41 The Representation of Word Stress

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1 Introduction

Since the publication of Hayes (1985), the asymmetries between iambs and trochees have been a central theme in the literature on stress. Two types of asymmetries can be distinguished. One has to do with quantity. It has frequently been claimed that iambs do not allow a heavy syllable in the weak position, and require a heavy syllable in the strong position. Kager (1993) deals with asymmetries of this type on the basis of a theory whose central hypothesis is that feet are built over moras, rather than syllables. The recent literature, however, has shown that these "quantitative asymmetries" are not supported empirically. It is simply not true, for instance, that iambs invariably constrain the occurrence of heavy and light syllables in the way just described. A particularly convincing argument to this effect is given in Altshuler (2009), with respect to Osage. (See also CHAPTER 44: THE IAMBIC–TROCHAIC LAW and CHAPTER 57: QUANTITY-SENSITIVITY.)

There is a second class of asymmetries, however, which remains valid. These are "parsing asymmetries," which have to do with the direction of foot construction in a word. Two authors have argued that such parsing asymmetries can only be explained if the representation of word stress is fundamentally changed. Interestingly, however, they disagree as to *how* it should be changed. While Gordon (2002) proposes to *simplify* the representation of word stress by eliminating foot structure completely, Hyde (2001, 2002, 2008) recognizes not only foot structure but, in addition, a new type of structure, the "overlapping foot," thus *complicating* the representation of stress in order to account for the asymmetries.

In this chapter I consider the ongoing debate about the representation of word stress from the perspective of parsing asymmetries. In §2, after presenting some of the most important asymmetries, I briefly sketch Gordon's account, which is as simple as it is radical. In his view, asymmetries can be accounted for if foot structure is abolished. Word stress representations contain only gridmarks, as in Prince (1983) and Selkirk (1984).

In the spirit of Gordon, then, we might say that feet are superfluous if we want to account for the *distribution* of stress in the words of the world's languages. This raises the question of whether feet are necessary at all. Interestingly, if we broaden our scope to include other phenomena as well, the evidence for foot structure becomes overwhelming. In §3 I present some cases from the recent literature which support the existence of feet, thus suggesting that representations with only gridmarks are too impoverished.

If foot structure does exist, then how do we account for the *distribution* of stress in the words of the world's languages? Is it still reasonable to formulate the relevant constraints in terms of the grid only? Or must they be stated in terms of foot construction, with gridmarks playing only a marginal role? In §4 I present an overview of Hyde's work, in which the claim is made that the distribution of stress can best be explained in terms of constraints regulating foot construction. Gridmarks only read off some of the basic properties of a word's foot structure. This is a continuation of the tradition initiated by Liberman and Prince (1977). Other authoritative studies, such as Hayes (1984, 1995), have argued for the same idea, which also led to development of the "bracketed grid" notation (Halle and Vergnaud 1987). There are some important differences between the various "tree-cum-grid" theories, however. In §5 I give a brief overview of one issue where theories seem to differ. This concerns the status of headedness in foot structure. Is a foot inherently headed, even if it is not accompanied by a gridmark? Or is it the case that a foot is inherently headless unless there is a gridmark accompanying it, marking one syllable as the head? In the first approach, some or all of the properties of foot structure can simply be read off the grid. In this view foot structure is primary and the grid secondary. In the second approach, in which the grid is imposed on foot structure, the grid is primary and foot structure secondary.

2 Explaining parsing asymmetries without foot structure

Hyde (2001, 2002) shows that some non-existing systems can easily be derived with generally accepted foot inventories (see CHAPTER 40: THE FOOT). Let us consider three of these cases. The first one is the Australian language Garawa, which can be compared with what Hyde (2002: 329) calls "Anti-Garawa," an unattested system.

(1) *Garawa*   *Anti-Garawa*

```
 x   x   x           x   x   x
(1 2)(3 4)(5 6)     (1 2)(3 4)(5 6)
 x     x   x         x   x     x
(1 2) 3 (4 5)(6 7)  (1 2)(3 4) 5 (6 7)
```

In these representations foot structure is indicated by round brackets and headedness is represented by gridmarks. Garawa can be derived with the following rules. One trochee is built at the left edge. Then trochees are built from right to left. Furthermore, degenerate feet are not allowed. In odd-parity words this creates a lapse following the stressed initial syllable. If we change just two ingredients of this system we derive a non-existing pattern. One *iamb* is built at the *right* edge, and then a series of iambs from left to right. We then derive a system in which odd-parity words contain a lapse before the final (stressed) syllable.

The second example is a pair consisting of the Australian language Pintupi, which can easily be derived by the rules of the theory, and Anti-Pintupi, which can be derived just as easily but does not exist.

(2) *Pintupi* *Anti-Pintupi*

```
 x   x   x             x   x   x
(1 2)(3 4)(5 6)      (1 2)(3 4)(5 6)
 x   x   x               x   x   x
(1 2)(3 4)(5 6) 7    1 (2 3)(4 5)(6 7)
```

In Pintupi, trochees are built from left to right. Degenerate feet are not allowed. In odd-parity words this creates a lapse at the right edge of a word. Anti-Pintupi can be derived just as easily, by constructing iambs from right to left, so that the lapse is located at the left edge.

Finally, consider Piro, spoken in Brazil and Peru, and Anti-Piro, an impossible system.

(3) *Piro* *Anti-Piro*

```
 x   x   x              x   x   x
(1 2)(3 4)(5 6)       (1 2)(3 4)(5 6)
 x   x     x            x     x   x
(1 2)(3 4) 5 (6 7)    (1 2) 3 (4 5)(6 7)
```

In Piro, one trochee is built at the right edge. Remaining trochees are built from left to right; degenerate feet are not allowed. In odd-parity words this creates a lapse before the stressed penultimate syllable. Anti-Piro can be derived by changing just two ingredients. One iamb is built at the left edge; remaining iambs are built from right to left. In odd-parity words this creates a lapse after the peninitial syllable.

The three non-existent cases have in common that iambic structure refers to the right edge. In Anti-Garawa one iamb is constructed at the right edge, while in Anti-Pintupi and Anti-Piro foot construction starts at the right edge. One might suppose, then, that iambs cannot refer to a word's right edge. This, however, is not true; languages where iambs are constructed from right to left do exist. One example is Suruwaha, spoken in Brazil (Hyde 2002: 320), which is the mirror image of Araucanian, spoken in Chile and Argentina (Hyde 2002: 320). In this language iambs are constructed from left to right. These systems are illustrated in (4):

(4) *Araucanian* *Suruwaha*

```
   x   x   x           x   x   x
(1 2)(3 4)(5 6)      (1 2)(3 4)(5 6)
   x   x   x          x   x   x   x
(1 2)(3 4)(5 6) 7    (1)(2 3)(4 5)(6 7)
```

In Araucanian the final syllable is unparsed in odd-parity words. In Suruwaha the first syllable of odd-parity words is assigned a degenerate foot.

It seems as if these two languages employ two different strategies to achieve the same goal: a rhythmic pattern in which every other syllable is stressed. To achieve this, Araucanian leaves the final syllable unparsed; if this were not the case, a clash would be created at the right edge, disturbing the rhythmic alternation. In Suruwaha, on the other hand, a degenerate foot is constructed at the left edge. Otherwise, there would be a lapse at the left edge, disturbing the binary rhythmic pattern. If it is true that a binary rhythmic pattern is the primary goal, we might just as well express that target directly, without the mediation of feet. A comparison of Araucanian and Suruwaha, then, suggests that feet might be superfluous; all that seems to matter is rhythmic alternation.

