MORAS ARE UNNECESSARY FOR STRESS AND OTHER WEIGHT-RELATED PHENOMENA

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ABSTRACT

The mora is a widely used and highly valuable tool for the analysis of a variety of linguistic phenomena, including but not limited to stress behavior, syllabification, templatic morphology, compensatory lengthening, and tone patterning. Moraic Phonology posits moraic representations in the underlying representations of segments. While the utilization of the mora allows for a breadth of analyses of separate but related processes, the mora also conflates these processes by relating them each to the mora itself. This can be seen as a boon of the theory in that it connects phenomena previously thought unrelated. However, this leads to the challenging task of reconciling a larger set of incorrect predictions of the theory, including moraic mismatches in which the moraicity of segments appears different for separate processes. In the time since Hayes (1986, 1989) it has become clear that many phenomena that are analyzed using moras can be derived computationally – including via mora assignment/licensing (Crowhurst and Michael 2005; Gordon 2002; Hayes and Wilson 2008; Kiparsky 2003; Zec et al. 2003). This weakens the predictive power of representational mora and assigns more power to computation (of mora assignment or otherwise), without interfering with the status of the mora as the locus of the myriad of different processes for which moras are considered relevant. The use of mora-assigning or mora-licensing processes in computational analyses reduces the strong predictive power of representational accounts, but still conflates many separate processes to be related to the unit itself. For this reason, I suggest a re-examination of the domains which are typically analyzed with moras in order to determine for which processes the mora is a necessary, and preferable tool of analysis. I propose that stress assignment can be computed in a variety of languages without reference to moras or moraic representations. To show this, I build upon Crowhurst and Michael (2005) and Prince (1993) and present an Optimality Theoretic analysis of the stress patterns of several languages which have historically presented issues for moraic analyses, without utilizing moras.

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CHAPTER 1

BACKGROUND

The relative importance placed on *computation* compared to *representations* in phonological research has varied from theory to theory since at least the early 20th century (Anderson 1985). The pendulum swings from representation to computation and back again. The same linguistic data can be accounted for in systems with rich representations, or with rich computational systems, with theories differing on relative importance placed in each domain. I will define representation as the discrete units of language and the information encoded in them. This includes segments, features, prosodic structure, autosegmental tiers, etc. Computation will be defined as any process which derives information, over representations or otherwise. For example, Chomsky and Halle (1968) proposed powerful rules (computation) which proved capable of accurate descriptions of a variety of linguistic phenomena, while subsequent approaches such as x-slot theory (McCarthy 1981), metrical phonology (Liberman and Prince 1977), and moraic phonology (henceforth MP) (Hayes 1989) each in their own way propose detailed representations upon which comparatively simple rules act, and which are just as capable of linguistic description.

Optimality Theory (OT), which I will use for my analysis, is highly concerned with computation. Of course, representations of the input and output (or underlying and surface forms) are important, but much of the work of the framework is focused upon which constraints are active in a language (i.e. if they are ranked high enough to affect the derivation or not) and how they are ranked in order to derive the correct output candidates from the input. Analyses in OT often assume some tenets of a representation-heavy theory, such as x-slots or MP. This can be seen in the multitude of faithfulness constraints on moraicity (e.g. dep-mora, max-mora, etc.). In this way, aspects of the chosen representational theory are inherited by the analysis in OT. The ‘theoretical residue’ from a prior framework can persist even in subsequent frameworks. Although this is not inherently problematic, assumption of a prior theory also assumes any difficulties associated with that theory. It may be advantageous to develop a computational account for weight behavior with the goal of determining for which processes moraic representations are necessary. In section 1.1 I detail relevant aspects of MP, followed by cases where the theory makes incorrect predictions or fails to account for behavior in 1.2. In the same section I further show that OT analyses which utilize moras inherit many of the problems associated with MP, and navigating these problems weakens the representational predictions of the theory. In section 2 I present a computational analysis in OT of the stress patterns of three languages that have historically presented difficulties for moraic analyses – without utilizing moras as a unit of analysis. Instead, I choose to follow Campos-Astorkiza (2003) and utilize root nodes to represent timing and to distinguish between representations of geminate and singleton consonants, long and short vowels, and long and short diphthongs. I further introduce scales inspired by Crowhurst and Michael (2005) and Prince (1993) in order to separate other phenomena which the mora governs into several sets of constraints and scales. Weight is then derived from the complex interplay of these scales governing closed/open syllables, sonority effects, and root nodes.

1.1 Moraic Phonology

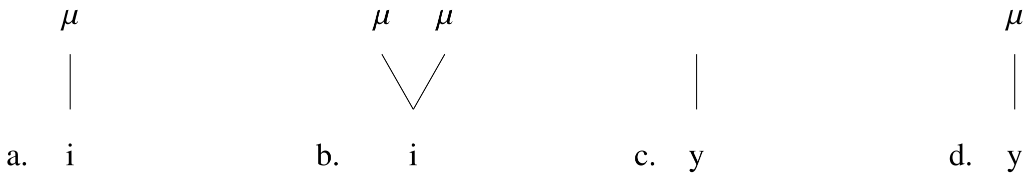
MP is highly concerned with the representations of words and segments. While rules indeed act upon moraic representations, crucial to the theory is the concept that moras are present in the underlying representations (UR) of segments, and that the moraicity of segments in the UR distinguishes between certain phonemes. MP presents a representational explanation for weight effects by specifying which types of segments (e.g. vowels, singletons, geminates, etc.) possess a mora in their underlying representations and which do not, and which prosodic positions are assigned a mora (e.g. onset, coda, nucleus) and which are not. The mora itself is proposed as both an abstract unit of weight and an abstract prosodic unit of the prosodic hierarchy. Hayes (1989) states:

> "In moraic theory, the prosodic tier plays a dual role: it allows length to be represented, and it forms the lowest relevant level of prosodic structure, serving as the basic unit for syllable weight, stress assignment, and tone."

The mora is then the target for tone/stress-related phenomena, not the segment or other prosodic positions. For example, the mora (not the vowel or syllable nucleus) is proposed to constitute a tone-bearing unit (TBU) onto which tone can be assigned. As moras are presented as the targets of weight- and tone-related processes in MP, the underlying moraicity of a segment, as well as the assignment of a mora to a segment – or lack thereof – should have effects on all weight-related processes in a given language in the absence of additional rules/constraints. The weight of a syllable may be calculated simply by counting the moras that are assigned to that syllable.

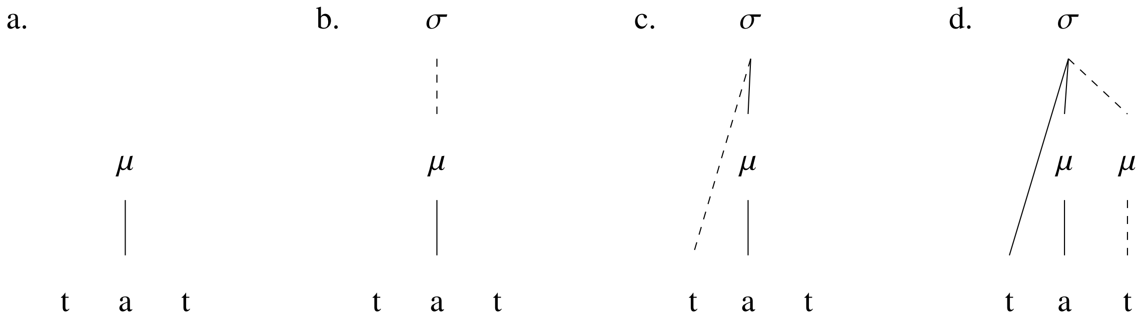
Both URs and surface representations (SR) in MP include phonemes on a segmental tier which are bound to moras on an autosegmental prosodic tier. In MP, a distinction is drawn between segments whose underlying representation includes mora associations (e.g. vowels, geminates) and segments that are assigned moras at a later stage in the derivation. In the UR short vowels (1a) are assigned one mora (monomoraic), long vowels (1b) two moras (bimoraic), and glides (1c) are assigned no mora (nonmoraic). All singleton consonants, not just glides, are nonmoraic. Geminate consonants (1d) are monomoraic. In this way, underlying moraicity distinguishes between featurally identical phonemes (e.g. long and short vowels and glides, and singletons and geminates). The underlying moraicity of segments then replaces featural accounts of these distinctions, such as [±long], while still committing to a phonemic difference between these segments in their URs.

(1) Underlying representations of: a short vowel, a long vowel, a glide (or any singleton consonant), and a geminate consonant.



Languages wherein syllables with coda consonants attract stress are proposed to have an additional process referred to as Weight-By-Position (WBP) which occurs during syllabification, and that assigns moras to the surface representations of segments. Syllabification occurs in autosegmental MP by first linking a “selection of certain sonorous moraic segments” to the syllable node (2a-b) (Hayes 1989). Which sonorous mora-bearers are selected for this is considered language-specific. Generally vowels are linked to the syllable node during this step of syllabification, and therefore this part of the syllabification process in MP could be said to be equivalent to assigning the nucleus of a syllable. Any language in which non-vocalic sonorants can also serve as syllable nuclei can be said to include those sonorants in the selection of sonorous moraic segments that are assigned to the syllable node in the first step of syllabification. Second, any onset segments are then linked directly to the syllable node (2c), prior to incorporation of coda consonants. This can be seen as an instantiation of the Maximal Onset Principle in MP, as onsets are incorporated into syllable structure prior to codas. Third, in a language without WBP, singleton coda consonants are then linked to the preceding mora. The syllabification of onsets/codas is said to rely on language specific parameters on syllable well-formedness. Both onsets and singleton codas are assigned to syllables without contributing weight (as the quantity of moras determines the weight of a syllable in MP, and onsets are linked to the syllable node with no moras, while singleton codas are linked to the mora of the preceding vowel). A geminate coda, which is inherently representationally moraic, will have their mora linked to the same syllable node of the preceding segment, while the segment itself is linked directly to the syllable node of any subsequent syllable. In this way, a geminate coda should behave as ambisyllabic, while only contributing weight to one syllable – it is linked to one syllable via the mora it possesses (giving weight to that syllable), and to a second syllable in the same way as any onset consonant, directly to the syllable node (contributing no additional weight).

