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Quantity Sensitivity as the Result of Constraint Interaction

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1. Introduction

Traditionally, quantity sensitivity is assumed to be a parameter: in some languages syllable weight systematically influences the distribution of stress, while in others it doesn't. But conceiving quantity sensitivity as a parameter runs into problems with languages that are *partially quantity-sensitive*, in the sense that they show weight effects in certain contexts, but not in others. In this paper I want to propose a new approach to quantity sensitivity in terms of Optimality Theory (Prince & Smolensky 1993), claiming that an analysis in terms of violable constraints can do without the parameter of quantity sensitivity. Thus, the idea of quantity sensitivity as a parameter is, I will propose, both inadequate and not necessary.

In this paper quantity sensitivity is seen as the result of the interaction between constraints that favor weight effects and others that obscure them. If the former are top-ranked in the constraint hierarchy, we will get a typical quantity-sensitive language, if they are bottom-ranked, a quantity-insensitive one. But interestingly, a hierarchy where constraints triggering weight effects are in an intermediate position will generate a stress system where quantity sensitivity emerges only in certain contexts, precisely where those constraints can show their influence because higher ranked constraints are already satisfied.

To give an example, in a language that, in the terminology of Hayes (1995), disrespects syllable weight in metrical parsing, the constraint *CLASH will typically dominate the *weight-to-stress principle* (henceforth WSP). The two constraints are defined as follows:

(1) *CLASH: adjacent syllables must not bear stress
(cf. Kager 1994; Pater 1995)

(2) WSP: heavy syllables are prominent
(cf. Prince 1990; Prince & Smolensky 1993)

If *CLASH dominates the WSP, sequences of heavy syllables will receive an alternating stress pattern, as illustrated in the following tableau:

Tableau 1: Typical quantity-insensitive language: *CLASH >> WSP

/H.H/	*CLASH	WSP
(a) ('H).('H)	*!	
☞ (b) ('H.H)		*

Candidate (b), which parses two heavy syllables into a foot, wins against the quantity-sensitive parsing of (a) where heavy syllables form each a foot of their own and thus create a stress clash.

On the other hand, a typical quantity-sensitive language will display the opposite ranking, with the WSP dominating *CLASH. In this case candidate (a) wins because it satisfies the WSP.

Tableau 2: Typical quantity-sensitive language: WSP >> *CLASH

/H.H/	WSP	*CLASH
☞ (a) ('H).('H)		*
(b) ('H.H)	*!	

Many of the aspects of the following analysis are already present in the literature on the subject. Most notably, Kager (1993a, 1993b), with his *Rhythmic Uniformity Hypothesis*, proposes that a ban against adjacent stressed syllables is one of the most salient characteristics of a quantity-insensitive parsing,[1] and Kager (1995) observes that top-down stressing might be another mechanism responsible for strictly alternating stress assignment. These observations are recast here as the effect of the constraints *CLASH and LEFTMOST, both dominating the WSP in 'more'

[1] An idea also present in Prince (1980) regarding the stress pattern of Estonian.

quantity-insensitive languages. Generally, most of the constraints used in the following analysis have already been proposed in previous work, or are in any case grounded on insights that have often been discussed in metrical theory. New is only the hypothesis that these principles alone - in different ranking - can account for weight effects, as well as for their absence, without any additional parameter of quantity sensitivity being needed.

I will begin with an outline of the major assumptions with respect to the foot inventory of languages. Then I will discuss two *partially quantity-sensitive* languages, German and Finnish, and show in which contexts quantity sensitivity emerges and in which it doesn't. A discussion of Estonian follows, based on the analysis of Kager (1994), which will be argued to be a language just one step further towards complete quantity insensitivity. Finally, I will show how a completely quantity-insensitive language can be derived by the same constraints that generate quantity-sensitive languages.

The empirical focus of this paper is limited to trochaic systems. In terms of constraints this means that there is a constraint TROCH, requiring feet to be head-initial, which dominates its mirror image constraint IAMB, requiring feet to be head-last. I will express TROCH as an alignment constraint, following McCarthy & Prince (1993b):

(3) TROCH = ALIGN (FT, L, HEAD(FT), L)
$\forall$ foot $\exists$ head of the foot such that the left edge of the foot and the left edge of the head of the foot coincide.
(cf. RHTYPE=T in Prince & Smolensky 1993; McCarthy & Prince 1993b)

An extension of the analysis to iambic systems should in principle be possible, but cannot be considered here, due to lack of space.

2. Foot typology and metrical constraints

In Hayes (1995) the set of feet that natural languages use to organize their metrical structure is drawn from a fixed set of foot types. He assumes that there are three types of feet appearing in the stress system of languages: the syllabic trochee, the moraic trochee, and the iamb. Each of them takes a certain fixed shape. The syllabic trochee consists of two syllables, regardless of their weight.[2] The moraic trochee can consist either of two light syllables or of a single heavy one. Finally, the iamb can be again a single heavy syllable or a foot composed of a light syllable followed either by another light syllable or by a heavy one.

(4) Asymmetric foot inventory (Hayes 1995: 71)

Syllabic trochee:	('σσ)
	('H), in certain contexts
Moraic trochee:	('LL) or ('H)
Iamb:	(L'σ) or ('H)

Following Hayes, we could adopt a strict interpretation of the fixed-foot-type inventory, assuming that a specific language is parametrized for exactly one of the three foot types. However, this would lead to problems in the analysis of a language like German. As we will see below, German is a trochaic language where syllable weight influences stress assignment. Nevertheless, in loan-words beginning with a light syllable followed by a heavy one, secondary stress falls on the light syllable, creating a highly marked ('LH) trochee:[3]

(5) À.vant.gar.díst 'avantgardist'
('L H) H

[2] According to Hayes, a single heavy syllable may also qualify as a proper syllabic trochee, in certain circumstances. Under the assumption that feet are parsed maximally, a heavy syllable can form a foot of its own when a disyllabic parsing is not possible, as - in languages with a left-to-right parsing - at the end of words with an odd number of syllables and in monosyllabic words (cf. Hayes 1995:102).

[3] The only other analysis this example could receive is one where the first syllable forms a degenerate foot of its own. This would mean that the constraint that requires initial stress, which we will identify with ALIGN (PRWD, L, FT, L), dominates FT-BIN, the constraint requiring at least bimoraic feet. We will see below that ALIGN (PRWD, L, FT, L) is itself dominated by the constraint assigning main stress close to the right edge of the prosodic word. If ALIGN (PRWD, L, FT, L) dominates FT-BIN, then RIGHTMOST, too, must dominate FT-BIN, and in that case we should have words where main stress falls on a final light syllable. But this never happens in German (cf. the discussion below). I conclude that in the example under discussion we are not dealing with a parsing of the ('L)H type, but with an ('LH) trochee. Moreover, there is no evidence elsewhere in German for the presence of degenerate feet; the minimal word for example consists of a single heavy syllable.

Thus, in German a type of foot appears that is not predicted by a foot inventory as given above and, moreover, this foot appears only in a limited contexts, precisely at the left edge of the prosodic word.

In an analysis based on violable constraints not only the parsing of feet, but also the shape that metrical feet can take will be the result of constraint interaction. Let us see what this means for trochees.

I will assume here that feet have to be binary, either at the moraic or at the syllabic level, in other words, that the constraint FT-BIN is undominated.[4]

(6) FT-BIN: feet must be binary at some level of analysis (μ, σ)
(Prince 1980; McCarthy & Prince 1986; Prince & Smolensky 1993)

This constraint allows for the following types of feet, all of them containing either two moras or two syllables:

(7) (LL)
(H)
(LH)
(HL)
(HH)

It is clear that not all of these feet are equally well attested in trochaic systems. Let us call *canonical trochees* the moraic trochee proposed by Hayes, and term *non-canonical* trochees the remaining ones:[5]

(8)

Canonical trochees	Non-canonical trochees
('H)	('HL)
('LL)	('LH)
	('HH)

[4] This limits the discussion to languages without degenerate feet. Degenerate feet are highly marked, but, at least for languages as e.g. *Auca* (cf. Hayes 1995), or for languages that allow for minimal words consisting of a single light syllable, violations of FT-BIN cannot be excluded. I won't go here into the discussion which are the circumstances under which FT-BIN can be violated (see Kager (1995) for discussion of a proposal in terms of catalexis).

[5] See also Prince (1990) for a markedness hierarchy of foot-types.

The claim here will be that there is a set of stress pattern constraints that can cut down the rather large set of feet allowed by FT-BIN, and, specifically, work against *non-canonical* trochees. There is a crucial difference in assuming this from an approach that fixes once and for all the inventory of possible feet: if the type of feet used in a language depends on constraint interaction, it will be the ranking of these constraints that determines in which contexts which feet can surface. So we might find a language that usually parses syllables into ('LL) and ('H) trochees, but where under certain circumstances also more unusual trochees, e.g. ('LH), ('HL) and ('HH) trochees can appear.

The most influent constraint militating against *non-canonical* trochees is the WSP. When in a dominating position, it rules out ('LH) and ('HH) trochees because both feet contain unstressed heavy syllables.

There is one specific structure in German where the WSP is not strong enough to exclude ('LH) feet. Take the example

(9) èx.pe.ri.men.tíe.ren 'experiment'
'H L L H 'H H

In words with this structure the WSP would be violated anyway because assigning stress to the fourth, heavy syllable would create a stress clash with the syllable bearing main stress. Instead of shifting stress to the third, light syllable, most speakers prefer not to assign any stress at all to the word-medial syllables: underparsing is chosen to avoid the creation of an ('LH) foot. Thus, an additional constraint is called for, which explains the avoidance of ('LH) in this context. Hayes (1985, 1995) notes that prominence contrasts based on intensity lead to trochaic grouping while prominence contrasts based on duration lead to iambic grouping, terming this regularity the *Iambic/Trochaic Law*. He draws the conclusion that trochees tend to consist of units of equal duration, while the units forming iambs normally differ in length. I will express this observation in the following constraint:

(10) ITL: feet must observe the Iambic/Trochaic Law. The components of a trochaic foot must be equal, the elements of an iambic foot must contrast in quantity.

For trochees this means that the ITL will ban both ('LH) and ('HL) feet, whenever its ranking in the constraint hierarchy permits it. On the other hand, it will be satisfied by ('H) feet, consisting of two moras and ('LL) and ('HH) feet, consisting of two syllables of equal duration. I will tentatively assume that a constraint of this type is responsible for the markedness of ('LH) trochees, as in the German example above. There remains some arbitrariness to this move since the anti-('HL) function of the ITL cannot be observed in the languages discussed in this paper: all of them have a strong ban against adjacent stressed syllables and thus a light syllable following a heavy stressed syllable could not be stressed for independent reasons. Nevertheless, it has often been observed in the literature (cf. Prince 1990; Kager 1993a; Hayes 1995; among others) that ('HL) trochees have a marked status and we conclude that they must be discriminated against by some constraint. I must leave to further research the question whether ('LH) and ('HL) trochees can be banned by one and the same constraint (as proposed here with the ITL), or whether different constraints are at work. In the remainder of the paper I will point out whenever the discussion bears crucially on the ITL.

