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Unaccentedness in Japanese

Junko Ito and Armin Mester
University of California, Santa Cruz
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Un poème n'est jamais fini, seulement abandonné.
Paul Valéry

Abstract: A characteristic, though not necessary, property of so-called pitch accent languages is the existence of unaccented words. Work on unaccentedness in Japanese found a concentration of such words in very specific areas of the lexicon, defined in prosodic terms. While unaccentedness might be some kind of default, the prosodic rationale for the way it is distributed over the lexicon is far from clear. This paper investigates the underlying structural reasons for the distribution, and develops a formal OT-account, which involves two well-known constraints: RIGHTMOST and NONFINALITY. The tension between the two, usually resolved by ranking (NONFINALITY >> RIGHTMOST), finds another surprising resolution in unaccentedness: no accent, no conflict. Besides providing a more detailed analysis of Japanese word accent, which takes into consideration other mitigating phonological and morphological factors, a secondary goal of the paper is to gain an understanding of the similarities and differences between pitch accent and stress accent languages.

Key words: Pitch accent, unaccentedness, Japanese, Optimality Theory, lapse, antepenultimacy, OTWorkplace

1. Introduction

A familiar, if not unproblematic, distinction among systems of word prosody is that between lexical stress accent (Arabic, Spanish, Swahili, etc.) and lexical pitch accent (Lithuanian, Northern Bizkaian Basque, Somali, etc.).[*] While the term *pitch* here refers to the plain fact that the primary phonetic manifestation is a specific modulation of fundamental frequency, the notoriously multifaceted correlates of *stress* are a cross-linguistically variable composite of several phonetic factors including intensity, pitch, and length. The two types of lexical accent are not even mutually exclusive since there are systems combining both, such as the Mayan language Uspanteko (Bennett and Henderson 2013), or the continental Scandinavian languages with their tonal accents (Accent I and Accent II, see Riad 1996 for an overview)[1] superimposed on a stress-accent system.[2]

A shared property of stress accent and pitch accent is that at most one main *prominence*, whether realized as a pitch excursion or as stress, is permitted per ω-domain.[3] Trubetzkoy (1939) referred to this as *gipfelbildend* (in English, *culminative* (Hayes 1995)), and it relates to the issue of prosodic headedness. A major difference between pitch accent and stress accent is *obligatoriness* in the sense of Hyman 2006. Many lexical pitch accent systems permit unaccented content words and thus allow violations of obligatoriness. This is never found with stress, where stressless content words are not encountered (see Hayes 1995 for a discussion of alleged counterexamples). In McCawley's (1977) words, *n* syllables allow *n* stress patterns, but *n+1*

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1 In Danish, the tonal accents developed into a glottal accent, with stød (accented) and without stød (unaccented), see Riad 1998 and Basbøll 2003 for discussion and Ito and Mester 2015a for an OT analysis.

2 Intonation researchers in the tradition of Bolinger (1958, 1965, 1982) use the term *pitch accent* for an intonation prominence, a wholly different (though of course not entirely unrelated) concept. We will here use the term exclusively for lexical accent, a property of the prosodic word (ω).

3 One prominence means one prominence at the highest level, disregarding any non-primary accents/stresses (if such are permitted at all).

accent patterns—with accent on any one of the *n* syllables, plus no accent. For Japanese, accentual minimal pair sets like *háshi* 'chopstick', *hashí* 'bridge', and unaccented *hashi* 'edge' illustrate this point, cf. also sets like *ínochi* 'life', *kokóro* 'heart', *atamá* 'head', and unaccented *karada* 'body'.[4]

Not all pitch accent languages allow unaccented words. They are excluded in Sanskrit,[5] Ancient Greek (both Indo-European), and accentual dialects of Korean (isolate), such as North Gyeongsang in South-Eastern Korea. Besides Japanese, they are permitted in Nubi (a Sudanese Arabic-based creole, see Gussenhoven 2006), Irakw, Somali (both Cushitic), and Northern Bizkaian Basque (isolate; Gussenhoven 2004:170-184), to cite a few examples. This alone supports Hyman's (2006) assessment that *pitch accent*, different from *tone* and *stress*, does not constitute a coherent linguistic/typological primitive, but rather a range of related choices that grammars (and hence languages) can make from a menu of more fundamental prosodic factors.

In the overwhelming number of stress systems where there is good evidence that one and only one of the stressed syllables of every word is singled out as the main stress, it is virtually definitional that main stress always coincides with the head of the word in prosodic structure—the head syllable of its head foot. Given that heads are unique and obligatory, a one-to-one relation between prosodic headship and main stress immediately guarantees culminativity (at most one main stress) and obligatoriness. In Japanese, pitch accent is not an obligatory property of words, but it turns out that there continues to be a very close relation between prosodic headship and main prominence—a one-way implication requiring the pitch accent of a word to coincide with its prosodic head. We state this constraint in (1).

(1) Word Prominence to Word Head (WdPromToWdHd): If PrWd contains a main prominence, it coincides with the prosodic head of PrWd—the head syllable of its head foot.

WdPromToWdHd is not violated by rule-based accent in Japanese,[6] and the affinity between word accent and prosodic headship is arguably due to fundamental properties shared by stress accent and pitch accent:

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[4] In transliterating Japanese, we follow in broad outline the romanization of *Kenkyusha's New Japanese-English Online Dictionary,* 5th edition, 2004-2008 (http://kod.kenkyusha.co.jp/demo/wadai/honmon.jsp?id=0001070. retrieved 10/25/2014). The transliteration is closest to the Hepburn romanization, whereby /ʃ, tʃ, dʒ~ʒ/ are rendered as ⟨sh, ch, j⟩, respectively. Long vowels are transliterated by doubling the vowel symbol <aa, ii, uu, ee, oo>, or by macrons ⟨ā, ī, ū, ē, ō⟩. The coda nasal is transliterated as ⟨n⟩.

[5] I.e., abstracting away from sentence-level phenomena such as the unaccentedness of non-initial finite verbs in main clauses.

[6] The situation with lexically idiosyncratic accent (see section 2.1) is unclear, one view is that, protected by faithfulness constraints, it can violate the constraint. WdPromToWdHd allows us to dispense with an oft-assumed

> "[T]he two great modes of prominence, pitch-accent and stress, are notably distinct in their systematic properties. Most striking perhaps is the independence of pitch-accent from the kind of rhythmic effects that accompany true stress. [...] Nevertheless, certain formal properties are shared by these two modes of prosody, indicating that there may be an abstract notion of 'prominence' neutral as to realization that functions in both worlds" (Prince 1983:88-89).

Our main goal in this paper is to investigate the question whether the existence of unaccented content words must simply be taken as a fact of nature in certain pitch accent systems, or whether we can isolate specific factors that lead to it, and capture them in a formal analysis. Section 2 delves into the details of the Tokyo Japanese pitch accent system, and focuses in particular on the distribution of unaccented and accented words. Previous work has found a concentration of unaccented words in very specific areas, defined in prosodic terms, where unaccentedness is some kind of default; less clear is the prosodic rationale for the particular distribution of (un)accentedness. Section 3 investigates the underlying structural reasons and develops a formal OT-account, involving well-known constraints also seen at work in many stress systems, such as RIGHTMOST ("accent on the last foot"), NONFINALITY ("no accent on a word-final constituent"), and INITIALFOOT ("the word begins with a foot"). As we will show, unaccentedness in a pitch accent language like Japanese can be a means of resolving the conflicts between some of these constraints that arise once any accent is assigned by *avoiding an accent altogether*. In later sections, we follow up on the basic analysis by using OTWorkplace to explore the structure of the constraint system and some of the typological predictions. Section 4 explores both the core system (only light syllables) and the full system (light and heavy syllables) in OTWorkplace, and section 5 develops a detailed argument to the effect that what matters for unaccentedness is the prosodic profile of the word in terms of foot structure, not mora count. Section 6 explores further refinements arising in truncations, native items, and variation patterns, and section 7 concludes.

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accent-related OCP constraint, violated if there are two or more tonal accents in a prosodic word domain. Since the head of PrWd is always the head of its head foot, fulfilling WDPROMTOWDHD always means fulfilling a weaker constraint requiring the accent to coincide with a foot head. Pitch accent seeks foot-heads in systems with both pitch accent and stress accent, such as Uspanteko (Bennett and Henderson 2013) or Swedish (Riad 1996, Gussenhoven 2004, among others). The same situation holds for the intonational pitch accents in languages like English (Pierrehumbert 1980, Selkirk 1984) where pitch accent is tropic to stressed syllables. The possibility of WDPROMTOWDHD violations arises in other pitch accent languages—thus Kiparsky 2003, building on Sauzet 1989 and Golston 1990, identifies Ancient Greek pitch accent as tropic not to footheads, but rather as falling immediately before the head of a word-final trochaic foot, and previous versions of this paper explored the idea that there might also be situations in Japanese where thematic accent does not fall on footheads (i.e., cases not due to lexically idiosyncratic accents). We leave this issue for future exploration, noting that the current analysis works best if WDPROMTOWDHD is unviolated. (We are grateful to Clemens Poppe and Alan Prince for helpful comments that led to crucial clarifications).

2. Unaccentedness in Japanese: facts and generalizations

2.1 Preliminaries

Unaccentedness plays a major role in the lexicon of Standard Tokyo Japanese (henceforth referred to as "Japanese" in this paper).[7] The phonetic characteristics of Japanese pitch contours (see Poser 1984b, Beckman 1986, Kubozono 1988, Pierrehumbert and Beckman 1988) include two main features, the initial rise and the accentual fall. The pitch contour of a prosodic word—more precisely, of a minor phrase[8] (*bunsetsu* 文節 in Japanese, also called "accentual phrase")—begins with a boundary %Low and then proceeds on a phrasal High until it reaches the accented syllable, if present. The accentual High*Low complex is a steep fall, as on the syllable *ta* in a form like *tabesaseráreta* 'was forced to eat'. In the absence of an accent, as in *iresaserareta* 'was forced to put in' the pitch stays on the phrasal High. The concatenation of these tones results in an overall pattern %Low+High+(High*Low)%.

Accentually, words fall into two types, the thematic accent type and the athematic accent type, to use Martin's (1952) terms. *Thematic* accent is assigned by rule and falls on the syllable containing the antepenultimate mora (or on the initial syllable in shorter words), according to Martin's (1952:33) well-known three-mora rule. We will refer to this pattern as "(ante)-penultimate accent". Thematic accent is a systematic property of all inflected words—in Japanese, this includes verbs (*dōshi* 動詞) and *i*-type adjectives (*keiyōshi* 形容詞).[9] Here the only piece of unpredictable information is accentedness itself, not accent location. Verb roots are underlyingly either accented or unaccented, and the agglutinative structure of Japanese, with multiple suffixes, results in accent mobility. This is shown in forms with stem extensions, where the accent systematically migrates towards the end of the word, showing (ante)penultimacy for accented roots: ^{3}*tábe-ta* 'ate', ^{3}*tabe-sáse-ta* 'made to eat', ^{3}*tabe-sase-ráre-ta* 'was made to eat', etc. For unaccented roots, there is no change: ^{0}*ire-ta* 'inserted', ^{0}*ire-sase-ta* 'made to insert, ^{0}*ire-sase-rare-ta* 'was made to insert', etc. Employing a notation frequently used in Japanese reference works (but counting not from the beginning of the word, as is the usual practice, but from the end, in accordance with the direction of Japanese accent assignment), we indicate the location of the accented mora by a superscripted number: ^{3}*tabe-ta* "antepenultimate mora accent", etc. In this notation, a superscripted "^{0}" means unaccentedness: ^{0}*ire-ta*, etc. In addition, we often also mark the accented vowel with an acute (^{3}*tábe-ta,* etc.), for clarity.

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[7] See Uwano 1999 and Kubozono 2012 for the accentual systems of the major Japanese dialects.

[8] Or simply a minimal phrase, in a model with recursively defined subcategories (Ito and Mester 2007, 2009a, 2009c, 2010, 2013).

[9] In addition, certain suffixes are preaccenting, such as the verbal nonpast suffix *–(r)u*.

Many uninflected words also have thematic accent. For example, even though the accent location in nouns is in principle a lexical property and unpredictable (see below), large parts of the noun lexicon have thematic (ante)penultimate mora accent. This holds, for example, for 3μ and 4μ family names and place names, which, with few exceptions, are either unaccented (^{0}*Ueda,* ^{0}*Itō;* ^{0}*Inoue*, ^{0}*Ishikawa*, ^{0}*Hiroshima,* ^{0}*Shibuya*[10]) or have thematic accent (^{3}*Áraki,* ^{3}*Sátō;* ^{3}*Haráguchi,* ^{3}*Ichíkawa;* ^{3}*Nágano,* ^{3}*Nagásaki*).

Athematic accent is the property of the rest of the accented lexicon, i.e., of all accented uninflected items not having thematic accent. This includes nouns, adverbs, and all other words. In athematic items, not only accentedness, but also accent location is unpredictable. Thus in an accented noun, the accent can in principle fall on any syllable, as determined at underlying representation. This is illustrated in (2).

(2) Accented: ^{1}hashí 'bridge', ^{2}ko.kó.ro 'heart, ^{3}í.no.chi 'life'
Unaccented: ^{0}hashi 'edge', ^{0}ne.zu.mi 'rat, mouse', ^{0}sa.ka.na 'fish'

The split between thematic and athematic accent parallels similar bifurcations in other pitch accent languages such as Ancient Greek, where thematic accent (assigned by the recessive accent rule) is essentially limited to finite verbs and some nominal paradigms. Athematic accent in Japanese is in principle (but by no means statistically, as we will see below) unconstrained in terms of its location. In other languages it is often limited to a specific window (such as the last three syllables in Ancient Greek). More abstractly related are subgeneralizations like the fact that in English stress, final syllable extrametricality is a prerogative of nouns and certain classes of suffixed adjectives, and is not found in the rest of the lexicon.[11]

2.2 Accent generalizations

Our main concern here is the existence of unaccented words, which is a feature of some pitch accent languages like Japanese but not others, as noted in the Introduction above. Does such unaccentedness have specific structural roots within the grammar of the language, or is it just a contingent property? That is, within a language that permits unaccentedness, is it simply a lexical accident that certain items are unaccented, or are there reasons why certain types of words tend to be unaccented, but not others? It is sometimes said that unaccentedness is a kind of default in Japanese (Tanaka 2001), and statistically speaking this is not unreasonable (see Kitahara 2001

[10] There are few examples of this kind: Unaccented three-mora place names are apparently rare.
[11] Smith 1998 suggests that athematic accent, and the resulting accentual dichotomies, is due to a special variety of faithfulness limited to nouns, resulting in a larger variety of accent locations in output forms than otherwise permitted by markedness.

for detailed statistics about unaccentedness and accent location, on the basis of a large lexical database of Japanese by Amano and Kondo 1999). However, both the conception of unaccentedness as just a lexical accident and the idea that it is simply a default are problematic in the face of the recent discovery that unaccentedness in Japanese shows a high degree of correlation with prosodic shapes. There must be reasons why items of certain prosodic profiles, but not others, are prone to have no accent; a sheer random distribution, and a general preference for unaccentedness, cannot explain this fact.