(2) Syllabification with WBP



If a language has a WBP process, however, any remaining unassigned nonmoraic segments after onsets are assigned as in (2c) are either assigned a mora via WBP or not. Syllabification then continues as normal, with moraic segments – including those assigned a mora by WBP, as in (2d) – linking their mora to the syllable node and nonmoraic segments linking themselves to the mora of the preceding vowel. This instantiation of WBP in the syllabification process prevents onsets and syllable nuclei from receiving weight via WBP, as both nuclei (sonorous mora-bearers) and onsets (prevocalic segments) are assigned to the syllable structure prior to the implementation of WBP. In many languages (e.g. Egyptian Arabic and Latin (Kenstowicz 1994, p. 291-292), Brazilian Portuguese (Wetzels 2007) and Cahuilla (Hayes 1995)) stress assignment is attracted to closed syllables. Singleton coda consonants (as in a CVC syllable) are underlyingly nonmoraic, and therefore should contribute no additional weight compared to an open CV syllable. Thus the singleton coda in languages like these will need to be assigned a mora in order to contribute weight to the syllable. For these languages a WBP rule is posited that creates a mora for any remaining nonmoraic segments and links those segments to the newly created mora[1]. Thus singleton codas in all languages are underlyingly nonmoraic, but receive a mora in languages where closed syllables are heavy via WBP during the syllabification process.

While languages may differ concerning their exact instantiation of WBP, and therefore the codas to which they assign a mora (Hayes 1989), the underlying moraicity of segments in the same language should not differ regardless of the specific process involved. Languages which do not assign weight to coda consonants will not have a WBP rule, or have a WBP rule which is so constrained as to do no work in the language. In such a language, any CVC syllable will be monomoraic (i.e. syllables with the same underlying moraic content will all be the same weight). There are languages which appear to only assign weight to certain coda segments, indicating that languages can have highly specific WBP rules. Furthermore, due to WBP occurring in the syllabification process, the URs of any singleton consonants themselves are still nonmoraic even in languages where they appear to contribute weight in the SR.

Let us now examine a few analyses which utilize the mora. In an autosegmental framework like MP, segments – specified for their featural properties – are represented linearly on a segmental tier. These segments can link to and delink from units on other tiers, allowing the explanation of

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[1] Though one may have additional constraints on trimoraic or superheavy syllables that prevents this in some environments, or one may choose to bake such a constraint into the WBP rule itself as in (Hayes 1989).

many phenomena that appear to extend over domains larger (or simply separate from) the segment. One type of evidence in favor of separate tiers comes in the form of tonal reassignment. In Margi (Goldsmith 1976), the definite suffix /árì/ is characterized by high tone on /a/ and low tone on /i/. Ordinarily the suffix surfaces as such, seen in (3a). However, when a stem vowel is glided (de-vocalised) as in (3b), the low tone formerly associated with the stem /i/ is realized as part of a contour low-high tone on the remaining adjacent vowel /a/. In this way, tonal assignment in Margi is sensitive to the available tone-bearing units (TBUs). Here, the TBUs appear to include vowels and not glides. This is predicted in MP because singleton glides are representationally defined as nonmoraic and vowels as monomoraic. The suffix realized as [ná] in (3c-d) functions differently. It appears to lack tone of its own, assimilating to the preceding high tone in (c). However, (d) shows that the contour low-high tone on /bdlǔ/ is not in 1-to-1 correspondence with the vowel segment. If the /na/ suffix assimilates in tone to the previous vowel segment, then you would expect [nǔ] with a contour tone in (d). Instead, the contour low-high tone on /u/ in the underlying lexical representation appears to be split in the definite form into a low tone on the first vowel and a high tone on the second.

(3) Margi tone assignment (Goldsmith 1976).

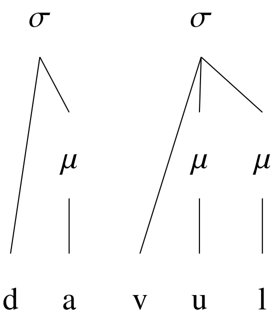
a. /sál/ – ‘man’ → [sál-árì] – ‘man’ (definite)
b. /tì/ – ‘morning’ → [tj-ǎrì] – ‘morning’ (definite)
c. /sá/ – ‘go astray’ → [sá-ná] – ‘go astray’ (definite)
d. /bdlǔ/ – ‘lead astray’ → [bdlə̀-ná] – ‘lead astray’ (definite)

This data suggests that contour tones in Margi are formed of constituent autosegments – individual high and low tones on a separate tier from the vowels segments. These tones can be combined into contour tone sequences on one vowel (e.g. (3b)), and contour tones on one vowel can be decomposed into sequences of high-low or low-high tones across multiple vowels (e.g. (3d)). If tone is a featural property of the vowel segments themselves, then deletion of a vowel would result in deletion of the associated tone. In which case, one could not explain the combinatory/decompositional nature of tone in Margi. In a moraic analysis, moras are the TBUs. This can be represented by tonal units/constituents (here, high and low tones) on an autosegmental tier, with the realization of tone occurring via the linking of the tonal constituents on their tier to moras on the moraic tier. The moras are each already assigned to vowels, as vowels are representationally defined in MP as moraic in the UR.

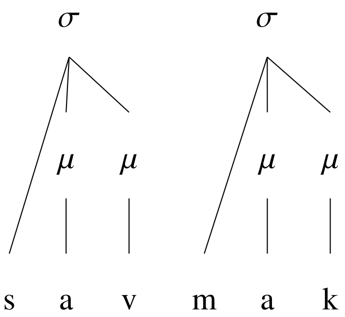
Other autosegmental theories can account for the Margi tone data, not just MP. However, compensatory lengthening (CL) – wherein the deletion of a segment causes another (usually adjacent) segment to be lengthened – is often proposed to require moraic representations. For example, Hayes (1989) is argues for MP over other autosegmental theories of timing primarily by presenting CL data for which MP makes correct predictions in contrast to x-slot or CV theory. In MP, CL occurs when a segment is deleted, leaving a stranded mora on the prosodic tier. An adjacent segment (though most often a preceding segment) links to that mora which contributes additional duration to the segment. Compensatory lengthening is predicted by MP to not be triggered by deletion/delinking of onsets because onsets are not assigned a mora. If no mora is stranded by the deletion of a segment, then no mora exists for other segments to link to and thereby lengthen.

For example, in Turkish the deletion of [v] is accompanied by CL on the preceding vowel only when [v] is in coda position (Sezer 1986). The surface forms of the Turkish words in (6a) and (6b) would be represented in MP as in (4) and (5), below. It is clear from the surface representations shown that no moras are linked to the onset [v] in [davul], but moras are assigned to both coda consonants in [savmak] via WBP. Deletion of the onset [v] in (4) does not strand a mora, and therefore CL does not occur. In (5) the coda [v] bears a mora, and therefore deletion of the segment [v] strands the mora that it was linked to. This mora then becomes linked to the preceding vowel. Due to moras encoding a durational contrast (here, short vs. long vowels), [a] is lengthened to [aː].

(4)



(5)



To summarize, in (6a), an onset [v] is deleted with no CL. In (6b), a [v] in coda position is deleted with CL of the preceding vowel. Moraic theory accounts for this asymmetry in CL with a stipulation concerning the representation of the syllable. Specifically, that onsets in MP are obligatorily nonmoraic, while codas may contribute weight via WBP. Hayes (1989) suggests that CL occurs when an unlinked mora (e.g. from the result of deletion) is linked to a (generally adjacent) segment. As onsets inherently lack moras in MP, onset deletion as in (6a) does not leave a stranded mora and therefore can not trigger CL, whereas deletion of a moraic coda as in (6b) can. Segment-based prosodic representations without the mora (e.g. CV- and X-Theory) make no representational distinction between codas and onset consonants and therefore struggle to account for this asymmetry. The mora is a valuable tool of analysis for tone, CL, stress, and many other linguistic phenomena.

(6) Compensatory lengthening in Turkish (Sezer 1986)

a. /da.vul/ → [da.ul]

b. /sav.mak/ → [saː.mak]

The presence of moras in the URs of segments is crucial to essentially all processes which act on moras. When tone is realized on moraic segments, this can be said to follow from the the moraicity of the segment and the assertion that moras are TBUs. When tone falls on a nonmoraic segment, or skips over a moraic segment for another, additional mechanisms must be proposed to account for this behavior. Some computation must occur, whether rule-based, constraint-based, or otherwise. This additional computation is often proposed to involve modifying the moraic content of the representation itself, not altering the processes involved (e.g. here, tone assignment). This allows one to to perpetuate MP and the predictions it makes. If tone assignment is completely unmodified and continues in the same way as prior analyses, but the moraic content of the relevant stimulus is proposed to be altered by some separate process, then one can maintain the underlying moraicity proposed in MP. Though, the addition, subtraction, or licensing of moras via different processes weakens the representational predictions of MP, as the moraicity of URs are then only predictive of surface forms to the extent that no moras have been altered by these additional processes.

1.2 Movement Towards Computation

Watson (2002) presents the data from San'ani Arabic in (7) below. Stress appears to fall on a word-final superheavy syllable if present, as in (7a-b). Otherwise stress is located on the rightmost (non-final) heavy syllable up to the antepenultimate, as in (7c-d). In the absence of a word-final superheavy syllable, or a heavy syllable within the last three syllables of the word (i.e. up to the antepenultimate), then stress falls on the first CV syllable in the word, as in (7e-h).

(7) Stress in San'ani Arabic (Watson 2002).

a. mak.ˈtuːb	‘office’
b. da.ˈrast	‘I/you (MASC SG) learnt’
c. ˈsaː.fa.rat	‘she traveled’
d. mi.ˈgam.bar	‘sitting’
e. mak.ˈta.ba.tiː	‘my library’
f. ˈli.bi.sat	‘she wore/put on’
g. ˈka.tab	‘he wrote’
h. ˈra.ga.ba.tih	‘his neck’

It has been proposed that the reason heavy syllables are stressed only up to the antepenultimate is because WBP in San'ani Arabic only applies to the last three syllables of the word (Davis 2011). This does not contradict MP because WBP is a language-specific process characterized by assignment of a mora to segments in coda position, and it appears that only coda are affected in San'ani Arabic. Furthermore, additional language-dependent restrictions on WBP which limit the set of coda segments that receive weight are possible (Hayes 1989). A constraint on WBP which allows it only up to the antepenultimate syllable would be highly specific but possible within the theory. However, the power of this analysis should be considered. There is no level of prosodic structure which corresponds to "last three syllables of the word." The existence of a constraint that prevents WBP from applying to pre-antepenultimate (or earlier) syllables suggests WBP constraints can apply to identical segments in identical syllables differentially depending on the location of that syllable within a word – without being limited to prosodic constituents.

This analysis presents an additional issue. Moras in MP are the targets/loci of stress. It should not be possible to specify that stress is assigned to CV syllables and not CVC syllables if they are both monomoraic. If WBP only applies to the last three syllables of the word, then both [mak] and [ta] in (7e) are monomoraic. There is no principled reason within this framework that [ta] should receive stress over [mak].

Additional data of stress assignment in San'ani Arabic is shown in (8) below, this time concerning words that contain geminates. In (8a) a CVG syllable with a geminate coda receives stress, much like a heavy CVC syllable from the above data. CVG and CVV syllables within the final three syllables of a word are also stressed over word-final superheavy syllables as in (8b). However, (8c-d) show that in contrast to CVC syllables, CVG and CVV syllables even in pre-antepenultimate position can receive stress. [saʤ] and [haː] in (8c-d) are in pre-antepenultimate position but possess mora representationally, not through WBP. They therefore would be considered bimoraic syllables and thus attract stress.