Alternative proposals have been made in the literature to account for the markedness of ('LH) feet, but haven't been adopted here for various reasons. In their analysis of iambic and cretic shortening in pre-classical Latin Prince & Smolensky (1993) propose a constraint PK-PROM which requires the head of a foot to be heavy. This constraint discriminates against ('LH) trochees, but it has also the effect of ruling out ('LL) trochees, a fact that in the case of German would wrongly predict extensive underparsing of strings of light syllables. The same is true for RHHRM (Prince & Smolensky: 59; see also Prince 1990), which in favoring length at the end of constituents could subsume the anti-('HL) function of the ITL. But again, alongside the *non-canonical* ('HL) trochees it endangers the parsing of *canonical* ('LL). As an interesting alternative to the present approach we could also extend a proposal by Kager (1993a) who attributes the markedness of ('HL) trochees to the presence of a foot-internal lapse. If we substitute a constraint *LAPSE for the ITL we could use this constraint to eliminate ('LH) trochees as well, if we assume that heavy syllables don't have any prominence in an ('LH) foot. However, in German the ('LH) trochee is avoided by extensive underparsing of the word-medial syllables. This doesn't create a foot-internal lapse, but a long sequence of syllables without any prominence. It seems strange that in order to avoid a foot-internal lapse an even longer lapse of unfooted syllables should be created. Kager (1993a, 1993b) proposes that ('LH) feet are marked because they create a mora clash between the prominence on the light syllable (assigned at the syllable level) and the intrinsic prominence of the following heavy syllable (on the mora level). If we want to recast this observation in the form of output constraints, we have to suppose that the intrinsic prominence of the heavy syllable is still present in the output, a move that will lead to complications when we consider the clash-avoiding 'HH parsing of sequences of heavy syllables (cf. fn.13). Finally, Hanson & Kiparsky (1996) propose a constraint termed EUPODY which specifically excludes ('LH) trochees in their analysis of Finnish stress. They don't however give further explanation for why the ('LH) trochee should be marked, and the ban on word-medial ('LH) trochees in Finnish could also be attributed to the WSP.

Summarizing, several of the trochees allowed by FT-BIN are paralyzed by the WSP and the ITL:

(11) WSP --> *('LH), *('HH)
ITL --> *('LH), *(HL)

Note, however, that there are also constraints that might favor the presence of feet that don't satisfy the WSP and the ITL.

Consider the constraint PARSEσ, which requires all syllables to be parsed into feet:

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

This constraint might enforce the parsing of ('LH) and ('HL) feet, because it will favor the parsing of single light syllables into feet over skipping them in order to obtain better trochees.

Alignment constraints can lead to the construction of unusual trochees as well. We will see that in German there is a constraint requiring the left edge of the prosodic word to be aligned with a foot.

(13) ALIGN (PRWD, L, FT, L):
∀ prosodic word ∃ foot such that the left edge of the prosodic word and the left edge of the foot coincide.
(McCarthy & Prince 1993b)

When this constraint is active, even an initial light syllable followed by a heavy one can become the head of a foot and a *non-canonical* ('LH) trochee will be created. However, this foot will then appear only at the beginning of a prosodic word.

Finally, there may also be constraints that favor the parsing of ('HH) feet. Consider a language where the constraint *CLASH is high ranked. In this case the parsing of two heavy syllables into perfect ('H)('H) trochees will be excluded, because this would lead to a stress clash between the two syllables. On the other hand, parsing an ('HH) trochee avoids clash and obtains also a better ranking on the constraint PARSEσ than the other clash-avoiding parsing ('H)H, where only the first syllable is parsed into a foot and the second syllable is skipped.

Summarizing the discussion so far, we can say that although FT-BIN allows for a rather large array of foot-types, there are other stress pattern constraints, like the WSP and the ITL, which will militate against certain types of feet. Which feet are allowed in a specific language, under this approach will depend on the ranking of these constraints with respect to alignment constraints and constraints such as PARSEσ and *CLASH. This means that the foot inventory is not fixed once and for all and cannot be drawn from a limited set of feet. It is limited by the constraint FT-BIN, but the exact shapes of feet can vary from language to language and from context to context in a specific language.

3. Secondary stress in German loan-words

In this paper I will concentrate on a subpart of the metrical system of German. I will consider only loan-words, for the simple reason that morphologically underived native words consist usually of a single heavy syllable, or, depending on one's interpretation of words ending in a schwa or schwa plus sonorant, of maximally two syllables. Thus, only in loan-words an articulated rhythmical pattern that is not influenced by morphological boundaries can be observed.

Moreover, I won't discuss in any detail the distribution of main stress, which displays rather idiosyncratic characteristics (cf. Wurzel 1970, 1980a, 1980b; Benware 1980; Giegerich 1985; Eisenberg 1991; Vennemann 1990; Féry 1995; Alber 1997). Main stress in loan-words falls on one of the last three syllables of the word, but it cannot always be predicted on which. A possible analysis might be to divide loan-words into several lexical classes exhibiting stronger or weaker extrametricality effects, a phenomenon that could be captured by constraints of the NONFINALITY type (Alber 1997). For the purpose of this paper I will abstract away from the effects of NONFINALITY and assume that the constraint RIGHTMOST alone accounts for main stress assignment:

(14) RIGHTMOST = ALIGN (PRWD, R, HEAD (PRWD), R)
∀ prosodic word ∃ head of the prosodic word such that the right edge of the prosodic word and the right edge of the head coincide (cf. EDGEMOST, Prince & Smolensky 1993).

Following Giegerich (1985) and Ramers (1992), in contrast to Vennemann (1990), I will assume that in German syllables closed in a consonant and syllables containing a long vowel or a diphthong are heavy, while open syllables containing a short vowel are light. Except for extrametrical syllables, long vowels not bearing main stress are shortened (cf. Wurzel 1980b:930) and therefore the only heavy syllables that we will encounter in the domain of secondary stress are closed syllables or syllables containing a diphthong.

In what follows, I will give a short description of the pattern of secondary stress in German. The distribution of stress in the examples is based on the judgments of 14 native speakers, including myself. The use of judgments has turned out to be necessary since no clear phonetic or phonological clues such as vowel reduction seem to correlate with (absence of) secondary stress in German. Some speakers, however, systematically insert a glottal stop, or, with high vowels, a glide, before vowel-initial syllables which bear main or secondary stress (cf. Wiese

1996 for a discussion of foot-initial glottal stop insertion).[6] They distinguish between

(15)	Thè.o.ríe vs.	'theory'
	Ò.ze.ʔà.no.gra.phíe	'oceanography'

Whenever examples could be found with a context for potential insertion of a glottal stop they were tested with the speakers exhibiting the phenomenon and listed with a glottal stop in the examples. Note that glottal stop insertion at foot boundaries can be take as an argument for the presence of word-medial secondary stress in German, against contrary claims in the literature (cf. Féry 1995). Disagreements found in the judgments of speakers are given in the footnotes.

Schematically, secondary stress in German loan-words can be described as follows (see below for discussion and more examples):

(16)	- one syllable preceding main stress:			
	L -->	L	E.lán	'spirit'
	H -->	not clear	Sex.tánt	'sextant'
		or	Sèx.tánt?	
	- two syllables preceding main stress:			
	σσ -->	'σσ	Thè.o.ríe	'theory'
	- three syllables preceding main stress:			
	LHσ -->	'LHσ	Kà.lei.do.skóp	'kaleidoscope'
	or	L'Hσ	Ka.lèi.do.skóp[7]	

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[6] There seems to be a rather wide range of dialectal variation in glottal stop insertion. Seven of the speakers, all speaking a southern variety, insert glottal stops only at the beginning of vowel initial morphemes. The remaining speakers tend to insert a glottal stop before main stress as well (e.g. *The.ʔá.ter* 'theater') and two of them also systematically before vowel initial syllables bearing secondary stress. Since, as far as I know all varieties of German insert a glottal stop at the beginning of a (vowel initial) morpheme, in this position the glottal stop may not be indicative to determine a foot boundary, but could instead be due to independent constraints and won't be transcribed henceforth.

[7] When the initial syllable is light and the second heavy, some speakers allow for stress to fall on the second syllable. Three of the speakers consulted preferred stress on the second syllable in *Kaleidoskop* 'kaleidoscope', but on the initial syllable in all other words of

otherwise	'σσσ	Phì.lo.so.phíe	'philosophy'
		Pèr.ver.si.t´ät	'perversity'

- four syllables preceding main stress:

σσLH -->	'σσLH	èx.pe.ri.men.tíe.ren	'experiment'
or	'σσ'LH	èx.pe.rì.men.tíe.ren[8]	
otherwise	'σσ'σσ	Ò.ste.ʔò.po.ró.se	'osteoporosis'
		Àr.gu.mèn.ta.tión	'argumentation'

- five syllables preceding main stress:

σσLHσ -->	'σσL'Hσ	Èx.pe.ri.mèn.ta.lís.mus	'experimentalism'
otherwise	'σσ'σσσ	Ò.ze.ʔà.no.gra.phíe	'oceanography'
		ò.no.mà.to.po.ʔé.tisch	'onomatopoetic'
		Pà.lä.ʔòn.to.lo.gíe	'paleontology'

The syllable preceding main stress is unstressed, although some doubt remains as to the stress of word-initial heavy syllables in this context. Initial syllables are stressed, with some variation possible among speakers when the first syllable is light and followed by a heavy one. After the two initial syllables stress falls on odd-numbered syllables, counting from left to right, except when an even-numbered syllable is heavy and preceded by a light one. In that case either the heavy syllable is stressed (when not adjacent to main stress), or both the heavy and the light syllable are unstressed (when the heavy one is adjacent to main stress), again with some variation possible among speakers in the latter case.

At a first, superficial glance, in German loan-words there seems to be evidence both for quantity sensitivity and for quantity insensitivity.

Main stress is usually said to be quantity-sensitive. It cannot retract beyond a heavy penult (cf. Giegerich 1985; Ramers 1991; Vennemann 1992).

(17) * ... ´ σ.H.σ#

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similar structure, one preferred second syllable stress in all cases except *Determinismus* (cf. fn. 12).

[8] This second pattern is available for 3 of the 14 speakers I consulted.