Our proposal builds on the insights in previous work on unaccentedness, including Giriko 2008, 2011, Kubozono 2006, Kubozono and Ogawa 2004, Oda 2006, Tanaka 1996, 2008, Tanaka 2001, and Tateishi 1992. Starting with the main statistical facts, we can extract from the literature two large-scale generalizations. First, there is a very broad distinction among vocabulary strata[12] between native items (in their majority unaccented) and loan items (in their majority accented) (see Hayashi 1982, Shibata 1994, Kubozono 1996, 2006, Ogawa 2004, and Shinohara 2000). Second, phonological length (more specifically, mora count) affects the accentedness tendencies of nouns for both native words and loanwords (Akinaga 1998). Typical examples following the phonological length generalization appear in (3).[13]

(3)

	Native words			Loanwords		
$\leq 2\mu$	accented	^{2}néko	'cat'	accented	^{2}pári	'Paris' (F)
3μ	unaccented	^{0}nezumi	'mouse'	accented	^{3}póteto	'potato'
4μ	unaccented	^{0}hagetaka	'vulture'	unaccented	^{0}itaria	'Italia' (I)
$\geq 5\mu$	accented	^{3}hototógisu	'cuckoo'	accented	^{3}arubáito	'Arbeit' (G)

Both generalizations are broad tendencies and not hard-and-fast rules, as attested, for example, by well-known minimal pairs in native words, where two forms are segmentally identical and contrast only in the presence vs. absence of accent, such as ^{2}*áme* 'rain' vs. ^{0}*ame* 'candy', ^{2}*ása* 'morning' vs. ^{0}*asa* 'hemp', ^{2}*sáke* 'salmon' vs. ^{0}*sake* 'alcohol', ^{1}*haná* 'flower' vs. ^{0}*hana* 'nose, ^{1}*kakí* 'fence' vs. ^{0}*kaki* 'persimmon'. Even so, a mere perusal of the pages of an accent dictionary reveals the reality of the length generalizations in (3), which serve as useful rules-of-thumb for second language learners of Japanese when encountering an unknown word.

These generalizations (and further subgeneralizations established in recent work, in particular, by Kubozono and his co-researchers) present an obvious challenge to the accentologist, as no

[12] See Ito and Mester (1995a, 1995b, 1999, 2009b) for an overview of the major phonological differences between the various vocabulary strata.

[13] We indicate source languages as follows: D=Dutch, F=French, G=German, I=Italian, K=Korean, P=Portuguese, R=Russian, S=Spanish. English, as a default, remains unmarked.

sweeping generalization is in sight that could account for this kind of structurally controlled distribution of accentedness and unaccentedness. Simply asserting that unaccentedness is the 'default', or that it somehow correlates with length ('the longer, the more likely to be unaccented') does not even begin to account for the observations. We are also not aware of any articulatory or perceptual explanations that have even been attempted. Why do 4μ words tend to be unaccented, whether loans or native? Why do 3μ loans tend to be accented, but 3μ native words unaccented? On the other hand, why do both shorter (2μ) and longer (5μ and longer) words tend to be accented? Given the overwhelming importance of prosodic size and mora count, basic rhythmic and structural features of Japanese must be at play here, ultimately rooted in the rhythmic foot type of Japanese, the bimoraic trochee (Poser 1990). Our task then is to identify these factors, to capture their interaction within an analysis that covers the main generalizations and cross-linguistic implications, and to identify any remaining issues.

2.3 Faithfulness and the Emergence of the Unmarked

We start with the observation that the length generalizations in (3) for native words are far less robust than those for loanwords (see Kitahara 2001 and Kubozono 2006 for statistical results). This is perhaps not surprising, given that unpredictable accent and accent positions must be specified in some way or other, be it by the feature [+accent] (McCawley 1968), *-marking (Haraguchi 1977), a linked High-tone (Poser 1984b), or a linked High*Low-tonal complex (Pierrehumbert and Beckman 1988). In Optimality Theory (OT, Prince and Smolensky 1993), such lexically specified markings are protected by accentual faithfulness constraints, as proposed by Alderete (2001:216). Thus, underlyingly accented ^{2}/kokóro/ 'heart' cannot delete its accent *^{0}[kokoro] (violation of MAXACCENT), nor move it to another position *^{3}[kókoro] (violation of NOFLOPACCENT). Similarly, forms like ^{0}/sakana/ 'fish' underlyingly specified as unaccented cannot insert an accent *^{3}[sákana] (violation of DEPACCENT).

Thematic (ante)penultimate accent means that the item has no underlying accent specification (≠ being underlyingly specified as unaccented, such as ^{0}/sakana/). The grammar will therefore determine accentedness and accent location as an Emergence-of-the-Unmarked (EoU) effect (McCarthy and Prince 1994). Lacking lexical markings, such items are literally unmarked in terms of their accentuation. Nonce words, for example, receive their accent in this way. Loanwords are similar to nonce words in that they are also composed of a sequence of sounds not associated with meaning in the native language, as are strings of syllables such as ^{3}*kakikúkeko* (k-column of the syllabary), ^{3}*akasátana* (first five sounds of the *a*-row of the syllabary), or ^{3}*namuamidábutsu* 'Hail to Amitābha Buddha' (mantra chanted by Japanese Pure Land Buddhists). All of these have thematic (ante)penultimate accent.

The loanword pattern is also not exceptionless, but further detailed investigations by Kubozono 2006 have revealed that the deviant patterns can be traced to two factors, both involving the source word influence in different ways. (i) Although the majority of loans do not take into account the prominence location of the source word, some newer loans preserve the original prominence location of the source word, as in examples like ^{5}*ákusento* 'áccent', ^{1}*fondyú* 'fondúe', or ^{7}*apóintomento* 'appóintment', not the expected antepenultimate *^{3}*akusénto, **^{3}*fóndyu,* *^{3}*apointoménto*. (ii) If the (ante)penultimate vowel is epenthetic (in the sense of not being present in the source word, but inserted for phonotactic reasons), the accent often falls elsewhere instead (e.g. ^{4}*andérusen*, *^{3}*anderúsen* '(Hans Christian) Ándersen' from Danish, vs. ^{4}*andáason* 'Ánderson' from English).[14]

In OT terms, these factors are also related to faithfulness. The first class of items again has lexically specified accent. One might consider reaching beyond the Japanese lexicon and appealing to Output-Output (source-loan) prominence faithfulness, which must be higher-ranked for words like ^{1}*fondyú* or ^{5}*ákusento* than the constraints leading to the regular (ante)penultimate pattern. But it is unclear whether the synchronic grammar is the right place to model such language contact phenomena.

Avoiding accented epenthetic vowels (^{4}*andérusen*, not *^{3}*anderúsen*) means that speakers are aware that these vowels are not present in the source word (Northrup 2012), and the faithfulness constraint HEADDEP ("Every segment in a prosodic head in the output has a correspondent in the input") proposed by Alderete 2000 is in force. For such unassimilated loanwords, speakers must be cognizant of (and hence faithful to) the segmental and prosodic profile of the original source word, and such vowels are perhaps not part of the underlying representation. Long-established loans like ^{3}*kurisúmasu* 'Chrístmas' do not exhibit faithfulness to the primary stress of the source word, nor do they avoid accenting an etymologically epenthetic vowel, which is therefore best considered part of the underlying representation.

Appropriate faithfulness constraints thus account for the native lexically-specified accent positions as well as the unassimilated loanwords that are influenced by the structure of the source word. Setting such faithfulness-dependent cases aside, we can start assessing the details of the general loanword pattern again, and consider whether they might be analyzable as EoU effects. A few more examples are listed below to show their full generality.[15] As before, the acute mark indicates stress on the loan sources, and pitch accent on the Japanese loans.

[14] Since the accent always—at least abstracting away from superheavy syllables, see Ito and Mester 2013b—falls on the head (=initial) mora of the syllable, we find ^{4}*.an.dáa.son* and not *^{3}*.an.daá.son.*

[15] Japanese traditional accent terminology divides these into four categories: *atamadakagata* 頭高型 'initial-high', *nakadakagata* 中高型 'middle-high', *odakagata* 尾高型 'final high', and *heibangata* 平板型 'flat-plateau'.

(4)

2-3μ: (ante)penult	^{2}pá.ri	'París' (F)	^{2}sá.bo	'sabot' (F)	^{3}bá.na.na	'banána'
	^{2}pí.za	'pízza'	^{2}mó.ka	'mócha'	^{3}pó.te.to	'potáto'
4μ: unaccented	^{0}a.me.ri.ka	'América'	^{0}i.ta.ri.a	'Itália' (I)	^{0}tee.bu.ru	'táble'
	^{0}a.ri.ba.i	'álibi'	^{0}su.te.re.o	'stéreo'	^{0}in.to.ro	'íntro'
5^{+}μ: (ante)penult	^{3}a.ru.bái.to	'Árbeit' (G)	^{3}garapágosu	'Galápagos'		
	^{3}asuparágasu	'aspáragus'	^{3}rosanzérusu	'Los Ángeles'		
	^{3}ka.ri.kyú.ra.mu	'currículum'	^{4}aruzénchin	'Argentína'		

Even though 1μ loanwords are rare, they are instantiated in the terms for musical notes (*dó, ré, mí*, etc.), which are are all accented, as are a handful of accented abbreviations such as *pé* 'p.', an abbreviation for ^{0}*peezi* 'page'. The (ante)penultimate accents for 2-, 3- and 5^{+}μ cases fall within the final 3μ window, and can be considered as an "antepenultimate" system in traditional metrical terms: accent on the antepenult, otherwise (i.e., if no antepenult) on the penult, otherwise (i.e., if no penult) on the ultima. Since 'accented' is here equivalent to '(ante)penultimate accent', an even simpler statement as in (5) can be given.

(5) Accent generalization: 4μ words are unaccented, all others accented.

Additional evidence for this pattern is found in truncations (Poser 1984a, 1990, Ito 1990, Mester 1990, Ito and Mester 1992, etc.), where loanwords are shortened to 2, 3, or 4μ, as illustrated in (6). The variation in truncation size depends on several different factors, including sociolinguistic and euphonic ones.[16]

(6)

	Truncation	Base	Gloss
2μ truncations: accented	^{2}súto	sutoráiki	'strike'
	^{2}púra	purasuchíkku	'plastic'
3μ truncations: accented	^{3}dáiya	daiyamóndo	'diamond'
	^{3}ánime	animéeshon	'animation'
4μ truncations: unaccented	^{0}rihabiri	rihabiritéeshon	'rehabilitation'
	^{0}asupara	asuparágasu	'asparagus'

[16] Labrune 2002 has argued for an accent cut generalization, where truncation occurs immediately before the accent of the original loanword input. While this interesting generalization appears to work for certain cases, such as *suto*||ráiki, *daiya*||móndo, *rihabiri*||téeshon, for others it predicts unattested truncated outputs, such as **purasu*||chíkku (instead ^{2}*púra*), **ani*||méeshon (instead ^{3}*ánime*), **asupa*||rágasu (instead ^{0}*asupara*). Thus, while the position of the accent in the base form may play a role in the truncation size, it does not seem to be the sole deciding factor (see also Shinya 2002).

For our purposes here, of interest is not the variation itself, but the fact that whatever the accent position of the input form (usually antepenultimate, given the length of such loanwords that are subject to shortening), the truncated outputs all obey the accent generalization "4μ unaccented, otherwise accented". Oho 2009 makes the interesting observation that loan truncations rigorously follow the accent generalization because neither the source word accent position nor the etymologically epenthetic nature of vowels play a role in an OT Base-Truncatum (output-output) correspondence relation (Benua 1995). The Base to which the Truncated Form corresponds is the full prosodic output form in Japanese, not the loan source. The source word is relevant when deriving the loanword itself, but only the output loanword structure is relevant when deriving its shortening.

Poser 1984b (see also Poser 1990 and Mester 1990) has noted the same pattern in another area of prosodic morphology, namely in Japanese hypocoristic formation. Here long names (e.g., *Wasáburō, Shinzaburō, Masanosuke, Momótarō*) are truncated down to the size of either a single foot (=2μ) or two feet (=4μ). The accentual profile follows the familiar generalization. We find (ante)penult accent in 2μ hypocoristics: ^{2}*Wása(-chan),* ^{2}*Shín(-chan),* ^{2}*Mása(-chan),* ^{2}*Mómo(-chan)*, and lack of accent in 4μ forms: ^{0}*Shinzabu(-chan),* ^{0}*Masanoke(-chan),* ^{0}*Wasaburo(-chan), Momotaro(-chan)*.[17]

Table (7) summarizes the overall pattern, and we can now proceed to investigate the formal prosodic factors behind this bipartite accented/unaccented generalization.

(7)

	1μ	2μ	3μ	4μ	5⁺μ
Loanwords and nonce words	accented	accented	accented	*unaccented*	accented
Loanword truncations[18]	accented	accented	accented	*unaccented*	
Hypocoristics[19]		accented		*unaccented*	

3. Antepenultimacy and unaccentedness: the basic analysis

One of the goals of this paper is to contribute to the understanding of the similarities and differences between stress accent and pitch accent through the detailed study of an individual system, complementing typological approaches that necessarily paint with a broad brush. Unlike unaccentedness, antepenultimacy is a feature not only of pitch accent languages like Japanese,

[17] Accented 4μ variants are also possible for some speakers, where the accent position is the one faithful to the full name. That is, the name *Momótarō* has the following possible hypocoristic variants: *Mómo-chan* (2μ, (ante)penult accent), *Momotaro-chan* (4μ, unaccented), and *Momótaro-chan* (4μ, faithfully accented).

[18] Truncations longer than two bimoraic feet do not exist because of the templatic binarity requirements explored in Ito and Mester 1992.

[19] Hypochoristic truncata are always integer multiples of strictly bimoraic trochees (Poser 1984a).

but also of familiar stress languages such as Latin and English, and in fact of numerous genetically unrelated stress accent systems, such as Damascene Arabic (McCarthy 1980) or Macedonian (Beasley and Crosswhite 2003). Goedemans and Hulst 2013 list many other examples across the globe, including Banggarla (Pama-Nyungan), Georgian (Kartvelian), (Modern) Greek (Indo-European), Paumari (Arauan), Sahu (West Papuan), as well as the Austronesian languages Kela (Apoze), Mae, Paamese, and Tiruray. Our strategy will be to start out by trying to understand the similarities shared by all these systems, whether they involve pitch or stress accent, as arising from a set of identical (or very similar) constraints, and subsequently ask where exactly the two types of systems diverge in terms of constraint ranking.

3.1 Binary footing and antepenultimacy

In standard metrical foot-based theory, inaugurated by Prince 1976 and further developed in Hayes 1980 and later works, antepenultimacy is analyzed as binary trochaic (left-headed) footing at the right word edge, modulo extrametricality. Typical cases are given below from English, Latin, and Macedonian (see Beasley and Crosswhite 2003, Franks 1989, Hayes 1995, Mester 1994, and Pater 2000). In order to keep a sharp focus on the essential questions, we will here first abstract away from the effects of syllable quantity, and limit our attention to light-syllable-only forms even in languages with quantity distinctions, like Latin or Japanese.

(8) Antepenultimate stress systems

	English	*Latin*		*Macedonian*	
(śs)	(císty)	(héri)	'yesterday'	(tátko)	'father'[20]
(śs)⟨s⟩	(cíne)⟨ma⟩	(fémi)⟨na⟩	'woman'	(tátkov)⟨tsi⟩	'fathers'
s(śs)⟨s⟩	a(cáde)⟨my⟩	a(gríco)⟨la⟩	'farmer'	vo(déni)⟨čar⟩	'miller'
ss(śs)⟨s⟩	metri(cáli)⟨ty⟩	labe(fáce)⟨re⟩	'shake'	vode(níča)⟨ri⟩	'millers'
sss(śs)⟨s⟩	univer(sáli)⟨ty⟩	epitha(lámi)⟨a⟩	'bridal songs'	vodeni(čári)⟨te⟩	'the millers'

In OT terms (Prince and Smolensky 1993), antepenultimacy results from the interaction of the constraints on foot form and on primary stress location (9).

(9) a. Foot form: FTBIN, TROCHEE, RHYTHMICHARMONY, WEIGHT-TO-STRESS, etc.
b. Primary stress: RIGHTMOST, NONFINALITY

[20] Extrametricality is not in force because feet must be minimally binary.

The bimoraic trochaic foot of Japanese, whose importance was first noted by Poser 1984, with much subsequent evidence and argumentation provided by various authors (Poser 1990, Ito 1990, Ito and Mester 1992, Kubozono 2002, among others), has played a prominent role in the Prosodic Morphology literature (see McCarthy and Prince 1986 and work cited there). In terms of accent location, various researchers (Poser 1990, Katayama 1998, Kubozono 2006) noted the similarities to antepenultimate stress and used the bimoraic trochee to account for the placement of word accent. Extending Poser's (1990) proposal of Foot Invisibility for certain cases of compound accentuation, the regular antepenultimate accent can be located by making the final foot invisible, and placing the accent in the rightmost position of the visible word, as in *ká⟨nada⟩* 'Canada' and *terorí⟨suto⟩* 'terrorist' (see Katayama 1998 and Kubozono 2006). In such Foot Invisibility accounts, the foot position within the word is crucially different from that of the analysis of antepenultimate stress systems, where the binary foot is placed in non-final position, e.g., as in (*Cána*)⟨*da*⟩, or *metri*(*cáli*)⟨*ty*⟩. In either analysis, the prominence falls on the antepenultimate syllable, […s***S***⟨ss⟩] vs. […s(***S***s)⟨s⟩],[21] even though both the location of the foot itself (final vs. nonfinal in the prosodic word) and the position of the accent with respect to the foot (pre-foot vs. on the foot-initial head) are crucially different.