All the non-existing systems mentioned above share the same property; in an odd-parity word there is a lapse, entailing that the rhythmic alternation is disturbed. This again suggests that binary rhythm is the only relevant factor, which leads Gordon to adopt the strategy of expressing this directly, without foot structure. Essentially, then, the idea is that the "anti-systems" in (1)–(3) cannot exist because they do not realize the ideal of binary rhythm.

The ideal of rhythmic alternation is expressed on the grid, using the following two constraints.

(5) a. *Lapse (Gordon 2002: 502)
A string of more than one consecutive stressless syllable may not occur.
b. *Clash (Gordon 2002: 506)
A stress domain may not contain adjacent stressed syllables.

Having established that the non-existing systems can be explained on the assumption that they lack the ideal rhythm in odd-parity words, the question arises of how we can account for systems which do exist, even though alternating rhythm is disturbed in odd-parity words. Let us turn first to Pintupi. To account for this language, Gordon makes use of Non-finality, a device that can be motivated independently (Prince and Smolensky 1993; see chapter 43: extrametricality and non-finality for a definition and discussion). In this view, Pintupi has alternating rhythm, but the final syllable is excluded from stress assignment. This becomes clear when we compare Pintupi with another Australian language, Maranungku.

(6) *Pintupi* *Maranungku*

```
    x   x   x              x   x   x
    1 2 3 4 5 {6}          1 2 3 4 5 6
    x   x   x              x   x   x   x
    1 2 3 4 5 6 {7}        1 2 3 4 5 6 7
```

I have indicated the Non-finality requirement imposed on the final syllable with curly brackets (braces). The two representations in (6) demonstrate that there is only one difference between Pintupi and Maranungku. In the former, but not the latter, the final syllable cannot be stressed. This explains why Pintupi has a lapse at the end of the word.

We can also see why Anti-Pintupi does not exist. There is no equivalent of Non-finality operating at the left edge; there is no Non-initiality. Therefore, an initial lapse cannot be created. To see this consider again Anti-Pintupi and Surahawa.

(7) *Anti-Pintupi* *Suruwaha*

```
  x x x          x x x
1 2 3 4 5 6    1 2 3 4 5 6
    x   x   x    x   x   x   x
1 2 3 4 5 6 7    1 2 3 4 5 6 7
```

Anti-Pintupi has an initial lapse in odd-parity words. This lapse is automatically eliminated in favor of a binary rhythmic alternation. A gridmark is therefore inserted on the first syllable. This creates a system that does exist: Suruwaha.

Before I go on to discuss the other asymmetries, we should note that, although Araucanian and Suruwaha both exhibit binary rhythm, there is still a difference between them. Recall from (4) that they can easily be distinguished by foot structure; Araucanian builds iambs from left to right, and Suruwaha from right to left.

From the point of view of the grid-only approach, the difference resides in the number of gridmarks in odd-parity words; there are fewer marks in Araucanian than in Suruwaha. This can be explained with the use of Alignment constraints, according to Gordon (2002: 498). Every gridmark has to be aligned with the right or left edge, depending on the language, as determined by the constraint (family) ALIGN(x_1,L/R). Every syllable separating the gridmark from its designated edge adds a violation. Since this is true for *every* gridmark, the constraint automatically reduces the number of gridmarks. If Alignment is satisfied, one and one only gridmark is created, located at the left or right edge, depending on the language.[1] In order to achieve rhythmic alternation, then, *LAPSE must be ranked higher than ALIGN(x_1,L/R). I illustrate the minimization effect of ALIGN(x_1,L/R) in (8):

(8)

1 2 3 4 5 6 7	ALIGN(x_1,L/R)
☞ a. x x x 1 2 3 4 5 6 7	*,***,***** (9)
b. x x x x 1 2 3 4 5 6 7	**,****,****!** (12)

In Araucanian, ALIGN(x_1,L/R) has maximal effect, reducing the number of gridmarks. *LAPSE, however, must be satisfied. The result is that the minimal number of

[1] Such systems do exist. They are analyzed with the ranking ALIGN(x_1,L/R) >> *LAPSE. These are languages where, in principle, one stress is created at the left/right edge of a word. In older theories, these languages were accounted for with unbounded feet (e.g. Hayes 1980; Hammond 1984; see Kager 1995 for an overview). Since Prince (1985) there has been general agreement that unbounded feet do not exist. The most common force creating additional stresses in languages that tend to prefer just one stress in each word is WEIGHT-TO-STRESS (Prince 1983; Prince and Smolensky 1993; Kager 1999). If this constraint is highly ranked, a language has one stress in each word, unless a word contains one or more heavy syllables. For a typology of unbounded systems where heaviness does not play a role, see Gordon (2002). For a typology of unbounded systems where weight does play a role, see Hyde (2001, 2006).

gridmarks is inserted, such that no violation of *Lapse is created. To account for the fact that the last syllable is stressed in even-parity words, Align(x_1,R) must dominate Align(x_1,L) in Araucanian. This is shown in (9).

(9)

1 2 3 4 5 6	Align(x_1,R)	Align(x_1,L)
☞ a. x x x 1 2 3 4 5 6	**,**** (6)	*,***,***** (9)
b. x x x 1 2 3 4 5 6	*,***,***!** (9)	**,**** (6)

To account for the fact that the number of gridmarks is maximized in odd-parity words in Suruwaha, Gordon proposes AlignEdges, which demands that a syllable located at the edge must have a gridmark (Gordon 2002: 497). In Suruwaha, this constraint must dominate Align(x_1,R), which explains why four gridmarks are created in a seven-syllable word, rather than just three, as in Araucanian. Notice that AlignEdges also requires a gridmark on the initial syllable in the even-parity words of Suruwaha. However, in this environment, a gridmark on the first syllable either creates a clash, or a lapse, as shown in (10).

```
(10)  x x   x   x         x     x   x
      1 2 3 4 5 6         1 2 3 4 5 6
       ↑                      ↑
      clash               lapse
```

Both *Clash and *Lapse dominate AlignEdges in Suruwaha. This explains why the final, rather than the initial, syllable is stressed in even-parity words.

This is the basic system proposed by Gordon. I will now demonstrate that it cannot derive Anti-Garawa, which is given again in (11), but without foot structure.

(11) *Anti-Garawa*

```
        x   x   x
      1 2 3 4 5 6
        x   x     x
      1 2 3 4 5 6 7
```

To guarantee that the final syllable is stressed, AlignEdges must be high-ranked. However, in even-parity words the initial syllable should not be stressed by AlignEdges. This constraint must therefore be lower-ranked than *Clash and *Lapse, just as in Suruwaha. To ensure that in even-parity words the final syllable is stressed, we also have to rank Align(x_1,R) above Align(x_1,L), again just as in Suruwaha. Interestingly, with the two rankings *Clash, *Lapse >> AlignEdges and Align(x_1,R) >> Align(x_1,L) it is impossible to derive the pattern in (11), which contains a lapse before the last stressed syllable in odd-parity words. This pattern violates AlignEdges and *Lapse. Inserting a gridmark on the initial syllable solves both violations, giving (12):

(12) *Anti-Garawa resolved (Suruwaha)*

```
  x   x   x
1 2 3 4 5 6

x   x   x   x
1 2 3 4 5 6 7
```

Insertion of the initial gridmark creates a system with a binary rhythm. This is a possible system, which is exemplified by Suruwaha.

