Chapter 4

Quantitative meter

4.1 Introduction

At first glance, the subject of syllable weight for poetic meter may appear trivial. Nearly all of the world's quantitative meters are described as exhibiting the same arity and criterion, namely, binary weight with the so-called Latin criterion (i.e. light iff C_0V). To the extent that languages ostensibly vary in the scansion of weight, it is usually attributed to differences in syllabification rather than to weight per se. For example, **V**trV is heavy in Sanskrit but (usually) light in Latin. This difference is conventionally ascribed to syllabification, that is, Vt.rV in Sanskrit vs. V.trV (∼ Vt.rV) in Latin (Steriade 1982; but cf. Steriade 2008). In this sense, Sanskrit and Latin treat weight identically, but diverge in terms of syllable structure.

As this chapter argues, even if one puts aside issues related to syllabification, weight is richly complex in quantitative meter. Indeed, some of the most fine-grained weight scales yet documented for any phonological phenomenon derive from meter (Ryan 2011a, 2011b). In perhaps all such cases, the complexity coexists with a binary criterion. Thus, the conventional analysis of weight as dichotomous is not incorrect; it is just not a complete description of the meter. To give one example, in the Ancient Greek hexameter, heavy syllables are permitted both metron-initially and metron-finally. But metron-final heavies tend significantly to be heavier heavies than metron-initial heavies, all else being equal. From this discrepancy, a continuum of intra-heavy weight is diagnosed, which includes VT < VN < VV < VVC (§4.4.2).

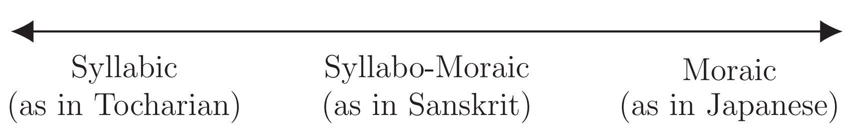


Figure 4.1: The typological range of quantity sensitivity in meter, from purely syllabic to purely moraic.

As background, a meter is termed quantitative if it relates syllable weight or mora count to metrical strength.[1] Quantitative meter is often opposed to accentual meter, which

[1] A definition such as "a quantitative meter is any meter that regulates weight" would belie the standard usage of the term, as even the English iambic pentameter would then be identified as quantitative. For

regulates stress, but in fact a single meter can be simultaneously quantitative and accentual (Ryan 2017b). Quantitative meters vary along a continuum typologically in terms of the importance that they ascribe to syllables vs. moras, as schematized in Figure 4.1. At one extreme are SYLLABLE-COUNTING meters, which fix the number of syllables per line but neglect their weights, as in, for instance, French (Biggs 1996), Georgian (Silagadze 2009), and Tocharian (Bross et al. 2013, 2014) — usually, though not always, languages lacking phonemic vowel length. This label is an oversimplification in two respects. First, "counting" should not be taken literally. If a line requires, say, eight syllables, it need not be because the poet counts to eight; rather, it presumably reflects nested structure with simple constraints such as, "a line/hemistich/foot must be binary" (see §4.6 on the *haiku*). Second, these meters sometimes turn out to exhibit subtle sensitivities to weight and/or stress, even though they do not enforce them rigidly (e.g. Bross et al. 2013 on Tocharian B, Kümmel 2016 on Gathic Avestan). Thus, the true extremes of the continuum in Figure 4.1 — a truly pure syllabic or moraic meter — may not exist. A Tocharian B verse is exemplified in (1) (THT 5 a4–6). Every line of this meter must be 14 syllables, reflecting the colometry $4^{|}3^{||}4^{|}3$ (where $^{||}$ is a major caesura and $^{|}$ a minor caesura).

(1)
a. wñā-neś (po)yśi $^{|}$ karuntsa $^{||}$ mā tañ ñyātstse $^{|}$ śolantse :
b. mā r= asānmeṃ $^{|}$ laitalñe $^{||}$ ceṃ sklok ptārka $^{|}$ pälskomeṃ :
c. kos tne ñakta $^{|}$ pelaikni $^{||}$ (po) śaiṣṣents= ā$^{!}$naiwacci :
d. tary= akṣā-ne $^{|}$ pudñäkte $^{||}$ teki ktsaitsñe $^{|}$ srukalñe 68

At the other extreme are MORA-COUNTING meters, in which each line must contain a fixed number of moras. In the most extreme cases, syllable structure is ignored (again with the caveat that subtle tendencies might obtain). Japanese *haiku*, with its 5-7-5 tercets, is the most famous example. Moraic meter is also found in the *karintaa* chants of the Arawakan language Nanti (Michael 2004). A refrain couplet is followed by verse couplets. The mora counts of the two lines of the refrain are normally duplicated in each verse. Two illustrations are provided in (2). In (a), the moraic pattern is 7-6, and in (b), it is 7-7. Unlike Japanese, nasal codas do not count as moraic in Nanti meter, despite being true codas (Crowhurst and Michael 2005). It can also be seen in (2) that syllable count is not regulated, nor is the distribution of heavies and lights.

(2)

a.	Refrain	iinkiro iinki	7 moras	(5 syllables)
		iinkiro bee	6 moras	(5 syllables)
	Verse	birorityo tyamparo	7 moras	(7 syllables)
		kogapage pini	6 moras	(6 syllables)
b.	Refrain	kee kage kakega	7 moras	(6 syllables)
		kee kage kakega	7 moras	(6 syllables)
	Verse	pairo nopuhoo-	7 moras	(5 syllables)
		nopuhonkatakera	7 moras	(7 syllables)

Most of the world's quantitative meters fall somewhere between these two extremes.

example, for some English poets, a metrical position may be filled by two syllables, but only if the first is light. This is a quantitative restriction, but it concerns position size rather than metrical strength (see Hanson and Kiparsky 1996:299).

Within this range, meters vary widely in how sensitive they are to moras vs. syllables. Vedic Sanskrit meters, for instance, come close to being syllabic, in that lines have fixed syllable counts, but certain positions are regulated for weight (Oldenberg 1888, Arnold 1905, Kiparsky to appear). For example, Vedic meters of the DIMETER type comprise lines of eight syllables each, of which the fifth position is light, the sixth heavy, and the seventh light, as in (3). Positions in the first half of the line — and the ultima — are largely free (notated ×), though they might exhibit a weak tendency towards the iambic pattern implied by the specified positions (Ryan 2014).

(3) ××××⏑–⏑×

The licenses in (3) reflect two putative universals of quantitative meter. First, line-final position is typically indifferent to weight (FINAL INDIFFERENCE). This may be due to final lengthening, which prolongs a final light; it might also be attributed to extrametricality, such that the final syllable is essentially in fermata (Ryan 2013a). Second, endings tend to be stricter than beginnings (FINAL STRICTNESS). These two principles might seem at first blush to be at odds with each other, but the term "final" has different scopes. Final indifference affects only the final syllable, whereas final strictness applies more generally across metrical constituents (but never overrides final indifference). Thus, metrical strictness tends to increase up to the penult, inclusive. Final strictness may follow from prosodic headedness, in that constituents above the metron are head-final (cf. Hayes 1983 on English). For example, if the second hemistich is the head hemistich, mapping constraints can be indexed to the head (cf. Ryan 2017b on Latin and Old Norse). This analysis would comport with natural prosody, where there is a tendency across languages for prosodic constituents above the p-phrase to be right-headed, even in verb-final languages (see §5.13.1). Note that final indifference, as defined, applies only to quantitative as opposed to accentual meters, but final strictness applies to all meters.

Closer to the mora-counting end of the spectrum, some meters exhibit lines of fixed mora count, but impose restrictions on how those moras are distributed in syllables. Take the Sanskrit/Prakrit *āryā* meter (Ollett 2012; cf. also Deo 2007). Each line comprises eight metra (*gaṇa*s). Each metron normally comprises four moras, with two exceptions: First, the line-final metron comprises only a single syllable, of any weight (though it is traditionally scanned as bimoraic even if light; cf. final indifference above). Second, the sixth metron of even lines must be a light syllable. Thus, odd lines have 30 moras, even lines 27. The grouping into four-mora blocks is not merely a descriptive convenience. For one, it rules out certain syllabic configurations a priori. For example, both lines in (4) contain 30 moras. But only (a) is a possible odd-parity *āryā*, since (b) splits a syllable between metra.

