PROSODIC RECURSION AND SYNTACTIC CYCLICITY INSIDE THE WORD

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Abstract of the dissertation

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by

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This dissertation proposes a model of the syntax-phonology interface within the word; in this model, morphosyntax is cyclic but phonology is parallel. Words that span multiple phases (Chomsky 2000, 2001, Marantz 2001) are transferred from syntax to phonology ("spelled out") multiple times. The spelled out material is evaluated by a parallel Optimality Theory grammar (OT; Prince and Smolensky 1993/2004), which builds output prosodic structure. The cyclic syntax-parallel phonology model predicts that transferring words from syntax to phonology over multiple phases results in **recursion of Phonological Words** (PWds) in some languages. In these languages, prosodic recursion reflects cyclic word construction.

Chapters Two and Three provide support for this prediction from the morphosyntactic and phonological structures of two unrelated, endangered North American languages, Chukchansi Yokuts and Creek (also known as Muskogee or Seminole). Based on firsthand fieldwork, Chapter Two explores a syntactic contrast in Chukchansi between verbs spelled out over two phases and verbs spelled out over one phase. Chukchansi illustrates the prediction of the cyclic syntax-parallel phonology model: biphasal verbs display PWd recursion, while monophasal verbs do not. In

combination with Chukchansi prosodic patterns, syntactically-motivated PWd recursion accounts for a complicated pattern of templatic morphology typical of Yokuts languages.

Chapter Three refines the model by investigating biphasal verbs in Creek, which also have PWd recursion. Creek verbs show different types of mismatches between syntactic and prosodic constituents, which necessitates a revision to the constraints of Match Theory (Selkirk 2009, 2011). These mismatches support the parallel phonology part of the model in two ways: the syntax-prosody mapping must occur in parallel with autosegmental docking, and the outputs of all syntactic phases are evaluated by the phonology in parallel (Cheng and Downing 2012, 2016).

Chapter Four extends the cyclic syntax-parallel phonology model to languages without PWd recursion. This chapter clarifies the precise structure of the input representation of multiphasal verbs, and then examines the factorial typology produced from this input and the constraints discussed in the previous chapters. The typology includes languages with different recursive PWd structures, as well as languages without any PWd recursion at all. The predicted typology of prosodic structures of multiphasal words closely matches the attested range of language variation.

This dissertation brings together insights from several theories in multiple sub-fields of linguistics, including Phase Theory, the Copy Theory of Movement, Distributed Morphology and Match Theory. The analyses provide evidence in favor of several specific proposals in these theories, such as phase extension (den Dikken 2007, Gallego 2010, Bošković 2014) and the influence of phonology on the syntax-prosody mapping (Selkirk 2011, Elfner 2012). The cyclic syntax-parallel phonology model provides a tool for assessing the claims of one sub-field using evidence from another sub-field. The prosodic organization of a word can provide insight into its phasal derivation; conversely, the morphosyntactic structure of a word can shed light on the complex prosodic structure it displays.

ACKNOWLEDGMENTS

I'm going to start this acknowledgments section off with a disclaimer: I'm mentally exhausted from months of writing and years of research, so this section is going to be somewhat stream-of-consciousness rambling. I promise to do my best to at least mention most of you here, but if you're reading this and wondering why I neglected to acknowledge your contribution to this work, be assured that it is an omission on the page but not on the heart or mind. And to you, dear reader, bear with me for these few pages—always the first part of a dissertation I read, and invariably the most enjoyable—and don't mind the meandering thoughts. I pledge that the rest of the dissertation is at least four times as coherent and one-fifth as fun to read. With the disclaimer in place, here's some crucial thanks.

"Thanks" is too small a word for what Karen Jesney has done in her role as my adviser. Karen has been involved in every step of my journey from lowly first-year PhD student to the completion of a dissertation. She has greatly improved every single one of my arguments on the phonological side, and pointed out the many holes and stumblings on the way. She has tirelessly edited reams of my writing, and often reminded me to keep the reader's perspective in mind. I cannot count the times that I've come to her freaking out or feeling lost, and every single time she has put me back on my path and restored my spirits. Moreover, she has helped me out in countless other ways, some of which go far beyond the job description of a PhD adviser. Karen, I don't know what I'm going without you as adviser, but I am pretty certain I'll still bug you with email—hopefully not too constantly!

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Rachel should seriously write an advice column for linguistics PhD students. Roumi Pancheva has single-handedly taught me almost everything I know about aspectual structure, and most of this was outside the classroom. Roumi has both inspired all the good ideas I've had in my aspect research and helped keep these ideas from floating off into the clouds. Maria Luisa Zubizarreta has always kept me focused on the big picture of my work and helped me to persuasively communicate its relevance. And Mario Saltarelli has been a delight to talk to—who knew that the fundamental ideas of Minimalism have theoretical analogues in physics and chemistry? Thank you to all of you for making my arguments stronger, my writing clearer, and my mind calmer.

Just as it takes a village to raise a child, it takes a department to raise a PhD student. And, in my case, it takes a department to watch a small child while his dad, i.e., me, teaches and presents. I can confidently assert that I have enjoyed every single course I've taken at USC, and that I appreciate all of the faculty here. Special thanks go to Khalil Iskarous, who has been so involved in my research from day one that it's a shock he isn't on my committee. I owe a great deal to Hagit Borer, Louis Goldstein, Elena Guerzoni, Hajime Hoji, Elsi Kaiser, Audrey Li, Andrew Simpson, and Barry Schein for giving me a broad knowledge base in linguistics and making me a well-rounded scholar. Thanks go to Frankie Hayduk and Guillermo Ruiz for their invaluable help over the years keeping my paperwork organized. And, of course, a huge "Fight On!" to Brandon Washington, who has been a rock, a mentor, a friend, and most of all a role model for how to be a good human being and father.

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A big thank you goes to Holly Wyatt, her sister Jane, and her whole family for welcoming me to the Chukchansi language and people. Holly, your dedication to and knowledge of your mother tongue is as inspiring as it is vital. Your patience with years of my pesky linguistic questions is more than admirable. My work on Chukchansi is indebted to you; I only hope to repay you in some small way with this research. Also, thanks for always being "mich' bich'ich'!" "Ma'alo'" to my SaySiyat Mama' 'Oemaw a 'Oebay Tawtawazay (a.k.a, Chao Shan-He), for teaching me your tongue, and to all the SaySiyat people I have had the pleasure of meeting and talking to. And thank you to the Graduate School at USC for funding my fieldwork with a Research Enhancement Fellowship, without with my research would not be nearly as developed.

Okay, I've rambled on much too long, and I need to wrap this up. Thanks to my friends in Fresno, Los Angeles, Annapolis, and all over the dang globe. Thanks to my family for being there no matter what, for the memories, the hugs, the food—OH, the food!—and, perhaps most relevantly, for letting me ask you for grammatical intuitions on Armenian. I love doing fieldwork on my family! Thank you to all my aunties and uncles, and especially to Auntie Gassia for giving me that last bit of confidence and support at the end. Thank you to my grandparents for coming halfway across the globe in search of a better life, and for being a bridge to my Armenian roots. To my dad, Ara, and my mom, Vivy, thank you for your support, your encouragement, and your real talk; I hope I'm doing you proud. To my sister, Madeleine: I hope graduate school and research will be as fruitful and fulfilling for you as it has been for me.

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To my children, Frannie, Zekiel, and whoever may come, this dissertation is dedicated to you. You are the reason I do this. I hope I inspire you to do even greater things.

Table of Contents

1. Introduction

1.1. Overview

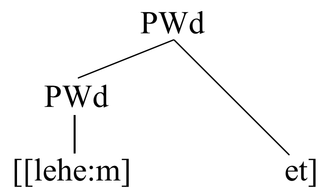
This dissertation explores the relationship between the morphosyntactic structure of words and their phonological form; specifically, how the phonology of words reflects their structural derivation. A fruitful avenue of morphological research posits that words are built from the root outward in a series of distinct cycles, similar to the cycles of the syntactic derivation of sentences, known as phases (Chomsky 2000, 2001). In a model like Distributed Morphology (DM; Halle and Marantz 1993) where words are built by the same syntactic principles as sentences, the morphological derivation also proceeds in phases (Marantz 2001). As syntax transfers material to phonology at each phase, morphological derivation in the syntax predicts that phonological structure is sensitive to phases. In this dissertation, I propose and defend the thesis that, in several unrelated languages, phonology reflects phasal morphological derivation by recursion of Prosodic Words (PWds). In these languages, **syntactic cyclicity inside words** results in **prosodic recursion**.

Throughout this dissertation, I marshal evidence that in some languages, (1) a morphologically complex word contains an internal chunk that is a cohesive phonological unit, (2) this phonological unit is best modeled as an internal PWd in a recursive structure, and (3) the internal PWd corresponds closely to an internal morphological cycle, or more specifically, a syntactic phase. For example, in Chukchansi Yokuts (Penutian: California), the root /lihm/ 'run' appears with a fixed CVCV:C shape with the causative suffix /-e-/ (1).

(1)	/lihm	e	(i)t/	→ [<u>**lehe:m**</u>-e-t]
	'run'	CAUSATIVE	RECENT.PAST	
	"just made X run"			(personal fieldwork)

I argue in **Chapter Two** that the fixed CVCV:C shape is an internal PWd in a recursive structure (2). The fixed shape is due to general prosodic properties of Chukchansi, namely disyllabic PWd minimality and iambic stress.

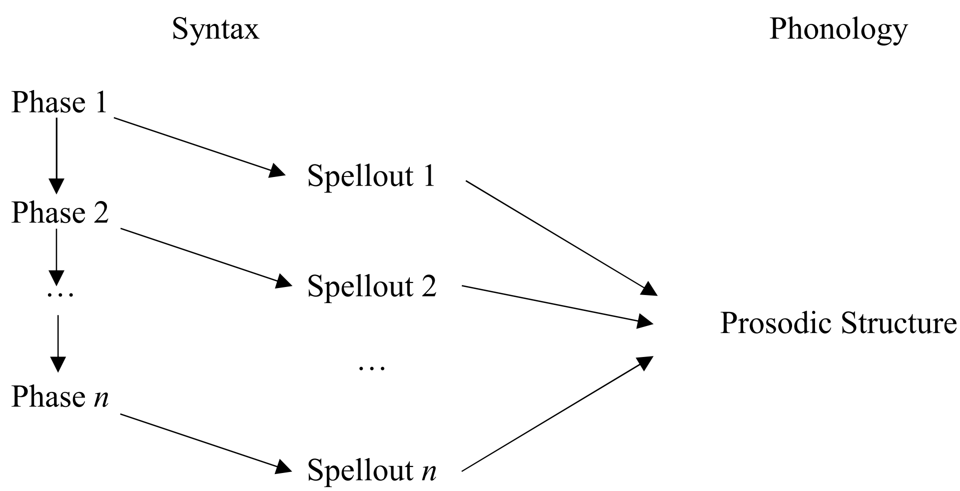
(2)



In (1), the causative suffix /-e-/ is the phonological exponent of a **phase head** in the syntax, which sends the material it merges with, i.e., the verbalized root 'run' /lihm/ in its complement, to the phonology ("spells it out") in an early phase. I propose that material spelled out in an early phase, like /lihm/, forms an internal PWd in a recursive structure, like $[\text{lehe:m}]_{\text{PWd}}$ in (2) (see e.g., Inkelas 1989, McCarthy and Prince 1993, Selkirk 1995, Truckenbrodt 1995, Itô and Mester 2007, 2009a-b, 2013, Elfner 2012, 2015 and Myrberg 2013 for recursion of prosodic units).

This dissertation argues that the internal PWd is not formed through cyclic interpretation of phonological structure immediately after spellout. Rather, recursive PWds are built in a parallel Optimality Theoretic (OT; Prince and Smolensky 1993/2004) phonological grammar, as an optimal solution to the multiple spellout of material from the syntax. **Chapter Three** shows that syntactic and phonological words in Creek (Muskogean: SE USA; also known as Muskogee or Seminole) can be mismatched due to the interaction of autosegmental docking and foot parsing with the syntax-phonology mapping. This interaction provides evidence that phonology takes all the syntactic constituents transferred in multiple phases and maps them to prosodic constituents in parallel (Cheng and Downing 2012, 2016). A simple one-to-one correspondence between syntactic and phonological cycles (e.g., Samuels 2010, Scheer 2008, 2011) cannot capture this interaction (though see D'Alessandro and Scheer 2015 for an amendment to the purely cyclic model that does not enforce a one-to-one correspondence). (3) illustrates the model defended in this dissertation, in which syntax transfers material to the phonology over multiple cycles, but phonology maps all of the transferred material to prosodic structure at once. Crucially, phonological constraints operate in parallel with the syntax-prosody mapping, which can thus be influenced by phonological information.

(3) Model of Multiple Spellout and Parallel Phonology



The empirical domain investigated in this dissertation is agglutinative and polysynthetic verbs that include aspectual and temporal or modal affixes. These verbs are formed by head movement of the verb root inside *v*P up into the TP domain (Travis 1984), which contains temporal and modal affixes. Since the clause is widely held to have two phases, CP and *v*P (Chomsky 2000, 2001), these verbs span two phases and thus two spellout domains. I show in this dissertation that the phasal structure of these verbs influences their prosodic structure, resulting in PWd recursion when allowed by the phonological grammar.

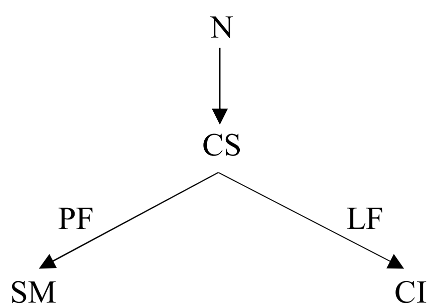
This dissertation makes several contributions to the studies of morphosyntax, phonology, and their interface. First, it provides further evidence that words are built in the same way as sentences: word-internal structure is built in the syntax, spelled out in distinct phases, and mapped to phonological form (e.g., Marvin 2002, Newell 2008, Samuels 2010, Newell and Piggott 2014). It adds to the growing body of work arguing that the syntax-phonology mapping is not an automatic algorithm, but crucially relies on phonological information (e.g., Bošković and Nunes 2007, Wolf 2008, Agbayani, Golston and Ishii 2015, Hsu 2016). Lastly, it shows that **recursion in phonology**, often unexpected or thought to be atypical (e.g., Scheer 2008, Vogel 2009), is actually an optimal way to reflect **cyclicity in syntax**.

The rest of this chapter is organized as follows. §1.2 gives background on the issues relevant to the morphosyntax-phonology interface and situates the positions taken by the dissertation with respect to the field. The relevant issues include the phasal structure of verbs (§1.2.1), the translation of morphosyntactic into phonological representation (§1.2.2), and the Match Theory (Selkirk 2009, 2011) model of syntax-prosody mapping (§1.2.3). §1.3 lays out the proposed model of the morphosyntax-phonology interface inside the word. Specifically, §1.3.1 articulates how morphological material is built in syntax and transferred to phonology, and §1.3.2 how the transferred material is assigned phonological structure. §1.4 overviews the remaining chapters of the dissertation.

