Clash, Lapse and Directionality

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1. Typological (a)symmetries

The typology of stress patterns that we find among the world's languages displays an astonishing symmetry, and much of the research in metrical theory over the last decades has concentrated on this property. There are languages where main stress is assigned close to the right edge of the prosodic word, others where it is assigned close to the left edge. There are quantity-sensitive languages, where heavy syllables systematically attract stress, and quantity-insensitive languages, where syllable weight does not influence stress placement at all. In metrical theory therefore it has been proposed that the typology of stress systems is to a large extent determined by a limited set of binary parameters (e.g. among others Hayes 1980, Prince 1983, Halle and Vergnaud 1987, Hayes 1995). An incomplete list includes the following parameters:

(1)
   a. Foot-type: a language makes use of either left-headed (trochaic) or right-headed (iambic) feet.
   b. Directionality of parsing: feet are built either starting from the left or starting from the right edge of the prosodic word.
   c. Location of main stress: main stress is assigned either close to the left or close to the right edge of prosodic words.
   d. Quantity sensitivity: stress placement either is sensitive to syllable weight or it is not

However, researchers have also often observed that the typology of stress patterns does contain certain empirically attested asymmetries that should be accounted for. To name but one well-known case, Hayes (1995: 73) observes that quantity-insensitive systems are typically trochaic and accounts for this fact by proposing a universal asymmetrical foot-inventory from which quantity-insensitive iambs are excluded.

Furthermore, with the rise of optimality theory (Prince and Smolenky 1993), attention has been drawn to phenomena showing that the picture of binary parameters that are either on or off for a certain language is too simple. For instance, it has been observed (Alber 1997) that there are languages that are neither consistently quantity-sensitive nor consistently quantity-insensitive. In these partially quantity-sensitive systems heavy syllable attract stress only in case no higher ranked constraints prohibits it. When all higher ranked constraints are satisfied, the constraint requiring heavy syllables to be stressed can show its force and quantity-sensitive patterns emerge.

On a similar line, Rosenthall and van der Hulst (1999) propose that contrary to what is usually assumed, closed CVC syllables are not consistently light or consistently heavy in a specific language. There are languages where the weight of CVC syllable changes according to context. Context-sensitive weight, they claim, arises when CVC syllables are generally heavy (or light) in a certain language but change their weight under the pressure of constraints that favor heavy (or light) CVC syllables only in a specific context. Thus, with the concept of constraint violability, the possibility of further asymmetries in the typology emerges.[1]

In this paper I will discuss one well-known typological gap in the logical possibilities given by the parameters above and show how an analysis in terms of violable constraints can account for the resulting asymmetry. As has been noted by Kager (1993, 2000, 2001), Hayes

[1] See also Pater (2000) for non-uniformity in English secondary stress assignment.

(1995), van de Vijver (1998) and Hyde (2001) not every possible setting of the foot-type parameter is attested for every possible setting of the parameter of directionality of foot parsing. While we do have both trochaic systems where feet are parsed in a left to right fashion and trochaic systems where feet are parsed from right to left, for iambic systems only left to right parsing is attested. We do not find iambic systems where the counting of stress placement starts from the right.[2] This typological observation is illustrated schematically as follows for stress systems that parse disyllabic feet:

(2) a. Trochaic system, left-to-right directionality (= left-aligning)
(σ̀σ)(σ̀σ)
(σ̀σ)(σ̀σ)σ
b. Trochaic system, right-to-left directionality (= right-aligning)
(σ̀σ)(σ̀σ)
σ(σ̀σ)(σ̀σ)
c. Iambic system, left-to-right directionality (= left-aligning)
(σσ̀)(σσ̀)
(σσ̀)(σσ̀)σ
d. Iambic system, right-to-left directionality (= right-aligning): not attested
(σσ̀)(σσ̀)
σ(σσ̀)(σσ̀)

There are many languages with a pattern as in a., where in odd-numbered strings of syllables every odd-numbered syllable (except the last one) is stressed, beginning to count from the left edge. These languages are said to display a trochaic, left-to-right rhythm. In an analysis that makes use of feet we can say that trochaic feet are built beginning at the left edge of the prosodic word, or, using an alignment approach (McCarthy and Prince 1993), that feet are aligned as much as possible to the left. The languages in b. display a trochaic rhythm as well, as we can see from stress placement in the even numbered string of syllables. This string can be analyzed as consisting of two left-headed, hence trochaic feet. However, the construction of feet here starts beginning from the right edge, as can be deduced from the parsing of words with an odd-numbered string of syllables. In the terminology of alignment, feet are aligned to the right, in this case. Example c. represents an iambic system, the even numbered string can be analyzed as consisting of two right-headed feet. The odd-numbered string shows us that feet are aligned to the left. Finally, d., the unattested system, is again iambic, but right-aligning.

Directionality of foot-parsing has been analyzed since McCarthy and Prince 1993 in terms of gradient alignment constraints. McCarthy and Prince propose that the constraints responsible for directionality in foot parsing are ALL-FT-LEFT, requiring feet to be as close as possible to the left edge of the word, and ALL-FT-RIGHT, requiring feet to be as close as possible to the right edge. The two constraints are defined as follows:

(3) ALL-FT-LEFT/RIGHT = ALIGN (FT, L/R, PRWD, L/R)
∀ foot ∃ prosodic word such that the left/right edge of the prosodic word and the left/right edge of the foot coincide.
McCarthy and Prince (1993)

[2] Hayes (1995: 262ff.) is more cautious in this regard and states that the existence of right-to-left iambic systems is at least very doubtful.

The typology of left-aligning trochees and right-aligning trochees as in (2 a-b) is derived in a straightforward way. Left-aligning trochaic systems are generated by the ranking ALL-FT-LEFT >> ALL-FT-RIGHT, left-aligning trochees by the inverse ranking. This is illustrated in the following tableaux:

Tableau 1: left-aligning trochaic system

	ALLFTL	ALLFTR
☞ (a) (σ̀σ)(σ̀σ)σ	**	***
(b) σ(σ̀σ)(σ̀σ)	***!	**

Tableau 2: right-aligning trochaic system

	ALLFTR	ALLFTL
(a) (σ̀σ)(σ̀σ)σ	***!	**
☞ (b) σ(σ̀σ)(σ̀σ)	**	***

A violation mark is assessed for each syllable that occurs between a foot and the relevant word edge. Thus candidate a. in the first tableau will have two violation marks for ALLFTL since the second foot is two syllables away from the left word edge. It will collect three violation marks on ALLFTR since its first foot is three syllables away from the right edge.

Note that full satisfaction of ALLFTL (or ALLFTR) is possible only if not more than one foot per word is parsed and if this foot is built right at the left (or right) edge of the word. Since directionality is a relevant concept only in systems which parse more than one foot, I will assume that a constraint such as PARSEσ (Prince and Smolensky 1993), requiring all syllables to be parsed into feet, is dominating the directionality constraints in the cases under discussion.

Although these alignment constraints easily derive the two attested trochaic systems they clearly overgenerate when it comes to iambic systems. If we analyze directionality as the result of the ranking between ALLFTL and ALLFTR, there is no way to prevent these constraints from generating a right-aligning iambic system under a dominant ranking of ALLFTR.

In this paper I will show that the typological asymmetry in the directionality of foot parsing can be accounted for in a straightforward way if directionality itself is interpreted as the result of a different set of constraints than those proposed in McCarthy and Prince (1993) and most subsequent work. Specifically, I propose to dispense with the constraint ALLFTR and to maintain only the constraint ALLFTL, requiring feet to be aligned to the left edge of the word. This move allows to generate both left-aligning trochaic and iambic systems and excludes the non-attested right-aligning iambic systems. The question then remains what constraint might be responsible for the generation of right-aligning trochaic systems. My proposal is that right-aligning trochaic patterns are not the result of a high-ranked alignment constraint at all, but the result of requirements of rhythm. Let us compare odd-numbered strings of left-aligning and right-aligning trochees:

(4) a. Trochaic system, left-aligning: final stress lapse
(σ̀σ)(σ̀<u>σ)σ</u>
b. Trochaic system, right-aligning: no stress lapse
σ(σ̀σ)(σ̀σ)

In systems with binary feet, as the ones discussed so far, right-alignment of feet has one clear advantage over left-alignment. A system as in b. displays a strictly alternating stress pattern, where every other syllable is stressed. The left-aligning pattern in a., on the other hand, is rhythmically defective, since at the end of the word there is a sequence of two unstressed syllables, a so-called stress lapse.[3] We can therefore interpret the typology of directionality in trochaic systems as the result of the ranking of ALLFTL with respect to a constraint requiring strictly alternating rhythm. If ALLFTL is high-ranked, a left-aligning system will be generated. If the rhythm constraint against stress lapses is dominant, left-alignment will be worse, but strict alternation of stress peaks will be guaranteed. Directionality is thus determined by the tension between the requirement of aligning feet to the left on the one hand and and by the necessity of generating a perfectly rhythmical pattern on the other.

Let us now consider how iambic systems rate in terms of left alignment and rhythmic requirements:

(5) a. Iambic system, left-aligning
(σσ̀)(σσ̀)σ
b. Iambic system, right-aligning: not attested
σ(σσ̀)(σσ̀)

If we compare the systems in a. and b. we realize that a. rates better than b. both in terms of left-alignment and in terms of rhythmic alternation. While in a. all feet are aligned as much as possible to the left edge of the word, this is not true for b. and while in a. every other syllable is stressed, b. displays a stress lapse at the beginning of the word. This means that, all other things being equal, there is no reason to ever generate a right-aligning iambic system, since such a system would rate worse under both constraints triggering directionality, while its competitor, the left-aligning iambic system, rates better on both left-alignment and the requirements of rhythm.

This paper will be organized as follows: In section 2., data supporting the typological generalizations is discussed (2.1); the analysis of the typological gap is laid out for systems with binary feet in 2.2 and a rhythm constraint against stress lapses is proposed; in 2.3 systems with degenerate feet are analyzed and a constraint against clashes is advanced to account for the typological asymmetries in this type of systems. In section 3. the consequences of a rhythmic approach to directionality for other aspects of metrical theory are illustrated. The interaction between rhythmic secondary stress assignment and main stress assignment is examined in subsection 3.1 In 3.2 another prediction of the proposal, the non-existence of initial dactyl systems, is discussed. Section 3.3 shows how directionality effects can be derived without further assumptions in quantity-sensitive systems. In section 4. I compare the present approach to previous analyses of the typological asymmetry. Section 5. discusses (and discards) the possibility of unifying the constraints against stress lapses and stress clashes in a single constraint favoring rhythmical alternation.

2. Directionality and rhythm

2.1 The typological gap: the data

In the schematic illustration of stress-systems above I have abstracted away from the placement of main stress, which in many languages is, in fact, independent from the rhythm displayed by the placement of secondary stresses. Moreover, I have treated all syllables on a

[3] From now on I will underline syllables that form a stress lapse.

par, not considering the possibility that some syllables might be heavier than others and thus attract stress. In this section, I will continue to exclude the variables of main stress placement and quantity sensitivity and postpone the discussion of these aspects to later sections of the paper. However, I will consider a further parameter of stress typology, the possibility or impossibility of languages to parse degenerate feet.

Many languages require feet to be binary, i.e., not to be smaller than two syllables (for quantity-insensitive languages) or two moras (for quantity-sensitive languages). Nevertheless, there are languages that allow for degenerate feet in the sense that they allow feet to consist of a single light syllable (in quantity-sensitive languages) or a single syllable regardless of weight (in quantity-insensitive languages). If we combine this parameter with the parameters of foot-type and directionality, we get the following logical possibilities:

(6) Typology of stress-systems considering foot-type, directionality and minimal foot-size:

	only binary feet	degenerate feet possible
Trochaic, left-aligning	a. (σ̀σ)(σ̀σ)σ L→R parsing	e. (σ̀)(σ̀σ)(σ̀σ) R→L parsing
Trochaic, right-aligning	b. σ(σ̀σ)(σ̀σ) R→L parsing	f. (σ̀σ)(σ̀σ)(σ̀) L→R parsing
Iambic, left-aligning	c. (σσ̀)(σσ̀)σ L→R parsing	g. (σ̀)(σσ̀)(σσ̀) R→L parsing
Iambic, right-aligning	d. σ(σσ̀)(σσ̀) R→L parsing	h. (σσ̀)(σσ̀)(σ̀) L→R parsing

In the table above two ways of classifying languages according to directionality appear: we can classify languages according to their left- or right-aligning rhythm, or we can classify them, using the derivational concept of left-to-right or right-to-left parsing. The two ways of classification do not correspond in each case and I will discuss briefly the consequences of this difference for the analysis of the typological gap.

Note that in binary systems left-alignment corresponds to the traditional classification of left-to-right parsing: a left-aligning language traditionally would have been classified as a language with left-to-right parsing, i.e. a language where feet were build starting from the left edge of the word. In systems allowing for degenerate feet though, the situation is reversed: a left-aligning language with degenerate feet traditionally would have been classified as having a *right-to-left* parsing (see Crowhurst and Hewitt 1995). For instance, a system with degenerate feet as in (6e) that "starts building feet" from the right, parsing the initial leftover syllable into a degenerate foot, is at the same time a system that aligns feet as much as possible to the left. It is easy to see this by comparing (6e) and (6f) above, repeated here for convenience:

(7) a. Trochaic, left-aligning system with degenerate feet (6e) = right-to-left parsing

$(\grave{\sigma})_1(\grave{\sigma}\sigma)_2(\grave{\sigma}\sigma)_3$ good left-alignment: Ft_2: * + Ft_3: *** = 4
bad right-alignment: Ft_1: **** + Ft_2: ** = 6

b. Trochaic, right-aligning system with degenerate feet (6f) = left-to-right parsing

$(\grave{\sigma}\sigma)_1(\grave{\sigma}\sigma)_2(\grave{\sigma})_3$ bad left-alignment: Ft_2: ** + Ft_3: **** = 6
good right-alignment: Ft_1: *** + Ft_2: * = 4

The parsing in a., which traditionally would have been classified as "parsing from the right", has less left-alignment violations (the second and the third foot are closer to the left edge) than system b., while b., the "left-to-right-parsing system", has less right-alignment violations than a.

This difference in classification has consequences for the exact definition of the goal that we want to set in this paper. As outlined above, we want to explain the typological observation that certain iambic systems do not exist. For binary systems it has been claimed that "right-to-left" parsing, that is, right-aligning iambic systems do not exist. But once we take into account systems with degenerate feet we have to make clear which patterns exactly will be excluded by our analysis. A derivational approach would probably maintain that since right-to-left iambic parses are not attested for binary systems, the same should be true for languages that allow for degenerate feet. Thus, the systems a traditional approach would expect not to exist are (6d) and (6g), the right-to-left parsing iambs. If we analyze stress patterns in terms of alignment, on the other hand, we might expect that if binary right-aligning iambs do not exist, the same should be true for right-aligning iambs that allow for degenerate feet. We would therefore expect that there are no languages such as (6d) and (6h).

In this section I will first discuss data from languages that are representatives of the types of stress systems (6a-c) and (6e-f), which are expected to exist under both the derivational and the alignment approach to directionality. I will then present data of languages that display a pattern as in (6g), a pattern which is expected to exist only under the alignment approach to directionality. Finally, I will then summarize the discussion in the literature on the typological gap regarding iambic systems and conclude that indeed there are reasons to believe that there are no languages of the type (6d) and (6h). This means that we will have to conclude that the classification of stress patterns in terms of alignment is more promising than the one in terms of iterative foot-construction. Moreover, we thus prepare the empirical ground for the subsequent analysis, which, crucially, predicts that (6d) and (6h) are not attested as stress patterns.