Secondly, the fact that German allows for monosyllabic words (e.g. *Klub*, 'club') can be taken as an indication for the quantity-sensitivity of its metrical system. If we follow Prince & Smolensky (1993) in assuming that there is a constraint LEXWD ≈ PRWD requiring lexical words to correspond to prosodic words, then this constraint will ensure that a word consists of at least one foot. In a strictly quantity-insensitive language feet are minimally disyllabic and a word should therefore consist of at least two syllables. The only possibility for German to be still analyzed as a quantity-insensitive language would be to have LEXWD ≈ PRWD dominated by some other constraint. This would mean that monosyllabic words, differently from polysyllabic words, have no prosodic structure at all, a move with consequences yet to be determined.

On the other hand, secondary stress seems to have quantity-insensitive properties. As we mentioned above, at the beginning of a word stress can fall on a initial light syllable, even if the second one is heavy:

(18)	Kà.lei.do.skóp	'kaleidoscope'
	'L H L	
	Dè.ter.mi.nís.mus	'determinism'
	'L H L	
	À.vant.gar.díst	'avantgardist'
	'L H H	
	È.man.zì.pa.tión	'emancipation'
	'L H 'L L	
	à.mal.ga.míe.ren	'amalgamate'
	'L H L	
	À.dap.ta.tión	'adaptation'
	'L H L	

It would seem that simply the first two syllables of the word are parsed into a foot, regardless of their weight.

Also in sequences of heavy syllables we find a stress pattern that is characteristic of a quantity-insensitive parsing. Sequences of heavy syllables receive alternating stress, with every other heavy syllable remaining stressless:

(19)	Pèr.ver.si.t´ät	'perversity'
	'H H L	

	àu.then.ti.síeren	'authenticate'
	'H H L	
	Àk.zen.tu.ʔíe.rung	'stressing'
	'H H L	

Finally, when we have a sequence where a heavy syllable is followed by two light syllables, parsing resumes only on the third syllable, and again it would seem that a disyllabic ('HL) foot is preferred to the quantity-sensitive ('H) trochee:

(20)	Èn.zy.klò.pä.díe	'encyclopedia'
	'H L 'L L	

But also in the environment of secondary stress, in word-medial position, we can find cases where heavy syllables do attract stress and interrupt the pattern of "stress on every odd-numbered syllable".

In the example

(21)	Èx.pe.ri.**mèn**.ta.lís.mus	'experimentalism'
	'H L L '**H** L	

stress on the fourth, heavy syllable could in principle be due to stress preservation of the main stress of the unsuffixed form *Èx.pe.ri.**mént*** 'experiment'. But the same explanation is not available for examples of the following type, where the form *Dè.ter.mi.nís.mus* is stressed on the first syllable, while, when prefixed by *Àuto-*, stress can again fall on the fourth, heavy syllable:[9]

(22)	Àu.to.de.tèr.mi.nís.mus	'self-determinism'
	'H L L 'H L	

[9] *Àu.to.**dè**.ter.mi.nís.mus* seems also to be a possible, though somehow artificial sounding stress pattern. It conveys the feeling that the morphological boundary between *Auto-* and *-determinismus* is underlined with some sort of pause. We can analyze this alternative pronunciation as a case where a prosodic word boundary is introduced between the morphemes, forcing stress on the initial syllable of the second one. The prosodic structure of this alternative pronunciation would therefore resemble that of a compound. For the purpose of the argument it is only important that the pronunciation *Àu.to.de.**tèr**.mi.nís.mus* is available as well, which is true for 13 of the 14 speakers consulted.

Words with this sequence of heavy and light syllables are extremely hard to find, but even if we make up an example, stress assignment follows the pattern of the two examples above. So we can take

(23) Àn.te.zé.dens 'antecedent'

and suffix it with *-alismus*, creating the - non-existing, but possible -

(24) Àn.te.ze.dèn.ta.lís.mus 'antecedentalism'
'H L L 'H L

where again the main stress of the unsuffixed form is not preserved as secondary stress on the third syllable, but rather the fourth, heavy syllable attracts stress.

Another structure that resists a simple parsing into syllabic trochees is one where an `σσLH sequence is followed by main stress. For most speakers, in this case the third syllable remains stressless, as a matter of fact, none of the three syllables following the initial stressed syllable bears stress:

(25) èx.pe.ri.men.tíe.ren 'experiment'
'H L L H 'H H
mè.di.ka.men.t´ös 'medicinal'
'L L L H 'H
à.ssor.ti.men.tíe.ren[10] 'to assort'
'L H L H 'H H

Admittedly, it is very difficult to judge if the fourth syllable in these cases doesn't bear any stress. We will however give indirect evidence for the correctness of this pattern later on in the analysis. For the moment note that in any case a quantity-insensitive parsing with stress on the third syllable is excluded for most speakers:

[10] This again is a non-existing, but possible word formed by attaching the suffix *-ieren* to *Assortiment* ('assortment').

(26) *èx.pe.rì.men.tíe.ren 'experiment'
'H L 'L H 'H H

Summarizing, we can say that in German there is evidence both for quantity-sensitive and for quantity-insensitive patterns. Let us now see step by step how this stress pattern can be analyzed and how the mixed properties can be derived.

3. 1. Constraint hierarchy and ranking arguments

The constraint hierarchy I want to propose for German loan-word stress is as follows:

```
(27)            FT-BIN, TROCH
                      |
                RIGHTMOST
                      |
ALIGN (PRWD, L, FT ,L), *CLASH
                      |       /
                  ITL,WSP
                      |
                  PARSE σ
                      |
                  ALL-FT-L
```

I will discuss each domination relation one by one in the next sections, but note that some effects of this hierarchy can already be seen now. We see that the constraints FT-BIN and TROCH are top-ranked. This will give us a language with strictly binary, left-headed feet. The constraint RIGHTMOST is also rather high-ranked, it dominates the major part of the remaining stress pattern constraints. The result will be a language where the requirements of main stress assignment override the requirements of secondary stress assignment. The constraint *CLASH is in an undominated position, hence we won't find any adjacent stress bearing syllables. The WSP, which is the constraint largely responsible for weight effects, is located in an intermediate position in the hierarchy. This will be one of the reasons for the nature of partial quantity sensitivity of German that was discussed in the previous section. PARSEσ dominates the constraint ALL-FT-L, a ranking that leads to a parsing in a left-to-right fashion, but since the two constraints are ranked at the bottom of the hierarchy, the left-to-right parsing will often be interrupted in order to satisfy higher ranked constraints. Finally, note the presence of the constraint ALIGN (PRWD, L, FT, L) in a very high position in the hierarchy. This constraint asks for alignment of the left edge of the prosodic word with a foot, which in a trochaic language like German is equivalent to a requirement of initial stress. However, ALIGN (PRWD, L, FT, L) is not undominated, and we will see that it can be violated when in competition with the regularities of main stress assignment.

3. 1. 1. RIGHTMOST >> ALIGN (PRWD, L, FT, L): main stress overrides secondary stress

Words with final stress which consist of a light syllable followed by a heavy one show us that although German loan-words have a strong requirement of initial stress, this requirement can be violated when main stress assignment is at stake. Take the example

(28) E.lán 'spirit'
L('H)

Align (PrWd, L, Ft, L) would require the first syllable to be stressed, in analogy to words like À.vant.gar.díst. However, this would mean to shift main stress away from its rightmost position violating Rightmost by one syllable. Since this doesn't happen, Rightmost must dominate Align (PrWd, L, Ft, L). The tableau illustrates the evaluation of the candidates:

Tableau 3

Candidates	Ft-Bin	Troch	Rightmost	Align (PrWd, L, Ft , L)
☞ (a) E.(lán)				σ
(b) (É.lan)			σ	
(c) (E.lán)		*!		
(d) (È).(lán)	*!			

Note that (c), representing an iambic parse, is a dangerous candidate, since it is indistinguishable in its output form from candidate (a). Parsing an iamb would be an elegant means to satisfy both Rightmost and Align (PrWd, L, Ft, L). But as we will see further on, Troch dominates Rightmost and therefore the iambic option is ruled out by the high ranking constraint favoring head-initial feet. Rightmost will turn out to be dominated also by Ft-Bin , and it is a violation of this constraint which makes candidate (d) fail.

The high ranking of Rightmost reflects the fact that main stress assignment outranks most of the constraints determining the regularities of secondary stress assignment. As a consequence, main stress assignment and secondary stress assignment are largely independent[11]: the requirements of main stress assignment can override most of the requirements on secondary stress, but once the necessities of main stress are satisfied, the constraints regulating secondary stress can emerge and display their force. Therefore, in what follows I will assume that main stress is fixed somewhere near to the right edge of the prosodic word.

3. 1. 2. PARSEσ >> ALL-FT-L: exhaustive left-to-right parsing

The alignment constraint ALIGN (FT, L, PRWD, L) (ALL-FT-L in short) is used since McCarthy & Prince (1993b) to account for the directionality of foot parsing:

(29) ALL-FT-L = ALIGN (FT, L, PRWD, L)
∀ foot ∃ prosodic word such that the left edge of the prosodic word and the left edge of the foot coincide.
(McCarthy & Prince 1993b)

If dominated by PARSEσ, this constraint has the effect that feet are parsed exhaustively in a left-to-right fashion: as many syllables as possible have to be parsed into feet and all feet have to be aligned as much as possible to the left edge of the prosodic word.

In words consisting of an odd number of light syllables before main stress we see that this partial constraint hierarchy is active in German:

[11] Leading to the same results as van der Hulst's (1984) *main stress first theory*

(30)	Ò.ze.ʔà.no.gra.phíe	'oceanography'
	('LL) ('LL) L	
	ò.no.mà.to.po.ʔé.tisch	'onomatopoetic'
	('LL)('L L)L	
	Là.ti.tù.di.na.rísmus	'latitudinarianism'
	('LL)(LL) L	

The following tableau illustrates the interaction of PARSEσ and ALL-FT-L. Candidate (b) would be the optimal candidate in terms of alignment: abstracting away from the main stress foot, it contains a single foot and this foot is aligned perfectly to the left edge of the prosodic word. But thus it leaves three syllables unparsed and therefore is less optimal than candidate (a) and (c). The competition between (a) and (c) is decided by ALL-FT-L; (a) wins, because it violates ALL-FT-L only by two syllables, while in candidate (c) the second foot is misaligned by three syllables with the left edge of the prosodic word. Note that all candidates observe the higher ranked constraints of the hierarchy such as ALIGN (PRWD, L, FT, L), *CLASH, FT-BIN, and TROCH.

Tableau 4

Candidates	PARSEσ	ALL-FT-L
☞ (a) (ò.no).(mà.to).po.(é.tisch)	*	σσ
(b) (ò.no).ma.to.po.(é.tisch)	***!	
(c) (ò.no).ma.(tò.po).(é.tisch)	*	σσσ!