1.2. Background: The Morphosyntax-Phonology Interface

This dissertation operates within the inverted Y- or T-model of linguistic computation or structure-building in current Minimalist theory (Chomsky 1993). In this model, a set of items is taken from the mental lexicon (the lexical array or Numeration 'N') as the input to the computational system (CS), also known as narrow syntax. In Distributed Morphology (DM), CS builds the structure of words as well as sentences. CS builds structure by merging two items to create a larger item, either from N ('external merge') or from the current syntactic derivation ('internal merge'). When there are no more items left in the Numeration for external merge and no more uninterpretable features left to motivate internal merge, CS stops and must wait for a new Numeration to begin another cycle. Once CS can no longer merge items in a given cycle, it sends the finished structure to the interfaces with the conceptual-intensional system (CI), which interprets meaning, and the sensory-motor system (SM), which interprets the articulatory and acoustic forms of spoken language (or the visual forms, in signed language). The interfaces between the linguistic structure built by CS and the interpretive systems CI and SM are traditionally known as Logical Form (LF) and Phonetic Form (PF), respectively (4).

(4) Minimalist Model of Linguistic Computation



Current Minimalist theory adopts a cyclic theory of syntactic computation, where syntactic structure is transferred to the interfaces, PF and LF, at points in derivation known as **phases** (Chomsky 2000, 2001, Nissenbaum 2000, Abels 2003; see also Uriagereka 1999, Epstein and Seely 2002 for other models of multiple spellout). Once all uninterpretable features, i.e., morphosyntactic features of lexical items that cannot be read by the CI or SM components, are eliminated, the structure built by CS is transferred to the LF and PF interfaces with CI and SM, respectively. Under the assumption that phase heads are the locus of uninterpretable features (Chomsky 2004), once each phase head has finished eliminating its uninterpretable features, typically through movement of or agreement with other syntactic items, its complement is sent to the LF and PF interfaces, or "spelled out." While some work uses the term "spellout" to mean "assign phonological structure," I use this term in a different way (5).

(5) Spellout: transfer of syntactic material out of narrow syntax (CS) to postsyntactic component (PF). "Spelled out" material retains morphosyntactic representation and provides the input to PF. PF then assigns phonological representation to the spelled out material, i.e., "phonologizes" it.

The PF interface is responsible for phonologization, or translating the morphosyntactic material spelled out by CS into a phonological representation that can be pronounced or heard by the SM component. I take PF to involve formal operations on morphological and phonological features, and SM to be concerned with the actual articulation and perception of phonological material, often called phonetic implementation. While Minimalism seeks to eliminate unnecessary levels of representation and cycles of computation, there is evidence that significant activity happens during the PF branch, i.e., between the transfer out of narrow syntax (CS) and the output phonological representation interpreted by SM. This dissertation provides an answer to both the question about the nature of this PF activity and about the influence of phasal spellout on the output of PF. The model I propose consists of a single phonological derivation that operates on the spellout of all phases from CS in parallel. In the following sub-sections I situate this model with respect to the current state of the field.

1.2.1. Phases in the Verbal Domain

The cyclic computation of morphosyntax outlined above is driven by **phase heads**, morphosyntactic heads that send material out of morphosyntax to the interfaces with the CI and SM systems. The elements generally accepted to be phase heads differ between sentential syntax (i.e., above the word) and morphosyntax (i.e., within the word). Sentential phase heads are typically agreed to include C, transitive *v* (sometimes written *v**; Chomsky 2000, 2001), D (Svenonius 2004), and sometimes P (Abels 2003) and Appl (McGinnis 2001). Phase heads are generally assumed to be the loci of uninterpretable features, i.e., abstract morphosyntactic features that cannot be interpreted by the CI or SM systems (Chomsky 2005, Newell 2008). Morphological phase heads are typically agreed to include the categorizing little *x* heads, i.e., *v*, *n*, and *a* (Marantz 2001, 2007, Marvin 2002); in Distributed Morphology (Halle and Marantz 1993), categorizing heads, like *v*, merge with an acategorial lexical root to form a syntactic category, like a verb (Marantz 2001; see also Borer 2005). There have been some attempts at bridging the gap between sentential and morphological phase heads. For instance, Marvin (2002) suggests that the categorizing little *v* phase head that merges with the root and the *v* phase head that assigns accusative Case, introduces the external argument and provides active semantics (Burzio 1986, Kratzer 1996) are the same phase head. Bošković's (2013, 2014) claim that every major lexical category (V, N, A and P) generates phasehood in sentential syntax is similar to categorizers (*v, n, a, p*) being phase heads in the DM model. However, there is no general consensus uniting sentential and morphological phase heads.

Likewise, there is a difference between sentential syntax and morphosyntax in the material that is generally accepted to be spelled out by phase heads. In sentential syntax, phase heads transfer their complements to the interfaces (Chomsky 2000, 2001, Abels 2003) once the heads' uninterpretable features have been deleted. The material in the complement, i.e., the spellout domain, is then "invisible" to higher phase heads, as stated in the Phase Impenetrability Condition (Chomsky 2000, 2001).

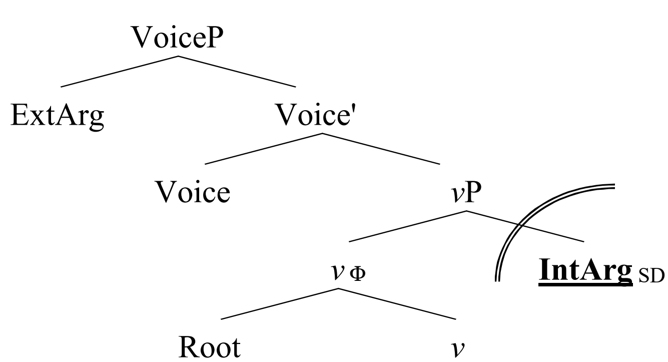
(6) Phase Impenetrability Condition: In phase α with head H, the domain of H is not accessible to operations {outside α (2000)/at ZP (the next strong phase) (2001)}; only H and its edge are accessible to such operations.

There is general agreement in morphosyntax, however, that at least some categorizing phase heads are in the same spellout domain as their complements. Newell (2008), for instance, distinguishes the categorizing phase heads {*v, n, a*} from the sentential phase heads {*v**, C, D}, and argues that the former are spelled out with their complements, while the latter are not. Marantz (2001, 2007) proposes that the first categorizer merged with the acategorial, lexical root does not spell out the root. First-merged categorizers often determine the LF and PF interpretation of the roots they merge with, so that the categorizers and roots must be in the same spellout domain (Embick 2010; see also Bobaljik and Wurmbrand 2013). On the other hand, Marantz (2001, 2007) argues that categorizers merged later in the derivation are not necessarily in the same spellout domain as their complements. These later-merged categorizers would thus behave like sentential phase heads in transferring their complement and not themselves to the interfaces.

I claim based on evidence from Chukchansi that first-merged categorizers like *v* do not spell out the root they merge with at all. Instead, the categorizer and the root (which I together refer to as "the categorized root") are spelled out together by the next phase head merged. This claim is in accord with the consensus view of morphosyntax that first-merged categorizers and their roots are in the same spellout domain (Marantz 2007, Embick 2010). However, this claim departs from the view where the categorized root forms a complete spellout domain by itself (Newell 2008). As demonstrated in Chapter Two, the categorized root in Chukchansi only forms its own spellout domain when another categorizer merges on top of it; on its own, the categorized root does not form its own spellout domain. Chukchansi supports the claim that later-merged categorizers are not in the same spellout domain as their complements, similar to sentential phase heads.

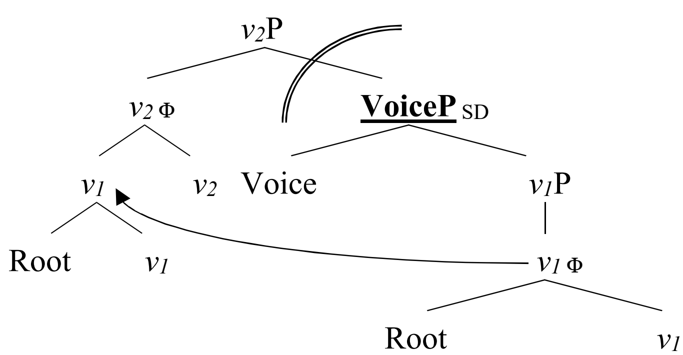
The contrast between the spellout domains of first-merged and later-merged categorizers does not mean that these two types of categorizers must have inherently different phasal properties. On the contrary, I claim that all categorizers—and phase heads in general—spell out their complements. A first-merged categorizing *v* does not spell out its root because the root **head-adjoins** to the categorizer (Kastner 2016). While the root provides the lexical semantics of the verb, the categorizer *v* introduces an event variable into the syntax (Davidson 1980, Higginbotham 1995, Harley 2013). The resulting adjoined $[v\text{+Root}]_v$ structure, the verbalized root, takes an internal argument as its complement, which captures the fact that both the root and *v* can make selectional requirements on the internal argument (Kastner 2016). The head Voice, which introduces or suppresses the external argument syntactically as its specifier (Kratzer 1996, Pylkkänen 2008, Marantz 2013b, Harley 2013), merges on top of this structure ((7), with the phase head marked by subscript Φ and the spellout domain by subscript SD and highlighting).

(7) Phasal Structure in the Verbal Domain.



While the verbalized root [v+Root]$_v$ is ordinarily not spelled out early, I claim that there are higher verbal phase heads in some languages that do spell out the verbalized root early along with any other material in the phase head's complement. For convenience, through the dissertation I indicate a first-merged verbal categorizer by "v_1" and a higher verbal phase head by "v_2." Chukchansi and Creek both provide evidence for higher verbal phase heads; while these phase heads form a natural class within each of the two languages, the Chukchansi phase heads do not appear to be identical to the Creek phase heads. Higher verbal phase heads in Chukchansi include the causative, the durative and the distributive. In Chapter Two I argue that all these heads take a single eventuality denoted by the verbalized root and create a complex eventuality. Essentially, these heads embed one eventuality inside another eventuality, e.g., of causation. Because these heads introduce another eventuality, they are v categorizing heads, similar to the lower v_1 that merges with the root and types it as an eventuality. These higher v_2 heads are therefore phasal and spell out their complement, the lower VoiceP including the verbalized root; the verbalized root first head-moves to the higher v_2 suffix to form a morphologically complex word ((8), with the arguments omitted).

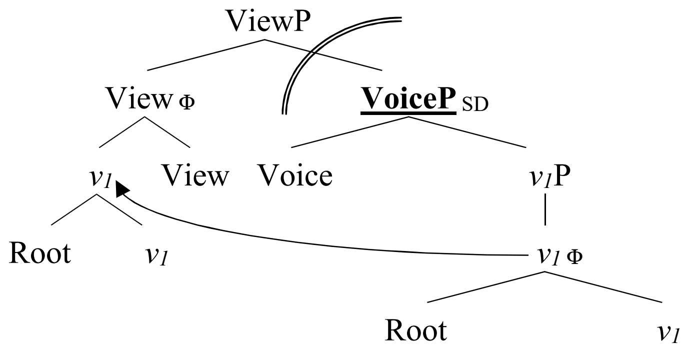
(8) Higher v_2 Phase Head in Chukchansi



In Creek, the higher verbal phase head is viewpoint aspect, which situates the eventuality signified by the verbalized root with respect to reference time. Viewpoint aspect has been argued to be phasal in other languages (Hinterhölzl 2006, Bošković 2014), though this is not generally agreed upon. While there is no broadly accepted account of viewpoint aspect's phasal status, one current attempt is Bošković's (2013, 2014) **dynamic** view of phasehood. Dynamic phasehood, while not broadly accepted, has also been proposed by Den Dikken (2007) and Gallego (2010). In Bošković's (2013, 2014) account of dynamic phases, the phasehood of major lexical categories, equivalent to categorizers in DM, extends upward to the highest head in the extended projection. For example, Bošković (2014) proposes that the phasehood of a lexical verb extends up to viewpoint aspect in languages where it the highest head in the extended verbal domain.

In the account I give of Creek, the phasehood of the first-merged categorizer *v* extends upward to the highest head in its extended domain, which I take to be the domain of event structure. Viewpoint aspect is the highest head that takes an event variable as an argument, and thus "closes the lexical VP [verbal] domain" (Bošković 2014; see also Wurmbrand 2014). This is similar in spirit to Chomsky's (2000, 2001) conception of the *v*P phase as an independent unit at LF, i.e., "full argument structure." In Creek, I characterize the verbal phase with the viewpoint aspect phase head as full event structure. Higher heads belong to the T domain, and manipulate times, propositions and/or worlds, not eventualities. The phase generated by *v* extends to View(point Aspect) through head movement. View then spells out its complement, including the verbalized root and any other event structure-related heads (9).

(9) Higher Viewpoint Aspect Phase Head in Creek



1.2.2. Models of Phonologization

The material spelled out by a phase head has a morphosyntactic representation, which must be phonologized, i.e., translated into a purely phonological representation that can be interpreted by the phonetic component SM for purposes of articulation and perception. In order to understand the effects of phase-based spellout on phonologization, I investigate two questions: (1) how sensitive phonologization is to purely phonological factors and (2) whether phonologization proceeds strictly in phases or not. This dissertation provides evidence that (1) one aspect of phonologization, the syntax-prosody mapping, is sensitive not only to prosodic factors but also conditions on autosegmental docking, and (2) the spellout of all the phases is phonologized in parallel. In this section I discuss models of phonologization in general, while in §1.2.3 I focus on the specific issue of the syntax-prosody mapping.

Two major current models of the morphosyntax-phonology interface include Distributed Morphology (DM; Halle and Marantz 1993) and Optimality Theory (OT; Prince and Smolensky 1993/2004). As OT is a broad framework that comprises many different models, I consider only some of the OT models of the morphosyntax-phonology interface: OT-CC (McCarthy and Wolf 2007), Stratal OT or LPM-OT (Kiparsky 2000, Bermúdez-Otero 2011, 2013), the Ternary Model of Morphology-Phonology Correspondence (Walker and Feng 2004), Match Theory (Selkirk 2009, 2011) and phase-based OT models including Cheng and Downing (2012, 2016) and Šurkalović (2015). In DM, phonologization proceeds serially, i.e., in involves several specific operations that are ordered sequentially. These operations include fusion and lowering of adjacent structure nodes, linearizing hierarchically-ordered morphemes, building of prosodic structure, vocabulary insertion, i.e., inserting phonologically-contentful **morphs** in place of abstract, purely morphosyntactic **morphemes**, and readjusting the phonological forms of these morphs. Arregi and Nevins (2012) argue that hierarchical operations like Fusion and Lowering occur before linearization, while linear operations like readjustment rules occur afterward. Individual operations are also ordered with respect to each other, i.e., separate readjustment rules and insertion of specific morphemes all follow a language-particular order.