In prototypical stress systems, foot structure, virtually by definition, cannot be divorced from prominence (see Bennett 2012 for recent discussion) in this way. Word prominence, cashed in as primary stress, coincides with the head syllable of the head foot of the prosodic word. On the other hand, in pitch accent systems, various factors (including the existence of unaccented words and the nonexistence of secondary pitch accent analogous to secondary stress) in principle allow for the possibility that the foot itself might not contain the locus of word prominence, or culminativity.

Instead of taking this route and already starting out with such a major analytical difference, which is likely to make the two systems incommensurable from the outset without having an unassailable basis in the facts, our strategy is to understand pitch accent, like stress accent, also as word prominence associated with the head of the head foot (see (1) above)—with the option of violability, available in an OT grammar for intrinsic reasons. As we show below, pursuing the formal similarities in this way allows us to identify the real differences, ultimately leading to a better understanding of both types of accent systems.

[21] For ease of comparison, both pitch accent prominence and stress accent prominence are here indicated by capital 'S'.

3.2 Initiality and word prominence

Given the same prosodic constraints leading to (ante)penultimate accent, we are of course left with two related questions: (i) Why is ^{3}*A.(mé.ri).ca,* with antepenultimate prominence, good for English but bad for Japanese? (ii) Why is unaccented ^{0}*amerika* good for Japanese but bad for English?

(10)

	Latin/English stress accent	Japanese pitch accent	
(Ss)	(cíty)	(pári)	
(Ss)⟨s⟩	(Cána)⟨da⟩	(kána)⟨da⟩	
s(Ss)⟨s⟩	A(méri)⟨ca⟩	**a(méri)⟨ka⟩*	→ *wrong prediction*
ss(Ss)⟨s⟩	metri(cáli)⟨ty⟩	tero(rísu)⟨to⟩	
sss(Ss)⟨s⟩	univer(sáli)⟨ty⟩	asupa(rága)⟨su⟩	

Somewhat surprisingly, the answer—albeit still a partial one—lies in yet another similarity between the two types of systems, namely INITIALFOOT (11), the requirement that the prosodic word begin with a foot aligned with its left edge (Hayes 1982). In English—abstracting away from cyclic effects (Kiparsky 1979)—this is the factor responsible for the initial secondary stress in longer words such as (*Phìla*)(*délphi*)⟨*a*⟩, (*Wìnne*)*pe*(*sáu*)⟨*kee*⟩, and (*Tàta*)*ma*(*góu*)⟨*chi*⟩.[22]

(11) INITIALFOOT: Align-Left (PrWd, Foot). Violated by an unfooted syllable (o) at the left edge of PrWd: $*_{\omega}[$o

In Japanese, even though there is no phonetic secondary accent, evidence for a left-aligned initial foot is nevertheless abundant in prosodic morphology, and there is additional evidence for dense foot structure from artificial language learning experiments (Bennett 2014) and from phonetic cues to foot structure involving the duration of affrication (Shaw 2007).[23] Ito and Mester 1992 show that loanwords can only be truncated in such a way that a proper initial

[22] In Latin the evidence for a word-initial secondary prominence is more subtle, but still beyond reasonable doubt (see Allen 1973:181). In the light of more recent work, (11) can be seen an instance of a more general STRONGSTART requirement (Selkirk 2011:470).

[23] A reviewer expresses some doubts regarding the force of Shaw's findings, maintaining that they only show longer frication before accented vowels, not in foot-initial position. A look at Shaw's examples makes it clear, however, that this view is mistaken: Accent has nothing to do with the occurrence of longer frication in Shaw's results, the crucial tokens have affricates like /tʃ/ before unaccented vowels: e.g., ^{0}(*chimi*)*tsu* 'accuracy' (word-initial/foot-initial), ^{4}(*ún*)(*chin*) 'fare' (word-internal/foot-initial), ^{3}(*íno*)*chi* 'life' (word-internal/unfooted), ^{0}(*machi*)*da* (a name, word-internal/foot-medial). Shaw's interpretation of the data as involving segmental cues to foot structure is therefore well-taken (see Bennett 2012 on the cross-linguistic pervasiveness of such foot-based phonotactics).

bimoraic foot appears in the truncated output. The left-aligned foot condition explains why [(*kón*)*bi*] is a well-formed (and attested) truncation, but not *[*dé*(*mon*)].

(12)	attested truncations	(démo)	(róke)	(kón)bi	(páa)ma
	impossible truncations	*dé(mon)	*ró(kee)		
	sources	demonsutoréeshon 'demonstration'	rokéeshon 'location'	konbinéeshon 'combination'	paamanénto 'perm'

In the language game *Zuuja-go* (ZG), words are prosodically split into two parts whose order is reversed, as illustrated in (13) (for details and analysis, see Tateishi 1989, Ito, Kitagawa, Mester 1995, and Sanders 1999; we will return later in section 6.1 to the accentuation of such templatic word formations). The crucial point here is that a left-aligned foot must appear in the output, as indicated.

(13)	^{0}kara oke	'karaoke'	→ ZG	^{0}(*oke*) kara	^{0}ku suri	'drug'	→ ZG	^{0}(*suri*) ku
	^{2}koo híi	'coffee'	→ ZG	^{0}(*hii*) koo	^{0}pi yano	'piano'	→ ZG	^{0}(*yano*) pi
	^{0}ka ban	'bag'	→ ZG	^{0}(*ban*) ka				

When the ZG-reversal does not make an initial foot available, as in (14), either the vowel of the first syllable is lengthened, or segmental reversal takes place in a different way, both resulting in a proper bimoraic foot.

(14)	^{3}kónbi	'combination'	→ ZG	bi.kon	→ *further modification*	^{0}(*bii*)kon, ^{3}(*bin*)ko
	^{3}pántsu	'pants'	→ ZG	tsu.pan	→ *further modification*	^{0}(*tsuu*)pan, ^{3}(*tsun*)pa
	^{3}kóora	'Cola'	→ ZG	ra.koo	→ *further modification*	^{3}(*raa*)ko

Both the truncations and the ZG-game thus illustrate the INITIALFOOT constraint at work in Japanese.

But if the antepenultimacy constraints (RIGHTMOST modulo NONFINALITY) and INITIALFOOT are operative in both Latin/English stress accent and Japanese pitch accent, what distinguishes the two systems? Our central hypothesis is that the root cause is a difference in parsing, as in (15).

(15)		Parsings:				
English	antepenultimacy>>INITIALFOOT	(Ss)	(Ss)s	**s(Ss)s**	(Ss)(Ss)s	(Ss)s(Ss)s
Japanese	INITIALFOOT>>antepenultimacy	(Ss)	(Ss)s	**(Ss)(Ss)**	(Ss)(Ss)s	(Ss)s(Ss)s

Capitalization indicates pure prosodic headship, so (Ss) stands for a trochaic foot without commitment as to the phonetic accessories of headship (primary/secondary intensity peak, pitch excursion, lengthening, etc.). 2σ words [(Ss)] are too short for antepenultimacy, and default to penult prominence.[24] Antepenultimacy and INITIALFOOT do not conflict in 3σ forms, the single initial foot in [(Ss)s] satisfies both INITIALFOOT and antepenultimacy (RIGHTMOST-modulo-NONFINALITY). Nor do they conflict in 5σ and longer forms ([(Ss)(Ss)s], [(Ss)s(Ss)s], etc.), where two or more feet can be built, one fulfilling antepenultimacy, the other fulfilling INITIALFOOT. The conflict only arises in the 4σ case [s(Ss)s], where in English INITIALFOOT is violated in order to fulfill antepenultimacy, as in *A(méri)ca*, whereas in Japanese it is more important to place a PrWd-initial foot, and the bipodal [(Ss)(Ss)] arises.[25] This still does not explain why the Japanese two-footed forms are *un*accented (^{0}[(*ame*)(*rika*)], etc.), but it does give an answer to one part of the puzzle, namely, why they do *not* have antepenultimate accent like the rest of the forms.

Why, then, does a two-footed form [(Ss)(Ss)] lead to unaccentedness, and not to pre-antepenult accent [(*áme*)(*rika*)] or penult accent [(*ame*)(*ríka*)]? This is where we encounter a fundamental difference between stress accent and pitch accent. As discussed in the introduction, unaccented words are only allowed in pitch accent systems. The *obligatoriness* of stress accent can be considered to be due to the undominated status, in stress accent systems, of the word prominence constraint, whereby words are required to have a phonetic prominence/accentual peak. On the other hand, for pitch accent systems, if the word prominence constraint is low ranking, an unaccented form can emerge as the winner when all possible accent positions are ruled out by higher ranking constraints.

Teasing the puzzle apart in this way has led us to an interesting cross-linguistic comparison, beyond merely noting the shared antepenultimacy coupled with some odd systematic exceptions. It is thus incorrect to literally *identify* the Japanese pitch accent rule with the Latin stress rule (as, for example, in Shinohara 2000:58,63,76, see also Kubozono 2006:1153-1156, 2009:172-173). While they share many important features, there are two significant differences: In Japanese, the

[24] The full analysis of these short forms will turn out to have interesting consequences, as discussed in the next section.

[25] Martin Krämer (pers. comm.) drew our attention to a very similar pattern that emerged in a nonce word experiment probing the default stress assignment in Italian (see Krämer 2009:160-190): While trisyllables of the form LLL showed a significant percentage of antepenultimate stress (44.9%, vs. 55.1% penult), quadrisyllables of the form LLLL had overwhelmingly penult stress (91.7%, vs. 8.3% antepenult).

word-initial foot requirement is more strict, and the requirement to assign a main prominence more lenient. This becomes clear, of course, only once the constraint system is more fully worked out, covering both accented and unaccented items (and does not treat the latter as an unexplained appendix added on to the actual analysis). The next section lays out the formal OT constraint system that accounts for this basic accent system.

3.3 Antepenultimacy and unaccentedness

In order to focus on the essential features of the accentual system and to abstract away from the disruptions of the pattern that arise when heavy syllables are part of the string to be prosodified, we first continue to limit our attention to the subsystem consisting of all-light-syllable words (16). Here weight-sensitive constraints are not at play, and the quantity-insensitive core of the analysis is clearly visible in isolation.

(16) Summary of prosodic profiles of all-light-syllable words[26]

accented			unaccented	accented		
1L	2L	3L	4L	5L	6L	7L
^{1}(**Ĺ**)	^{2}(**Ĺ**L)	^{3}(**Ĺ**L)L	^{0}(LL)(LL)	^{3}(LL)(**Ĺ**L)L	^{3}(LL)L(**Ĺ**L)L	^{3}(LL)(LL)(**Ĺ**L)L
(dó)	(pári)	(bána)na	(riha)(biri)	(kuri)(súma)su	(meto)ro(póri)su	(ana)(kuro)(nízu)mu
(ré)	(páte)	(góri)ra	(ame)(rika)	(asu)(fáru)to	(eko)no(mísu)to	(namu)(ami)(dábu)tu
(mí)	(mémo)	(sháto)ru	(kari)(suma)	(pia)(nísu)to	(asu)pa(rága)su	(abu)(suto)(ráku)to

We define in (17) the core constraints leading to antepenultimacy, as motivated in the previous section.

(17) a. WORDACCENT: A prosodic word contains a prominence peak. Violated by prosodic words not having a prominence peak (peak=primary stress or pitch accent, in Japanese: High*Low).

b. RIGHTMOST: * FT' … FT…]$_{\omega}$ Violated by any foot following the head foot within the prosodic word. This is the *End Rule* (*Final*) of Prince 1983, in a version modeled on the foot-based restatement in McCarthy 2003:111.

c. NONFINALITY (FT'): * FT']$_{\omega}$ Violated by any head foot that is final in its PrWd (Prince and Smolensky 1993:45).[27]

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[26] Glosses: (musical notes); Paris, paté, memo; banana, gorilla, shuttle; rehabilitation, America, charisma; Christmas, asphalt, pianist; metropolis, economist, asparagus; anachronism, (Buddhist chant), abstract.

[27] "Final" in the sense that the right edge of FT' coincides with the right edge of PrWd.

d. INITIALFOOT: $*_{\omega}[$o A prosodic word begins with a foot (Ito and Mester 1992:31, McCarthy and Prince 1993:81). Violated by any prosodic word whose left edge is aligned not with the left edge of a foot, but of an unfooted syllable.

e. PARSE-σ: *o All syllables are parsed into feet (Prince and Smolensky 1993:62). Violated by unfooted syllables.

f. NOLAPSE: *oo Syllables are maximally parsed. Violated by two consecutive unparsed syllables

Beyond the general PARSE-σ (17e), we will see the workings of another constraint NOLAPSE (17f), which militates against sparse footings leaving more than one successive syllable in a string unparsed.[28]

The ranking of these constraints in antepenultimacy languages (English, Latin, etc.) is illustrated in (18), where each of the contending candidates violates a higher ranked constraint, and the winner (a) violates only low-ranking INITFT and PARSE-σ.

(18) Antepenultimacy (English/Latin) ranking:

			WDACC	NOLAPSE	NONFIN(FT')	RIGHTMOST	**INITFT**	PARSE-σ
/amerika/	► a.	[3][a(méri)ka]					*	**
	b.	[4][(áme)(rika)]				*!		
	c.	[2][(ame)(ríka)]			*!			
	d.	[4][(áme)rika]		*!				**
	e.	[0][(ame)(rika)]	*!					

INITIALFT and WORDACC exchange places in Japanese (19), and the unaccented form emerges as optimal for this input.

[28] NOLAPSE (17f) is a parsing constraint targeting pairs of unfooted syllables, closest in spirit perhaps to the PARSE-2 constraint of Kager 1996. It should not be confused with a rhythmic constraint targeting stress lapses (see Alber 2005, for example), which groups together all unstressed syllables, whether parsed or unparsed, and has little relevance for a language without word stress (see also the passage from Prince 1983 quoted in the introduction).

(19) Unaccented (Japanese) ranking:

			INITFT	NOLAPSE	NONFIN(FT')	RIGHTMOST	**WDACC**	PARSE-σ
/amerika/	► a.	[0][(ame)(rika)]					*	
	b.	[4][(áme)(rika)]				*!		
	c.	[2][(ame)(ríka)]			*!			
	d.	[4][(áme)rika]		*!				**
	e.	[3][a(méri)ka]	*!					**

RIGHTMOST is violated in (19b) because the head foot containing the word prominence is followed by another foot. The penult-accented (19c) fulfills RIGHTMOST, but violates NONFIN(FT'). While INITFT ensures parsing of word-initial syllables, low-ranking PARSE-σ does not play much of a role for the parsing of the rest of the word. Rather, it is NOLAPSE that is decisive in accounting for the illformedness of (19d) [4][*(áme)rika*], which fulfills both WDACC and RIGHTMOST, at the cost of leaving the last two syllables unfooted. Candidate (19e), with antepenultimate accent, fulfills RIGHTMOST and NONFIN(FT'), but violates INITIALFT. Rather than receiving an accent in a "wrong" (non-antepenultimate) position, it is better to have no accent at all, and the unaccented candidate (19a) with a low-ranking WDACC violation emerges victorious. A low-ranking, and hence eminently violable, WDACC does not mean that all words become unaccented. Rather, whenever the dominant constraints, NONFIN(FT'), RIGHTMOST, NOLAPSE, and INITIALFT, can be fulfilled without violating WDACC, the latter exerts its force, ensuring antepenultimate prominence for 3-, 5-, and 6σ cases. This is shown in (20), where the unaccented candidates lose because of their violations of WDACC. The same point carries over to even longer strings of light syllables, which are of course vanishingly rare in the lexicon, but the 8σ word [3]*erekutoroníkusu* 'electronics' is an example.