Trochaic, left-aligning systems parsing binary feet (type 6a) are among the most wide-spread stress systems of the world's languages. A typical example for such a system is Pintupi (data from Hansen and Hansen 1969. I follow the analysis in Hayes 1995). In this language, main stress falls on the initial syllable of a word and secondary stress on every other syllable thereafter, except for final syllables, which are never stressed:

(8) Pintupi: trochaic, left-aligning system with binary feet:

a.	páɳa (σ́σ)	'earth'
b.	t^j úʈaya (σ́σ)σ	'many'
c.	máɭawàna (σ́σ)(σ̀σ)	'through (from) behind'
d.	púɭiŋkàlat^{j}u (σ́σ)(σ̀σ)σ	'we (sat) on the hill'
e.	t^{j}ámulìmpat^{j}ùŋku (σ́σ)(σ̀σ)(σ̀σ)	'our relation'
f.	múŋaŋkàlpilàt^{j}uŋku (σ́σ)(σ̀σ)(σ̀σ)σ	'finally we (went) together in the darkness'

Words with an even numbered string of syllables show us that Pintupi can be analyzed as parsing left-headed, trochaic feet, while odd-numbered strings make clear that foot construction starts at the left word edge, i.e., we are dealing with a left-aligning language. Other clear examples of languages using binary, left-aligning, trochaic feet listed in Hayes

(1995) include the quantity-insensitive languages Anguthimri, Badimaya, Bidyara/Gungabula, Piro, Pitta-Pitta and Wangkumara and the quantity-sensitive systems of Estonian, Cairene Arabic, Palestinian Arabic, Egyptian Radio Arabic, Early Latin and Lenakel (verbs and adjectives). In the *Stresstyp* database[4] I found the following additional languages: Alyawarra, Aranda, Diyari, Dyirbal, Finnish, Karelian, Kokata, Laragia, Martuyhunira, Mayapi, Mocama, Nunggubuyu and Polish.

Warao (Osborn 1966) is a typical example of a language making use of binary, right-aligning trochees (type 6b):

(9) Warao: trochaic, right-aligning system with binary feet

a. koránu 'drink it!'
σ(σ́σ)

b. yiwàranáe 'he finished it'
σ(σ̀σ)(σ́σ)

c. nàhoròahàkutái 'the one who ate'
(σ̀σ)(σ̀σ)(σ̀σ)(σ́σ)

d. yàpurùkitàneháse 'verily to climb'
(σ̀σ)(σ̀σ)(σ̀σ)(σ́σ)

e. enàhoròahàkutái 'the one who caused him to eat'
σ(σ̀σ)(σ̀σ)(σ̀σ)(σ́σ)

Even-numbered strings of syllables display a trochaic rhythm and odd-numbered strings show that feet are right-aligned. Main stress is assigned to the rightmost foot. Also for this type of stress pattern it is possible to find several cases in Hayes (1995): the quantity-insensitive languages Cavineña and Nengone, and the quantity-sensitive languages Inga, Lenakel (nouns) and Wargamay. *Stresstyp* in addition contains Apuriña, Leti, Malakmalak, Muna, Nyawaygi, Taba, Tawala and Tukang Besi.

St. Lawrence Island Yupik is an example of an iambic, left-aligning language making use of binary feet (type 6c). As most iambic systems (see Hayes 1995) this language is quantity-sensitive. I annotate heavy syllables (in the case of St. Lawrence Island Yupik CVV(C) syllables) with 'H' and light syllables with 'L'. Data and analysis in terms of foot structure are taken from Hayes (1995):[5]

(10) St. Lawrence Island Yupik: iambic, left-aligning system with binary feet

a. aŋ yáχ ɬaχ ɬáŋ yux túq 'he wants to make a big boat'
(L Ĺ) (L Ĺ) (L Ĺ)

b. á:ŋ qaχ ɬáχ ɬaŋ yúx tuq 'he wants to make a big ball'
(H́) (L Ĺ) (L Ĺ) L

Example a., an even-numbered sequence of light syllables, shows us that St. Lawrence Island

[4] *Stresstyp* is a database developed at the University of Leiden, which at the moment of consultation contained the description the stress patterns of 510 languages. Each entry contains the classification of the language's stress pattern according to a predefined set of binary parameters as well as the description of the pattern as found in the source (see also Goedemans, van der Hulst and Visch 1996, Goedemans and van der Hulst to appear). I list only languages for which *Stresstyp* gives clear examples that support the described stress pattern.

[5] Originally, the data is from Krauss 1975, 1985 and Jacobson 1985. I am assuming with Hayes that final syllables do form foot heads (and hence mark them with an accent) although they are destressed in certain contexts (see Hayes 1995: 240, 258).

Yupik displays an iambic rhythm. Example b. consists of an even-numbered string of syllables as well, but since the system is quantity-sensitive the first, heavy syllable can form a foot of its own and parsing resumes right after it. In the odd-numbered string of light syllables following the first heavy syllable feet are build in a left-to-right fashion, i.e., the system is of the left-aligning type.

Other binary, left-aligning iambic systems of this type are Cayuga, Chickasaw, Choctaw, Hixkaryana, Menomini, Munsee Delaware, Unami, Seminole/Creek, Seneca, Southern Paiute, the Yupik Eskimo languages in general (Hayes 1995) and Auracanian (*Stresstyp*).

Stress systems allowing for degenerate feet are maybe less wide-spread than those using only binary feet. Nevertheless, there are some clear cases discussed in the literature.

Let us first consider a left-aligning trochaic language that parses degenerate feet (type 6e). A representative of such a system is Passamaquoddy (LeSourd 1993, see also Green 1995 and Hyde 2001):

(11) Passamaquoddy: trochaic, left-aligning system with degenerate feet

a. tópkwan — 'dirt, soil'
(σ́σ)

b. tòpkánamkw — 'dirt, soil (particulate)'
(σ̀)(σ́σ)

c. wìcohkémal — 'he helps the other'
(σ̀σ)(σ́σ)

d. wìcòhkekémo — 'he helps out'
(σ̀)(σ̀σ)(σ́σ)

e. wìcohkètahámal — 'he thinks of helping the other'
(σ̀σ)(σ̀σ)(σ́σ)

f. tèhsàhkwapàsoltíne — 'let's (pl.) walk around on top'
(σ̀)(σ̀σ)(σ̀σ)(σ́σ)

As the even-parity strings show, Passamaquoddy has a basic trochaic rhythm. In odd-numbered strings of syllables we see that this language displays exhaustive parsing, that is, all syllables are parsed into feet, even the single syllable that is left over after all other syllables have been parsed into binary feet. The fact that this degenerate foot appears at the left edge of the word shows us that we are dealing with a language displaying left-aligning directionality. Main stress is assigned to the rightmost foot.

Languages with a similar rhythmic pattern are Maithili (Hayes 1995) and Jaqaru (*Stresstyp*).

Ono (Phinnemore 1985) is a language that can be analyzed as displaying right-aligning trochaic rhythm with degenerate feet. The degenerate foot is placed at the right word edge and thus feet are aligned as much as possible to the right. Main stress falls on the leftmost syllable:

(12) Ono: trochaic, right-aligning system with degenerate feet

a. sé.kao — 'space under a house'
(σ́σ)

b. ló.lot.nè — 'many'
(σ́σ)(σ̀)

c. á.ri.lè 'I went'
(σ́σ)(σ̀)
d. mé.si.kè.ne 'you will sit'
(σ́σ)(σ̀σ)
e. á.ri.mà.ge.à.ke 'he always goes'
(σ́σ)(σ̀σ)(σ̀σ)

Other languages with a similar pattern mentioned in Hayes (1995) are Cahuilla, Hungarian, Icelandic, Livonian and Maranungku.[6] In *Stresstyp* we find in addition Bagundji, Iaai, Narrinyeri, Ningil, Shoshone, Taz Selkup.

A left-aligning iambic system allowing for degenerate feet (type 6g) is instantianted by Weri (Hayes 1981, based on Boxwell and Boxwell 1966). In Weri main stress is assigned to the final syllable and secondary stress to alternating syllables preceding main stress:

(13) Weri: left-aligning, iambic system with degenerate feet
a. ŋɪntíp 'bee'
(σσ́)
b. kʊ̀ľipʊ̀ 'hair of arm'
(σ̀)(σσ́)
c. ʊľʊ̀amít 'mist'
(σσ̀)(σσ́)
d. àkʊnètepál 'times'
(σ̀)(σσ̀)(σσ́)

Surawahá (Everett 1996, Hyde 2001) has a similar system and Tübatulabal has been analyzed in these terms by some linguists (see Hayes 1995 for a summary). In *Stresstyp* we find Cebuano, Marind and Urubú-Kaapor.

Let us now turn to the cases of iambic languages that are expected not to exist. To my knowledge, there are no languages that have ever been described as displaying an iambic, right-aligning pattern as in (6d) and (6h), with either two initial unstressed syllables, in the case of strictly binary patterns, or two adjacent, final stresses, as in the case of systems allowing for degenerate feet. In *Stresstyp*, no convincing cases of such stress patterns could be found. However, there are iambic systems that have been described as displaying a "right-to-left" parsing, and it is worthwhile having a closer look at them. The languages described in these terms are Tiberian Biblical Hebrew, Tübatulabal, Aklan and Weri (Hayes 1995). I will not discuss Tiberian Biblical Hebrew, since the original claim that it parses right-to-left iambs (McCarthy 1979b) has been revised in work by other analysts (see Hayes 1995 for a summary and van de Vijver 1998 for an analysis in terms of trochaic feet). Tübatulabal and Aklan have a rather complex quantity-sensitive stress system, but, as far as directionality is concerned, they are similar to Weri. Aklan is described by Hayes (1981) as having main stress that is in part lexically determined and secondary stress assigned to heavy syllables and alternating light syllables preceding main stress:

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[6] It should be mentioned, however, that Hayes (1995) attributes stress on final syllables in these languages to word- and phrase-final phonetic lengthening. In his theory, degenerate feet occur only in strong (= main stressed) position.

(14) Aklan (Hayes 1981):

a. ʔatùbaŋ-án 'genitals'
(LL̀)(LH́)

b. mà-pa-ŋ-ísdaʔ 'go fishing-actor-fut.'
(L̀)(LH́)H

As can be inferred from the foot-structure that I have assigned to the examples above, this language can be interpreted in a similar way as Weri, as a left-aligning iambic language allowing for initial degenerate feet, with the only difference that Aklan parses quantity-sensitive iambs. Therefore, in our typology, it falls into class (6g), which is expected to exist.

Tübatulabal can be analyzed in the same way:

(15) Tübatulabal (van de Vijver 1998, based on Voegelin 1935):

a. wɨtáŋhatál 'the Tejon Indians'
(LĹ)(LĹ)

b. tcíŋiyál 'the red thistle'
(Ĺ)(LĹ)

It is interesting that the majority of the systems that have claimed to be exceptions to the typological generalization of the non-existence of "right-to-left" iambs should in fact be systems of a very specific type: systems that allow for the parsing of degenerate feet. This cannot be a coincidence and in fact, under the present approach it is not. If we interpret directionality in terms of alignment, Weri, Aklan and Tübatulabal are not exceptions at all, but simply left-aligning systems with degenerate feet, the iambic counterpart of trochaic languages such as Passamaquoddy.[7]

2.2 Directionality and rhythm in systems with binary feet

I will start to present my approach to directionality considering metrical systems that restrict their foot inventory to feet that are strictly binary, that is systems of the type (6a.to d.). The goal of this section is therefore to show that systems (6a.to c.) are predicted to exist, while (6d.) is not.

Iterative parsing of binary feet has been analyzed since McCarthy and Prince (1993) as an interaction of alignment constraints such as ALLFTL and ALLFTR with the constraints

[7] In order to explain the existence of this type of languages other linguists have proposed to reanalyze them as being trochaic (see Hayes 1995, van de Vijver 1998 for a trochaic analysis of Tübatulabal, but Kager 1993 for a possible iambic analysis of the same language). This is in fact a possibility. If we take the abstract pattern of syllables with a Weri-like accent pattern, it can be interpreted as being either iambic and left-aligning (i), or as being trochaic and right-aligning (ii):

i.	(σσ́)(σσ́)	(σ́)(σσ́)	iambic, left-aligning
ii.	σ(σ́σ)(σ́)	(σ́σ)(σ́)	trochaic, right-aligning

If we should decide that the trochaic interpretation is the only possible one, we would have to conclude that the typological gap includes not only right-aligning iambic systems, but also left-aligning iambic systems with degenerate feet. I cannot see any reason why left-aligning iambic languages with degenerate feet should be prohibited (while their trochaic counterparts are not) and will therefore not further pursue the trochaic interpretation. I will instead assume that, in principle, the iambic interpretation of patterns such as the one displayed by Weri is at least a possibility.

FTBIN, requiring feet to consist of either two syllables or two moras and the constraint PARSEσ, requiring all syllables to be parsed into feet.

(16) FT-BIN: feet must be binary at some level of analysis (μ, σ)[8]
(Prince 1980; McCarthy and Prince 1986; Prince and Smolensky 1993)

PARSEσ: syllables must be parsed into feet
(Prince and Smolensky 1993)

When FT-BIN is ranked over PARSEσ and this constraint in turn over the alignment constraints determining directionality, we obtain iterative foot parsing, as is illustrated in the following tableau for a system of left-aligning trochees:

Tableau 3: left-aligning trochaic system with binary feet

	FT-BIN	PARSEσ	ALLFTL
☞ (a) (σ̀σ)(σ̀σ)σ		*	**
(b) (σ̀σ)σσσ		***!	
(c) (σ̀)(σ̀σ)(σ̀σ)	*!		* ***
(d) σ(σ̀σ)(σ̀σ)		*	* **!*

Candidate a., displaying iterative parsing wins over candidate c. since a., contrary to c., does not violate the requirement to parse only binary feet. Candidate b. restricts parsing to binary feet as well, but since it parses only a single foot, it rates worse on the requirement that all syllables must be footed. The constraint ALLFTL, though lowest-ranked, does not remain completely inert, in fact it decides the competition between candidate a. and d., which rate equally well on the higher-ranked constraints, but diverge on the evaluation of left-alignment. I will adopt this analysis of iterative parsing and assume from now on that languages with binary feet are languages where constraints such as FT-BIN and PARSEσ are ranked above the constraints determining directionality.

However, in contrast to what is usually assumed in the literature, I interpret directionality in systems with binary feet to be the result of the interaction between the constraint ALLFTL requiring left-alignment and a constraint on rhythm, banning sequences of unstressed syllables. I will call this constraint *LAPSE and define it in the simplest possible way (see Gordon 2002 for the same definition):

(17) *LAPSE: rhythm is alternating; no two adjacent unstressed syllables.

A restriction against stress lapses has been recognized as an important principle for the organization of metrical structure at least since Selkirk (1984) (see also Nespor and Vogel 1989, Kager 1993, 1994, 2000, 2001, Green and Kenstowicz 1995, Elenbaas and Kager 1999, Hyde 2001). Usually, the anti-lapse constraint has been defined in a more restrictive way than the one proposed here, in order to crucially exclude it from targeting the final ... (σ̀<u>σ)σ</u> # sequence in a left-aligning trochaic system. Thus, for example, Kager (1994) proposes a definition of an anti-lapse constraint (PARSE-2, in his terminology) that requires one of two

[8] With respect to the requirement of foot binarity I will continue to abstract away from quantity sensitivity (but see the discussion below) and hence consider only that part of the definition that is relevant for quantity-insensitive language, i.e. the requirement that feet consist of two *syllables*.

adjacent stress units (syllables or moras) to be parsed by some foot. This allows him to account for the fact that languages with a ternary parsing mode as Estonian skip light syllables, but never heavy syllables in parsing:

(18) a. (σ̀σ) L (σ̀σ) → o.k. for PARSE-2
b. *(σ̀σ) H (σ̀σ) → banned by PARSE-2 because none of the two moras of the heavy syllable are parsed into a foot

Similarly, Green and Kenstowicz (1995) use an anti-lapse constraint to derive systems with degenerate feet. In these systems FT-BIN is clearly violated by the occurrence of feet consisting of a single syllable. However, if FT-BIN can be violated in these systems the question arises why the constraint should be violated by parsing feet that are smaller rather than parsing feet that are larger than binary feet. Both subminimal and oversized feet would do equally well on constraints such as PARSEσ and the oversized foot would actually rate better on the directionality constraint ALLFTL. An anti-lapse constraint can distinguish between the two cases, favoring the degenerate foot parsing:

(19) a. (σ̀σ)(σ̀σ)(σ̀) → o.k. for PARSEσ, no lapses
b. (σ̀σσσσσ) → o.k. for PARSEσ, excluded by an anti-lapse constraint

It seems clear to me from these proposals as well as from the other cases discussed in the literature that some provision against stress lapses is needed in the theory of stress. My aim here is to show how such a constraint can explain the asymmetry in directional foot parsing and for this goal the most simple, strictly rhythmic definition of *LAPSE is sufficient.