Phases have two main effects in DM: placing the sequential and locality conditions on operations. First, just as operations are ordered serially, phonologization of phases is also ordered serially: the output of each phase undergoes the series of morphophonological rules in turn. For example, in Marvin (2002, 2013), English words are assigned stress after each phase is spelled out. After another phase is spelled out, the new material is added to the already parsed material and incorporated into the prosodic structure. Typically, DM accounts of phases in phonology propose that the PIC holds in phonology as well as syntax, i.e., after one spellout domain has been translated into phonological representation, it cannot be altered (e.g., Samuels 2010). Newell (2008) argues, however, that stress can be assigned either at an early phase (as in Cupeño and Turkish) or post-cyclically, disregarding phasal structure (as in Ojibwe). Newell (2014) marshals evidence that the PIC does not hold at all in phonology, and likely not in syntax either. Instead, the principle of Phonological Persistence (Dobler et al. 2011) militates against alteration of previous phases, which phonological processes may sometimes override. No consensus has settled on either of these competing proposals about the PIC.

Locality conditions govern morpheme interaction, including selectional allomorphy in vocabulary insertion and triggering of readjustment rules. Embick (2010, 2013) adduces two distinct locality conditions on morphemes that interact: they must either be linearly adjacent or in the same phase. Morphemes that are neither adjacent nor in the same phase cannot interact with each other, i.e., their behavior with respect to one other is phonologically transparent. Unlike with the sequentiality conditions above, it is broadly accepted in DM that morphemes in the same spellout domain can combine non-compositionally or non-predictably, especially through selectional restrictions (Bobaljik and Wurmbrand 2013, Harley and Tubino-Blanco 2013, Marantz 2013b).

In OT, the phonological derivation involves the generation of output candidates from a single input (GEN); the output candidates are then evaluated in parallel by a ranking of violable constraints to choose a winner, which surfaces (EVAL). The input to a parallel OT derivation typically has a linearly-ordered segmental representation, which is phonological. In a sense, vocabulary insertion and linearization of morphemes happens before the phonological derivation. On the other hand, the phonological segments of the input are affiliated with distinct morphemes, and there are constraints enforcing faithfulness to the input morphological affiliation (see, e.g., Russell 1999, Walker and Feng 2004). OT analyses also commonly use syntax-prosody mapping constraints, including alignment of morphological categories with phonological categories (McCarthy and Prince 1993). Match Theory (Selkirk 2009, 2011), which I adopt in this dissertation and discuss in §1.2.3, is currently the most widely-accepted framework for syntax-prosody mapping in OT.

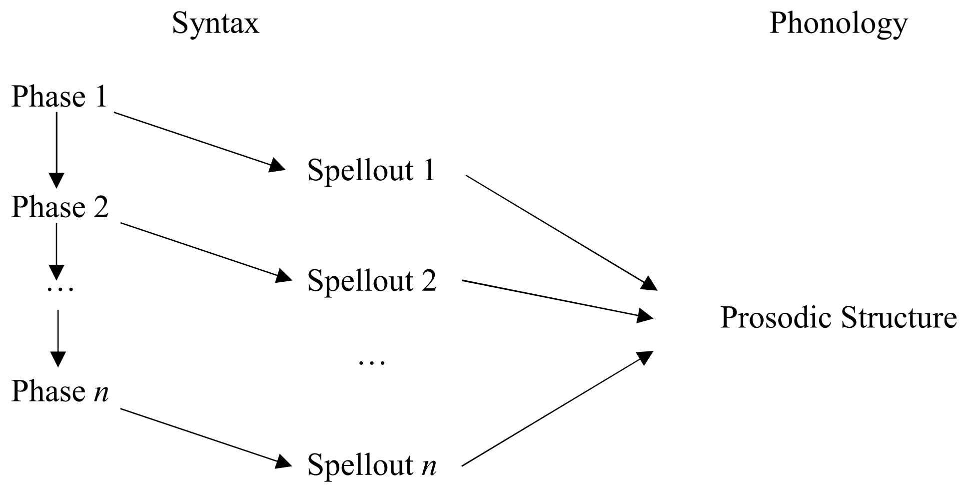
Because morphological and phonological factors can interact in OT, phonologization is predicted to be influenced by purely phonological factors in most OT models of the interface. For example, Agbayani and Golston (2010) and Agbayani, Golston and Ishii (2015) demonstrate that the linearization of words in Ancient Greek and Japanese is sensitive to both prosodic constraints and the OCP. Hsu (2016) demonstrates that copy pronunciation in Bangla is sensitive to prosodic constraints; Franks (1998) and Bošković and Nunes (2007) argue similarly for other languages, including Serbo-Croatian, in a non-OT model. These findings contrast with purely syntactic accounts of linearization (Kayne 1994) and copy pronunciation (Chomsky 1993, Nunes 2004), where these processes are automatic functions of spellout and are not sensitive to phonological factors. Wolf (2008) proposes serial insertion of morphs in an OT-CC model in which the input in the model is fully morphosyntactic, while the output is fully phonological. Wolf (2008) argues that vocabulary insertion, which happens in the phonological derivation in this model, is sensitive to phonological constraints. While vocabulary items, i.e., morphs, are present in the input to the phonology in Walker and Feng's (2004) Ternary Model of Morphology-Phonology Correspondence, the output selection of these morphs is also sensitive to phonological constraints.

I now discuss two questions relevant to phase-based OT approaches to the morphosyntax-phonology interfaces: (1) are there separate OT derivations corresponding to each morphosyntactic phase, and (2) can the constraint rankings differ between the grammars associated with different phases? In parallel OT models, which are still the most widely adopted, there is only a single phonological derivation, regardless of cyclicity in the morphosyntax. Cheng and Downing (2012, 2016) argue that the phonology operates in a single, parallel derivation once all the phases have been spelled out. Phasal spellout in this parallel OT model comes from alignment constraints that map phases onto prosodic domains. On the other hand, most work incorporating phase-based spellout with OT is typically serial, i.e., each spellout cycle provides the input to a separate phonological derivation, that is, operation of GEN and EVAL (e.g., Ishihara 2003). For example, if a word is spelled out over two phases, it would go through two cycles of an OT grammar. Šurkalović (2015) takes a different approach to phase-based phonology: each phonological derivation is cumulative, including the material from all the phases that have been spelled out by the morphosyntax at that point. Phasal spellout in Šurkalović's (2015) model affects the phonological derivation through Phase-Phase Faithfulness constraints, which demand that later, cumulative derivations remain faithful to the output of earlier derivations.

In the above OT frameworks that incorporate distinct cycles of phonological derivation, the constraint ranking of all the cycles is identical. A different serial model of OT, Stratal OT or LPM-OT (Kiparsky 2000, Bermúdez-Otero 2011, 2013), the OT successor to Lexical Phonology and Morphology (LPM; Kiparsky 1982, Kaisse and Shaw 1985, Mohanan 1986) diverges in this regard. Stratal OT has three distinct, serially-ordered phonological derivations—Stem, Word and Phrase, respectively—which have distinct constraint rankings. Together, these three derivations build up the utterance from morphemes to full words and phrases. While Stratal OT does not in itself make reference to phase-based spellout, it can model phasal effects on phonological structure by evaluating the material spelled out in a word-internal phase in a Stem-level derivation.

I propose a model that combines the phasal morphosyntactic derivation of DM outlined in §1.2.1 with a single, parallel OT derivation as in Cheng and Downing (2012, 2016). In this cyclic syntax-parallel phonology model, the cumulative material spelled out over all the phases is mapped to prosodic structure in parallel ((10), repeated from (3)).

(10) Model of Cyclic Syntax and Parallel Phonology

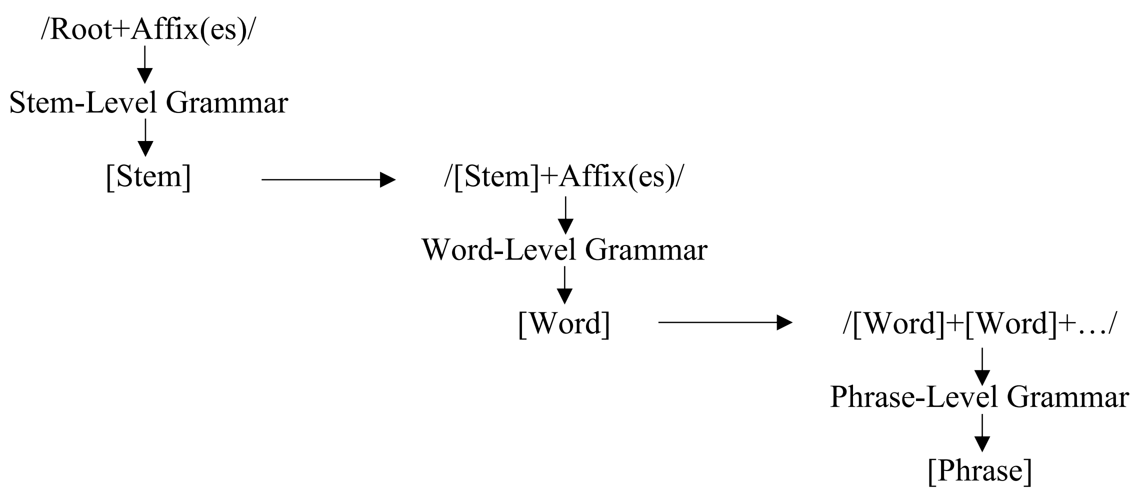


Unlike in Cheng and Downing's (2012, 2016) model, which uses alignment constraints, the effects of phase-based spellout come through the combination of head movement (Travis 1984) and multiple copies (Chomsky 1993) in the morphosyntax. Essentially, I argue that lower and higher copies of the same morpheme are spelled out at different phases; through syntax-prosody mapping constraints, the parallel OT derivation may reflect the presence of multiple morphosyntactic copies by prosodic recursion (§1.3, Chapter Two) or by other prosodic structure in a factorial typology (Chapter Four). Evidence from both Creek and Chukchansi illustrates the two major points of the model: phonologization is sensitive to purely phonological constraints, and the cumulative output of all phases is evaluated in parallel.

Specifically, multiphasal verbs in Chukchansi and Creek demonstrate that the syntax-prosody mapping is influenced by constraints on parsing, phonotactics, and autosegmental docking. These verbs are best modeled by parallel evaluation of these constraints in a single OT grammar, not by ordered rules or cyclic OT derivations with or without different constraint rankings. The influence of phonology on phonologization adds to the chorus of previous evidence (e.g., Bošković and Nunes 2004, Wolf 2008, Agbayani, Golston and Ishii 2015, Hsu 2016). The parallel OT derivation of the cumulative output of all phases also supports Cheng and Downing's (2012, 2016) proposal, and is reminiscent of Šurkalović's Phase-Phase Faithfulness model. This latter aspect of the model prevents the PIC from being active in phonology, supporting Newell (2014); there is no prior phonological cycle at all that could be subject to the PIC in a single parallel OT derivation.

In fact, the multiphasal verbs in Chukchansi and Creek provide empirical evidence against two of the serial models of the morphosyntax-phonology interface: Stratal or LPM-OT and a phase-based phonological model with a strong PIC. A contrast between monophasal and biphasal verbs in Chukchansi can be captured in the cyclic syntax-parallel phonology model (10) but not in Stratal OT (§2.6). In a Stratal OT account, both monophasal and biphasal verbs will go through the same rankings of constraints in the Stem-level and Word-level grammars (11).

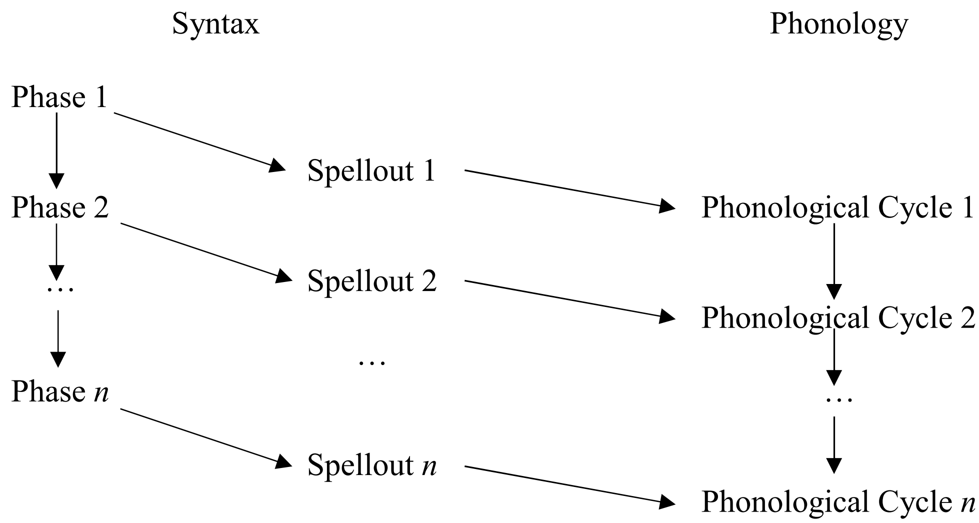
(11) Stratal OT Model



In the Stratal OT model, both types of verb will thus undergo the same phonological effects, since the model is not sensitive to the phasal derivation of words. A Stratal OT account of Chukchansi must stipulate the phonological contrast between the two types of verb.

A model where the PIC holds in phonology (Samuels 2010) cannot account for the domain of regular stress in biphasal Creek verbs (§3.6; (12)).

(12) Model of Phase-Based Phonology



The stress domain in Creek verbs is not only determined by their phasal derivation, but also by their phonological properties. Specifically, both the first and the second phases' phonological inputs interact to delineate the extent of parsing into binary iambic feet. While this interaction of different phases in Creek can be accounted for in the cyclic syntax-parallel phonology model (10), a phase-based phonological model must give a later phonological phase the power to alter or delete the prosodic structure of an earlier phase. Alteration and deletion of previously-built material is incompatible with a phonological PIC.

Because I am investigating phonological effects on the syntax-prosody mapping, I make the simplifying assumption that the other phonologization processes are not affected by phonological constraints in Chukchansi and Creek. More specifically, I assume that constraints responsible for the default cases of linearization, copy pronunciation and vocabulary insertion are not dominated by phonological constraints in these languages. This assumption allows me to isolate the relationship between phonology and the syntax-prosody mapping; not isolating this relationship would create exponential complexity in possible phonological influence on the phonologization as a whole. However, I do not advance any positive arguments that these processes are not influenced by phonology.

1.2.3. Match Theory

I lastly look at the part of the morphosyntax-phonology interface that this dissertation focuses on: the syntax-prosody mapping, which involves the translation of syntactic constituency, e.g., X_0s, into prosodic constituency, e.g., PWds. More broadly, the syntax-prosody mapping is a way for phonology to make reference to morphosyntactic structure. There are two types of approach to this reference: Direct Reference (Kaisse 1985, Odden 1987), in which phonology directly references morphosyntactic domains, and Indirect Reference (e.g., Selkirk 1984, Nespor and Vogel 1986), in which phonology builds prosodic domains that reference morphosyntactic domains. In a phase-based Direct Reference framework (Pak 2008, Scheer 2008, 2012, Samuels 2010), the spellout domains themselves delineate the extent of the phonological cycle. As such, phonological constraints cannot greatly influence the size or scope of the material that undergoes positional phonological processes, apart from resyllabification. In Indirect Reference frameworks, on the other hand, phonological factors, including constraints on prosodic well-formedness, can interact with the syntax-prosody mapping (e.g., McCarthy and Prince 1993, Selkirk 1995, *inter multa alia*). The most widely accepted Indirect Reference framework at present is Match Theory (Selkirk 2009, 2011); MATCH constraints demand that a syntactic constituent be matched by a corresponding prosodic constituent, as in (13).