The same reasoning applies to Anti-Piro, whose pattern is given again in (13), without foot structure.

(13) *Anti-Piro*

```
  x   x   x
1 2 3 4 5 6

  x     x   x
1 2 3 4 5 6 7
```

The presence of stress on the final syllable indicates that ALIGNEDGES is high-ranked, as in Suruwaha. To ensure that in even-parity words the final syllable is stressed, ALIGN(x_1,R) must dominate ALIGN(x_1,L). With these rankings, it is impossible to derive the stress pattern of odd-parity words in (13). Again, this pattern has a lapse, and violates ALIGNEDGES. Both violations can be eliminated by inserting a gridmark over the first syllable, and by moving the gridmark of the second syllable to the third, as shown in (14).

(14) *Anti-Piro resolved (Suruwaha)*

```
  x   x   x
1 2 3 4 5 6

x   x   x   x
1 2 3 4 5 6 7
```

Again this pattern is actually attested, and is exemplified by Suruwaha.

I have shown in this section that grid-only frameworks can easily explain the asymmetries occurring in binary rhythmic patterns. They do so in a way that is as simple as it is radical. Foot structure is eliminated, and only stresses are preserved, represented as gridmarks. As far as the *distribution* of stress is concerned, grid-only approaches do rather well. Surely this explains why the grid-only approach is still adopted (see for recent applications Karvonen 2005, 2008; also Gordon 2003: 179, note 4, where he confidently states that "a grid-based theory of stress offers a closer fit to the typology of stress than foot-based metrical theories"). It seems, then, that grid-only approaches are sufficient, and that foot structure is therefore superfluous.

Interestingly, however, if we go beyond the *distribution* of stress, and broaden our scope to other phenomena, we find abundant evidence for feet. In the next section I will present a few arguments in favor of foot structure. Then, in §4, I will investigate what this means for the theory of stress.

3 Evidence for foot structure

In this section I present evidence for the existence of foot structure. First I demonstrate that, in a sequence of two unstressed syllables, not every syllable behaves identically. Then I show that foot structure is necessary to define the domains within which certain phenomena apply. The third type of evidence for foot structure has to do with weight. (For further discussion of foot structure see CHAPTER 39: STRESS: PHONOTACTIC AND PHONETIC EVIDENCE and CHAPTER 40: THE FOOT.)

3.1 Unstressed syllables do not behave identically in lapses

De Lacy (2002, 2007a) shows that in Ayutla Mixtec, spoken in Mexico, there is a close relation between the position of stress and tonal quality. One generalization is that the leftmost high tone receives word stress. This is illustrated by the following examples:

(15) ML'H [kūnù'rá] 'his tobacco'
L'HH [sù'tʲáí] 'I will swim'
LM'H [sùtʲā'í] 'I will not swim'

If all tones in a word are the same, the first syllable becomes stressed:

(16) 'HHH ['ʃínírá] 'he understands'
'LLL ['ʃàtùì] 'my trousers'
'MMM ['ʃīɲūrā] 'his pineapple'

Prince (1983) establishes that patterns of this type pose no problems for the grid-only approach, as they are an instance of what he calls the "default-to-same-side" pattern.[2] Interestingly, however, Ayutla Mixtec has yet another pattern, which turns out to be quite problematic. If a word has a sequence of a high tone immediately followed by a low tone, then the high tone must be stressed, even if it is preceded by another high tone. If there is more than one such sequence, then the high tone of the first sequence is stressed. This is illustrated in (17).

(17) H'HL [lú'lúrà] 'he is small'
LMH'HL [vìʃīí'ráà] 'he is not cold'
'HLHL ['ʃáàʃíìʔ] 'is not eating'

The low tone attracts stress to the high tone immediately to its left. To explain this pattern, de Lacy proposes that HL is parsed as a trochee, (HL). Thus, in a word with the structure HHL, as in the first example in (17), the parse H(HL) is better than (HH)L. The result is that a high tone immediately preceding a low

[2] In systems where "default-to-same-side" obtains, a gridmark is assigned to the syllables with a certain property (in this case the syllables with a high tone); one End-Rule applies at a low level and another End-Rule at a higher level. In Ayutla Mixtec, both End-Rules apply at the left.

tone receives word stress, because it is the head of a trochee. With a grid-only approach it is difficult to explain these facts. It seems as if an unstressed syllable with a low tone behaves differently from an unstressed syllable with a high tone; the former but not the latter seems to avoid a lapse. By its very nature, the grid structure of an unstressed syllable with a low tone is identical to the grid structure of an unstressed syllable with a high tone. This indicates that a grid-only framework cannot account for these facts.[3]

I now turn to the second type of evidence for foot structure: the proper characterization of domains.

3.2 The characterization of domains

A stressed syllable and a neighboring unstressed syllable often form a domain within which a phenomenon applies. A grid-only approach is notoriously bad at defining domains of this type, as it can only define a primary stressed position, secondary stressed positions, and unstressed positions. It is impossible to express the fact that some unit creates a bond with another unit.[4]

An example showing this is provided by Guugu Yimidhirr, a language spoken in Australia (Zoll 2004; Elías-Ulloa 2006). In this language long vowels can only occur in the first and/or the second syllable of a word, but nowhere else. Some illustrative examples, from Elías-Ulloa (2006: 231–232), are given in (18):

(18)	a.	ˈguːgu	'language-ABS'
		ˈbuːraˌjaj	'water-LOC'
		ˈdaːbaˌŋalŋaˌla	'ask-RED-IMP'
	b.	maˈgiːl	'branch-ABS'
		maˈjiːŋu	'food-PURP'
		maˈgiːlnajˌgu	'branch-PL-EMPH'
	c.	ˈbuːraːj	'water-ABS'
		ˈdjiːraːlˌgal	'wife-ADESS'
		ˈbuːraːjˌbigu	'water-LOC-EMPH'

In a theory that recognizes feet, it is easy to characterize the domain within which the long vowels can occur; it is the initial foot, which is also the head of the word. This foot can either be a trochee or an iamb, depending on the presence and location of a long vowel. On the other hand, in a grid-only account it is difficult to understand why long vowels are restricted to the first two syllables of the word. This is a consequence of the fact that in this approach the first two syllables cannot be characterized as a domain. The facts illustrated in (18) are therefore

[3] Other phenomena showing that not all syllables behave in the same way in a lapse are high vowel deletion in Old English (Dresher and Lahiri 1991) and vowel balance effects in Scandinavian (Bye 1996) and Old Frisian (Smith 2004; Smith and van Leyden 2007). Unfortunately, due to lack of space I cannot discuss these phenomena here.

[4] The domain-defining character of the foot is the oldest evidence in favor of its existence (Selkirk 1980). It turns out to be very difficult to find cases where it is absolutely impossible to define a domain with grids only. An interesting example is provided by Pearce (2006), who argues that feet in Kera create the domains for tone association. I suspect, however, that an alternative is possible with gridmarks only, such that (certain) tones tend to anchor to strong positions on the grid. The role of the foot as a domain delineator is systematically eliminated in Majors (1998). She argues that feet do not play a role in stress-dependent harmony.

problematic for a grid-only framework. Let us now turn to the third type of evidence: syllable weight.