(4)
a. –⏑⏑ | –⏑⏑ | –⏑⏑ | –⏑⏑ | –⏑⏑ | ⏑⏑⏑⏑ | –⏑⏑ | – (30 moras)
b. *–⏑–⏑⏑⏑ | –⏑⏑ | –⏑⏑ | –⏑⏑ | ⏑⏑⏑⏑ | –⏑⏑ | – (30 moras)

Moreover, certain metra are internally constrained syllabically. In particular, an odd-parity metron must not be ⏑–⏑, while the sixth metron of an odd-parity line must be ⏑⏕⏑. (⏑–⏑ is special in that it is the only grouping of four moras that cannot be divided into two positions of two moras each.) A descriptive syllabic template for the *āryā* is given in (5) (ignoring boundary requirements), and exemplified by a couplet in Māhārāṣṭrī Prakrit in (6) (*Sattasaī* 148).

(5)

a. $\left\{\begin{array}{c} -\,- \\ -\smile\smile \\ \smile\smile- \\ \smile\smile\smile\smile \end{array}\right\} \left\{\begin{array}{c} -\,- \\ -\smile\smile \\ \smile\smile- \\ \smile\smile\smile\smile \\ \smile-\smile \end{array}\right\} \left\{\begin{array}{c} -\,- \\ -\smile\smile \\ \smile\smile- \\ \smile\smile\smile\smile \end{array}\right\} \left\{\begin{array}{c} -\,- \\ -\smile\smile \\ \smile\smile- \\ \smile\smile\smile\smile \\ \smile-\smile \end{array}\right\} \left\{\begin{array}{c} -\,- \\ -\smile\smile \\ \smile\smile- \\ \smile\smile\smile\smile \end{array}\right\} \left\{\begin{array}{c} \smile\smile\smile\smile \\ \smile-\smile \end{array}\right\} \left\{\begin{array}{c} -\,- \\ -\smile\smile \\ \smile\smile- \\ \smile\smile\smile\smile \end{array}\right\} \left\{\begin{array}{c} - \\ \smile \end{array}\right\}$

b. $\left\{\begin{array}{c} -\,- \\ -\smile\smile \\ \smile\smile- \\ \smile\smile\smile\smile \end{array}\right\} \left\{\begin{array}{c} -\,- \\ -\smile\smile \\ \smile\smile- \\ \smile\smile\smile\smile \\ \smile-\smile \end{array}\right\} \left\{\begin{array}{c} -\,- \\ -\smile\smile \\ \smile\smile- \\ \smile\smile\smile\smile \end{array}\right\} \left\{\begin{array}{c} -\,- \\ -\smile\smile \\ \smile\smile- \\ \smile\smile\smile\smile \\ \smile-\smile \end{array}\right\} \left\{\begin{array}{c} -\,- \\ -\smile\smile \\ \smile\smile- \\ \smile\smile\smile\smile \end{array}\right\} \quad \smile \quad \left\{\begin{array}{c} -\,- \\ -\smile\smile \\ \smile\smile- \\ \smile\smile\smile\smile \end{array}\right\} \left\{\begin{array}{c} - \\ \smile \end{array}\right\}$

(6)

a. ṇiddā|lasapari|ghummira|taṃsava|laṃtad|dhatāra|ālō|ā

b. kāmas|sa vi duv|visahā |diṭṭhiṇi|vāā |sa|simuhī|ē

As mentioned at the outset of this chapter, nearly all quantitative meters observe the Latin criterion (light iff C_0V), whereby codas count for weight. The Khalkha criterion (light iff C_0VC_0), which ignores codas, is considerably less common for metrics than it is for stress (where the two criteria are roughly equally frequent). For example, in his survey of syllable weight across phenomena, Gordon (2006) notes 18 languages with weight-sensitive meter in his sample.[2] Every one employs the Latin criterion. Nevertheless, he offers three caveats. First, Fijian lacks codas, and is therefore actually indeterminate between the Latin and Khalkha criteria. Second, the sample is not genealogically diverse, in that almost all of the meters derive, either by inheritance or borrowing, from two broad metrical traditions, namely, Indo-European and Semitic. For example, Malayalam and Thai are not Indo-European languages, but their meters ultimately descend from Sanskrit. Third, he mentions Kayardild (Evans 1995) as being one case of the Khalkha criterion for metrics, though the language was not included in his core survey.

Nevertheless, this conclusion about Kayardild is not secure from Evans (1995). The relevant passage appears to be a spell for raising the dead, quoted in (7) (p. 597). This is part of a 12-line text, but the remainder of the text, as with Evans' other texts, is prose.

(7)

7.	dangka=tha=ka	raba-nharra	dangka=tha=ka	raba-nharra
8.	riin-ki=ka	mawurru-wa	riin-ki=ka	mawurru-wa
9.	dangka=tha=ka	raba-nharra	dangka=tha=ka	raba-nharra
10.	riin-ki=ka	mawurru-wa	riin-ki=ka	mawurru-wa
	riin-ki=ka	mawurru (sic)		

Evans (1995) notes the "strict 4/4 metre" of this fragment, adding that "the long vowel in *riinki* is metrically equivalent to two short vowels." Thus, the meter is not syllable-counting, since long vowels count for double. But codas are evidently irrelevant, as in *dangka=tha=ka*, where *tha* and *ka* are "syllabic fillers" used to bring the metron up to size, coda [ŋ] being inert. That said, the passage contains only four words, repeated, of which *riinki=ka* is one. It is therefore not strong evidence for an established meter that ignores codas.

Nanti, however, is a strong case for the Khalkha criterion in metrics. As treated above,

[2]These are Arabic, English, Estonian, Fijian, Finnish, Ancient Greek, Hausa, Hindi, Hungarian, Old Icelandic, Japanese, Latin, Luganda, Malayalam, Persian, Tamazight Berber, Telugu, and Thai.

long vowels count as bimoraic for the meter, but coda nasals (the only codas) are ignored. Michael (2004) quotes several lines in which nasals appear not to count towards the moraic total. He notes that the mora count requirement is not entirely rigid (p. 252f), which means that one should approach isolated examples with caution, but the Khalkha criterion appears to be systematic in this case.

A third case that might be mentioned in this connection is Gathic Avestan meter. Avestan is traditionally taken to be syllable-counting, but Kümmel (2016) argues that it also has weight tendencies. As he suggests, these tendencies largely, though not entirely, ignore consonants. On his account, this is because clusters are usually parsed into onsets, often at the expense of sonority sequencing (e.g. "ə$_{\mu}$.rš may$_{\mu\mu}$"). One might entertain the alternative that codas are parsed normally, but vary in their moraicity (cf. Kwak'wala). In other words, whether the Latin or Khalkha criterion is appropriate hinges on the analysis of syllabification. However, the question of weight-sensitivity in Avestan meter is rife with subtleties, and I leave it here (cf. also Bross et al. 2013 on the question of weight-sensitivity in Tocharian B syllable-counting meters, though Tocharian lacks long vowels).

Weight criteria for metrics are usually binary, but Persian adds to the Latin criterion sensitivity to a superheavy (i.e. trimoraic) grade, yielding the scale V < VX < VXX (Hayes 1979b, 1988). Superheavies scan as ‿ line-internally and as ‿ line-finally. Because of this line-final treatment, one cannot simply say that they are de facto disyllabic.

4.2 Variable weight due to optional processes

In many quantitative meters, certain syllable types are free to scan as heavy or light. As this section describes, such syllables need not be regarded as being intermediate in weight. They are traditionally analyzed in terms of optional rule/process application. Four examples are presented, namely, optional resyllabification, variable syllabification of clusters, optional shortening in hiatus, and underspecified vowel length.