Assuming that high-ranking FT-BIN and PARSEσ are responsible for the generation of strictly binary systems, directionality is determined entirely by the tension between ALLFTL and *LAPSE. Thus, a left-aligning, trochaic system will be a system where it is more important to left-align feet than to avoid a stress lapse:[9]

Tableau 4: left-aligning trochees: ALLFTL triggers left-alignment

			ALLFTL	*LAPSE
☞	(a)	(σ̀σ)(σ̀σ)(σ̀σ)(σ̀σ)σ	** **** ******	*
	(b)	σ(σ̀σ)(σ̀σ)(σ̀σ)(σ̀σ)	* *** ***** ****!***	
	(c)	(σ̀σ)(σ̀σ)σ(σ̀σ)(σ̀σ)	** ***** ******!*	*

The candidates in this tableau parse as many syllables into feet as possible (obeying PARSEσ) without violating FT-BIN. Candidate a. wins the competition since it rates best on left-alignment, although the pattern displays a final stress lapse. Candidate b. avoids this lapse, but rates worse on ALLFTL. Finally, candidate c. is both badly left-aligned and displays a medial stress lapse. Since this candidate is suboptimal with respect to a. and b. on both constraints it is predicted not to exist. In fact, to my knowledge there are no systems that align feet both to the left and the right edge.

The reverse ranking of the constraints under discussion leads to the generation of right-aligning trochaic systems:

[9] Throughout this paper I will assume that trochaic systems are generated by a ranking where a constraint requiring left-headed feet dominates a constraint requiring right-headed feet, while iambic systems are generated by the reverse ranking.

Tableau 5: right-aligning trochees: *LAPSE triggers right-alignment

		*LAPSE	ALLFTL
	(a) (σ̀σ)(σ̀σ)(σ̀σ)(σ̀σ)σ	*!	** **** ******
☞	(b) σ(σ̀σ)(σ̀σ)(σ̀σ)(σ̀σ)		* *** ***** *******
	(c) (σ̀σ)(σ̀σ)σ(σ̀σ)(σ̀σ)	*!	** ***** *******

In this case, candidate b. wins, since it is the only candidate avoiding a stress lapse.
Now consider iambic systems:

Tableau 6: left-aligning iambs:best both for *LAPSE and ALLFTL

		*LAPSE	ALLFTL
☞	(a) (σσ̀)(σσ̀)(σσ̀)(σσ̀)σ		** **** ******
	(b) σ(σσ̀)(σσ̀)(σσ̀)(σσ̀)	*!	* *** ***** ****!***
	(c) (σσ̀)(σσ̀)σ(σσ̀)(σσ̀)	*!	** ***** ******!*

Since iambic systems parse right-headed feet, no stress lapse can arise under left-alignment. Thus, a string of left-aligning iambic feet satisfies *LAPSE *and*, among the candidates permitted by FT-BIN and PARSEσ, rates best also on ALLFTL. Candidate b. rates worse than a. on both constraints. Whatever the ranking between the two constraints, b. can never turn out to be the optimal candidate, hence this pattern will never be attested. Candidate c., with a medial lapse, is excluded as before.

Using the notion of harmonic bounding (Samek-Lodovici 1992, Prince and Smolensky 1993, Samek-Lodovici and Prince 1999), we can say that the right-aligning iambic parsing exemplified by candidate b. and the parsing displaying a medial lapse in c. are harmonically bounded by candidate a. Under the definition of harmonic bounding given in Samek-Lodovici and Prince (1999), a candidate is harmonically bounded if there is another candidate that is (a) at least as good on all constraints, and (b) better on at least one constraint. We have assumed so far that the typology of rhythm in systems with binary feet is determined by the four constraints FT-BIN, PARSEσ, ALLFTL and *LAPSE. If we limit ourselves to this set of constraints we see indeed that candidate b. and c. are harmonically bounded by a.: no matter how these four constraints are ranked, candidate a. rates at least as good as b. and c. on all constraints and rates better than b. and c. on ALLFTL and *LAPSE:

Tableau 7: Harmonic bounding of b. and c. by a.

	FT-BIN	PARSEσ	*LAPSE	ALLFTL
☞ (a) (σσ̀)(σσ̀)(σσ̀)(σσ̀)σ		*		** **** ******
(b) σ(σσ̀)(σσ̀)(σσ̀)(σσ̀)		*	*!	* *** ***** ****!***
(c) (σσ̀)(σσ̀)σ(σσ̀)(σσ̀)		*	*!	** ***** ******!*

Note, however, that candidate b. and c. are harmonically bounded only with respect to the constraint set just discussed. As soon as other constraints enter the picture it might be the case that b. or c. outwin a. on these constraints. The generalization that b. and c. never win is therefore only true with respect to the basic typology of rhythmic foot parsing, which, by hypothesis, is generated by the four constraints above and nothing else. We will in fact see in a subsequent section that as soon as we take into account main stress assignment and the constraints by which it is determined, a candidate with a medial lapse similar to c. can emerge as a winner under certain, well-defined circumstances.

In sum, in the analysis proposed here directionality is seen as the result of the tension between requirements of foot alignment and requirements of rhythm. Left-to-right directionality is accounted for, as in previous approaches, in terms of the constraint ALLFTL. Right-alignment, on the other hand, is seen as the result of a constraint demanding strictly rhythmical alternation. This is a phenomenon emerging only in trochaic systems, because only in trochaic systems can right-alignment lead to the optimization of rhythmic alternation. In an iambic system, no choice between the two requirements has to be made since the left-aligning parse is *also* perfectly rhythmical. Finally, a right-aligning iambic system is not attested because it satisfies neither the demands of foot-alignment, nor the constraint on rhythmic well-formedness:

Tableau 8: Rating of binary systems on foot-alignment and rhythmic alternation:

	Left-alignment	Rhythm
left-aligning trochees	(σ̀σ)(σ̀σ)σ good	σ̀ σ σ̀ <u>σ σ</u> bad
right-aligning trochees	σ(σ̀σ)(σ̀σ) bad	σ σ̀ σ σ̀ σ good
left-aligning iambs	(σσ̀)(σσ̀)σ good	σ σ̀ σ σ̀ σ good
right-aligning iambs	σ(σσ̀)(σσ̀) bad	<u>σ σ</u> σ̀ σ σ̀ bad

In some sense, an approach in these terms reflects two fundamental characteristics of metrical structure observed already in the first theories of stress in generative grammar (Liberman and Prince 1977, Prince 1983 and subsequent work). Metrical structure is organized into constituents (represented in metrical trees or foot-structure), and metrical structure is characterized by rhythmical alternation (represented in the metrical grid). It is therefore expected that the basic typology of rhythm should be determined by principles referring to both kinds of structure: ALLFTL to the placement of metrical constituents and *LAPSE to rhythmic alternation.

2.3 Directionality and rhythm in systems with degenerate feet

In languages that allow for degenerate feet, there are no stress lapses and we might wonder why we should find the same typological asymmetry in these languages as in languages allowing only for binary feet. The answer is very simple: in these systems alternating rhythm is disturbed by *too many* stresses.

I will analyze systems with degenerate feet following Green and Kenstowicz (1995). Under their proposal systems of this type are generated by the ranking PARSEσ >> FT-BIN, *LAPSE.[10] The following tableau shows how this ranking generates a system with left-aligning trochees:

Tableau 9: left-aligning trochaic system with degenerate feet

	PARSEσ	FT-BIN	*LAPSE	ALLFTL
(a) (σ̀σ)(σ̀<u>σ)σ</u>	*!		*	**
☞ (b) (σ̀)(σ̀σ)(σ̀σ)		*		* ***
(c) (σ̀σ)(σ̀σ)(σ̀)		*		** ***!*
(d) (σ̀<u>σσσσ</u>)		*	*!	

[10] Green and Kenstowicz (1995) use modified definitions of these constraints, but the core idea of their analysis is preserved here. See Everett (1996) for discussion of these patterns and a proposal involving a redefinition of FT-BIN.

Because of the high ranking of PARSEσ a strictly binary parsing of feet as in candidate a. is not sufficient, even though parsing all syllables of an odd-numbered string into feet means to necessarily violate FT-BIN. Among the three candidates that display exhaustive parsing candidate d. is ruled out because its oversized foot violates the anti-lapse condition. Note that even though the ranking between PARSEσ and FT-BIN on the one hand and *LAPSE on the other is irrelevant, it is crucial that *LAPSE dominate ALLFTL, otherwise the "unbounded" foot in d. would win. The competition between the remaining two candidates b. and c. is decided here by ALLFTL, which chooses the left-aligning candidate as a winner. Systems with degenerate feet thus are mainly the result of a high ranked requirement of exhaustive parsing combined with a ban against oversized feet resulting from the ranking of *LAPSE over ALLFTL.

Getting back to the problem of directionality, we see that while *LAPSE has an important function in the generation of systems with degenerate feet, it has no influence on directionality in this case. Nevertheless, also in systems of this type directionality is determined by principles of rhythm, more precisely, by a constraint against two adjacent stressed syllables:

(20) *CLASH: rhythm is alternating; no two adjacent stressed syllables

The insight that metrical systems use various strategies to avoid stress clashes has played an important role from the very beginning of generative metrical theory (see Liberman and Prince 1977). I am again using here the simplest possible definition of an anti-clash constraint (Gordon 2002, but see Kager 1994, Plag 1999, Pater 2000 for other recent proposals).

Let us first consider trochaic systems of the left-aligning type.[11]

Tableau 10: Left-aligning trochaic systems: ALLFTL triggers left-alignment

	ALLFTL	*CLASH
☞ (a) (σ̀)(σ̀σ)	*	*
(b) (σ̀σ)(σ̀)	**!	

In systems allowing for degenerate feet, a dominant ALLFTL constraint forces the creation of a single degenerate foot at the left edge of the word. In trochaic systems this leads to the creation of a stress clash at the left edge and hence to violation of the lower ranked constraint against clashes. The clash-avoiding candidate b. has to lose, since it rates worse on ALLFTL, its second foot being two syllables away from the left edge.

Trochaic systems with the inverse ranking show us how *CLASH can determine directionality. Since stress clashes have to be avoided, candidate b. wins and the resulting system is of the right-aligning type:

Tableau 11: right-aligning trochaic systems: *CLASH triggers right-alignment

	*CLASH	ALLFTL
(a) (σ̀)(σ̀σ)	*!	*
☞ (b) (σ̀σ)(σ̀)		**

As in systems with binary feet, also in systems allowing for degenerate feet iambic languages have only one option. Optimal left-alignment turns out to coincide with optimal rhythm:

[11] Clashing sequences are boxed.

Tableau 12: left-aligning iambic systems: best both for ALLFTL and *CLASH

	ALLFTL	*CLASH
☞ (a) (σ̀)(σσ̀)	*	
(b) (σσ̀)(σ̀)	**!	*

The left-aligning candidate a. is also the candidate that manages to avoid a stress clash, while b. rates badly on ALLFTL as well as on *CLASH. Thus, the right-aligning iambic parse is harmonically bounded by the left-aligning parse, a. will always be better than b. The reason for this is again foot-structure: since iambs are right-headed, they can create a clashing sequence at the end of a word, but not at the beginning. This means that if we want to avoid clashes, we must place the unary foot at the beginning of the word - and this parse happens to be optimal also for the requirements of left-alignment.

Thus, interpreting directionality as the result of the interaction between the requirement to align feet to the left and the requirement to generate a perfectly alternating rhythm again leads to the correct typological predictions. We do find both left-aligning and right-aligning trochaic systems with degenerate feet, but iambic systems with degenerate feet are always of the left-aligning type.

In this system, right-alignment as a primitive does not play any role. The claim is that feet do have a tendency to left-align, but that there is no constraint requiring the right-alignment of feet. This bias in favor of the left edge of prosodic (or morphological) categories has been observed in other phonological phenomena as well. Thus, Beckman (1998) observes that typically initial positions allow for more contrasts than non-initial positions. The examples she discusses include the first syllable in Shona and Tamil roots which differs from non-initial syllables in permitting features that do not occur non-initially. Another well-known case is that of onset positions in a syllable, which allow for a larger inventory of segments than coda positions. She terms this phenomenon favoring contrast in initial positions *positional faithfulness*. Furthermore, Beckman proposes that first syllables of words in certain languages are "loaded" with segmental material (see her discussion of the first syllable in Tamil), a phenomenon she calls *prominence maximization.* Following this idea, Alber (2001) proposes that a series of phenomena, e.g. the existence of monosyllabic templates in reduplication and truncation, can be derived from constraints requiring segmental material to appear in first position.

Nelson (2002) proposes that in reduplication we can observe a bias for the left-edge as well. She claims that the reduplicant always copies the initial portion of the base, not the final one. Nelson shows that in all cases where it would seem that copying starts from the right edge of the base, the anchoring point for reduplication is in fact a category that is prominent for other reasons, e.g. because it is the syllable of the base bearing main stress.

In the analyses just mentioned (except for *prominence maximization*) it is maintained that the left edge of prosodic or morphological categories is "special" in that it is more faithful and thus, in some sense, carries more information than non-initial positions. This fact is not surprising, since after all the left edge of a category is the first part that listeners hear and is therefore important for word-recognition (see also Alber 2001). In stress systems, however, the left-edge bias might be due to some additional factor. Hayes (1995:266) observes that left-aligning systems are more widespread across the world's languages and proposes that this preference might be due to the fact that left-aligning systems require less phonological pre-planning in speaking. Compare a left-aligning and a right-aligning trochaic systems with binary feet:

(21) a. (σ̀σ)(σ̀σ)
(σ̀σ)(σ̀σ)σ
b. (σ̀σ)(σ̀σ)
σ(σ̀σ)(σ̀σ)

In a left-aligning system we do not have to know beforehand whether a word consists of an even or an odd number of syllables. We can start producing the word placing stress on the first syllable and every other syllable thereafter. In right-aligning systems, on the other hand, the first syllable is stressed only in even-parity sequences, in odd-numbered sequences stress falls on the second syllable. Thus, although the right-aligning system is perfect in terms of alternating rhythm, it has disadvantages in terms of processing: before starting to place stress we have to know the number of syllables in the word.

While left-alignment is optimal for the pre-planning of stress placement, right-alignment *per se* has no advantage of this type. It turns out to be optimal only when it helps to optimize rhythmic wellformedness. Hence, right-alignment is a by-product of the requirements of rhythmic wellformedness, but not a primitive of metrical systems.

3. Consequences of directionality determined by rhythm

3.1 Directionality and main stress assignment

In this section I will turn to the interaction between main stress and secondary stress and to the patterns that are predicted by the present proposal to exist or not to exist once we take into account main stress assignment. I will concentrate on systems that parse binary feet since these are the systems where rhythm is disrupted most dramatically through main stress placement.