3.3 *Evidence from syllable weight*

Prince (1983) shows that the grid-only framework can explain the relationship between syllable weight and the position of stress. This seems to suggest that the effect which weight has on the position of stress can be described without making use of foot structure. However, once we broaden our view beyond the distribution of stress in the strict sense, it becomes obvious that weight does provide us with convincing evidence for foot structure. Here I present one case: allomorph selection in Shipibo, spoken in Brazil and Peru.[5]

Shipibo has two allomorphs meaning 'again': /ribiː/ and /riːba/. The allomorph /ribiː/ has a long vowel in the second syllable, /riːba/ in the first syllable. Elías-Ulloa (2006) shows that allomorph selection is determined by foot structure. The language has two different feet: moraic trochees and iambs. The former is preferred; iambs are only built if the construction of moraic trochees is not possible. Furthermore, both moraic trochees and iambs must be bisyllabic. Two other high-ranking constraints are relevant here. The constraint Weight-to-Stress is inviolable, so a heavy syllable cannot be left unparsed. There is also one Alignment constraint that is high-ranked: the left edge of a word must be aligned with the left edge of a foot. Consider the following forms (from Elías-Ulloa 2006: 7), where the relevant allomorphs are underlined:

(19) *Allomorph selection in Shipibo*

a.	(pi-ˈriː)(ba-kɨ)	'eat-again-PAST'
b.	(ˈputa)(riˌbiː)-kɨ	'throw-again-PAST'
c.	(ˈputa)(-ma-ˌriː)(ba-kɨ)	'throw-CAUS-again-PAST'
d.	(ˈputa)(-ˌjama)(-riˌbiː)-kɨ	'throw-NEG-again-PAST'

In (19a), /riːba/ is selected, allowing all syllables of the word to be parsed into feet. If the other allomorph had been selected, the form /pi-ribiː-kɨ/ would have been created. This form cannot be correctly parsed into foot structure. One possible parse is (ˈpi-ri)(ˌbiː-kɨ), but this representation contains an uneven trochee, which is not allowed in Shipibo. Another realization might be pi-(riˈbiː)-kɨ. But this structure violates the Alignment constraint, which is not possible either.

In (19b), /ribiː/ is selected; this is again explained by foot structure. If the other allomorph had been selected, a form would have been created that could not be properly parsed, viz. /puta-riːba-kɨ/. The parse (ˈputa)(-ˌriːba)-kɨ is unacceptable, because it contains an uneven trochee. The alternative (ˈputa)(-ˌriː)(ˌba-kɨ) is also bad, because it contains a monosyllabic iamb, a type of foot that is non-existent in this language. Yet another alternative would be pu(ta-ˈriː)(ˌba-kɨ), but this representation violates the requirement that a word should begin with the left edge of a foot. This constraint is very highly ranked in Shipibo. The form that is actually realized, (19b), does not suffer from any of these problems. It is parsed

[5] Other cases are reduplication in Kosraean (Kennedy 2005) and tonal spread in Capanahua (Hagberg 1993).

into appropriate feet and only the final syllable is left unparsed. The same can be said for (19c) and (19d). We see, then, that foot structure explains this instance of allomorph selection.

In the grid-only framework the distribution of the two allomorphs remains a puzzle. Consider again (19a), or rather its alternative, where the wrong allomorph is selected. This is the form /pi-ribiː-kɨ/. In a theory that only has gridmarks it is possible to parse this form as in (20):

```
(20)   x
       x     x
       x   x x    x
      pi - ri biː - kɨ
```

There seems to be no particular reason why this form should be rejected. There is a smooth rhythmic alternation, and the heavy syllable is stressed. In a grid-only framework, then, no constraint is able to eliminate this form. The reason, of course, is that there are no feet in this approach. It therefore lacks the essential ingredients with which the distribution of the two allomorphs in Shipibo can be explained.

In this section I have presented three types of evidence for foot structure: the phonology of lapses, the characterization of domains, and the interaction between weight and foot parsing.

On the basis of this evidence we can conclude that foot structure does exist. Gordon's approach might be economical, and also explain asymmetries, but its lack of foot structure makes it inadequate. Consequently, we are forced to explain the asymmetries in a theory of stress that does include foot structure. A priori, this looks like an almost impossible task, because, as we saw in §2, it is precisely the presence of foot structure that makes it so difficult to explain why certain systems do not exist. In the next section I will present a brief overview of the most important aspects of Hyde's (2001, 2002) work, where an account is offered of the asymmetries in a theory that does include foot structure.

4 Explaining parsing asymmetries with foot structure

One of the central ideas in Hyde (2001, 2002) is that iambs and trochees are derived by word-edge Alignment constraints; there are no separate constraints of the type Foot=Iamb and/or Foot=Trochee. In particular, the following two constraints are important:

(21) a. Hds-L
The left edge of every foot-head is aligned with the left edge of some prosodic word.

b. Hds-R
The right edge of every foot-head is aligned with the right edge of some prosodic word.

If Hds-L is high-ranked, then a word is parsed with trochees, while if Hds-R is high-ranked, it is parsed with iambs. This is similar to Gordon's approach.

The difference is that in Gordon's theory gridmarks are subject to Alignment, whereas in Hyde's approach foot-heads undergo Alignment. I demonstrate the effects of Alignment with the tableau in (22). I use Hyde's notation; vertical lines indicate headedness.

(22)

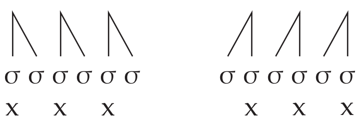
σ σ σ σ σ σ	Hds-L	Hds-R
☞ a. σ σ σ σ σ σ	**,**** (6)	*,***,***** (9)
b. σ σ σ σ σ σ	*,***,***!** (9)	**,**** (6)

In Hyde's framework all syllables must be dominated by a foot. There is no such thing as weak layering (Itô and Mester 1992). Absence of weak layering triggers foot construction, and Alignment maximally reduces the number of feet.

In principle, then, a trochee can only be created by Hds-L. Likewise, iambs can only be created by Hds-R. From this it follows that there is only a two-way contrast. In classical foot theory there is a four-way contrast: in principle, iambs as well as trochees can be right-aligned as well as left-aligned. The reduction to a two-way contrast is the basis of Hyde's explanation of the asymmetry problem.

Hyde's theory has two other important ingredients. The first one is a constraint, GridmarkMapping, which requires that feet contain a gridmark, which must occupy some head position. Mapping is illustrated in (23).

(23) *Trochees* *Iambs*



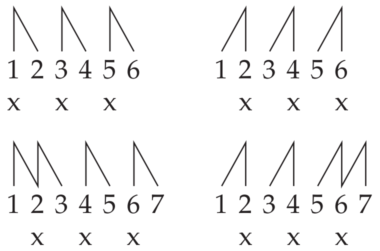
The second important ingredient is the idea that feet can overlap. This means that the following configuration is allowed:

(24) *Overlapping feet*

Because of the presence of the gridmark in the head position of the first foot, *both feet* satisfy GridmarkMapping. This is because the gridmark is located in the domain of both feet.

Hyde is able to explain the minimization patterns by making use of overlapping feet. Recall that these are the patterns where the odd-parity words have relatively few stresses. (25) illustrates this with Araucanian and its mirror image Nengone (Hyde 2002: 320), a language of New Caledonia.