(8) Additional stress data in San'ani Arabic (Watson 2002).

a. ji.ˈħib.bu	'they (MASC) love/like'
b. mit.ˈʔax.xi.raːt	'late (FEM PL)'
c. mu.ˈsaʤ.ʤi.la.ti	'my recorder'
d. ˈhaː.ka.ða.haː	'like this'
e. ˈdaw.wart	'I/you (MASC SG) looked for'
f. ˈsaː.fart	'I/you (MASC SG) traveled'

Another issue involves the asymmetry in stress assignment in (7a) and (8e). Assuming an extrametrical word-final segment in Arabic[2] (7a) is of the form CVC.CVV (both bimoraic/heavy) and (8e) is of the form CVC.CVC (both bimoraic/heavy). To account for this difference in stress assignment within MP, Davis (2011) suggests that WBP in San'ani Arabic only applies to words which do not already have a bimoraic/heavy syllable. This also would be possible, as it applies only to coda and constitutes a language-specific constraint on WBP. Although, the power of this too can be questioned. This analysis would suggest that language-specific constraints on WBP can be conditional – rather than applying to all codas (with language-specific restrictions), WBP could differentially apply to the same segments based upon the structure of other syllables in the word. These types of language-specific WBP processes may be the most preferable analysis that maintains representational mora, but it begs the question: What constrains the set of possible targets of WBP?

Though rare, deletion of onset consonants can result in CL. This constitutes a problem for MP, as the theory captures the tendency of onset consonants not contributing to syllable weight by specifying that onsets must be nonmoraic (Hayes 1989). Moraic analyses of languages with onsets that appear to carry weight often involve a process by which moras are assigned to the relevant onset. Even if onsets were not stipulated to be nonmoraic and WBP was able to apply to them, one would still have to explain why weight-related processes are much less common for onsets than for codas (though this question is not exclusive to MP).

One language proposed to have CL as a result of onset deletion is the Nilotic language Maasai. It appears that multiple processes can lead to the deletion of /k/. One of these processes deletes /k/ when it appears between non-high back vowels (Wallace 1981). This occurs when a stem-final /k/ receives a suffix that is identical to the preceding vowel (Tucker and Mpaayei 1955). This deletion can be seen in (9), where the suffixation of the past tense/imperative allomorphs [a] and [o] result in deletion of a stem-final /k/ in both cases. The result is two adjacent vowels which then surface as a long vowel. Boldface corresponds to the stem for ease of recognition. Hyphens indicate morpheme

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[2] Which presents it's own representational issue. If the segment is extrametrical, then a word-final CVV syllable would be nonmoraic. This is because long vowels are represented in MP as one segment which is linked to two moras. An extrametrical segment would leave no moras in the syllable [tiː] in (7e). One possible alternative is that only syllable coda are extrametrical.

boundaries.

(9) Maasai intervocalic /k/ deletion (Tucker and Mpaayei 1955).

Stem	*Gloss*	*Past*	*Imperative*
a. lak	‘untie’	a-ta-**la**-a	ta-**la**-a
b. ibok	‘prevent’	a-**ibo**-o	**imbo**-o

In the examples above, it could be argued that deletion of /k/ results in a long vowel because the two identical adjacent short vowels after deletion are phonetically realized as long. However, it seems that /k/-deletion can occur in another context shown in (10) below. When an intervocalic /k/ is preceded by a high vowel and followed by a low vowel, the /k/ is deleted and is still accompanied by elongation of the following vowel (Wallace 1981). One could characterize /k/ deletion in Maasai as being broadly restricted to intervocalic environments, although it appears the two deletion processes have different results. A separate vowel raising rule is said to change the stem vowels [e] and [o] to the high vowels [i] and [u] respectively (Tucker and Mpaayei 1955). Regardless, the stem vowels in this second /k/ deletion process are different in quality from the following suffixal /a/, yet the stem vowels remain in the output (albeit raised). It’s therefore clear that the long [aː]/[aa] in the output can’t be derived from two adjacent [a] vowels, as was a possibility for (9) above. Nor can the long vowel in the output be derived from vowel coalescence involving the stem vowel and suffix, because the stem vowels remain present in the output in addition to the vowel lengthening of the suffix. It also cannot be the case that the past tense/imperative morphemes are underlyingly long, as the past tense and imperative suffixes both surface as short vowels when the stem-final segment is a vowel or other consonants besides /k/ (which do not delete intervocalically). This can be seen in forms like tá-nàp-a - ‘carry him/it (imperative)’ where the first morpheme indicates the class of verb, the second is the stem, and the final /a/ is the imperative morpheme (Koopman 2001). Under a moraic account the vowel lengthening in (9) is expected, as two identical monomoraic vowels are concatenated. There’s no reason to believe this involves compensatory lengthening. It isn’t clear why vowel lengthening occurs in (10) however, as the stem vowel and its associated mora are still present/linked and are not contributing to the subsequent long vowel. Instead it appears as if compensatory lengthening has occurred via deletion of the intervocalic /k/, but this onset /k/ should not possess a mora. It's therefore not clear why this second /k/-deletion process results in a long vowel under a representational moraic account.

(10) Maasai vowel lengthening (Tucker and Mpaayei 1955).

Stem	*Gloss*	*Past*	*Imperative*
a. dek	'curse'	a-te-**di**-aa	te-**di**-aa
b. lok	'intercept'	a-to-**lu**-aa	to-**lu**-aa
c. ipek	'jeer'	a-**ipi**-aa	**impi**-aa
d. irrok	'cough'	a-**irru**-aa	**irru**-aa

The Samothraki dialect of Greek is another language purported to have onset-deletion processes that affect syllable weight. In this dialect /r/ deletes in onset position regardless of the number of preceding consonants in the onset cluster. Example (11a) shows /r/ deletion in a simplex onset, and (11b-c) complex onsets of two and three consonants respectively. Synchronically /r/ deletion does not involve lengthening of a vowel, but diachronically /r/ deletion appears to have resulted in CL of the following vowel (Katsika and Kavitskaya 2015).

(11) Comparison between Standard and Samothraki Greek words (Katsika and Kavitskaya 2015).

Standard Greek	Samothraki Greek	*Gloss*
a. ˈɾi.zɐ	ˈiː.zɐ	'root'
b. ˈvɾi.kɐ	ˈviː.kɐ	'find.sp.1sg.ind'
c. ˈɐ.spɾɔs	ˈɐ.spuːs	'white'

Several different analyses of the Samothraki Greek facts have been proposed. Hayes (1989) describes this dialect and proposes an analysis that does not involve CL via onset deletion. In his account, vowel epenthesis occurs preceding /r/, followed by intervocalic deletion of /r/, and then a merger of the two separate vowels into one long vowel. This is much like the first Maasai /k/-deletion process in (9), and is the same argument that Hayes constructs to account for the similarly problematic data of CL from onset deletion in other languages like Onondaga. The epenthesis analysis is questioned by Topintzi (2006), who points out that while an epenthesis account may work for onset clusters, there is no motivation for epenthesis in the simplex onset case (e.g. (11a)). Mora preservation analyses of the data in Optimality Theory are also identified as insufficient by Topintzi, as they require that onsets be moraic to begin with. Their analysis (painted broadly) is that CL is actually not a mora preservation process, but instead is about preserving the position of segments via moras (as a prosodic unit of syllable structure).

Meanwhile, Kiparsky (2011) presents an analysis in Stratal OT which proposes that onset /r/ was syllabified into the nucleus of the syllable, citing that rhotics are cross-linguistically avoided in onset position as part of a preference for low-sonority onsets. Kiparsky posits that a minimum sonority licensing constraint on mora in Samothraki Greek includes /r/, resulting in /r/ being representationally defined as moraic and incorporated into the nucleus of syllables. However, the proposal of a sonority threshold that determines which segments hold moras suggests that the representations of segments as well as their prosodic structure are computationally defined. This marks a major swing of the pendulum towards computation, and constitutes a major divergence from the representational moraicity of Hayes (1989). The licensing of mora in this way suggests that the moraic representations of MP in (1) are not immutable. Segments over a certain sonority threshold (here /r/) can be licensed for moras and be incorporated into the syllable nucleus. In this analysis it is no longer the case that vowels would be obligatorily moraic, but rather that the sonority threshold for moraicity in most languages includes all of the vowels present in the inventory of those languages. This is advantageous over the MP account of representational moraicity in that this can more easily account for languages such as Tashlhiyt Berber – in which a variety of segments can operate as syllable nuclei – by suggesting that the sonority threshold is quite low. However, this raises the question: If it is possible to computationally derive the moraicity of segments and moraicity is what determines stress, tone, CL, and templatic behavior, then is it possible to computationally derive those same linguistic phenomena without reference to the mora?

CHAPTER 2

ANALYSIS

I will examine the stress patterns of three languages – Ngalakgan, Selkup, and Nanti – which have for separate reasons proven difficult to account for in MP. I will do so without recourse to moraic representations, showing that these challenging cases can be analyzed without moras. Crowhurst and Michael (2005) show that computation of sonority, diphthong/monophthong contrast, length, and an closed/open syllable contrast are necessary to account for the stress system of Nanti, though they utilize moras to encode length and to define closed syllables. I will build on their work by assuming that the computation of this information is indeed necessary[1] and incorporating it into my analysis – albeit with an entirely unique set of constraints that make no reference to moraic representations, and that may apply more generally to languages besides Nanti.