3. 1. 3. ITL >> PARSEσ: underparsing of word-medial syllables

The left edge of the prosodic word is, as we will see below, under the influence of the constraint ALIGN (PRWD, L, FT, L), and the right edge is under the influence of the constraints conditioning main stress assignment. Since both of these constraints are rather high ranked, the only environment where we can see the influence of lower ranked constraints such as the ITL and the WSP is word-medially. As already discussed, the WSP and the ITL are both constraints that may play a role in ruling out a non-canonical ('LH) trochee. In German, in fact, we need both of them for precisely this purpose. There is one structural pattern where the WSP alone is not sufficient to rule out word-medial ('LH) feet and thus to generate the right output. Take such cases as

(31)	èx.pe.ri.men.tíe.ren	'to experiment'
	('H)L L H ('H H)	
	mè.di.ka.men.t´ös	'medicinal'
	('L L)L H ('H)	
	à.ssor.ti.men.tíe.ren	'to assort'
	('L H) L H ('H H)	

Here satisfaction of the WSP by assigning stress to the fourth, heavy syllable *-men-* is excluded in any case because this would lead to a stress clash with the syllable bearing main stress. In other words, the WSP will be violated no matter which parsing we chose. But if the WSP is violated in any case, the lower ranked constraints should decide over the best parsing and therefore the parsing ('H)L('LH)('H), which obeys *CLASH and only minimally violates PARSEσ, should be chosen. But this is not the case. Instead, for most speakers all three medial syllables remain unstressed. We must conclude that there is another constraint, besides the WSP, working against ('LH) trochees, which here is taken to be the ITL. The following tableau shows the constraint interaction:

Tableau 5

Candidates	*CLASH	WSP	ITL	PARSEσ
☞ (a) (èx).pe.ri.men.(tíe.ren)		*		***
(b) (èx).pe.(rì.men).(tíe.ren)		*	*!	*
(c) (èx).pè.ri.(mèn).(tíe.ren)	*!			**
(d) (èx).(pè.ri).(mèn).(tíe.ren)	**!			

Candidate (c) would contain only canonical trochees. However, it must fail because it violates the high ranked constraint against adjacent stress bearing syllables. The same is true for (d), which would rate even better on PARSEσ, but collects two violations of *CLASH. This candidate thus also gives us a ranking argument for *CLASH over PARSEσ. The only other candidates not violating *CLASH or any of the higher ranked constraints are (a) and (b). (b) rates well on PARSEσ, but is excluded because it contains a non canonical ('LH) trochee. Both (a) and (b) violate the WSP, thus this constraint doesn't allow for any decision between the two of them. An additional constraint, in my proposal the ITL, is needed to exclude the parsing of ('LH) trochees in this context.

There is a minority of speakers (see fn. 8) who accept stress on the third syllable in examples with this structure. They prefer a non-canonical ('LH) foot to extensive underparsing and I conclude that for them any additional constraint against ('LH) trochees must be lower ranked than PARSEσ. Note, however, that they don't extend their acceptance of stress on a light syllable preceding a heavy one to examples as in (21), (22) and (24), where it would mean a gratuitous violation of the WSP.

As mentioned before, it is hard to determine whether the fourth syllable *-men-* is indeed stressless. While the pronunciation shown in candidate (b) is clearly impossible, there remains some margin of doubt as to the impossibility of (c). The judgment in these cases is also more difficult because word-medial secondary stresses are weaker than word initial ones. Nevertheless, we will see in the discussion of sequences of heavy syllables, that there is more evidence for the ranking of *CLASH above the WSP and it is precisely this ranking that rules out stress on a heavy syllable before main stress.

3. 1. 4. WSP >> PARSEσ, ALL-FT-L: word-medial weight effects

Consider again the examples

(32)	Àu.to.de.tèr.mi.nís.mus	'self-determinism'
	('H)L L ('H) L	
	Èx.pe.ri.mèn.ta.lís.mus	'experimentalism'
	('H)L L ('H) L	
	Àn.te.ze.dèn.ta.lís.mus	'antecedentalism'
	('H)L L ('H) L	

In these examples quantity sensitivity emerges word-medially: the fourth, heavy syllable attracts stress satisfying the WSP, but at the cost of violating ALL-FT-L.

Tableau 6

Candidates	*CLASH	WSP	ITL	PARSEσ	ALL-FT-L
☞(a) (Àu).to.de.(tèr).mi.(nís.mus)				***	σσσ
(b) (Àu.to).(dè.ter).mi.(nís.mus)		*!	**!	*	σσ
(c) (Àu).(tò.de).(tèr).mi.(nís.mus)	*!			*	σσσσ
(d) (Àu).to.de.ter.mi.(nís.mus)		*!		****	
(e) (Àu).to.de.(tèr.mi).(nís.mus)			*!	**	σσσ

Candidate (a) is the optimal output. It satisfies *CLASH, the WSP and the ITL at the cost of underparsing the word-medial light syllables. Candidate (b), which represents a typical quantity-insensitive pattern, would rate better in terms of PARSEσ and of left alignment, but the construction of an ('LH) trochee is blocked both by the WSP and the ITL. (c) would parse all medial syllables without violating the WSP or the ITL, but it violates the high ranked constraint against stress clash. Differently from cases as *experimentieren*, underparsing is no option here, as we can see in (d): the WSP makes this candidate fail. Finally, candidate (e) is blocked by the constraint ranking because its parsing violates the ITL. Note, however, that this candidate is indistinguishable in its distribution of stressed syllables from the winning candidate. The exclusion of ('HL) feet thus is blocked by the established constraint ranking, and by the anti-(HL) function assumed to be part of the ITL, but nothing in the data can tell us for sure if the light syllable in these contexts is footed together with the preceding heavy syllable or if it is left unfooted.

As for the interaction between the WSP and PARSEσ, the ranking of the two constraints hinges crucially on the definition of the ITL as well. Take sequences where a heavy syllable is followed by two light ones, forming an HLL sequence, and where this sequence is immediately followed by the main stress syllable, as in the following example:

(33) Pà.lä.ʔòn.to.lo.gíe 'paleontology'
'L L **'H L L**
Lè.pi.dòp.te.ro.ló.ge 'butterfly expert'
'L L **'H L L**

In word-medial ...HLL´σ... sequences in principle three parsings are possible that don't violate any of the higher ranked constraints such as FT-BIN, TROCH or *CLASH:

- ('H)LL: obeys WSP; obeys ITL; violates PARSEσ twice
- H('LL): violates WSP; obeys ITL; violates PARSEσ only once
- ('HL)L: obeys the WSP; violates ITL; violates PARSEσ only once

The three parsings correspond to the following three candidates:

Tableau 7

Candidates	WSP	ITL	PARSEσ
☞ (a) (Pà.lä).**(ʔòn).to.lo.**(gíe)			**
(b) (Pà.lä).ʔ**on.(tò.lo).**(gíe)	*!		*
(c) (Pà.lä).(ʔ**òn.to).lo.**(gíe)		*!	*

Note that candidate (a) and (c) could both correspond to the actual output, while (b) must result to be suboptimal. In this paper I assume that the ITL includes in its definition not only a ban against ('LH) trochees, but also against ('HL) trochees and in this case the last of the three possible parses can be excluded as suboptimal, because a parsing violating the ITL won't be allowed even if it guarantees better results on PARSEσ, since the former of the two constraints dominates the latter, as we have seen above. The competition between (a) and (b) is then decided by the WSP and the fact that (a) results as the winning candidate shows us that the WSP must dominate PARSEσ. If, however, the ITL should have to be abandoned in favor of a different constraint which discriminates exclusively against ('LH) trochees (but see the discussion of alternatives in section 3.), then (c) will turn out to be optimal in any case: it obeys the WSP, violates PARSEσ only once and contains an ('HL) foot against which there isn't any direct evidence in a language like German. In this latter case it would not be possible to determine the ranking between the WSP and PARSEσ and the constraint hierarchy would have to be modified, though only in this specific point.

There is an additional complication to this case. Always assuming that candidate (c) is excluded by the ITL, note that candidate (b) would lose against candidate (a) also for the simple fact that it is aligned worse to the left than (a). But we have seen that ALL-FT-L is dominated by PARSEσ. This means that ALL-FT-L is not strong enough to exclude (b) in this case. If the WSP was of no importance here, the ranking PARSEσ >> ALL-FT-L would wrongly choose (b) as the optimal candidate because it counts fewer violations of PARSEσ. Another constraint is needed to exclude (b) and this constraint is the WSP.

3. 1. 5. ALIGN (PRWD, L, FT, L) >> WSP, ITL: ('LH) feet are permitted word-initially only

There are, however, contexts where the WSP and the ITL are clearly violated. Consider again the examples in (18), where an initial light syllable is stressed, forming a weight-disrespecting ('LH) trochee with the following heavy syllable. Thus, in

(34) À.vant.gar.díst 'avantgardist'
('L H) H

we find precisely those non-canonical trochees that are excluded by the WSP and the ITL in word-medial contexts. We will attribute this fact to the influence of the constraint ALIGN (PRWD, L, FT, L) which outranks WSP and ITL. We see that ('LH) trochees *are* a possibility in German, but at the same time we can conclude that the environment where they appear is very restricted. They surface only word-initially, where the WSP and the ITL are overridden by the alignment constraint requiring the left edge of the prosodic word to be aligned with the left edge of a foot. In the following tableau we can see the three constraints at work:

Tableau 8

Candidates	ALIGN (PRWD, L, FT, L)	WSP	ITL
☞ (a) (À.vant)gar.(díst)		*	*
(b) A.(vànt).gar.(díst)	*!		

Candidate (a) will win, although it violates both the WSP and the ITL leaving the second, heavy syllable unstressed; candidate (b), which would satisfy them, must lose, because it violates alignment of the left edge of the prosodic word with the left edge of a foot.[12]

3. 1. 6. *CLASH >> WSP: alternating stress on heavy syllables

This ranking reflects the fact that heavy syllables remain unstressed in contexts where stressing would generate a clash. This can be seen clearly in the parsing of sequences of heavy syllables, where only every other syllable is stressed (cf. also (19)):[13]

(35) Pèr.ver.si.t´ät 'perversity'
('H H) L

Which of the two heavy syllables is stressed is determined by the alignment constraints, either by ALL-FT-L, or, as in this case, by ALIGN (PRWD, L, FT, L).

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[12] As mentioned earlier, there is some variation among speakers with respect to this pattern. I conclude that speakers preferring stress on the second syllable allow for the ranking of ALIGN (PRWD, L, FT, L) under the WSP and ITL.

[13]The analysis here is based on the assumption that heavy syllables *do not* bear inherent stress of some degree. If we were to assume that heavy syllables bore inherent stress, we would have to distinguish more than just one level of secondary stress in the case of an ('HH) foot: a weak stress assigned inherently to heavy syllables, and a stronger stress, falling on the head of the ('HH) foot. *CLASH, then should refer only to clash between heads of feet, a solution that seems to complicate the picture unnecessarily.

