Shapes of the Generalized Trochee

RENÉ KAGER
University of Utrecht

1. Setting the stage

One major goal of metrical theory is to characterize the foot typology which adequately models the patterns of rhythmic alternation found in stress languages. In line with this research program, this paper[1] aims at the following three goals. Firstly, providing new empirical evidence for the foot parsing mode known as the generalized trochee (GT), which was originally proposed by Prince (1980), and was elaborated on by Hayes (1991). Secondly, narrowing down the set of empirically attested shapes of the GT. Thirdly, proposing a theory of two-layered foot parsing that rationalizes the attested variation in shape of the GT. This theory relies heavily on clash avoidance, and provides further evidence for the mora as a rhythmic unit apart from the syllable (cf. Prince 1983, Kager 1992a).

The asymmetric foot inventory of Hayes (1991) contains two types of trochaic feet, the SYLLABIC TROCHEE (1a) and the MORAIC TROCHEE (1b). Each of these characterizes one style of rhythmic alternation in trochaic stress systems:

(1)	a.	**Syllabic trochee:**	Construct	(* .) $\sigma\ \sigma$		
	b.	**Moraic trochee:**	Construct	(* .) $\sigma_\mu\ \sigma_\mu$	or	(*) $\sigma_{\mu\mu}$

The syllabic trochee is indifferent to the weight of syllables that it organizes, i.e., it is QUANTITY INSENSITIVE. In contrast, the moraic trochee is QUANTITY SENSITIVE, since it demands that a bisyllabic foot consists of precisely two light syllables $[\sigma_\mu\sigma_\mu]$, and a monosyllabic foot of precisely one heavy syllable $[\sigma_{\mu\mu}]$.

Anyula (Kirton 1967) illustrates the syllabic trochee in its simplest form. It has no contrast of syllable quantity, and for this reason might be called 'trivially quantity insensitive'. Characteristically, it has a bisyllabic WORD MINIMUM, based on its foot, and a stress pattern which avoids adjacent stressed syllables, i.e., SYLLABLE CLASH. Syllabic trochees are assigned initially and finally.

1 This research was supported by the Linguistic Research Foundation, which is funded by the Netherlands organization for scientific research, NWO, grant no. 300-171-023. For comments on earlier versions of this paper, I wish to thank Janet Grijzenhout, Mike Hammond, Kristin Hanson, Bruce Hayes, Paul Kiparsky, Aditi Lahiri, Alan Prince, Harry van der Hulst, and Ellis Visch. (All of whom I exempt from responsibility for any errors or misconceptions.)

```
(2)  a.  (*   .)              b.   .  (*    .)
         há.wu                     ni.wán.ji
         'cloud'                   'animal flesh'

     c.  (*   .) (*   .)      d.   (*   .)  .  (*   .)
         má.ru.wá.ra               má.ru.wa.rá.la
         'cousin'                  'with the cousin'
```

In trisyllabic words (cf. 2b), the conflict between the initial and final foot seems to be resolved in favor of the latter.

Nunggubuyu (Hore 1981) constitutes a typical moraic trochee language. Stress is on all heavy syllables and on alternate light syllables. Again, the word minimum equals the minimal foot, which in this case is bimoraic. Another feature often found in moraic trochee systems is that syllable clashes are allowed to some extent, as can be seen in (3b,c).[2]

```
(3)  a.  (*)                  b.  (*)   (*   .)  (*    .)
          –                        –     ˘    ˘    ˘    ˘
         yúul  'bushland'         ngàa.dhì.ya.rrí.nya 'tree species'

     c.    .  (*)  (*   .) (*)  (*    .)
           ˘   –    ˘   ˘   –    ˘    ˘
         dhu.màa.mù.gu.nàa.mú.rra 'snake species'
```

When two adjacent syllables are stressed in Nunggubuyu, the first must be heavy, while the second may be either light or heavy. This signals that clash is defined as a pair of adjacent stressed moras, rather than syllables.

The notion of MORAIC RHYTHM can be represented by aligning each mora with a grid element (cf. Prince 1983), as in (4). Sonority factors designate initial moras of bimoraic syllables as strong, which under bipositional representation translates as trochaic internal prominence in bimoraic feet $[\sigma_{\mu\mu}]$ (cf. Prince 1983, Kager 1992a). This has important external rhythmic consequences. In particular, a strong first mora of a heavy syllable, (e.g., *màa* or *nàa* in 4), does not clash with the first mora of a following syllable (*mù* and *mú*), since a weak mora intervenes:

```
(4)     .  (*.) (*   .) (*.) (*    .)
       dhu.màa.mù.gu.nàa.mú.rra
```

In Nunggubuyu, as in most other moraic trochee systems, the mora is the unit of foot parsing as well as rhythm (i.e., clash avoidance). Similarly, syllabic trochee systems such as Anyula, take the syllable as their unit of foot parsing and rhythm. This correlation between parsing units and rhythmic units was stated by Kager (1992a) as the RHYTHMIC UNIFORMITY HYPOTHESIS:

(5) **Rhythmic Uniformity Hypothesis**
Parsing units imply rhythmic units.

In this paper, I will focus on a third type of trochaic system, one which combines an underlying distinction of syllable quantity and syllable-based rhythm, the latter diagnosed by rhythmic alternation (and clash avoidance) based

---

2 Actually Nunggubuyu is bidirectional, main stress being assigned by a non-iterative moraic trochee at the right edge, and secondary stress by iterative moraic trochees from left to right. I also abstract away from two destressing rules (cf. Kager 1990).

on the syllable. To avoid syllabic clash, some syllabic systems even locate heavy syllables in unstressed positions of trochaic feet. These are referred to as *truly quantity insensitive*, or *quantity disrespecting* (cf. Hayes 1991), as distinct from 'trivially quantity insensitive' systems, which lack a weight contrast. Syllable-based rhythm and quantity insensitivity apparently diagnose the syllabic trochee as the relevant foot for such systems. But the situation is more complex. Hayes (1991) observes many systems where syllabic [σ σ] and moraic trochees [$\sigma_{\mu\mu}$] cooccur. This cooccurrence forms the empirical basis of the generalized trochee.