With most recent approaches in metrical theory I assume that the assignment of main stress is determined by the two constraints RIGHTMOST and LEFTMOST, requiring the main stress foot to be aligned as much as possible with the right/left edge of the prosodic word:

(22) RIGHTMOST = ALIGN (PRWD, R, HEAD-FT, R)
∀ prosodic word ∃ head-foot of the prosodic word such that the right edge of the prosodic word and the right edge of the head-foot coincide

LEFTMOST = ALIGN (PRWD, L, HEAD-FT, L)
∀ prosodic word ∃ head-foot of the prosodic word such that the left edge of the prosodic word and the left edge of the head-foot coincide.
(EDGEMOST in Prince and Smolensky 1993)

In this section I will first discuss two types of stress patterns where the requirements of main stress and secondary stress placement do not conflict. In these systems, the rhythmic pattern of secondary stress is not disrupted by main stress placement and the resulting systems are identical to the typology of stress patterns already presented. I will briefly show how systems of this type can be generated with the constraints proposed so far. I will then discuss so-called *bidirectional systems* (Elenbaas and Kager 1999), where, on the contrary, secondary stress rhythm is disrupted by the necessities of main stress placement. The constraint set employed here predicts certain types of bidirectional systems, but not others, and I will discuss in detail the stress pattern of Garrwa, which is said to display a stress-pattern not predicted by the present proposal.

In systems where main stress is assigned to the same edge to which secondary stress feet are aligned, no conflict between secondary stress rhythm and main stress placement can arise. Take for instance Pintupi, as exemplified in (8). Pintupi parses left-aligning trochees and main stress is leftmost as well. These are cases where the requirements of main stress and secondary stress simply coincide. Hence, it does not matter where LEFTMOST or RIGHTMOST are ranked with respect to the directionality constraints. Considering that iambic systems with right-aligning secondary stress do not exist, there are the following logical possibilities for systems of this type, all of which are attested by some language:[12]

(23) Systems where alignment of main stress and secondary stress coincide:

a. left-aligning trochees with leftmost main stress: e.g. Pintupi, Estonian, Finnish
(σ́σ)(σ̀σ)
(σ́σ)(σ̀σ)σ
ranking: ALLFTL >> *LAPSE,
LEFTMOST (unordered w.r.t. the directionality constraints)

b. right-aligning trochees with rightmost main stress: Warao, Cavineña, Nengone
(σ̀σ)(σ́σ)
σ(σ̀σ)(σ́σ)
ranking: *LAPSE >> ALLFTL
RIGHTMOST (unordered w.r.t. the directionality constraints)

c. left-aligning iambs plus leftmost main stress: Southern Sierra Miwok, Southern Paiute, Araucanian
(σσ́)(σσ̀)
(σσ́)(σσ̀)σ
ranking: LEFTMOST, *LAPSE, ALLFTL (unordered w.r.t. each other)

Another case of non-conflict are languages where main stress is assigned to the rightmost or leftmost foot created by the constraints that generate the rhythmic pattern of secondary stress. Consider e.g. Wargamay (Dixon 1981, see also Hayes 1995): in sequences of light syllables,[13] main stress falls on the first syllable in words with an even number of syllables and on the second syllable in words with an odd number of syllables:

(24) Wargamay: position of main stress determined by secondary stress footing

báda	'dog'
(σ́σ)	
gíɟawùlu	'freshwater jewfish'
(σ́σ)(σ̀σ)	
gagára	'dilly bag'
σ(σ́σ)	

[12] The examples of languages for the patterns in this section, if not otherwise indicated, are drawn from the descriptions in Hayes (1995). In the rankings described in this section I tacitly assume that the constraint referring to main stress placement that is not mentioned is dominated by its mirror-image constraint mentioned in the ranking, i.e., in (23a) LEFTMOST dominates RIGHTMOST.

[13] I abstract away from the fact that in Wargamay heavy syllables, which always occur word-initially, can attract main stress.

ɟuɽágay-mìri 'Niagara-Vale-FROM'
σ(σ́σ)(σ̀σ)

Following Hayes (1995), we can analyze such a system as making use of binary trochees which are parsed in a right-to-left, i.e. right-aligning fashion. Main stress is computed on secondary stress in the sense that the position of main stress varies with the position of the leftmost foot generated by the right-aligning parse. Languages in which main stress placement is determined by the foot structure generated by secondary stress parsing thus do not disturb the pattern of rhythmic parsing. We have again three possible scenarios, all of which are attested for some language.

(25) Systems where main stress is computed on secondary stress placement:
   a. left-aligning trochees with rightmost main stress: Cairene Arabic, Palestinian Arabic
      (σ̀σ)(σ́σ)
      (σ̀σ)(σ́σ)σ
   b. right-aligning trochees with leftmost main stress: Wargamay, Nyawaygi
      (σ́σ)(σ̀σ)
      σ(σ́σ)(σ̀σ)
   c. left-aligning iambs with rightmost main stress: Seminole/Creek, Unami, Munsee, Cayuga
      (σσ̀)(σσ́)
      (σσ̀)(σσ́)σ

In terms of constraints, these system are generated by subordinating RIGHTMOST or LEFTMOST to the constraints ALLFTL or *LAPSE generating directionality.

Tableau 13: Rankings generating systems where main stress is computed on secondary stress:

a. left-aligning trochees with rightmost main stress					
			ALLFTL	*LAPSE	RIGHTMOST
☞	(a)	(σ̀σ)(σ́σ)σ	**	*	*
	(b)	(σ̀σ)σ(σ́σ)	***!	*	
	(c)	σ(σ̀σ)(σ́σ)	* **!*		
b. right-aligning trochees with leftmost main stress					
			*LAPSE	ALLFTL	LEFTMOST
☞	(a)	σ(σ́σ)(σ̀σ)		* ***	*
	(b)	(σ́σ)σ(σ̀σ)	*!	***	
	(c)	(σ́σ)(σ̀σ)σ	*!	**	
c. left-aligning iambs with rightmost main stress					
			ALLFTL	*LAPSE	RIGHTMOST
☞	(a)	(σσ̀)(σσ́)σ	**		*
	(b)	(σσ̀)σ(σσ́)	***!	*	
	(c)	σ(σσ̀)(σσ́)	* **!*	*	

In the case of left-aligning trochaic systems with rightmost main stress it is the constraint ALLFTL which, by dominating RIGHTMOST, forces main stress to vary according to secondary stress placement. Each attempt to align main stress more to the right must fail because it would lead to worse left-alignment of feet.

Right-aligning trochaic systems are systems that tend to avoid lapses. Hence, here it is *Lapse which, if it dominates Leftmost, generates the pattern of a language such as Wargamay: in odd-numbered strings of syllables main stress cannot be on the leftmost syllable since in that case we would create a lapse.

In order to generate a left-aligning iambic system where main stress is computed on secondary stress at least one of the directionality constraints, AllFtL or *Lapse, has to dominate Rightmost. In odd-parity strings main stress cannot fall on the last syllable, since this would result both in bad left-alignment and in the creation of a lapse.

So far we have seen systems where main stress placement cannot influence secondary stress placement in any interesting way. Now let us consider cases where the requirements of main stress and secondary stress assignment diverge. This happens when main stress is assigned to the opposite side of secondary stress alignment and, moreover, main stress does not depend on the placement of secondary stress feet.

(26) Bidirectional systems: main stress to the opposite side from secondary stress alignment:

a. left-aligning trochees with rightmost main stress: Piro, German loanwords,[14] Lenakel verbs and adjectives

(σ̀σ)(σ̀σ)(σ́σ)

(σ̀σ)(σ̀σ)σ(σ́σ)

b. left-aligning iambs with final main stress: unattested so far

(σσ̀)(σσ̀)(σσ́)

(σσ̀)(σσ̀)σ(σσ́)

c. right-aligning trochees with initial main stress: Garrwa[15]

(σ́σ)(σ̀σ)(σ̀σ)

(σ́σ)σ(σ̀σ)(σ̀σ)

In these cases, the predictions of the present proposal don't work out as we might expect them to. The first pattern, attested by Piro, German and Lenakel, is no problem. The pattern is generated by the ranking responsible for left-aligning trochees, AllFtL >> *Lapse, combined with the ranking of Rightmost over AllFtL (cf. tableau below). This allows for the main stress foot to be aligned close to the right edge of the prosodic word. Pattern b. is predicted to exist, but so far I was not able to find a language that displays it. It should be generated by Rightmost dominating AllFtL and *Lapse, thus allowing for a right-aligning, lapse-generating main stress foot.

Tableau 14: Rankings generating bidirectional systems:

a. left-aligning trochees with rightmost main stress					
			Rightmost	AllFtL	*Lapse
☞	(a)	(σ̀σ)(σ̀σ)σ(σ́σ)		** *****	*
	(b)	(σ̀σ)(σ̀σ)(σ́σ)σ	*!	** ****	*
	(c)	σ(σ̀σ)(σ̀σ)(σ́σ)		* *** ****!*	

[14] Alber (1997, 1998)

[15] "Garrwa" is the current spelling convention for the Australian language known as Garawa in the literature (p.c. Ilana Mushin).

b. right-aligning trochees with leftmost main stress			
	RIGHTMOST	ALLFTL	LEFTMOST
☞ (a) (σσ̀)(σσ̀)σ(σσ́)		** *****	*
(b) (σσ̀)(σσ̀)(σσ́)σ	*!	** ****	
(c) σ(σσ̀)(σσ̀)(σσ́)		* *** ****!*	*

It is claimed that pattern c. is displayed by the language Garrwa, but the present approach predicts that such a pattern should not exist. Since LEFTMOST forces stress on the first syllable, only two options are in principle open for the parsing of secondary stress, as exemplified below:

(27) a. (σ́σ)σ(σ̀σ)(σ̀σ)
b. (σ́σ)(σ̀σ)(σ̀σ)σ

The parsing in a. is harmonically bounded by the parsing in b.: both candidate a. and candidate b. violate *LAPSE, but b. rates better than a. in terms of left-alignment. In other words, when stress is fixed on the initial syllable, a lapse is unavoidable and under any ranking the candidate with the best left-alignment, i.e. the pattern in b., should be chosen. This means that if leftmost main stress is mandatory, secondary stress feet should always align to the left. This prediction, which is a problem here, will in fact turn out to be an advantage when we consider the non-existence of initial dactyl systems.

A note of caution is due when building typological generalizations on systems as in (26). First of all, in order to discover whether a language displays one of the above patterns, it is necessary to have the description of stress placement in strings of at least seven syllables. Consider, for example, the stress pattern of languages of the type in (26a) as it appears in shorter strings of syllables:

(28) a. 6 syllables: (σ̀σ)(σ̀σ)(σ́σ)
b. 5 syllables: (σ̀σ)σ(σ́σ)

In an even numbered string of six syllables, as in a., it is impossible to determine the direction of parsing of secondary stress feet. The same is true for a string of five syllables: since only one secondary stress foot is present, no direction of parsing can be determined. This means that we will detect bidirectional systems only if the description of the data is accurate enough to describe stress placement in words of seven syllables and more. Considering the limited space often dedicated in grammars to stress assignment, it is therefore not surprising that few descriptions of bidirectional systems are available. I must attribute to this scarcity of data the fact that, to my knowledge, no language as in (26b) has been described so far.[16]

Moreover, from the description of the data it must be clear that morphology doesn't play any role in generating the pattern where the main stress foot is separated from secondary stress feet by a syllable. If it is not carefully excluded that morphology plays any role in generating the above patterns it might well be that, for instance, the single main stress foot on the right is due to a stress attracting suffix. Thus, it is important to check the sources for morphological influence on the stress pattern even more carefully than in other cases. This has been done, for instance, in the case of Lenakel (see the detailed discussion in Hayes

[16] There are many descriptions of languages where main stress is assigned to an iamb at the right edge of the prosodic word (e.g. Turkish). Unfortunately, in none of these cases secondary stress rhythm is mentioned. If any of these languages displays secondary stress, it should be left-aligning and hence of the type described in (26b).

1995), but it is less clear whether the same is true for Garrwa. I will therefore devote some effort to the discussion of the Garrwa data and argue that it is at least possible that its stress pattern is generated under the influence of morphological boundaries.

The main source for stress in Garrwa is Furby (1974). In Furby's description of Garrwa phonology word stress occupies only half a page, since her main concern was evidently to lay out the basic sound inventory and the syllable structure of the language. She does not mention whether morphology influences the basic stress pattern. There are seven words where both main stress and secondary stress are given, of which only five are seven or more syllables long. None of these five words seems to be morphologically simple:[17]

(29) a. ŋánkiřikìřimpàyi — 'fought with boomerangs'
(σ́σ)σ(σ̀σ)(σ̀σ)

b. ŋámpalàŋinmùkunjìna — 'at our many'
(σ́σ)(σ̀σ)(σ̀σ)(σ̀σ)

c. nářiŋinmùkunjìnamìřa — 'at your own many'
(σ́σ)σ(σ̀σ)(σ̀σ)(σ̀σ)

d. nímpalàŋinmùkunànjimìřa — 'from your own two'
(σ́σ)(σ̀σ)(σ̀σ)(σ̀σ)(σ̀σ)

The only two examples that support the claim that Garrwa has right-aligning secondary stress feet are example a. and c., since only in these odd-parity examples directionality is visible. Example a. might be a case of reduplication, with reduplication of the string *-kiři-*, and in c. several suffixes are involved. Furby (1978:7) indicates that *-nmuku-* is a plural suffix. In comparing example b. with c. and d., we see that c. and d. have in common the suffix *-mìřa-*, indicating possession, a suffix and meaning that b. lacks. We can therefore argue for the following morphological analysis of c.:

(30)	nářiŋi-	nmùku-	njìna-	mìřa	'at your own many'
	you many	pl.	'at'	'own'	

Any of the present suffixes might disturb the stress pattern of the word by attracting stress. As long as only two words of this structure of a single language[18] are available, I find it inconclusive as a counterexample.

Nevertheless, if for the time being we take for granted that there are other languages that have the stress pattern hypothesized for Garrwa, there is still a possible explanation available for the generation of such patterns. It has been observed (Plag 1999, Pater 2000), that constraints against stress clash make a distinction between secondary stress clashes and clashes that involve a main stress. Pater (2000) notes that adjacent secondary stresses are tolerated in English, as e.g. in *Tì.còn.de.ró.ga*, while a main stress adjacent to a secondary stress leads to destressing. Thus, suffixation of *-ation* to a stem like *infórm* results in loss of the main stress of the stem, even though in other cases of this type the main stress of the stem is preserved as a secondary stress. Instead of the expected *ìn.fòr.má.tion* we get *ìn.for.má.tion*. Plag and Pater attribute phenomena like this to the existence of two clash

[17] Furby describes medial stressed syllables as bearing tertiary stress. Tertiary stress is reinterpreted here as secondary stress.
[18] No other instances of a bidirectional pattern of this type could be found in *Stresstyp*.

constraints, one banning sequences of stressed syllables in general, and another one banning a sequence of a main stressed and a secondarily stressed syllable. We might then hypothesize that also the mirror image constraint of *CLASH, i.e. *LAPSE must be split into two constraints: a more general constraint banning sequences of stressless syllables and a more specific constraint targeting sequences of stressed syllables that are not close to a main stress.