4.2.1 Optional resyllabification

First, as treated in §3.4, a Māhārāṣṭrī Prakrit word may end with either a vowel (long or short) or a short vowel followed by the nasal *anusvāra*, transcribed *ṃ*. When an *ṃ*-final word immediately precedes a vowel-initial word, *ṃ* optionally resyllabifies as its onset, becoming *m*. With resyllabification, the ultima scans as light; otherwise, it remains heavy. Thus, while one might speak loosely of final VN being intermediate in weight, or weightless, as standardly analyzed, it evinces an optional process in binary weight setting.

4.2.2 Optional cluster or geminate compression

Second, the best-known case of variable weight concerns *muta cum liquida* (MCL) clusters, as in Latin and Ancient Greek. I consider Virgil's Latin here. MCL-eligible clusters in Latin include any nonstrident obstruent plus liquid, that is, {p, b, t, d, k, g, f} plus {r, l} (though one might exclude *tl* and *dl*). As traditionally analyzed, MCL clusters are optionally COMPRESSED into onsets (*a.kra*) or SPLIT across syllables (*ak.ra*). Clusters straddling a word or morpheme boundary are normally split (*ab .lī.to.ra*, *ab.lā.ta*), and those in word onsets are normally compressed (*da.re .brac.chia*), such that syllable boundaries tend to coincide with morpheme boundaries. MCL clusters are also assumed to be compressed after a long vowel or consonant, though their status in this context is irrelevant for scansion, since weight is not affected (*crē.bra*). Variation is found after a short vowel when the vowel and cluster are tautomorphemic. In (8), for instance, *suprēmum* is compressed in (a), scanning as ⏑– –, but split in (b), scanning as – – –.

(8)
a. vul.ne.ri|bus .dō|nec ‖ .pau|lā.t$_{\mathrm{im}}$ ē|vic.ta **.su|prē.mum** (Aeneid 2.630)
b. con.di.mu|s et .mag|nā ‖ **.sup|rē.mum** |vō.ce .ci|ē.mus (Aeneid 3.068)

Some MCL clusters are more likely to be compressed than others. Figure 4.2 shows the approximate compression rates for Virgil based on books I–VI of the *Aeneid* (with macrons from Pharr 1964). Only clusters immediately following a short vowel within the word are considered, excluding the prefixes *ab*-, *ob*-, and *sub*-. An automated parser collected all lines containing each cluster in this context and attempted parsing the line with and without compression, tallying which (if any) treatment was successful. (In some cases, due to extraneous factors, neither treatment succeeds, in which case the line is ignored; but it is never the case that both succeed.) The error bars in Figure 4.2 are 95% confidence intervals based on the binomial. Clusters attested fewer than ten times in the relevant context are excluded (viz. *bl*, *dr*, *fl*, *fr*, and *gl*).

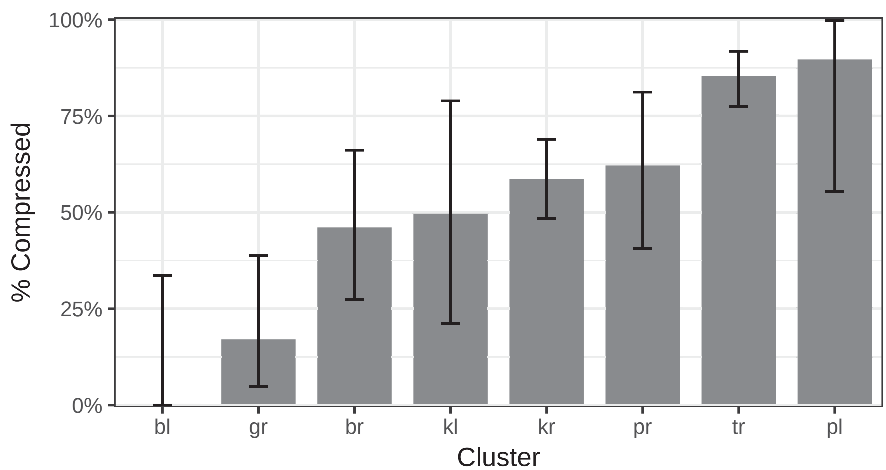


Figure 4.2: Estimated compression rates for V_V(V) clusters in Latin.

One trend that is clear from Figure 4.2 is that voiceless MCL clusters (TR) are more compressible than voiced ones (DR). Steriade (2008) notes a similar generalization for Ancient Greek, connecting it to the greater likelihood of intrusive vowels for DC than TC in modern languages (e.g. Colantoni and Steele 2005, Davidson 2006). Vowel duration may also be relevant, in that vowels tend to be longer before voiced than voiceless consonants cross-linguistically. For example, in English, DR is shorter than TR, but vowels are longer before DR.[3] If vowel duration matters for Latin, it would be difficult to reconcile with the

[3]This was confirmed using the Buckeye corpus (Pitt et al. 2007). I collected all words with V{T,D}RV

analysis in terms of variable syllabification of the cluster. At any rate, the phonetic facts are unclear for Latin. Variable syllabification remains viable prima facie.[4] As a similar case, geminates are optionally parsed as light in Tashlhiyt Berber meter (Dell and Elmedlaoui 2017). In §2.7.7, this optionality was suggested to arise from optional simplification in the paraphonology, which is akin to the treatment of MCL clusters in Latin. Compare also the variable syllabicity of certain words in English meter, such as *flower*, which can scan as one or two syllables.

4.2.3 Optional correption in hiatus

Third, in Vedic Sanskrit, as in many other languages, a long vowel in HIATUS (i.e. immediately preceding another vowel) is free to scan as long or short, though the latter predominates (Gunkel and Ryan 2011).[5] This shortening is known as CORREPTION ("vocalis ante vocalem corripitur"). As Gunkel and Ryan (2011) observe, a priori, one might approach variable weight in one of two ways.[6] The first approach is BINARY WEIGHT WITH BIMODAL PHONOLOGY. On this approach, weight is strictly binary, and the relevant phonological rule applies optionally as an all-or-nothing Bernoulli process. For correption, one would say that a long vowel optionally shortens in hiatus (with high odds, say, 80%). On this analysis, the phonology generates a bimodal distribution: Some hiatus vowels shorten completely, and others do not shorten at all; there is no partial shortening.

Another conceivable approach is INTERMEDIATE WEIGHT WITH UNIMODAL PHONOLOGY (cf. West 1970 on intermediately heavy positions in meter). On this approach, long vowels in hiatus are intermediate in duration between long and short. Due to this intermediacy, they can be shoehorned into either strong or weak positions, but will be more felicitous in one than the other as a function of their phonetic proximity to the target category. A hypothetical schema is illustrated in Figure 4.3, which assumes a logistic function from normalized duration to binary positional strength (as could be implemented in maxent HG). V.C is aggregately short enough that it is virtually always mapped onto weakness, and VV.C onto strength.[7] The normalized duration of VV.V, however, falls in zone of variation. While this second approach is likely closer to the phonetic reality, I tentatively assume the former, discrete approach here, which is more standard in metrics. (In subsequent sections, I shall argue for gradient weight on independent grounds.)

straddling the first and second syllables, excluding the suffix *-ly*. In a mixed model with the identity of the first vowel as a random intercept, the voicing of the cluster contributes positively and significantly to the duration of the first vowel. But the voiced clusters themselves are significantly shorter.

[4] Another possible approach to MCL variation assumes that MCL clusters are parsed uniformly, but their different weight propensities follow from their different durations (cf. Steriade 2008; §4.6).

[5] This assumes that the two vowels surface as disyllabic. In Vedic, it is more common for underlying /VV#V/ to fuse into a single vowel [VV], in which case correption is moot.

[6] While I assume a syllable-based framework here, this discussion applies equally to an interval-based framework (§4.6). Either must contend with the variable weight of **VV**#V, for which the parse is invariant.

[7] I refer to the aggregate duration here because a phonetics-phonology model of this sort requires normalization (cf. Flemming 2001, Steriade 2009).