A simple example of a GT system is Pintupi (Hansen and Hansen 1969). It has a quantity contrast as well as syllable-based rhythm. As in many Australian languages, the vowel length distinction on which the quantity contrast is based is restricted to the initial syllable of the stem. For this reason, it is impossible to establish whether a heavy syllable may occupy a weak position in a foot [$\sigma_{\mu\mu}\sigma_{\mu\mu}$] or [$\sigma_{\mu}\sigma_{\mu\mu}$]. Still, syllabic trochees [$\sigma_{\mu\mu}\sigma_{\mu}$] are diagnosed by rightward alternation of secondary stresses, which follows the pattern of (6a), rather than (6b):

(6) a. [$\sigma_{\mu\mu}$ σ_{μ}][σ_{μ} σ_{μ}][σ_{μ} σ_{μ}] ... Syllabic trochee parsing
b. [$\sigma_{\mu\mu}$][σ_{μ} σ_{μ}][σ_{μ} σ_{μ}][σ_{μ} ... Moraic trochee parsing

Interestingly, there is also evidence for the moraic trochee [$\sigma_{\mu\mu}$] in the form of the bimoraic word minimum: all monosyllables in Pintupi contain long vowels.

To account for such 'mixed' systems Hayes suggests that trochaic systems may build syllabic and moraic trochees next to each other on the same iterative pass of foot construction. Formalizing this idea, Hayes proposes the GENERALIZED TROCHEE (GT), which is the net result of adding up all proper expansions of the syllabic trochee (1a) and moraic trochee (1b):

(7) **Generalized trochee**: Construct

$$\begin{matrix}(* & .)\\ \sigma & \sigma\end{matrix} \quad \text{else} \quad \begin{matrix}(*)\\ \sigma_{\mu\mu}\end{matrix}$$

Observe that the double-light expansion of the moraic trochee [σ_{μ} σ_{μ}] is subsumed under the bisyllabic foot [σ σ], so that essentially the GT is a foot type which includes all bisyllabic expansions of trochees, plus the monosyllabic heavy foot [$\sigma_{\mu\mu}$]. The latter is formed by default only, where no bisyllabic foot can be formed (i.e., in monosyllabic words and possibly at the end of the domain). This relationship reflects MAXIMALITY of foot parsing: whenever a string matches two expansions of a single foot scheme, the longest expansion is selected. In Pintupi, which has rightward parsing, this produces (6a) rather than (6b).

Observations on a number of other languages lead Hayes to hypothesize that the syllabic trochee (1a) may be completely eliminated as a foot type, since all languages with syllabic trochees either require a generalized trochee analysis, or else have no distinction of syllable quantity.[3] This so-called GENERALIZED TROCHEE HYPOTHESIS receives strong confirmation from a typological survey that I conducted on Australian languages, reported on in Kager (1992b).

Now consider Estonian (Hint 1973), the system for which Prince (1980) introduced an ancester of Hayes' generalized trochee. Estonian, as Pintupi, has a bimoraic word minimum, diagnosing the bimoraic trochee. But it is an even more telling example of a generalized trochee system because its distinction of quantity is unrestricted positionally, and all expansions of the GT are attested. Slightly

3 In a recent version of Hayes' manuscript, which came to my attention after presentation of this paper, the syllabic trochee has been redefined as the former GT, i.e., as [σ σ] or [$\sigma_{\mu\mu}$]. Hayes accordingly defines the degenerate foot as [σ_{μ}], so that [$\sigma_{\mu\mu}$] no longer counts as degenerate in a syllabic trochee system.

simplifying the Estonian stress pattern,[4] this may be described as follows. Main stress is initial, and secondary stresses fall on nonfinal odd-numbered syllables, counting rightward from the main stress, and disrespecting syllable quantity. Final syllables are stressed only if they are heavy, and when no stressed syllable precedes. That is, when rightward construction of bisyllabic trochees leaves one unfooted syllable at the edge of the domain, the only proper GT to be constructed is the monosyllabic heavy foot [$\sigma_{\mu\mu}$], as the degenerate foot [σ_μ] is excluded (cf. Prince 1980,532):

(8)	a.	(* .) (* .) (* .) .	b.	(* .) (* .) (* .) (*)
		$\sigma\ \sigma\ \ \sigma\ \sigma\ \ \sigma\ \sigma\ \ \sigma_\mu$		$\sigma\ \sigma\ \ \sigma\ \sigma\ \ \sigma\ \sigma\ \ \sigma_{\mu\mu}$

All (attested) iterative trochaic systems with syllabic rhythm and a free distinction of syllable quantity have this property of monosyllabic heavy feet at the edge of the domain where the iteration ends (cf. Kager 1992b).

For Estonian, it can be illustrated by the quantitative minimal pair of examples of (9a,b), where a difference in quantity of final syllables is reflected in a difference of stress. Example (9c) shows that a final syllable (even if it is heavy) is unstressed when the penult is stressed. This points to syllabic clash avoidance.[5] All examples are taken from Prince (1980).

(9)	a.	pí.mes.tà.va.le	'blinding (ill.sg.)'
	b.	pí.mes.tà.va.màit	'blinding (part.pl.)'
	c.	kín.nast	'glove (part.sg.)'

We actually find that in Estonian all predicted shapes of the GT are attested:

(10)	a.	[$\sigma_\mu\sigma_\mu$]	ré.ti.[lì.le]	'ladder (all.sg.)'
	b.	[$\sigma_{\mu\mu}\sigma_\mu$]	Ép.pet.[tùs.te].lè.ki	'lessons, too (all.pl.)'
	c.	[$\sigma_\mu\sigma_{\mu\mu}$]	pí.mes.[tà.vas].se	'blinding (ill.sg.)'
	d.	[$\sigma_{\mu\mu}\sigma_{\mu\mu}$]	vá.ra.[sèi.mat].tè.le	'earliest (all.pl.)'
	e.	[$\sigma_{\mu\mu}$]	pá.he.[mài]<t>	'worse (part.pl.)'

Considering the GT systems discussed so far, Pintupi and Estonian, there is every reason to believe that the GT parsing mode avoids syllabic clash, rather than mora clash. Of course, this is what we would expect from the Rhythmic Uniformity Hypothesis, since bisyllabic feet prevail under the GT parsing mode.