The constraints/scales which I propose are listed in (12) below. I adopt some of the concepts used in Crowhurst and Michael (2005) in their analysis of Nanti stress data. They propose two sonority scales, separate for the foot and word-level. Their foot-level constraint scale is [*P(ft)/Hi » *P(ft)/Mid » *P(ft)/Lo], and their word-level constraint scale is [*P(pw)/Hi » *P(pw)/Mid » *P(pw)/Lo]. Each scale is based on the constraint *P or 'no peak' – which assigns violations to the nuclei of foot-level and word-level stress peaks respectively, with a three-way sonority distinction. I seek to broaden their analysis with a more general set of constraints which attempt to target the same phenomena. Specifically, I too adopt a sonority scale for both feet and prosodic word-level processes. Where they use a three-way sonority distinction between high, mid, and low vowels in their analysis, I follow the structure of the syllable-level sonority scale introduced by Prince (1993) and used in their Encapsulated Segmental Syllable Theory, and apply the same structure to the foot- and prosodic word- levels of prosodic hierarchy. Their constraints, as well as those of Crowhurst and Michael (2005) and mine, are of the form *P or 'no peak.' The Prince (1993) instantiation also targets syllable nuclei only, and encapsulates a universal fixed scale of constraints on segments that mirrors the sonority hierarchy. For example, [*P/t » ... » *P/a], where the scale can be seen as a

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[1] It is possible that computation of still other mora-extrinsic information is necessary to account for the stress behavior in other languages

ranking of the sonority of every segment, with constraints on low sonority segments listed higher on the constraint ranking. Thus low sonority segments (e.g. /t/) are dispreferred as syllable peaks over high sonority segments (e.g. /a/) in a gradient way that mirrors the sonority hierarchy, rather than a set of three constraints which only distinguish low, mid, and high. My sonority scales mirror this but are applied to the foot and prosodic word domains, shown in (12a,b)). The peak of a foot is the stressed syllable, and the peak of a word is the syllable with word-level/primary stress. These constraints target the syllable nucleus, and not the rhyme or syllable overall, as I am following the behavior of the constraints in Crowhurst and Michael (2005) and Prince (1993), and also because it has been proposed that a distinction between nuclear and non-nuclear segments is necessary – even in MP (Steriade 1991). There may be reasons to also posit sonority constraints that instead target codas, or the rime. For example, Lithuanian has been described with an umlaut pattern that values CVV and CVS (sonorant) syllables as heavy, and CV and CVO (obstruent) syllables as light (Zec 1995). While I will leave the exact instantiation of this to further research, one possibility that would fit my analysis is to incorporate another set of sonority constraints that form a scale applied to syllable codas[2], mirroring the syllable margin constraints in Prince (1993). One benefit of choosing gradient sonority scales over the Crowhurst and Michael (2005) scales is that languages with more than a three-way sonority contrast for stress calculation can be accounted for. Though it remains to be seen if this prediction is borne out in the linguistic typology. It also is a simpler proposal than the three-way contrast, in that the gradient sonority scale proposed in Prince (1993) is necessary to account for languages like Tashlhiyt Berber, and all that my constraints require is that the same exact scale be applied to subsequent levels of the prosodic hierarchy (not just syllables, but feet and prosodic words), rather than proposing separate constraints which target specific vocalic sonority thresholds while still necessitating that they apply to additional levels of the prosodic hierarchy.

The length scale that I propose is also in the form of a *P constraint scale, much like the proposed sonority scales. This scale is necessary to account for languages with vowel length effects on stress assignment. In their analysis of Nanti, Crowhurst and Michael (2005) propose a length scale

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[2] Or perhaps even to syllable margins (onsets and codas) broadly. This would require stipulation as to why onsets do not tend to factor into weight/stress/etc. computation, but this is necessary in MP and other frameworks as well.

comprised of the constraints: [*P/$\sigma\mu$ » *P/$\sigma\mu\mu$] which assign violations to stressed syllables (foot peaks) which are monomoraic or bimoraic respectively. They also propose two diphthong scales comprised of the foot level constraints [*P(ft)/Mon » *P(ft)/Diph] and the word level constraints [*P(wd)/Mon » *P(wd)/Diph], each of which prefer diphthongs to monophthongs by assigning violations to the nuclei of stressed (or primary stress) syllables which are monophthongal or diphthongal. Crowhurst and Michael (2005) combine their diphthong and vowel sonority scales, while I will conflate the diphthong and length scales into one. I assume the two-root representations from Selkirk (1990), with some modifications. Specifically, I directly adopt that geminate consonants and vowels are representationally defined by two root nodes – which are linked to the prosodic hierarchy. However, Selkirk assumes moras as the lowest unit of the prosodic hierarchy, while I will assume instead a nonmoraic representation of prosodic structure. Namely that syllable structure is composed of an onset and rime, and the rime composed of nucleus and coda. In my instantiation, root nodes are linked to the prosodic hierarchy not via moras, but directly to the onset, nucleus, or coda positions. My representations will also differ with regards to diphthongs. In Selkirk's instantiation, short diphthongs are comprised of two root nodes and one prosodic position (mora), while long diphthongs are comprised of two root nodes and two prosodic positions (moras). Instead, I apply the McCarthy (1988) representations of contour segments such as affricates or prenasalized consonants – consisting of one root node with two sets of features (e.g. place or nasal). In my instantiation then, short diphthongs will consist of one root node (like a short vowel) with two sets of place features, while long diphthongs consist of two root nodes (like long vowels). My length scale, shown in (12c), involves a high ranking constraint *P(ft)/1Root1Pl banning syllable nuclei that dominate one root node and which contain only one set of place features (short vowels). This is followed by *P(ft)/1Root2Pl which assigns violations for nuclei that dominate one root node that has two place features (light diphthongs), and which is followed by *P(ft)/2Root1Pl which assigns violations for nuclei that dominate two root nodes each with one set of place features (long monophthongs)[3].

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[3] For languages which differentiate long diphthongs and long monophthongs, an additional constraint targeting long diphthongs may be necessary, possibly of the form *P(ft)/2Root2Pl that assigns violations for nuclei that dominate

Lastly, I suggest the coda constraints in (12d), which assign violations to stressed syllables (i.e. foot peaks) that do not contain a geminate, or that do not contain a coda. I chose to create constraints that apply to the peaks of feet instead of utilizing existing constraints such as NoCoda or *Geminate in order to keep these constraints specific to stress, though it is not clear if this is preferable to more general constraints. In Crowhurst and Michael (2005) the length scale is comprised of the two constraints [*P(ft)/Mon » *P/VC-μ], where the first constraint is as described in the previous paragraph, and the second constraint assigns violations for stressed syllables with branching moras (one V and one C, or one [-consonantal] and one [+consonantal]).

More details of the Crowhurst and Michael (2005) analysis will be given in section 2.3 where I explain and analyze Nanti stress behavior.

(12) My constraint scales

a. Sonority scale (feet)	[*P(ft)/ζ » ... » *P(ft)/α]
b. Sonority scale (prosodic word)	[*P(pw)/ζ » ... » *P(pw)/α]
c. Length scale	[*P(ft)/1Root » *P(ft)/1Root2Pl » *P(ft)/2Root]
d. Coda constraints	[GemPeak(ft), CodaPeak(ft)]

Using this set of constraints I will analyze the three languages listed above – Ngalakgan, Selkup, and Nanti. All of which exhibit characteristics that are difficult to account for in MP, or in separate frameworks that retain representational assumptions about moraic structure. I use the same constraints/scales to analyze each language, albeit with some additional necessary constraints on a language-specific basis. I will explain the stress behavior and list the relevant constraints in the analysis of each respective language. Not every language will be sensitive to each constraint or scale. Only Nanti exhibits any sonority effects, for example, while Ngalakgan and Selkup do not

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two root nodes, each of which have two place features. It is also possible to separate the length and diphthong scales into constraints like *P(ft)/1Root, *P(ft)/2Root, and *P(ft)/1Pl, *P(ft)/2Pl. This may be preferable in that it allows differential ranking of the root node and place constraints. This could account for languages in which short diphthongs are dispreferred for stress compared to short monophthongs, or in which long diphthongs are dispreferred for stress compared to long monophthongs. Even languages in which all diphthongs are dispreferred for stress over monophthongs, or vice versa. My (non-decomposed) constraints in (12c) instead predict that short diphthongs will be preferred over short monophthongs, and that long monophthongs will be preferred to short diphthongs, remaining agnostic to the behavior of long diphthongs.

interact with the sonority scales and therefore the sonority scale constraints in these languages are proposed to be sufficiently low-ranking as to do no work in the languages.

In addition to the above scales and constraints, I assume the following high-ranking general foot structure constraints in each language but do not include them in tableau for lack of space. These constraints necessitate the parsing of syllables into feet via Parse-Syl, while banning degenerate feet via FootBinarity. Both constraints are adopted from Prince (1993).

(13) General constraints on foot structure

a. FootBinarity - Feet are binary (syllables)

b. Parse-Syl - Syllables must be parsed into feet

Each analysis was constructed in conjunction with OTSoft (Hayes, Tesar, and Zuraw 2013) to verify that these constraints and constraint rankings do not result in any contradictions in any of the three analyzed languages.

2.1 Ngalakgan

Stress in the Australian aboriginal language Ngalakgan appears to be sensitive to the length or weight of a syllable. What is more interesting is that heavy syllables with placeless segments (e.g. geminates, homorganic nasals) do not attract stress, but heavy syllables without placeless segments do. In Ngalakgan standard stress assignment occurs left to right in trochees, shown in (14a-b). One can observe that primary stress is attracted to heavy CVC syllables in (14c-d), while codas without their own place features are ignored for stress calculation in (14e-g).

(14) Ngalakgan stress assignment (Davis 2003).

a. cíwi

b. céraTa

c. purúTci

d. màcapúrka

e. cákanta

f. cápatta

g. ŋáNaʔpay

MP suggests that WBP is a language-specific process characterized by assignment of a mora to segments in coda position. Additional language-dependent restrictions on WBP are possible, limiting the set of coda segments which receive weight on a language-specific basis (Hayes 1989). The problem that the Ngalakgan data presents for MP is that the underlying representations of geminate consonants are said to be inherently moraic, yet syllables with geminate codas (i.e. CVG) in Ngalakgan don't attract stress while syllables with singleton codas (i.e. CVC) syllables do. This cannot be explained as a restriction on WBP because geminates are considered underlyingly moraic. If WBP is present in Ngalakgan it can add a mora to nonmoraic codas, but this would result in CVG and CVC syllables both being bimoraic syllables. If they are equal in weight, there is no principled reason for CVC to attract stress and not CVG. Some stipulation is required to consider geminates nonmoraic in this language, running counter to the fundamental claims of representational moraicity. Alternatively, if WBP is represented by a markedness constraint such as the Weight-to-Stress Principle (Prince 1993) then any heavy syllables (with either geminate or singleton codas) should satisfy the constraint. Both of these instantiations of WBP predict that geminates should at least not be treated as lighter than singletons. MP therefore cannot account for the Ngalakgan data in a straightforward way. This has led to prior analyses of Ngalakgan that argue against moraic representations, such as Baker (1997).

On the other hand, Davis (2003) presents an analysis which maintains the underlying moraicity of geminates utilizing a high ranking constraint that requires moraic elements possess place features. This analysis suggests that representational moraicity in Ngalakgan is not wholly predictive of weight-related processes. The proposal of this constraint suggests that moraicity – even underlying moraicity, not just moras assigned by WBP processes – is to some degree computationally defined. In other words, some process exists which evaluates each segment for place features, and assigns or does not assign a mora accordingly. If moraicity – and therefore stress and tone assignment, CL, and every other weight-sensitive process – requires mora-extrinsic computation, then the predictive power of underlying moraic representations is weakened.