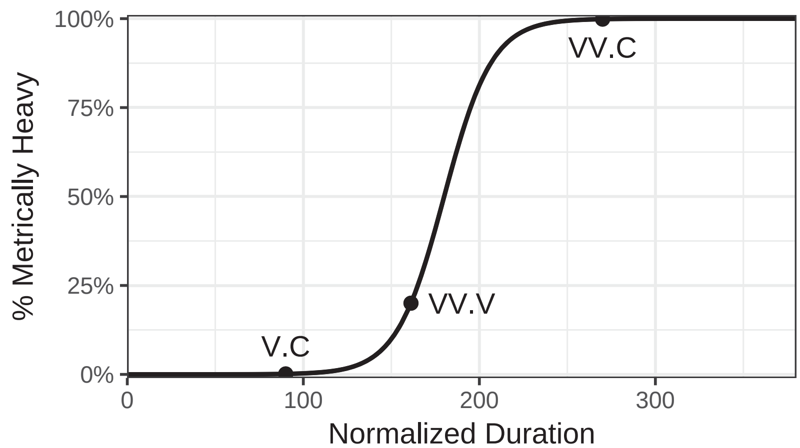


Figure 4.3: Illustration of intermediate weight with unimodal phonology. A logistic function maps normalized duration onto p(heavy), where p(heavy) is the percentage of the time that a syllable type occupies a strong metrical position.

4.2.4 Underspecified vowel length

As a final example of variable weight, certain word-final vowels in Vedic vary freely in length even before consonants (Macdonell 1910:62). For example, *ádha* "then" is realized as *ádha* 36 times and as *ádhā* 72 times before a following CV-initial word in the R̥g-Veda. This variation is usually metri causa, in that the final vowel of *ádha* takes on whichever length best suits its position. But it is not always so. In (9), for instance, the two variants occupy the same metrical context. Moreover, only certain (albeit many) words and endings are permitted to vary. For example, *iva* "like" and *utá* "also" have the same metrical shape as *ádha*, but cannot lengthen.[8] Further, *ihá* "here" is of the same semantic field as *ádha*, but lengthens only rarely (2%). Nor would it simplify the analysis to assume that *ádha* is underlyingly long-final. Long-final words of the same shape, such as *máyā* "by me," cannot shorten. Thus, the variation is at least partly lexically conditioned, though not randomly so; for one thing, it never afflicts nonfinal vowels. This complicates the lexicon and phonology, but does not complicate weight on the view just adopted.

(9) a. ádha yác cā́rathe gaṇé (R̥g-Veda 8.46.31a)
b. ádhā víśvāsu háviyo (R̥g-Veda 5.17.04c)

4.3 Superheavy avoidance

Conventional wisdom holds weight to be binary in archaic Indo-European meters such as in Vedic Sanskrit and Ancient Greek. Nevertheless, these meters also exhibit a clear sensitivity to a superheavy (or "overlong") grade of weight, in that superheavies are significantly avoided in cadences (Hoenigswald 1989, 1991). The cadence is no doubt singled out because it is the strictest part of the line (cf. final strictness in §4.1).

[8] Acute accents indicate pitch accents, which are irrelevant for length and metrification in Vedic.

Consider the R̥g-Veda. Figure 4.4 shows that the incidence of superheavies sharply declines in the cadences of three meters. The meters are labeled 8, 11, and 12 based on the number of syllables per line (*pāda*).[9] The 8-syllable meter is the dimeter described in §4.1; it has the cadence ⏑–⏑×. The 11- and 12-syllable meters are TRIMETER; they have the cadences –⏑–× and ⏑–⏑×, respectively. Final position is omitted from the figure, as is any position that is filled by lights over two thirds of the time. For example, only the first ten positions of the 12 are shown because the 11th is ⏑ and the 12th is ×. The 9th of the 12 is also ⏑, but it is interpolated in the figure. A superheavy is taken to be any short vowel followed by at least three consonants (**VCC**CV) or long vowel followed at least two consonants (**VVC**CV).[10]

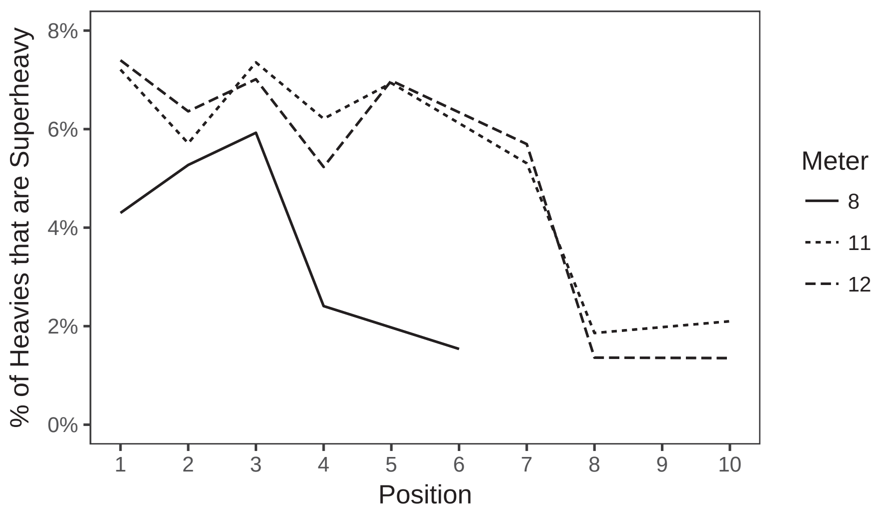


Figure 4.4: Superheavy incidence declines in R̥g-Vedic cadences, judging by the proportion of heavies in each position that are superheavy. Weak positions are skipped and interpolated in the plot.

Thus, regardless of the meter, the final two strong positions of the line strongly eschew superheavies. In this zone, ∼2% of heavies are superheavy.[11] In earlier parts of the line, the rate is roughly three times as great. Though it is not shown in the figure, ultraheavies are avoided even more stringently in the cadence, being four times as frequent in the pre-cadence (though given their rarity, this difference is not significant). Superheavies are also eschewed in verse relative to prose. In a (later) Vedic prose corpus of four Brāhmaṇas (240,272 words), superheavies comprise 12.7% of heavies, treating resyllabification the same as in verse. This

[9]The tradition takes each *pāda* type to be further subdivided into meters according to stanzaic structure. But since stanzaic structure is irrelevant here, *pāda* size alone suffices. Moreover, I omit "special" meters and sections here, such as the epic *anuṣṭubh*, trochaic *gāyatrī*, the Vālakhilya, repeated *pāda*s, and so forth, taking only "normal" dimeter and trimeter, as in Gunkel and Ryan (2011).

[10]These parses need not be consistently accurate for syllabification, and at any rate their accuracy for individual items is moot: It is hard to say whether a word like *saṃskr̥tam* "Sanskrit" should be *saṃ.skr̥.tam* or *saṃs.kr̥.tam*; either way it scans as a cretic. But the aggregate effect of superheavies is clear, which means that at least some of the time, VCCCV is parsed as VCC.CV.

[11]This zone corresponds loosely to the traditional notion of the cadence, but overreaches it by one position in the case of the 8 and 12.

prose result suggests that superheavies are avoided even in the pre-cadence, though their avoidance in the cadence is much stronger.

At first glance, superheavy avoidance might appear paradoxical, in that it is strongest in the positions that are the "heaviest" (i.e. filled with heavies the greatest proportion of the time). For example, in the 8 and 12, the penult is filled by a heavy over 98% of the time, the highest rate anywhere in the line. Yet it is precisely in this position that superheavies are the most avoided. Nevertheless, the paradox is resolved if it is recognized that superheavy avoidance is independent of prominence mapping. Prominence mapping instantiates the rhythm of the meter, and can be implemented by $\mathrm{S}\leftrightarrow\sigma_{\mu\mu}$, as in Chapter 2, only now taking S to refer to metrical strength rather than stress (Hanson and Kiparsky 1996, Ryan 2017b). Since this constraint applies most strongly (if not exclusively) to the cadence in Vedic, it can be so indexed: $\mathrm{S}_{\mathrm{cadence}}\leftrightarrow\sigma_{\mu\mu}$. Meanwhile, a constraint penalizing superheavies came up in both Chapter 2 and 3, namely, $*3\mu$. This constraint can also be indexed to the cadence: $*3\mu_{\mathrm{cadence}}$. (Both constraints have to be weighted rather than strictly ranked, given that exceptions occur.) In short, as a hypothesis, cadences are strict for both prominence and phonology more generally, though it remains to be explored how generally phonological markedness asserts itself in cadences.