In the remainder of this paper I will analyze two more trochaic systems with distinctions of syllable quantity and (apparently) syllable-based rhythms. These systems, Finnish and Yindjibarndi, differ from those discussed earlier, however, in that they avoid mora clash as well as syllable clash. From the viewpoint of foot parsing, these systems seem to avoid particular shapes of the GT (Yindjibarndi avoids both L-H and H-H, and Finnish just L-H). Consequently they resist a straightforward analysis under the GT, whose bisyllabic expansion [$\sigma\sigma$] is blind to the internal structure of syllables parsed. I will propose an alternative two-layered theory, which allows optional access to moraic rhythm in syllabic parsing.

---

4 For expository purposes I abstract away from optional ternary alternation, as well as from the phenomenon of overlength. Prince (1980) and Hayes (1991) provide detailed analyses.

5 Overlong syllables, which are always stressed, may be followed by another stressed syllable.

2. Avoidance of [$\sigma_\mu\sigma_{\mu\mu}$] trochees in Finnish

The first language to be discussed is Finnish, which is closely related to Estonian. Finnish, as Estonian, has strictly initial main stress, and secondary stress that alternates rightward. The secondary stress data on which my analysis is based are from the description by Kiparsky (1991a, p.c.).[6] According to this description, the binary alternation of secondary stresses becomes locally ternary in precisely one context. This is when a light syllable would be stressed directly before a heavy syllable. Here, the light syllable remains unstressed, and stress skips over to the heavy syllable. This produces a locally ternary pattern, as shown in (11i-l). Final syllables are stressed under the same conditions as in Estonian: they must be heavy, and may not follow a stressed syllable, cf. (11i).

(11)	a.	˘ ˘ ˘ ˘	ló.pe.tè.ta	'finish (negative)'
	b.	˘ ˘ - ˘ ˘	ló.pe.tèt.ta.va	'to be finished'
	c.	- - ˘ ˘	téu.ras.tà.mo	'slaughterhouse'
	d.	˘ ˘ - -	ló.pe.tèt.tiin	'one finished'
	e.	- - - ˘ - ˘	púo.lus.tèt.ta.vìs.sa	'defensible'
	f.	˘ - ˘ ˘ ˘ ˘	á.loit.tè.li.jà.na	'as a beginner'
	g.	˘ - ˘ ˘ ˘ ˘ ˘	ó.pet.tè.le.mà.na.ni	'as something I have been learning'
	h.	˘ - - - ˘	í.han.tèel.lis.ta	'idealistic (partitive)'
	i.	˘ ˘ ˘ -	ló.pe.te.tàan	'one finishes'
	j.	˘ - ˘ - ˘	rá.kas.tu.nèi.ta	'infatuated lovers'
	k.	˘ - ˘ - -	ló.pet.ta.jài.set	'concluding ceremonies'
	l.	˘ ˘ - ˘ ˘ - ˘	lú.e.tùt.te.lu.tèl.la	'to gradually cause to have been read'
	m.	˘ ˘ ˘ - ˘ ˘ ˘ ˘ ˘	ká.no.ni.sòi.ma.nà.ni.kò.han	'in a state of having been canonized by me, of course (essive sg.)'

Rephrasing the generalization in terms of trochaic feet we find that Finnish secondary stress avoids the light-heavy foot [$\sigma_\mu\sigma_{\mu\mu}$], while all other predicted shapes of the generalized trochee are attested:[7]

(12)	a.	[$\sigma_\mu\sigma_\mu$]	ló.pe.[tè.ta]	'finish (negative)'
	b.	[$\sigma_{\mu\mu}\sigma_\mu$]	ló.pe.tèt.ta.va	'to be finished'
	c.	[$\sigma_\mu\sigma_{\mu\mu}$]	*Not attested*	
	d.	[$\sigma_{\mu\mu}\sigma_{\mu\mu}$]	ló.pe.[tèt.tii]<n>	'one finished'
	e.	[$\sigma_{\mu\mu}$]	ló.pe.te.[tàa]<n>	'one finishes'

Stress patterns of other GT languages show that Finnish is not unique in avoiding light-heavy trochees, as will be demonstrated below for two Australian languages, Yindjibarndi and Guugu Yimidhirr. Another example is Gooniyandi (McGregor 1990), which is analyzed in Kager (1992b).

From the viewpoint of the GT, avoidance of L-H feet is a mystery. Essentially the bisyllabic GT is a quantity insensitive foot, which predicts that the quantity of the syllables that are parsed is completely irrelevant. But for Finnish this is incorrect, since L-H feet are avoided. We now arrive at the (paradoxical)

---

6 Slightly different patterns of secondary stresses are reported by Harms (1960, 1964) and Carlson (1978).

7 The insight that Finnish avoids L-H trochaic feet is due to Kiparsky (1991a) and is also found in unpublished work by Hayes.

heart of the issue. Quantity insensitive stress systems which avoid syllable clashes must be based on syllabic feet; still some of these systems measure moraic quantity in avoiding L-H feet. How to reconcile these observations? In the next section, I will propose a two-layered theory of foot parsing which explains avoidance of L-H trochees as a clash avoidance effect on the mora layer.

3. A two-layered theory of foot parsing

My core hypothesis is that the GT effect derives from the hierarchical nature of the metrical representation. With Halle and Vergnaud (1987) and Kager (1992a) I assume that stress systems select either syllables, or moras as stressable elements. Here I propose to formalize this STRESSABLE ELEMENT PARAMETER by assigning foot parsing to one of two layers in the hierarchical metrical grid. This two-layered theory of foot parsing is summarized in the TWO-LAYER HYPOTHESIS:

(13) **Two Layer Hypothesis**
Foot parsing brackets together elements on one of two layers: the syllable layer, or the mora layer.