(20)

				INITFT	NOLAPSE	NONFIN(FT')	RIGHTMOST	WDACC	PARSE-σ
/banana/	►	a.	^{3}[(bána)na]						*
		b.	^{0}[(bana)na]					*!	*
		c.	^{2}[ba(nána)]	*!		*!			*
/baruserona/	►	d.	^{3}[(baru)(séro)na]						*
		e.	^{0}[(baru)(sero)na]					*!	*
		f.	^{5}[(báru)(sero)na]				*!		*
		g.	^{2}[(baru)se(róna)]			*!			*
		h.	^{5}[(báru)serona]		*!*				***
		i.	^{4}[ba(rúse)(rona)]	*!			*!		*
/asuparagasu/	►	j.	^{3}[(asu)pa(rága)su]						**
		k.	^{0}[(asu)(para)(gasu)]					*!	
		l.	^{4}[(asu)(pára)(gasu)]				*!		
		m.	^{2}[(asu)(para)(gásu)]			*!			
		n.	^{6}[(ásu)paragasu]		*!**				****
		o.	^{3}[a(supa)(rága)su]	*!					**

To sum up so far, the gist of our explanation of the structural causes for unaccentedness is that 4σ-words are exhaustively footed into two feet [(Ss)(Ss)]. Given this specific situation and the dominated status of WORDACC, unaccentedness is optimal. Exhaustive footing is not the key factor here, since 6σ items like ^{3}(*asu*)*pa*(*rága*)*su* 'asparagus', ^{3}(*aka*)*de*(*mízu*)*mu* 'academism', or ^{3}(*ea*)*ro*(*bíku*)*su* 'aerobics' are assigned sparsely footed parses (^{3}[(*asu*)*pa*(*rága*)*su*] (20j), etc.) over fully footed but unaccented parses ^{0}[(*asu*)(*para*)(*gasu*)] (20k), etc.) because WORDACC dominates PARSE-σ. The overall ranking of the constraints in Japanese is given in (21).

(21) INITIALFOOT NOLAPSE NONFINALITY(FT') RIGHTMOST

WORDACCENT

PARSE-σ

What we have found, then, is a principled reason why unaccentedness emerges as optimal in 4σ words, while accentedness and antepenultimacy are unbeatable elsewhere. The success of the analysis underlines the crucial role of foot structure even in a pitch accent language like Japanese, far removed from the audible alternating pattern of a densely stressed language like English. Seen in a more general light, our OT analysis is crucially based in Prosodic Hierarchy Theory (see Selkirk 2011 and work cited there), where prosodic units are organized in a hierarchical structure. For the investigation of word accent, the relevant units are prosodic word, foot, syllable, and mora, which we assume to be universally present in the grammars of all languages.[29] Following Ito and Mester (1992:12) (see also Selkirk 1996:15), we assume for our purposes here that the HEADEDNESS constraint is universally unviolated, so that all prosodic units are headed at the next level of structure.[30] As a result, GEN does not even generate candidates without any feet, which would not fulfill HEADEDNESS. This is not intended as a claim of substance, but rather a simplifying assumption made for convenience. As a result, the accented and minimally footed ^{3}[*a*(*méri*)*ka*)] and the unaccented and exhaustively footed ^{0}[(*ame*)(*rika*)] are competing candidates, but not the unfooted ^{0}[*amerika*]. Crucially, unaccentedness is not rooted in unfootedness since an unfooted ^{0}[*amerika*] does not even come close to an explanation: It would be mysterious why unaccentedness would not also affect, qua footlessness, besides words of 4 syllables, words of 3, 5 and indeed 6+ syllables.

3.4 Minimal word exclusion

As it stands, however, the analysis has at least one major gap: All monomoraic and bimoraic items, such as *mémo* 'memorandum', are wrongly predicted to be unaccented, as shown in (22). It thus predicts too much unaccentedness, and for a very basic class of forms. The crucial competing candidates (22ab) consist of a single foot, which is necessarily final within its prosodic word. NONFINALITY(FT') therefore wrongly declares this (single) final foot unable to bear accentual prominence, ruling out (22b) and instead selecting the unaccented (22a).

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[29] The presence of the category *syllable* has recently been contested for Japanese (in Labrune 2012 and Vance 2013), building on the well-known traditional kana conception rooted in the writing system, but see Kawahara 2012, to appear for a restatement of the considerable evidence for syllables in Japanese experimental phonetics and phonology, and Kubozono 1989:264-271 for a classic study strongly motivating the syllable as a constituent besides the mora in Japanese speech errors and other psycholinguistic data.

[30] In pitch accent systems, the prosodic requirement of headedness is not equivalent to the WORDACCENT requirement, whereas in stress accent systems, where they do not diverge, they can been considered equivalent.

(22)

				InitFt	NoLapse	NonFin(Ft')	Rightmost	WdAcc	Parse-σ
/memo/	*wrong winner*	► a.	^{0}[(me.mo)]					*	
	intended winner	b.	^{2}[(mé.mo)]			*!			

The problem plainly lies with the ranking NonFinality(Ft')>>WordAcc, which cannot easily be reversed, however, since it is basic to our analysis of unaccentedness in 4σ words like [^{0}(*ame*)(*rika*)], repeated below with the crucial candidates and constraints. For ease of comparison, the ranking paradox is depicted in (23).

(23)				NonFin(Ft')	WdAcc
/amerika/	*correct* unaccented winner	► a.	^{0}[(ame)(rika)]		*
		b.	^{2}[(ame)(ríka)]	*!	
/memo/	*incorrect* unaccented winner	► c.	^{0}[(me.mo)]		*
		d.	^{2}[(mé.mo)]	*!	

How might one approach this ranking paradox? For some reason, bimoraic forms (single-foot words) do not seem to be subject to NonFinality(Ft'), as far as pitch accent is concerned. One possibility is to revise the NonFinality(Ft') constraint so that they are not subject to this constraint because they are too short. This move would follow the lines of the whole form exemption clause of traditional Extrametricality Theory: "[...] extrametricality rules are blocked if their application would mark the entire stress domain as [+ ex]" (Hayes 1982:235), or "[...] extrametricality may never render an entire phonological string invisible" (Halle and Vergnaud 1987:50). For example, NonFinality(Ft') might be defined so that it is violated only when there is another landing site for the accent (24).

(24) NonFinality(Ft') (reformulated; to be rejected) — $*X\ Ft']_\omega$ Violated if non-null material X precedes a right-aligned head foot in the prosodic word.

Given such a reformulation, an accented final foot constitutes a violation in longer forms, where X is not zero, but is exempt from the constraint in bimoraic forms, since X is zero.

(25)

			NONFIN(FT'), version (24)	WDACC
/amerika/	►a.	^{0}[(ame)(rika)]		*
	b.	^{2}[(ame)(ríka)]	*!	
/memo/	c.	^{0}[(me.mo)]		*!
	►d.	^{2}[(mé.mo)]		

Are we witnessing, then, the ultimate triumph of Extrametricality over the NONFINALITY conception argued for by Prince and Smolensky 1993:44-58? There are reasons to be doubtful. Although a reformulation like (24) is not inconceivable, it remains unsatisfactory. The whole form exemption clause of Extrametricality Theory was always a serious liability since it stipulates something that can be explained, in a principled way, as arising from the interaction of independent and elementary constraints: WORDACC (often equated with HEADEDNESS) requires a head foot (with primary stress), even if this means having a foot in final position. WORDACC thus trumps NONFIN(FT'), which we find violated in short forms.

But for pitch accent systems like Japanese, which allow violations of WORDACC in output forms, we need the opposite ranking NONFIN(FT') >> WORDACC, as in (23), so this simple constraint interaction scenario is not available. A return to an extrametricality-type analysis is formally possible, as shown in (25), but perhaps we can do better. What we see in action here, we contend, is rather a more specific version of WORDACC (26) applying to a specific prosodic profile: Words that are prosodically minimal, coextensive with a single rhythmic unit (in Japanese, a bimoraic foot). In the words of McCarthy and Prince 1990:231, "[t]he prosodic hierarchy, as a principle of representational well-formedness, guarantees that words are made of feet, feet of syllables, syllables of moras. The minimal expansion of the category word […] therefore consists of a single foot."

(26) MINWORDACCENT: ω_{min} contains a prominence peak. Violated when ω_{min} does not contain a prominence (peak=primary stress or pitch accent, in Japanese: High*Low).

With MINWORDACC, but not general WORDACC, dominating NONFIN(FT'), the correct accented bimoraic form emerges as the winner (27c). Given the very nature of the constraint, there are no ill effects on non-minimal words (27a).

(27)

			MINWDACC	NONFIN(FT')	WDACC
/amerika/	►a.	^{0}[(ame)(rika)]			*
	b.	^{2}[(ame)(ríka)]		*!	
/memo/	c.	^{0}[(me.mo)]	*!		*
	►d.	^{2}[(mé.mo)]		*	

Although MINWORDACC does the intended analytical work, the exact status of such a constraint, and the motivation for it, are worth investigating. The requirement that minimal words need an accent even when this means violating NONFIN(FT') will hopefully turn out to be the effect of some kind of interaction of more elementary constraints with WORDACC, but this requires a separate investigation and theoretical development. We will here continue to work with MINWDACC as a descriptive stand-in. Minimal words have a special status cross-linguistically known as *minimal word effects* (McCarthy and Prince 1990 et sqq.). Besides setting a lower limit on content word size in many languages, they serve as templates in a host of prosodically defined word formation processes, for example, as patterns for morphological reduplication and truncation.[31] One-foot prosodic words are a major milestone in language acquisition (*banána* > *nána*, *giráffe* > *ráffe*, *élephant* > *éfa*, etc., see Demuth 1996), where they set an upper limit on word size that is respected for a significant amount of time before longer items are mastered. Work on phonological acquisition has therefore posited constraints requiring prosodic words to be coextensive with feet, such as Pater 's (2004:227) WORDSIZE constraint stating that "[a] word is made up of a single trochee". For Japanese, among 2μ-words those with initial accent are statistically dominant and constitute between 50% (for most familiar items) and 70% (for least familiar items) of all 2μ-words, see Kitahara 2001. Furthermore, a consistent finding in acquisition studies is that learners acquire the pitch pattern of initially accented LL-words like ^{2}*néko* 'cat' significantly earlier than that of unaccented LL-words like ^{0}*buta* 'pig' (Hallé, de Boysson-Bardies and Vihman 1991, Ota 2003).[32] The idea behind (26) is that the minimal word phase is not just a transitory period in language acquisition, but remains active in

[31] The cross-linguistic evidence for the special role of such minimal prosodic words is considerable and includes, for example, a process of vowel lengthening in Serbian/Croatian restricted to monosyllabic bases that can be argued, following Zec 1999, to be driven by the desire to create a minimal or 'perfect' prosodic word (see Bennett and Henderson 2013 and Ito and Mester 2015a for further examples; the latter paper also outlines way of subsuming perfect word effects under an expanded conception of Match Theory). An interesting alternative has been suggested to us by Natalie DelBusso and Alan Prince, viz., to replace MINWDACC by FOOTHEADACC, requiring all footheads to have accent. While we find such an alternative attractive in principle, it requires modifications and rerankings of a number of constraints in our present analysis, and we leave it for future research to pursue the ramifications.
[32] John Alderete (pers. comm.) suggests that accented words might have an advantage in terms of segmentation.

adult phonology as a constraint interaction effect (see Ito and Mester 2015a for further discussion of such "perfect word effects").[33]

3.5 Foot form

Returning to our main topic, we have so far endeavored to build the analysis of the pitch accent system of Japanese on the same well-established constraints that have been motivated for stress accent systems, in order to gain a more precise understanding of the similarities and differences between the two kinds of prosodic organization. Through differential rankings of these constraints, we have succeeded in giving a formal explanation for the similarity in ante-penultimacy as well as for the emergence of unaccentedness in the pitch accent system.

Besides the prosodic factors leading to antepenultimacy and unaccentedness discussed so far, several other constraints, some of them mentioned in passing, lie at the heart of the accentual system of Japanese. The familiar foot structure constraints, FOOTBINARITY and MORAICTROCHEE, are given in (28).[34]

(28) Foot structure constraints

FOOTBINARITY (FTBIN): Feet are minimally binary at some level of analysis (μ, σ). Violated by unary feet.
MORAICTROCHEE (MT): Feet are (H), (LL), and (L). Violated by iambs: (lL), (lH), (hL), (hH), and trochees >2μ: (Lh), (Hl), (Hh)

In general, binarity constraints come in two varieties, a minimal and maximal version (Mester 1994), and FTBIN here is the minimal version of foot binarity (Prince and Smolensky 1993:50) penalizing unary feet. In a mora-counting system like Japanese, the relevant level of analysis is the mora, which is coextensive with the syllable in the all-light-syllable core system. A separate undominated maximal version of FTBIN rules out ternary and larger feet. Since the maximal version plays no role in the analysis, we simply refer to the minimal version as FTBIN. FTBIN is ranked above NONFIN(FT'). We have so far only considered FTBIN-fulfilling winning candidates, but FTBIN-violations are in fact encountered, e.g., by the monomoraic names for musical notes: ^{1}[(*dó*)], ^{1}[(*ré*)], ^{1}[(*mí*)], etc. The relevant candidates and constraints are shown in (29ab). The unfooted form ^{0}[*do*] has no violations of FTBIN, but does not fulfill HEADEDNESS and is therefore not among the competing candidates (see the end of section 3.3 above). With heavy syllables

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[33] A reviewer suggests that MINWDACC starts out undominated, and learners must be exposed to evidence before they can demote it.

[34] "H" and "L" stand for "heavy syllable" and "light syllable" (not for "high tone" and "low tone"). We use larger font size to indicate footheads.

entering the analysis in the next section, we will see more trapped light syllables that require footing in violation of FTBIN.

(29)

			MT	FTBIN	MINWDACC	INITIALFT	NOLAPSE	NONFIN(FT')	RIGHTMOST	WDACC	PARSE-σ
/do/	►	a. ^{1}[(dó)]		*				*			
		b. ^{0}[(do)]		*	*!			*		*	
/memo/	►	c. ^{2}[(mé.mo)]						*			
		d. ^{1}[(memó)]	*!					*			
		e. ^{2}[(mé)mo]		*!							*
		f. ^{0}[(memo)]			*!					*	
/banana/	►	g. ^{3}[(bána)na]									*
		h. ^{2}[(baná)na]	*!								*

The high-ranking foot form constraint MORAICTROCHEE (MT) ensures antepenultimate (and not penultimate) accent (29g), and penultimate (and not ultimate) accent in (29c). For all-light-syllable inputs like (29), a simple constraint TROCHEE requiring head-initiality would be sufficient, but the full analysis in section 4.2 will require a mora-based version. MORAIC TROCHEE (MT) is a cover constraint used here to keep the overall number of constraints small (in particular, in the interest of an efficient calculation and evaluation of the factorial typology of the analysis within OTW). It expresses what would otherwise be the concerted action of TROCHEE together with other rhythmic constraints (such as *HL), in a more principled setting. MT is unviolated in our analysis of Tokyo (Standard) Japanese, but Poppe 2014 has convincingly argued that the accentual system of a Shizuoka dialect spoken in Hamamatsu differs from that of Tokyo Japanese in that both trochaic and iambic feet play a significant role, with many output forms manifesting iambic parsing.

It is now time to collect all the ingredients of our analysis as developed so far.