4.4 Gradient weight in meter I: positional discrepancies

4.4.1 Kalevala Finnish

As the remaining case studies in this chapter illustrate, even in ostensibly binary meters, poets are sensitive to detailed continua of syllable weight in choosing how to metrify syllables. I begin with the *Kalevala*, a Finnish/Karelian epic of 22,795 lines (Lönnrot 1849). Each line normally contains eight syllables, though this total can be increased by resolution or decreased by late phonological rules (Kiparsky 1968). As the descriptive template in (10) suggests, a line comprises four disyllabic trochaic metra. The mapping rule is then that stressed syllables must be heavy in strong positions (S) and light in weak ones (W) (Sadeniemi 1951, Kiparsky 1968, Leino 1994). To a first approximation (cf. Ryan 2017b), "stress" here refers to primary stress, which is always word-initial in Finnish. Consistent with final strictness, the rigidity of the mapping rule increases over the course of the line. The first foot is largely if not entirely unregulated. The following three feet are stricter, but exceptions are not uncommon.

(10)	Foot 1	Foot 2	Foot 3	Foot 4
	S W	S W	S W	S W

In this case, it is the ostensible exceptions that reveal weight gradience, in that violations of the mapping rule tend to be minimal. For example, if a poet places a stressed heavy in a weak position, it tends to be on the lighter side of heavies (e.g. VC as opposed to VV or VVC). Of course, to make such an argument, it is necessary to have a control condition, demonstrating that VC is not just chosen frequently, but chosen more frequently than one would otherwise expect. To this end, one can compare stressed heavies in strong positions to stressed heavies in weak positions, showing that the former are aggregately heavier (Ryan 2011a). Indeed, not only are they heavier in the aggregate, but as weight increases, the skew increases towards strong positions increases, revealing an intra-heavy continuum of weight.

The model is a mixed effects logistic regression. The fixed effects are factors involving syllable shape, as summarized in Figure 4.5. The random effects are intercepts for word shape, defined as the word's heavy-light template with the syllable in question X-ed out (e.g. X–⏑⏑⏑ for *ajattelevi*). On the motivation for including shape as a random effect, see Ryan (2011a). In brief, syllable types are often distributed differently in words of different shapes, and words of different shapes are distributed differently in meter. For example, in the present corpus, word-initial X is over twice as likely to be heavy in a disyllable than in a trisyllable (87% vs. 34%). Disyllables and trisyllables are also distributed somewhat differently within the line, to some extent metri causa, but also due to irrelevant factors such as end-weight. Random effects for shape control for these potential confounds by absorbing any skewness in weight that can be attributed to shape.

	$\hat{\beta}$	SE	z	p
(Intercept)	15.007	1.842	8.2	$< .0001$
Rime VT (vs. V)	8.217	0.217	37.9	$< .0001$
Rime VN (vs. VT)	3.388	0.650	6.0	$< .0001$
Rime VV (vs. VN)	1.261	1.173	1.1	$= .282$
Rime VVC (vs. VN)	40.887	5.493	7.4	$< .0001$
Onset N (vs. T)	−0.737	0.176	−4.2	$< .0001$
Onset Ø (vs. N)	−0.540	0.221	−2.4	$= .015$

Figure 4.5: Regression table for syllable weight in the *Kalevala*. Factor levels are forward-difference coded, and thus interpretable only with respect to the specified level of comparison (positive ⇒ heavier than the comparandum).

As data, I take all (30,122) primary stressed syllables in the *Kalevala* falling within the final three feet (recall that the first foot is largely unregulated), excluding monosyllables. The dependent variable is whether the syllable occupies a strong (1) or weak (0) position. Factor levels are forward-difference coded in Figure 4.5, meaning that each is interpreted relative to the specified comparandum rather than to the general intercept (Ryan 2011a:421). This coding characterizes the significance of each step of a scale. Onset and rime structure are treated separately in Figure 4.5, so that they can be arranged in terms of universally expected scales.[12] The resulting scales are given in (11).

(11) Rime scale: V < VT < {VN, VV} < VVC
Onset scale: Ø < N < T

All of these results agree with the universal phonology of weight. First, the skeletal rime scale is V < VC < VV < VVC, as in Kashmiri and Pulaar stress, except now gradiently.

[12]They could in principle be combined into a single 15-level factor, but the results are then harder to interpret, since (1) some levels are sparsely populated and (2) typological expectations are less clear (e.g. is TVT expected to be heavier or lighter than ØVN? — see §1.3 on the issue of noncontainment). This model was also attempted with a vowel height factor, but it did not converge.

Second, sonority is further overlaid on this scale, such that VT $<$ VN, as in, say, Kwak'wala stress. Finally, onset presence and voicing matters. Filled onsets are heavier than empty onsets, and among filled onsets, voiceless/obstruent onsets are heavier than voiced/sonorant onsets, just as in Pirahã stress, which also observes Ø $<$ N $<$ T for onsets.

4.4.2 Homeric Greek

The basic weight template for the Homeric hexameter is given in (12) (Maas 1962, Raven 1962, Halle 1970, West 1982, Prince 1989, Ryan 2011a). Each metron is divided into two parts, namely, after West (1982), the LONGUM (obligatory $-$) and (except finally) the BICEPS ($-$ or $\smile\smile$).

(12)

Foot 1	Foot 2	Foot 3	Foot 4	Foot 5	Foot 6
$- \left\{\begin{array}{c} - \\ \smile\smile \end{array}\right\}$	$- \left\{\begin{array}{c} - \\ \smile\smile \end{array}\right\}$	$- \left\{\begin{array}{c} - \\ \smile\smile \end{array}\right\}$	$- \left\{\begin{array}{c} - \\ \smile\smile \end{array}\right\}$	$- \left\{\begin{array}{c} - \\ \smile\smile \end{array}\right\}$	$- \left\{\begin{array}{c} - \\ \smile \end{array}\right\}$

Heavies in bicipitia tend to be heavier than heavies in longa. West (1982:39) notes that lighter heavies — including Vː in hiatus, V preceding an MCL cluster, and so forth (cf. §4.2) — are avoided in bicipitia relative to longa: "the biceps, being of greater duration, requires more stuffing." Indeed, this sentiment finds an ancient precedent among the Greek rhythmicians (Allen 1973:255, West 1982:18).

As Ryan (2011a) argues, this discrepancy between biceps and longum diagnoses a continuum of intra-heavy weight. Figure 4.6 is based on 24,677 parsed lines from the *Iliad* and the *Odyssey*. Note that VV $<$ VVC is highly significant, though this contrast is not shown in the table. VCC, for its part, falls in the range of VV, being marginally heavier than VN (not shown) and marginally lighter than VVC. Ryan (2011b) also reports that Ø $<$ C $<$ CC_1 for onsets in this corpus, though he does not test voicing.

	$\hat{\beta}$	SE	z	p
(Intercept)	−3.357	1.452	−2.3	$= .021$
Rime VN (vs. VT)	0.265	0.034	7.8	$< .0001$
Rime VV (vs. VN)	0.217	0.026	8.3	$< .0001$
Rime VCC (vs. VV)	0.005	0.101	0.1	$= .958$
Rime VVC (vs. VCC)	0.208	0.105	2.0	$= .049$

Figure 4.6: Regression table for syllable weight in the *Iliad*. Factor levels are forward-difference coded, as in Figure 4.5. Interactions are omitted.

The Homeric Greek scales are summarized in (13). See also Ryan (2011a, 2011b) for similar analyses of meters in Latin, Old Norse, Sanskrit, and Tamil. The Tamil study reveals at least nine statistically significant grades of weight.