Under this theory the syllabic trochee is formalized as trochaic parsing on the syllable layer (14a), while the moraic trochee translates as trochaic parsing on the mora layer (14b). For expository purposes I depict foot bracketing around pairs of stressable elements, while prominences project over these elements:

```
(14) a.   *  .   *    .   *  .   *    .   *  .
         (σ  σ) (σ    σ) (σ  σ) (σ    σ) (σ  σ) . . .       σ layer
          |  |   |\   |   |  |\  |\   |\  |  |
          μ  μ   μμ   μ   μ  μμ  μμ   μμ  μ  μ  . . .       μ layer

     b.   σ  σ    σ    σ  σ    σ     σ     σ    σ  σ  . . . σ layer
          |  |    |\   |  |    |\    |\    |\   |  |
         (μ  μ) (μμ) (μ  μ) (μμ)  (μμ)  (μμ)  (μ  μ)  . . . μ layer
          *  .    *.   *  .    *.    *.    *.   *  .
```

How do we derive the 'GT effect' that monosyllabic heavy feet occur in syllabic systems precisely in those cases where no bisyllabic feet can be constructed? Borrowing terminology from Prince and Smolensky's (1992) HARMONIC THEORY, we may describe this as follows: the constraint that heavy syllables are stressed is subordinated to that of foot bisyllabicity. Thus, quantity reasserts itself wherever bisyllabicity makes no claims. As a first step towards formalization in a two-layered theory, I propose that universally at the mora layer all mora pairs that form heavy syllables are bracketed as bimoraic constituents, regardless of the layer at which directional foot parsing applies. I will call this principle QUANTITY SENSITIVITY, after Prince (1983).

(15) **Quantity Sensitivity**
In systems with distinctions of syllable quantity, mora pairs that form heavy syllables are bracketed into bimoraic constituents.

The internal prominence of $[\sigma_{\mu\mu}]$ moraic constituents depends on sonority factors. Normally it is trochaic as sonority tends to decline between both moras of heavy syllables (cf. Prince 1983). Kager (1992a) argues that this intrinsic trochaic prominence of heavy syllables rhythmically conditions foot parsing in iambic systems, and, more generally, explains many rhythmic asymmetries between trochaic and iambic systems. As shown above for Nunggubuyu it also explains the directional asymmetries in clash avoidance in moraic trochee systems.

I will now formalize the 'GT effect' in the two-layered theory. The intuitive idea is that the scansion at the parsing layer is dominant, but if that scansion is left underspecified, (part of) the scansion may be read off the other layer. To formalize the default realization of bimoraic constituency at syllable layer, I propose a universal principle of HARMONIC CONSTITUENT COPYING:

(16) **Harmonic Constituent Copying**
Constituency is copied from one layer to another, provided that no conflicting scansions arise.[8]

Consequently, a heavy syllable that remains unfooted at syllable layer (because of bisyllabic minimality) will still be interpreted as a foot because of its intrinsic status as a bimoraic constituent on the mora layer. In pure moraic systems, all all moraic feet will be copied to the (empty) syllable layer.

Assuming this two-layered theory, let us now return to the stress pattern of Estonian, abstracting away from optional ternarity and overlength. The analysis contains parametric specification of the following: (a) the layer at which foot parsing takes place (here, syllable layer), as well as the dominance of feet (trochees) and the directionality (from left to right), (b) the layer at which rhythmic conditions are observed during parsing, in particular clash avoidance (here, syllable layer), and (c) the location of primary stress (here, the initial foot):

(17) Two-layered analysis of (simplified) Estonian
a. Parsing: construct trochees from left to right on the syllable layer.
b. Rhythm: avoid clash on the syllable layer.
c. Word Layer: End Rule Left.

When I discuss Finnish and Yindjibarndi below, it will become fully clear why the layers of parsing and rhythm must be distinguished.

For expository reasons, I will use different symbols to indicate the source of constituents. That is, '[*.]' indicates an intrinsic moraic constituent due to QS (15), '{* }' a constituent copied from another layer by HCC (16). Finally, '#' indicates a strong position on the mora layer that is induced by a strong position on the syllable layer dominating it. (The principle behind this will be discussed below.) This results in the representations of (18):

```
(18) a.  (*                )     b.  (*                   ) ER
         (*   . )(*   .)  .          (*   . )(*   .){* }  σ
          # [*.]{#   .}  .            # [*.]{#   .}[*.]  μ
         pí.mes.tà.va.le             pí.mes.tà.va.màit
```

Summarizing, the GT effect is derived by constructing trochees on the syllable layer, and by copying monosyllabic heavy feet from the mora layer into the syllable layer where no conflicting bracketings arise.

We now return to Finnish, which as I mentioned differs minimally from Estonian in disallowing light-heavy feet under secondary stress. As I will show the intrinsic trochaic nature of heavy syllables gives a rhythmic explanation of the avoidance of L-H feet, based on moraic clash avoidance. Of course, this provides further evidence for the mora as a rhythm unit. From the hierarchical nature of the

8 The ban against conflicting scansions may not need stipulation, as it is apparently an instantiation of the general principle of structure preservingness.

multi-layered grid, interaction between adjacent grid layers may be expected. The main source of interaction between layers is a well-established principle of grid structure, the CONTINUOUS COLUMN CONSTRAINT (CCC, cf. Prince 1983, Hayes 1991):

(19) **Continuous Column Constraint**
If a syllable forms a rhythmic beat on a given level, it must also form a rhythmic beat on all lower levels.

The CCC entails that whenever syllabic parsing produces a strong position on the syllable layer, a prominence is induced on the mora layer. When a L-H trochee is constructed at the syllable layer, a strong position is induced at the mora layer below the initial light syllable. This induced prominence clashes with the intrinsic mora prominence of the second syllable of the L-H foot. This is shown in (20a). In contrast no mora clash arises in a double heavy foot (cf. 20b), since the second (weak) mora of the initial syllable rhythmically separates both mora prominences:

```
(20)  a.   (*    . )     σ layer       b.   (*      . )     σ layer
            #  [*.]      μ layer            [*.] [*.]       μ layer
            |   |                            |    |
            |  Intrinsic prominence          |   Intrinsic prominence
           Induced prominence               Intrinsic prominence
```

Crucially it takes a two-layered representation of foot structure, in a hierarchical grid, to make reference to the intrinsic mora prominence of a syllable that is not stressed itself. Intrinsic moraic prominences condition foot parsing from a layer hidden below the syllabic parsing layer.

Having identified the rhythmic trigger of L-H avoidance I now go on to formalize avoidance itself. I adopt a proposal from Prince (1983), Van der Hulst (1991), Kager (1992a), and Lahiri (1992), which I will call RHYTHMIC SKIPPING:

(21) **Rhythmic Skipping**
To avoid clash, directional foot parsing may skip one stressable element.