(31) *LAPSE: rhythm is alternating; no two adjacent unstressed syllables.
*LAPSE$_{\text{WEAK}}$: rhythm is alternating; no two adjacent weak unstressed syllables.
(weak = not belonging to a main stress foot)

While *LAPSE excludes any sequence of unstressed syllables, *LAPSE$_{\text{WEAK}}$ excludes only sequences of unstressed syllables that are not close to a main stressed syllable. The rationale behind this proposal is that an unstressed syllable close to a main stressed syllable is in some sense "stronger" than unstressed syllables that are close to a secondary stress or other unstressed syllables. The spirit of a constraint such as *LAPSE$_{\text{WEAK}}$ is therefore similar to the licensing constraint for lapses close to main stress proposed by Kager (2000, 2001; see discussion below). If we split *LAPSE into two constraints it is not difficult to derive the Garrwa pattern:

Tableau 15

	LEFTMOST	*LAPSE $_{\text{WEAK}}$	*LAPSE	ALLFTL
☞ (a) (σ́σ)σ(σ̀σ)(σ̀σ)			*	*** *****
(b) (σ́σ)(σ̀σ)(σ̀σ)σ		*!	*	** ****
(c) σ(σ́σ)(σ̀σ)(σ̀σ)	*!			* *** *****

Candidate a. can win under this hierarchy, because its lapse, being close to the main stress foot, is in some sense more tolerable than the lapse generated in candidate b. Candidate b. violates *LAPSE$_{\text{WEAK}}$ because both syllables involved in the lapse are weak, since neither of them is part of the main stress foot. Thus, directionality in this pattern is not determined by the usual ranking between *LAPSE and ALLFTL (in fact, the ranking between these constraints is irrelevant), but by *LAPSE$_{\text{WEAK}}$, which determines the position of the lapse and therefore the position of secondary stress feet.

In conclusion of this section we can say that the proposal to interpret directionality of parsing as being determined in part by rhythm constraints does not run into major problems once we consider the influence of main stress assignment. Most attested systems could be derived without problems. There are two open questions, though. The present theory predicts systems with left-aligning iambic feet and rightmost main stress and so far no language of this type could be found. Moreover, the theory needs an additional constraint to generate systems with right-aligning trochees and leftmost main stress. In the next section I will show that the difficulty that the theory has in deriving this latter type of systems is actually an advantage. It might be the case that languages such as Garrwa exist, but it seems clear that there are no languages with a pattern similar to Garrwa, but where the single foot at the left edge of the prosodic word bears secondary stress. This is predicted by the theory.

3.2 The non-existence of initial dactyls

The set of constraints proposed so far cannot generate a pattern with a single secondary stress foot at left edge of the prosodic word, followed by a parsing of right-aligning trochees:

(32) Initial dactyl system: predicted not to exist
(σ̀σ)(σ̀σ)(σ́σ)
(σ̀σ) σ (σ̀σ)(σ́σ)

We can imagine that there could be a constraint, let us call it INITIALSTRESS, that requires the first syllable to be stressed. But even if such a constraint should occupy a high position in the constraint hierarchy, this cannot result in the generation of the initial dactyl sequence, since this candidate will always lose against a competing candidate that rates better on ALLFTL:

Tableau 16

			INITIALSTRESS	*LAPSE	ALLFTL
	(a)	(σ̀σ)σ(σ̀σ)(σ́σ)		*	*** ****!*
	(b)	σ(σ̀σ)(σ̀σ)(σ́σ)	*!		* *** *****
☞	(c)	(σ̀σ)(σ̀σ)σ(σ́σ)		*	** *****

Candidate a. rates worse than candidate b. on *LAPSE and worse than c. on ALLFTL. In other words, candidate a. has both a lapse and bad left-alignment, while there are other candidates that are doing better on at least one of these two constraints. In the terms of Samek-Lodovici and Prince (1999), candidate c. harmonically bounds candidate a. since c. rates at least as well as a. on all constraints and better than a. on at least one constraint, i.e. ALLFTL. The only hope for a. would be that there is a higher constraint able to exclude all the other candidates.

A pattern as exemplified in candidate a. has been claimed to exist in languages such as Indonesian (Cohn 1986), Hawaiian (Prince 1983) and Spanish (Roca 1986). However, Kager (1991b, 2000, 2001) has shown that these are exactly cases where other principles than those determining the basic stress patterns of the language are involved. The most interesting case is that of Indonesian. The claim that Indonesian displays the initial dactyl pattern rests on examples such as the following:

(33) a. dèmilitèrisási 'demilitarization'
(σ̀σ)σ(σ̀σ)(σ́σ)
b. àmerikànisási 'Americanization'
(σ̀σ)σ(σ̀σ)(σ́σ)

As Kager (2000, 2001) notes, the relevant words are all borrowed from Dutch, where they have the same stress contour:

(34) a. dèmilitàrisátie
b. Àmerikànisátie

Kager notes that the Dutch words are morphologically derived from the bases *milité:r* and *amerikán*, and argues that the complex words are cases of stress preservation: *dèmilitàrisátie* and *Àmerikànisátie* bear a secondary stress on the fourth syllable not because this corresponds to the basic stress pattern, but because the final stress of the base is preserved as a secondary stress after suffixation. He concludes that Indonesian must have borrowed the Dutch words together with their stress pattern.[19]

[19] For Indonesian stress cf. also Goedemans and van Zanten (to appear), who claim that the most wide-spread variety of Indonesian, i.e. the variety spoken by Javanese speakers, has no system of word stress at all.

German is another case where the initial dactyl pattern can be found under similar circumstances. German loanwords have rightmost main stress and a pattern of left-aligning trochaic secondary stress feet (Alber 1997, 1998). This means that the basic stress pattern of the language should be determined by the ranking RIGHTMOST >> ALLFTL >> *LAPSE. However, there are morphologically complex words where we can find the initial dactyl pattern. In all of these cases we can show that stress-preservation is involved:

(35) kɔ̀n.ti.nɛn.tá:l → kɔ̀n.ti.nɛn.tá.l-i.tɛ́:t 'continental, continentality'
(σ̀σ)σ(σ́) → (σ̀σ)σ(σ̀σ)(σ́)

When *kɔ̀n.ti.nɛn.tá:l* is affixed with the stress attracting suffix *-i.tɛ́:t* the main stress of the base word is preserved as a secondary stress in the derived word. We have an initial dactyl pattern instead of the expected stress on the third syllable *.nɛn.*

It seems thus that many cases of supposed initial dactyl languages can be interpreted as involving a higher faithfulness constraint F requiring the preservation of the stress of the base (cf. Kager 2000, 2001 for a discussion of Hawaiian and Spanish). This constraint (called "F" in the tableau), if high-ranked, can favor the initial dactyl candidate:

Tableau 17: Initial dactyls as the result of stress preservation

kɔntinɛntàl-itɛ:t	F	RIGHTMOST	ALLFTL	*LAPSE
☞ (a) kɔ̀n.ti.nɛn.tá.l-i.tɛ́:t (σ̀σ)σ(σ̀σ)(σ́)			*** *****	*
(b) kɔ̀n.ti.nɛ̀n.ta.l-i.tɛ́:t (σ̀σ) (σ̀σ) σ(σ́)	*!		** *****	*
(c) kɔn.tì.nɛn.tà.l-i.tɛ́:t σ (σ̀σ) (σ̀σ)(σ́)			* *** *****!	

Candidate b. displays the pattern found in words where morphology does not disturb stress placement: main stress is rightmost and secondary stress aligns to the left. However, this is not a possibility in this case, since in b. the main stress of the base is not preserved, the fourth syllable *-ta-* is not stressed. For this reason candidate b. is excluded by the faithfulness constraint F, requiring derived forms to preserve the main stress of their bases. Candidate c. is an attempt to generate a perfectly rhythmical parse *and* to preserve stress on the fourth syllable. Since in German loanwords secondary stress feet align to the left, this is excluded here by the ranking of ALLFTL over *LAPSE.

To conclude, we can say that the exclusion of initial dactyl systems is a welcome consequence of the present proposal. Few systems of this type have been claimed to exist and there are good arguments to believe that most if not all of them display the initial dactyl system only in derived environments, due to the influence of affixes.

3.3 Rhythmic directionality and quantity sensitivity

A language is said to have a quantity-sensitive stress pattern when heavy syllables can influence the placement of stress. Typically, in quantity-sensitive languages syllables with long vowels, and, in some languages, syllables closed in a consonant attract stress. In Optimality Theory, the stress attracting property of heavy syllables is usually attributed to the *weight-to-stress principle* (WSP), a violable constraint requiring heavy syllables to be stressed:

(36) WSP: heavy syllables are prominent
(Prince and Smolensky 1993)

A heavy syllable in a sequence of light syllables can disrupt the otherwise regularly alternating stress pattern of a language by attracting stress. The question that arises in this context is whether the present approach to directionality can account for directionality effects in quantity-sensitive languages as well. We will see that it can, and that again the theory correctly generates both left- and right-aligning trochaic systems and excludes right-aligning iambic systems from the typology. Consider the following sequences of heavy and light syllables in a typical quantity-sensitive language where heavy syllables attract stress:

(37) a. ... (Ḣ)(Ḣ)(Ḣ) ...
b. . #LLL(Ḣ)... , ... (Ḣ)LLL#
c. ... (Ḣ)LLL(Ḣ) ....

In typical quantity-sensitive languages, sequences of heavy syllables as in a. form sequences of monosyllabic feet where no directionality effects are visible. Directionality effects will typically show up in sequences of light syllables, though. I will therefore concentrate on odd-numbered sequences of light syllables that occur close to a heavy syllable. Two contexts are logically possible: one where an odd-parity string of light syllables occurs between a heavy syllable and the (left or right) word-boundary, as in b. above, and one where the same string occurs between two heavy syllables, as in c.

In a quantity-sensitive language that parses trochaic feet we expect two possible parses for #LLLH ... strings:

(38) a. #(L̀L)L(Ḣ) → good left-alignment, lapse
b. #L(L̀L)(Ḣ) → bad left-alignment, no lapse

A language that parses feet as in a. will be a language that favors left-alignment over rhythmic wellformedness. In fact, although the foot built on the light syllables is left-aligned, the parse has created a stress lapse. The lapse can be avoided, as in b., if left-alignment is minimally violated. So far we have the same situation as in the case of quantity-insensitive systems with binary feet: ALLFTL ranked over *LAPSE generates a left-aligning systems, the opposite ranking generates a right-aligning system.

If we consider ... HLLL# sequences, the situation does not change much, we have again two main options for a trochaic parse:

(39) a. ... (Ḣ)(L̀L)L # → good left-alignment, lapse and clash
b. ... (Ḣ)L(L̀L)# → bad left-alignment, no lapse, no clash

The parse in a. is again the structure where left-alignment is more important than the constraints on rhythm. In this case the satisfaction of ALLFTL leads not only to a final stress lapse, but also to a clash between the heavy syllable and the following light one. Pattern b., as before, exemplifies the perfectly alternating parse, no clashes or lapses occur, but feet are right-aligned. The first, left-aligning parse will be generated by the ranking of ALLFTL over the rhythm constraints *CLASH and *LAPSE, while the perfectly rhythmical pattern b. is generated by *CLASH, *LAPSE >> ALLFTL.

In sequences where an odd-numbered string of syllables is embedded between two heavy ones the same two options are open again:

(40) a. ... (H̀)(L̀L)L(H̀) ... → good left-alignment, lapse and clash
b. ... (H̀)L(L̀L)(H̀) ... → bad left-alignment, no lapse, no clash

The pattern in a. will be that of a language satisfying ALLFTL at the cost of *CLASH and *LAPSE, while a language parsing a structure as in b. will satisfy the rhythmic wellformedness constraints at the cost of left-alignment.

In the following paragraphs I will discuss two examples, one of a left-aligning and one of a right-aligning quantity-sensitive trochaic language. Next, a language with "mixed" properties, i.e., a language whith both right- and left-alignment effects is presented. It will be shown that this "mixed" pattern is the result of a ranking where only one of the rhythm constraints dominates ALLFTL. Finally, I will conclude this section by showing that also among quantity-sensitive systems right-aligning iambic patterns are predicted not to exist.

Trochaic, quantity-sensitive languages that parse feet in a left-aligning fashion can be found among the dialects of Arabic. Thus, Hayes (1995) analyzes Cairene Arabic as parsing quantity-sensitive trochaic feet from left to right. Syllables containing a long vowel and syllables closed in a consonant count as heavy for stress. Parsing resumes right after a heavy syllable. Main stress - except for superheavy syllables, who attract main stress independently - is assigned to the righmost foot created by this parsing:

(41) Cairene Arabic: trochaic, quantity-sensitive, left-aligning system

a. šaǰarátuhu 'his tree (nom.)'
(L̀L)(ĹL)L

b. qattála 'he killed'
(H̀)(ĹL)

c. ʔadwiyatúhu 'his drugs (nom.)'
(H̀)(L̀L)(ĹL)

d. ʔinkásara 'it got broken'
(H̀)(ĹL)L

Note that there is no evidence for secondary *stress*, but unambiguous evidence for secondary stress *feet* stems from the fact that main stress is determined by their placement (see the analysis in Hayes 1995).[20]

The strictly left-aligning pattern is generated by the ranking ALLFTL >> *LAPSE, *CLASH, as exemplified for *ʔinkásara*:

[20] For the present proposal this means that - at least in certain languages - the constraints *LAPSE and *CLASH cannot refer to phonetically prominent syllables, but must target syllables that are prominent in a more abstract sense, e.g. by being the head of a foot (thanks to Eric Baković for having pointed out this problem).

Tableau 18: trochaic, quantity-sensitive, left-aligning parsing: Cairene Arabic

ʔinkasara	ALLFTL	*LAPSE	*CLASH
☞ (a) ʔinkásara (H̀)(ĹL)L	*	*	*
(b) ʔinkasára (H̀)L(ĹL)	**!		

Candidate a. wins over candidate b. because of its good left-alignment, although the first and the second syllable clash and the two final syllables create a stress lapse.

Leti is a trochaic language where quantity-sensitive feet are aligned to the right. Hume (1997, 1998) describes the stress pattern as follows: main stress falls on the penultimate syllable; secondary stress falls on alternating syllables preceding main stress; syllables with long vowels count as heavy and are always stressed.

(42) Leti: trochaic, quantity-sensitive, right-aligning system

a. pʷɔ̀rsayɔ́ra 'seaside gate'
(L̀L)(ĹL)

b. kavàlkivnútna 'iron frying pan'
L(L̀L)(ĹL)

c. mà:nʷorʸóri 'bird+buffalo=crow'
(H̀)L(ĹL)

d. rò:nénu 'they eat turtle'
(H̀)(ĹL)

e. mà:nʷá:na 'chick'
(H̀)(H́)L

Example a. shows us that Leti is a trochaic language and example b. that feet are right-aligned. Example c. has the same sequence of heavy and light syllables as *ʔinkásara* above, but this time the string of light syllables after the heavy one is parsed in a right-aligning fashion, avoiding both a stress lapse and a stress clash. Hence, the ranking of the two rhythm constraints with respect to ALLFTL will be reversed:[21]

Tableau 19: trochaic, quantity-sensitive, right-aligning parsing: Leti

	*LAPSE	*CLASH	ALLFTL
(a) mà:nʷórʸori (H̀)(ĹL)L	*	*	*
☞ (b) mà:nʷorʸóri (H̀)L(ĹL)			**!

We might ask what happens when only one of the two rhythm constraints dominates ALLFTL. A ranking of the type *LAPSE >> ALLFTL >> *CLASH will generate a pattern

[21] As can be deduced from example d. and e., clashes are not absolutely forbidden in Leti. Clashes are not generated to optimize left-alignment, but they occur to optimize other constraints, such as PARSEσ (in the case of d.) or the WSP (in the case of e.).

identical to the one of Leti. In fact, as long as *LAPSE dominates ALLFTL, we will get a right-aligning pattern, in order to avoid lapses in odd-numbered sequences of light-syllables.

