems is governed by the same post-cyclic introduction and association of a rhythmic melody.

Vogel and Scalise (henceforth V&S) first consider the (secondary) stress pattern of underived words in which they attest the following stress patterns:

(104) i. σ́ ... grú, cáne, lámpada
ii. σσ́ ... metá, lavóro, catástrofe
iii. σ̀σσ́ ... còlibrí, òbilísco, Àristótele
iv. σ̀σσσ́ ... mèrcoledí, tèmperatúra

To describe this it is sufficient for V&S to postulate the following rule:

(105) **Initial Stress Rule (ISR)**

$$\sigma \;\rightarrow\; [+str] \;/\; \# \text{---} \; \sigma_1 \; \underset{[+str]}{\sigma}$$

The first syllable is stressed if it is separated from the mainstressed syllable by minimally one syllable.

V&S proceed with the stress pattern of derived words and they establish that the following generalizations, which were found to be true for underived words, are also valid for the majority of the derived vocabulary:

(106) a. There are no stress clashes (i.e. no sequences of stressed syllables)
b. Words begin with a stressed syllable (unless this would lead to a clash)
c. There are no sequences of more than two unstressed syllables.

The set of stress patterns that conform to these generalizations as far as derived words are concerned shows more types than we have seen for the underived words, which is due to the fact that the former may be much longer:

(107) i-iv. see above
v. σ̀σσ̀σσ́ ... èlegàntemènte
vi σ̀σσ̀σσσ́ ... màtemàticaménte
vii. σ̀σσσ̀σσ́ ... èffervescèntemènte
viii. σ̀σσσ̀σσσ́ ... dòlorosìssimaménte

ix. σ̀σσ̀σσ̀σσ́ ... ràpprésentatìvaménte

x. σ̀σσσ̀σσ̀σσ́ ... ràzzionalìzzabìlitá

... ...

... σ̀σσσ̀σσ̀σσ̀σσ́ ... prècipitèvolìssimèvolménte

Most of these patterns (all except vi and viii) can be derived by applying, after the ISR, a rule assigning alternating stress applying from right to left. V&S formulate this rule as follows:

(108) **Stress Insertion Rule (SIR)**

$\sigma \rightarrow [+str] \ / \ \sigma \ - \ \sigma$ (right-to-left)

What is lacking so far is an account of the remaining patterns: vi and vii. When we compare vi with vii and viii with ix we see that longer sequences of syllables can satisfy the above generalizations in two ways. A third alternative: σ̀σ̀σσ̀σσ́... is blocked by the presence of the ISR. The question then is whether in these cases the choice of a particular rhythmic pattern is arbitrary or whether it is determined by particular factors. As for the second possibility there are two candidates: syllable weight or cyclicity. V&S dismiss syllable weight as a possible factor by simply giving a list of the relevant counterexamples. That syllable weight is irrelevant is not very surprising if it means anything at all to say that Italian is a syllable-timed language. By definition all syllables are of equal weight in a syllable-timed language. They choose for the second possibility: "secondary stress in complex words depends on the stress of the smaller components contained within them." (p.277). According to the view expressed above concerning the relation between cyclic stress and lexical stress the presence of cyclic stress is possible, given the unpredictability of main stress in Italian. The following examples illustrate the dependency of cyclic stress on the stress pattern of embedded words:

(109 ìmpossìbilitá - impossíbile

ìntenzionàlitá - intenzionále

I will now survey how V&S propose to derive the stress pattern of complex words and then account for the same data using the grid-theory. Consider the following four examples:



(110) a. víno + áio -> vináio

b. spígolo + óso + íssimo -> spìgolosíssimo

c. fébbre + íle + ménte -> fèbbrilménte

d. ín + fedéle + tá -> ìnfedeltá

Note that there is a rule of vowel deletion, which I will not discuss here. V&S argue that forms such as these motivate the following rule:

(111) **Clash Avoidance Rule**

$\underset{[+str]}{\sigma} \rightarrow [-str] \ / \ - \ \underset{[+str]}{\sigma} \begin{Bmatrix} \sigma \\ \# \end{Bmatrix}$ (right-to-left)

This rule must operate from right to left because of the form in c. Left to right application would delete the stress on the first syllable. Of course one could assume that this stress is restored by the ISR. But this leads to less economical derivations, something that, according to the authors, should be avoided. Now consider the following examples:

(112) a. beáto + itúdine -> bèatitúdine

b. dolóre + óso -> dòlorόso

c. dolóre + óso + íssimo -> dòlorosíssimo

The secondary stress that we expect to find on the second syllable occurs on the first. To account for this V&S propose another rule:

(113) **Stress Reversal Rule**

$\underset{[-str]}{\sigma}\underset{[+str]}{\sigma} \rightarrow \underset{[+str]}{\sigma}\underset{[-str]}{\sigma} \ / \ \# \ - \ \ldots \ \underset{[+str]}{\sigma}$

Again the correct result cannot be obtained by the ISR since after application of this rule the CAR would remove the initial stress in each case. Recall that this rule applies from right to left.