Rhythmic skipping is related to the WEAK LOCAL PARSING mode of ternary systems in Hayes (1991), which skips a syllable after every foot constructed. From a survey of ternary systems (Estonian, Pacific Yupik, Winnebago, and others), Hayes concludes that skipped syllables must be light. Interestingly, a two-layered theory explains why heavy syllable skipping is generally impossible. On the mora layer, heavy syllables are simply not stressable elements, hence ineligible for skipping. On the syllable layer, the need for rhythmic heavy syllable skipping never arises, since the proper rhythmic distance between stresses is encoded in the bisyllabic parsing foot itself. If a heavy syllable would be skipped by weak local parsing, its unfooted position would be automatically filled in by Harmonic Constituent Copying of a monosyllabic heavy foot from the mora layer, thereby cancelling the effect of skipping.

I now return to Finnish to illustrate this theory. First the fact must be accounted for that main stress is strictly initial, even in words that start with a L-H sequence. I adopt Hayes' (1988) proposal that the word layer of Finnish is constructed prior to the foot layer, an option called TOP-DOWN GRID CONSTRUCTION.[9] Consequently the location of the main stressed syllable becomes

9 Similar proposals are made by Van der Hulst (1984), Lahiri and Van der Hulst (1988), and Kager (1989).

independent of the output of directional foot parsing, and main stress is strictly initial. The Continuous Column Constraint (19) guarantees that the initial syllable is strong on subordinated grid layers. The complete two-layered analysis is stated below:

(22) Two-layered analysis of Finnish
- a. Word Layer: End Rule Left.
- b. Parsing: construct trochees from left to right on the syllable layer.
- c. Rhythm: avoid clashes on the syllable AND the mora layer.

We find that both Finnish and Estonian construct feet at the syllable layer, hence avoid syllabic clash as predicted by Rhythmic Uniformity. The difference is that Finnish, but not Estonian, measures the implied rhythm at the mora layer.[10]

The analysis of Finnish is illustrated in (23). (23a) shows the correct parsing of a word that contains a light-heavy sequence. At syllable layer, the syllable *lu* is skipped in order to avoid clash on the mora layer. If skipping had not taken place, the structure of (23b) would have arisen, in which the mora *lu* (its prominence induced by syllabic parsing) clashes with the strong first mora of the bimoraic foot *tel* (which is due to Quantity Sensitivity):

```
(23)  a.  (*                           )  b.     (*                          )
          (* .)(*    .)  .  (*     .)            (* .)(*    .)(*     .)  .
          {# .}[*.]  .   .  [*.]  .               #    [*.]  .  # [*.]  .
          lú.e.tùt.te.lu.tèl.la          NOT    *lú.e.tùt.te.lù.tel.la

      c.  (*                   )          d.    (*                 )
          (*   . )  .  (*   . )                 (*   .)(*    .)  .
           # [*.]  .  [*.]  .                   {#   .}[*.]  .   .
          ló.pet.ta.jài.se<t>                   ló.pe.tèt.ta.va

      e.  (*               )              f.    (*              )
          (*   .)  .  {* }                      (*   .)(*    . )
          {#   .}  .  [*.]                      {#   .}[*.][*.]
          ló.pe.te.tàa<n>                       ló.pe.tèt.tii<n>

      g.  (*                                 )  i.   (*                    )
          (*   .)(*   . )  .  (*   .)(*   .)         (*  . )(*     . )  .
          {#   .}  .  [*.]  .  {#   .}{#   .}         # [*.][*.] [*.]  .
          ká.no.ni.sòi.ma.nà.ni.kò.ha<n>             í.han.tèel.lis.ta
```

Additional evidence for the claim that light-heavy feet are avoided in Finnish comes from Savo dialects (Skousen 1972, Kiparsky 1991a), where initial $[\sigma_{\mu}\ \sigma_{\mu\mu}]$ is repaired into $[\sigma_{\mu\mu}\ \sigma_{\mu\mu}]$ by gemination, e.g., */mi.tään/* => *[mít.tään]* 'anything'. In my theory, this reduces to moraic clash resolution. We thus find that mora clashes are both avoided and repaired in Finnish. Avoidance is implemented in skipping during foot parsing, and repair in initial gemination.

---

10 Kiparsky (1991a) bases his analysis of Finnish on the unificationist idea that sequences with iambic quantity $[\sigma_{\mu}\sigma_{\mu\mu}]$ trigger iambic prominence. This may account for local ternarity, e.g., *[ló.pe][te.tàan]*, but it is rather unclear how syllable clash avoidance is to be expressed in this analysis. E.g., what principle causes parsing to avoid **[ká.no][ni.sòi][mà.na][nì.ko].han*? If rhythmic skipping were to be assumed this would miss an important generalization, namely that both effects (L-H avoidance and rhythmic skipping) are reactions on clash, either at the mora layer or the syllable layer.

An alternative analysis of Finnish, based on the moraic trochee, was suggested to me by Aditi Lahiri (p.c.). Assuming moraic trochees, avoidance of L-H feet follows from the bimoraic foot. A L-H sequence is parsed as an unfooted light syllable plus a bimoraic foot. In (24), light syllables that remain unfooted in this context are underlined. Avoidance of syllable clashes is built into the analysis by rhythmic skipping. A syllable, light or heavy, is skipped to avoid syllable clash (i.e., after every heavy syllable). In (24), skipped syllables appear in boldface:

```
(24)  a.   (*                                   )
           (*   .)  .  (*)   .  (*   .) (*   .)
           ˘    ˘   ˘   –    ˘   ˘    ˘   ˘    ˘
           ká.no.ni.sòi.ma.nà.ni.kò.ha<n>

      b.   (*                         )    c.   (*                 )
           (* .) (*)    .   .  (*)    .         (*   .) (*)    .
           ˘   ˘   –    ˘   ˘   –     ˘         ˘    ˘   –     –
           lú.e.tùt.te.lu.tèl.la                ló.pe.tèt.tii<n
```

The major similarity between this analysis and mine is rhythmic skipping. However, Lahiri's analysis crucially allows skipped syllables to be of any weight. This runs into Hayes' (1991) observation, discussed above, that syllables skipped by weak local parsing must be light. The second problem of heavy syllable skipping in a moraic parsing mode is that it violates Quantity Sensitivity (15), i.e., the intrinsic stress of bimoraic syllables. Relaxing QS would entail the loss of explanation of all 'intrinsic stress' phenomena observed by Kager (1992a).