(25) *Nengone* *Araucanian*



Nengone has trochees. Its foot-heads are therefore left-aligned. In odd-parity words a sequence of two adjacent foot-heads is created at the left edge. This is the consequence of maximal satisfaction of Hds-L. Inserting one gridmark in the domain of the two feet satisfies GridmarkMapping. Consequently, only three stresses are generated, even though there are four feet.

Araucanian is the mirror image of Nengone. Maximal satisfaction of Hds-R creates iambs, and in odd-parity words there is a sequence of two adjacent foot-heads at the right edge. The two last feet satisfy GridmarkMapping with only one gridmark. The introduction of overlapping feet, then, makes it possible to account for the minimization patterns.

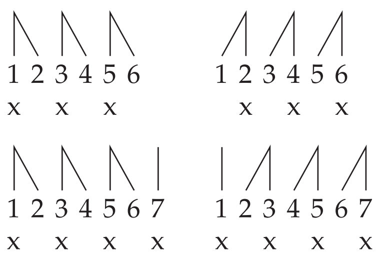
The maximization patterns, where odd-parity words receive more stresses than is necessary to create a rhythmic alternation, are explained with two additional constraints, given in (26).

(26) a. PrWd-L
The left edge of every prosodic word is aligned with the left edge of some foot-head.

b. PrWd-R
The right edge of every prosodic word is aligned with the right edge of some foot-head.

I illustrate these constraints with Maranungku and Suruwaha.

(27) *Maranungku* *Suruwaha*



In Maranungku, the left edge of a prosodic word must be aligned with a foot-head. A trochee is therefore built at the left edge. The heads of all other feet must be aligned with the right edge of a word. This would normally mean that iambs would have to be built, but Hyde stipulates that two adjacent feet can never dominate two adjacent unstressed syllables. This excludes the following structure:

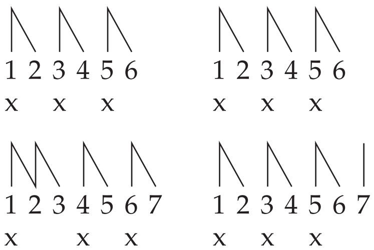
(28) *Excluded by stipulation*

The implication of this stipulation is that if PrWd-L, which requires a trochee at the left edge, is high-ranked, then the other feet cannot be iambic, even though iambs better satisfy right-alignment. The mirror image is also true, of course; if PrWd-R, which requires an iamb at the right edge, is high-ranked, then the other feet cannot be trochaic, even though trochees better satisfy left-alignment.

Maranungku has the ranking PrWd-L >> Hds-R, which derives the representation on the left in (27). This is an instance of maximization, because, in an odd-parity word, as many gridmarks are present as there are feet. Suruwaha has the ranking PrWd-R >> Hds-L, deriving the pattern on the right in (27). Again, in the odd-parity words the number of stresses equals the number of feet. Maranungku has traditionally been analyzed as a language with trochees built from left to right, with a degenerate foot at the right. Suruwaha has been described as its mirror image, with iambs built from right to left and a degenerate foot at the left (cf. (4)).

In principle, every foot receives a gridmark, although, due to overlapping feet, this does not necessarily mean that there are as many gridmarks as there are feet. At the right edge, Non-finality might exclude the presence of a gridmark over the last syllable. Furthermore, at the left edge, the first syllable can be subject to a constraint called InitialGridmark (Hyde 2002: 320), which requires the presence of a gridmark on the first syllable of a word. If these constraints are high-ranked, this can lead to a situation where a foot is not accompanied by a gridmark. Pintupi has high-ranking Non-finality, while Garawa has high-ranking InitialGridmark, as illustrated in (29).

(29) *Garawa* *Pintupi*



Garawa is like Nengone (cf. (25)) in the sense that feet are attracted to the left by high-ranking Hds-L. There are also two differences. In Garawa, InitialGridmark is high-ranked, so the initial syllable must have stress. The constraint against clashing gridmarks is also high-ranked, excluding an immediately following gridmark in the domain of the second foot. With these two constraints dominating GridmarkMapping, the first foot of the two overlapping feet is stressed, whereas the second foot is not. We thus get a stressless trochee. This is a foot with a head, but without a gridmark. The absence of a gridmark in the second foot creates a lapse immediately after the initial stress.

Pintupi is similar to Maranungku (cf. (27)), but has high-ranking Non-finality. If the final syllable is a foot-head, then it may not receive a gridmark. This creates a lapse at the right edge.

With the system described here it is very easy to explain all the asymmetries mentioned in §2, which are listed again in (30).

(30)

Anti-Garawa	*Anti-Pintupi*	*Anti-Piro*
x x x (1 2)(3 4)(5 6)	x x x (1 2)(3 4)(5 6)	x x x (1 2)(3 4)(5 6)
x x x (1 2)(3 4) 5 (6 7)	x x x 1 (2 3)(4 5)(6 7)	x x x (1 2) 3 (4 5)(6 7)

In Anti-Garawa, one iamb is built at the right edge, and the other iambs are built from left to right, so that, in odd-parity words, a lapse is created before the final stress. In Hyde's theory it is impossible to derive such a pattern. There are two ways to stress the final syllable of a word: either Hds-R or PrWd-R is high-ranked. With these two systems, it is impossible to create a lapse before the final stress. With high-ranking Hds-R, we derive Araucanian, as already shown in (25). This is a language with a minimization pattern, where in odd-parity words stresses are economically placed, so as to avoid a lapse. With high-ranking PrWd-R we get a system like Suruwaha, whose basic structure is given in (27). This is a maximization pattern, where an extra stress is created so as to avoid a lapse. Anti-Garawa, then, is ruled out, because it cannot be derived.

There is also no place for Anti-Pintupi. The particular property of this imaginary system is that there is no stress on the *initial* syllable. There is only one way to block a stress on a peripheral syllable, Non-finality, which, however, can only block stress on a final syllable. Since there is no equivalent Non-initiality preventing stress from the initial syllable, Anti-Pintupi cannot be derived.

Anti-Piro is also impossible. In this imaginary system, one iamb is built at the left edge, creating a fixed stress on the peninitial syllable. To place a fixed stress at the left periphery two constraints are available. Either Hds-L or PrWd-L must be high-ranked. In the former case we derive Nengone, whose basic configurations are shown in (25). Nengone is a minimization pattern, where the minimal number of stresses is economically placed so as to avoid a lapse. With high-ranking PrWd-L Maranungku is derived, as shown in (27). Maranungku displays a maximization pattern, where an additional stress is inserted so as to avoid a lapse. Thus there is no way to generate a system like Anti-Piro.

Hyde's system is similar to Gordon's in one sense. Neither uses the classical alignment constraints that refer to *feet*. In particular, AllFeet-L/R and PrWd-L/R (McCarthy and Prince 1993) are eliminated.

(31) a. AllFeet-L/R
The left/right edge of every foot is aligned with the left/right edge of some prosodic word.

b. PrWd-L/R
The left/right edge of every prosodic word is aligned with the left/right edge of some foot.

In these constraints, Hyde replaces the argument *foot* by *foot-head*, as shown in (21) and (26), whereas Gordon replaces it by *gridmark*. These two changes are almost identical, since a foot-head normally has exactly the same distribution as a gridmark.

The crucial difference, of course, is the notion of overlapping feet. We might say that, where Gordon eliminates foot structure entirely, Hyde introduces a new type of structure. Of course, Hyde is aware of the fact that this concept must be motivated on independent grounds, a task which he undertakes in Hyde (2008).