(13) MATCHWORD: A word in syntactic constituent structure must be matched by a constituent of a corresponding prosodic type in phonological representation, call it ω [PWd].

(Selkirk 2009)

Other formulations of MATCH constraints involve correspondence between both edges (Selkirk 2011) and exhaustive domination of terminal nodes (Elfner 2012).

I argue for the Indirect Reference hypothesis, specifically the Match Theory model, based on evidence from Chukchansi and Creek. Mismatches between spellout domains and prosodic units support the interaction of syntax-prosody mapping constraints with purely phonologically constraints, which can only happen in an Indirect Reference type of model (Selkirk 1986, 1995, Nespor and Vogel 1986). I also revise the formulation of MATCH constraints, in the vein of Elfner's (2012) recharacterization of MATCH in terms of dominating terminal nodes, not edge correspondence. Chukchansi and Creek display minimal mismatches between syntactic and prosodic units; these languages also show a contrast between undermatches, where the syntactic unit is smaller than the prosodic unit, and overmatches, where the syntactic unit is bigger than the prosodic unit. Neither minimal mismatches nor a contrast between under- and overmatches are predicted by Selkirk's (2009, 2011) or Elfner's (2012) formulations of MATCH constraints. A Direct Reference framework in which the phasal spellout of morphosyntactic material determines the size of phonological chunks (e.g., Pak 2008, Scheer 2008, 2012, Samuels 2010, Šurkalović 2015) cannot capture the mismatches between spellout domains and prosodic units. To capture these mismatching phenomena, I formulate the MATCHWORD constraints as follows:

(14) Revised MATCHWORD Constraints

a. MATCHWORD(All): Suppose there is an X_0 in the input syntactic representation that exhaustively dominates a set of morphemes α. Assign a violation mark for every segment that (1) is an exponent of a morpheme in α and (2) is **not** dominated by a PWd in the output phonological representation corresponding to the X_0.

b. MATCHWORD(Only): Suppose there is an X_0 in the input syntactic representation that exhaustively dominates a set of morphemes α. Assign a violation mark for every segment that (1) is an exponent of a morpheme **that is not** in α (2) and is dominated by a PWd in the output phonological representation corresponding to the X_0.

The revised constraints account for the Chukchansi (§2.7) and Creek (§3.4.3) data; they also predict a factorial typology of possible syntax-prosody mappings for multiphasal words. Chapter Four illustrates the predicted typology with attested languages.

1.3. Proposal: Cyclic Morphosyntax and Parallel Phonology

I now briefly illustrate how the model of cyclic DM morphosyntax and parallel OT phonology outlined above works, using the multiphasal Chukchansi verb in (15) (adapted from (1)).

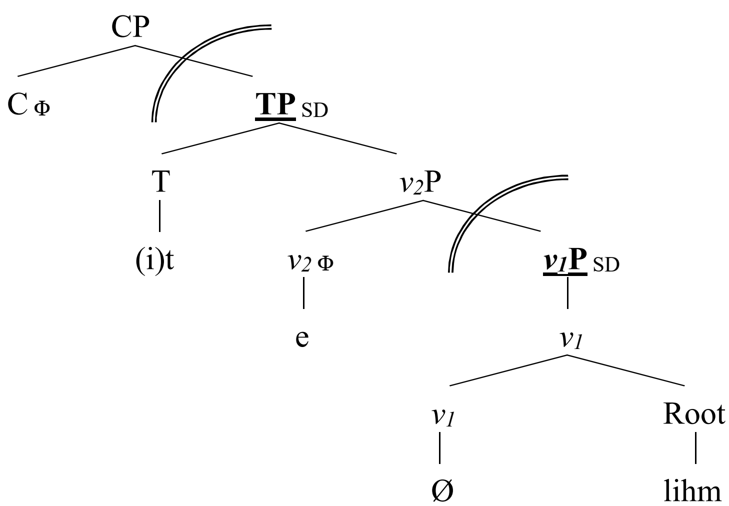
(15)	/lihm	Ø	e	(i)t/	→ [[**<u>lehe:</u>**]$_{PWd}$ m-e-t]$_{PWd}$
	'run'	v_1	v_{2CAUS}	$T_{RECENT.PAST}$	
	"just made X run"				

This section follows the derivation of (15) from its construction in morphosyntax to its final phonological output. §1.3.1 shows how multiple spellout of the verbalized root results from head movement leaving copies. §1.3.2 demonstrates that these multiple copies of the verbalized root optimally result in PWd recursion in Chukchansi.

1.3.1. Head Movement and Multiple Spellout

When a morphologically complex verb contains a higher *v* phase head affix, the verb's morphemes are spelled out over two phases. The input to phonology, therefore, contains multiple, distinct syntax outputs. For example, the morphologically complex verb /lihm-Ø-e-(i)t/ from (15) has the following two spellout domains: the lower v_1P is spelled out by the higher v_2 phase head and TP is spelled out by the C phase head (16). The two outputs spelled out in v_1P and TP are both present in the input to the parallel phonological derivation of the word.

(16) Cyclic Spellout from Syntax

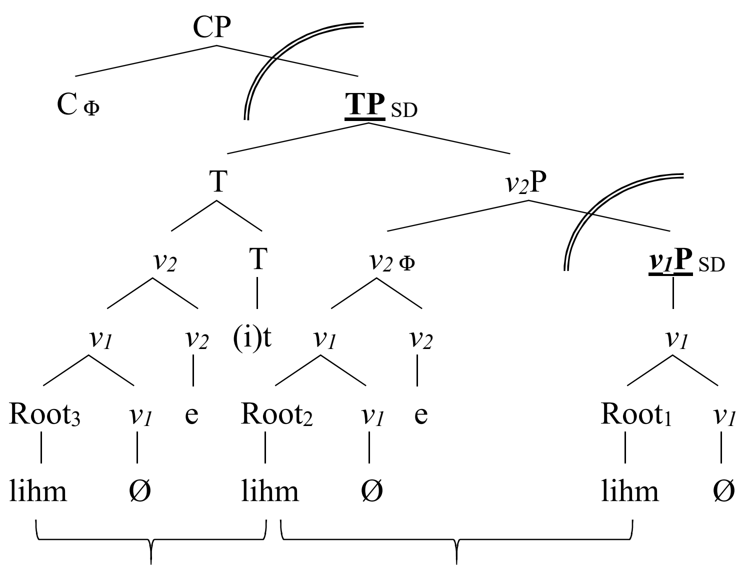


One crucial component of this model is that morphologically complex words like /lihm-Ø-e-(i)t/ → [lehe:met] are formed by head movement. While several theoretical options for head movement have been advanced, I adopt Travis' (1984) original proposal that lower heads move up to higher heads by head adjunction and form a complex X_0, whose label is identical to the higher head that the lower heads have adjoined to. For example, when the root head-adjoins to v_1, the label of the complex X_0 is v_1. Since v_1 is a phase head, the entire adjoined root+v_1 structure inherits v_1's phasal properties, i.e., spelling out its complement but not itself. Baker (1986, 1988) argues that the order of morphemes in a morphologically complex word mirrors the hierarchy of heads in the complex X_0. For example, the syntactic structure of /lihm-Ø-e-(i)t/ in (16) is reflected transparently in the morphological order (17).

(17) Morphological Order: /lihm- -Ø- -e- -(i)t/

The other key element of this model is that head movement leaves lower copies (Chomsky 1993), so that each complex X_0 contains copies of lower heads. These copies are morphosyntactically identical, but occur in different places in the tree. To capture both these properties, Chomsky proposes that the copies form a chain, with a head (highest copy) and a tail (lowest copy, i.e., at the site of merger). For example, the Root in (18) forms a chain (shown by the connecting lines) with the head in T and the tail in v_1.

(18) Syntactic Structure of /lihm-Ø-e-t/ with Copies



While Chomsky (1993) argues that only the highest copy of the chain is spelled out and pronounced, lower copies are sometimes pronounced, either instead of or together with higher copies (e.g., Franks 1998, Bošković and Nunes 2007, Hsu 2016). However, pronunciation of lower copies most commonly occurs with functional elements, not lexical words (i.e., words containing a lexical root). When a chain spans more than one spellout domain, Nunes (2004) argues that the highest copy in each phase is spelled out. I have found no evidence that lower copies of lexical words in a phase are pronounced; when a lower copy of a lexical word is pronounced, it is the highest copy in its phase. This contrasts with function words, for which lower copies in a phase can be pronounced (Hsu 2016).

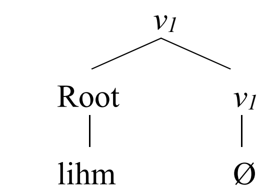
Based on the contrast between the copy pronunciation of functional and lexical words, I propose that in each phase, only the highest copy of a lexical word, i.e., the X_0 containing the highest copy of the lexical root, is matched to a PWd. As detailed in Chapters Two and Three, I formulate the revised MATCHWORD constraints, MATCHWORD(All) and MATCHWORD(Only) (14), to only evaluate the X_0 highest copy of a lexical word in a phase and its corresponding PWd (19).

(19) MATCHWORD(All, Only): Suppose there is an X_0 in the input syntactic representation that has **the highest copy of a lexical root in a spellout domain** and exhaustively dominates a set of morphemes α. Assign a violation mark for every segment that (1) is an exponent of a morpheme that ***{is/is not}*** in α and (2) ***{is/is not}*** dominated by a PWd in the output phonological representation corresponding to the X_0.

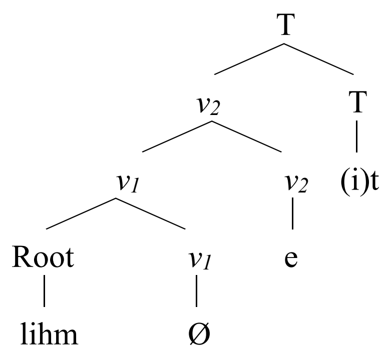
When multiple complex, head-adjoined X_0s contain a copy of a lexical root, only the highest X_0 in the spellout domain has a corresponding PWd. For example, in a syntactic derivation like /lihm-Ø-e-(i)t/ → [lehe:met] (18), where the higher verbal (v_2) head /-e-/ is phasal, the spellout domains are v_1P and TP. The X_0s with the highest copies of the root /lihm/ in each spellout domain are the complex heads v_1 and T (20). Crucially, there is no impetus to build a corresponding PWd for the intermediate complex X_0 in v_2.

(20) X_0s with the Highest Copy of a Lexical Root

a. First Phase (v_1P)



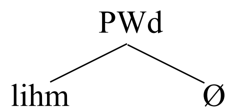
b. Second Phase (TP)



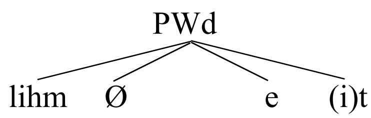
1.3.2. Optimal Recursive Prosodic Structure

Once the syntactic derivation has finished spelling out all its material, the phonology operates, including the syntax-prosody mapping constraints. The input to the syntax-prosody mapping is the combination of X_0s in (20). The most important property of this input is that there are **multiple distinct X_0s** yet **multiple identical copies** of the root /lihm/. The MATCHWORD constraints map the X_0 with highest copy of the root in a phase to a distinct PWd. If there are two phases and thus two X_0s with a highest copy of the root, then MATCHWORD demands that the output of (20) have two PWds, each one containing an exponent of the root. If each X_0 is matched to its own unique PWd, then the first X_0 (20a) corresponds to the PWd in (21), and the second X_0 (20b) corresponds to the PWd in (22).

(21) PWd One (corresponding to v_1):



(22) PWd Two: (corresponding to T):

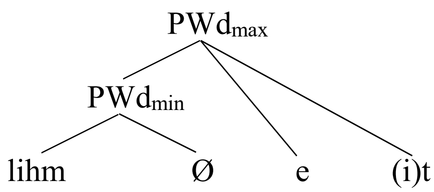


However, phonology optimally chooses only to insert one morph of each morpheme, regardless of how many copies of that morpheme have been spelled out over all the cycles. Pronunciation of multiple copies is extremely marked; single copy pronunciation is optimal (see, e.g., Franks 1998, Bošković and Nunes 2007, Hsu 2016). In fact, I am not aware of any cases where more than one copy is pronounced in a single phase (see also Nunes 2004) or where a lexical root is pronounced twice. In order to prevent multiple morphs from being inserted as exponents of multiple copies, phonology must treat identical copies of a morpheme as a **single instance** of that morpheme. Several different constraints have been proposed to prevent more than one output morph from being inserted for an input morpheme; I use the morpheme faithfulness constraint INTEGRITY-M.

(23) INTEGRITY-M: assign a violation mark if an input morpheme corresponds to more than one output morph (see McCarthy & Prince 1993 for INTEGRITY, and Walker and Feng 2004 and Wolf 2008 for morphological faithfulness constraints)

To satisfy MATCHWORD, both PWds (21) and (22) must be present in the output, i.e., there must be one PWd that dominates the morph [lihm] and a second PWd that dominates all the morphs [lihm], [e] and [(i)t] (leaving aside the zero morph [Ø]). To satisfy INTEGRITY-M, only one morph [lihm] must be present. In order to have an output with both these PWds but only one morph [lihm], the first PWd (21) must be embedded inside the second PWd (22). This results in a recursive structure in which [lihm] is dominated by both the first, minimal PWd and the second, maximal PWd (24).

(24) Output of Syntax-Prosody Mapping: Recursive PWds



Among the violable prosodic structure constraints defined by Selkirk (1995), (24) only violates the constraint NonRecursivity (Nespor and Vogel 1986, Selkirk 1995).

(25) NonRecursivity: Assign a violation mark to a prosodic category C^i that is dominated by C^j, i = j (adapted from Selkirk 1995 to penalize daughter, not mother nodes)

If MatchWord and Integrity-M dominate Non-Recursivity, the grammar will select the recursive PWd output (24) from the biphasal input (20) with the two X_0s have highest copies of the root in a phase. Since MatchWord only demands that these X_0s be matched to PWds, not X_0s with lower copies of the root in a phase, NonRecursivity eliminates the candidate with a PWd for every single X_0 that is spelled out. Due to other phonological constraints in Chukchansi detailed in Chapter Two, when the root /lihm/ forms its own PWd, it is augmented to a disyllabic iambic foot (Lˈ H). Also, the final consonant /m/ of the root is mismatched with the corresponding PWd; §2.7 shows how bifurcating MatchWord into two constraints, MatchWord(All) and MatchWord(Only), allows minimal mismatches. In (26), the X_0s with the highest copies of the root in each phase are highlighted.