Tableau 9

Candidates	*CLASH	ALIGN (PRWD, L, FT, L)	WSP	PARSEσ
☞ (a) (Pèr.ver).si.(t´ät)			*	*
(b) (Pèr.)(vèr.)si.(t´ät)	*!			*
(c) Per.(vèr.)si.(t´ät)		*!	*	**
(d) (Pèr)ver.si.(t´ät)			*	**!

The tableau shows that candidate (a) wins, violating the WSP, but satisfying *CLASH. Candidate (b) fails because parsing each heavy syllable into a foot of its own creates a stress clash. Candidate (c) would avoid clash as well, but fails on ALIGN (PRWD, L, FT, L). As to candidate (d), it is indistinguishable in its output form from candidate (a). Our constraint ranking predicts this candidate to fail because it rates worse than the winning candidate on PARSEσ. In fact, nothing in the proposed constraint hierarchy prohibits the parsing of ('HH) trochees, except the WSP, and this constraint must be violated here in any case to satisfy high-ranked *CLASH. But note that similarly to the exclusion of ('HL) feet, the presence of ('HH) feet is not visible in German, but is given here as the predicted outcome of the constraint hierarchy.

Note that the behavior of sequences of heavy syllables also gives us a strong argument to rule out candidate (c) in tableau 5. Although this candidate was not clearly excluded as a possible pronunciation, we can rule it out now because of the ranking *CLASH >> WSP, which we have established on independent grounds.

Finally, let us note that these cases of sequences of heavy syllables stressed in an alternating fashion contribute largely to the impression of quantity insensitivity in the distribution of secondary stress. Syllable weight seems to be of no importance for foot-parsing. Thus the constraint *CLASH is quite crucial in disguising quantity sensitivity.

3. 1. 7. *CLASH and the top of the hierarchy

In principle, it should be possible to determine the ranking of *CLASH and ALIGN (PRWD, L, FT, L) with respect to each other. The crucial cases are words with one heavy syllable preceding main stress:

(36) Sex.tánt 'sextant'
H

Due to the high ranking of RIGHTMOST, the position of main stress cannot be changed by shifting stress to the initial syllable and thus satisfying both ALIGN (PRWD, L, FT, L) and *CLASH . This means that in words of this structure the constraints against stress clash and the constraint requiring initial stress are directly competing with each other. If a secondary stress falls on the first syllable, the requirement of initial stress will be satisfied, but *CLASH will be violated; if the first syllable remains stressless, a stress clash is avoided, at the cost of an ALIGN (PRWD, L, FT, L) violation. Since in German there is no process (such as vowel reduction in English) connected to the absence or presence of secondary stress, it is extremely difficult to judge whether in these cases the first syllable does or does not bear secondary stress. Note that glottal stop insertion isn't a possible test here either, since the foot edge of the initial syllable would coincide with the left edge of the prosodic word, where generally a glottal stop is inserted in any case even in the varieties of German where glottal stops are not inserted before morpheme-internal feet. I will therefore leave open the question of the ranking of the two constraints *CLASH and ALIGN (PRWD, L, FT, L).

As for the ranking of RIGHTMOST and *CLASH we must conclude that these two constraints never compete with each other. There is no context where RIGHTMOST can be satisfied at the cost of violating *CLASH, or where *CLASH is observed at the cost of a RIGHTMOST violation. Wherever a conflict between the two constraints could emerge, it will be resolved by violating the low ranked PARSEσ, by simply not parsing into feet the syllables that could create a stress clash. Take e.g. a word-final sequence as ...HH#. Unless the penultimate syllable can be incorporated into a foot with the antepenultimate syllable, the optimal parse will be ...H('H), a structure that violates low ranked PARSEσ and the WSP, but that satisfies both *CLASH and RIGHTMOST.

Also in contexts where the constraint TROCH could be in conflict with *CLASH, exhaustive underparsing will be chosen instead of violating either one of the high ranked constraints. In principle, parsing an iamb and thus violating TROCH could be a means of avoiding a stress clash, as in the first three syllables of

(37) *(èx).pe.rì.men.tíe.ren 'to experiment'
('H)(L 'L) H ('H H)

But, as we have already discussed, multiple violation of PARSEσ is preferred instead:

(38) èx.pe.ri.men.tíe.ren 'to experiment'
('H)L L H ('H H)

As for the ranking between *CLASH and FT-BIN, there is simply no context where these two constraints could conflict. Creating a degenerate ('L) foot could at most lead to a stress clash with adjacent syllables and the creation of feet with more than two syllables cannot be a better means for avoiding it than the creation of disyllabic feet.

Finally, while *CLASH clearly dominates the WSP, the ranking of this constraint with respect to the ITL cannot be established either. The typical situations where stress clash arises in a trochaic language are sequences where a stressed heavy syllable is followed by another potentially stress bearing syllable:

(39) a. ('H)('LH)
b. ('H)('LL)
c. ('H)('H)

In the examples of the type (a) and (b), both *CLASH and the ITL can be satisfied at the cost of the low ranked PARSEσ by skipping the light syllable following the heavy one:

(40) a. ('H)L('H) **Àr.gu.mèn**.ta.tión 'argumentation'
b. ('H)L('L **Èn.zy.klò**.pä.díe 'encyclopedia'

and the clash in (c) can be resolved by incorporating two heavy syllables into a foot, a parsing that wouldn't violate the ITL in any case

(40) c. ('HH) **Pèr.ver**.si.t´ät 'perversity'

3. 1. 8. FT-BIN, TROCH >> RIGHTMOST: main stress is assigned rightmost, - but always to the head of a binary trochee.

All loan-words obey the top-ranked constraints FT-BIN and TROCH, even if this entails a minimal violation of RIGHTMOST. In

(41) Ès.pe.rán.to 'esperanto'
('H)L ('H) L

main stress falls on the penultimate syllable. A better rating on RIGHTMOST, with stress falling on a final, light syllable, is not possible, since this would violate either FT-BIN (parsing a degenerate monomoraic foot, cf. candidate (b)) or TROCH (parsing an iamb, cf. candidate (c)):

Tableau 10

Candidates	FT-BIN	TROCH	RIGHTMOST
☞ a) Es.pe.(rán).to			σ
b) Es.pe.ran.(tó)	*!		
c) Es.pe.(ran.tó)		*!	

The conclusion is that, even if the constraints determining the position of main stress impose their requirements on most of the stress pattern constraints, also main stress assignment is subject to higher ranked constraints which cannot be violated and thus main stress can never fall on a final light syllable.

Note also that the three constraints discussed here are solely responsible for the quantity sensitivity of main stress assignment mentioned earlier. Main stress assignment cannot skip a heavy penultimate syllable, because this would violate RIGHTMOST without any improvement on foot structure. Precisely because it is heavy, a heavy penultimate can form a binary trochee and thus has to be assigned main stress in order to satisfy best RIGHTMOST.[14] The WSP doesn't play any role in the quantity-sensitive characteristics of main stress assignment and therefore it is not relevant that it is dominated by RIGHTMOST.

3. 2. Conclusions

The overall picture emerging from the proposed hierarchy is that of a language where the edges of the prosodic word have a rather rigid structure. At the right edge, main stress has to be assigned, as much to the right as possible, and - if we abstract away from extrametricality effects - only in the limits of FT-BIN and TROCH. At the left edge the high ranked ALIGN (PRWD, L, FT, L) ensures initial stress, regardless of the weight of the initial syllable. Only word-medially, in the space that runs from the third syllable to the main stressed syllable, the rhythmical pattern of secondary stress develops freely and the influence of the lower ranked stress pattern constraints emerges. Feet are parsed exhaustively in a left-to-right fashion (cf. *(ò.no).(mà.to).po.(é).tisch*), with a strong ban against clash leading to alternating stress on sequences of heavy syllables (cf. *(Pèr.ver).si(t´ät)*), but where heavy syllables *do* attract stress when no risk of clash arises (cf. *(Àu).to.de.(tèr).mi.(nís).mus*).

Thus, the partial quantity sensitivity of German loan-words is due to the complex interaction of the constraints described above. ALIGN (PRWD, L, FT, L) will obscure weight effects at the left edge of the prosodic word. *CLASH will ensure that heavy syllables are followed by a stressless syllable, either by incorporating a following heavy syllable into an ('HH) foot, or by skipping a following light syllable, parsing ('H)L, creating thus an apparently quantity-insensitive pattern.

On the other hand, the WSP will favor weight effects word-medially, where ALIGN (PRWD, L, FT, L) is satisfied vacuously and wherever no risk of stress clash arises. Finally, the ITL will disrupt a strictly alternating stress pattern, banning ('LH) trochees in word-medial position (cf. *(èx).pe.ri.men.(tíe).ren*). WSP and ITL can assert their force even at the cost of extensive underparsing and of violating the optimal alignment of every foot to the left edge of the prosodic word.

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[14] On the other hand, a final heavy syllable can be skipped because some words are subject to the constraint NONFINALITY, preventing the final syllable from bearing stress.

In sum, German loan-word stress is partially quantity-sensitive because the constraints that favor weight effects are located in an intermediate position in the constraint hierarchy: below the constraints ALIGN (PRWD, L, FT, L) and *CLASH, but above PARSEσ and ALL-FT-L.

4. Finnish

The Finnish data presented here is based on Carlson (1978), when not noted otherwise, and has been verified with native speakers. I will not consider here the cases of optionality discussed in Carlson, which would complicate the comparison with the German stress system.[15] A recent constraint based analysis of Finnish stress can be found in Hanson & Kiparsky (1996). For an earlier discussion of the partially quantity-sensitive characteristics of Finnish stress see Kager (1992, 1993b). The pattern of Finnish stress can be summarized as follows, where syllables containing a long vowel or closed in a consonant are heavy:

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[15] Carlson (1978) observes that overlong syllables (i.e. syllables containing a long vowel and a coda consonant) optionally attract stress (i.a) even where a heavy syllable normally would be stressless (i.b):

(i)	(a)	rá.kas.tel.**làan**.ko 'L H H 'H L	or	(b)	rá.kas.tèl.**laan**.ko 'L H 'H 'H L	'to love, question'

Moreover, Carlson notes that word-final syllables are metrically ambiguous. Stress can fall on a final heavy syllable, but it can also fall on a preceding light syllable:

(ii)	(a)	táis.te.le.**vàn** 'H L L **'H**	or	(b)	táis.te.**lé**.van 'H L **'L** H	'fighting'

Kager (1993b) treats final consonants as extrametrical, but Carlson cites also a single case where a final heavy syllable containing a long vowel is stressless. He doesn't give any optional pronunciation with final stress in this case:

(iii)	ká.his.**té**.lee 'L H **'L** H	'rustle, 3rd sg. pres.'