(13) Rime scale: V $<$ VT $<$ VN $<$ {VV, VCC} $<$ VVC
Onset scale: Ø $<$ C $<$ CC_1

4.5 Gradient weight in meter II: final indifference

As discussed in §4.1, one way in which weight in quantitative meter differs from weight for stress is that meters overwhelmingly favor the Latin criterion, while stress systems are more evenly divided between the Latin and Khalkha criteria. Another difference is that syllabo-moraic quantitative meters virtually always exhibit final indifference,[13] whereas stress systems often do not. Recall from §4.1 that final indifference refers to the suspension of weight sensitivity in line-final position.[14] Stress systems can exhibit a similar phenomenon with final syllable extrametricality, as in Latin, but many lack this property. This section argues that despite exhibiting final indifference, syllabo-moraic meters can (and perhaps always do) show weight tendencies in final position. Thus, final indifference should be interpreted as a suspension of *categorical* weight restrictions in final position, not as a lack of weight sensitivity altogether.

4.5.1 Homeric Greek

Consider once again the Ancient Greek hexameter. Line-final position accepts a syllable of any weight, as implied by the template in (12), and is thus said to be indifferent (*adiáphoros*). However, closer examination reveals that Homer is not wholly indifferent to weight line-finally; he significantly prefers a heavy there. For example, words of the shape $\smile\!\_\!\times$ are light-final 42% of the time nonfinally. Line-finally, they are light-final 18% of the time (Fisher's exact test odds ratio = 3.35, $p < .0001$). As the mixed model in the next paragraph demonstrates, the same bias applies more generally across word shapes.

Indeed, the heavier the heavy, the more skewed it is towards final position, suggesting (once again) that Homer is sensitive to a continuum of weight. A logistic regression predicts whether a word token is line-final (1) or not (0). The fixed effect is ultima rime shape $\in$ {V, VC, VV, VVC}. Word shape is a random effect, as in §4.4.2. A word is included only if it has more than one syllable and its ultima contains a mid vowel or diphthong, as vowel length in these cases is encoded orthographically. The resulting data comprise 13,280 line-final words and 30,580 nonfinal words.

Figure 4.7 summarizes the results of this model separately for the *Iliad* and the *Odyssey*. In both, V < VC < VV < VVC is observed, with every link significant. Rime V is given as zero with no error because it is the baseline level. (Against another interpretation of these results whereby lighter syllables are avoided line-medially, see footnote 15.)

4.5.2 Classical Latin

The Latin hexameter, as in Virgil, shows the same line-final tendency as the Greek. While Virgil permits both lights and heavies line-finally, he prefers heavies there (Allen 1973). Indeed, the magnitude of his preference generally scales with the weight of the syllable along the typologically expected scale, as Figure 4.8 illustrates. The model is set up as in §4.5.1,

[13] "Mora-counting" meters such as the *haiku* appear not to exhibit this license.

[14] The context is sometimes also given as period-final or prepausal. Indifference is occasionally encountered line-internally, as before caesura.

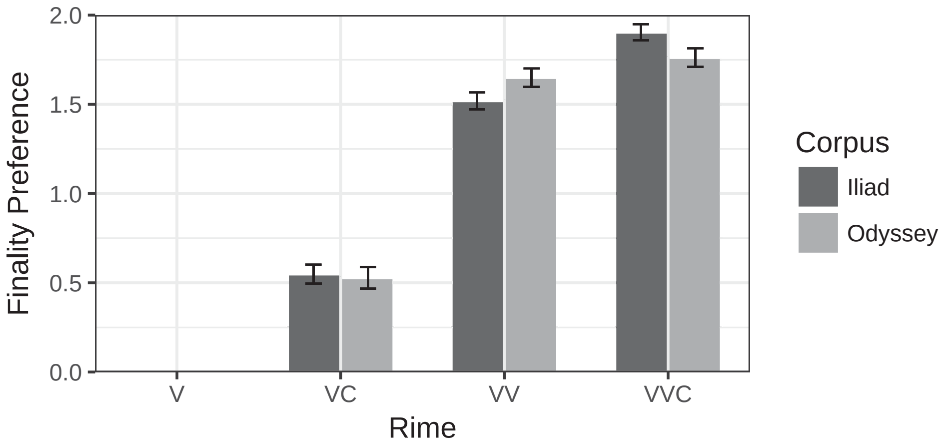


Figure 4.7: The heavier the rime type, the higher its bias towards line-final position, based on the two Homeric corpora. "Finality Preferences" are coefficients in a logistic model and error bars are their standard errors.

except that V and VC are now subdivided by vowel height, with Mid V being the baseline. High V is omitted because a line cannot end with a short high vowel for independent reasons.

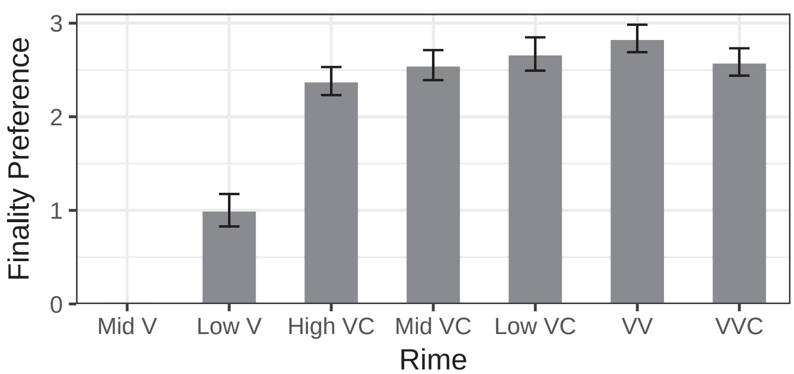


Figure 4.8: A graded heaviness preference for line-final position in Virgil's *Aeneid*.

Figure 4.8 suggests the scale Mid < Low < VC < VV. This height effect agrees with the typology, where lower vowels are if anything heavier than higher vowels. VC < VV is clearly significant if VC is pooled; it is only Low VC whose error overlaps with that of VV. One seeming anomaly in Figure 4.8 is that VVC appears to be lighter than VV, albeit not significantly. This trend might reflect superheavy avoidance in the cadence, as described in §4.3. Indeed, Ryan (2013a) finds a significant contrast of VV < VVC for final position in Latin using a different, prose comparison model. Ryan (2013a) also argues that, across languages and meters, weight preferences in final position do not always favor heavies. Some quantitative meters, such as Catullus' hendecasyllables and the Old Norse *dróttkvætt*, exhibit a gradient pro-light tendency in final position.[15]

[15]The prose comparison model also addresses the possible objection to the present model that perhaps Virgil is not avoiding line-final lights, but favoring line-medial lights in words of the relevant shapes (though

In summary, final indifference is potentially viable as a universal in the sense that quantitative meters do not rigidly enforce a criterion line-finally. But quantitative preferences still leak through. In the Homeric and Virgilian hexameters, final position skews heavy, presumably because the second halves of metra are normally bimoraic in that meter. In the Phalaecian hendecasyllable, by contrast, final position skews light, since the cadence is otherwise trochaic in that meter, as schematized in (14). In short, final position shadows the expected polarity of the meter, just not categorically.

(14) ××–⏑⏑–⏑–⏑–×

4.6 Interval Theory

Though this book assumes that the syllable is the domain over which weight is computed, an alternative approach is that of Interval Theory (Steriade 2008, 2011, 2012). I bring up this theory in a chapter on meter, but it applies to nearly all weight-sensitive phenomena, including stress. The INTERVAL, short for total vowel-to-vowel interval, extends from the left edge of each vowel to that of the following vowel. If no vowel follows, it extends to the end of the relevant prosodic group. A group-initial onset is extraprosodic. For example, two lines of Latin hexameter are parsed in (15) and (16) using syllables and intervals, respectively. Bars separate intervals. The meter is the same either way; it is only the criterion that is adjusted. An interval is light in Latin iff it is V or VC (I return to this criterion and the issue of optional processes below).