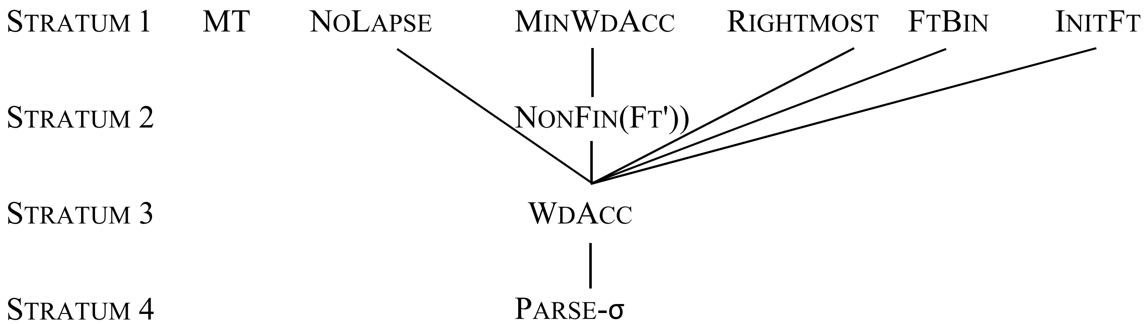
(30) Accent constraints: WORDACCENT (17a), MINWORDACCENT (26), RIGHTMOST (17b), NONFINALITY(FT') (17c)

Parsing constraints: PARSE-σ (17e), INITIALFOOT (17d), NOLAPSE (17f)

Foot structure constraints: FTBIN (28a), MT (28b)

The ranking of the constraints in (30), as motivated so far, is given in (31), where the system is linearly organized into four strata.

(31)



3.6 Exploring the Japanese accent system in OTWorkplace

We have implemented our analysis, both the core system and the full version in OTWorkplace (OTW),[35] a computational tool eminently suitable to illustrate its essential features and to probe its implications. Its authors characterize OTW as "a software suite that uses Excel as a platform for interactive research with the analytical tools of modern rigorous OT". Its goals are "to provide[…] within Excel an environment for OT research, to calculate the basic objects and structures of the theory, and to present them in a form suitable for sorting, filtering, revision, inventive re-combination, and interactive manipulations of all kinds".

Here we use OTW to explore the basic structure of the constraint system governing the lexical pitch accent system of Japanese, and some of the typological predictions that come with adopting a particular constraint system.

3.7 The core system: light syllables only

In (32), we reproduce an OTW violation tableau for the schematic monosyllabic input "1L" (="L"="one light syllable"). Numbers in cells indicate the number of violations for the candidate. In order to increase readability, we have replaced some of the notations specific to OTW with more familiar representations, and have added an example column with an actual Japanese word. It is important, however, to keep in mind that the parse selected holds for all 1L-inputs, not just

[35] OTWorkplace_X_68a, version of June 3, 2014; authors: Alan Prince, Bruce Tesar, and Nazarre Merchant. The program is open-source and distributed without charge, downloadable from https://sites.google.com/ site/ otworkplace/. We are very much indebted to Alan Prince for introducing us to OTWorkplace, sharing with us his own implementation of an earlier version of this paper and related class notes, and for much stimulating discussion. The current version of this paper would not have been possible without his help.

for the example chosen. For each input (1L, 2L, etc.), OTW automatically generates the complete set of all candidates that are parsed as prosodic words. For 1L, since we make the simplifying assumption that HEADEDNESS is part of GEN, the footless forms [L] and [Ĺ] are also headless and do not qualify, and {[^{1}(Ĺ)], [^{0}(L)]} is the full set of candidates to be considered.

(32)

Input	Output	Example	Opt(imum)	MT	NOLAPSE	MINWDACC	RIGHTMOST	FTBIN	INITFT	NONFIN(FT')	WDACC	PARSE-σ
1L	^{1}[(Ĺ)]	[(dó)]	WINS					1		1		
	^{0}[(L)]	[(do)]				1		1			1	

Violations are numerically marked—reverting to classical OT notation, "1" can be replaced by "*", "2" by "**", etc. For 2L=LL, OTW automatically generates all 11 candidates, and the tableau selecting the winning parse [(ĹL)] appears in (33).

(33)

Input	Output	Example	Opt	MT	NOLAPSE	MINWDACC	RIGHTMOST	FTBIN	INITFT	NONFIN(FT')	WDACC	PARSE-σ
2L	a. ^{2}[(ĹL)]	[(mémo)]	WINS							1		
	b. ^{2}[(Ĺ)L]	[(mé)mo]						1				1
	c. ^{2}[(Ĺ)(L)]	[(mé)(mo)]					1	2				
	d. ^{0}[(LL)]	[(memo)]				1					1	
	e. ^{1}[L(Ĺ)]	[me(mó)]						1	1	1		1
	f. ^{1}[(L)(Ĺ)]	[(me)(mó)]						2		1		
	g. ^{0}[(L)L]	[(me)mo]				1		1			1	1
	h. ^{0}[L(L)]	[me(mo)]				1		1	1		1	1
	i. ^{0}[(L)(L)]	[(me)(mo)]				1		2			1	
	j. ^{1}[(LĹ)]	[(memó)]		1						1		
	k. ^{0}[(LL)]	[(memo)]		1		1					1	

OTW is more than a program that checks the consistency of the ranking, it also provides a number a useful pieces of information about the candidate set. Even though there 11 possible candidates in (33), only 4 of them are potential optima that win under some other ranking. The rest (the 7 shaded candidates) are harmonically bounded. The accented binary trochee (33a) harmonically bounds the unary footed (33ef), as well as the iambic candidate (33j). Similarly the unaccented binary trochaic candidate (33d) harmonically bounds unary footed (33ghi), as well as iambic (33k). As strings increase in length, the number of harmonically bounded candidates increases—thus for 6L, there are 1311 overall output candidates, 1303 of which are harmonically bounded, leaving only 8 potential optima. This illustrates the inherent restrictiveness of OT.

Another important observation about the candidate set can be made in (34), the tableau selecting the optimal parse for 3L. Here some losing candidates have identical violation profiles, such as (34bc), (34de), and (34fg). More constraints are necessary in case it becomes important to differentiate these (e.g., when studying the factorial typology of the system), and can easily be added: For example, ALIGN(FT, R,PRWD,R), inserted at the bottom of the hierarchy, decides in favor of the second candidate in each pair.

(34)

Input		Output	Example	Opt	MT	NOLAPSE	MINWDACC	RIGHTMOST	FTBIN	INITFT	NONFIN(FT')	WDACC	PARSE-σ
3L	a.	3[(ĹL)L]	[(bána)na]	WINS									1
	b.	0[(L)(LL)]	[(ba)(nana)]						1			1	
	c.	0[(LL)(L)]	[(bana)(na)]						1			1	
	d.	2[(L)(ĹL)]	[(ba)(nána)]						1		1		
	e.	1[(LL)(Ĺ)]	[(bana)(ná)]						1		1		
	f.	3[(Ĺ)(LL)]	[(bá)(nana)]					1	1				
	g.	3[(ĹL)(L)]	[(bána)(na)]					1	1				

We henceforth omit harmonically bounded candidates, duplicate candidates with identical violation profiles, and otherwise uninformative candidates, violating high-ranking constraints already discussed previously. Tableau (35) selects the optimal—unaccented—parse for 4L, and in contrast, accented outputs are selected for 5-7L inputs.

(35) Input	Output	Opt	MT	NoLapse	MinWdAcc	Rightmost	FtBin	InitFt	NonFin(Ft')	WdAcc	Parse-σ
4L /itaria/ 'Italy'	^{0}[(LL)(LL)]	WINS								1	
	^{2}[(LL)(ĹL)]								1		
	^{3}[L(ĹL)L]							1			2
	^{4}[(ĹL)(LL)]					1					
	^{4}[(ĹL)LL]			1							2
5L /kurisumasu/ 'Christmas'	^{3}[(LL)(ĹL)L]	WINS									1
	^{0}[(LL)(LL)(L)]						1			1	
	^{2}[(L)(LL)(ĹL)]						1		1		
	^{4}[(L)(ĹL)(LL)]					1	1				
6L /metoroporisu/ 'metropolis'	^{3}[(LL)L(ĹL)L]	WINS									2
	^{0}[(LL)(LL)(LL)]									1	
	^{2}[(LL)(LL)(ĹL)]								1		
	^{4}[(LL)(ĹL)(LL)]					1					
7L/anakuronizumu/ 'anachronism'	^{3}[(LL)(LL)(ĹL)L]	WINS									1
	^{0}[(LL)(LL)(LL)(L)]						1			1	

The essence of OT's ranking logic is that in each winner-loser pair for a specific input, each constraint favoring the loser must be dominated by some constraint favoring the winner (see Brasoveanu and Prince 2011): Being a winner in OT means beating every competitor on the highest-ranking constraint that distinguishes the two. This is most clearly brought out in the comparative tableau format (Prince 2000). For our analysis, OTW provides a summary of the essential winner-loser competitions, the *skeletal basis* partially reproduced in (36) that supports the ranking relations in (31).

(36)

Input	Winner	Loser	MT	NoLapse	MinWdAcc	Rightmost	FtBin	InitFt	NonFin(Ft')	WdAcc	Parse-σ
4L	⁰[(LL)(LL)]	⁴[(ĹL)LL]		W						L	W
1L	¹[(Ĺ)]	⁰[(L)]			W				L	W	
4L	⁰[(LL)(LL)]	⁴[(ĹL)(LL)]				W				L	
2L	²[(ĹL)]	²[(Ĺ)L]					W		L		W
4L	⁰[(LL)(LL)]	³[L(ĹL)L]						W		L	W
4L	⁰[(LL)(LL)]	²[(LL)(ĹL)]							W	L	
6L	³[(LL)L(ĹL)L]	⁰[(LL)(LL)(LL)]								W	L

In each row representing one such competition, "W" in a constraint column means that the constraint in question favors the winner, "L" that it favors the loser, and no mark that it favors neither. Thus the first row tells us that the fact that unaccented but fully footed (LL)(LL) beats accented (ĹL)LL, with a final string of two unparsed syllables, justifies the ranking NoLapse >> WdAcc: NoLapse's "W" needs to dominate WdAcc's "L". Parse-σ's "W" cannot do the crucial domination (shown by shading) because it is independently known, from the 6L candidate, that WdAcc has to dominate Parse-σ.

The summary skeletal basis shows the most informative winner-loser pairs. Perhaps not surprisingly, here there are four 4L pairs, and one pair each from 1L, 2L, and 6L. Candidate pairs of 3L, 5L, and 7L given in the earlier tableaux only provide additional support for already established rankings. In this way, OTW isolates very clearly the core empirical data that lead to the essential elementary ranking conditions (ERCs), in the terminology of Brasoveanu and Prince 2011, that support the ranking in the grammar. Viewed in the context of learnability and acquisition, the small size of the skeletal basis highlights the advantages of OT as a theory of grammatical competence (see Tesar and Smolensky 1998 and Prince and Tesar 2004) over alternative frameworks, in particular, frameworks where the essential idea that a grammatical derivation is a selection between competing candidates is present, such as in many versions of Minimalism (Chomsky 1993), but has remained informal and has not received a fully explicit format (with notions like ERC set, etc.) that admits to rigorous formal treatment.

3.8 The full system: light and heavy syllables

Moving our analysis beyond all-light-syllable words, we start with a complete list of the syllable profiles of 1-7μ words, including all possible combinations of light (L) and heavy (H) syllables.

(37) Schematic prosodic profiles:

	1μ	2μ	3μ	4μ	5μ	6μ	7μ
all L	L	LL	LLL	LLLL	LLLLL	LLLLLL	LLLLLLL
with 1H		H	HL, LH	HLL, LHL, LLH	HLLL, HLL, LLHL, LLLH	HLLLL, LHLLL, LLHLL, LLLHL, LLLLH	HLLLLL, LHLLLL, LLHLLL, LLLHLL, LLLLHL, LLLLLH
with 2H				HH	HHL, HLH, LHH	HHLL, HLHL, HLLH, LHHL, LHLH, LLHH	HHLLL, HLHLL, HLLHL, HLLLH, LHHLL, LHLHL, LHLLH, LLHHL, LLHLH, LLLHH
with 3H						HHH	HHHL, HHLH, HLHH, LHHH
# of profiles	1	2	3	5	8	13	21

Besides the general restriction that the accentual tonal complex has to appear on the head (=initial) mora of the syllable, forms with heavy syllables are subject to a number of weight-related constraints. Their interaction with the previously established constraint system explains how pitch accent is placed in words with the various prosodic profiles in (37). Along the way, we will also establish some of the other constraint rankings that were left undetermined in all-L words.

With quantity sensitivity entering the system, a single heavy syllable also qualifies as a moraic trochee (H), besides the light syllable trochee (LL). The definition of the foot form constraint MORAICTROCHEE is given in (38) (repeated from (28)), together with two other weight-related constraints, the general WEIGHT-TO-STRESS-PRINCIPLE (WSP) and NONFINALITY(SYLLABLE), a constraint against word-final footheads.

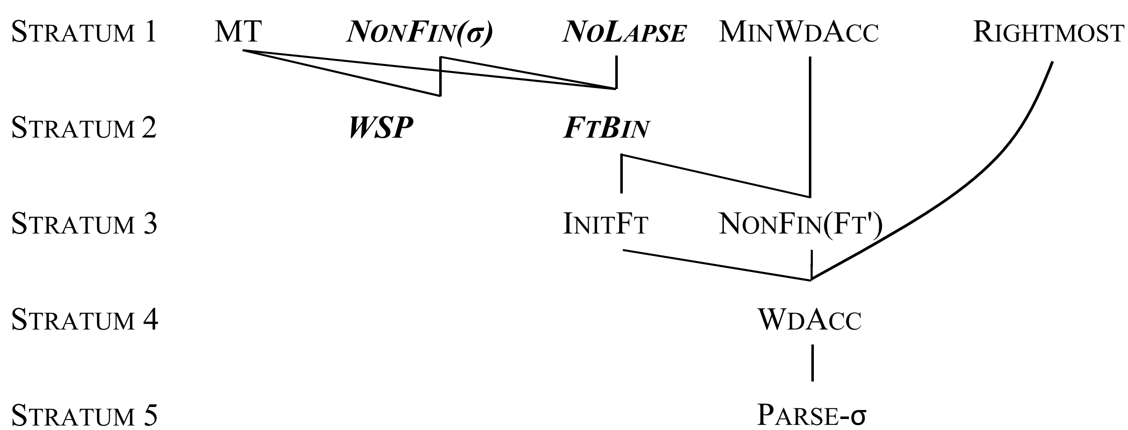
(38) Weight (QS) constraints

MoraicTrochee (MT)	Feet are (H), (LL), and (L). Violated by iambs: (lL), (lH), (hL), (hH), and trochees >2μ: (Lh), (Hl), (Hh)
Weight-to-Stress-Principle (WSP)	Heavy syllables are footheads. Violated when a heavy syllable is not a foothead: *.h., *(hX), *(Xh)
NonFinality(σ)	Word-final syllables are not footheads. Violated when a word-final syllable is a foothead: *(H)]PrWd, *(L)]PrWd, etc.

The version of the Weight-to-Stress-Principle given here is suited for pitch accent systems (we keep the term "stress" for reasons of familiarity, the reader could substitute "strength" for "stress"). NonFinality(Syllable) is familiar from many stress systems that avoid stress on word-final syllables, but allow them to be footed, resulting in phenomena like iambic reversal, see Prince and Smolensky 1993:58 for examples and references; see also Kager 1999:165-166 for the distinction between foot- and syllable-targeting NonFinality; versions of both play a role in the Japanese system, as first recognized by Kubozono (1995:30).

The overall constraint system is given in (39), with the newly introduced constraints in italics. Some of these ranking relations, such as NoLapse>>FtBin and FtBin>>InitFt, will be established in the next section. These eleven constraints are linearly organized into five strata.

(39)



The interaction among the constraints turns out to explain a significant portion of the uneven and skewed way unaccentedness is distributed among forms of different prosodic shapes, including some distinctions between quantitative profiles astonishing in their subtlety. As a preview and as a reference point for the arguments in the following sections, we provide in (40) OTW's compact skeletal basis that presents the winner-loser competitions, adapting the notation to that employed in this paper.