It is clear that some extrametricality phenomenon is involved here, but more data is required to allow for a detailed analysis. For the purpose of the present analysis I will consider only the pronunciation in (ii.a), where final heavy syllables behave in the same way as heavy syllables word-medially.

(42) - main stress falls on the first syllable, regardless of its weight:

#'Lσ ...	rá.kas.tèl.laan.ko	'to love, question'
	ló.pe.tè.ta[16]	'finish, neg.'
#'Hσ ...	táis.te.lè.van	'fighting'
	pér.ke.le	'devil'

- secondary stress falls on every odd-numbered syllable, counting from the left, except when the syllable is light and followed by a heavy one. In that case stress falls on the (even-numbered) heavy syllable. If alternating stress is thus interrupted, counting resumes with the heavy syllable:

'σσ'LL'LLL	ó.pet.tè.le.mà.na.ni[17]	'as something I have been learning'
'σσ L'HL	ó.pet.ta.màs.sa	'at teaching, iness.'
'σσ L'HLL'HL	vá.lis.tu.màt.to.mi.àn.ne	'your uneducated'
'σσ'HLL'HHL	j´är.jes.tèl.mä.li.s`yy.del.lä	'systematicity'

The constraint hierarchy I propose for Finnish is the following:

(43) FT-BIN, TROCH, *CLASH, LEFTMOST
| |
WSP ITL
|
PARSEσ
|
ALL-FT-L

As we can see, the lower part of the hierarchy is identical to the one established for German loan-words. The most conspicuous difference with respect to German consists in the fact that in Finnish main stress falls on the first syllable of the prosodic word, i.e. Finnish has a high ranked constraint LEFTMOST, the mirror image of the constraint RIGHTMOST, active in German:

[16] Kiparsky (1991), as reported in Kager (1993b).
[17] Kiparsky (1991), as reported in Kager (1993b).

(44) LEFTMOST = ALIGN (PRWD, L, HEAD (PRWD), L)
∀ prosodic word ∃ head of the prosodic word such that the left edge of the prosodic word and the left edge of the head coincide.

The constraint ALIGN (PRWD, L, FT, L) is lacking from the hierarchy, since its requirements are already subsumed under the requirements of LEFTMOST. Finally, in Finnish there are no cases like *experimentieren* in German, where some additional constraint besides the WSP is necessary to rule out ('LH) feet. And, as in German, it is not possible to determine with absolute certainty the absence or presence of ('HL) feet. Hence it is not possible to determine the exact position of the ITL or whatever constraint for it militates against ('LH) and ('HL) trochees in metrical systems. However, as we will see, the ITL is violated when satisfaction of LEFTMOST is at stake, and therefore must be dominated by this constraint.

Due to the intermediate position of the WSP, Finnish, just as German, is a partially quantity-sensitive language and thus gives evidence for the inappropriateness of a parameter of quantity sensitivity. As in German, quantity-insensitive parsings are triggered on the one hand by an alignment constraint that targets the left edge of the prosodic word and, on the other hand, by the high ranking of the constraint *CLASH that makes sure that syllables following stressed heavy syllables remain stressless. But, again as in German, there are contexts where heavy syllables attract stress and quantity sensitivity emerges.

Finnish parses feet exhaustively in a left-to-right fashion, the typical pattern generated by PARSEσ dominating the constraint ALL-FT-L. Take words with an odd-numbered sequence of light syllables:

(45) ó.pet.tè.le.mà.na.ni 'as something I
('LH)('LL)('L L) L have been learning'

The tableau shows that candidate (a) wins, where most syllables are parsed into feet and all feet are aligned as much as possible to the left. As in German, (c), with perfect alignment of all feet to the left and (b), with misalignment of the second foot, must fail.

Tableau 11

Candidates	PARSEσ	ALL-FT-L
☞ (a) (ó.pet).(tè.le).(mà.na).ni	*	σσ σσσσ
(b) (ó.pet).te.(lè.ma).(ná.ni)	*	σσσ σσσσσ!
(c) (ó.pet).te.le.ma.na.ni	*****!	

The same example shows us that LEFTMOST, the constraint regulating main stress assignment, overrides the WSP.

(46) **ó. pet**.tè.le.mà.na.ni 'as something I
('L H) have been learning'

Thus, in the following tableau, candidate (a) wins, although it violates the WSP, because it satisfies the requirement of initial main stress. Candidate (c), which would satisfy LEFTMOST and the WSP, must fail, because it violates FT-BIN and *CLASH.

Tableau 12

Candidates	FT-BIN	*CLASH	LEFTMOST	WSP
☞(a) (ó.pet).(tè.le).(mà.na).ni				*
(b) o.(pét).(tè.le).(mà.na).ni			σ!	
(c) (ó).(pèt).(tè.le).(mà.na).ni	*!	*!		

LEFTMOST here has the same effect as ALIGN (PRWD, L, FT, L) had in German. The prosodic word has to begin with a stressed syllable and therefore a quantity-disrespecting ('LH) trochee is allowed in this context. The possibility of ('LH) at the beginning of the word indicates that LEFTMOST must dominate the ITL as well.

The WSP is not only dominated by LEFTMOST, but also by a constraint against stress clash. In sequences of heavy syllables stress is assigned in an alternating fashion, violating the WSP every other syllable and creating the impression of a quantity-insensitive parsing.

(47) j´är.jes.tèl.mä.li.s`yy.del.lä 'systematicity'
('H H) (H)[18]L L ('H H) L

Tableau 13

Candidates	*CLASH	WSP	PARSEσ
☞ (a) (j´är.jes).(tèl).mä.li.(s`yy.del).lä		**	***
(b) (j´är).(jès).(tèl).(m`ä.li).(s`yy).(dèl.lä)	****!		

(b) would be a typical output for a quantity-sensitive language: every heavy syllable bears stress. Moreover, it would also rate better on PARSEσ, incorporating all syllables into feet. But the violations of *CLASH are fatal and candidate (a) wins.

However, the WSP asserts its force in contexts where heavy syllables can attract stress without violating *CLASH or LEFTMOST. And it is here, word-medially and with a light syllable preceding the heavy one and creating thus a buffer against stress clash, that quantity sensitivity emerges, at the expense of leaving syllables unparsed and aligning feet worse to the left. Take the example

(48) vá.lis.tu.**màt**.to.mi.**àn**.ne 'your uneducated, part. pl.'
('LH) L ('H) L L ('H)L

In this example, the heavy syllables *-mat-* and *-an-* attract stress, and a preceding odd-numbered syllable is skipped[19] for stress assignment. This parsing violates ALL-FT-L, but allows to satisfy the WSP. Also PARSEσ is violated more often than it would be in a parsing that ignores the requirement of heavy syllables to be stressed:

(49) *vá.lis.tù.**mat**.tò.mi.**àn**.ne
('LH)('L H)('L L)('H) L

---

[18] Since it cannot be determined whether Finnish allows ('HL) feet, it remains unclear, if in these cases a heavy syllable followed by a light syllable is parsed as ('H)L, or if the light syllable is incorporated. For concreteness, I will assume that ('HL) feet are not allowed.
[19] Cf. Kager (1993b) for an alternative analysis of skipping of light syllables in Finnish and the markedness of ('LH) feet (cf. section 3). Hanson & Kiparsky (1996) attribute skipping entirely to the markedness of ('LH) feet (cf. their constraint EUPODY).

The tableau shows us the competition of the two candidates:[20]

Tableau 14

Candidates	WSP	PARSEσ	ALL-FT-L
☞ (a) (vá.lis).tu.(màt).to.mi.(àn).ne		****	σσσ σσσσσσ
(b) (vá.lis).(tù.mat).(tò.mi).(àn).ne	*!	*	σσ σσσσ σσσσσσ

The output of the winning candidate would be compatible with yet another foot structure, a structure where the third and the fourth and the sixth and the seventh syllable are parsed together into iambs:[21]

(50) vá.lis.**tu.màt**.to.**mi.àn**.ne 'your uneducated, part. pl.'
('L H)**(L'H)** L **(L 'H)** L

To generate this pattern, we would have to modify our constraint hierarchy into a ranking where the constraint TROCH is dominated both by the WSP and PARSEσ. It would mean that an iamb can be created when this allows to make heavy syllables prominent and to parse more syllables into feet. Such a ranking, however, would lead to problems when applied to another set of structures. Consider the example

(51) pér.ke.le 'devil'
('H) L L

If TROCH was really ranked below PARSEσ, then also in these cases creating an iamb would be an elegant means to simultaneously escape stress clash and parse all syllables into feet, as in the unattested

[20] In the following tableau, the winning candidate counts, as a whole, less ALL-FT-L violations than the losing candidate simply because it parses less feet. Note, however, that this depends also on the length of the word. In an example like

(i) ó.pet.ta.màs.sa 'at teaching, iness.'
('LH) L ('H) L

ALL-FT-L is violated more often by the second foot than it would be, if stress was assigned to the third syllable.

[21] an anonymous HILP-reviewer informs me that this structure was actually proposed by Kiparsky (1991) in an unpublished talk at BLS.

(52) *pér.ke.lè
('H)(L 'L)

We conclude that the only ranking compatible with all the data is one where TROCH is ranked above PARSEσ and hence underparsing is preferred to the parsing of iambs.

Summarizing, Finnish is partially quantity-sensitive in a very similar sense as the German loan-word lexicon and thus shows that the phenomenon of partial quantity sensitivity is by no means exceptional. At the left edge of the prosodic word syllable weight has no effect on metrical structure, due to the high ranked constraint LEFTMOST. The high ranking of *CLASH makes sure that stress cannot resume right after a heavy syllable and this again leads to a pattern with quantity-insensitive characteristics. On the other hand, the WSP overrides the requirements of PARSEσ and ALL-FT-L, leading in certain word-medial contexts to a quantity-sensitive parsing that disrupts strictly alternating stress. In both languages partial quantity sensitivity is due to the intermediate position of the WSP in the constraint hierarchy. Weight-effects will disappear whenever this constraint is violated in order to respect higher ranked constraints and they will appear when the WSP can fulfill its requirements at the cost of lower ranked ones.

5. Estonian

Estonian is a language where the effects of quantity-sensitivity are obscured almost completely because of the high ranking of the constraints *CLASH, PARSEσ and ALL-FT-L on the one hand and the low ranking of the WSP and the ITL on the other. In fact, it has often been analyzed as a language that - except in a very specific context - parses weight-disrespecting syllabic trochees (cf. Hayes 1995; Kager 1992). Under our approach, it is not necessary to assume that Estonian is quantity-insensitive, nor that it is quantity-sensitive, since the concept of parametrization for quantity sensitivity has lost its value. Rather, it is a language where constraints favoring the effects of syllable weight on metrical structure are bottom-ranked, while constraints militating against such effects are in a dominating position. Estonian parses trochees just as Finnish and German, and the syllabic-trochee-effect is due to the fact that this language prefers to parse all syllables into feet, to align all feet to the left and to avoid stress clashes.