Hayes (1989) presents an argument against x- and cv-slot representations on the basis that they aren't constrained enough — they over-generate. If the moraicity of coda consonants, derived from WBP, is based on language-specific parameters with no constraints, then one could take a similar position against MP. Several of the prior analyses of problematic data presented in this paper propose stipulations on WBP which allow it to target identical segments or syllables differentially depending on position in the word, conditional statements, sonority of segments, or a combination of other factors. It may be the case that accounting for the spectrum of coda weight behavior cross-linguistically requires this – that no limitations be placed on the form of WBP. However, over-generation only becomes more problematic with the introduction of constraints that act upon the moraicity of non-coda segments, as with the above Davis (2003) analysis of Ngalakgan. Furthermore, if mora-extrinsic information (e.g. segment sonority or place) is necessary to account for weight-related behavior in some languages, then it is clear that information in addition to mora count is being used by these processes. Stress assignment can't look only at moras, additional computational mechanisms are required. The implementation of these mechanisms will differ depending on theoretical framework. These additional mechanisms could surface perhaps in the form of restrictions on moraicity of segments in the UR or SR, as markedness constraints in an Optimality Theoretic analysis, or via reference to independent scales (e.g. sonority), none of which are mutually exclusive. Regardless of implementation, mora-extrinsic information is required to account for the Ngalakgan stress behavior. Even analyses which maintain the underlying moraicity of geminates require processes which evaluate segments and assign or delete moras. In which case, the moraicity of segments are computationally defined. In contrast to this, my analysis seeks to take this emphasis on computation to the logical extreme – that moraic information is not necessary for stress assignment. If computation of mora-extrinsic information is necessary, and this computation could involve computation of mora assignment or computation of weight effects without reference to the mora, then it is useful to examine whether the intermediate step of mora assignment is necessary. The goal is not to disprove the mora, but to critically examine whether the mora is necessary to the processes which it is said to affect. My analysis of Ngalakgan relies primarily on the following constraints.

(15) Ngalakgan constraint list

a. Align-L(Ft,L,PrWd,L) - The left edge of each foot is aligned to the left edge of prosodic word.

b. *P(ft)/-place - No peak contains placeless segments.

c. CodaPeak - Each peak contains a coda.

d. Trochaic - Binary feet are trochaic (left headed).

In a simple CVCV bisyllabic word like /ciwi/ below, where there are no coda or placeless segments, the default trochaic stress pattern emerges. From this data it is not yet clear which of CodaPeak or Trochaic is ranked higher than the other, as either ranking would select the correct candidate[4].

(16)

ciwi	CodaPeak	Trochaic
☞a. (cí.wi)	*	
b. (ci.wí)	*	*!

When heavy syllables are introduced, the ranking of CodaPeak and Trochaic becomes clear. A high ranking Align-L(ft,wd) constraint assigns violations to candidates with feet that are not aligned to the left edge of the prosodic word. This, together with FootBinarity, constituting a ban on degenerate feet, eliminates (c.) as a candidate. The choice of the two remaining candidates determines whether stress falls on the foot initial open CV syllable, following the trochaic stress pattern, or whether stress instead falls on the foot final closed CVC syllable. Here, ranking CodaPeak over Trochaic selects for the correct candidate (a.), with stress on the closed syllable. This indicates that closed syllables can attract stress away from the trochaic stress pattern.

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[4] A higher ranked DEP constraint prevents epenthesis from resolving violations to CodaPeak in this language. This is not unwarranted, as epenthesis does not appear to occur in this language. Baker (2008) references epenthesis in specific contexts in Ngalakgan only to argue against the possibility.

(17)

puruTci	Align-L	CodaPeak	Trochaic
☞a. (pu.rúT).ci			*
b. (pú.ruT).ci		*!	
c. pu.(ruT.cí)	*!	*	*

In stimuli that are parsed into two bisyllabic feet, Align-L no longer does any work. CodaPeak prevents open syllables from attracting stress. As the first foot contains only open syllables, and one must be stressed, each candidate will receive at least one violation. The candidates in which the heavy syllable in the second foot is not stressed receive two violations – one for each foot – and are eliminated. The final determination comes from Trochaic, resulting in the default trochaic stress pattern when all else is equal.

(18)

macapurka	Align-L	CodaPeak	Trochaic
☞a. (mà.ca)(púr.ka)	**	*	
b. (ma.cà)(púr.ka)	**	*	*!
c. (mà.ca)(pur.ká)	**	**!	
d. (ma.cà)(pur.ká)	**	**!	

Finally, in cases with geminate or homorganic nasal codas, the *P(ft)/-place constraint that assigns violations to placeless segments in stressed syllables becomes relevant. In /cakanta/ below, Align-L(ft,wd) and the ban on degenerate feet result in two final candidates, (a.) and (b.). CodaPeak would prefer (b.) is selected as the output, as it contains a stressed closed syllable. Instead, ranking *P(ft)/-place above CodaPeak results in elimination of this candidate, as the homorganic nasal is featurally placeless. Stress must then fall on the only remaining locus of stress available, the foot initial open syllable.

(19)

cakanta	Align-L	*P(ft)/-place	CodaPeak	Trochaic
☞a. (cá.kan).ta			*	
b. (ca.kán).ta		*!		*
c. ca.(kan.tá)	*!		*	*

This constraint ranking accounts for Ngalakgan stress behavior with a few generic prosodic markedness constraints (e.g. Align-L, Trochaic), a constraint that bans placeless segments in stressed syllables (*P(ft/-place)), and a constraint that prefers closed stressed syllables over open stressed syllables (CodaPeak). No moraic representations or mora-assigning computation is necessary to account for the stress behavior in this Ngalakgan data.

2.2 Selkup

The Uralic language Selkup below is one of several languages in which CVV syllables attract stress over CVC and CVG syllables, which pattern as light (Halle and Clements 1983; Ringen and Vago 2011). Languages of this pattern present difficulty for MP due to the proposal of the underlying moraic representation of geminates; both CVV and CVG syllables should have bimoraic representations, and therefore be equal in weight. Ringen and Vago (2011) present an analysis in which stress falls upon the rightmost syllable with a long vowel, as seen in (20a-c). Otherwise stress falls on the first syllable (20d,e,g). CVC syllables don't attract stress, consistent with a language without a WBP process (20e). Geminates too, don't attract stress despite being considered underlyingly moraic within MP (20f-h).

(20) Selkup stress – geminates and closed syllables are light (Davis 2011; Halle and Clements 1983; Ringen and Vago 2011).

a. quˈmoːqi
b. ˈuːcɨqo
c. uːˈcɔːmɨt
d. ˈqumɨnɨk
e. ˈamɨrna
f. ˈuːcɨkkak
g. ˈɛsykka
h. ɛsˈsɪːqo

I utilize the same full constraint list as described in the Analysis section 2 above, with the addition of two constraints. The first is Align-R(Pk,PrWd), which suggests that the right edge of a stress peak should align with the right edge of the prosodic word. The second of the constraints is an altered form of the constraint *[ ][+stress,-heavy] (Hayes and Wilson 2008) – or ‘stress light syllables only in word-initial position.’ This constraint assumes a definition of ‘light’ or ‘heavy’ syllables. This is problematic when my analysis does not explicitly define a ‘heavy’ syllable, instead choosing to examine the factors which affect weight (closed syllables, vowel quality, length) individually, and how stress is derived from that information. My alternative to this constraint is a new constraint which affects not [-heavy] syllables, but that instead targets nuclei that dominate one root node. My constraint then is *1Root[ ][+stress] – ‘stress syllables with single-root nuclei only in word-initial position.’

Introduction of these two constraints and use of *P(ft)/1Root can account for the Selkup data above. The closed syllable constraints and sonority scales are not necessary (and therefore are proposed to be low-ranking) because Selkup stress does not appear to be sensitive to vowel quality or closed syllables.

(21) Selkup constraint list

  a. Level 1
    i. *P(ft)/1Root
    ii. *1Root[ ][+stress]
  b. Level 2
    i. Align-R(Pk,PrWd)

In this analysis, the constraints which prefer stress on closed syllables and the constraints which prefer stress on long vowels are separate. Therefore there is no issue with CVC and CVG syllables patterning as light while CVV syllables pattern as heavy. This follows if the constraints favoring closed syllables, namely CodaPeak and GemPeak, are ranked sufficiently low, while *P(ft)/1Root is ranked high enough to disprefer short monophthongal nuclei.

This can be seen with /qumɨnɨk/ below. Each syllable is the same length, so *P(ft)/1Root does no work. Instead, *1Root[ ][+stress] determines the winning candidate by assigning violations for any non-word-initial stressed light syllables. These must be ranked above Align-R(Pk,PrWd), or the preference for right-most stress would incorrectly affect even light syllables.

(22)

qumɨnɨk	*P(ft)/1Root	*1Root[][+stress]	Align-R
☞a. ˈqumɨnɨk	*		**
b. qumɨˈnɨk	*	*!	
c. quˈmɨnɨk	*	*!	*

For a case with a geminate consonant, examine /ɛsykka/ below. It plays out in much the same way. CodaPeak and GemPeak are ranked low enough that closed syllables in Selkup do not attract stress. The nucleus of the closed syllable is equally as monophthongal/single-rooted as in the other syllables, thus stress falls into the default pattern on the first syllable.

(23)

ɛsykka	*P(ft)/1Root	*1Root[][+stress]	Align-R
☞a. ˈɛsykka	*		**
b. ɛˈsykka	*	*!	
c. ɛsykˈka	*	*!	*

In /uːcɔːmɨt/ two long vowels are available for stress. These are preferred over assignment of stress to the final CVC syllable, as *P(ft)/1Root assigns a violation for a short vowel. Which of the syllables with long vowels receives stress is then dependent on the constraint Align-R(Pk,PrWd), which enforces right-most stress.

(24)

uːcɔːmɨt	*P(ft)/1Root	*1Root[][+stress]	Align-R
☞a. uːˈcɔːmɨt			
b. ˈuːcɔːmɨt			*!
c. uːcɔːˈmɨt	*!	*	

The below example /sɪːqo/ contains both a geminate and long vowel. Still, the coda constraints are low ranked and so the syllable containing a geminate is not preferred for stress. Instead *P(ft)/1Root ensures that only the long vowel can receive stress.

(25)

ɛs sɪːqo	*P(ft)/1Root	*1Root[][+stress]	Align-R
☞a. ɛsˈsɪːqo			*
b. ˈɛs sɪːqo	*!		**
c. ɛs sɪːˈqo	*!	*	

In this way, the proposed constraints can account for the Selkup data without issues arising concerning the weight of CVC and CVG syllables compared to CVV syllables. This is because the mora conflates closed syllables and segmental length contrasts, while the present analysis separates them to be governed by two different sets of constraints.