Optimality Theory struggles with what Hyde calls the "odd-parity problem." This problem can be divided into two sub-problems: the "even-only problem" and the "odd-heavy problem." The introduction of overlapping feet provides a solution which is not available in standard approaches. For reasons of space I will only discuss the first instance of the odd-parity problem.

The even-only problem is caused by the fact that, in odd-parity words, Faithfulness constraints are in conflict with two other constraints: FootBinarity (the constraint that penalizes degenerate feet) and Parse-σ (the constraint requiring that syllables be dominated by feet). Suppose that the Faithfulness constraints are ranked below FootBinarity and Parse-σ. Under this ranking it is better to insert or delete a syllable than to create a violation of either FootBinarity or Parse-σ, as shown in the following tableau:

(32)

1 2 3 4 5 6 7	Parse-σ	FootBinarity	Max	Dep
a. (1 2)(3 4)(5 6) 7	*!			
b. (1 2)(3 4)(5 6)(7)		*!		
☞ c. (1 2)(3 4)(5 6)(7 8)				*
☞ d. (1 2)(3 4)(5 6)			*	

This tableau shows what happens to a word with an uneven number of syllables. The first candidate, (32a), contains an unparsed syllable, violating Parse-σ. (32b) has a final, monosyllabic foot, violating FootBinarity. In (32c), a vowel is inserted. In this way an extra syllable is created, so that at the right edge a binary foot is built. FootBinarity and Parse-σ are therefore satisfied, although Dep is violated. Finally, in (32d) a vowel is removed, so that both Parse-σ and FootBinarity are again satisfied, although Max is violated.

We can see, then, that in an odd-parity word Parse-σ and FootBinarity can be satisfied if a syllable is inserted or deleted. From this it follows that there should be languages in which all words contain an even number of syllables. These languages would have the ranking Parse-σ, FootBinarity >> Max, Dep. However, no language like this has ever been attested. This illustrates the phenomenon referred to as the even-only problem.

Hyde (2008) shows that the even-only problem does not arise in a theory with overlapping feet. In such a theory, it is possible to satisfy FootBinarity and Parse-σ without violating Faithfulness. In other words, with overlapping feet, no conflict arises between FootBinarity and Parse-σ on the one hand and the two Faithfulness constraints on the other. This is shown in (33):

(33)

1 2 3 4 5 6 7	Parse-σ	FootBinarity	Max	Dep
☞ a. 1 2 3 4 5 6 7				
b. 1 2 3 4 5 6 7 8				*!
c. 1 2 3 4 5 6			*!	

The candidate with overlapping feet, (33a), does not violate any constraint. Contrary to this, the two candidates in which the uneven number of syllables has been changed into an even number do violate Faithfulness. The candidate with overlapping feet thus harmonically bounds the two candidates where Faithfulness is violated. This means that the two constraints FootBinarity and Parse-σ can never have the effect of changing an underlying form with an uneven number of syllables into a surface form with an even number. Overlapping feet, Hyde concludes, are the solution to the even-only problem.

In this section I have shown that asymmetries can be explained with a representation of word stress that includes feet. Iambic and trochaic structure is not the result of the constraints Foot=Iamb and Foot=Trochee, but rather of the alignment of *foot-heads*. The patterns thus established are subject to GridmarkMapping. Syllables containing a gridmark are phonetically stressed. In representations with overlapping feet there is a tendency to minimize the number of gridmarks, because a sequence of two overlapping feet satisfies GridmarkMapping with one gridmark. Under the pressure of certain constraints (*Clash, as in Garawa, or Non-Finality, as in Pintupi) it can happen that a foot ends up without a gridmark. Thus, in Hyde's framework feet are not necessarily stressed, although they are always headed.

In the next section I will briefly point out that Hyde is not very explicit about one property of his theory that is quite innovative. His theory is the only one, as far as I know, that makes use of feet that are headed, even though they are not stressed.

5 Stresslessness is not the same as headlessness

In Hyde's framework feet are not necessarily stressed. In overlapping feet the number of stresses is a proper subset of the number of feet. Let us consider some instances of overlapping feet, and see how they interact with stress.

(34) *Nengone* *Araucanian* *Garawa*

Nengone has overlapping trochees, with a stressed syllable in the middle. Araucanian has overlapping iambs, also with stress in the middle (cf. (25)). Finally, Garawa has overlapping trochees, with a stress in initial position, as shown in (29).[6]

These representations indicate that headedness is not expressed by gridmarks. In Hyde's framework a foot can be an iamb, even though it does not have a gridmark in its final syllable, as in Araucanian; similarly, a foot can be a trochee, even without a gridmark in its initial syllable, as in Nengone and Garawa.

This is a unique aspect of Hyde's theory. Most recent theories claim that headedness is expressed on the grid. Some theories claim that feet *must have heads*, so that for each foot there must be a gridmark accompanying it. Theories of this type invoke a principle like the Faithfulness Condition, originally formulated in Halle and Vergnaud (1987: 15–16).[7]

Meanwhile, another theory on the relation between foot structure and headedness has been developed. In this theory, headedness is disconnected from foot structure. In these theories there are two foot types; headed feet, which are accompanied by a gridmark, and headless feet, which are not accompanied by a gridmark. The loose connection between headedness and foot structure is expressed by the Separability Hypothesis (Crowhurst and Hewitt 1995b: 39), which states that feet can be headed or headless. Normally, a foot does have a head, but under the pressure of certain constraints, it can happen that a foot is not able to acquire a head. Proponents of the Separability Hypothesis are Hagberg (1993), Crowhurst and Hewitt (1995a, 1995b), Bye (1996), and Crowhurst (1996). Bye occupies a special position among them, because he assumes that feet can sometimes have two heads; when this happens there are two gridmarks in a single foot.[8]

It is clear that Hyde's theory differs from both views just mentioned. On the one hand, it (implicitly) uses the Faithfulness Condition, because all feet are inherently headed. (Heads are not expressed on the grid, but by line structure, as we have already seen; a head has a vertical line, whereas a dependent has a slanted line.) Yet the theory also recognizes the Separability Hypothesis, in the sense that there is a separate mode of representation, the grid, where a gridmark may or may not accompany a foot. Hyde's theory, therefore, does not recognize headless feet, but it does recognize stressed (headed) feet and unstressed (headed) feet. In this sense, Hyde's theory is certainly representationally richer than all other recent theories.

There is some evidence from Vogul, a language of Siberia, that feet can be headed, even if they are not stressed. In Vogul, stress does not seem to be quantity-sensitive (Vaysman 2009). The main stress is realized on the initial syllable, and there are secondary stresses on every other syllable thereafter. If, however, the final syllable is a target for secondary stress, this stress is not realized. Syllable quantity is irrelevant for this distribution. Only syllables with long vowels are heavy: words with a heavy syllable have exactly the same stress patterns as words with only light syllables. These regularities are illustrated in (35).

[6] The mirror image of Garawa (overlapping iambs with stress on the final syllable) does not exist. This system could only arise with a constraint requiring stress on the final syllable, together with high-ranking *Clash. However, in Hyde's system there is no constraint requiring stress on the final syllable. Therefore, two overlapping iambs at the right edge will always have stress in the middle (the minimization pattern).

[7] Halle and Vergnaud's Faithfulness Condition should not be confused with the Faithfulness constraints of OT. The former is a condition on the relation between a foot and its head.