At this point one might wonder why V&S do not assume that all stresses but the rightmost one are simply deleted, after which ISR will assign initial stress in each case. The reason is of course that if the stress of the embedded word does not clash with a stress on the next morphological layer and is not located on the second syllable it survives as a cyclic stress. The ISR does apply to derived words but after CAR:

(114) meravíglia + óso -> mèraviglióso

V&S demonstrate finally that the rules they have proposed must be partially ordered as in (115). Other orderings lead to longer derivation or to the wrong output:

(115)
$$\text{CAR} \; - \; \begin{Bmatrix} \text{ISR} \\ \text{SSR} \end{Bmatrix} \; - \; \text{SIR}$$

They furthermore assume that all these rules operate at the post-cyclic level.

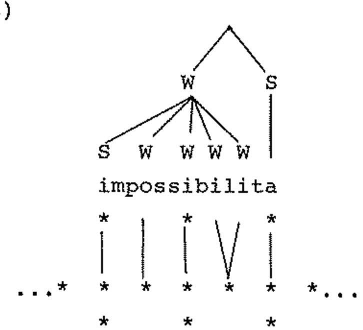
Let me now show how the facts reported by Vogel & Scalise will be accounted for in the (revised) tree-cum-grid framework. First of all I assume that main stress assignment is cyclic. I will also assume that CAR is a cyclic rule. In this way I do not have to say anything about its direction of application:

(1Ø7) **CAR (cyclic)**

```
* *       *
σ σ  ->  σ σ
```

On the last cycle a complete prosodic structure will be assigned, in which syllables outside the stress foot are gathered into a foot to account for the initial beat:

(1Ø8)



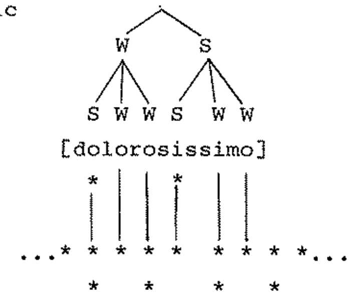

The star on the third syllable then is a cyclic stress. The corresponding stress foot assigned at the inner cycle [impossibile] has been erased.

Clearly, the above account makes no use of rule order except for the fact that we assign CAR to the lexical phonology. Let me give here one example of a derivation involving the application of the CAR:



(1Ø9)

```
                dolore]  oso]  issimo]
                 * * *   * *   *  * *
   1st cycle       *      *     *
   2nd cycle       Ø                      CAR
   3rd cycle              Ø               CAR
                --------------------------
   post-cyclic
```




Let me add a critical note regarding the cylic stresses. Some speakers of Italian (including linguists) claim that the syllables between the main stressed syllable and the initial syllable are subject to variable stressing. This does not imply that cyclic stresses do not occur, not even if no trace of an alternating pattern could be found phonetically. But it is an indication of the fact that the occurrence of cyclic stresses cannot be predicted by hard-and-fast rules but rather follows from certain tendencies that may overrule the effect of PG, which between the main stress and polar initial stress may apparently move in either direction in Italian.

As for initial stressing, it has been claimed (e.g. in Selkirk 1984) that a secondary stress may fall on the first or second syllable, depending on the preceding environment. V&S mention a limited set of examples that indeed have an alternation between secondary stress on the first or the second syllable. As a possible reason (apart from dialectal difference) V&S mention the preceding context:

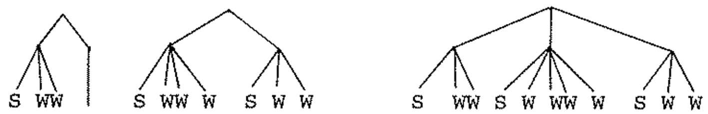
(11Ø)

```
  *    *   *     *
  * ** * * ** *  * * *
societa oceanografica

*      *   *      *
*  * ** ** * * ** *  * * *
associazione oceanografica
```

Similar observations concerning English (Tíconderoga versus Fort Ticónderoga) and Dutch are found in Prince (1983) and in van der Hulst and Moortgat (1981) respectively.

If it is true that initial stressing is only regular if the word has no lefthand environment it is possible to assume either that prosodic structure is erased when going from the lexical to the post-lexical, i.e. phrasal level, or that the complete prosodic structure is assigned at the phrasal level, and not earlier:

(111)




[societa] [oceanografica] -> [societa oceanografica]

After (re)grouping, strings of syllables between main stresses are associated to the rhythmic melody, and it may be the case that there is a conflict here between associating left-to-right or right-to-left. The shift from the secondary stress in Italian suggests that association is from right-to-left in this language.