2.3 Nanti

Stress in Nanti is described by Crowhurst and Michael (2005) as proceeding left-to-right in iambs, with a ban on prosodic word final feet. This can be seen below in the (26a,b), where feet are aligned to the left of the prosodic word, and stress falls on the second syllable in each foot. The final syllable in the prosodic word – here /te/ in both examples, where square brackets indicate the end of the prosodic word – is left unfooted due to the aforementioned ban on footed syllables in the final position of a prosodic word.

(26) Iambic stress (Crowhurst and Michael 2005)

a. o.gó.te.ro (o.gó).te].ro ‘she will know it’

b. i.pì.ri.ní.te (i.pì)(ri.ní).te] ‘he sits’

The presence of heavy syllables can draw stress from the iambic pattern. In (27a) the first syllable is closed and draws stress over the open second syllable, despite this violating the iambic stress pattern. (27b) shows a similar case where the third syllable is closed and draws stress from the open fourth syllable, again violating the iambic stress pattern and further showing that stress on a heavy syllable appears prioritized over stress clash. In (27c) the stress pattern returns to iambic, with the second foot indicating that the CVC /man/ is at most equal in weight to the CVV /tai/ (CVV ≥ CVC). Finally, (27d) shows that a superheavy syllable of CVVC draws stress from a heavy CVV syllable. The pattern from this data is representative of CVVC > CVV ≥ CVC > CV.

(27) Heavy syllables alter the pattern (Crowhurst and Michael 2005)

a. òŋ.ko.wo.gó.te.ro	(òŋ.ko)(wo.gó).te].ro	'she will harvest it'
b. o.tá.sòŋ.ka.kse.ro	(o.tá)(sòŋ.ka).kse].ro	'she blew on it'
c. i.kà.man.tái.ga.kse.na	(i.kà)(man.tái).ga.kse].na	'they MASC told me'
d. o.sà.ráan.tai.ga.kse	(o.sà)(ráan.tai).ga.kse]	'they MASC tore it with a purpose'

The facts thus far are easily explained within MP if one assumes that Nanti is a language which has a WBP process – under which the codas in the closed syllables receive a mora and thus those syllables are heavier than syllables without codas/additional moras. Stress would not be drawn to /man/ in (27c) because both /man/ and /tai/ are equally bimoraic syllables (after application of WBP). The superheavy syllable /raan/ in (27d) would receive weight via WBP in the same way, though this syllable possesses a (bimoraic) long vowel, resulting in a trimoraic syllable which attracts stress over the adjacent bimoraic /tai/[5].

Crowhurst and Michael (2005) make significant departures from MP in their analysis within OT, choosing instead to use a closed syllable scale (where CVC > CV, and CVVC > CVV), shown in (29). This allows them to avoid attesting trimoraic superheavy syllables in Nanti. They still utilize the mora in their analysis, and suggest that CVV > CV is the result of the moraic representational difference between short and long vowels. In this way, their analysis separates weight derived from a closed coda, and weight derived from moraic representations.

Nanti is especially interesting because the stress system appears to be sensitive to vowel quality/sonority. In (28a) the first syllable /a/ is a higher sonority vowel than in the second syllable /wo/, and with syllable weight equal (both being light V or CV syllables), stress is attracted away from the iambic pattern to the syllable with the lower/more sonorous vowel. In (28b) sonority plays

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[5] Although the standard distinction is between zero, one, and two moras. Preference for a trimoraic representation may require additional computation in the form of a further condition on mora quantity, if it is not assumed that weight is calculated by simple mora count

a similar role where the mid vowel in the first syllable /no/ attracts stress over the high vowel in the second syllable /ʃi/. This can result in a stress clash as in (28c), where the first foot is parsed as iambic because the first syllable /pi/ has a less sonorant vowel than the second syllable /po/, resulting in the default iambic pattern. The second foot however stresses /ka/ over /kse/, resulting in a stress clash, a trochaic foot, and even violates the ban on final feet in a prosodic word. This indicates that when weight (and open/closedness) are equal, stress calculation in Nanti is sensitive to vowel sonority, prioritized over constraints such as stress clash, the default iambic stress pattern, and non-finality of feet within a prosodic word.

These vowel sonority effects on syllabification in Nanti provide a challenge for representational moraicity in MP. This is because all vowels should be similarly specified as underlyingly monomoraic (if short) or bimoraic (if long) within this framework. This sonority effect on stress assignment in Nanti represents necessary mora-extrinsic computation.

Nanti stress appears to be sensitive to whether a syllable has a short monophthongal nucleus, or a light diphthong. The light diphthong discussed in Crowhurst and Michael (2005) is /ɯi/). The example (28d) shows that when all other things are equal /a/ > /ɯi/. On the other hand (28f,g) show cases where /o/ receives stress over /ɯi/ and vice versa, indicating that /o/ = /ɯi/. Crowhurst and Michael (2005) then assume that if /o/ = /ɯi/, it follows that also /ɯi/ > i (because /o/ > /i/). The same argument can be used for /e/. The final scale would then be /a/ » /o/, /ɯi/ » /e/, /i/.

(28) Influence of sonority and diphthongs on Nanti stress (Crowhurst and Michael 2005)

a. (à.wo)(te.hái).gʒi].ri	‘we approached him/them’
b. (nò.ʃi)(po.ká).kse].ro	‘we will have said’
c. (pi.pò)(ká.kse)].na	‘you came to me’
d. (jà.mɯi)(ta.kói).ga.kse].na	‘they helped us with something else’
f. (nò.tɯi)(já.kse)].ro	‘I knocked it over’
g. (no.tɯí).je].ro	‘I will knock it over’

This sonority data cannot be accounted for within MP without additional mechanisms to assess sonority. Furthermore, if light diphthongs are indeed heavier than monophthongs of the same vowel quality (e.g. /ɯi/ » /i/) in Nanti, this causes additional problems for MP analyses as there should be no moraic difference between the two. Stress calculation in Nanti therefore must include some mora-extrinsic computation, whether that be related to sonority or segmental/skeletal/root node structure (diphthong vs monophthong) or both. To account for the sonority effect Crowhurst and Michael (2005) propose a vowel quality scale under which there are constraints against high, mid, and low vowels. They propose one such scale at the foot level (29a) and one at the prosodic word level (29b) for secondary and primary stresses respectively. Their diphthong scale of constraints is similarly segmented in (29c,d). The coda scale (29e) consists of one constraint that bans non-branching [-consonantal] nodes (i.e. *CV), and another that effectively bans peaks without a coda. The final scale proposed (29f) is a quantity scale using mora, consisting of two constraints, one of which bans monomoraic peaks and the other which bans bimoraic peaks.

(29) Crowhurst and Michael (2005) scales/constraints

a. Sonority scale (feet)	[*P(ft)/Hi » *P(ft)/Mid » *P(ft)/Lo]
b. Sonority scale (prosodic word)	[*P(pw)/Hi » *P(pw)/Mid » *P(pw)/Lo]
c. Diphthong scale (feet)	[*P(ft)/Mon » *P(ft)/Diph]
d. Diphthong scale (prosodic word)	[*P(wd)/Mon » *P(wd)/Diph]
e. Coda scale	[*P(ft)/Mon » *P/VC-μ]
f. Weight/mora scale	[*P/$\sigma\mu$ » *P/$\sigma\mu\mu$]

As previously stated, the goal of the constraint scales I propose in (12) in section 2 is to generalize the Crowhurst and Michael (2005) constraint scales in (29) and to do so without utilizing mora. The Crowhurst and Michael (2005) sonority scales at both the foot and prosodic word level are necessary to account for Nanti stress data, but the three-level low/mid/high distinction prevents the analysis from extending to languages with more or less fine-grained sonority behavior. That is why I adopt the form of Prince (1993) *P constraints, which are gradient over the set of all segments and apply only at the syllable level, and propose similar constraints that function at the foot and prosodic word levels of the prosodic hierarchy. My length scale replaces the mora/weight scales of Crowhurst and Michael (2005) and additionally accounts for the Nanti diphthong behavior.

Concerning the Crowhurst and Michael (2005) coda scale, I choose instead to propose constraints which can be independently ranked and which value closed syllables (whether with a singleton or geminate coda) for stress assignment. This is because the preference for stressing closed syllables does not appear to be a universal behavior, and therefore is not indicative of a universal hierarchy in the same way that sonority is. This allows one to account for the spectrum of behavior between languages where closed syllables with singleton or geminate codas attract stress/are considered heavy via a high ranking of the coda constraints, while also allowing differential ranking of the constraints to account for languages in which geminates or singleton closed syllables are valued over one another, or in which closed syllables are not favored for stress.

I will now show that Nanti stress data can be accounted for using the constraints and scales proposed in (12). For a full analysis of Nanti from base principles, including foot structure and parsing, look to Crowhurst and Michael (2005). I assume their analysis of Nanti foot structure (e.g. align-L(ft,wd), no prosodic word final feet) and concern this analysis primarily with the application of stress patterns within the existing proposed foot structure. In addition to the constraints listed in the Analysis section (2), I include the two constraints from Crowhurst and Michael (2005) listed below. The full ranking of Nanti constraints is given at the end of the section.

(30) General constraints on foot structure

a. Clash - Avoid stress on adjacent syllables.

b. MSR - Align the foot containing primary stress with the right edge of the prosodic word.

The vowel in each parsed foot in the word (o.ko)(wo.go).te].ro/ below is /o/, so no sonority effects will be observable for this word. Instead, word-level constraints dominate. Violation of Clash eliminates (e.) as a candidate. For the other candidates, MSR and Iambic determine that the output is in the default iambic stress pattern. The square brackets indicate the boundary of the prosodic word.

(31)

o.ko.wo.go.te.ro	Clash	MSR	Iambic
☞a. (o.kò)(wo.gó).te].ro		*	
b. (ò.ko)(wo.gó).te].ro		*	*!
c. (o.kó)(wo.gò).te].ro		***!	
d. (ò.ko)(wó.go).te].ro		**!	**
e. (o.kò)(wó.go).te].ro	*!		

In (no.ko)(ga.ko).ta].ro there is a vowel quality difference in the second foot (ga.ko). Stress on the output candidate is realized on the lower vowel in the second foot, resulting in (gá.ko), despite this violating the iambic stress pattern. Therefore the relevant vowel quality constraint (here *P(ft)/o) must be ranked higher than Iambic. The constraint evaluates all stressed syllables/foot peaks. This means that even when stressed as (gá.ko), as it indeed is in the correct output, the other feet of the word can contribute violations to the same constraint if they contain a stressed /o/. In comparison, the *P(wd) constraints evaluate only the word-level/primary stress. *P(ft)/a is ranked below these constraints and thus does no work in the language. This is because /a/ is the lowest sonority segment in Nanti. This predicts that when sonority is relevant /a/ will never be disfavored over another segment.