The ranking *CLASH >> ALLFTL >> *LAPSE, on the other hand, generates a hybrid system not easily accounted for in traditional frameworks that don't make use of violable constraints. An example for such a language is Finnish. The following analysis of Finnish is based on Alber (1997) (see also Kager 1992a, b; if not otherwise noted the data is from Carlson 1978):

(43) a. ó.pet.tè.le.mà.na.ni[22] 'as something I have been learning'
(ĹH)(L̀L)(L̀L)L
b. vá.lis.tu.màt.to.mi.àn.ne 'your uneducated'
(Ĺ H)L(H̀)LL(H̀)L
c. táis.te.lè.van[23] 'fighting'
(H́)L(L̀L)
d. jä̋r.jes.tèl.mäl.li.sỳy.del.lä 'systematicity'
(H́)H(H̀)HL(H̀)HL

The basic stress pattern of Finnish is that of a left-aligning, trochaic language, as can be seen in example a., where all odd-numbered syllables are stressed. The ranking determining directionality should thus be ALLFTL >> *LAPSE: feet are left-aligned and the two final syllables in odd-numbered strings of light syllables (e.g. in a. above) are allowed to form a stress lapse. Main stress in Finnish falls on the first syllable, regardless of its weight. This leads to quantity-insensitive structures at the left edge of the word, where an initial light syllable is stressed even when it is followed by a second heavy syllable, which in principle should attract stress (examples a. and b.). Word-internally, however, quantity sensitivity emerges and all heavy syllables, i.e. all syllables containing long vowels and all closed syllables, are stressed, even if the alternating stress assignment is thus disrupted. In example b., for instance, the fourth, heavy syllable bears stress. This means that Finnish is not a language where left-alignment is optimized at any cost. Heavy syllables can lead to bad left-alignment because they must bear stress. There is one more context where feet are not aligned as much as possible to the left. These are contexts as in example c., where the second foot is not aligned as much to the left as it could be. The reason is that Finnish has a strong ban on stress clash. Stress clash is avoided under all circumstances, also in sequences where we have adjacent strings of heavy syllables (cf. d.). The ranking *CLASH >> ALLFTL >> *LAPSE correctly predicts these facts: we are dealing with a language that prefers left-alignment over satisfaction of *LAPSE, but not at the cost of generating a stress clash. The tableau illustrates this:

Tableau 20: hybrid trochaic, quantity-sensitive parsing

	*CLASH	ALLFTL	*LAPSE
(a) táis.tè.le.van (H́)(L̀L)L	*!	*	*
☞ (b) táis.te.lè.van (H́)L(L̀L)		**	

[22] Kiparsky (1991), as reported in Kager (1992a, b).
[23] Carlson notes that final heavy syllables are optionally light, i.e. there are two possible stress patterns for this example, one where the final syllable is considered as heavy, and therefore receives stress (*tái.ste.le.ván)*, and another one, where it is light, and therefore unstressed (*tái.ste.lè.van*). I will consider only this latter option here.

Candidate a. would display a good left-aligning parsing, as it is otherwise observed in the language. However, a. loses against b. since in this case left-alignment would lead to a stress clash. The result is a language that is of the left-aligning type, but, under the pressure of *CLASH, displays what would seem to be right-alignment.

Let us now repeat the reasoning for iambic patterns. Consider again strings where directionality effects are visible in adjacency to heavy syllables:

(44) a. #(LL̀)L(H̀) → good left-alignment, no lapse, no clash
b. #L(LL̀)(H̀) → bad left-alignment, lapse and clash

c. ... (H̀)(LL̀)L# → good left-alignment, no lapse, no clash
d. ... (H̀)L(LL̀) # → bad left-alignment, lapse

e. ... (H̀)(LL̀)L(H̀) ... → good left-alignment, no lapse, no clash
f. ... (H̀)L(LL̀)(H̀) ... → bad left-alignment, lapse and clash

In each context, the right-aligning parses b., d. and f. violate both left-alignment *and* at least one of the two rhythm constraints. The left-aligning parses a., c. and e., on the other hand, rate better both under ALLFTL *and* under *LAPSE and *CLASH. This means that as we have seen already in quantity-insensitive parsings, right-aligning iambs are bound to lose under any ranking. The proposed constraints effectively exclude a right-aligning iambic parsing from the typology also in the case of quantity-sensitive languages. The following tableau illustrates this for the three contexts:

Tableau 21

	*LAPSE	*CLASH	ALLFTL
☞ (a) #(LL̀)L(H̀)			***
(b) #L(LL̀)(H̀)	*	*	* ***
☞ (c) (H̀)(LL̀)L #			*
(d) (H̀)L(LL̀)	*		**
☞ (e) (H̀)(LL̀)L(H̀)			* ****
(f) (H̀)L(LL̀)(H̀)	*	*	** ****

No matter how we rank the above constraints, the right-aligning candidates b., d. and f. are bound to lose, since they are harmonically bounded by the winning, left-aligning candidates a., c. and e., respectively. In each case the left-aligning structure rates at least as well as the right-aligning structure on all three constraints and better on at least *LAPSE and ALLFTL.

In conclusion, the theory correctly predicts that the only attested quantity-sensitive iambic languages will be of the left-aligning type (for an example see St. Lawrence Island Yupik discussed in 10).

We have seen in this section that although heavy syllables disturb the strict alternation of stress in quantity-sensitive languages in the contexts where directionality effects are visible the same explanation holds as in quantity-insensitive systems. In trochaic systems, when ALLFTL outranks the constraints on rhythmic wellformedness a left-aligning system is generated, with the opposite ranking a right-aligning language results. Moreover, we have seen that under a "mixed" ranking of the type *CLASH >> ALLFTL >> *LAPSE we get the hybrid system of Finnish, with basic left-alignment, but some right-alignment effects in contexts where a clash could arise. Finally, it has been demonstrated that left-alignment is the only option available for iambic systems. Right-aligning quantity-sensitive iambic parses violate both ALLFTL and at least one of the two rhythm constraints.

4. Previous approaches

The first in-depth analysis of the typological asymmetry in directional foot-parsing has been presented by René Kager in his 1993 article, even though, under his approach, right-aligning iambic systems are not excluded altogether, but only highly marked. Kager's approach to foot parsing is largely derivational, but by introducing filters on stress clashes and stress lapses he anticipates already the important role that rhythm constraints play in later accounts. Subsequent explanations for the typological gap were elaborated by van de Vijver (1998), Kager (2000, 2001), Hyde (2002) and Gordon (2002). For reasons of space I will not present a detailed discussion of each of these accounts, but limit myself to considering in detail Kager's (2000, 2001) proposal, since it is the one that most closely resembles the proposal in this paper. I will discuss along more general lines the accounts of van de Vijver (1998), Hyde (2002) and Gordon (2002).

In his dissertation, Ruben van de Vijver (1998) proposes an analysis based on violable constraints to account for the non-existence of right-aligning iambic systems. The main goal of his thesis is to show that iambic feet are not a primitive of metrical structure, but the result of constraint interaction. Van de Vijver proposes two constraints, TROCHEE, which requires feet to be left-headed and *EDGEMOST, a constraint that militates against stress on initial and final syllables. When TROCHEE outranks *EDGEMOST a trochaic parsing is generated, as in a. below. When *EDGEMOST outranks TROCHEE, we get an iambic parsing, as in b:

(45) a. (σ̀σ)(σ̀σ)σ TROCHEE >> *EDGEMOST
b. (σσ̀)(σσ̀)σ *EDGEMOST >> TROCHEE

In a. all feet are trochaic, but stress falls on an edgemost (the first) syllable. This is avoided under the iambic parsing in b. The non-existence of right-aligning iambs is explained by the fact that right-aligning iambs would violate both constraints:

(46) σ(σσ̀)(σσ̀) violates both *EDGEMOST and TROCHEE

Under this perspective, iambic parsing in even-numbered strings of syllables becomes something highly marked, since also this parsing violates both constraints:

(47) (σσ̀)(σσ̀) violates both *EDGEMOST and TROCHEE

In fact, van de Vijver maintains that languages that parse in an iambic fashion often avoid stress on the final syllable. He analyzes several languages where this is indeed the case and, more interestingly, also several languages that do have final stress, but where this final stress can be attributed to the influence of a third, independent constraint. For instance, there are iambic languages such as Creek where main stress is on the rightmost foot, and thus it is the constraint RIGHTMOST that forces main stress onto the last syllable in even-numbered strings of syllables. Since iambic parsing, under this approach, is the direct consequence of avoiding edgemost stress it is therefore crucial that final stress in iambic systems can be attributed to some constraint other than those that determine the basic typology of rhythm.

It is not clear, however, whether iambic parsing with final stress can always be attributed to additional factors. Take, for instance, the basic stress assignment in Araucanian (Echeverria and Contreras 1965):

(48) a. wulé 'tomorrow'
(σσ́)
b. tipánto 'year'
(σσ́)σ
c. elúmuyù 'give us'
(σσ́)(σσ̀)
d. elúaènew 'he will give me'
(σσ́)(σσ̀)σ
e. kimúfalùwulày 'he pretended not to know'
(σσ́)(σσ̀)(σσ̀)

Main stress in Araucanian is leftmost, so this cannot be the reason for final stress in even-parity strings. Moreover, secondary stress falls on the final syllable only in even strings of syllables, so lexically determined final stress seems to be excluded as well, since in that case stress should be consistently final.

There is yet another problem with van de Vijvers proposal. His theory predicts unattested stress systems when *EDGEMOST and TROCHEE both satisfy their requirements at the cost of other, lower ranked constraints. The following tableau shows what happens in even-numbered strings of syllables, when both constraints outrank the constraints PARSEσ and ALLFTL:

Tableau 22

			*EDGEMOST	TROCHEE	PARSEσ	ALLFTL
	(a)	σσ(σ̀σ)(σ̀σ)			**	** ***!*
☞	(b)	σ(σ̀σ)(σ̀σ)σ			**	* ***
	(c)	(σσ̀)(σσ̀)σσ		*!*	**	**
	(d)	(σσ̀)(σσ̀)(σσ̀)	*!			** ****
	(e)	(σ̀σ)(σ̀σ)(σ̀σ)	*!			** ****

Only the first three candidates obey high-ranked *EDGEMOST and of those, only the first two pass TROCHEE. They pay satisfaction of the two high-ranked constraints with two PARSEσ violations, but since this constraint is low ranked, the violations do not have any effect. ALLFTL decides between the first two candidates and b. wins because of its smaller number of left-alignment violations. Nevertheless, a parsing as in b., with stress "retracting" from both edges, to my knowledge, is not attested among the world's languages. In other words, in addition to left-aligning iambic structures, there is another parsing that satisfies both TROCHEE and *EDGEMOST: a trochaic parsing where only the middle portion of the string is footed. But rhythmic footing, as far as we know, always "starts" at an edge. It thus seems that interpreting iambic parsing as a strategy to avoid edgemost stress is not without problems.

In two handouts of talks, Kager (2000, 2001) develops a theory of asymmetrical directionality in foot parsing that is very similar to the one proposed in this paper. The explanation for the absence of right-aligning iambic systems and the absence of initial dactyl systems, as in the present proposal, is based on rhythm constraints against stress lapses and stress clashes. The main difference is that Kager's constraints are in part positional licensing constraints. This fact makes a comparison between the two approaches particularly interesting, since it gives us the opportunity to test the different predictions that analyses in terms of markedness constraints and analyses in terms of licensing constraints make in general.

Kager observes that in systems that parse binary feet lapses occurring at the end of the word and lapses occurring close to the main stress are more tolerable than lapses that occur in other contexts. Hence, he proposes two positional licensing constraints that restrict the contexts in which lapses can occur and a context-free markedness constraint against lapses in general. LAPSE-AT-PEAK requires lapses to occur close to a main stress, LAPSE-AT-END requires them to be final and *LAPSE militates against lapses in general:

(49) LAPSE-AT-PEAK: a lapse must be adjacent to the peak
LAPSE-AT-END: a lapse must be adjacent to the right edge
*LAPSE: no two adjacent unstressed syllables

One of the interesting facts about Kager's proposal is that these constraints alone are enough to generate directionality effects - the theory does not need any alignment constraints like ALLFTL or ALLFTR. Thus, violations of constraints can be counted very locally, no distances to edges are "measured" in syllables.

Let us now see how the different typologies of stress systems are generated. The three constraints concerning lapses are fully satisfied in structures where no lapses occur at all, i.e. in even- numbered strings of syllables in general and in the following parsings of odd-numbered strings:

(50) a. Right-aligning trochaic system:
σ(σ̀σ)(σ̀σ)(σ̀σ)

b. Left-aligning iambic system:
(σσ̀)(σσ̀)(σσ̀)σ

The third attested binary pattern are left-aligning trochaic parses:

(51) Left-aligning trochaic system:
(σ̀σ)(σ̀σ)(σ̀<u>σ)σ</u>

This parsing, attested e.g. in Pintupi, (cf. 8), requires some additional constraint that triggers the generation of the final stress lapse. In languages where main stress is initial, this constraint is LEFTMOST. If LEFTMOST is high-ranked, the perfectly rhythmical right-aligning parse in (50) is no option, since the left-aligning trochaic system in (51) allows for better satisfaction of the requirement to assign main stress initially.

The interaction between LAPSE-AT-END and LAPSE-AT-PEAK is crucial at this point. When LAPSE-AT-END dominates LAPSE-AT-PEAK, this ranking guarantees that the lapse that is created will necessarily occur at the end of the word. When LAPSE-AT-PEAK dominates LAPSE-AT-END, the lapse will occur close to the main stress as e.g. in the pattern supposedly displayed by Garrwa: [24]

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[24] Note that Kager's analysis for Garrwa, should this language really display the initial dactyl pattern, is similar to the one proposed in this paper: the lapse between the second and the third syllable is tolerated because it occurs close to the main stress.

(52) Left-aligning trochaic systems with leftmost main stress:

a. (σ́σ)(σ̀σ)(σ̀σ)σ → LAPSE-AT-END >> LAPSE-AT-PEAK

b. (σ́σ)σ(σ̀σ)(σ̀σ) → LAPSE-AT-PEAK >> LAPSE-AT-END

In other words, left-alignment in trochaic parsings is due to a requirement of initial stress. Whenever the first syllable has to be stressed, a lapse is inevitable in an odd-numbered string of syllables parsed in a trochaic fashion. The only open option is as to where this lapse might occur. This issue is settled by the respective ranking of LAPSE-AT-END and LAPSE-AT-PEAK.

However, there are also trochaic languages of the left-aligning type such as Cairene Arabic, where main stress is assigned to the rightmost foot created by secondary stress parsing:

(53) Left-aligning trochaic system with rightmost main stress:

(σ̀σ)(σ̀σ)(σ́σ)σ

Here, left-alignment cannot be explained by a requirement of initial main stress. To explain left-alignment in these cases, Kager resorts to the constraint ALIGN-L, requiring the word to begin with a foot. ALIGN-L, like LEFTMOST in the examples above, leads to the creation of a lapse.

Thus, right-aligning trochaic systems and left-aligning iambic systems are the result of high-ranking constraints against lapses, in a very similar way as proposed in the present paper. Left-alignment in trochaic systems, on the other hand, is seen as being triggered by constraints demanding initial stress combined with the requirement that lapses be licensed.

Crucially, an account in these terms can exclude the non attested right-aligning iambic system:

(54) Right-aligning iambic system:

σ(σσ̀)(σσ̀)(σσ̀)

A parsing of this type cannot be generated with the constraints discused so far since it is bound to lose against competing candidates. If main stress is leftmost in the language at stake, a parsing wihout lapses is possible and hence optimal:

(55) Iambic system with leftmost main stress:

(σσ́)(σσ̀)(σσ̀)σ

If main stress is rightmost, there are two possibilities. If RIGHTMOST has to be satisfied fully because it is high-ranked, we will get the following parsing:

(56) Iambic system with rightmost main stress: RIGHTMOST satisfied fully

(σσ̀)(σσ̀)σ(σσ́)

This parsing violates *LAPSE and LAPSE-AT-END, but it satisfies LAPSE-AT-PEAK and this makes it win over the right-aligning parse in example (54), which would violate both licensing constraints: the occurring lapse is neither final nor close to the main stress.