(40)

Input	Winner	Loser	MT	NonFin(σ)	NoLapse	MinWdAcc	Rightmost	WSP	FtBin	InitFt	NonFin(Ft')	WdAcc	Parse-σ
LH	^{3}[(Ĺ)H]	^{0}[(LH)]	W					L	L			W	L
LH	^{3}[(Ĺ)H]	^{0}[L(H)]		W				L	L	W		W	
HLH	^{3}[(H)(Ĺ)H]	^{5}[(H́)LH]			W				L				W
L	^{1}[(Ĺ)]	^{0}[(L)]				W					L	W	
HLL	^{0}[(H)(LL)]	^{4}[(H́)(LL)]					W					L	
LL	^{2}[(ĹL)]	^{2}[(Ĺ)L]							W		L		W
LHL	^{3}[L(H́)L]	^{3}[(L)(H́)L]							W	L			L
LLLL	^{0}[(LL)(LL)]	^{3}[L(ĹL)L]								W		L	W
HLL	^{0}[(H)(LL)]	^{2}[(H)(ĹL)]									W	L	
HLLLL	^{3}[(H)L(ĹL)L]	^{0}[(H)(LL)(LL)]										W	L

4. Prosodic profile versus mora count

One of the major accentual generalizations about forms with all light syllables was that unaccentedness reigns supreme in 4μ words (=4L words in the core system). Once we broaden our scope to the full quantity-sensitive system, one might have expected that all 4μ words, whatever their syllabic make-up, would obey this mora count generalization. One of the more subtle predictions of our analysis, however, is that this should not be the case: The source of unaccentedness lies in a specific foot structure profile, not in the sheer number of moras. Among the five possible prosodic profiles of 4μ words in (41), unaccentedness is predicted for only two (LLLL and HLL), not for the other three (LLH, HH, and LHL). Remarkably, this is exactly borne out by the facts, as we will now show, supporting not only our analysis, but also the more general idea that unaccentedness can be a consequence of foot structure.

(41) Accent patterns of 4μ words

a.	^{0}[(LL)(LL)]	*unaccented*
b.	^{0}[(H)(LL)]	
c.	^{4}[(ĹL)H]	*accented (preantepenult mora)*
d.	^{4}[(H́)H]	
e.	^{3}[L(H́)L]	*accented (antepenult mora)*

Our full analysis, as summarized in (39), correctly predicts these differing accentual patterns for 4μ words, as well as for other prosodic profiles of differing lengths. The dividing line is the quantity of the last two syllables: LL-final words with initial LL (41a) or initial H (41b) are fully footed into two bimoraic feet. This and only this is the prototypical unaccentedness profile. Whenever the last two syllables are not LL—i.e., in words with final H beginning with LL (41c) or H (41d), or in words with a trapped final L (41e)—the final syllable is left unparsed due to NONFIN(σ), and the optimal candidate has an accent on the foot preceding it, fulfilling all of NONFIN(FT'), RIGHTMOST, and WDACC.[36] Conversely, leaving the final syllable unparsed in this way is nonoptimal for LL-final words because this inevitably leads to two unfooted syllables, violating NOLAPSE: *^{4}(Ḗ)LL and *^{4}(ĹL)LL.

4.1 Final (LL)]Wd as the unaccentedness profile

This result contains an important insight: The crucial property causing unaccentedness is *not* the overall mora count, but rather the word-final syllable profile …LL]Wd.

(42)	a.	^{0}[(LL)(LL)]		b.	^{0}[…(H)(LL)]	
		^{0}(ita)(ria)	'Italy'		^{0}(kaa)(soru)	'cursor'
		^{0}(sopu)(rano)	'soprano'		^{0}fu(ran)(neru)	'flannel'
		^{0}(ara)(bama)	'Alabama'		^{0}ri(haa)(saru)	'rehearsal'
		^{0}(sina)(rio)	'scenario'		^{0}ka(rip)(puso)	'Calypso'

In (42b), the word-final LL is in a sense stranded after H and must be parsed together as a foot, which leads to the unaccented configuration in the familiar way. On the other hand, in words not having an H as their antepenultimate syllable, final LL is only trapped by the initial foot in the 4L configuration: [(LL)(LL)] (42a). Any additional syllables to the left, whether L or H, will lead to antepenultimacy (e.g., […(LL)(ĹL)L] or […(H)L(ĹL)L]), fulfilling NONFIN(FT'). There are thus two unaccented footing profiles, [(LL)(LL)] and […(H)(LL)].

[36] In his 2015 inaugural address as president of the LSJ (Linguistic Society of Japan), Haruo Kubozono pointed to a wug test using variations on *Mona Lisa* which confirms exactly this accentual pattern: unaccented ^{0}*monariza* and ^{0}*monriza*, but accented ^{4}*mónarii* and ^{4}*mónarin.*

(43) Unaccentedness configuration …LL]Wd

Input		Output	Opt	MT	NonFin(σ)	NoLapse	MinWdAcc	Rightmost	WSP	FtBin	InitFt	NonFin(Ft')	WdAcc	Parse-σ
LLLL	a.	^{0}[(LL)(LL)]	WINS										1	
/itaria/	b.	^{2}[(LL)(ĹL)]										1		
'Italy'	c.	^{3}[L(ĹL)L]									1			2
	d.	^{3}[(L)(ĹL)L]								1				1
	e.	^{4}[(ĹL)(LL)]						1						
	f.	^{4}[(ĹL)LL]				1								2
HLL	g.	^{0}[(H)(LL)]	WINS										1	
/kaasoru/	h.	^{2}[(H)(ĹL)]										1		
'cursor'	i.	^{2}[(H)(Ĺ)L]								1				1
	j.	^{4}[(H́)(LL)]						1						
	k.	^{4}[(H́)LL]				1								2
	l.	^{4}[(H́L)L]		1										1
LHLL	m.	^{0}[L(H)(LL)]	WINS								1		1	1
rihaasaru	n.	^{2}[L(H)(Ĺ)L]								1	1			2
'rehearsal'	o.	^{4}[L(H́)LL]				1					1			3

Besides the by now familiar fact that WdAcc, violated by the unaccented winners (43a,g,m), is dominated by NonFin(Ft') (43b,h), InitFt (43c), and Rightmost (43e,j), we see that it also ranks below FtBin (43d,i,n), NoLapse (43f,k,o), and MT (43l).[37]

4.2 H-final words and the effect of NonFin(σ)

Next we consider H-final words, where the dominance of NonFin(σ) over WSP forestalls the otherwise expected Ft+Ft exhaustive parsing pattern for 4μ forms (LLH, HH), and results in accent on the preantepenultimate mora:[38] ^{4}(*dóra*)*gon*, ^{4}(*shán*)*puu,* not *^{0}(*dora*)(*gon*) or

[37] We henceforth omit profiles violating MT, i.e., candidates containing feet that are not moraic trochees, such as (HL), (LH), (HH), (HH), since this constraint is never violated in winning candidates.

[38] Another (ante)penultimate pattern is found in older LLH loans such as *bitámin* 'Vitamín' (G.), where the winner appears to contain a monomoraic medial foot [L(Ĺ)H] (or an iambic foot [(LĹ)H]). The pattern is similar to that of compound accent with short second members (Kubozono 2009), such loans therefore may have been interpreted as

*[0](*shan*)(*puu*). Just as in the case of unaccented words seen earlier in (42), we find preantepenultimate mora accent not only with 4μ words, but also when more material precedes (44).

(44) a. […(ĹL)H]

a. […(ĹL)H]		b. […(H́)H]	
(dóra)gon	'dragon'	(shán)puu	'shampoo'
a(réru)gii	'allergy'	ka(rén)daa	'calendar'
(heri)(kópu)taa	'helicopter'	(esu)ka(rée)taa	'escalator'
(afu)ga(nísu)tan	'Afganistan'	ko(men)(tée)taa	'commentator'

As illustrated in (45), a final H, itself unfooted due to NONFIN(σ), is preceded by a bimoraic foot whose head receives the accent, which is tropic to syllable/foot heads.

(45) Accented configuration …H]$_{Wd}$: LLH, HH

Input	Output	Opt	MT	NONFIN(σ)	NOLAPSE	MINWDACC	RIGHTMOST	WSP	FTBIN	INITFT	NONFIN(FT')	WDACC	PARSE-σ
LLH /doragon/	a. [4](ĹL)H]	WINS						1					1
	b. [0][(LL)(H)]			1								1	
	c. [2][(LL)(H́)]			1							1		
	d. [4][(ĹL)(H)]			1			1						
HH /shanpuu/	e. [4][(H́)H]	WINS						1					1
	f. [0][(H)(H)]			1								1	
	g. [2][(H)(H́)]			1							1		
	h. [4][(H́)(H)]			1			1						
LLLH /arerugii/	i. [4][L(ĹL)H]	WINS						1		1			2
	j. [3][(LL)(Ĺ)H]							1	1				1
	k. [0][(LL)L(H)]			1								1	1
LHH /karendaa/	l. [4][L(H́)H]	WINS						1		1			2
	m. [0][L(H)(H)]			1						1		1	1
	n. [0][(L)(H)(H)]			1					1			1	

compound structures (see Withgott 1982:158 and Karvonen 2005 for similar cases in English and Finnish). Another possibility is a strictly mora-counting type of antepenultimacy, which cannot reach beyond the penult in XLH structures (René Kager, pers. comm.).We leave these cases for future exploration.

An important ranking established here is FtBin >>InitFt: *a*(*réru*)*gii* (45i) violating InitFt, beats (*ar*)(*rú*)*gii* (45ii), violating FtBin.

Monosyllabic forms (46ac) also violate NonFin(σ) because our simplifying incorporation of Headedness into Gen entails that no candidate parsed as a prosodic word can lack foot structure altogether.

(46) One-foot profiles

a.	^{2}[(H́)]		b.	^{2}[[(ĹL)]		c.	^{1}[(Ĺ)]	
	(pán)	'bread' (P)		(mémo)	'memo'		(dó), (ré), (mí)	'do, re, mi'
	(pén)	'pen'		(páte)	'paté' (F)			(musical notes)

In particular, if the candidate consists of a single syllable, this syllable must be footed, hence the winning candidates in (47ac) also have a NonFin(σ) violation. Bisyllabic minimal words, on the other hand, do not violate NonFin(σ) (47b), but since they are composed of a single foot, are still subject to MinWdAcc (see section 3.3), which forces violations of NonFin(Ft').

(47)

Input	Output	Opt	MT	NonFin(σ)	NoLapse	MinWdAcc	Rightmost	WSP	FtBin	InitFt	NonFin(Ft')	WdAcc	Parse-σ
H /pan/	^{2}[(H́)]	wins		1							1		
	^{0}[(H)]			1		1						1	
LL /memo/	^{2}[(ĹL)]	wins									1		
	^{0}[(LL)]					1						1	
L /do/	^{1}[(Ĺ)]	wins		1					1		1		
	^{0}[(L)]			1		1			1			1	

Here we see that both NonFin(σ) and NonFin(Ft') are violable constraints, and that FtBin violating forms can also be winners.

A surprising winning FtBin-violating profile makes its appearance in another H-final profile, where the preceding L is trapped initially [(Ĺ)H] (48a) or medially by a preceding H [H(Ĺ)H] (48b).

(48) a. [(Ĺ)H]

(pú)rin	'pudding'	b.	[...(H)(Ĺ)H]	
(sá)ron	'salon' (F)		(ran)(dé)buu	'rendezvous' (F)
(kí)tii	'kitty'		pu(ran)(kú)ton	'plankton'
			(in)(taa)(fé)ron	'interferon'

This trapped L-syllable, which cannot join what precedes in a moraic trochee, forms a monomoraic foot, violating FTBIN, and receives the accent, as the last but non-final foot in the word (49). The following H remains unfooted due to NONFIN(σ).

(49)

[...(Ĺ)H] Input	Output	Opt	MT	NONFIN(σ)	NOLAPSE	MINWDACC	RIGHTMOST	WSP	FTBIN	INITFT	NONFIN(FT')	WDACC	PARSE-σ
LH /purin/	a. ^{3}[(Ĺ)H]	WINS						1	1				1
	b. ^{0}[L(H)]			1						1		1	
	c. ^{2}[L(H́)]			1						1	1		1
HLH /randebuu/	d. ^{3}[(H)(Ĺ)H]	WINS						1	1				1
	e. ^{5}[(H́)LH]				1			1					2
	f. ^{0}[(H)L(H)]			1								1	1

The perhaps most significant point here is the dominance of NOLAPSE over FTBIN, which is responsible for the selection of (*ran*)(*dé*)*buu* (49d), with its accented monomoraic foot, over (*rán*)*debuu* (49e), with a fatal two-syllable lapse. Thus FTBIN-violating winners emerge not only for single L-words (46c), but also when the L is prosodically trapped in the accenting environment.

4.3 Final unfooted L

Finally, we turn to prosodic profiles cases with final unfooted L, including the case of 4μ items of the form LHL (41e), which our analysis correctly predicts to receive accent on their H syllable, falling squarely on the antepenultimate mora, as shown in (50). The parse here is (50a) [L(H́)L], not the accentually identical (50b) [(L)(H́)L] with a word-initial subminimal foot (L), because of the ranking FTBIN>>INITFT established above in (45ij).[39]

(50) Profile: LHL

Input	Output	Opt	MT	NONFIN(σ)	NOLAPSE	MINWDACC	RIGHTMOST	WSP	FTBIN	INITFT	NONFIN(FT')	WDACC	PARSE-σ
LHL	a. ^{3}[L(H́)L]	WINS								1			2
/kechappu/	b. ^{3}[(L)(H́)L]								1				1
'ketchup'	c. ^{0}[(L)(H)(L)]			1					2			1	

This case perhaps most clearly shows that the syllable is essential in addition to the mora. Denying the role of the syllable in Japanese (as in Labrune 2012, see Kawahara to appear) would mean that the four moras could be parsed as two bimoraic feet (i.e., splitting the medial H-syllable into two feet) as *[(*.ke.cha*)(*p.pu.*)], incorrectly predicting unaccentedness. Given the universal prosodic hierarchy assumed here (see section 3.3 above), GEN does not produce such candidates that violate syllable integrity.

In fact, the 4-mora LHL case is nothing more than a subcase of the straightforward pattern of rightmost footing modulo NONFINALITY(FT'), namely, […(ĹL)L] and […(H́)L] in (51), with some illustrative tableaux in (52) with different preaccentual material.

(51) a. ^{3}[…(ĹL)L]

(bána)na	'banana'	(búu)ke	'bouquet'
(baru)(séro)na	'Barcelona'	ke(cháp)pu	'ketchup'
(kon)(sépu)to	'concept'	(kon)(kóo)su	'concourse'
(jaa)na(rízu)mu	'journalism'	(aru)(bái)to	'part-time job' (G)
(bai)(ori)(nísu)to	'violinist'	(in)su(tán)to	'instant'

b. ^{3}[…(H́)L]

[39] A reviewer draws attention to the candidate ^{0}[L(H)L], whose violation profile matches that of the winner except for an additional WORDACC violation. For this very reason, it is harmonically bounded by the winner and therefore not included in the tableau.

(52) […(ĹL)L], […(H́)L]

Input	Output	Opt	MT	NonFin(σ)	NoLapse	MinWdAcc	Rightmost	WSP	FtBin	InitFt	NonFin(Ft')	WdAcc	Parse-σ
HLLLL	a. ^{3}[(H)L(ĹL)L]	WINS											2
/jaanarizumu/	b. ^{0}[(H)(LL)(LL)]											1	
HL	c. ^{3}[(H́)L]	WINS											1
/buuke/	d. ^{0}[(H)(L)]			1					1			1	
HHL	e. ^{3}[(H)(H́)L]	WINS											1
/konkoosu/	f. ^{0}[(H)(H)(L)]			1					1			1	

The fact that (52a) with antepenultimate accent wins over unaccented (52b) shows again that exhaustive parsing has low priority and is subordinated to the requirement to have an accent.

4.4 Prosodic profiles: the signature of unaccentedness

To summarize, generalizations in terms of mora count (or for that matter, syllable count) are neither revealing nor factually accurate. The schematic profiles organized in terms of mora count in (37) above can be more insightfully organized with footing as in (53) below, where "…" can be null.