(32)

no.ko.ga.ko.ta.ro	*P(ft)/o	Clash	MSR	Iambic
☞a. (nò.ko)(gá.ko).ta].ro	*		**	**
b. (nó.ko)(gà.ko).ta].ro	*		****!	**
c. (no.kò)(gá.ko).ta].ro	*	*!	**	*
d. (no.kò)(ga.kó).ta].ro	**!		*	
e. (nò.ko)(ga.kó).ta].ro	**!		*	*

In (o.sa)(raan.tai).ga.kse] below, there is a vowel quality difference between the syllables of the first foot, and a length difference between those in the second foot. Although this requires a complex interplay of constraint scales, ultimately the deciding constraints are CodaPeak, *P(ft)/o, and MSR. *P(ft)/o causes the lower vowel /a/ in the first foot to attract stress, and MSR prevents that from being the main stress of the word. Stress being located on /raan/ or /tai/ is determined by CodaPeak, which favors closed syllables for stress. If /raan/ were an open syllable, then *P(ft)/1Root2Pl would be the deciding constraint, which would favor long vowels over short diphthongs[6].

(33)

o.sa.raan.tai.ga.kse	CodaPeak	*P(ft)/o	*P(ft)/1Root2Pl	MSR
☞a. (o.sà)(ráan.tai).ga.kse]	*			***
b. (o.sá)(ràan.tai).ga.kse]	*			****!
c. (ò.sa)(ráan.tai).ga.kse]	*	*!		***
d. (o.sà)(raan.tái).ga.kse]	**!		*	**

In (i.ka)(man.tai).ga.kse].na the first foot again has a vowel quality difference, and the second foot has a difference in length and closedness of the syllable. Here, the high ranking *P(ft)/1Root prefers syllables with nuclei that are either long vowels (or long diphthongs) or short diphthongs. Because (man) contains a short monophthongal nucleus, it violates this constraint and (tai) is preferred. If the nuclei of the syllables in the second foot were both long vowels or were both diphthongs, then this constraint could not decide between stress targets in that foot, and instead CodaPeak would decide. This can be seen as the interplay between the length scales and the preference for closed syllables.

(34)

i.ka.man.tai.ga.kse.na	*P(ft)/1Root	*P(ft)/i	CodaPeak	MSR
☞a. (i.kà)(man.tái).ga.kse].na	*		**	
b. (i.ká)(man.tài).ga.kse].na	*		**	*!
c. (ì.ka)(man.tái).ga.kse].na	*	*!	**	
d. (i.kà)(mán.tai).ga.kse].na	**!		*	
e. (ì.ka)(mán.tai).ga.kse].na	**!	*	*	

In contrast, each footed syllable in (i.ri)(no.ri).je] is open and the same length. Here, only the sonority scale and default word-level stress constraints should apply. Additionally, the difference between the foot and prosodic word level constraints can be seen here, where the foot level constraint assigns violations for each stressed /i/, and the prosodic word level constraint assigns violations

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[6] Alternatively, if /ai/ is a long diphthong, then /raan/ would still receive stress due to the vowel quality difference, exemplified by the constraint *P(ft)/i.

only to an /i/ that receives word-level/main stress. Due to the more marked nature of /i/ compared to /o/, reflected by higher ranking constraints banning stressed /i/ (namely *P(ft)/i and *P(wd)/i), the main comparison falls between the candidates which both stress /o/. The constraint Clash then decides the output form. If not for stress clash, then each candidate would be considered equal for MSR, and the incorrect candidate (b.) would be decided by Iambic, as it only violates the iambic stress pattern once, in comparison.

(35)

i.ri.no.ri.je	*P(ft)/i	*P(pw)/i	Clash
☞a. (ì.ri)(nó.ri).je]	*		
b. (i.rì)(nó.ri).je]	*		*!
c. (í.ri)(nò.ri).je]	*	*!	
d. (ì.ri)(no.rí).je]	**!	*	
e. (i.rì)(no.rí).je]	**!	*	

Below in (36) is the full constraint list, excluding foot-building/foot-structure constraints which I adopt entirely from Crowhurst and Michael (2005). Each level is ranked with respect to one another, but the constraints within each level are unranked. Each ranked scale can be observed in this constraint ranking. For example, based on (12) the length scale should be realized by the following ranking of constraints: [*P(ft)/1Root » *P(ft)/1Root2Pl » *P(ft)/2Root]. These constraints are ordered in exactly this way in the below hierarchy, interspersed with other constraints and scales. The sonority scale, of form [*P(ft)/ζ » ... » *P(ft)/α], shows the same logic, whereby each *P(ft) constraint is ranked by sonority, with constraints on lower sonority segments ranked higher. The constraints included in this analysis are the vowels in the phonological inventory of Nanti. The scale itself should theoretically be comprised of a list all segments from all languages, but I only display the constraints referring to segments in the inventory of the relevant language. Every constraint on the sonority scale that is more marked than those presented here (e.g. all those that refer to consonants) are presumed to be high ranking in this language, preventing nuclei containing those segments from receiving stress.

The constraints in level 7 were not found relevant to any distinction in Nanti, but it may be the case that they are simply low ranked enough to not affect Nanti stress patterns. This is because the *P(pw) constraints of level 7 are the two lowest/most sonorant vowels in the inventory, and are thus predicted to be ranked lower than the other sonority constraints. *P(pw)/o is predicted to be ranked higher than *P(pw)/a, but in the absence of stimuli which make this distinction they are placed together at the bottom of the ranking. Likewise, *P(ft)/2Root is predicted to be low-ranking, at least below *P(ft)/1Root2Pl. While *P(ft)/2Root does not appear relevant in Nanti, the position of the constraint at the bottom of the hierarchy is predicted by its position in the length scale. Lastly, There are no geminates in Nanti, so the ranking of GemPeak at the bottom of the hierarchy also follows.

(36) Full constraint hierarchy

- a. Level 1
  - i. *P(ft)/1Root
- b. Level 2
  - i. *P(ft)/i, *P(pw)/i
- c. Level 3
  - i. CodaPeak, *P(ft)/e, *P(pw)/e
- d. Level 4
  - i. *P(ft)/o
- e. Level 5
  - i. Clash, *P(ft)/a, *P(ft)/1Root2Pl, MSR
- f. Level 6
  - i. Iambic
- g. Level 7
  - i. *P(pw)/o, *P(pw)/a, *P(ft)/2Root, GemPeak

CHAPTER 3

DISCUSSION

I have examined stress assignment in several languages and found that reference to moras was unnecessary in accounting for their behavior. If this proves to be a larger trend in stress computation, tone assignment, or still other phenomena, then it may prove worthwhile to narrow down the scope of the mora to those in which moras are necessary. Further research is essential to determine the extent to which this holds for stress systems in other languages, and for other phenomena that are typically analyzed using the mora. Regardless, the move towards computation of moraicity – whether via the licensing of mora based on mora-extrinsic information or via computation of the same mora-extrinsic information alone – proves necessary and advantageous over strictly representational accounts.

It may be the case that the computation of moras is necessary and even preferable, especially in explaining templatic and prosodic structure phenomena. However, it is also the case that the conflation of the mora with such a wide variety of linguistic processes results in moraic mismatches and incorrect predictions in many languages. These problems are not rare. In a survey of ~400 languages, Gordon (2002) found that of the languages with tone, a slight majority of them (25/49) treat CVS (S = sonorant) as heavy for tone assignment. But only 3 languages treat CVS as heavy for stress (3/78) and only 2 languages treat CVS as heavy for templatic processes (2/55). The conclusion that Gordon draws is that stress and tone are often process-sensitive in a way that is not captured in representational theories of weight.

Paramore (2025) presents a similar argument against these same MP accounts of weight phenomena. He refers to these standard moraic accounts that assume language-specificity of moraic representations as the 'variable-weight approach.' Under a variable-weight approach if a coda segment is found to be moraic for stress, for example, then it will be considered moraic for all processes in that language. This type of moraic account is untenable with regards to the overwhelming evidence of frequent moraic mismatches within the same languages. In light of similar evidence presented in this paper against the necessity of representational mora, Paramore (2025) instead suggests that all codas are universally moraic. Crucially, in his framework each phenomena in a given language (e.g. stress, tone, CL, etc.) can target moras in differentially, as opposed to variable-weight accounts that suggest moraicity is universal in a language regardless of the given phenomenon. In his account, which like the present paper also examines only stress assignment, the mora itself is assigned the sonority information of the segments that it dominates. Crucially, only three sonority values are encoded, which exist as a sonority scale. The scale is comprised of vocalic, sonorant, and obstruent levels. A mora dominating a vowel will be represented as a vocalic mora – μ_V. A mora dominating a sonorant (coda) consonant will be assigned a sonorant mora – μ_R. And a mora dominating an obstruent (coda) consonant will be assigned an obstruent mora – μ_O. Constraints are then proposed that can act on these moras at different sonority thresholds. The constraint $S \rightarrow [\mu\mu]_\sigma$ targets any mora, obstruent, sonorant, or vocalic. This is representative of a process in a language which values syllables with long vowels (CVː) and syllables with sonorant or obstruent codas (CVR, CVO) as heavy. Two further constraints are proposed: $S \rightarrow [\mu_R\mu_R]_\sigma$ and $S \rightarrow [\mu_V\mu_V]_\sigma$, which target both sonorant and vocalic moras, or just vocalic moras, respectively. Thus with $S \rightarrow [\mu_R\mu_R]_\sigma$, languages that treat CVː and CVR as heavier than CVO and CV can be accounted for, while a high-ranking $S \rightarrow [\mu_V\mu_V]_\sigma$ constraint can account for languages in which only CVː patterns as heavy and CVR, CVO, and CV all pattern as light.

While Paramore (2025) suggests that vowel quality is not used in syllable weight distinctions, this analysis cannot account for languages like Nanti in which vowel sonority effects on stress have been attested. Even if it is the case that all languages with the appearance of vowel quality effects on weight can be analyzed without reference to vowel quality, there are independent reasons that suggest the presence of gradient sonority effects (not limited strictly to obstruent, sonorant, and vocalic). For example, the Prince (1993) proposal of Basic and Encapsulated Syllable Theories, which introduce a gradient sonority scale in order to account for languages such as Tashlhiyt Berber in which sonority computation at the syllable level is strictly necessary. If gradient sonority computation is necessary for syllabification, and therefore necessary for processes such as mora assignment (computation), then it would be theoretically simpler to extend the already posited gradient sonority scale rather than propose a separate scale for distinct levels of the prosodic hierarchy.

Furthermore, this specific instantiation of constraints which target syllables with two moras (of the same quality threshold) necessarily conflates the vowel and coda, and the sonority scale presented predicts that there will be no cases in any language in which CVO pattern as heavier than CVR (or CVː). Although Ngalakgan, described above, presents just such a pattern. CVː and CVO pattern as heavier than CVG and CVR. While this may be analyzed as representative of a constraint on placelessness, this pattern should not be possible in the Paramore (2025) account, which suggests that only moraicity and sonority enter the calculation for stress assignment in every language.