To conclude this section, let me draw attention to the following. In Bruce (1983) we find an extremely interesting report on rhythm in Swedish, in which it is shown that a pattern of strong and weak syllables is found in between main stresses according to the following rule:

> Generally, the unstressed syllables will be alternately weak and strong starting from the upcoming stress and counting backwards. Phonetically this is reflected as an alternation in relative durations between successive syllables. (p. 35)

Consider the following examples taken from Bruce (1983, 40):

(112)

| | | | |
|---|---|---|---|
| | soldater me kapital | | soldater me kapital |
| stress | - + -   -   - - + | -> | - + -   -   - - + |
| strength | - + -   -   - - + | | - + +   -   + - + |
| | attentat me soldater | | attendat me soldater |
| stress | - - +   -   - + - | -> | - - +   -   - + - |
| strength | - - +   -   - + - | | + - +   +   - + - |



The level called "stress" by Bruce is much like our degenerate grid level (except for the fact that Bruce does not report an antipole stress), while the "strength" level corresponds closely to our rhythmic melody, associated from right-to-left. Observe that, according to Bruce, a strong beat can be added on the syllable that immediately follows a syllable with main stress. This suggests that clash avoidance may not be a real phenomenon, when dealing with beats that occur on different levels, i.e. the stress level and the strength level (in Bruce's terminology) or the degenerate grid and the rhythmic melody (in the terminology employed here).

### 4.4. Metrical feet

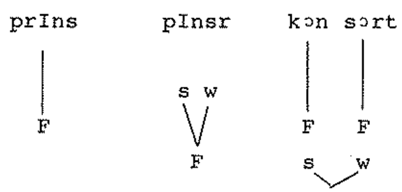
The position that has been defended in the previous sections entails that word internal prosodic structure does not comprise the type of foot structure that is familiar from the standard arboreal theory. The type of foot structure that occurs in the arboreal theory discussed in the previous sections always has a head syllable which has main stress, or, when a left-hand environment is missing, the strongest non-primary stress. The notion foot defended here stands much closer then to more traditional usages of the term as found, for example, in the work of Abercrombie (1965, 1967). In this section I will look at the typical argument in favor of using the type of foot that characterizes alternating stress. I will show that the argument is not compelling by discussing a reanalysis of the type of data on which the argumentation is based. Finally I will refer to a case discussed in Lozano (1982) where it is clear that the reanalysis that is suggested for the type of data at issue is correct.

Selkirk (1978), Kiparsky (1979) and Hayes (1982) have discussed a number of phenomena that are typically used to argue in favor of standard metrical foot structure. Selkirk discusses the phenomenon of closed syllable adjustment in French and Kiparsky uses the phenomenon of flapping. Here I will discuss one of Hayes' examples. Consider the following SPE-type of rule:

(113) $$\emptyset \rightarrow t \;/\; n \;\_\; s \begin{Bmatrix} \# \\ V \end{Bmatrix}$$

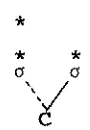
This rule accounts for the fact that in a word like **prince** or **pincer** an epenthetic **t** may appear between the **n** and the **s**. The SD of the rule is motivated by the fact that no **t** is inserted in a word like **consort** or **pincet**. In the latter case the sequence **ns** is followed by a stressed vowel, whereas in the former case this sequence is word final or followed by an unstressed vowel. Hayes points out that the disjunction found in the rule appears in other rules as well. I quote:

> The recurrent, mysterious disjunction found in these rules has been clarified by Kiparsky (1979), who suggested that they be restricted to apply **within the metrical foot**, where feet can be defined independently on the basis of the English stress system (cf. Selkirk 1980). For example, in **prince** and **pincer**, the [n] and [s] are within the same foot, thus permitting [t] insertion, whereas in **consort** the intervening foot boundary blocks the rule:



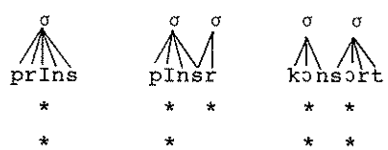

The question must now be answered how we are going to avoid the recurrent disjunction mentioned above if we abandon standard metrical foot structure. The only possibility is to invoke the notion of **ambisyllabicity**. Let us assume that there is a quite general rule that creates ambisyllabic consonants:

(114)



I.e. a stressed syllable attracts a following consonant if the next syllable is unstressed. Given such a rule we can formulate the epenthesis rule as a simple syllable domain rule:

(115)






$$\emptyset \rightarrow t \; / \; n - s)_{\sigma}$$

Given the rule that creates ambisyllabic consonants, we can reformulate all rules of this type as syllable domain rules, which means that we no longer have a recurrent disjunction in our rules.