(26) MATCHWORD, INTEGRITY-M >> NONRECURSIVITY

/lihm-Ø/$_{X0}$, /lihm-Ø-e/$_{X0}$, **/lihm-Ø-e-(i)t/$_{X0}$**	MATCHWORD	INTEGRITY-M	NONRECURSIVITY
☞ [[(leˈhe:)]$_{PWd}$ met]$_{PWd}$			1
[[[(leˈhe:)]$_{PWd}$ me]$_{PWd}$ ʔit]$_{PWd}$			2 W
[(leˈhem)]$_{PWd}$ [(ˈlih)met]$_{PWd}$		1 W	L
[(ˈlih)met]$_{PWd}$	1 W		L

This ranking models the syntax-prosody mapping of (20) to (24), which takes two X_0s with identical highest copies of the root in a phase and builds recursive PWds. As I argue in this dissertation, this mapping is attested in several languages, including Chukchansi (Chapter Two) and Creek (Chapter Three). Chapter Four compares the typology predicted by the constraints in (26) to the attested typology; the predicted and attested typologies closely match.

1.4. Outline of the Dissertation

This dissertation is organized into five chapters. Chapter One has set up the proposed model of cyclic syntax, which spells out material in multiple phases, and parallel phonology, which can reflect multiple spellout by prosodic recursion. The rest of the dissertation illustrates and refines this model, giving a detailed picture of the syntax-prosody mapping.

Chapter Two provides empirical evidence for the proposed model using firsthand fieldwork data from Chukchansi, a critically endangered Yokuts language of central California. Chukchansi shows a **syntactic contrast** between biphasal verbs, which have a higher verbal (v_2) suffix like the causative /-e/ (27a), and monophasal verbs, which do not have a v_2 suffix (28a). In biphasal verbs, the root is spelled out twice, while in monophasal verbs it is only spelled out once. These two types of verbs show a similar **phonological contrast**: biphasal verbs form recursive PWds due to double spellout of the root (27b), while monophasal verbs form a single PWd (28b). The phonological contrast is easily captured in the cyclic syntax-parallel phonology model advocated in this dissertation, but must be stipulated in Stratal OT (Kiparsky 2000, Bermúdez-Otero 2011, 2013).

(27) Biphasal verb = Recursive PWds

a. Syntax	b. Phonology
v_2 suffix ‘CAUSATIVE’ = Biphasal verb	Double spellout of root = Recursive PWds
/lihm e (i)t/ ‘run’ CAUSATIVE RECENT.PAST Root v_2 T “just made X run”	PWd_{max} PWd_{min} [[(le.ˈhe:m)] et]

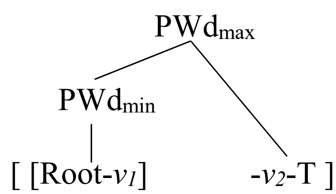
(28) Monophasal verb = Single PWd

a. Syntax	b. Phonology
No v_2 suffix = Monophasal verb	Single spellout of root = Single PWd
/lihm (i)t/ ‘run’ RECENT.PAST Root T “just ran”	PWd [(ˈlih).mit]

Chapter Three adds precision to the proposed model using secondary data from Creek, an endangered Muskogean language spoken in Oklahoma and Florida (SE USA; Martin 2011). Chapter Three argues two main points: (1) syntactic X_0s and phonological PWds can be **mismatched** in different ways, requiring two distinct MATCHWORD constraints, and (2) the syntax-prosody mapping can be influenced by purely phonological factors, including constraints on autosegmental docking. These two points together support a model where the syntax-prosody mapping occurs **in parallel** with the rest of phonology. In Creek, all verbs are biphasal in the syntax; however, whether a biphasal Creek verb will display PWd recursion is determined purely by phonological constraints. Chapter Three concludes by demonstrating that a phase-based phonological model with a strong PIC (Samuels 2010) cannot account for the mismatches in Creek.

Chapter Four looks at the typology of syntax-phonology mapping predicted by the proposed cyclic syntax-parallel phonology model. Specifically, this chapter investigates the possibilities for prosody to reflect multiple spellout in verbs, and compares the predicted prosodic structure with the attested typology of multiphasal verbs. PWd recursion (29), attested in Chukchansi and Creek as well as in Ojibwe and Cupeño (Newell 2008), is only one possible prosodic mapping of cyclic syntax within words.

(29) Recursive PWd: Chukchansi, Creek, Ojibwe, Cupeño



Freely ranking the constraints posited by the model predicts other possibilities, including a single PWd (30a), two recursive PWds (30b) and two consecutive PWds (30c). These possibilities are similar but not identical to Selkirk's (1995) typology of function words cliticized to lexical words, since they distinguish between affixal PWds in a recursive (30b) and in a flat (30c) structure.

(30) Typology of PWd Structures

a. Single PWd	b. Two Recursive PWds	c. Two Consecutive PWds
Armenian, Saisiyat	Turkish	Purépecha
PWd [Root-v_1-v_2-T] [gerkatsˈnem] [makθiˈʔæl]	PWd PWd$_{min}$ PWd$_{min}$ [[Root-v_1] [v_2-T]] [[gideˈcek] [tim]]	PPh PWd PWd [Root-v_1] [v_2-T] [piˈré] [xaˈtí]

Chapter Four then looks at some possible challenges for the typology, including languages that are predicted but not attested, and languages that are attested but not predicted. While these challenges appear to be amenable to the model proposed in the dissertation, further research can refine the analyses offered.

Chapter Five concludes the dissertation, overviewing the proposed model with the greater precision argued for in Chapters Three and Four. The chapter then explores empirical extensions of this model, including other possible examples of PWd recursion in multiphasal verbs and the possibility of PWd recursion reflecting multiphasal nouns. Chapter Five finishes by offering some final words on the interface of syntax and phonology.

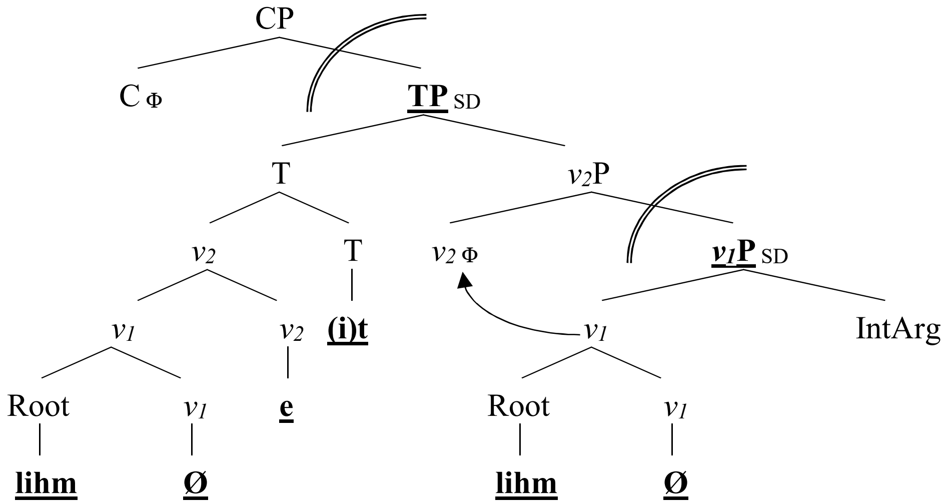
2. Biphasal Verbs and Recursive PWds in Chukchansi Yokuts

2.1. Introduction

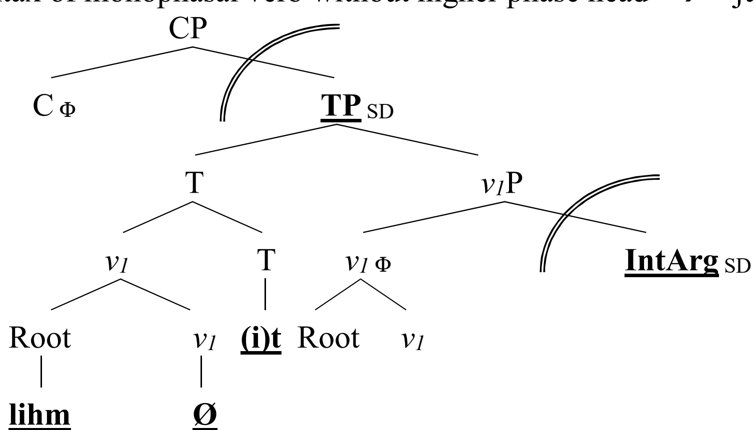
In this chapter I illustrate the cyclic syntax-parallel phonology model with firsthand data from Chukchansi Yokuts (Penutian: California). I argue that Chukchansi provides an example of a language where morphosyntactic cyclicity results in Prosodic Word (PWd) recursion. Chukchansi also gives evidence in favor of two proposals from Chapter One: cyclic spellout is evaluated by parallel phonology and MATCH constraints (Selkirk 2009, 2011) encourage minimal mismatches.

I demonstrate that Chukchansi displays a **contrast in the syntactic structures** of verbs spelled out over two different phases (biphasal verbs) and verbs spelled out in a single phase (monophasal verbs). The contrast is due to the presence or absence of a higher phase head (v_2 or *n*) in the morphosyntax of the verb. Biphasal verbs have a higher phase head v_2, which creates a complex event, e.g., a causative or durative. v_2 spells out the verbal material in its complement v_1P early, e.g., in /lihm-Ø-e-(i)t/ "just made X run" (1). Monophasal verbs only have the lower phase head v_1, which categorizes the root as a verb; v_1 does not spell out verbal material early, e.g., in /lihm-(i)t/ "just ran" (2). In (1-2), phase heads are marked by a subscript $_\Phi$ and their complement spellout domains by a subscript $_{SD}$ and highlighting.

(1) Syntax of biphasal verb with v_2 → "just made X run"



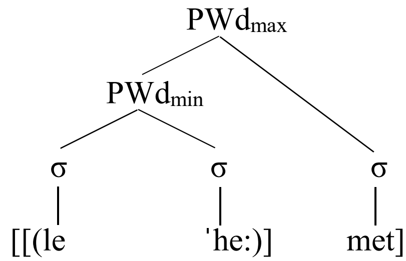
(2) Syntax of monophasal verb without higher phase head → "just ran"



I then argue the syntactic contrast between biphasal (1) and monophasal (2) verbs results in a **phonological contrast** of between recursive and single PWd structures. Multiple spellout of the verbalized root (v_1+root) in biphasal verbs (1) is reflected in the phonology by PWd recursion: the verbalized root is contained in the internal PWd$_{min}$, while other morphosyntactic material (v_2 and T suffixes) are contained only in the external PWd$_{max}$. Due to a disyllabic minimality requirement on PWds, a verbalized root with only one underlying vowel, like /lihm/, is augmented to a disyllable with an epenthetic vowel. Because Chukchansi prefers to parse words into iambs, the epenthetic material is arranged so that the PWd$_{min}$ forms a light-heavy (LˈH) foot [(le.ˈhe:m)] (3).

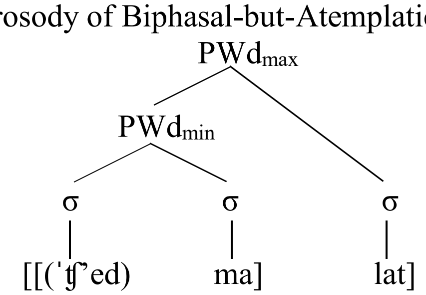
The constant light-heavy LH disyllable that occurs with v_2 suffixes gives the appearance of a **template**, i.e., a fixed prosodic shape that appears in a specific morphological content irrespective of the underlying root material.

(3) Prosody of Biphasal/Templatic Verb: /lihm-Ø-e-(i)t/ → [[(le.ˈhe:m)]et]



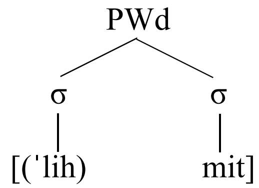
The LH "template" only appears with underlyingly one-vowel roots like /lihm/, which cannot meet the disyllabic minimality requirement on their own. Verbalized roots like /ʧʼedma/ 'think' that have at least two underlying vowels automatically meet disyllabic PWd minimality. These verbalized roots display neither augmentation nor rearrangement of underlying material (4), even with a v_2 suffix, e.g., the causative /-la-/, in /ʧʼedma-Ø-la-(i)t/ "just made X think." These forms nevertheless do have PWd recursion, as shown by the lack of expected stress on the penultimate syllable [ma] in (4).

(4) Prosody of Biphasal-but-Atemplatic Verb: /ʧʼedma-Ø-la-(i)t/ → [[(ˈʧʼed).ma]lat]



When verbalized roots with a single underlying vowel are spelled out in one phase like /lihm-Ø-(i)t/, PWd recursion does not occur. The root and obligatory tense or mood suffix in T together meet disyllabic minimality, so that there is once again no augmentation or rearrangement (5).

(5) Prosody of Monophasal/Atemplatic: /lihm-Ø-it/ → [(ˈlih).mit]



PWd recursion induced by biphasal verbal syntax thus has a **visible phonological effect** on the verb: the LH template. However, the presence of the template depends on the phonological characteristics of the verb's morphological material. Table 1 shows how the presence or absence of the LH template in the three types of verb above (3-5) depends on phonological and syntactic conditions. The template only appears when both a v_2 suffix, e.g., the causative /-e/ and /-la/, underlined in the table, makes the verb biphasal, and the root has one underlying vowel.

Table 1. Presence and Visibility of PWd Recursion = LH Template

		Phonology: Root Material	
		One-Vowel = Sub-minimal /lihm/	Multi-Vowel = Minimal /ʧʼedma/
Syntax	Monophasal (no v_2) = Single PWd	No LH Template (5) [[(ˈlih)mit]PWd	No LH Template [(ˈʧʼed)mat]PWd
	Biphasal (v_2) = PWd Recursion	**LH Template (3) [[(leˈhe:m)]PWd et]PWd**	No LH Template (4) [[(ˈʧʼed)ma]PWd lat]PWd

This chapter is structured as follows. §2.2 presents the data and key generalizations of templatic verbal morphology in Chukchansi. §2.3 argues that templatic morphology is simply the visible effect of PWd recursion in Chukchansi, which results from the multiple spellout of a biphasal verb. Chukchansi thus illustrates the model proposed in Chapter 1, in which cyclic verbal morphosyntax is reflected by PWd recursion. §2.4 and 2.5 flesh out this illustration in its syntactic and phonological details, respectively. §2.6 demonstrates that Stratal OT (Kiparsky 2000, Bermúdez-Otero 2011, 2013) cannot account for the Chukchansi data. §2.7 looks at mismatches between X_0s and PWds in Chukchansi, and introduces the two constraints MATCHWORD(All) and MATCHWORD(Only). §2.8 gives more evidence in favor of the cyclic syntax-recursive phonology model of Chukchansi verbal morphology. §2.9 shows that further complications of templatic morphology are amenable to this model. §2.10 concludes the chapter.

2.2. Templates: Data and Generalizations

Chukchansi is a member of the Yokuts language family of Central California, which is part of the Penutian group. Like the few other surviving Yokuts languages, Chukchansi is critically endangered, with fewer than ten remaining speakers. Except where noted, all of the data in this chapter were collected through one-on-one elicitation sessions in English with the two most active native speakers over a period of several years. Similar to other Yokuts languages, Chukchansi has been documented before, including in Newman (1944), Broadbent (1958), and Collord (1968), a descriptive grammar of the language. Further documentation and revitalization efforts on Chukchansi are currently being undertaken, including the compilation of a dictionary (Adisasmito-Smith 2016), traditional narratives, and language classes for young children.