In what follows, I will adopt, with minor modifications, the constraint based analysis for Estonian proposed by Kager (1994).[22] I will ignore the phenomena of (optional) ternary rhythm and overlength, discussed in detail in Prince (1980), Kager (1994) and Hayes (1995) (see also Bye, this volume). Data is from Prince (1980), if not otherwise noted. The constraint hierarchy of Estonian is as follows:

```
(53)    FT-BIN, TROCH, *CLASH, LEFTMOST
                              |
                           PARSEσ
                          /    |
                         /  ALL-FT-L
                        /      |
                     ITL      WSP
```

[22] Kager doesn't note in the constraint hierarchy a constraint like the ITL, since in fact this constraint has no effects in Estonian. Here it has been introduced into the analysis to allow for a comparison with German. The WSP plays a minor role in his analysis because of the introduction of the constraint PARSE-2 and the splitting up of ALL-FT-L. Kager proposes to substitute PARSEσ with the constraint PARSE-2, a constraint that requires that one of two adjacent stress units (syllables or moras) be parsed into a foot. This constraint is independently needed for the analysis of weak local parsing, but, as Kager notes, substituting it for PARSEσ entails a modification of the constraint ALL-FT-L. Practically, ALL-FT-L has to be split up into a series of constraints, ALL-FT$_1$-L, ALL-FT$_2$-L, ALL-FT$_3$-L ..., evaluating left alignment on a foot-by-foot basis. I won't substitute PARSE–2 for PARSEσ, since splitting up ALL-FT-L into a series of constraints could make it possible in a language to interleave the series of ALL-FT-L constraints with other constraints, e.g.:

(i) ALL-FT$_1$-L >> ALL-FT$_2$-L >> WSP >> ALL-FT$_3$-L ...

This could lead to the rather strange prediction that there might be a language where the third foot observes the WSP (skipping for example a light syllable preceding a heavy one, just as in Finnish), while the second foot doesn't. However, Kager's analysis can be maintained as a whole, even if both PARSEσ and PARSE–2 are integrated into the constraint hierarchy. Finally, I won't follow Kager's distinction of two *CLASH constraints, one specified for the syllable, the other for grid marks, simply because this distinction becomes relevant only for the treatment of overlong syllables.

As German and Finnish, Estonian is a trochaic language, and, as in Finnish, main stress falls on the first syllable. In other words, the constraints FT-BIN, TROCH and LEFTMOST are top-ranked, and from now on we won't consider candidates which violate any of these constraints. But differently from the two languages discussed earlier, in Estonian the constraint which is mostly responsible for weight-effects, the WSP, is bottom-ranked, and differently from German the ITL as well must be low-ranked. Estonian is therefore a language where the effects of syllable weight on metrical structure will emerge in even less contexts than in German and Finnish.

Let us now consider the single rankings in detail. PARSEσ >> ALL-FT-L generates a stress pattern of left-aligning feet, as we can see in words with odd-numbered sequences of light syllables:

(54) pí.mes.tà.va.le 'blinding, ill. sg.'
('L H) ('L L) L

Tableau 15

Candidates	PARSE σ	ALL-FT-L
☞ (a) (pí.mes).(tà.va).le	*	σσ
(b) (pí.mes).ta.(vá.le)[23]	*	σσσ!
(c) (pí.mes).ta.va.le	***!	

Underparsing (candidate (c)), or worse alignment (candidate (b)) leads to failure.

Up to here Estonian is identical to Finnish. However, if we consider word-medial ...LH... sequences, we see that in Estonian in these cases stress can fall on a light syllable followed by a heavy one:

(55) pí.mes.tà.vas.se 'blinding, ill. sg.'
('LH) ('L H) L

Both the WSP and the ITL are clearly violated here, but with this violation a better rating on PARSEσ and ALL-FT-L can be obtained. In the

[23] Candidate (b), however, is possible under the optional ternary parsing, similarly to candidate (b) in the following tableau.

following tableau, candidate (b), where the fourth, heavy syllable bears stress, must lose, because two syllables are not parsed into feet. Also candidate (c), which would rate equally well as (a) on PARSEσ, at the cost of an ITL violation, is no possible parse, because the second foot is misaligned by three syllables against the two violations of ALL-FT-L of the winning candidate.

Tableau 16

Candidates	PARSE σ	ALL-FT-L	WSP	ITL
☞ (a) (pí.mes).(tà.vas).se	*	σσ	*	*
(b) (pí.mes).ta.(vàs).se	**!	σσσ		
(c) (pí.mes).ta.(vàs.se)	*	σσσ!		*

Thus, the ranking of PARSEσ and ALL-FT-L over WSP and ITL is crucial here to create the impression of a quantity-insensitive parsing.

The ranking of *CLASH over the WSP is the other ranking that, as in German and Finnish, leads to a strictly alternating stress pattern. As illustrated before, the effects of this ranking become visible in sequences of heavy syllables, as e.g. in:

(56) kín.nas<t> 'glove, part. sg.'
('H H)

Again, parsing two heavy syllables into a foot (cf. (a)), is preferred to a stress clash between adjacent heavy syllables.

Tableau 17

Candidates	*CLASH	WSP
☞ (a) (kín.nast)		*
(b) (kín.)(nàst)	*!	

With these rankings we would already have demonstrated where most of the quantity disrespecting effects of the Estonian stress pattern come from. The ranking of *CLASH over PARSEσ and ALL-FT-L eliminates the remaining cases. Consider an example like

(57) `γp.pet.tà.yat.tèk<s>
('H H) ('L H) ('H)
(Hint 1973, reported in Hayes 1995; no glosses are given)

If *CLASH was dominated by ALL-FT-L, a parsing as in

(58) *`γp.pèt.ta.yàt.teks
('H)('H L)('H H)

should be optimal: it would rate equally well on PARSEσ, violate the WSP only once and, crucially, obtain a better result on ALL-FT-L. But satisfaction of the lower ranked constraints would be obtained at the cost of a stress clash. The ranking of *CLASH over ALL-FT-L ensures that this possibility is not open. As the following tableau shows, the winning candidate is again the one with alternating stress assignment.

Tableau 18

Candidates	*CLASH	ALL-FT-L
☞ (a) (`γp.pet).(tà.yat).(tèks)		σσ σσσσ
(b) (`γp).(pèt.ta).(yàt.teks)	*!	σ σσσ

Finally, *CLASH dominates PARSEσ and thus makes sure that a stress clash cannot arise in ...HLL# sequences, even when a ...('H)('LL)# parsing would rate better on PARSEσ. Thus the right parsing is

(59) vá.lu.sàt.te.le
('L L)('HL) L
(Hint 1973, reported in Hayes 1995; no glosses are given)

again with strictly disyllabic feet, and not

(60) * vá.lu.sàt.tè.le
('L L)('H)('L L)

with a stress clash between third and fourth syllable. The tableau shows the competition between *CLASH and PARSEσ in these contexts:

Tableau 19

Candidates	*CLASH	PARSEσ	ALL-FT-L	WSP	ITL
☞ (a) (vá.lu).(sàt.te).le		*	σσ		*
(b) (vá.lu).(sàt).(tè.le)	*!		σσ σσσ		
(c) (vá.lu).sat.(tè.le)		*	σσσ!	*	

Candidate (a), with a strictly alternating stress pattern wins, because, in contrast to (b), it respects *CLASH. (c) represents yet another attempt to avoid stress clash, by underparsing the heavy syllable. It fails because of the additional violation of ALL-FT-L.

So far, the hierarchy established has generated a strictly disyllabic pattern. There is, however, a context, where Estonian parses monosyllabic feet. This is the case in words with an odd number of syllables where the final syllable is heavy:

(61) ká.va.làtt 'cunning, part.sg.'
('L L)('H)

In these words the final syllable is parsed into a foot of its own, thus defeating any analysis that would postulate strictly disyllabic feet for this language. Kager's (1994) analysis, which we have adopted here, can account for this. In word-final position no clash with a following syllable can arise. Thus, in this context a heavy syllable, being bimoraic, *can* form a foot of its own and, in order to obey PARSEσ, it *must* form a foot. It is in this sense, that quantity-sensitivity emerges and candidate (a) wins over candidate (b) in tableau 20. The fact that the constraint PARSEσ with its requirement of exhaustive parsing plays an important role in the parsing of word-final monosyllabic feet is reminiscent of the explanations given in earlier work on Estonian for the divergence from disyllabic parsing in these contexts (Prince 1980; Hayes 1995).

Tableau 20

Candidates	*CLASH	PARSE σ	ALL-FT-L	WSP	ITL
☞ (a) (ká.va).(làtt)			σσ		
(b) (ká.va).latt		*!		*	

Summarizing, Estonian is a language where the same constraints observed in German and Finnish - in a different ranking - generate a pattern where the effects of syllable weight on stress assignment are almost completely obscured, due to the low position of the WSP and the ITL in the hierarchy. As in German and Finnish, *CLASH dominates the WSP, PARSEσ and ALL-FT-L and thus stress assignment can never be resumed right immediately after heavy syllables.

In addition, in Estonian PARSEσ and ALL-FT-L dominate the WSP and the ITL, and hence sequences of light syllables followed by heavy ones will be parsed with stress falling on the light syllable:

(62) ... LHLH ... -> ... ('LH)('LH) ...

The result is a stress pattern with stress on every other syllable, final heavy syllables in words with an odd number of syllables being the only ones that escape an analysis in terms of disyllabic feet.

6. Complete quantity insensitivity

Up to now, we have given evidence for the fact that the parameter of quantity sensitivity is not adequate. The stress systems of German, Finnish and Estonian cannot be analyzed by parsing strictly disyllabic feet, nor do these languages display a typical quantity-sensitive pattern. If we assume that they are parametrized as quantity-insensitive, then additional principles are necessary to explain why, for example, Finnish skips word-medial light syllables and Estonian can parse wordfinal, but not word-initial monomoraic feet. Of course, explanations have been given in the literature for the divergence of these systems from strict disyllabic parsing, repair strategies have been proposed, and in part these very same explanations have been encoded here as constraints. The claim made here is that these principles, such as avoidance of stress clash, or exhaustive parsing, when considered to be ranked violable constraints, can alone generate patterns where the stress attracting force of heavy syllables is respected and patterns, where it is not. There is no need to postulate, in addition, a parameter of quantity sensitivity. With Estonian we have seen a language where the constraints responsible for weight effects are already ranked at the very bottom of the hierarchy, generating an almost completely quantity-insensitive parsing. However, to prove that we can do without a parameter of quantity sensitivity, we have to show that we can also generate a completely quantity-insensitive pattern, possibly using the same constraints, but in a different ranking.