(53) Schematic prosodic profiles

a. Accented on final/penult μ	b. Accented on antepenult μ	c. Accented on preantepenult μ	d. Unaccented
^{1}[(Ĺ)]	^{3}[…(ĹL)L]	^{4}[…(ĹL)H]	^{0}[(LL)(LL)]
^{2}[(ĹL)]	^{3}[…(H́)L]	^{4}[…(H́)H]	^{0}[…(H)(LL)]
^{2}[(H́)]	^{3}[…(Ĺ)H]		

4μ items are neither across-the-board unaccented, nor do they hold a monopoly on unaccentedness. The signature of unaccentedness is rather a final LL sequence (53d), where NoLapse forces the footing of these two syllables into a foot. The whole form then has the rhythmic shape Ft+Ft, which results in unaccentedness as an equilibrium effect, satisfying both Rightmost and NonFinality(Ft'). H-final (ĹL)H and (H́)H are accented because their final loose H does not violate NoLapse, and WordAcc favors this parse. On the other hand, L(H́)L has just a single light syllable at the end which can follow an accented foot (Ḣ) without constituting a lapse.

Words of all these shapes thus constitute principled exceptions to the broad '4μ unaccentedness' generalization, which in hindsight appears as a rather crude mora-counting approximation to the actual data and to the genuine generalization rooted in prosodic constituent structure. The fact that this follows directly from our analysis can be taken as significant support for the overall approach taken here, relying on rhythmic principles and their interaction within a formal grammar based on priority rankings.

5. Further challenges

We have presented a unified OT analysis for a large body of fairly complex accentual data, but there are still many subgeneralizations uncovered by past research that remain to be explored. This section takes up a few of these cases, for which we believe an extension of our analysis can offer some explanation, receive further support, and/or serve as a guideline for future exploration. The cases involve truncation patterns (6.1), special properties of native lexical items (6.2), and patterns of systematic variation (6.3).

5.1 Loanword truncation patterns

We noted earlier that truncated loanwords (see section 2.3 and the discussion surrounding (6)) follow the same accentual patterns as nontruncated ones.

(54)

		truncated loans		cf. nontruncated loans	
2μ	LL	^{2}(bíru)	'building'	^{2}(pári)	'Paris'
	H	—		^{2}(pán)	'bread' (P)
3μ	LLL	^{3}(áni)me	'animation'	^{3}(bána)na	'banana'
	HL	^{3}(dái)ya	'diamond'	^{3}(rán)pu	'lamp'
	LH	—		^{3}(pú)rin	'pudding'
4μ	LLLL	^{0}(riha)(biri)	'rehabilitation',	^{0}(shina)(rio)	'scenario'
	HLL	^{0} (kon)(bini)	'convenience store'	^{0}(tee)(buru)	'table'
	HH	—		^{4}(shán)puu	'shampoo'
	LLH	—		^{4}(dóra)gon	'dragon'
	LHL	^{3}de(páa)to	'department store'	^{3}to(rén)do	'trend'

There are gaps in the prosodic profiles among the truncated loans (i.e., the blank cells for H, LH, HH, LLH), because of truncation-specific requirements (see Ito and Mester 1992, Labrune 2002, and the discussion of truncation variation above in section 2.3). Of interest here is the fact that for words that we might have expected to truncate to LLH or HH, such as ^{4}*animéesyon*, 'animation', ^{3}*konpoonénto* 'component', the truncated outputs are not *^{4}*ánimee*, *^{4}*kómpoo*, but instead the trimoraic LLL and HL (^{3}*ánime*, ^{3}*kónpo).*

A further interesting challenge to the analysis is the existence of an exception to the exception to the four-mora unaccentedness generalization, so to speak, which arises in truncated loan compounds. The vast majority of four-mora truncations are actually compound truncations, with each member consisting of one bimoraic foot. Here, whatever the internal rhythmic composition of the two feet, the whole truncated loan compound is unaccented, as shown in (55). This includes the H-final cases LLH and HH, which are accented in non-truncated forms (see (45) above).

(55)

LL+LL	^{0}(seku)(hara)	'sexual harassment'	
	^{0}(puchi)(buru)	'petit bourgeois' (F)	
H+LL	^{0}(waa)(puro)	'word processor'	
	^{0}(kon)(masu)	'concert master'	
LL+H	^{0}(paso)(kon**)**	'personal computer',	* ^{4}(páso)(kon**)**
	^{0}(roke)(han)	'(film) location hunting'	* ^{4}(róke)(han)
H+H	^{0}(baa)(ten)	'bartender'	* ^{4}(báa)(ten)
	^{0}(jii)(pan)	'jeans pants'	* ^{4}(jii)(pan)

Whereas the simple loans ^{4}(*táku*)*shii* 'taxi' and ^{4}(*gáa*)*den* are accented, corresponding truncated loan compounds, such as ^{0}(*paso*)(*kon*) and ^{0}(*jii*)(*pan*), are unaccented.[40] The most likely cause for their divergent behavior lies in their prosodic form: While a non-truncated simplex loanword like (*táku*)*shii*, like all other words ending in H, simply receives the optimal prosodic parse with non-exhaustive footing, a truncated loan compound like ^{0}(*paso*)(*kon*) is fitted to a template and hence appears fully footed as Ft+Ft—exactly the locus of unaccentedness.

There are various ways of formally implementing this—for example, we could posit a special version of the WSP indexed to truncated loans (in the sense of Pater 2006) dominating

[40] Their unaccentedness also does not conform to the general accentuation pattern associated with the most closely corresponding class of regular (non-truncated) compounds, namely those whose second member does not exceed one bimoraic foot. According to Kubozono 1999:174-176, such forms are as a default accented on the last syllable of the first member, and unaccentedness is a marked pattern.

NonFin(σ), which would result in full footing. For our purposes here, a more principled approach suggests itself, capitalizing on the fact that the truncations in question are compounds.

The idea is to reduce their unaccentedness to the fact that their compound status entails that each part, including the second part, has to minimally be a foot. A restriction along these lines was first motivated by Poser (1984:140, note 52) for Sino-Japanese compounds, who tentatively suggests that they "[…] contain a boundary across which a foot may not be constructed," and consequently "even a two mora compound will contain two feet […]," crediting Mark Liberman for the idea. We call the relevant constraint LexFt (56) and insert it at the top of the hierarchy above FtBin.

(56) LexFt: Every lexical morpheme (i.e., full content morpheme, not grammatical formative) minimally projects its own foot.

The tableaux in (57) contrast simplex loans and truncated loan compound with identical syllable quantities: LLH vs. LL+H, HH vs. H+H. As shown, top-ranking LexFt is responsible for the difference in footing and hence accentuation.

(57)

Input	Output	Opt	LexFt	MT	NonFin(σ)	NoLapse	MinWdAcc	Rightmost	WSP	FtBin	InitFt	NonFin(Ft')	WdAcc	Parse-σ
LLH	^{4}[(ĹL)H]	WINS							1					1
/doragon/	^{0}[(LL)(H)]				1								1	
LL+H	^{4}[(ĹL)H]		1						1					1
/paso+kon/	^{0}[(LL)(H)]	WINS			1								1	
HH	^{4}[(H́)H]	WINS							1					1
/shanpuu/	^{0}[(H)(H)]				1								1	
H+H	^{4}[(H́)H]		1						1					1
/jii+pan/	^{0}[(H)(H)]	WINS			1								1	

LexFt has the advantage that it accounts for a further generalization. Different from other 3μ loanwords, which are overwhelmingly accented (see (3) and section 2.3 above), 3μ compound truncations are unaccented. This observation is due to Oho 2009, who goes on to show in an experiment with an associated wug test that the generalization holds for both established forms (58a-c) and nonce formations (58d).

(58) a.	^{0}seku+me	'section mate'	sekushon méeto
b.	^{0}fami+ma	'family mart'	famirii máato
c.	^{0}meru+bo	'mailbox'	meeru bókkusu
d.	^{0}supa+ma	'super matching'	suupaa mátchingu

Unaccentedness of these forms is again due to LEXFT, which entails that each part, including the second, has to be a foot. LEXFT dominates FTBIN, therefore this also holds for monomoraic second compound members.

(59)	a.	3μ compound truncations[41] =Ft Ft = unaccented	^{0}[(LL)(L)] ^{0}(seku)(me) 'section mate', ^{0}(meru)(bo) 'mail box'
	b.	3μ simplex truncations = Ft σ = accented	^{3}[(ĹL)L] ^{3}(tére)bi 'television', ^{3}(áni)me 'animation'

Given this prosody, unaccentedness follows for 3μ compound truncations (59a) exactly as in (57), with full footing. A contrasting simplex truncation, where LEXFT has no effect, is given in (60b).

(60)

	Input	Output	Opt	LEXFT	MT	NONFIN(σ)	NOLAPSE	MINWDACC	RIGHTMOST	WSP	FTBIN	INITFT	NONFIN(FT')	WDACC	PARSE-σ
a.	LL+L	^{3}[(ĹL)L]		1						1					1
	/seku+me/	^{0}[(LL)(L)]	WINS			1								1	
b.	LLL	^{3}[(ĹL)L]	WINS							1					1
	/anime/	^{0}[(LL)(L)]				1								1	

[41] 3μ compound truncations are asymmetric in that only the second, and not the first, foot can be unary: We find [(LL)(L)], not [(L)(LL)], so perhaps INITIALFT still requires a proper bimoraic foot. In a similar vein, *zuuja-go* 3μ forms are also unaccented, according to Ito, Kitagawa and Mester 1996, which might also be due to their templatic nature—unless other more general forces are at work leading to unaccentedness.

5.2 The native lexicon

Our analysis has so far been mainly restricted to the loan vocabulary, because this is where unmarked prosody has the best chance to unfold itself, unhampered by the morphological idiosyncrasies characteristic of the native lexicon of most languages.

As already pointed out in section 2.2, there is at least one major discrepancy between the native lexicon and the loan lexicon: While 3μ loans (^{3}*bánana*, etc.) are mostly accented (93%), 3μ native items (e.g., ^{0}*nezumi* 'mouse') are mostly unaccented (71%), with Sino-Japanese items ranging in between. Is there a specific reason for the discrepancy? Why are there more unaccented forms in this particular section of the native lexicon? In light of the analysis in the preceding section, for native 3μ words like ^{0}*nezumi* unaccentedness would be the expected outcome if the foot structure was Ft+Ft: ^{0}(*nezu*)(*mi*), fully footed into two feet, attaining the unaccented equilibrium. As pointed out by John Whitman (pers. comm.), it is likely that Old Japanese morphemes were maximally bimoraic. If so, all longer words are compounds, often obscured through numerous changes, and 3μ forms must ultimately consist of a 2μ morpheme and a 1μ morpheme. Well-known examples from etymological dictionaries are given in (61).

(61) Etymologically:

a. ^{0}*sakana* 'fish' from *sake+na*, 'food that goes well with sake'
b. ^{0}*nezumi* 'mouse' from *ne+sumi*, lit. 'root+live', 'those that live in dark/low places'

Just as in the case of the 3μ truncated compounds discussed in the previous section, if the compound status of these items were taken as a synchronic reality, undominated LexFt would force the footing of the monomoraic items *na* and *ne,* and unaccentedness would arise due to the balanced two-foot structure, with concomitant positional vocalic alternation (*sake~saka*) and *rendaku* voicing (*sumi~zumi*) found in many other examples.

(62) LexFt analysis:

a. */sake+na/* → ^{0}[(saka)(na)] 'fish'
b. */ne+sumi/* → ^{0}[(ne)(zumi)] 'mouse'

But some examples of this kind are likely to be folk etymologies, and a synchronic compound structure for all of these items is rather doubtful. More plausible is an indirect influence of history: Their historical origin as compounds may have persisted as a special prosodic marker in these words. For concreteness, we take this to be a lexicalized monomoraic foot, amounting to full lexicalized footing of the whole morpheme. 3μ forms will thus have two feet: ^{0}(*saka*)(*na*), ^{0}(*ne)(zumi*), resulting in unaccentedness.[42]

It is noteworthy that the unaccentedness of these native lexical items with a long history in the language and of recent loanword truncations have the same source of explanation in our analysis: a compounded Ft+Ft structure—perhaps an encouraging confirmation of the overall approach taken in this paper, which allows us to begin to probe what are prima facie unconnected phenomena in different lexical strata and different periods in the history of Japanese.

5.3 Variation and OTWorkplace

The complex accentual patterns found in Japanese are, as noted from the outset, broad statistical tendencies (see Kubozono 2006 and Kitahara 2001; the latter provides detailed statistics about unaccentedness and accent location, on the basis of a large lexical database of Japanese by Amano and Kondo 1999). In this paper, we have taken the default accentual system of Japanese to be the one that jibes best with the data in the study conducted by Kubozono 2006, supplemented by our own data collection.

Other patterns do exist, the most prevalent one being forms that have an accent in a location that is faithful to the location of main prominence in the original source word, such as ^{1}*fondyú* 'fondue' and ^{5}*ákusento* 'accent', which is due to underlying marking and faithfulness (see section 2.3). Besides such faithfulness cases, there are two other accentual (non-default) patterns that are more than sporadic exceptions. These are cases where the default system predicts unaccentedness, ^{0}[(LL)(LL)] and ^{0}[(H)(LL)], but what we find instead is antepenultimacy, ^{3}[L(ĹL)L], or pre-antepenultimacy ^{4}[(ĹL)(LL)], ^{4}[(H́)(LL)]. The frequency distribution of the LLLL variants in our corpus of 228 examples is as follows: unaccented 52.6%, preantepenultimate 27.6%, antepenultimate 18.9%, penultimate 0.9%, final 0%. Examples of the variation appear in (63).

(63) Variation in 4L words

Unaccented[43] ^{0}(LL)(LL)	^{0}anarogu 'ánalog', ^{0}anemone 'ánemone', ^{0}afurika 'África', ^{0}abokado 'avocádo', ^{0}arukari 'alkáli', ^{0}arupaka 'alpáca', ^{0}arubamu 'álbum'
Antepenult ^{3}L(ĹL)L	^{3}kurébasu 'crevásse' (F), ^{3}sutóresu 'stréss', ^{3}cherísuto 'céllist', ^{3}defórume 'deformér' (F), ^{3}toróide 'Tholoíde' (G), ^{3}papúrika 'páprika', ^{3}repúrika 'réplica'

[42] Another possibility is to posit a constraint PARSEROOT-σ_i demanding that every syllable of a root is parsed, a special markedness constraint indexed (in the sense of Pater 2006) to this specific lexical class *i* of native items. If PARSEROOT-σ_i is undominated for three-mora words of class *i*, monomoraic feet will appear instead of unparsed syllables (this kind of approach has been proposed by Buckley (1997) for Kashaya).

[43] The unaccented examples (default cases) are chosen from the beginning of the alphabetized list.

Preantepenult ^{4}(ĹL)(LL)	^{4}ákuseru 'accélerator', ^{4}áruzasu 'Alsáce' (F), ^{4}ófisharu 'offícial', ^{4}káruteru 'cartél', ^{4}sákusesu 'succéss', ^{4}múnieru 'meunière' (F), ^{4}rákurosu 'lacrósse' (F)

Besides these lexically fixed cases, some lexical items have several accentual variants as shown in (64): unaccented/antepenult variants (64a), unaccented/preantepenult variants 64b), antepenult/preantepenult variants (64c), and even all three variants 64d).

(64) Variants in 4L words

a.	^{0}akapera, ^{0}ananasu, ^{0}sukuramu, ^{0}somurie, ^{0}bajiriko, ^{0}dorakyura, ^{0}kobaruto ^{3}akápera, ^{3}anánasu, ^{3}sukúramu,^{3}somúrie, ^{3}bajíriko, dorákyura, ^{3}kobáruto 'a cappélla' (I), 'ánanas' (D), 'scrám', 'sommeliér' (F), 'basílico' (I), 'Drácula', 'cóbalt'
b.	^{0}akuriru, ^{0}apareru, ^{0}arupusu, ^{0}bekutoru, ^{0}manyuaru, ^{0}marakasu, ^{0}pasuteru ^{4}ákuriru, ^{4}ápareru, ^{4}árupusu, ^{4}békutoru, ^{4}mányuaru, ^{4}márakasu, ^{4}pásuteru 'acrýlic', 'appárel', 'Álps', 'Véktor' (G), 'mánual', 'máracas' (S), 'pastel'
c.	^{3}inísharu, ^{3}oáshisu, ^{3}torípuru 'initial', 'oasis', 'triple' ^{4}ínisharu, ^{4}óashisu, ^{4}tóripuru
d.	^{0}kokonatsu, ^{3}kokónatsu, ^{4}kókonatsu 'coconut'

HLL forms can also be either lexically fixed (65) or in variation.