(15) Syllables:
  a. .ar.ma .vi.rum.que .ca.nō .trō.iae .quī .prī.mu.s a.b ō.rīs. (Aeneid 1.001)
  b. .prī.a.mi.dē.n e.le.num .grā.iās .rēg.nā.re .pe.r ur.bīs. (Aeneid 3.295)
  –⏑⏑/–⏑⏑/––/––/–⏑⏑/––

(16) Intervals:
  a. |arm|a v|ir|umqu|e c|an|ō tr|ōi|ae qu|ī pr|īm|us |ab |ōr|īs| (Aeneid 1.001)
  b. <pr>|ī|am|id|ēn| el|en|um gr|āi|ās r|ēgn|ār|e p|er| urb|īs| (Aeneid 3.295)
  –⏑⏑/–⏑⏑/––/––/–⏑⏑/––

Interval Theory has pregenerative precedents. For example, Ryan (2016) points out that it is widespread in Norse philology, quoting, for instance, Pipping (1903): "The morae of a syllable are counted from its vowel to (but not including) the vowel of the following syllable." On this scheme, a syllable if heavy iff it contains three or more moras. What follows is a compact description of some (but not all) of the arguments that have been put forth for intervals, based loosely on Steriade (2008, 2011, 2012).

First, vowels in hiatus sometimes pattern as lighter than vowels before consonants. For long vowels, one could say that they shorten in hiatus (§4.2), but short vowels also show signs of being lighter in hiatus. For example, in Finnish, they reject secondary stress (e.g. *érgonòmi.a* vs. *tánanarìve*; Karvonen 2008).

one would still have a weight continuum to explain). Ryan (2013a) also shows that comparing Catullus' final words to Virgil's final words while controlling for word shape reveals a graded discrepancy, such that Catullus prefers lighter endings and Virgil prefers heavier endings, scaling with weight.

Second, intervals arguably better capture the typology of the treatment of final position for stress. With intervals, final VC is equivalent to medial **VC**V. There is thus no need to invoke final consonant extrametricality; it is "built in" to basic parse. Intervals, as Steriade (2008) notes, can also capture systems in which VC# is heavier than V#, as long as they do not require VC# to be equivalent to **VC**.CV. For example, intervals can handle a language in which stress is final unless the ultima is light (V).[16] Intervals would be refuted by an unbounded system in which VC# is equivalent to **VC**.CV, but it is not obvious that such a system exists. Insofar as such a system is unattested, it is another point in favor of intervals.

As a sample of potentially relevant cases, I consider the 18 unbounded systems enumerated by Hayes (1995:296f). 14 are disqualified because they do not have the necessary "VC heavy" criterion. Further, Classical Arabic is disqualified because it has extrametricality, and thus does not treat VC# as equivalent to **VC**.CV. Amele, Kwak'wala, and Yana remain. The latter two were discussed in Chapter 2. Kwak'wala turns out not to be diagnostic because of its leftmost-heavy-else-rightmost orientation.[17] Yana is also not diagnostic, at least pending further research, since its rule is only a tendency (§2.9.2), and the treatment of VC# is not secure. Amele is ostensibly the strongest case in the list for VC# = **VC**.CV, though it is arguably also not secure. Roberts (1987) describes the rule as leftmost heavy, else leftmost (modulo morphology). Amele has diphthongs (VW) but not phonemic vowel length. On Roberts' analysis, VC is always heavy, but VW is heavy only finally (but see below). Nonfinal VC (where C $\neq$ W) is rare within morphemes; Roberts (1987:347) notes that "clustering can occur word medially with certain lexical items (often names which may be some kind of reduced or composite form)." It is clear from Roberts' examples that stress is final unless the ultima is light, in which case stress is initial. What is less clear is that the system is unbounded. Roberts (1987) offers only one example of an implied simplex form with medial stress, namely, [jæˈwælti] "wind from north" (pp. 347, 358). (A handful of other examples showing nonfinal VC taking stress, such as [ˈhænse] "left hand," are compatible with default initial stress when the ultima is light.) If [jæˈwælti] turned out to be a compound, as is plausible a priori given its semantics and its rare internal coda, its stress might be explained otherwise. Finally, note that under Roberts' analysis, Amele breaks a near-universal: Word-internally, VW is lighter than VC. With the reanalysis that I suggest, the universal is restored: VW is always heavy in Amele. If the ultima is light, medial VW is passed over not because it is light, but because stress is not weight-sensitive in that situation; it is default leftmost.

The last couple of paragraphs should at least convey that teasing apart the predictions of interval and syllable theory is not as straightforward as it might first seem. Indeed, this is equally true for the experimental literature: As it stands, results appear to be mixed for syllables vs. intervals, with Hirsch (2014) supporting intervals, Garcia (2016, 2017b) largely supporting intervals, but not in every respect, and certain results in Ryan (2014)

[16]In Manam, for instance, stress falls on the rightmost heavy within the final three syllable window (Hayes 1995). With intervals, this case could be analyzed with ternary V < VX < VXX.

[17]Consider two schematic disyllables, *amán* and *ámpan*. With syllables, both contain heavies, and stress falls on the leftmost heavy. With intervals, VC|VC is light-light and therefore receives default rightmost stress, while VCC|VC is heavy-light and therefore receives stress on its only heavy. The two theories are therefore indistinguishable, since one cannot tell pretheoretically whether VCVC receives final stress due to weight attraction or to default rightmostness.

and Olejarczuk and Kapatsinski (2016) challenging intervals; see Ryan (2016:726) for a somewhat more detailed overview of this literature. For example, Garcia (2017b) finds that increasing the size of the penult onset increases the odds of antepenultimate stress in Portuguese, favoring intervals. But he also finds a tauto-augmenting effect of onset size for the antepenult, favoring syllables, or at least the incorporation of initial onsets.

A third argument for intervals is that syllable division judgments are sometimes ambiguous, even while the treatment of the same configuration in meter is invariant. This situation is expected if metrical systems rely on intervals rather than syllables. Fourth, intervals arguably better capture the typology of rhyme. In particular, for rhyme systems in which spans are not required to extend to the end of the line, the interval, but not syllable or rime, is attested as a minimum domain of correspondence. For example, Virgil has rhyming sets such as *Diōrēs*, *ōra*, *clāmōribus*, *honōrem*, *decōrae*, and so forth, in which the stressed interval of each word (here, *ōr*) rhymes. Finally, intervals are more restrictive than syllables concerning the relation of duration to weight. Because intervals are always parsed out to the vowel, is one cluster is heavier than another, it can only be because the heavier cluster is longer. With syllables, this correlation does not necessarily obtain; clusters might be syllabified differently for reasons not connected to duration.

Returning to the Latin criterion, a V or VC interval is light, while a VCC or longer interval is heavy (e.g. |arm|a v|ir|umqu|e| = –⏑ ⏑–⏑). A VV interval, as found when a long vowel stands in hiatus, is also normally heavy in Latin (e.g. <pr>|ī|am|id|ēn| = –⏑⏑–).[18] Thus, the criterial boundary for intervals is VC < VV. This criterion cannot be defined in terms of timing slots (as both sides have two) or moras (as Interval Theory rejects moras for the phenomena it purports to explain); a vowel prominence constraint seems necessary (cf. §2.5). A further complication is the treatment of clusters, which, as treated in §4.2, vary in their scansion. Unlike with syllables, variable parsing is not an option for intervals. |Vkr|V| must be parsed as such regardless of whether |Vkr| scans as heavy or light. Steriade (2008) implies a short vs. long parse, perhaps associated with realization of the rhotic (in this case) as a tap vs. trill.

Similarly, consider optional resyllabification, as in Māhārāṣṭrī Prakrit (§3.4, §4.2). A word-final consonant, which can only be the nasal *anusvāra*, optionally resyllabifies with a following vowel-initial word. Iff it does so, the ultima scans as light. With syllables, the analysis is obvious: Variable weight reflects variable syllabification. Indeed, such discrete variation is implied by the orthography, which renders the nasal with entirely different symbols depending on whether it is an onset or coda. With intervals, however, |VN| must be parsed as such regardless of whether it scans as heavy or light. One would have to assume either that N substantially lengthens in its coda variant (enough to fall in with heavy |VCC| as opposed to light |VC|) or that |VN#| (but not medial |VN|) is uniformly intermediate in duration and therefore free to occupy strong or weak positions (cf. Figure 4.3).