Chukchansi has a regular process of templatic verbal morphology, whereby verb roots receive a fixed prosodic template in the environment of certain suffixes. This process is common to all Yokuts language, including Yowlumne (Newman 1944 under the name “Yawelmani”, Hansson

2005) and Wikchamni (Gamble 1978). Outside of templatic environments, verb roots can have several different shapes, both underlyingly and on the surface (6).

(6) Different Root Shapes

a.	/wan 'give' "just gave"	it/ REC[1]	→	[**wa.n**it]	Root Shape: CVC
b.	/ʧiʃ 'cut' "cut"	hil/ MID	→	[**ʧiʃ**.hil]	Root Shape: CVC
c.	/ma:x 'collect' "can collect"	al/ POT	→	[**ma:.x**al]	Root Shape: CV:C
d.	/ʔaml 'help' "will help"	eʔ/ N.PST	→	[**ʔam.l**eʔ]	Root Shape: CVCC

Chukchansi has a CVX syllable maximum, where X can be either a single C or V: complex onsets and codas are impossible, and long vowels and codas cannot appear together. In order to fit the CVX maximum, some underlying root shapes undergo a change to different surface shapes (7-8). A high vowel is epenthesized to break up clusters of three consonants (7), while a long vowel shortens in a closed syllable to prevent a superheavy CV:C syllable (8) (see Kenstowicz and Kisseberth 1979 *inter alia* for Yokuts syllable phonotactics).

(7) Phonotactic Vowel Epenthesis

a.	/ʔaml 'help' "had helped"	taʔ/ REM	→	[**ʔa.mil**.taʔ]	Underlying Root Shape: CVCC Surface Root Shape: CVCVC $(\sigma_{\mu}\sigma_{\mu\mu})$

[1] The following morpheme abbreviations also appear in (12-15) and Table 3 (§2.4): adjunctive = ADJV; agentive = AGTV; benefactive = BEN; causative = CAUS; causative-inchoative = CS.IN; comitative = COM; consequent gerundial = C.GER; desiderative = DESID; distributive = DISTR; durative = DUR; hortative = HORT; imperative = IMPER; inchoative = INCH; middle PAST = MID; non-past = N.PST; passive = PASS; potential = POT; precedent gerundial = P.GER; processive = PROC; recent past = REC; reflexive = RFLX; remote past = REM; unaccusative = UNACC.

b.	/be:wn	xa/	→ [**be:.win**.xa]	Underlying Root Shape:	CV:CC
	‘sew’	HORT		Surface Root Shape:	CV:CVC
	“let’s sew!”				$(\sigma_{\mu\mu}\sigma_{\mu\mu})$

(8) Phonotactic Vowel Shortening

a.	/ma:x	ga/	→ [**max**.ga]	Underlying Root Shape:	CV:C
	‘collect’	IMPER		Surface Root Shape:	CVC
	“collect!”				$(\sigma_{\mu\mu})$
b.	/be:wn	eʔ/	→ [**bew.n**eʔ]	Underlying Root Shape:	CV:CC
	‘sew’	N.PST		Surface Root Shape:	CVCC
	“will sew”				$(\sigma_{\mu\mu})$

While the changes to root shape in (7-8) are predictable according to Chukchansi syllable phonotactics, other changes to root shape are not phonotactically predictable. In the environment of certain suffixes like the causative /-la, -e/ and the agentive /-ʧʼ/, roots surface as a light-heavy (LH) disyllable, no matter what their underlying shape is (9). Because the surface root shape is the same across roots with different underlying shapes, this LH shape is considered a **fixed template** (see Archangeli 1983, 1991 for Yowlumne Yokuts, McCarthy 1979 *inter alia* for Semitic languages). The root **bears** the LH template, while suffixes providing the environment for the LH template are **triggers** the template. The LH template, however, is not necessarily coextensive with the edge of the root: in (9a) and (9c), the second vowel of the template is epenthetic, and not part of the root itself, while in (9b) and (9d), the root-final consonant is outside of the template.

(9) Same Surface Shape = Fixed LH Template

a.	/wan	la	hil/	→ [**wa.na:**.la.hil]	Underlying Root Shape:	CVC
	‘give’	CAUS	MID		Surface Root Shape:	**CVCV:**
	“made X give”					$(\boldsymbol{\sigma_{\mu}\sigma_{\mu\mu}})$
b.	/ʔaml	e	taʔ/	→ [**ʔa.ma:.l**e.taʔ]	Underlying Root Shape:	CVCC
	‘help’	CAUS	REM		Surface Root Shape:	**CVCV:C**
	“had made X help”					$(\boldsymbol{\sigma_{\mu}\sigma_{\mu\mu}})$
c.	/ma:x	ʧʼ	i/	→ [**ma.xa:**.ʧi]	Underlying Root Shape:	CV:C
	‘collect’	AGTV	ACC		Surface Root Shape:	**CVCV:**
	“collector” (ACC)					$(\boldsymbol{\sigma_{\mu}\sigma_{\mu\mu}})$

d. /be:wn ʧ˺ ˀ/ → [**<u>be.we:.n</u>**iʧ˺] <u>Underlying Root Shape: CV:CC</u>
'sew' AGTV NOM Surface Root Shape: **CVCV:C**
"sewer" (NOM) **($\sigma_\mu\sigma_{\mu\mu}$)**

The second vowel of the LH template is long unless it is followed by two consonants; in this case the second vowel is short in order to conform to Chukchansi's CVX syllable canon (10). The quality of the second vowel of the LH template varies depending on the phonological properties of both the root and the suffix; see §2.7 for details.

(10) LH Template: H can be CVC

a. /ʔaml ʔa n'/ → [**<u>ʔa.mal'</u>**.ʔan'] Underlying Root Shape: CVCC
'help' DUR N.PST Surface Root Shape: **CVCVC**
"is helping" **($\sigma_\mu\sigma_{\mu\mu}$)**

b. /be:wn ʔhij ˀ/ → [**<u>be.wen'</u>**.hij'] Underlying Root Shape: CV:CC
'sew' ADJV NOM Surface Root Shape: **CVCVC**
"sewing place" (NOM) **($\sigma_\mu\sigma_{\mu\mu}$)**

The appearance of the LH template is not predictable based on the phonotactics of Chukchansi. The second vowel of the foot is epenthetic, but it is not inserted in order to break up a consonant cluster. For example, the underlying forms in (11a-b) above could satisfy the Chukchansi CVX syllable maximum without epenthesizing the second vowel [a:]. Moreover, there is no phonotactic reason for the epenthetic vowel to be long as opposed to short.

(11) LH Template not needed for phonotactics

a. /wan-la-hil/ → [wa.na:.la.hil] vs. unattested *[wan.la.hil]
b. /ʔaml-e-taʔ/ → [ʔa.ma:.le.taʔ] vs. unattested *[ʔam.le.taʔ]

The constant LH template occurs with eight different suffixes (template-triggers) in Chukchansi, many of which affect the segmental content of the template as well as imposing the LH shape; see §2.7 for more details. These suffixes do not share a common phonological property that could conceivably cause the template to surface. The suffixes vary in shape between a single consonant (12), a single vowel (13), a consonant and vowel (14), and two consonants followed by a vowel and another consonant (15).

(12) /C/ Template-Trigger
  a. /ʧʼ/ AGENTIVE (AGTV)

(13) /V/ Template-Trigger
  a. /e/ CAUSATIVE (CAUS; triconsonantal allomorph)
  b. /a/, /e/ DISTRIBUTIVE (DISTR)
  c. /a/ INCHOATIVE (INCH)

(14) /CV/ Template-Trigger
  a. /la/ CAUSATIVE (CAUS; general allomorph)
  b. /ʔa/ DURATIVE (DUR)
  c. /ta/ CAUSATIVE-INCHOATIVE (CS.IN)

(15) /CCVC/ Template-Trigger
  a. /ʔhij/ ADJUNCTIVE (ADJV)

Since both the shapes of these suffixes and the shapes of the roots they attach to vary, the phonotactics of the shapes cannot motivate the appearance of the LH template in the roots above (9-11). While there is no phonological property common to the template-triggering suffixes in (12-15), they do share a semantic property: their meaning relates to the event structure of the Chukchansi verb. The causative adds an initial event of causing to the meaning of the verb root (16a), while the inchoative and causative-inchoative add an initial event of causing and becoming, respectively, to the meaning of an adjective root (16b-c).

(16) Event structure: added initial event
  a. CAUSATIVE: VERB → make X VERB
  b. INCHOATIVE: ADJECTIVE → become ADJECTIVE
  c. CAUSATIVE-INCHOATIVE: ADJECTIVE → make X (become) ADJECTIVE

The durative and distributive modify the internal process of the verbal event (17). The durative indicates that the event is extended in time, usually giving a progressive reading (17a). The distributive indicates that the event is widespread in place or affects many objects. (17b).

(17) Event structure: modified internal event

a.	DURATIVE	VERB	→ is (in the process of) VERB-ing
b.	DISTRIBUTIVE	VERB	→ VERB a lot of OBJECTS, VERB all around

The agentive and adjunctive are active verbal nouns: they specify that the verbal event is an action, and then encode either the external argument of the event (18a) or a location or instrument associated with the event (18b).

(18) Event structure: active verbal noun

a.	AGENTIVE	VERB	→ one who VERBS
b.	ADJUNCTIVE	VERB	→ place/tool for one to VERB

In §2.4, I propose that these event structure-related suffixes are all **phase heads** that merge on top of a verbalized root (v_1 + the acategorial root) and spell it out from syntax to phonology. I argue that early spellout causes the root shape to change to LH.

Certain roots do not change their underlying shape to LH with the template-triggering suffixes above (19). These roots do not surface with the expected LH shape with the template-triggering suffixes; instead, their shape is predictable from phonotactics (19ii). These roots have the same surface shape with template-triggering suffixes as without them (19i).

(19) Roots not changing shape to (LH) foot

a.	i.	/ʧʾedma ‘think’ “had thought”	taʔ/ REM	→ [ʧʾed.ma.taʔ]	Root Shape: CVCCV

	ii.	/ʧʼedma	la	taʔ/	→	[ʧʼed.ma.la.taʔ]	Expected LH Shape
		‘think’	CAUS	REM			*[ʧʼe.dam.la.taʔ],
		“had made X think”					*[ʧʼe.de:.ma.la.taʔ]
b.	i.	/jo:jo	n’/		→	[jo:.jon’]	Root Shape: CV:CV
		‘call’	N.PST				
		“will call”					
	ii.	/jo:jo	ʧʼ	i/	→	[jo:.jo.ʧʼi]	Expected LH Shape:
		‘call’	AGTV	ACC			*[jo.jo:.ʧʼi]
		“caller” (ACC)					
c.	i.	/haj’k’it	hil/		→	[haj’.k’it.hil]	Root Shape: CVCCVC
		‘finish’	MID				
		“finished”					
	ii.	/haj’k’it	la	hil/	→	[haj’.k’it.la.hil]	Expected LH Shape:
		‘finish’	CAUS	MID			*[ha.ja:.k’it.la.hil]
		“made X finish”					*[ha.jik’.ti.la.hil]

All roots that do not change their shape, i.e., atemplatic roots, have at least two underlying vowels: /ʧʼedma/, /jo:jo/, /haj’k’it/. On the other hand, all roots that participate in templatic change, i.e., templatic roots, have only one underlying vowel: /wan/, /ʧiʃ/, /ma:x/, /se:p/, /ʔaml/, /lihm/, /gajs/, /be:wn/. In §2.3 I demonstrate that early spellout of the verbalized root (v_1 + root) results in the root forming a PWd by itself. As derived PWds in Chukchansi must have at least two syllables, roots with underlying vowels get augmented to an (LˈH) disyllabic iamb as a **minimality effect**; underlyingly multi-vowel roots meet minimality on their own and do not change.

As illustrated in this section, the following three generalizations capture the templatic verb morphology of Chukchansi (20).

(20)
a. Template-triggering suffixes relate to the **event structure** of the verb
b. Template-bearing roots have **one underlying vowel**
c. Templatic shapes are **LH disyllables**

The next section demonstrates that these three generalizations find a natural account in the cyclic syntax-recursive prosody model outlined in Chapter One.

2.3. Proposal: Template = Internal PWd_{min}

This section proposes that fixed templates in Chukchansi result from cyclic spellout reflected by prosodic recursion in the phonology. The general phonological grammar of Chukchansi yields templates as a reflex of prosodic recursion with one-vowel roots. I argue that the three descriptive generalizations of templatic change above have the following three theoretical analogues in the cyclic syntax-recursive prosody model (21).

(21)
a. Suffixes that trigger templates are **syntactically cyclic phase heads**, resulting in multiple spellout of the verb root and PWd recursion
b. Roots that bear templates are **phonologically sub-minimal**, with only one underlying vowel, unable to meet a disyllabic minimality requirement on PWds without augmentation
c. Target template shapes are **optimal disyllables**, i.e., (LˈH) iambs in Chukchansi

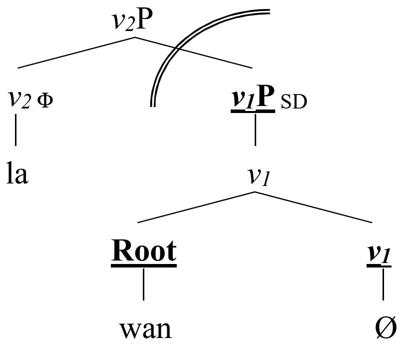
I now illustrate how this account works. The suffixes that trigger templates all relate to event structure. Specifically, template-triggering suffixes take the event denoted by the verbalized root (or property of the adjectivalized root) and then do one of two things. Higher *v* heads take the single event or property denoted by the categorized root and create a complex event, either adding an initial event of causing or becoming (the causative, inchoative, and causative-inchoative), or modifying the internal, dynamic process of the event (the distributive and durative). Higher *n* heads nominalize the event denoted by the categorized root, referring to the external argument or instrument (the agentive and adjunctive). These suffixes are **phasal** and spell out the categorized root in their complements, which itself combines an acategorial root and an event-introducing *v* head, or a property-introducing *a* head with the inchoative and causative-inchoative. §2.4 gives a detailed account of phasehood in Chukchansi.

These suffixes are the only ones in Chukchansi that form biphasal verbs, i.e., that spell out categorized roots at an early phase. These suffixes are the only ones that cause PWd recursion. Other suffixes either attach directly to an acategorial root (the unaccusative v_1 /-n-/) or are not phasal. Non-phasal suffixes in Chukchansi include tense and mood suffixes in T (or Infl), which appear at the end of the verb, and argument-structure changing suffixes Voice and Appl(icative), which do not create a complex event (see, e.g., Kratzer 1996, Pylkkänen 2008, Harley 2013 for Voice and Appl heads being distinct from event-semantic *v* heads).

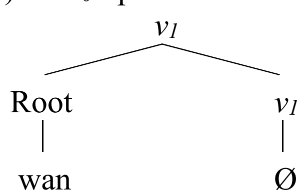
The presence of a higher phase head that spells out the categorized root results in PWd recursion. In the derivation of [wa.na:.la.hil] ((22), from (9a)), the acategorial root /wan/ head-adjoins to the categorizer v_1 /Ø/, which types it as an event (Kastner 2016). v_1 is a phase head by virtue of being a categorizer; however, v_1 does not spell out the root, because the two items are head-adjoined. Next, the causative v_2 phase head /-la/ merges on top of the verbalized root /wan-Ø/, which head-moves to v_2 (23). As a phase head, v_2 spells out the lower copies of the verbalized root in its complement, v_1P; the verbalized root is transferred to the phonology as an X_0 (24).