Kager (1992, 1993a) distinguishes *truly quantity-insensitive* systems from *trivially quantity-insensitive* systems. The former do have weight distinctions (e.g. distinctive vowel length, or a bimoraic word-minimum) but don't respect syllable weight in metrical parsing, the latter don't have any weight distinctions (e.g. they have only CV syllables) and therefore weight, trivially, cannot play any role in stress assignment (cf. also McCarthy & Prince 1986, Hayes 1995). Kager proposes that *truly quantity-insensitive* systems don't exist. Rather, all languages that have weight-distinctions display also some influence of syllable weight on metrical structure. Evidence for this hypothesis comes from a survey made by Kager on a large number of Australian languages, showing that practically all languages that have weight distinctions and a seemingly quantity-insensitive foot parsing, do also allow for monosyllabic feet in certain contexts. If Kager's hypothesis turns out to be right, we can end our analysis here. In other words, with Estonian we will have already found a language that displays as much a quantity-insensitive pattern as can be found in the world's languages. Note, however, that if a language should be found that has distinctive vowel length or a bimoraic word-minimum, but strictly parses disyllabic feet, then such a language could be analyzed all the same with the constraints discussed above, plus the addition of some modified version of the well-known constraint NONFINALITY (cf. Prince & Smolensky 1993) which targets not just syllables bearing main stress, but stressed syllables in general:

(63) NONFINALITY: the head of a foot must not be final

This constraint, when ranked above PARSEσ and the WSP in a constraint hierarchy as the one established for Estonian, can exclude exactly those cases that in Estonian still display weight-effects. No stress on final heavy syllables will be possible any more, because underparsing and a violation of the WSP are preferred to final stress.

7. Conclusions

In this paper I have shown that a rather limited set of stress pattern constraints can generate metrical systems of varying degrees of quantity sensitivity, from the 'more' quantity-sensitive systems of German loanwords and Finnish over the almost quantity-insensitive system of Estonian to a completely quantity-insensitive system. The constraints used in the analysis reflect regularities known from the very beginning of metrical theory: languages tend to parse syllables exhaustively into feet, heavy syllables attract stress, stress clashes are often avoided etc. Optimality theory, with its assumption that constraints are violable and organized in a domination hierarchy, offers us the possibility to derive more or less quantity-sensitive stress patterns using the same set of constraints in different rankings. The parts of the constraint hierarchy of the three languages that is crucial for the degree of quantity sensitivity they display is repeated here for reference:

German and Finnish:	*CLASH >> WSP >> PARSEσ >> ALL-FT-L
Estonian:	*CLASH >> PARSEσ >> ALL-FT-L >> WSP

The goal of the paper has been achieved in so far as it shows that hierarchies of violable constraints can derive both quantity-insensitive and partially quantity-sensitive languages. It is also quite clear how the same constraints can derive the typical quantity sensitive pattern (such as Egyptian Radio Arabic, analyzed by Hayes 1995 as strictly parsing moraic trochees), by ranking at the top of the hierarchy the constraints triggering weight effects (most importantly the WSP) and at the bottom constraints erasing them (e.g. *CLASH), reversing thus the hierarchy of languages such as Estonian:

Typical quantity-sensitive language:

WSP >> PARSEσ >> ALL-FT-L >> *CLASH

Here the ranking of WSP >> *CLASH will lead to stress on every single syllable of a sequence of heavy syllables, and the ranking of PARSEσ over *CLASH will prefer the 'quantity-sensitive' parsing ('H)('LL) over ('HL)L. Note also that a constraint banning ('HL) trochees (the ITL?) is crucial here in favoring an ('H)('LL)L parse over the 'quantity insensitive' ('HL)('LL), since the latter would rate better on the constraint PARSEσ.

Many questions have to be left for further research, to begin with the exact status of the constraint ITL, proposed here for the analysis of German. Specifically, it remains to be determined, whether the markedness of ('LH) trochees (besides from effects explainable by the WSP) observed in German, and the markedness of ('HL) feet noted in the literature have a common source in Hayes' iambic-trochaic law.

Moreover, the next step would clearly be to discuss exactly *which* types of quantity sensitivity the system predicts. In order to do this we have to examine all the possible rankings of the constraints discussed, an enterprise that easily covers a paper of its own. Even limiting ourselves to languages with leftaligning trochees and disregarding alignment constraints such as ALIGN (PRWD, L, FT, L), the remaining five constraints *CLASH, PARSEσ, ALL-FT-L, WSP and ITL lead to a factorial typology of 120 possible constraint hierarchies. We may exclude those hierarchies that lead to non-exhaustive parsing, where ALL-FT-L dominates PARSEσ, but we would still remain with the considerable number of 60 hierarchies to be examined. Most probably, some hierarchies will generate equal outputs, especially those that differ only in the ranking of the lowest constraints. Others will differ only in very specific contexts. The degree of variation predicted may seem to be exaggerated, but, if nothing else, the varying degree of quantity sensitivity of the languages discussed shows that there is much more place for variation than usually assumed.

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References

Alber, B. (1997). "Il sistema metrico dei prestiti del tedesco. Aspetti e problemi della teoria prosodica." Ph.D. thesis, University of Padova.

Benware, W. (1980). "Zum Fremwortakzent im Deutschen." *Zeitschrift für Dialektologie und Linguistik* **XLVII. Jg., Heft 3**, 289-312.

Duden Aussprachewörterbuch: Wörterbuch der deutschen Standardaussprache (1974) [2nd edition], edited by M. Mangold. Dudenverlag, Mannheim.

Eisenberg, P. (1991). "Syllabische Struktur und Wortakzent: Prinzipien der Prosodik deutscher Wörter." *Zeitschrift für Sprachwissenschaft* **10**, 37-64.

Carlson, L. (1978). "Word stress in Finnish." Manuscript, Dept. of Linguistics, MIT, Cambridge, Mass.

Féry, C. (1995). "Alignment, syllable and metrical structure in German." SfS-Report-02-95, University of Tübingen.

Giegerich, H. (1985). *Metrical Phonology and Phonological Structure. German and English*. Cambridge University Press, Cambridge.

Hanson, K. & P. Kiparsky (1996). "A parametric theory of poetic meter." *Language* **72/2**, 287-335.

Hayes, B. (1985). "Iambic and trochaic rhythm in stress rules." *Proceedings of the 11th Annual Meeting of the Berkeley Linguistics Society,* edited by M. Niepokuj & M. VanClay & V. Nikiforidou & D.Feder, 429-46.

——— (1986). Review of Giegerich (1985). *Journal of Linguistics* **22**, 229-35.

——— (1995). *Metrical Stress Theory: Principles and Case Studies.* The University of Chicago Press, Chicago.

Hint, M. (1973). *Eesti Keele Sõnafonoloogia I.* Eesti NSV Teaduste Akadeemia, Tallinn, Estonia.

Jessen, M. (1994). "A survey of German word stress." Manuscript, University of Stuttgart.

——— (1995). "German." *Arbeitspapiere des Instituts für Maschinelle Sprachverarbeitung* **4**, 113-39.

Kager, R. (1992). "Are there any truly quantity-insensitive systems?" *Proceedings of the 18th Annual Meeeting of the Berkley Linguistics Society,* 123-132.

——— (1993a). "Alternatives to the iambic-trochaic law." *Natural Language and Linguistic Theory* **11**, 381-432.

——— (1993b). "Shapes of the generalized trochee." *Proceedings of the West Coast Conference on Formal Linguistics* **11***,* 298-312.

——— (1994). "Ternary rhythm in alignment theory." Manuscript, Utrecht University.

——— (1995). Review of Hayes (1995). *Phonology* **12**, 437-464.

Kiparsky, P. (1991). "Quantity sensitivity and the nature of templatic parsing." Paper presented at the 17th Annual Meeting of the Berkeley Linguistic Society.

McCarthy (1995). "Extensions of faithfulness: Rotuman revisited." Manuscript, University of Massachusetts, Amherst.

McCarthy, J. & A. Prince (1986). "Prosodic morphology." Manuscript, University of Massachusetts, Amherst & Brandeis University.

McCarthy, J. & A. Prince (1993a). "Prosodic morphology I: Constraint interaction and satisfaction." Manuscript, University of Massachusetts, Amherst & Rutgers University.

McCarthy, J. & A. Prince (1993b). "Generalized alignment." *Yearbook of Morphology 1993*, edited by G. Booij & J. van Marle, 79-153. Kluwer, Dordrecht.

McCarthy, J. & A. Prince (1995). "Faithfulness and reduplicative identity." *University of Massachusetts Occasional Papers in Linguistics* **18***: Papers in Optimality Theory,* edited by J.Beckman & S. Urbanczyk & L. Walsh, 249-384. Graduate Linguistic Student Association, Amherst.

Muthmann, G. (1991). *Rückläufiges Wörterbuch: Handbuch der Wortausgänge im Deutschen, mit Beachtung der Wort- und Lautstruktur*. Max Niemeyer Verlag, Tübingen.

Pater, J. (1995). "On the nonuniformity of weight-to-stress and stress preservation effects in English." Manuscript, McGill University, Montreal.

Prince, A. (1980). "A metrical theory for Estonian quantity." *Linguistic Inquiry* **11**, 511-62.

——— (1990). "Quantitative consequences of rhythmic organization." *CLS* **26-II**: *Papers from the Parasession on the Syllable in Phonetics and Phonology,* edited by K. Deaton & M. Noske & M. Ziolkowski, 355-398. Chicago Linguistic Society, Chicago.

Prince, A. & P. Smolensky (1993). "Optimality theory: Constraint interaction in generative grammar." Manuscript, Rutgers University, New Brunswick & University of Colorado, Boulder.

Ramers, K.H. (1992). "Ambisilbische Konsonanten im Deutschen." *Silbenphonologie des Deutschen*, edited by P. Eisenberg & K.H. Ramers & H. Vater, 246-83. Narr, Tübingen.

van der Hulst, H. (1984). *Syllable Structure and Stress in Dutch*. Foris, Dordrecht.

Vennemann, T. (1990). "Syllable structure and simplex accent in Modern Standard German." *CLS* **26-II**: *Papers from the Parasession on the Syllable in Phonetics and Phonology*, edited by K. Deaton & M. Noske & M. Ziolkowski, 399-412. Chicago Linguistic Society, Chicago.

Wiese, R. (1996). *The Phonology of German.* Oxford University Press, Oxford.

Wurzel, W.U. (1970). "Der Fremdwortakzent im Deutschen." *Linguistics* **56**, 87-108.

——— (1980a). "Der deutsche Wortakzent: Fakten - Regeln - Prinzipien." *Zeitschrift für Germanistik* **3,** 299-318.

——— (1980b). "Phonologie." *Grundzüge einer deutschen Grammatik*, edited by K.E. Heidolph, 898-988. Akademie-Verlag, Berlin.