One might try to preserve QS in a moraic trochee analysis by translating heavy syllable skipping as a destressing rule. Destressing would then affect the righthand of two syllables in clash, applying iteratively from left to right. However, this analysis produces misparsings in strings of light syllables lying to the right of a heavy syllable, e.g., *[ká.no].ni.[sòi].[mà.na].[ní.ko].ha<n>* (and *[ká.no].ni.[sòi].ma.na.[ní.ko].ha<n>* after destressing). This shows that foot parsing itself includes a syllable clash avoidance mechanism.

4. Syllabic clash avoidance in Yindjibarndi

The third system which I will discuss is Yindjibarndi (Wordick 1982), which shows an interesting interaction between stress and a process of long vowel breaking. The long vowels are /aa, ii, uu, oo/. Wordick (1982,40) describes the process of long vowel breaking as follows: '... long vowels, especially high ones, may be pronounced either as part of a single syllable consisting of two morae or as part of two different ones, i.e., with one mora in each.' Long vowel breaking is optional in some contexts, but obligatory in others, depending on metrical conditions to be discussed below. I will tentatively formulate the rule as in (25).

(25) **Long Vowel Breaking**

```
σ            σ σ
|\           | |
μ μ    =>    μ μ
\ /          \ /
 H            H
```

Wordick (1980, 17-18) provides two arguments against treating long vowels as (underlying) sequences of two identical short vowels. Firstly '... the long vowel *oo* cannot be pronounced with medial breaking, ... and in fact there is no short *o* in the language'. Secondly, long vowels behave as tautosyllabic in the allomorphy of the objective suffix, which is sensitive to the number of syllables in the base, e.g., monosyllabic */thaa+u/* 'mouth (obj.)', and */mii+u/* 'limb (obj.)', versus bisyllabic */thara+yi/* 'mouth (obj.)', */tyi.a+yi/* 'chair (obj.)'. Yindjibarndi apparently has a bimoraic word minimum.

Let us now take a first look at the stress pattern of the language:

(26) *I. Words without long vowels in even-numbered syllables*

a.	˘ ˘ ˘	wílarrà	'moon'
b.	˘ ˘ -	pángkarrìi	'go (infinitive)'
c.	- ˘ ˘	káarrwarà	'loincloth'
d.	˘ ˘ ˘ ˘	párnrturràrna	'Venus'
e.	˘ ˘ - ˘	ngúnhungkìiri	'they'
f.	- ˘ - ˘	káarrwan^{y}t^{y}àangu	'slip, slide (infinitive)'

II. Words with long nonhigh vowels in even-numbered syllables

g.	˘ -	t^{y}arráarn	'frog'
h.	- -	páarnpaarn	'mulga parrot'
i.	˘ - ˘	purnngáarri	'cyclonic cloud'
j.	˘ - ˘ -	ngurnáapurràa	'approximately towards him'

III. Words with long high vowels in even-numbered syllables

k.	˘ -	pírri.ì *or* pirríi	'match'
l.	- -	máapu.ù	'mob (objective)'
m.	˘ - ˘	páli.ìrri *or* palíirri	'blue-tongue lizard'
n.	- - ˘	káayu.ùrru	'southward'
o.	˘ - -	mártu.urràa	'twilight'
p.	- - -	máapu.urràa	'in the general direction of the group'

The generalizations are as follows. Firstly, in words that have no long vowels in even-numbered syllables (cf. 26a-f) stresses fall as predicted under the rightward GT, with binary alternation. Secondly, final degenerate feet [σ_μ] are allowed, under syllabic clash avoidance, (cf. 26a,c,l). Thirdly, in words where long vowels are underlying in even-numbered syllables, these never surface in weak positions. Two strategies occur to avoid surface weak heavy syllables. One, which we already know from Finnish, is skipping a light syllable before a heavy syllable, so as to stress the latter. In Yindjibarndi skipping also applies to initial sequences of a light plus a heavy syllable (cf. 26g,i,j,k,m). Interestingly, the second way of avoiding unstressed heavy syllables is breaking up long vowels in even-numbered syllables, producing two light syllables. In (26k-p) dots indicate the separated halfs of broken vowels. Breaking competes or alternates with light syllable skipping in sequences of light-heavy (cf. 26k,m,o). But breaking is obligatory in sequences of heavy syllables, the second of which avoids being parsed as the weak syllable of a double-heavy trochee (cf. 26l,n,p). An isolated example occurs of an even-numbered syllable with a nonhigh long vowel, cf. (26h).

In the descriptive vocabulary of the GT, Yindjibarndi seems, at the surface at least, to require all but two predicted expansions of the GT:

(27)	a.	[$\sigma_\mu\sigma_\mu$]	[wíla][rrà]	[pírri][ì]
	b.	[$\sigma_{\mu\mu}\sigma_\mu$]	[káarrwa][rà]	[káayu][ùrru]
	c.	[$\sigma_\mu\sigma_{\mu\mu}$]	*Not attested*	
	d.	[$\sigma_{\mu\mu}\sigma_{\mu\mu}$]	*Marginally attested*, cf. [páarnpaarn]	
	e.	[$\sigma_{\mu\mu}$]	[pángka][rrìi]	

Apparently Yindjibarndi requires a set of GT expansions that is a subset of that of Finnish, as one more shape of the bisyllabic GT is missing, the double heavy foot. That is, at the surface no heavy syllables may occupy weak positions in feet. Parsing apparently requires the heavy-light foot [$\sigma_{\mu\mu}\sigma_{\mu}$], which points to syllabic foot parsing. But under a syllabic analysis, the quantity sensitivity of Yindjibarndi (which disallows heavy syllables in weak positions), cannot be expressed. It is this property that distinguishes Yindjibarndi from Finnish.[11] Therefore I take the mora to be the parsing unit. With parsing at mora layer, avoidance of L-H feet (cf. *purnngáarri*, instead of **púrnngaarrì*) becomes a simple matter of parsing, since L-H is not a proper moraic trochee. In addition to the mora, the syllable must be a rhythm unit, for three reasons. Firstly, final degenerate feet occur under strict syllable clash avoidance, e.g. *purnngáarri* 'cyclonic cloud', not **purnngáarrì*. Secondly, words with no long vowels in even syllables follow the pattern *káarrwarà* 'loincloth', instead of **káarrwàra* (hence *[$\sigma_{\mu\mu}$][σ_{μ} σ_{μ}]). Thirdly, the output of long vowel breaking conforms to it, cf. *káayu.ùrru* 'southward', instead of **káayù.urrù*. Avoidance of syllabic clash is implemented by switching the rhythm parameter to 'on' for the syllable layer, cf. (28b):

(28) Two-layered analysis of Yindjibarndi
- a. Parsing: construct trochees from left to right on the mora layer. Final degenerate feet are allowed.[12]
- b. Rhythm: avoid clash on the mora layer AND the syllable layer.
- c. Word Layer: End Rule Left.