(22)	/wan	Ø	la	hil/	→ [**wa.na:**.la.hil]
	Root	v_1	v_2	T	
	'give'	ACT	CAUS	MID	
	"made X give"				

(23) /wan-Ø-la-hil/: First Phase

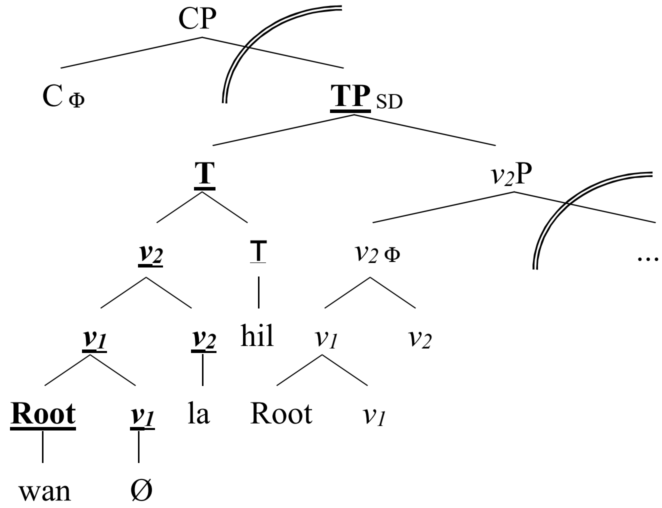


(24) X_0 Spelled Out in First Phase



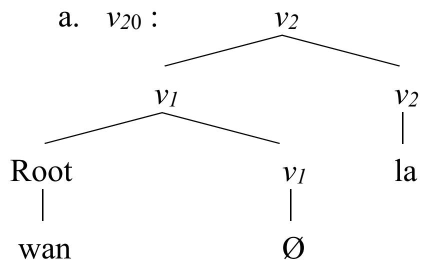
The adjoined head made of v_2 and the higher copy of the verbalized root keeps moving up the tree to the highest head, T. When the phase head C spells out its complement TP at the second phase, the adjoined heads in T and in v_2 are spelled out, including two copies of the verbalized root and the phase head v_2, and any higher heads. For example, when all the syntactic material of [wa.na:.la.hil] is spelled out by the phase head C (25), this includes both the lower adjoined X_0 in v_2, with the verbalized root /wan-Ø/ and the causative v_2 /-la-/ (26a), and the higher adjoined X_0 in T, with the verbalized root /wan-Ø/, the causative v_2 /-la-/ and the middle past T /-hil/ (26b).

(25) /wan-Ø-la-hil/: Second Phase

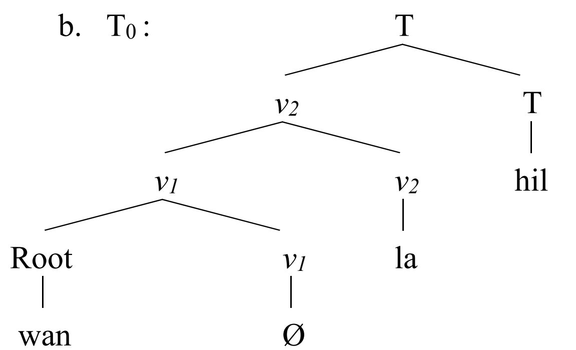


(26) X_0s Spelled Out in Second Phase

a. v_{20} :



b. T_0 :



Once the syntactic derivation has finished, the syntactic material that has been spelled out becomes the input to phonology. Constraints on vocabulary insertion and the syntax-phonology mapping compete with each other and with constraints on phonological well-formedness. The three constraints relevant to PWd recursion in Chukchansi are MATCHWORD, INTEGRITY-M and NON-RECURSIVITY.

(27) Constraints Relevant to PWd Recursion

a. MATCHWORD: Suppose there is an X_0 with the highest copy of a lexical root in a spellout domain. Assign a violation mark if there is no PWd in the output phonological representation corresponding to the X_0.

b. INTEGRITY-M: assign a violation if a single input morpheme corresponds to more than one output morph. (see Prince & Smolensky 1993/2004 for INTEGRITY, and Walker and Feng 2004 and Wolf 2008 for FAITH-M constraints)

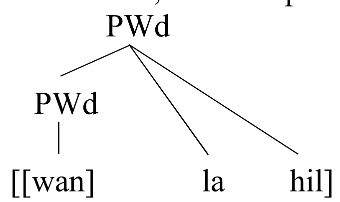
c. NON-RECURSIVITY: assign a violation for every prosodic category C^i dominated by C^j, i = j. (Selkirk 1995)

When syntax spells out a verb over two phases, MATCHWORD demands that the X_0s with the highest copies of the lexical root in each spellout domain correspond to distinct PWds. For example, in the biphasal verb (22), there are two spellout domains, v_1P (24) and TP (26). The X_0 with the highest copy of the lexical root in each of these spellout domains is v_{10} in v_1P (24) and T_0 (26b) MATCHWORD is satisfied if there is a PWd in the output corresponding to each of these two X_0s, i.e., one PWd corresponding to the X_0 /wan-Ø/$_{X0}$ (24) and the other to the X_0 /wan-Ø-la-hil/$_{X0}$ (26b). The lower X_0 in the TP spellout domain, the v_{20} (26a), does not contain the highest copy of a lexical root in this spellout domain. Therefore, MATCHWORD does not demand that there be an output PWd corresponding to the X_0 /wan-Ø-la/$_{X0}$ (26a). In a biphasal word, MATCHWORD is satisfied with two PWds, one for each spellout domain, even when three (or more) X_0s have been spelled out.

Both these PWds created to satisfy MATCHWORD will contain an exponent of the root /wan/, which is in both X_0s; because the categorizer v_1 is phonologically null, I leave it out of the discussion. While there are thus two copies of the root, each spelled out at a different phase, the copies are identical in both their morphosyntactic form and their semantics. When multiple, identical copies of a syntactic item are spelled out over several phases, only one exponent usually surfaces. In the input to phonology, multiple, identical copies count as a single morpheme;

INTEGRITY-M thus demands that only one morph be inserted for all the copies. For example, INTEGRITY-M is satisfied if there is only one morph [wan] in the output that is the exponent of the identical copies of the root /wan/ in /wan-Ø/$_{X_0}$ (24) and /wan-Ø-la-hil/$_{X_0}$ (26b). In order for two distinct PWds both to contain the morph [wan], these PWds must be recursively-layered (28).

(28) Two PWds, One Morph → PWd Recursion



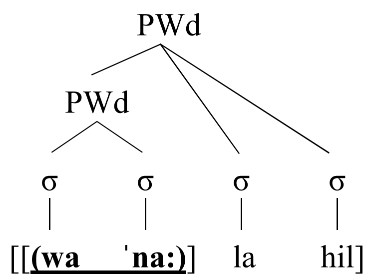
In Chukchansi, biphasal verbs show PWd recursion; MATCHWORD and INTEGRITY-M thus dominate NONRECURSIVITY in Chukchansi (29). A candidate with only one PWd, [wan-la-hil], violates MATCHWORD, while a candidate with two separate morphs of the root, [wana:][wan-la-hil], violates INTEGRITY-M. The winner, [[wana:]la-hil], has two distinct PWds, [wana:] and [wana:-la-hil], but only one morph of the root, [wana:], and so satisfies both MATCHWORD and INTEGRITY-M. [[wana:]la-hil] has two recursively-layered PWds, which violates low-ranking NONRECURSIVITY. The candidate [[[wana:]$_{PWd}$ la]$_{PWd}$ hil]$_{PWd}$ has three PWds, including one for the X_0 that is not the highest copy in a phase; this candidate violates NONRECURSIVITY an extra time for the third PWd. In (29), the input X_0 with the highest copy of the lexical root in each phase is highlighted.

(29) Biphasal Verb = Recursive PWds in Chukchansi

/wan/$_{X_0}$, /wan-la/$_{X_0}$, **/wan-la-hil/$_{X_0}$**	MATCHWORD	INTEGRITY-M	NONRECURSIVITY
☞ [[wana:]$_{PWd}$ la-hil]$_{PWd}$			1
[[[wana:]$_{PWd}$ la]$_{PWd}$ hil]$_{PWd}$			2 W
[wana:]$_{PWd}$-[wan-la-hil]$_{PWd}$		1 W	L
[wan-la-hil]$_{PWd}$	1 W		L

Chukchansi has a disyllabic minimality requirement on PWds. When a categorized root with only one underlying vowel, such as /wan-Ø/, forms an internal PWd in a recursive structure, it requires another vowel to meet disyllabic minimality. As demonstrated in §2.5.2, Chukchansi prefers to parse PWds into iambic feet; the optimal iambic disyllable is an (Lˈ H) foot (Prince 1990, Kager 1993, 1995, Hayes 1995). Therefore, the material forming the disyllable needed to meet the PWd minimality requirement is arranged to form an (Lˈ H) foot, like [(wa.na:)] (30). The constant (Lˈ H) foot appears as a **minimality effect** when one-vowel roots are spelled out twice due to a phase head suffix and gives the appearance of a fixed template.

(30) PWd Recursion → LH Foot = Template

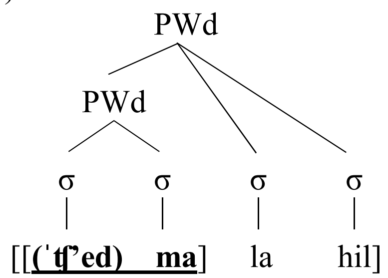


However, if the categorized root has at least two vowels, it can meet disyllabic minimality using its own underlying material. Since underlying material is less available for manipulation than epenthetic material, it cannot be freely rearranged to form an (Lˈ H) foot. For example, in the derivation of [ʧʼed.ma.la.hil] (31), the verbalized root /ʧʼed.ma-Ø/ is spelled out twice and forms an internal PWd, but does not change its shape (32). (31) contains the same template-triggering, phase head suffix /la-/ as (22), and thus has the same syntactic structure. The only difference between (22) and (31) is that the latter has a multi-vowel root, which prevents the emergence of the (Lˈ H) disyllable.

(31)

/ʧ’edma	Ø	la	hil/	→ [**<u>ʧ’ed.ma</u>**.la.hil]
Root	v_1	v_2	T	
‘think’	ACT	CAUS	MID	
“made X think”				

(32) PWd Recursion + Multi-Vowel Root → No Template

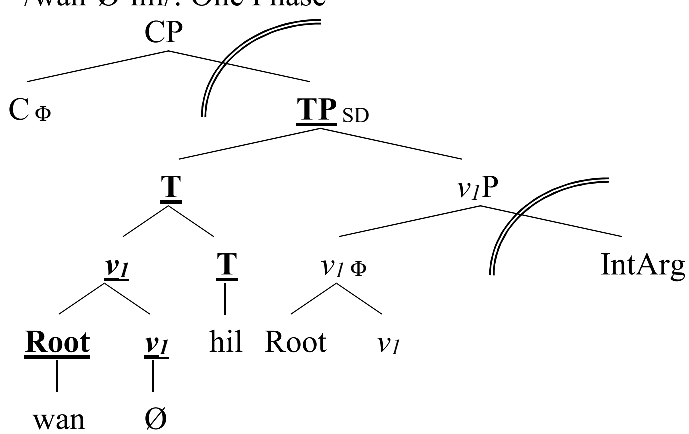


When no higher phase head is present in the syntax, the whole verb is spelled out in a single phase. For example, in the derivation of [wan.hil] (33), the verbalized root and its suffixes /wan-Ø-hil/ are spelled out by the C phase head (typically null in Chukchansi) (34). Two adjoined X_0s are transferred in the same spellout domain: the lower in v_1 /wan-Ø/ (35a) and the higher in T /wan-Ø-hil/ (35b).

(33)

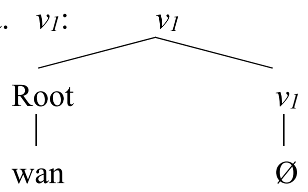
/wan	Ø	hil/	→ [**<u>wan</u>**.la.hil]
Root	v_1	T	
‘give’	ACT	MID	
“gave”			

(34) /wan-Ø-hil/: One Phase

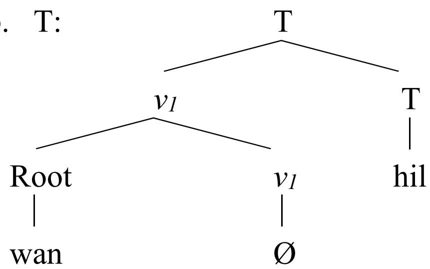


(35) X_0s Spelled Out

a. v_1:



b. T:



Since only the X_0 /wan-Ø-hil/ in T (35b) contains the highest copy of the lexical root in the single phase, MATCHWORD demands that there be one PWd, which will contain all the morphemes of the verb. One morph for each morpheme is inserted into the single PWd, and all three relevant constraints are satisfied. A recursive PWd output, with two PWds corresponding to the two X_0s, is eliminated by NONRECURSIVITY, as it does not do any better than the single PWd on MATCHWORD.

(36) Single X_0 = Single PWd in Chukchansi

/wan/$_{X0}$, **/wan-hil/$_{X0}$**	MATCHWORD	INTEGRITY-M	NONRECURSIVITY
☞ [wan-hil]$_{PWd}$			
[[wan]$_{PWd}$ hil]$_{PWd}$			1 W
[wan]$_{PWd}$-[wan-hil]$_{PWd}$		1 W	

Since the root morph (e.g., [wan]) does not form its own internal PWd, the disyllabic minimality condition on PWds applies to all the morphs together. Minimality is met using suffix material (e.g., [-hil]), which always provides another vowel in addition to the root (37). Again, the underlying material is not free to be rearranged into an optimal iambic LH disyllable, so **no template appears**.

(37) Single PWd + One Vowel Root → No Template

```
      PWd
     /   \
    σ     σ
    |     |
[(ˈwan)  hil]
```

The appearance of the fixed template in Chukchansi requires two conditions: **PWd recursion**, which only happens when a higher phase head is present, and **sub-minimal roots**, which only have one underlying vowel. When sub-minimal roots form an internal PWd by themselves, they must be augmented to meet minimality, and the epenthetic material required is arranged to form the **optimal disyllable** in Chukchansi, the LH foot. Therefore, a template can only appear when a higher phase head suffix attaches to a sub-minimal root, as illustrated in Table 2.

Table 2. Syntactic and Phonological Conditions on Templates

Verbalized Roots		Phonology	
		Sub-minimal (one-vowel) Root	Multi-Vowel Root
Syntax	No Phasal Suffix = Single PWd	No augmentation → no LH foot [wan.hil] (37)	No augmentation → no LH foot [ʧʔed.ma.hil]
	Phasal Suffix = PWd Recursion	**Augmentation to optimal disyllable = LH Template [[wa.na:] la.hil]** (30)	No augmentation → no LH foot [[ʧʔed.ma] la.hil] (32)

The following sections defend the above account of Chukchansi in both syntax (§2.4) and phonology (§2.5). §2.4 details the phasal structure of the syntactic derivations above (23-26, 34-35), and argues that only suffixes that appear to trigger templates are higher phase heads. §2.5 illustrates the preference for iambs in Chukchansi, and models how augmentation to a disyllable results in an LH foot in an OT grammar.