The above argument shows that, although standard metrical foot structure can be used to simplify the formulation of rules, it is not absolutely required. All examples that I know of (as offered by Hayes, Kiparsky and Selkirk) can be analyzed in essentially the same way.

The availability of a foot-based and a syllable-based analysis for segmental phenomena has recently been discussed in Lozano (1982). Lozano analyzes data from Spanish and shows that a particular process allows both a foot-based and a syllable-based analysis. She then continues by showing that the syllable-based analysis can be independently motivated. The process at issue is called **l**-velarization.

An initial glance at the data suggests that an **l** is velarized when occurring in the rhyme (e.g. (116a)), but Lozano supplies additional data showing that a velarized **l** can also be in onset position, albeit in the onset of an unstressed syllable (e.g. (116b)):

| | | | | | | |
|---|---|---|---|---|---|---|
| (116) | a. | azul | "blue" | b. | palo | "stick" |
| | | normal | "normal" | | pelo | "hair" |
| | | sutil | "subtle" | | fila | "line" |

A possible analysis of such facts would be to say that the **l** is velarized if it occurs inside a foot in non-initial position. According to Lozano, however, the additional data do not force one to adopt the view that the velarization rule has to refer to other than the rhyme position. To explain velarization in the cases under b. we only have to assume that the intervocalic **l** is ambisyllabic, i.e. that it is both part of a rhyme and a following onset. We see then that the same strategy used above can also be followed here in order to avoid reference to foot structure.

Lozano assumes that the rule creating an ambisyllabic **l** is itself a foot-based rule, but since my goal is to avoid reference to foot structure I will not follow her in this respect. As long as no other rule refers to "foot structure" the **l**-ambisyllabicity rule might just as well be formulated along the lines of the more general rule that we proposed for English.

The crucial point of Lozano's paper is that she continues to show that there is an independent reason for representing the **l** as ambisyllabic. This reason involves a process of vowel tensing. Among the non-low vowels there is an allophonic variation between tense (closed) vowels and lax (open) vowels that is determined by syllable structure. The former occur in open syllables, the latter in closed syllables. The important observation is that the lax vowels appear not only in syllables that are clearly closed, but also in those cases where they are followed by an **l** that is ambisyllabic according to the rule just mentioned. From this we may conclude that the ambisyllabicity is independently motivated.

It is of course not possible to conclude that the syllable-based approach to the type of data discussed in this section has been validated in general. The previous example does suggest, however, that such an approach has some credibility, and is certainly not less likely than the foot-based analysis.

I conclude that standard metrical foot structure, to the extent that it differs from the kind of foot structure that is assumed in the theory proposed in the previous sections, has no strong motivation apart from its primary motivation, which is to characterize alternating stress patterns. We have seen that alternating stress patterns can be characterized in terms of a rhythmic melody that does not impose a constituent structure on strings of syllables. Hence standard metrical foot structure can be eliminated from the theory.

### 4.5. Conclusions

In this chapter I have discussed several issues concerning the representation and analysis of stress. We compared in detail two current theories referred to as the grid-only and tree-only theory and concluded that there are no significant differences between these two theories, apart from the fact that in the latter we assign a detailed tree structure to the text. I then argued in favor of a compromise regarding the prosodic constituent structure. This compromise tied in well with the point of view, adopted in section 4.3.2., that main stress assignment should be separated from assignment of rhythmic structure. The former can be formalized in terms of the tree format, the latter in terms of an autosegmental theory. In the final section of this chapter it has been shown that argumentation in favor of standard metrical foot structure is inconclusive.

*Chapter 5*

# Dutch Stress

### 5.1. Introduction

In this chapter the focus is on Dutch stress and its relation to syllable structure. In section 5.2. I offer a discussion of the various ways in which stress assignment is sensitive to syllable structure. In section 5.3. an analysis is presented of the stress pattern of Dutch, focussing on monomorphemic words. I will offer two analyses that differ crucially with respect to the type of foot that is chosen. The first analysis is carried out within the standard metrical (arboreal) theory and the second within the tree-cum-grid theory that has been proposed in the previous chapter. I will argue in favor of the latter analysis.

### 5.2. Stress and syllable weight in Dutch

In section 3.4. I briefly discussed two cases in which there is a clear correlation between syllable structure and stress in Dutch. Simplex (i.e. morphologically unstructured) words with a final syllable of the shape (C)VVC (and to a lesser extent (C)VCC) are stressed on the final syllable almost without exception:

(1)

| | | |
|---|---|---|
| pistool | legioen | anakoloet |
| konijn | kapitaal | calamiteit |
| banaan | fenomeen | salamandrijn |
| konvooi | ceramiek | locomotief |
| kameel | avontuur | karikatuur |
| fontein | tamboerijn | valeriaan |
| juweel | pelikaan | capaciteit |