Harmonic Constituent Copying copies moraic trochees to the syllabic layer, where the syllabic rhythmic effects of moraic parsing are measured. Moras are skipped to avoid syllabic clashes, as shown in (29b,e,f). (Vowel sequences that are the result of breaking have been underlined.)

```
(29) a.  (*                     )  b.  (*            )   Word
         {* }    .    {* }   .         {* }    . {*}     σ
         [*.]    .    [*.]   .         [*.]    . (*)     μ
         káarr.wanʸ.tʸàa.ngu           káarr.wa.rà

     c.  (*               )  d.   (      *          )   Word
         {*    .}.  {* }              .  {* } .  {* }    σ
         (*    .).  [*.]              .  [*.] .  [*.]    μ
         már.tu.u.rràa            ngu.rnáa.pu.rràa

     e.  (*              )   f.   (*              )      Word
         {* }  .{*     .}         {* }  . .  {* }        σ
         [*.]  .(*     .)         [*.]  . .  [*.]        μ
         káa.yu.ù.rru             máa.pu.u.rràa
```

Under this analysis the function of Long Vowel Breaking becomes fully clear: the rule serves to satisfy the no-syllable-clash condition on the Yindjibarndi[13] foot

11 The foot required, the quantity sensitive syllabic trochee [σ (σ_{μ})] (cf. Hayes 1980), is dubious. Hayes (1991) convincingly shows that it should be eliminated from the theory.

12 As shown by Hayes (1991), Kager (1992a), and Kiparsky (1991b), word final degenerate feet need not be due to foot parsing proper, but can be derived in various other ways.

13 Other moraic trochee systems avoid syllabic clash by destressing, instead of breaking. This is the case in Ngiyambaa (Donaldson 1980), Wargamay (Dixon 1981), Nyawaygi (Dixon 1983), and to some extent in Nunggubuyu (Hore 1981), all Australian languages.

parsing mode. Breaking occurs precisely where otherwise a syllable clash would arise from mora layer parsing or from the juxtaposition of two long vowels. Light syllables in the output of vowel breaking are parsed regularly, including rhythmic skipping in (29c,e). That is, breaking may well apply in tandem with foot parsing.

5. Factoring out the rhythmic dimensions of trochaic foot parsing

On the basis of the systems discussed it can be concluded that rhythmic units are partly predictable from parsing units (cf. the Rhythmic Uniformity Hypothesis). Estonian and Finnish parse syllables, hence avoid syllable clash, while Nunggubuyu and Yindjibarndi parse moras, hence avoid mora clash. But languages may select a supplementary rhythmic unit different than that of foot parsing. This option is instantiated by Finnish and Yindjibarndi, where clash avoidance is switched to 'on' for both layers. These languages minimally differ in their parsing units, which captures their differences of quantity (in)sensitivity. Finnish parses syllables (and by the RUH avoids syllable clash), but also avoids mora clash (hence $*[\sigma_{\mu}\sigma_{\mu\mu}]$). Since syllables are parsing units, heavy syllables are allowed in weak positions of feet. Yindjibarndi parses moras (and by the RUH avoids mora clash), but also avoids syllable clash (hence $*[\sigma_{\mu\mu}][\sigma_{\mu}\sigma_{\mu}]$). Since moras are parsing units, heavy syllables are disallowed in weak positions of feet. This two-by-two arrangement of possibilities can be represented as in (30):

(30)	**Language**	**Parsing unit**	**Rhythmic unit**
	Estonian	Syllable	Syllable
	Finnish	Syllable	Syllable *plus mora*
	Nunggubuyu	Mora	Mora
	Yindjibarndi	Mora	Mora *plus syllable*

6. A puzzle: Guugu Yimidhhir

Finally, I will discuss a system that apparently poses problems to both the GT and the two-layered theory, but which as I will argue is still analysed more adequately under the latter theory. It is another Australian language, Guugu Yimidhirr (Haviland 1979). Its stress pattern is exemplified in (31):

(31)				
	a.	˘ ˘ ˘ ˘ ˘	mȁrr.bu.gàn.bi.gù	'still in the cave'
	b.	- ˘ ˘ ˘	búu.rra.yày.gu	'still in the water'
	c.	˘ - ˘ ˘	ma.gíil.ngay.gù	'just branches'
	d.	- - ˘ ˘	búu.rráay.bì.gu	'still in the water'

The following generalizations are due to Haviland (1979,41-43). Firstly, length contrasts are restricted to the first two syllables. Secondly, in words starting with L-L and H-L (cf. 31a,b), main stress is initial, with an alternating secondary stress pattern, avoiding syllable clash. Thirdly, in words that start with L-H (cf. 31c), main stress is on the second syllable, with an alternating secondary stress pattern, again avoiding syllable clash. Fourthly, in words that start with H-H (cf. 31d), main stress is on both heavy syllables, and alternating secondary stress resumes on the third syllable, with double syllable clash. The puzzle resides in the resumption of rhythmic alternation after a heavy syllable. While this respects syllabic clash avoidance in (31b) and (31c), it violates it twice in (31d).

In order to get a hint of the foot employed, it proves useful to examine the prosodic morphology of the system. Interestingly, Guugu Yimidhiir has bisyllabic reduplication, regardless of weight. This diagnoses the syllabic trochee [σ σ].