[8] Level stress in Scandinavian dialects necessitates this representation, according to Bye (1996).

(35) *Stress in Vogul* (Vaysman 2009: 207–242)

a.	*No stress on the last syllable (short vowel in the first syllable)*	
	ˈsam-ɛ-nəl	‘his/her/its eye (ABL)’
	ˈat-ɛ-nəl	‘his/her/its smell (ABL)’
b.	*Alternating stress (short vowel in the first syllable)*	
	ˈsam-aˌɣanəl	‘their (DUAL) eyes’
	ˈaki-ˌɣanəl	‘their (DUAL) uncles’
c.	*No stress on the last syllable (long vowel in the first syllable)*	
	ˈjoor-ɛ-nəl	‘his/her/its strength (ABL)’
	ˈaat-ɛ-nəl	‘his/her/its hair (ABL)’
d.	*Alternating stress (long vowel in the first syllable)*	
	ˈsaaɣrap-ˌɛ-nəl	‘his/her/its axe (ABL)’
	ˈtootap-ˌɛ-nəl	‘his/her/its chest (ABL)’

These facts seem to suggest that Vogul has trochees which are assigned without reference to quantity, i.e. quantity-insensitive trochees. A closer look at the language, however, reveals that this hypothesis cannot be maintained.

Some affixes have a number of allomorphs. Vaysman convincingly shows that the selection of the allomorphs is determined by the prosody. The moraic trochee plays a decisive role in this process. One example is the morpheme ‘your (SG)’, which has no fewer than four allomorphs. After stems ending in a consonant, either [-an] or [-anən] is selected, and after stems ending in a vowel, either [-n] or [-nən]. The choice is narrowed down further by properties of the stem’s prosodic structure. If the initial syllable of the stem has a short vowel (that is, if it is a light syllable), then [-n] or [-an] is selected; if, however, the stem’s initial syllable is heavy, or if the stem is bisyllabic, then [-nən] or [-anən] is selected. These facts are illustrated in (36).

(36) *Allomorphy in Vogul* (Vaysman 2009: 207–242)

a.	CVC-stem	
	sam-an	‘your (SG) eyes’
	put-an	‘your (SG) ice-crusts’
	pos-an	‘your (SG) lights’
b.	CV(C)CVC-stem	
	pasan-anən	‘your (SG) table’
	apiɣ-anən	‘your (SG) grandson’
	isnas-anən	‘your (SG) windows’
c.	CVVC-stem	
	saam-anən	‘your (SG) corners’
	puut-anən	‘your (SG) cauldrons’
	oos-anən	‘your (SG) sheep’
d.	CVCV-stem[9]	
	ala-n	‘your (SG) roofs’
	pici-n	‘your (SG) nests’
	oma-n	‘your (SG) female relatives’

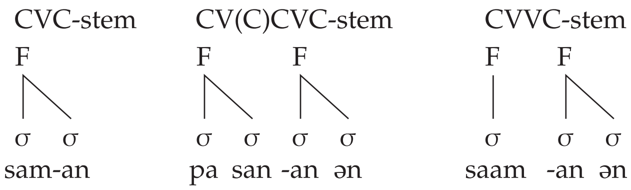
[9] There are no CV-stems in Vogul, i.e. monosyllabic stems ending in a vowel.

e. CVVCV-stem

saali-nən	'your (SG) reindeer'
iici-nən	'your (SG) evenings'
oopa-nən	'your (SG) paternal grandfathers'

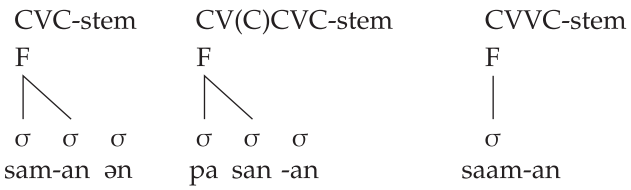
Vaysman argues that allomorph selection in Vogul can be explained if it is assumed that the language has moraic trochees. It has a type of foot, in other words, where the head is on the left, and where the number of moras is exactly two. Using moraic trochees we can see that an allomorph is selected in such a way that all syllables of a word are parsed. I demonstrate this in (37) with C-final stems, using Hyde's notation.

(37) *Exhaustive parsing in Vogul*



If the allomorphs were distributed differently, parsing could not be exhaustive, as shown in (38).

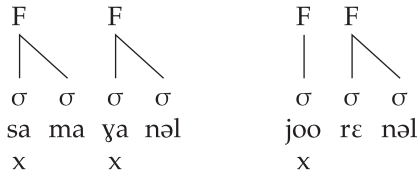
(38) *Illicit non-exhaustive parsing in Vogul*



If [-anən] were added to a CVC-stem, only the first two syllables could be parsed in a moraic trochee; the third syllable would have to remain stray, since no moraic trochee can be built on the monomoraic syllable. Similarly, if [-an] were added to a bisyllabic stem or to a monosyllabic stem with a long vowel, the suffix could not be parsed in a foot, because after a stem with a fully fledged moraic trochee it is impossible to give a light syllable its own moraic trochee.

If the language has moraic trochees, then how can we account for the fact that the distribution of stress seems to indicate otherwise? Recall, that, as far as the distribution of stress is concerned, Vogul seems to have syllabic trochees, a type of foot that is assigned without taking quantity into consideration. Vaysman proposes that the moraic trochees of Vogul can only be accompanied by a gridmark (stress) if the immediately preceding syllable is not stressed. Formally, this is an instance of clash resolution: in order to satisfy *CLASH, no stress (gridmark) is assigned to the head of a trochee if it is immediately preceded by a stressed syllable. I illustrate this in (39).

(39)



In ['sam-aˌɣanəl], both trochees can be assigned a gridmark, since the two stresses are separated by an unstressed syllable. In ['joor-ɛ-nəl], on the other hand, no gridmark can be assigned to the second trochee, because no syllable separates the two foot-heads.

The Vogul facts are quite important. On the grounds of allomorph selection, we know that the language must have moraic trochees, i.e. feet in which the syllable on the left is the head. Without a head in this position it would be impossible to characterize the Vogul foot as a trochee, rather than an iamb. Yet not all trochees have stress in this language. This can only mean that feet are always headed, even if they are not accompanied by a gridmark. This is precisely what is assumed by Hyde.

6 Conclusion

The parsing of a word by iambs differs in a number of ways from trochaic parsing. According to Kager (2007), this asymmetry is one of the great puzzles of metrical theory. Two proposals have been put forward to solve the problem. Gordon (2002) proposes to solve the asymmetry by eliminating its cause: foot structure. If there are no iambs or trochees, then we do not expect one type of foot to mirror the other's behavior. With foot structure eliminated, we are left with gridmarks only. Alignment constraints, interacting with constraints requiring rhythmic alternations, can account for the attested systems, and can also explain why certain systems are impossible. With respect to the *distribution* of stresses in the words of the world's languages, grid-only theories seem to be sufficient, and feet therefore seem to be superfluous.[10]

Nevertheless, feet are necessary. This becomes clear when we take a look at phenomena that go beyond the distribution of stress. There is a wide variety of phenomena leading us to conclude that it is unacceptable to eliminate foot structure from the representation of word stress.