If RIGHTMOST is ranked below LAPSE-AT-END we will get a parsing where main stress is placed as much as possible to the right, but only in such a way that a non-final lapse, as in

(56) is avoided. The result is again a left-aligning iambic system. The right-aligning iambic system as in (54) is no serious competitor, because of its unlicensed lapse.

(57) Iambic system with rightmost main stress: RIGHTMOST minimally violated, no lapse
(σσ̀)(σσ̀)(σσ́)σ

Kager uses a similar approach to the typological gap in systems that allow for degenerate feet. Similarly to the proposal here, the crucial constraints involved are constraints concerning stress clashes. In Kager's account, there is a context-free constraint against stress clashes as well as two licensing constraints, one requiring clashes to occur at the left edge of the prosodic word and another one requring clashes not to involve main stress peaks.

Perhaps the most interesting predictions of Kager's theory are obtained with respect to bidirectional systems, where main stress is assigned close to one edge of the prosodic word and secondary stress "drifts" towards the other edge. Take, for example, trochaic systems with leftmost main stress, as just discussed in (52). When LAPSE-AT-PEAK outranks LAPSE-AT-END a bidirectional system with an isolated main stress foot at the left edge results. A bidirectional trochaic system with rightmost main stress, as attested for Piro (see 26a), can be generated as well:

(58) Bidirectional trochaic system with rightmost main stress:
(σ̀σ)(σ̀<u>σ)σ</u>(σ́σ) → RIGHTMOST >> LAPSE-AT-END

Assuming that stress is "fixed" on the first syllable by high ranked ALIGN-L, also in this case a lapse is unavoidable. Furthermore, if RIGHTMOST dominates LAPSE-AT-END the lapse will be placed close to the main stress, so that the parsing at least satisfies LAPSE-AT-PEAK.

In essence, bidirectional systems can be generated when a lapse is unavoidable and LAPSE-AT-END is violated at the cost of some higher ranked constraint (LAPSE-AT-PEAK or RIGHTMOST). The resulting systems all have the stress lapse occurring close to the main stress because of the influence of LAPSE-AT-PEAK. Kager's theory thus captures in an elegant way the generalization that the lapses that can be observed in bidirectional systems always occur close to the main stress. What is not possible - and, in fact, is not attested - is a system where medial lapses occur between secondary stress feet, as in the following examples:

(59) (σ̀<u>σ)σ</u>(σ̀σ)(σ́σ)
(σ́σ)(σ̀<u>σ)σ</u>(σ̀σ)

Whenever a lapse is necessary and whenever for some reason it cannot be realized finally, it will be realized close to the main stress, thus satisfying at least LAPSE-AT-PEAK.

Note that with the constraints that we have seen so far, Kager predicts exactly the same metrical systems that our proposal predicts - maybe with the additional advantage that a system such as Garrwa falls out from the core of the theory without further assumptions.

There are two types of problems that I want to address regarding this approach to directionality in terms of positional licensing. The first concerns the consequences that abandoning constraints such as ALLFTL has for the analysis of quantity-sensitive systems. The second problem regards a characteristic of optimality-theoretic analyses of licensing in general: they predict that one possible repair strategy for not wellformed structures is to attract the licensor to the licensee, a strategy that is not borne out in all cases.

As we have seen in the previous section, directionality effects are observable also in quantity-sensitive languages, for instance in sequences of light syllables between heavy syllables:

(60) Left-aligning, trochaic, quantity-sensitive parsing:

a. ... (H̀)(L̀L)L(H̀)....

Right-aligning, trochaic, quantity-sensitive parsing

b. ... (H̀)L(L̀L)(H̀) ....

In Kager's theory, left-aligning trochaic systems are generated by some requirement of initial stress triggered either by LEFTMOST or by by ALIGN-L. The resulting language aligns feet to the left so that the unavoidable stress lapse occurs at the end of the word. In quantity-sensitive systems, however, it is not clear which constraint can force alignment of all feet to the left. Without further assumptions, it is not clear why the parsing in a., above, should ever be preferred over the parsing in b. A requirement for initial stress, as in quantity-insensitive languages, is not enough to force parsing to resume right after the heavy syllable. On the contrary, the parsing in a. is disfavored with respect to b. because of its clash and lapse. However, systems of this type are attested, e.g. in Cairene Arabic (cf. discussion above). One might think that this problem could be solved through integration of constraints targeting foot structure into the theory. Thus, if we add to the set of constraints a constraint against uneven trochees, for short *(HL), we might analyze parsings as in a. as attempts to avoid an alternative parse such as ... (H̀L)(L̀L)(H̀) ... where the heavy syllable and the following light syllable together are parsed into a foot. A solution of this type is in fact adopted by Hyde (2002), whose theory needs an integration for quantity-sensitive systems as well.[25] However, there are contexts in quantity-sensitive systems where left-alignment of feet cannot be explained readily with the requirements of foot-structure. Estonian (Hint 1973, Prince 1980, Kager 1994, Hayes 1995, Alber 1997) is a left-aligning, quantity-sensitive language where the requirement that heavy syllables be stressed is obscured in many contexts by the requirements of other constraints. Estonian must be a quantity-sensitive language since in words with an odd number of syllables where the last syllable is heavy we see that this heavy syllable is parsed into a foot of its own:

(61) ká.va.làtt 'cunning, part.sg.'

(ĹL)(H̀)

One of the constraints that can obscure weight-sensitivity is ALLFTL:

(62) pí.mes.tà.vas.se 'blinding, ill. sg.'

(ĹH)(L̀H)L

The fourth syllable in this example should in principle attract stress, similarly to the final heavy syllable in the previous example. However, it does not, since placing stress on the preceding light syllable allows to optimize left-alignment. Thus, a constraint such as ALLFTL can actually *lead* to the creation of an uneven (L̀H) trochee. We have therefore found a case where left-alignment of feet in a quantity-sensitive system cannot be triggered by wellformedness constraints regarding foot-structure. It is difficult to see how a theory that excludes constraints such as ALLFTL can explain the tendency of feet to be aligned to the left

[25] This type of solution is clearly inspired by the analysis of Cairene Arabic in Hayes (1995). The point of Hayes' analysis is explicitly to show that ('HL) trochees do not exist.

in these cases.[26]

The second problem I will discuss concerns a specific characteristic of analyses in terms of licensing in optimality theory. A constraint C that requires the element x to be licensed "close to" a licensor y can be satisfied in various ways:

- x may not occur at all: C is satisfied vacuously
- x may occur "close to" y: x is licensed, C is satisfied
- y may be moved "close to" x: x "attracts" the licensor and thus is licensed, C is satisfied

Kager's analysis deals in detail with the first two cases. Firstly, perfectly rhythmical systems that do not have lapses will vacuously satisfy LAPSE-AT-PEAK and LAPSE-AT-END and Kager correctly predicts that the licensing constraints have no influence on these systems, which are generated under the influence of a context free *LAPSE constraint. Secondly, whenever a lapse will occur for some independent reason the licensing constraints see to it that the offending structure is placed close to a licensor, that is, close to main stress or at the end of the word. Let us now explore the third option, which will prove to be problematic. Take a trochaic language with the following ranking:

(63) ALIGN-L >> LAPSE-AT-END >> LAPSE-AT-PEAK >> LEFTMOST

This is a ranking where the first syllable is stressed and, moreover, the licensing constraints on stresses are rather powerful and can be satisfied even at the cost of the constraint regulating main stress assignment. In an odd-numbered string of syllables they will generate the following pattern:

Tableau 23: attraction of the licensor in odd-numbered strings

	ALIGN-L	LAPSE-AT-END	LAPSE-AT-PEAK	LEFTMOST
☞ (a) (σ̀σ)(σ̀σ)(σ́σ)σ				****
(b) (σ́σ)(σ̀σ)(σ̀σ)σ			*!	
(c) (σ́σ)σ(σ̀σ)(σ̀σ)		*!		
(d) σ(σ́σ)(σ̀σ)(σ̀σ)	*!			*

Under the high ranking of ALIGN-L a lapse is unavoidable in this string. Candidate d., which would vacuously fulfill the licensing constraints is no option since the first foot is not aligned to the left. The winning candidate a. is a parsing where the offending lapse is placed at the end, satisfying LAPSE-AT-END. The structure in a. satisfies LAPSE-AT-PEAK as well and thus wins over candidate b., where the lapse is final, but not close to the main stress. Satisfaction of LAPSE-AT-PEAK is obtained through attraction of the licensor - main stress is moved close to the final lapse. Low-ranked LEFTMOST pays the cost: the candidates b. and c., with initial main stress, cannot win since in this case at least one of the licensing constraints would be violated. So far the pattern that is generated by this ranking is plausible. It could be the pattern of a left-aligning trochaic language where the position of main stress is computed on secondary stress parsing, as e.g. in Cairene Arabic. However, the pattern changes in a suprising way when we apply the same ranking to even-numbered strings of syllables:

[26] Note that stress on the third, light syllable cannot be explained by the presssure of the constraint PARSEσ, since the quantity sensitive parsing (LH)L(HL) would rate equally well on this constraint.

Tableau 24: no attraction of the licensor in even-numbered strings

	ALIGN-L	LAPSE-AT-END	LAPSE-AT-PEAK	LEFTMOST
(a) (σ̀σ)(σ̀σ)(σ́σ)				****!
☞ (b) (σ́σ)(σ̀σ)(σ̀σ)				

In even-numbered strings no lapses occur, hence the licensing constraints are fulfilled vacuously. The decision passes to the lower ranked constraint LEFTMOST, which will decide to assign main stress to the first syllable of the word. We thus have a rather odd system where main stress is attracted to the right edge of words in strings with an odd number of syllables while it is leftmost in even numbered strings. Systems of this type most probably do not occur.

I conclude that even though an approach in terms of licensing is promising, because, for instance, it can generate directionality effects without making use of alignment constraints, caution is in order with respect to the "licensor-attracting" structures it predicts to exist. Structures where the licensee attracts the licensor may occur in natural language,[27] but they generate unattested systems in this case.

The most recent analysis of the problem of asymmetrical directionality can be found in Brett Hyde's (2002) dissertation. It is difficult to compare Hyde's analysis to the one proposed here, or to the ones discussed above, because the treatment of the directionality problem is only one aspect of a general theory of stress developed in a thesis which makes very different assumptions from the theories discussed so far. In particular, Hyde assumes that feet can intersect, that is, that one syllable can simultaneously be part of two feet. Moreover, he assumes that there is no one-to-one correspondence between feet and stress, foot-structure being, to some extent, independent from the structure of the metrical grid. As to the principles that determine rhythm, they fall into two categories, unviolable conditions on the one hand, and violable constraints on the other. One of the unviolable conditions, for instance, is that of "Strict Succession", requiring all syllables to be exhaustively parsed into feet, an assumption that is in line with earlier theories of stress (e.g. Halle and Vergnaud 1987). The concepts of stress clash and stress lapse play a prominent role in this theory as well, but, differently from the present proposal, *LAPSE is considered to be an unviolable condition requiring alternation of foot-heads, while *CLASH is a violable constraint requiring alternation of grid-marks.

For reasons of space it is not possible to discuss in detail these assumptions and their consequences on metrical theory here. I will therefore summarize Hyde's approach to the directionality problem in very general terms and point out a problem regarding the predictions that the theory makes with respect to bidirectional systems.

Hyde distinguishes between stress patterns that conform to the *perfect grid*, in the sense of Prince (1983), and patterns that depart from perfectly alternating rhythm. Casting his distinction in the terminology and foot structure used in this paper, we will have the following two sets of patterns:

(64) Systems with perfect alternation: no lapses, no clashes
  a. Trochaic systems, binary, right-aligning:
     σ(σ̀σ)(σ̀σ)
  b. Iambic system, binary, left-aligning :
     (σσ̀)(σσ̀)σ

[27] Consider suffixes requiring to be aligned to a stressed syllable, such as English *-ic*, which triggers stress shift in the stem (e.g. *cháos - chaótic*). In this case the licensor (main stress) moves to the licensee (the suffix).

c. Trochaic system with degenerate feet, right-aligning:
(σ̀σ)(σ̀σ)(σ̀)

d. Iambic systems with degenerate feet, left-aligning:
(σ̀)(σσ̀)(σσ̀)

Systems departing from perfect rhythm:

e. Trochaic system, binary, left-aligning: final lapses
(σ̀σ)(σ̀σ)σ

f. Trochaic system with degenerate feet, left-aligning: initial clashes
(σ̀)(σ̀σ)(σ̀σ)

g. Iambic system, binary, right-aligning: initial lapses (not attested)
σ(σσ̀)(σσ̀)

h. Iambic system with degenerate feet, right-aligning: final clashes (not attested)
(σσ̀)(σσ̀)(σ̀)

Hyde first derives the patterns which conform to the perfect grid with the help of constraints referring to the alignment of foot-heads with the prosodic word edges. The stress patterns in (64) e. and f., which are not perfectly rhythmical, are the result of the interference of asymmetrical constraints with these alignment constraints. Thus, binary, left-aligning, trochaic systems as in (64e) are conceived as being basically a variety of the right-aligning trochaic systems with degenerate feet in (64c). The only difference with respect to these systems is, that in patterns such as (64e) we see the influence of high-ranked NONFINALITY, militating against final stress. In Hyde's representation, these are systems where the last foot-head lacks a grid mark:[28]

(65)
```
x     x     x
σ  σ  σ  σ  σ  σ  σ
|  /  |  /  |  /  |
```

Left-aligning trochaic systems with degenerate feet, as in (64f), are considered to be a variation of right-aligning trochaic systems with binary feet (64a). They display the same distribution of stress as right-aligning, binary trochees, with the difference that the initial syllable is stressed. This stress, according to Hyde, is due to the constraint INITIAL GRIDMARK, requiring the first syllable to be stressed.

The reason, why (64g), the binary, right-aligning, iambic system, does not exist is that there is no mirror-image constraint to NONFINALITY, requiring *initial* syllables not to be stressed. The reason why (64h), the right-aligning iambic system with degenerate feet, does not exist is due to the fact that there is no equivalent to INITIAL GRIDMARK requiring *final* syllables to be stressed. In this sense, Hyde's account is similar to the one presented in this paper, where it is proposed that ALLFTL lacks its mirror image constraint ALLFTR.

With the same set of constraints Hyde derives also the bidirectional systems of Piro and Garrwa. The stress pattern of Piro, for instance, is seen as a variation of the pattern of right-aligning trochaic systems with degenerate feet (64c):

[28] Remember that under Hyde's approach foot-structure is distinct from grid-structure. The grid-structure is represented in the top layer with "x"s, the foot-structure is given in the bottom layer, where vertical lines "|" indicate foot-heads.

(66)
```
x     x       x
σ σ σ σ σ σ σ
| /   |/    |/|/
```

As in the case of left-aligning binary trochee systems, this pattern is interpreted as being generated under the pressure of NONFINALITY. But while in the case of (65), the absence of final stress was obtained at the cost of leaving the final foot-head without a grid-mark, in this case NONFINALITY is obeyed at the cost of worse right-alignment of foot-heads (the last foot-head is further away from the right word edge than in 65). The derivation of the pattern of Garrwa follows a similar reasoning, with the difference that the crucial constraints in generating this pattern is INITIAL GRIDMARK.

What at a first glance looks as an advantage of theory, turns out to be a problem. In Hyde's theory, bidirectional systems are generated by the very same constraints that generate the basic patterns of secondary stress rhythm. The requirements of main stress placement do not influence the generation of these patterns. However, it seems to be the case that the bidirectional systems we know of are all systems where the foot that is isolated at the word-edge bears main stress (see Kager 1991b, 2000, 2001 and the discussion above). Patterns like that of Piro, but where a secondary stress foot is parsed alone at one edge and main stress is assigned to the other edge do not seem to exist:

(67) (σ́σ)(σ̀σ)σ(σ̀σ)

This fact is left unaccounted for in Hyde's theory, in contrast to the proposal made in this paper and to the approach offered in Kager (2000, 2001). Since bidirectional systems are generated by the very same constraints that generate all the attested secondary stress patterns, we would expect that bidirectional patterns with isolated secondary stress feet should occur without problems.