(32)	a.	$[\sigma_\mu\sigma_\mu]$	yimi=yimidhirr	'this same way again'
	b.	$[\sigma_\mu\sigma_{\mu\mu}]$	gadhii=gadhii	'very far away'

But assuming syllabic trochees, we run into an apparent counterexample to the Rhythmic Uniformity Hypothesis, since (32d) contains two syllable clashes. This odd property may be captured in a syllabic analysis by the stipulation that the phonetic stresses are read off the mora layer, rather than the syllable layer:

(33) A two-layered analysis of Guugu Yimidhirr
- a. Parsing: construct trochees from left to right on the syllable layer. Final degenerate feet allowed.
- b. Rhythm: avoid clash on the syllable layer *and* the mora layer.
- c. Phonetically interpret the *mora* layer.

As usual, mora clash avoidance accounts for initial skipping (cf. 31c). See (34):

```
(34)  a.   (*      .)(*     .)(*)     b.   (*       .)(*      .)   σ
           {#      .}{#     .}{#}          [*.]   . {#      .}   μ
           márr.bu.gàn.bi.gù               búu.rra.yày.gu

      c.    . (*        .)  (*)       d.   (*      . )  (*   .)  σ
            . [*.]      .   {#}            [*.] [*.] {#    .}  μ
           ma.gíil.ngay.gù                 búu.rráay.bì.gu
```

This analysis captures the puzzling pattern of clash avoidance of the system.

7. Conclusion

I have demonstrated that stress systems may avoid clashes with respect to either moras, syllables, or both. Units of rhythm are partly predictable from units of foot parsing, but languages may opt to include an additional rhythmic unit. The second result is deriving the GT effect from a two-layered theory of foot parsing, which has three advantages. Firstly, it rationalizes the L-H avoidance effect as mora clash avoidance. Secondly, it explains why skipping is restricted to light syllables. Thirdly, it breaks down the rhythmic variation between trochaic systems with distinctions of quantity into two dimensions, parsing layer and rhythmic layer.

References

Carlson, L. 1978. *Stress in Finnish.* Unpublished manuscript, MIT.

Dixon, R.M.W. 1981. Wargamay. *Handbook of Australian Languages*, vol. II., eds. R.M.W. Dixon and B.J. Blake, 1--144. Amsterdam: John Benjamins.

Dixon, R.M.W. 1983. Nyawaygi. *Handbook of Australian Languages*, vol. III., eds. R.M.W. Dixon and B.J. Blake, 431--525. Amsterdam: John Benjamins.

Donaldson, T. 1980. *Ngiyambaa: The Language of the Wangaaybuwan.* Cambridge: Cambridge University Press.

Halle, M., and J.R. Vergnaud. 1987. *An Essay on Stress.* Cambridge: MIT Press.

Hansen, K.C., and L.E. Hansen. 1969. Pintupi phonology. *Oceanic Linguistics* 8:153--170.

Harms, R.T. 1960. Stress and Juncture in Finnish. *American Studies in Uralic Languages* (Indiana University Publications, Uralic and Altaic Series, vol. 1), 7--12. Bloomington: Indiana University.

Harms, R.T. 1964. *Finnish Structural Sketch.* (Indiana University publications, Uralic and Altaic series, vol. 42). Bloomington: Indiana University.

Haviland, J.B. 1979. Guugu Yimidhirr. *Handbook of Australian Languages*, vol. I., eds. R.M.W. Dixon and B.J. Blake, 27--180. Amsterdam: John Benjamins.

Hayes, B. 1980. *A Metrical Theory of Stress Rules*. Bloomington: Indiana University Linguistics Club.

Hayes, B. 1988. Ternary Stress Assignment in Finnish, Estonian, and Other Languages. Paper presented at the Generative Phonology Workshop, Leiden, September 23, 1988.

Hayes, B. 1991. *Metrical Stress Theory: Principles and Case Studies*. Unpublished manuscript, UCLA.

Hint, M. 1973. *Eesti Keele Sonafonoloogia* I. Tallinn: Eesti NSV Teaduste Akadeemia.

Hore, M. 1981. Syllable Length and Stress in Nunggubuyu. *Work Papers of SIL-AAB, Series A*, No. 5.

Kager, R. 1989. *A Metrical Theory of Stress and Destressing in English and Dutch*. Dordrecht: Foris.

Kager, R. 1990. *Strict Binarity and Destressing Rules*. Unpublished manuscript, Stanford University.

Kager, R. 1992a. Alternatives to the Iambic-Trochaic Law. To appear in *Natural Language and Linguistic Theory*.

Kager, R. 1992b. Are There Any Truly Quantity Insensitive Systems? To appear in *Proceedings of the 18th Annual Meeting of the Berkeley Linguistics Society*.

Kiparsky, P. 1991a. Quantity Sensitivity and the Nature of Templatic Parsing. Paper presented at the *17th Annual Meeting of the the Berkeley Linguistics Society*.

Kiparsky, P. 1991b. *Catalexis*. Unpublished manuscript, Stanford University and Wissenschaftskolleg zu Berlin.

Kirton, J.F. 1967. Anyula Phonology. *Pacific Linguistics Series A*, No. 10, (Papers in Australian Linguistics, No. 1), 15--28.

Lahiri, A. 1992. The Germanic Foot in Metrical Theory. Paper presented at the University of Amsterdam, February 1992.

Lahiri, A., and H. van der Hulst. 1988. On Foot Typology. *Proceedings of the North Eastern Linguistics Society* 18 (Vol. 2), 286--299. Amherst: GLSA.

McGregor, W. (1990). *A Functional Grammar of Gooniyandi*. Amsterdam: John Benjamins.

Prince, A. 1980. A Metrical Theory for Estonian Quantity. *Linguistic Inquiry* 11:511--562.

Prince, A. 1983. Relating to the Grid. *Linguistic Inquiry* 14:19--100.

Prince, A., and P. Smolensky. 1992. Optimality: Constraint Interaction in Generative Grammar. Paper presented at the 11th *West Coast Conference on Formal Linguistics*, UCLA, February 26, 1992.

Skousen, R. 1972. On Capturing Regularities. *Papers from the Eighth Regional Meeting of the Chicago Linguistics Society*, eds. P.M. Peranteau et al., 567-577. Chicago: Chicago University Press.

Van der Hulst, H. 1984. *Syllable Structure and Stress in Dutch*. Dordrecht: Foris.

Van der Hulst, H. 1991. *The Book of Stress*. Unpublished manuscript, University of Leiden.

Wordick, F.J.F. 1982. *The Yindjibarndi Language*. (Pacific Linguistics, Series C, No. 71.)