Hyde attempts to explain the parsing asymmetries with a theory that does include foot structure. He eliminates the classical constraints on foot form from the theory, proposing instead that iambs and trochees are derived by alignment of foot-heads to the word's edge. The pattern of feet thus created is subject to interpretation by the grid. Here the notion of overlapping feet plays a major role. With this device it is possible to explain the minimization pattern in odd-parity

[10] Van der Hulst (1984) draws a similar conclusion, arguing that grid-only frameworks can do anything a foot-based theory can do. Yet van der Hulst does not eliminate foot structure. He proposes that main stress is generated by foot structure, whereas secondary stresses are created by the grid. In his view, this explains why the phenomena that are related to main stress differ systematically from the type of phenomena that are related to secondary stresses.

words. Overlapping feet can be motivated on independent grounds: overlapping feet solve the odd-parity problem.

In Hyde's theory, the grid is mostly subservient to foot structure. Feet are always inherently headed, with or without a gridmark.

REFERENCES

Altshuler, Daniel. 2009. Quantity-insensitive iambs in Osage. *International Journal of American Linguistics* 75. 365–398.

Bye, Patrik. 1996. Scandinavian "level stress" and the theory of prosodic overlay. *Nordlyd* 24. 23–62.

Crowhurst, Megan J. 1996. An optimal alternative to conflation. *Phonology* 13. 409–424.

Crowhurst, Megan J. & Mark Hewitt. 1995a. Directional footing, degeneracy, and alignment. *Papers from the Annual Meeting of the North East Linguistic Society* 25. 47–61.

Crowhurst, Megan J. & Mark Hewitt. 1995b. Prosodic overlay and headless feet in Yidin^y. *Phonology* 12. 39–84.

de Lacy, Paul. 2002. The interaction of tone and stress in Optimality Theory. *Phonology* 19. 1–32.

de Lacy, Paul. 2007a. The interaction of tone, sonority, and prosodic structure. In de Lacy (2007b), 281–307.

de Lacy, Paul (ed.) 2007b. *The Cambridge handbook of phonology*. Cambridge: Cambridge University Press.

Dresher, B. Elan & Aditi Lahiri 1991. The Germanic foot: Metrical coherence in Old English. *Linguistic Inquiry* 22. 251–286.

Elías-Ulloa, José A. 2006. Theoretical aspects of Panoan metrical phonology: Disyllabic footing and contextual syllable weight. Ph.D. dissertation, Rutgers University (ROA-804).

Gordon, Matthew. 2002. A factorial typology of quantity-insensitive stress. *Natural Language and Linguistic Theory* 20. 491–552.

Gordon, Matthew. 2003. The phonology of pitch accents in Chickasaw. *Phonology* 20. 173–218.

Hagberg, Lawrence R. 1993. An autosegmental theory of stress. Ph.D. dissertation, University of Arizona.

Halle, Morris & Jean-Roger Vergnaud. 1987. *An essay on stress*. Cambridge, MA: MIT Press.

Hammond, Michael. 1984. Constraining metrical theory: A modular theory of rhythm and destressing. Ph.D. dissertation, University of California, Los Angeles.

Hayes, Bruce. 1980. A metrical theory of stress rules. Ph.D. dissertation, MIT.

Hayes, Bruce. 1984. The phonology of rhythm in English. *Linguistic Inquiry* 15. 33–74.

Hayes, Bruce. 1985. Iambic and trochaic rhythm in stress rules. *Proceedings of the Annual Meeting, Berkeley Linguistics Society* 11. 429–446.

Hayes, Bruce. 1995. *Metrical stress theory: Principles and case studies*. Chicago: University of Chicago Press.

Hulst, Harry van der. 1984. *Syllable structure and stress in Dutch.* Dordrecht: Foris.

Hyde, Brett. 2001. Metrical and prosodic structure in Optimality Theory. Ph.D. dissertation, Rutgers University (ROA-476).

Hyde, Brett. 2002. A restrictive theory of metrical stress. *Phonology* 19. 313–359.

Hyde, Brett. 2006. Towards a uniform account of prominence-sensitive stress. In Eric Baković, Junko Itô & John McCarthy (eds.) *Wondering at the natural fecundity of things: Essays in honor of Alan Prince*, 139–183. Santa Cruz: Linguistics Research Center, University of California, Santa Cruz. Available at http://repositories.cdlib.org/lrc/prince/8.

Hyde, Brett. 2008. The odd-parity parsing problem. Unpublished ms., Washington University (ROA-971).

Itô, Junko & Armin Mester. 1992. Weak layering and word binarity. Unpublished ms., University of California, Santa Cruz.
Kager, René. 1993. Alternatives to the iambic-trochaic law. *Natural Language and Linguistic Theory* 11. 381–432.
Kager, René. 1995. The metrical theory of word stress. In John A. Goldsmith (ed.) *The handbook of phonological theory*, 367–402. Cambridge, MA & Oxford: Blackwell.
Kager, René. 1999. *Optimality Theory*. Cambridge: Cambridge University Press.
Kager, René. 2007. Feet and metrical stress. In de Lacy (2007b), 195–227.
Karvonen, Daniel. 2005. Word prosody in Finnish. Ph.D. dissertation, University of California, Santa Cruz.
Karvonen, Daniel. 2008. Explaining Nonfinality: Evidence from Finnish. *Proceedings of the West Coast Conference on Formal Linguistics* 26. 306–314.
Kennedy, Robert. 2005. The binarity effect in Kosraean reduplication. *Phonology* 22. 145–168.
Liberman, Mark & Alan Prince. 1977. On stress and linguistic rhythm. *Linguistic Inquiry* 8. 249–336.
Majors, Tivoli J. 1998. Stress-dependent harmony: Phonetic origins and phonological analysis. Ph.D. dissertation, University of Texas, Austin.
McCarthy, John J. & Alan Prince. 1993. Generalized alignment. *Yearbook of Morphology 1993.* 79–153.
Pearce, Mary. 2006. The interaction between metrical structure and tone in Kera. *Phonology* 23. 259–286.
Prince, Alan. 1983. Relating to the grid. *Linguistic Inquiry* 14. 19–100.
Prince, Alan. 1985. Improving tree theory. *Proceedings of the Annual Meeting, Berkeley Linguistics Society* 11. 471–490.
Prince, Alan & Paul Smolensky. 1993. Optimality Theory: Constraint interaction in generative grammar. Unpublished ms., Rutgers University & University of Colorado, Boulder. Published 2004, Malden, MA & Oxford: Blackwell.
Selkirk, Elisabeth. 1980. Prosodic domains in phonology: Sanskrit revisited. In Mark Aronoff & Mary-Louise Kean (eds.) *Juncture*, 107–129. Saratoga: Anma Libri.
Selkirk, Elisabeth. 1984. *Phonology and syntax: The relation between sound and structure*. Cambridge, MA: MIT Press.
Smith, Laura C. 2004. Cross-level interactions in West Germanic phonology and morphology. Ph.D. dissertation, University of Wisconsin, Madison.
Smith, Neil V. & Klaske van Leyden. 2007. The unusual outcome of a level-stress situation: The case of Wursten Frisian. *North-Western European Language Evolution* 52. 31–66.
Vaysman, Olga. 2009. Segmental alternations and metrical theory. Ph.D. dissertation, MIT (ROA-1011).
Zoll, Cheryl. 2004. Positional asymmetries and licensing. In John J. McCarthy (ed.) *Optimality Theory in phonology: A reader*, 365–378. Cambridge, MA & Oxford: Blackwell.