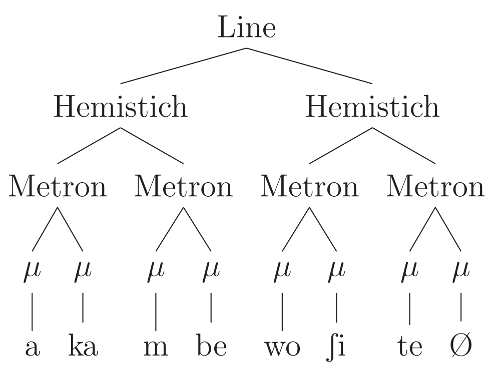
Interval Theory as defined above cannot account for tauto-augmenting onset effects, as described for meter in §4.4–4.5 and for stress in §2.9.3 (see Ryan 2014 for additional cases of both). One possible amendment to Interval Theory that would permit absolute-initial onset effects would be to parse the group-initial onset with the first interval instead of treating it

[18]Word-internally, VV.V usually scans as –×. Across a boundary, VV#V usually undergoes elision. Non-elision with correption is also possible in either case but unusual in Virgil.

as extraprosodic. Nevertheless, onset effects also obtain group-internally. Another possible amendment, as mentioned by Ryan (2014), would be to treat intervals as spanning successive p-centers rather than successive vowel edges. The p-center is roughly speaking the perceptual beat of the syllable. These tend to approximate the left edge of the vowel, but can anticipate it slightly for longer onsets. As such, p-center intervals predict that a longer onset should make the following domain slightly heavier (even while it increases the length of the preceding domain as well). See Ryan (2014) for further discussion.

Finally, consider so-called mora-counting meters, such as the *haiku*. Each line has a fixed number of moras, but no hard constraints on their distribution into syllables nor on the distribution of word boundaries. A stipulative constraint of the type LINE=7μ is undesirable (and indeed precluded with intervals). But if one assumes structure, fixed counts can fall out from binarity. For the seven-mora line, one can invoke three binary levels ($2^3 = 8$), plus catalexis of a mora (Hanson and Kiparsky 1996, Ryan 2017b), as in (17). The empty final position might also be enforced by SALIENCY, as in Hayes and MacEachern (1998) and Blumenfeld (2016). The labels in (17) are immaterial (metra might just as well be called positions). The structure in (17) splits syllables between metra (or even hemistichs), but this is arguably not a problem, since metrical constituents generally do not align with phonological constituents. For example, PWds and feet are regularly split across metra and (abstract) hemistichs cross-linguistically. The hemistichs in (17) are abstract, not meant to imply a caesura. Not all traditions require hemistichs to align with word breaks.

(17)



naku neko ni || **akambe wo shite** || temari kana (Issa)

In a mora-free setting, such as with Interval Theory, analyzing such a meter is less straightforward. One might begin by positing a line consisting of seven light intervals (or eight, with catalexis), as above, with the additional license that a heavy interval can substitute for two light intervals in any position. But it is not obvious how to implement such a context-free license in a constraint-based framework. The standard approach to ⏑⏑ = – licenses in metrics is to require some constituent to contain two moras. For example, the hexameter biceps can be ⏑⏑ or –. If each position is required to be bimoraic, say, due to FT-BIN, the license emerges (in bicipitia; it is quashed in the longum due to STRONG→HEAVY; Ryan 2017b). But with the *haiku*, there are no fixed positions, analogous to the biceps, to analyze as bimoraic or bicipital in any sense. Substitutions can span odd-even pairs or even-odd pairs. With a structure like (17), substitution can occur even across hemistichs. One might permit multiple line structures, but then the analysis of the meter is complicated.

This section is meant only to outline Interval Theory and to raise some issues with which it would have to contend. After all, this book assumes syllables, not intervals, and Interval Theory is yet to be promulgated in a (generative) publication. But a book about weight would be remiss to overlook the topic. If nothing else, I hope to have conveyed that the two approaches are less easily distinguished than one might expect. At first glance, they might appear to be radically different approaches to weight, and are often presented as such (including by me), but one might also regard intervals as being a kind of syllabification algorithm, namely, strict coda maximization.[19] Indeed, when scholars such as Pipping (1903) above talk about intervals, they refer to them as "syllables." On such a view, the syllables that the grammar manipulates are not necessarily the same entities that speakers utter when asked to syllabify a word, which is a language game constrained by extraneous desiderata, including the desire to shoehorn each chunk into a well-formed PWd (Steriade 1999).

4.7 Conclusion

Almost all quantitative meters exhibit the Latin criterion for weight, whereby codas "make position." But the Khalkha criterion (vowel length only, ignoring codas) is also attested, at least in Nanti, if not in Kayardild, and perhaps also as a tendency in Avestan. Indeed, once one includes tendencies, the Khalkha criterion is found as a tendency (VC $\lesssim$ VV) in several meters that select the Latin criterion for categorical weight (V < VX).

Ternary weight is attested in metrics in at least three independent ways. First, some meters scan superheavies differently from heavies (e.g. as $\_\smile$ line-internally). However, as suggested at the end of §4.1, superheavies cannot be analyzed as being literally disyllabic in such cases. Second, other meters scan heavies and superheavies identically (as $\_$), but avoid superheavies in cadences, revealing that the poets are still sensitive to their extra weight (§4.3). Third, gradient weight systems sometimes diagnose a superheavy grade, among other distinctions (§4.4).

A distinction is drawn between VARIABLE WEIGHT and GRADIENT WEIGHT. Variable weight reflects optional processes, such as optional resyllabification, variable syllabification of certain clusters, optional shortening in hiatus, optional simplification of geminates, and underspecified vowel length (§4.2). As such, weight is strictly binary, but syllables vary in their affiliations depending on whether the rule applies. Gradient weight describes the rather different situation in which syllable types fit better or worse in strong vs. weak positions in a way that does not reflect a discrete process of lengthening or shortening. For example, in various meters, VC is gradiently lighter than VV, even when both must be parsed as categorically heavy. Gradient weight in metrics sometimes reveals highly articulated continua of weight, comprising several significant gradations with quantifiable separations. It is

[19] Syllables with Strict Coda Maximization (SSCM) may not be identical to Interval Theory (IT) as conceived by Steriade (2008, 2012). For one thing, intervals do not comprise subconstituents, only the terminal string. But moraic theory also rejects constituents such as the onset, nucleus, and rime. Furthermore, IT rejects moras, whereas SSCM could conceivably be subject to moraic constraints, such as a cap on moras per syllable. But if all segments are moraified in SSCM, the two approaches come close to notational variance. Moreover, IT, for its part, is not viable if it is based on segment count alone. Recall Latin |Vkr|, which can scan as heavy or light, despite being trisegmental in either case. An IT analysis that posits that trilled but not tapped *r* counts towards the weight of the interval (vel sim.) approaches SSCM-cum-variable-moraicity.

documented for Finnish, Ancient Greek, Latin, Old Norse, Sanskrit, and Tamil (§4.4).

Gradient weight is also revealed by final position in quantitative meters, which is putatively indifferent cross-linguistically (FINAL INDIFFERENCE). As I have argued (§4.5), indifference should be interpreted as the suspension of categorical weight restrictions, not as the suspension of weight sensitivity altogether. In meters such as the hexameter, final position still exhibits a tendency to be heavy. Indeed, the effect is gradient: The lighter the syllable, the more it is avoided line-finally. But the position may be light or heavy.

Finally, the last section (§4.6) introduced Interval Theory, according to which the domain for weight (in meter and elsewhere) does not reflect syllable structure, but rather the total interval between the left edges of successive vowels. Some potential problems were raised for intervals, but the primary aim of the section was to illustrate that the two approaches are surprisingly convergent in their predictions, inviting further research into the specific phenomena for which they differ.