Finally, the proposal that all codas are moraic runs into the issue that geminates must still be differentiated from singletons representationally. This is resolved in Paramore (2025) by suggesting that geminates are underlyingly bimoraic, in contrast to standard MP accounts. This results in the theory bearing more similarity to x-slot theory, in which geminate consonants and vowels are assigned to two timing slots and singletons to one. The biggest difference between this instantiation of MP and x-slot theory is that onsets in MP are not assigned moras by stipulation, but onsets in x-slot theory are still assigned a timing slot. With a similar stipulation on x-slot theory – that onsets are not assigned timing slots (or perhaps that onsets are ignored by various processes) – the frameworks become largely identical with regards to predictions of weight for geminates/singletons and long/short vowels. The argument that Paramore (2025) presents in favor of their moraic account is that moras are typically considered necessary to account for CL in a variety of languages. There is no argument presented for stress assignment that requires or favors their proposed process-specific moraic framework over x-slot theory. While it is true that CL analyses are much more reliant on the mora as a unit of analysis, moraic analyses of CL phenomena are not entirely without issue.

Moras have proved to be a valuable tool of analysis for CL. Although, issues have been raised concerning the historical evidence used to argue for MP over other representational frameworks. Samothraki Greek is one such example, where issues with the Hayes analysis have been pointed out by Topintzi (2006) and Kiparsky (2011), both of whom still maintain moraic representations. Another example is found in Noske (2023), who presents an argument against the moraic analysis of Middle English CL by illustrating that the same primary sources on the Middle English data used by Hayes (1989) actually contradict his moraic analysis – namely Minkova (1982) and Minkova (1985). Furthermore, alternative analyses of CL which do not rely upon moraic representations have been proposed. While CL is typically considered a mora-conservation process, others have suggested that CL is instead related to the conservation of root nodes (Campos-Astorkiza 2003) and/or conservation of *position* (Topintzi 2006). Other nonmoraic analyses exist, such as that of Kavitskaya (2002) – which is largely concerned with presenting evidence of the incorrect predictions of moraic conservation accounts of CL by examining and comparing both synchronic and diachronic examples of the phenomenon, and proposes a phonologization account. Each of these analyses show that it is possible to account for CL within a nonmoraic representational framework[1]. Once you can account for CL effects without reference to the mora, then one should be skeptical of CL analyzed as moraic without clear justification for the need for moras in the analysis.

The assumptions concerning root nodes in the present analysis result in some problems which must be addressed. First, theories of root nodes concerning timing and/or syllabification (McCarthy 1988; Selkirk 1990) are not very specific as to the way in which root nodes are syllabified and associated with prosodic structure. It is not clear what exact process drives given root nodes in the UR to associate with the onset, nucleus, or coda positions. This leads to an overgeneration problem, as syllabification is not sufficiently constrained. Will a geminate consonant have one root node associated with the coda position of the first syllable in a bisyllabic word, while the second root node is associated with the onset of the second syllable, as is typical in MP? And if so, why do geminates typically give weight to the first syllable and not the second? Do they instead have both root nodes

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[1] Although Campos-Astorkiza (2003) utilizes a few constraints which refer to moras, these can each be easily adjusted to remove all reference to moraic representations. For example, they utilize the constraint $*3\mu - N$, which is described as "no sequence of three moras in the nucleus," and later use a constraint on consonants in the analysis of Piro onset clusters *CCC or "do not have more than three consonants in a cluster." The constraint on moraic quantity in the nucleus could be reformatted to target three consecutive vowels in a similar fashion to the consonant constraint. Although this may be unsatisfying in that vowel and consonant effects are separated into separate constraints, assumption of moraic representations requires a similar separation in this case as onsets are stipulated as nonmoraic (hence the reason Campos-Astorkiza (2003) did not refer to moras in *CCC).

linked to coda position of the first syllable when the first syllable receives weight, and both linked to onset position of the second syllable when that syllable receives weight? If so, we should expect that syllables with geminate codas/onsets should be categorically heavier than syllables with singleton codas/onsets – all else remaining equal. It's possible that if geminates in onset position contribute weight to that syllable (e.g. if deletion of the onset geminate results in CL) that the infrequency of geminates contributing weight to onsets can be derived from the preference for onset clusters to contain a difference in sonority (generally a sonority rise). Geminates would constitute a sonority plateau. This would predict a pattern concerning the languages that allow sonority plateaus in onset clusters and those that allow onset geminates. Though this does not account for the infrequency of CL resulting from deletion of a singleton onset. Making syllabification of root node representations more explicit may help to alleviate some of these issues.

Second, assumption of root node representations dispenses with autosegmental representations of length, but in so doing, conflates length with the segment to some degree. This is not 1-to-1, as phonological length distinctions can be implemented by proposing that long vowels/geminates have two root nodes while short vowels/singletons have one, though this results in similarity to x-slot theory in terms of the predictions made about the amount of weight contributed to a syllable. It is also similar to the Paramore (2025) instantiation of MP, in that geminates are bimoraic and singletons monomoraic in their account. One can view the aforementioned weight pattern in contrast to standard variable-weight instantiations of MP, which suggests geminates are monomoraic and singletons nonmoraic. Research should be conducted as to which of these is preferable.

Lastly, it's not clear how to account for the variety of templatic phenomena in a straightforward way. In semitic root-based morphology wherein a set of consonants form the root of the word with apparent epenthesis/infixation there are a couple alternatives. Perhaps the URs contain just the consonantal roots, and vocalic roots are inserted by rule. Alternatively, perhaps every root node is present in the UR and vowel alternations can be analyzed as part of a complex ablaut system. Other types of templatic phenomena such as onomatopoeia or diminutive templates in Japanese also present fairly unsatisfactory answers. Why can the diminutive form – typically considered a bimoraic template – of the name Mariko with the suffix [ʨaɴ] take the forms: [maɾi-ʨaɴ], [ɾiko-ʨaɴ], [mako-ʨaɴ], [maː-ʨaɴ] (Itô 1990), and [maʨ-ʨaɴ]? For MP, each form simply consists of two bimoraic feet. With root nodes, [maɾi-ʨaɴ] for example is composed of four and then three root nodes, while [maː-ʨaɴ] is three and three. It can't be vowel count which determines the possible forms either, as that also differs between stimuli. Assumption of root node representations alone will not give satisfactory answers on this phenomenon in the same way that assumption of moraic representations does; computation of acceptable forms as resultant from the interplay of separate scales/constraints will be necessary. It's not clear if a computational account can maintain the same natural analysis that moraic representations allow, however.

While there are certainly holes in the predictions of nonmoraic root node presentations, root node theories have not benefited from upwards of three decades of continued use and rigorous research as MP has. Nevertheless, further adaptations of MP consistently erode the predictions of moraic representations and place more and more responsibility on the computation of mora-extrinsic factors. Even proposals that push moraic representation further than in Hayes (1986) by suggesting all codas are moraic (Paramore 2025) require mora-extrinsic (i.e. at least sonority) process-specific (e.g. tone, stress, CL, etc.) computation, and further weaken the predictions of MP by positing representations that are reminiscent of those proposed in x-slot theory. If process-specific computation and the amendment of moraic representations is considered necessary to account for the variety of moraic mismatches, and doing so brings MP closer to alternative nonmoraic autosegmental representational frameworks and weakens the representational predictions of MP, the question becomes: what value do strictly moraic theories of representation provide?

Even in standard "variable-weight accounts" of MP, extensions of the theory are necessary to account for the behavior of many phenomena across languages. Section 1.2 contains a few examples of this. Crowhurst and Michael (2005) further shows that there are languages which require additional computation (i.e. of sonority, of diphthong/monophthong contrast, and of closed/open syllables) even when assuming moraic representations. Building on their analysis, I have shown that those proposed types of necessary additional computation are sufficient to account for stress phenomena in several languages even without reference to moras. Additional evidence that process-specific computation appears necessary even in moraic frameworks can be found in the prevalence of moraic mismatches cross-linguistically. If the computation of several types of mora-extrinsic information is necessary to account for stress behavior, and this additional computation alone proves sufficient to do so, one must question the necessity and preferability of moraic analyses of stress. A computational account which does not reference moras constitutes a more simple analysis than an account which maintains moraic representations while requiring the same computation of mora-extrinsic information.

CHAPTER 4

CONCLUSION

The pendulum of relative importance placed on representation and computation appears to be swinging back towards computation, even in theories of representation. Prior analyses which maintain the representational tenets of MP necessarily weaken the predictions of the theory. Mora-extrinsic computation is necessary, the only question is to what degree. It is clear, for example, that the sonority scale is relevant to the stress and tone patterns of many languages, and this fact is not explained by MP. The present analysis accounts for stress data which has proven difficult to explain within MP, and does so without reference to moras – neither representationally defined nor computationally derived. It is not my desire to assert that the present analysis of these languages is correct and prior analyses of these languages are not. Instead, I seek to suggest that moras are unnecessary to account for the stress patterns of several languages, and call for re-examination of the domains in which moras have historically proven useful (e.g. stress, tone, compensatory lengthening, templatic morphology, etc.) in order to determine if moras are *necessary* or *preferable* to alternative analyses in each domain. This re-examination need not use the constraints and scales proposed here, nor even be conducted within OT. Alternative computational methodologies such as those utilized within Gordon (2002) and Hayes and Wilson (2008) may prove more phonetically grounded avenues towards the same goal.

A large portion of the motivation behind representational mora and MP as a whole are compensatory lengthening effects (Hayes 1989), and the mora has been very successfully used in order to account for CL in many languages. However, much of the CL data used in the original argumentation for MP has been called into question, and CL in many languages can be analyzed without any reference to moras. There may be languages in which moras are necessary to account for CL. It is especially unclear how to account for long-distance compensatory lengthening effects, for example in Estonian and other Uralic languages (Borgeson 2022), without reference to moras. The fact that assumption of moraic representations leads to incorrect predictions regarding CL in many languages (e.g. onset deletion resulting in CL, and moraic mismatches), however, indicates that further examination of CL and other processes for which the mora is proposed as the locus may be necessary.

This is not just a problem with autosegmental moraic analyses. In 2006 a survey of the journals Phonology, Linguistic Inquiry, Language, and Natural Language & Linguistic Theory, found 129 constraints that refer to moras (Ashley et al. 2010). In the 2021 edition of OTSoft there are 140 total constraints that refer to moras (Hayes, Tesar, and Zuraw 2013). Some of these (e.g. faithfulness constraints) assume moraic representations in the UR. Many OT analyses often assume some degree of moraic representation, even as an intermediary step wherein moras are assigned by computation over sonority values (or other information). Yet, it is not clear if moras offer true explanatory value or if weight computation alone can account for the variety of weight behavior cross-linguistically, while moras continue to be used as a form of theoretical residue from prior work in the field.

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