Gordon's (2002) main goal is to propose a set of metrical constraints that can generate attested single stress and dual stress systems as well as systems with binary and ternary rhythm. He does not discuss in much detail the problem of the typological gap, but his analysis can account for at least part of the gap, that is the absence of right-aligning, binary iambs. Gordon's analysis again is based on very different assumptions from those in this paper, since his analysis is based entirely on the metrical grid and does not make use of metrical feet. Nevertheless, there are also many similarities to the accounts discussed so far. Thus, anti-clash and anti-lapse constraints play a major role in this proposal as well. In particular, Gordon assumes that binary systems and systems allowing for degenerate feet are the direct result of the two high-ranking rhythm constraints, *LAPSE and *CLASH . Both rhythm constraints militate for strictly alternating rhythm and thus do the work that traditionally is done by such constraints as PARSEσ and FT-BIN in generating patterns with binary feet or systems that parse both binary and degenerate feet. PARSEσ and FT-BIN do not play any role in his approach.

Gordon derives the perfectly rhythmical systems in (64 a-d) with high-ranked *LAPSE and *CLASH and various lower-ranked alignment constraints, which decide on the exact placement (i.e., directionality) of stress. For left-aligning, binary trochaic systems (64e), which depart from perfect rhythm, he proposes a similar solution as Hyde (2002): the system is generated by high-ranked NONFINALITY, at the cost of *LAPSE. Similarly to Hyde he concludes that right-aligning, binary iambic systems (64g) do not exist because there is no constraint requiring *initial* syllables not to be stressed. As for the left-aligning trochaic systems with degenerate feet (64f), they are generated under the influence of a ranking with high-ranked NONFINALITY and *LAPSE, combined with a relatively high ranking of a constraint requiring edgemost syllables to be stressed and a low ranking of *CLASH. This leads to stress on the two initial syllables in odd-parity strings.

The most interesting part of Gordon's paper concerns the factorial typology of the proposed constraint set. The author lists all the stress patterns generated by all the possible rankings of *CLASH, *LAPSE, NONFINALITY and the various alignment constraints that he proposes. But this is also the point where the major shortcomings of the proposal emerge. Of the 23 stress systems resulting from the factorial typology only 12 are attested, i.e., the system shows a high degree of overgeneration. Among the non-attested but predicted patterns there are also right-aligning iambic systems allowing for degenerate feet (64h), which have been claimed not to exist in the proposals discussed so far.[29] Moreover, the typology predicts bidirectional systems where the isolated foot at one edge bears secondary stress. Thus, Gordon's analysis runs into the same problems as Hyde's account, since such systems do not seem to exist.

A problem of another type arises through the substitution of PARSEσ with *LAPSE. In principle, a high-ranked *LAPSE constraint has the same effects as PARSEσ in quantity-insensitive languages. However, it fails to generate the same systems as PARSEσ in quantity-sensitive languages. Take for instance a string of heavy and light syllables such as ... HLLLH ... In order to have a binary parsing at all in a system like Gordon's, *LAPSE must dominate the alignment constraints responsible for directionality, such as ALLFTL and ALLFTR,[30] since otherwise a single foot at one word edge would be parsed. However, if *LAPSE dominates ALLFTL, no quantity-sensitive, left-aligning parsing could ever be generated in the above-mentioned string, since the right-aligning parse would always rate better in the ranking *LAPSE >> ALLFTL:

Tableau 25: left-aligning trochaic system

	*LAPSE	ALLFTL
☞ (a) ... (H̀)(L̀L)L(H̀) ...	*!	* ****
(b) ... (H̀)L(L̀L)(H̀) ...		** ****

5. Further issues: the unification of *LAPSE and *CLASH

In the account to directionality presented in this paper I have claimed that directionality effects can be analyzed as the result of the constraints ALLFTL, *LAPSE and *CLASH. It was also claimed that the constraint ALLFTR is not part of the set of metrical constraints. If it is possible to obtain the attested patterns with fewer constraints, the move to eliminate a constraint from the set of possible constraints should be seen as an advantage, this being the more restrictive choice of analysis. Fewer constraints mean fewer possible grammars generated by the factorial typology, hence more predictive power.
In this light it is worthwhile exploring the question whether it is possible to restrict the set of metrical constraints even further. We might e.g. ask, whether it is possible to unify the two rhyhthm constraints *LAPSE and *CLASH into one single constraint requiring perfectly rhythmical alternation:

[29] Gordon mentions that Central Alaskan Yupik displays a pattern of this type. But Miyaoka (1985) describes the accent on final, posttonic light syllables in this language as a preboundary accent, which arises only in very specific phonological and morphological contexts. Miyaoka proposes to distinguish this accent from regular rhythmical stress also because it often lacks iambic lengthening, which is characteristic for rhythmically stressed syllbables.
[30] In Gordon's system these constraints don't refer to feet, but to grid-marks, but this is irrelevant for the argument.

(68) *EQUAL PROMINENCE: rhythm is alternating: no two adjacent syllables of equal prominence.

*EQUAL PROMINENCE (*EP, for short) combines the forces of *LAPSE and *CLASH, it militates both against sequences of unstressed and sequences of stressed syllables.

In this section I will discuss this possibility and reject it on the basis of its wrong empirical predictions.

Note that the fact that there are languages that allow for lapses but not for clashes (or vice versa), is not in itself a counterargument to the unification of the two rhythm constraints. Take, for instance, Estonian. Estonian is a left-aligning trochaic language which therefore will have stress lapses in odd-numbered sequences of light syllables, as in example a. below. However, Estonian is also a language that has a very strong ban against stress clashes, as we can see in b., where sequences of heavy syllables are stressed in an alternating fashion:

(69)	a.	pí.mes.tà.va.le (ĹH)(ȽL)L	'blinding, ill. sg.' (Hint 1973, reported in Prince 1980)
	b.	´γp.pet.tà.yat.tèks (H́H)(ȽH)(H̀)	'teacher, transl.pl.' (Hint 1973, quoted in Hayes 1995, glosses are my own)

At a first glance it would seem that we need two constraints, one against lapses, which is violated, and one against clashes, which is not violated in this language. But suppose we try to use only the constraint *EP. We could then say that since clashes are forbidden, this constraint will dominate ALLFTL and thus a parsing as in b. is preferred, where two heavy syllables are parsed into one foot, instead of parsing all heavy syllables into feet of their own. Since *EP dominates ALLFTL we would expect the language to be of the right-aligning type, under a dominant *EP, lapses should be disallowed as well as clashes. However, there is yet another possibility that we have to take into account: it could be that, in general, *EP shows its force at the expense of ALLFTL, but that there is a *third* constraint, which can trigger *EP violations in certain contexts. It is not difficult to find such a constraint in Estonian. Main stress in this language is assigned consistently to the first syllable of the word, i.e., LEFTMOST must be high-ranked in the Estonian grammar. If we add LEFTMOST to the picture, we see that the influence of *EP notwithstanding, arhythmical sequences are generated in odd-numbered sequences of light syllables.

Tableau 26: Estonian: lapses, but no clashes

	LEFTMOST	*EP	ALLFTL
☞ (a) (H́H)(L̀H)(H̀)			** ****
(b) (H́)(H̀L)(H̀L)		*!	* ***
☞ (c) (ĹL)(L̀L)L		*	**
(d) L(L̀L)(L̀L)	*!		***
(e) (ĹL)L(L̀L)		*	***!

The tableau shows us that in sequences of heavy syllables *EP can show its force, preferring the badly left-aligned candidate a. over b., since the latter one displays a stress clash between the first two syllables. However, in strings consisting of light syllables, the avoidance of a lapse, as in candidate d., is not possible, since then it would not be possible to assign main stress to the leftmost syllable. Thus, a grammar as that of Estonian, with the possibility of lapses, but the impossibility of clashes, can be generated even if we do not have two distinct constraints *LAPSE and *CLASH. [31]

To find evidence for the existence of two separate rhythm constraints *LAPSE and *CLASH we must therefore find contexts where the two constraints are in competition with each other *and* where we can arguably exclude the influence of a third constraint. Take, for instance, a context, where *EP cannot distinguish between two competing structures, such as a string where two heavy syllables are followed by a light one:

(70) a. (H́)(H̀)L → *EP: * *LAPSE: √ *CLASH: * WSP: √ ALLFTL: *
b. (H́)HL → *EP: * *LAPSE: * *CLASH: √ WSP: * ALLFTL: √

Under a trochaic parsing there are two possibilities for an HHL string to be parsed into binary feet:[32] one as in a., where placement of stress on both heavy syllables leads to a stress clash and b., where underparsing of the last two syllables leads to a stress lapse. *EP cannot distinguish between the two candidates, but *LAPSE and *CLASH can. If we find a language where the distinction between two candidates of this type is relevant, we can conclude that the ranking of *LAPSE with respect to *CLASH is relevant and hence their existence is proved. We have, though, to be careful that the competition between the two candidates is not decided by some third constraint. In fact, also the weight-to-stress principle (WSP), requiring heavy syllables to be stressed, can decide between the two competitors, preferring a., where each heavy syllable is stressed. The constraint ALLFTL, on the other hand, would choose b., since this structure has only one foot and therefore will collect less ALLFTL violations than the parsing in a.

We find structures of this type in Standard Colloquial Bangla (Mitra and Das 2000). In Standard Colloquial Bangla, main stress is assigned to the first syllable of the word, unless the second syllable is heavy, in this case main stress is assigned to the second syllable, provided it is not the final one (cf. a., b., c. below). There is no contrastive vowel length in Bangla, the only syllables that count as heavy are those closed in a consonant. Secondary stress is assigned in an alternating fashion to odd-numbered light syllables, counting from the left, provided no clash with a preceding or following stressed syllable arises (cf. d., e., f.). Heavy syllables attract stress and interrupt the alternating stress of light syllable sequences. However, heavy syllables only bear secondary stress if they are not preceded by a stressed syllable (cf. f., g., h.):

(71) Standard Colloquial Bangla:[33]

a. pɔ́.t̪a.ka 'flag'
bá.t̪a.ʃa 'type of candy'
(ĹL)L
b. a.nón.d̪o 'happiness'
L(H́L)

[31] The same point could be made for Finnish (see analysis above), where *CLASH could be substituted by *EP and left-alignment could be explained by a strong requirement of initial stress as well.

[32] There are of course two more possibilities, i.e. to parse the string as (i) (H́)(H̀L) or (ii) (H́H)L. Since, in terms of stress placement, (i) is undistinguishable from a. and (ii) is undistinguishable from b., I will not discuss these structures here (but cf. footnote 34).

[33] The assignment of foot structure follows Mitra and Das 2000.

c. ʃɔ́.maj 'society'
pú.ruʃ 'man'
(ĹH)

d. ʃɔ́.ma.lò.co.na 'criticism'
ɔ́.no.bɔ̀.ro.t̪o 'continously'
(ĹL)(L̀L)L

e. pɔ́r.ja.lò.co.na 'deliberation'
(H́L)(L̀L)L

f. ɔ́.nɔ.bo.lɔ̀m.bon 'resourcelessness'
(ĹL)L(H̀H)

g. ɔ́.nɔ.bo.cʰèd̪.d̪o 'inseparable'
ɔ́.po.ri.hàr.jo 'inevitable'
(ĹL)L(H̀L)

h. ʃɔ́ŋ.rɔk.kʰòn 'conservation'
ɔ́n.t̪or.d̪ʰàn 'disappearance'
(H́H)(H̀)

Standard Colloquial Bangla thus has a binary, left-aligning, trochaic stress pattern. Stress placement is quantity-sensitive and stress clashes are avoided throughout. Similarly to Estonian it is a language that allows for lapses (e.g. in d.), but does not allow clashes. In their analysis of the Bangla stress pattern, Mitra and Das rank the constraint WSP over ALLFTL. That this must indeed be the case becomes clear in examples as g. above, where the heavy syllable attracts stress, preventing thus the second foot from being better aligned to the left.

Tableau 27: Standard Colloquial Bangla: heavy syllables attract stress

	WSP	ALLFTL
☞ (a) ɔ́.nɔ.bo.cʰèd̪.d̪o (ĹL)L(H̀L)		***
(b) ɔ́.nɔ.bò.cʰed̪.d̪o (ĹL)(L̀H)L	*!	**

Now consider again the HHL structures discussed above. In Bangla these structures receive the following parsing:

(72) ʃɔ́m.pot̪.t̪i 'belongings'
ʃɔ́n.t̪uʃ.t̪o 'satisfied'
(H́H)L

What determines that Bangla parses the sequence as (H́H)L and not, instead, as (H́)(H̀)L? Both an (H́H)L parsing and an (H́)(H̀)L parsing would violate *EP, hence this constraint cannot decide between the two structures. So what is the constraint that favors the former structure in Bangla? In principle the WSP and ALLFTL could be such constraints. Let us see what happens when we feed the HHL structure to the ranking already established on independent grounds for these constraints:

Tableau 28: Standard Colloquial Bangla: wrong results with *EP

	*EP	WSP	ALLFTL
(a) ʃɔ́m.pot̪.t̪i (H́H)L	*	*!	
☹ (b) ʃɔ́m.pòt̪.t̪i (H́)(H̀)L	*		*

We see that, contrary to the facts, the already established ranking chooses b. as the optimal candidate. Candidate a. would be favored by ALLFTL, but ALLFTL is dominated by the WSP which in turn decides for candidate b.[34] The rhythm constraint *EP assigns violations to both candidates, since neither of them displays perfectly rhythmical alternation.

If we limit ourselves to the set of constraints used so far there is no way out: the only possibility to explain the choice of a structure with stress lapse is to make use of the constraint *CLASH. But if *CLASH exists, there is no point in stipulating a unified constraint *EP. The introduction of *CLASH into the constraint ranking resolves the problem immediately:

Tableau 29: Standard Colloquial Bangla: correct results with *CLASH

	*CLASH	WSP	ALLFTL
☞ (a) ʃɔ́m.pot̪.t̪i (H́H)L		*	
(b) ʃɔ́m.pòt̪.t̪i (H́)(H̀)L	*!		*

*CLASH can decide between the two structures and, when ranked above the WSP, correctly chooses the non-clashing structure a.

Thus, the Bangla pattern shows us that there are cases where a structure with a stress lapse is preferred to a clashing structure and where the choice between the two structures cannot be attributed to a third constraint. Hence, *CLASH and *LAPSE exist independently from each other, it is not possible to merge them into one single constraint requiring alternating rhythm.

6. Conclusion

In this paper, directionality effects in the assignment of rhythmic secondary stress have been interpreted as the result of two fundamental principles active in metrical systems: a principle requiring feet to align as much as possible with the left edge of the word and a principle that requires stress to be alternating. Casting these principles into the format of the violable constraints ALLFTL, *LAPSE and *CLASH has allowed us to show how the interaction between these constraints generates the attested rhythmical patterns of the world's languages and only those. Specifically, the non-existence of right-aligning iambic patterns has been explained by the fact that these systems are suboptimal both in terms of left-alignment of feet and in terms of rhythmic wellformedness. Another welcome result of the theory is that it

[34] The constraint PARSEσ would prefer a clashing structure as well, since in this case the single light syllable could be parsed into a foot in a structure such as (H́)(H̀L).

predicts the non-existence of initial dactyl systems where a secondary stress foot is isolated at the left word edge. The interaction of the proposed constraints with the constraints regulating main stress assignment and quantity sensitivity have been checked and found to yield satisfactory results in most respects. Finally, the question whether the constraints of rhythmic wellformedness can be subsumed under a single constraint has been explored and evidence against it has been presented.

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