(65) Lexically fixed accents in HLL words

Unaccented ^{0}(H)(LL)	^{0}aidaho 'Idaho', ^{0}antena 'antenna', ^{0}faasuto 'first', ^{0}gondora 'gondola' (I), ^{0}konsome 'consommé (F)
Pre/antepenult[44] ^{4}(H́)(LL)	^{4}pándora 'Pandora', ^{4}rúuburu 'rublj' (R), ^{4}ríttoru 'litre' (F), kóntena 'container', ^{4}hánguru 'han-geul' (K)

(66) Variants in HLL words

^{0}bakkuru, ^{0}bookaru, ^{0}chembaro, ^{0}eeteru, ^{0}googuru, ^{0}kontena, ^{0}saaberu
^{4}bákkuru, ^{4}bóokaru, ^{4}chémbaro, ^{4}éeteru, ^{4}góoguru, ^{4}kóntena, ^{4}sáaberu
'búckle', 'vócal', 'cémbalo' (I), 'Äther' (G), 'góggles', 'contáiner', 'sábel' (D)

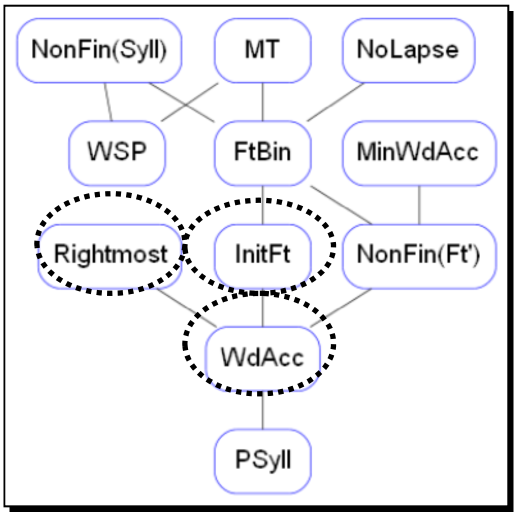
We take the antepenult and preantepenult systems to be variant (sub)grammars of Japanese, with different constraint rankings. Within the default accentual system in the concise OTW format in

[44] Since accent can only fall on the initial mora of the heavy syllable, antepenult and preantepenult accent are equivalent for HLL words.

(67a) equivalent to (39) above, ranking variation is found among the three circled constraints: RIGHTMOST, INITFT, and WDACC. All other rankings and ranking relations remain the same among the subgrammars. The different subgrammars: unaccented (default), antepenult, weak antepenult, and preantepenult, are depicted in (67b-d), with the crucial variations noted in circles.

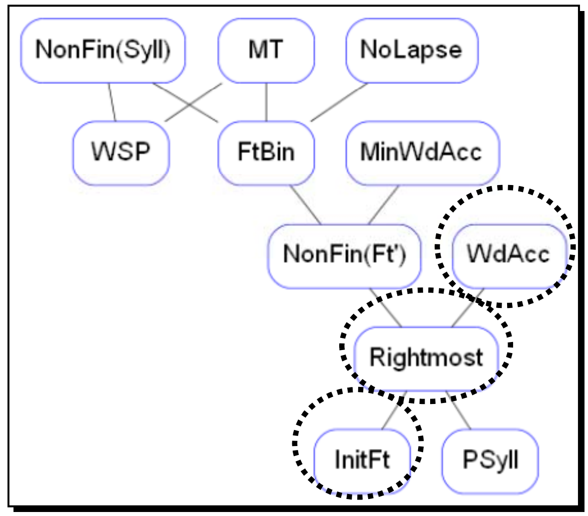
(67) a. Default unaccented system:

^{0}[(LL)(LL)], ^{0}[(H)(LL)]



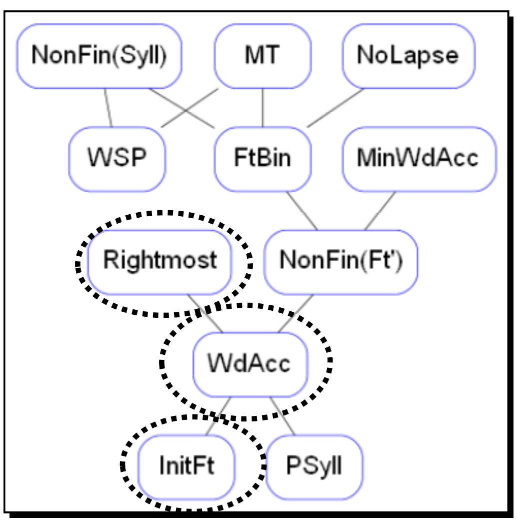
b. Antepenult system:

^{3}[L(ĹL)L], ^{4}[(H́)(LL)]



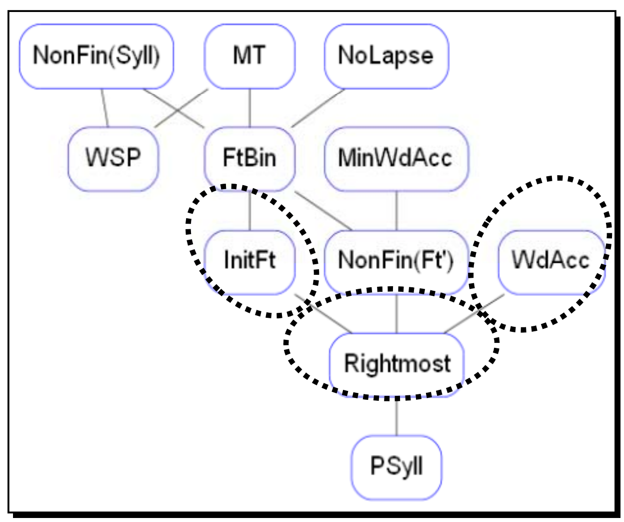
c. Weak antepenult system:

^{3}[L(ĹL)L], ^{0}[(H)(LL)]



d. Preantepenult system:

^{4}[(ĹL)(LL)], ^{4}[(H́)(LL)]



For reasons of space, we omit illustrative tableaux here, and present a summary of the relevant outputs of the four subgrammars in (68). In each case, we are considering three inputs: LLLL, HLL, and HLLLL. The latter is included to show a typical example where the same antepenultimate candidate ^{3}[(H)L(ĹL)L] emerges as the winner for all subgrammars.

(68)	Input	LLLL	HLL	HLLLL
a.	Default unaccented system	^{0}[(LL)(LL)]	^{0}[(H)(LL)]	^{3}[(H)L(ĹL)L]
b.	Antepenult system	^{3}[L(ĹL)L]	^{4}[(H́)(LL)]	^{3}[(H)L(ĹL)L]
c.	Weak antepenult system	^{3}[L(ĹL)L]	^{0}[(H)(LL)]	^{3}[(H)L(ĹL)L]
d.	Preantepenult system	^{4}[(ĹL)(LL)]	^{4}[(H́)(LL)]	^{3}[(H)L(ĹL)L]

In (68a), the familiar default system (67a), low-ranking WDACC ensures that ^{0}[(LL)(LL)] and ^{0}[(H)(LL)] emerge unaccented. In the antepenult system (68b), low-ranking INITFT (see (67b)) allows for the antepenultimate candidate ^{3}[L(ĹL)L] to win over the unaccented candidate ^{0}[(LL)(LL)] and the preantepenultimate candidate ^{4}[(ĹL)(LL)]. Because WDACC is ranked higher than RIGHTMOST, accented ^{4}[(H́)(LL)] wins over unaccented ^{0}[(H)(LL)].In the weak antepenult system (68c), INITFT continues to be low-ranking, hence the antepenultimate winner ^{3}[L(ĹL)L], but RIGHTMOST is ranked higher than WDACC (see (67c)), favoring unaccented ^{0}[(H)(LL)] over ^{4}[(H́)(LL)] . Finally, in the preantepenult system (68d), RIGHTMOST is lowest-ranked among the relevant constraints (see (67d)), so that the RIGHTMOST-violating candidates, ^{4}[(ĹL)(LL)] and ^{4}[(H́)(LL)], win over those that violate INITFT, ^{3}[L(ĹL)L], and WDACC, ^{0}[(LL)(LL)] and ^{0}[(H)(LL)].

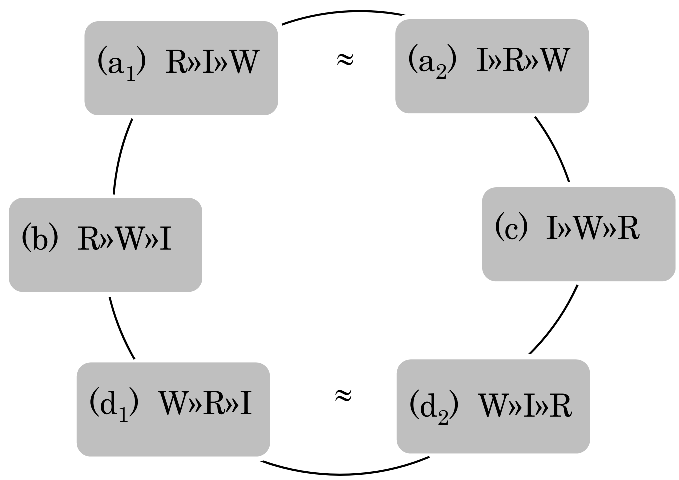
Since (67a) and (67c) each represent two grammars generating the same language (no crucial ranking between {RIGHTMOST, INITIALFOOT} and {INITIALFOOT, WORDACCENT}, respectively), we are dealing with six grammars all in all, which collectively exhaust all possible rankings of the three constraints (69), where R=RIGHTMOST, I=INITFT, W= WDACC.

(69)					
	(a_1)	R >> I >> W	≈	(a_2)	I >> R >> W
	(b)	R >> W >> I		(c)	I >> W >> R
	(d_1)	W >> R >> I	≈	(d_2)	W >> I >> R

We find it significant that these six systems form a class of grammars from an adjacent region in typological space, where two neighboring grammars differ only in the ranking of two constraints, as depicted in (70) (a "typohedron", in the terminology of the Rutgers typologists).[45]

45 We are very much indebted to the participants of the Rutgers Workshop on Formal Typology (May 2015) for helping us work this out, in particular, to Naz Merchant and Alan Prince.

(70)



This analysis of variation only attempts to formally capture what exactly the differences are in terms of constraint ranking. Which form goes with which subgrammar depends on various factors—genre of the word, source language, period of loan, etc.—which are worth exploring in their own right in a different kind of study, using philological and sociolinguistic methods. Closer to home, it is also beyond the scope of this investigation to assess the exact probabilities of the different variants, but nothing precludes implementing our analysis in models of partially ordered OT (Anttila 2002), or of stochastic OT (Zuraw 2010), that derive lexical type variation.

6. Conclusion

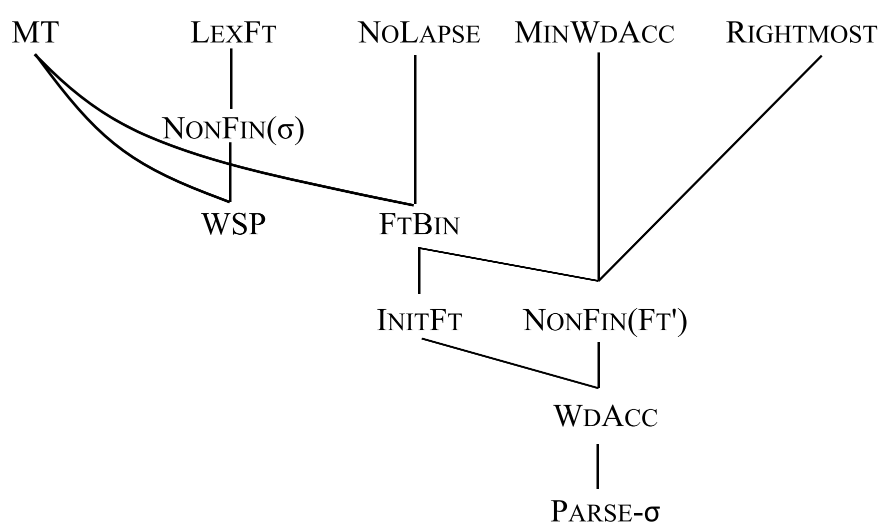
Starting out as an investigation into the well-known difference in obligatoriness between pitch accent and stress accent, this paper identified several vital themes essential to the understanding of how unaccented words can arise in a pitch accent system. The key to identifying the crucial factors and to unraveling the complexities is to give full justice to both the metrical and the accentual parts of the system, and to investigate the way in which metrical and accentual constraints interact in the grammar.

The single most important result is the central role of foot structure in any attempt to predict which kinds of forms will show a preference for unaccentedness, and which will not. While it is true that unaccented items show a concentration among 4μ forms, this only holds for certain 4μ forms (LLLL, HLL), and not for others (LLH, HH, LHL). The reason is that only the first are fully parsed into two feet (see section 5.2), and unaccentedness emerges as the optimal way of fulfilling both RIGHTMOST and NONFINALITY(FT') in such structures, and not in others. In other words, the actual explanation of unaccentedness is only very indirectly related to overall mora count—an explanation whose rationale would remain mysterious in any case—but is rather rooted in the overall rhythmic structure of the word, crucially involving feet. The accentual facts analyzed in this study follow from one basic fact: The main prominence in a word is assigned to satisfy a *violable* constraint. In Japanese, this constraint conflicts with the following: (i) a constraint against a word-final head foot; (ii) a constraint against the head foot being followed by other feet; (iii) a constraint against unfooted initials; and (iv) an anti-lapse constraint. In Japanese, (i)-(iv) outrank the constraint favoring main prominence. Between them, (i)-(iv) exclude all parses that could assign main prominence in 4μ words of the form LLLL, and words of any length ending in HLL. Focusing on LLLL, it follows that they are typically unaccented: (LL)(ĹL) is excluded by (i); (ĹL)(LL) by (ii); L(ĹL)L by (iii); and (ĹL)LL by (iv). Looking beyond Japanese and towards cross-linguistic implications, the central point is that when all or some of the constraints in the grammar that place limits on the *location* of the main prominence outrank the constraint that favors its *existence*, the former can cause the latter to be violated. Since these main-prominence limiting constraints are few, the theory developed in this study predicts few conceivable situations under which unaccented words could arise, which is in line with the known cross-linguistic facts. If it is actually true that GEN does not provide footless prosodic words—an assumption of convenience so far—, this imposes additional limitations on unaccentedness.

Given the central role played by the rhythmic foot in the analysis, it is an open question whether alternative foot-free accounts can be developed that can claim a comparable range of both descriptive coverage and depth of explanation, and we are looking forward to future explorations of these topics.

To conclude, we assemble all constraints that play a role in the analysis, and their ranking.

(71)



The key characteristics of the system arising from the constraint ranking depicted in (71) are threefold: (i) antepenultimacy, in broad outline similar (but crucially not identical) to what is found in familiar stress languages like Latin, English, and Macedonian (section 3.1-3.2), (ii) unaccentedness, arising through the option of a lower-ranking word prominence constraint in pitch accent systems (3.3), and (iii) avoidance of rhythmic lapses (3.3, 5.1-5.2). Quite striking is the fact that the constraints (on parsing, alignment, length, weight profile, lapses, foot structure, accentual headedness) and their interaction explain not only the broad generalizations and their cross-linguistic implications, but also the rather minute details of different accentual phenomena in Japanese. Once the system is in place, we have gained an understanding of further phonological phenomena that we did not even set out to investigate, such as the accentual properties of minimal words (3.4), truncations (6.1), language games (3.2), and other nonce formations (6.1), different behavior of native words vs. loans (6.2), and systematic variation (6.3)—and perhaps, with further exploration and theoretical development, of many other phenomena in Japanese and elsewhere.

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Department of Linguistics
University of California, Santa Cruz
Santa Cruz, CA 95064, USA
ito@ucsc.edu
mester@ucsc.edu
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