2.4. Phasal Syntax of Chukchansi Verbs

This section provides more evidence for the word-internal phasal structure proposed above in Chukchansi. Only the template-triggering suffixes are phase heads; other suffixes are not phasal, and thus do not induce PWd recursion or the appearance of the LH template. The arguments in this section come from word-internal evidence. I have not discovered sentence-level evidence for phasehood in Chukchansi, due to its extremely free word order: all six orders of subject, verb and object are grammatically acceptable, and most of these orders are produced spontaneously, sometimes in close succession. Moreover, elements within a phrase can be freely moved around the sentence, in violation of restrictions on left branch extraction and movement out of coordinate structure and other islands. This freedom of movement, combined with a preference for nominalization structures instead of embedded clauses, makes it difficult to find evidence for phases at the sentence level (Brian Agbayani, p.c.). Recent work by Adisasmito-Smith et al (in prep) comparing verbal argument structure and the basic word order of arguments suggests that sentence-level syntax closely parallels word-internal syntax.

2.4.1. Verbal Suffixes in Chukchansi

Besides the distinction between template-triggering and non-triggering suffixes, the most important distinction in Chukchansi morphology is between final and non-final suffixes. All lexical words in Chukchansi obligatorily have one and only one final suffix, which encodes tense or mood in verbs and Case in nouns and adjectives (38).

(38) Final Suffixes in Chukchansi Verbs

a. /wan taʔ/ → [wan.taʔ]
‘give’ REM
“had given”

b. /wan ga/ → [wan.ga]
‘give’ IMPER
“give!”

c. */wan/ → *[wan]

d. */wan-ga-taʔ/ → *[wan.ga.taʔ]

Lexical words may optionally have any number of non-final suffixes, or none at all. While non-final suffixes are rare on nouns, aside from nominalizing suffixes themselves, non-final suffixes are common on verbs. The relative order of non-final and final suffixes on the verb directly reflects their syntactic hierarchy, respecting the Mirror Principle (Baker 1986). Final verbal suffixes either have temporal or modal content, so are most likely located in T. Non-final suffixes are between the verbalized root and T: they manipulate argument and event structure, except for the desiderative /-maʔʃa-/ ‘want to’ and the processive /-mewo-/ ‘go while’. Final suffixes always scope over non-final suffixes (39).

(39) Mirror Principle: Final and Non-final Suffixes

/wan maʔʃa taʔ/ → [wan.maʔ.ʃa.taʔ]
‘give’ DESID REM
“had wanted to give” [[DESID] REM]
NOT “want to have had given” *[[REM] DESID]

Adisasmito-Smith et al (in prep) demonstrate that a suffix farther from the root scopes over a suffix closer to the root, again as expected under the Mirror Principle (40).

(40) Mirror Principle: Non-final Suffixes

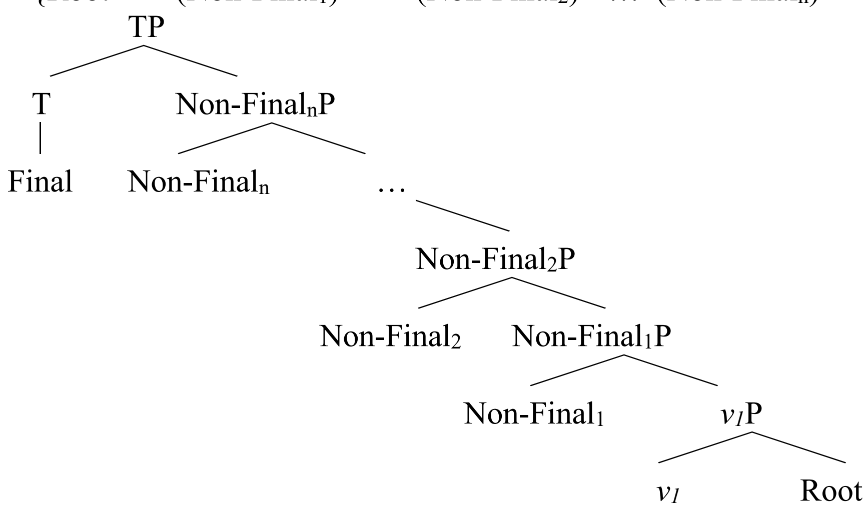
a. /wan la maʔʃa taʔ/ → [wa.na:.la.maʔ.ʃa.taʔ]
‘give’ CAUS DESID REM
“had wanted to make X give” [[CAUS] DESID]

b. /wan maʔʃa la taʔ/ → [wan.maʔ.ʃa.la.taʔ]
‘give’ DESID CAUS REM
“had made X want to give” [[DESID] CAUS]

The order of morphemes in the Chukchansi verb, with optional non-final suffixes and a single obligatory final suffix (41), transparently reflects its syntactic structure (42).

(41) {Root (Non-Final$_1$) (Non-Final$_2$) … (Non-Final$_n$) *(Final)}$_{X0}$

(42)



All template-triggering suffixes are non-final, and are typically adjacent to the root; see §2.6.3 below for an important exception. Other verbal suffixes in Chukchansi do not trigger templates. I give a full list of non-triggering suffixes in Table 3 attached to the root /xat/ ‘eat’, as well as the non-template-triggering unaccusative suffix /-n-/ in (43), which does not appear with the root /xat/.

Table 3. Non-Template-Triggering Suffixes in Chukchansi

Suffix			UR	Example	Gloss
Final	Finite Tense	NON.PAST (N.PST)	-eʔ, -n’	[xat-eʔ]	“will eat”
		RECENT.PAST (REC)	-it	[xat-it]	“just ate”
		MIDDLE.PAST (MID)	-hil	[xat-hil]	“ate” (yesterday)
		REMOTE.PAST (REM)	-taʔ	[xat-taʔ]	“had eaten” (long ago)
	Non-finite Tense	CONSEQUENT GERUNDIAL (C.GER)	-mi	[xat-mi]	“before/during eating”
		PRECEDENT GERUNDIAL (P.GER)	-taw	[xat-taw]	“after/during eating”
	Mood	IMPERATIVE (IMPER)	-ga	[xat-ga]	“eat!”
		HORTATIVE (HORT)	-xa	[xat-xa]	“let’s eat”
		POTENTIAL (POT)	-al	[xat-al]	“can eat”
Non-Final	Argument Structure	REFLEXIVE (RFLX)	-wʃ-	[xat-wiʃ-hil]	“ate oneself”
		PASSIVE (PASS)	-han-	[xat-han-hil]	“was eaten”
		BENEFACTIVE (BEN)	-ʃt-	[xat-ʃit-hil]	“ate for X”
		COMITATIVE (COM)	-mx-	[xat-mix-hil]	“ate with X”
	Other	PROCESSIVE (PROC)	-mewo-	[xat-mewo-hil]	“went eating”
		DESIDERATIVE (DESID)	-maʔʃa-	[xat-maʔʃa-n’]	“wants to eat”

(43) Unaccusative Suffix

/t’ul	n	it/	→	[t’ul.nut]
‘burn’	UNACC(USATIVE)	REC		

“burned” (intransitive)

cf. /t’ul-Ø=it/ ‘burn’-ACT-REC → [t’u.lut] “burned” (transitive)

2.4.2. Phase Head Suffixes

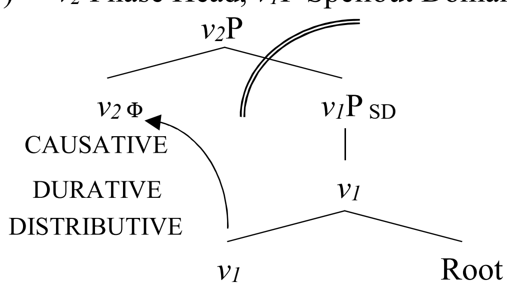
In this section I discuss the seven phase head suffixes in Chukchansi, all of which trigger templates. Categorizing heads (i.e., *v*, *n* and *a*) generate phasehood (Marantz 2001, 2007, Marvin 2002); template-triggering suffixes are all categorizing phase heads, either $v_{(2)}$ or *n*, while non-triggering suffixes (Table 3) are not categorizers and not phasal. All three syntactic classes of template-triggers are phasal under this definition: event-semantic suffixes (Verb → Verb = v_2), verbalizing suffixes (Adjective → Verb = *v*), and nominalizing suffixes (Verb → Noun = *n*). I show these suffixes in Table 4 attached to the root /ʔaml/ ‘help’ for the event-semantic and nominalizing suffixes and the root /gajs/ ‘good’ for the verbalizing suffixes; the rest of the sub-section shows what makes these seven suffixes phasal.

Table 4. Template-Triggering Suffixes in Chukchansi

Suffix		UR	Example	Gloss
Event-Semantics	CAUSATIVE (CAUS)	-la, -e	[ʔama:l-e-t]	“just made X help”
	DURATIVE (DUR)	-ʔa	[ʔamal’-ʔa-n’]	“is helping”
	DISTRIBUTIVE (DISTR)	-a	[ʔame:l-a-n’]	“helps many X”
Nominalizing	AGENTIVE (AGTV)	-ʧ’	[ʔama:l-iʧ’]	“helper”
	ADJUNCTIVE (ADJV)	-ʔhij	[ʔamal’-hij’]	“helping tool/place”
Verbalizing	INCHOATIVE (INCH)	-a	[gaje:s-a-t]	“just got better”
	CAUSATIVE-INCHOATIVE (CS.IN)	-ta	[gajes-ta-t]	“just made X get better”

Event-semantic (v_2) suffixes include the CAUSATIVE, DURATIVE, and DISTRIBUTIVE, which merge on top of verbalized roots (v_1 + Root), as in (44).

(44) v_2 Phase Head, v_1P Spellout Domain



Event-semantic v_2 suffixes take the event encoded by the verbalized root (v_1 + the root) and create a complex event. Specifically, v_2 suffixes embed the lower event under a second event denoted by the suffix: a cause (CAUSATIVE) or a dynamic (D-)state (Maienborn 2005; DURATIVE, DISTRIBUTIVE). v_1 introduces an event (e) into the syntax that involves the semantic content of the root. The type of event (i.e., “flavor” of v; Folli and Harley 2005) introduced by v_1 is determined in part by the lexical specification of the root, and the semantic combination of v_1 and the root can be non-compositional, since they are always sent to LF in the same phase (see, e.g., Marantz 2001, 2013a, Embick 2010, for non-compositional semantics only being possible with items in the same spellout domain). v_1 also selects for the allomorph of the root, suggesting that v_1 and the root are in the same spellout domain (Embick 2010, Harley and Tubino-Blanco 2013). Evidence for allomorphy selection by v_1 comes from the fact that nominalized, adjectivalized and verbalized forms of a cognate root can have different vocalic patterns. Since the lexical, morphosemantic root is identical in both forms, the allomorphy is triggered the categorizers *v*, *n* and *a* merged with the root (45).[2]

(45) Different Forms of Nominalized, Adjectivalized and Verbalized Roots

a.	**/so:nop'/**	√SNOT + *n* = 'snot'	vs.	**/sonp'/**	√SNOT + *v* = 'be snotty'
b.	**/gadja/**	√HUNGER + *a* = 'hungry'	vs.	**/gada:j/**	√HUNGER + *v* = 'be hungry'
c.	**/ʃe:ʔal/**	√RAIN + *n* = 'rain' (n.)	vs.	**/ʃeʔe:l /**	√RAIN + *v* = 'rain' (v.)
d.	**/hoj'no/**	√FLY + *n* = 'plane'	vs.	**/hoj'n/**	√FLY + *v* = 'fly' (v.)
e.	**/dehel'/**	√SCISSOR + *n* = 'scissors'	vs.	**/dihl/**	√SCISSOR + *v* = 'cut w/ scissors'

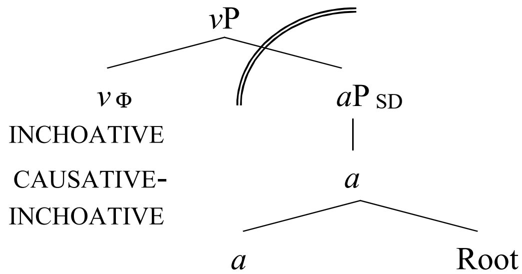
Higher v_2 suffixes, on the other hand, always have a compositional semantic combination with the verbalized event (v_1P). The CAUSATIVE always adds a causation event embedding the event of the verbalized root and an extra, agent external argument (i.e., it is a syntactic, not a lexical causative; Hale and Keyser 1993). The DURATIVE and DISTRIBUTIVE embed the event of the verbalized root under a dynamic or Davidsonian D-state (Maienborn 2005, Fábregas and Marín 2012). A D-state is a homogenous eventuality, i.e., without distinct sub-parts; unlike other states,

[2] Allomorph selection being limited to the same spellout domain seems to contradict the model of phonologization proposed in Chapter One, where the cumulative material transferred in all spellout domains is phonologized in parallel. In a single, parallel phonological derivation, however, the input must include some phonological information, and thus some phonologization happens before the phonology proper. The phonological information that must be present in the input includes unpredictable segmental information, typically labeled the underlying representation (UR). Predictable phonological information, which in this analysis includes the LH template, is not present in the input to phonology (see Prince and Smolensky 1993/2004 for a more in-depth discussion of inputs in parallel OT). I propose specifically that non-phonologically conditioned allomorph selection happens before the phonological derivation. I lay out arguments for this in more detail in §3.3.3 and §4.2.

D-states also have dynamicity, and are similar to activities in this sense. The D-state encoded by the DURATIVE indicates extension in time, and thus gives progressive readings of the embedded event encoded by the verbalized root. The D-state encoded by the DISTRIBUTIVE indicates extension in space, so that the embedded event occurs at multiple places or affects multiple objects. While the specific semantics of these suffixes requires more investigation, e.g., whether the durative includes imperfective viewpoint aspect (Smith 1991), it is clear that they all create complex events by embedding the event of the verbalized root under a secondary eventuality. As heads that introduce a secondary eventuality into the syntax, they are *v* heads (Harley 2013, Marantz 2013b), and are thus phasal.

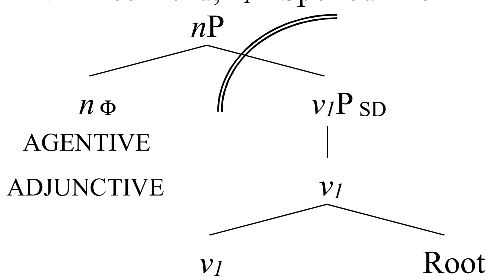
The other two types of phase heads are also categorizers, but change the category of their complement instead of creating a complex event. Verbalizing phase heads (the INCHOATIVE and CAUSATIVE-INCHOATIVE) take an adjectivalized root, which expresses a property or state, and add an initial change-of-state, when the property begins. This change-of-state is an event, and the INCHOATIVE and CAUSATIVE-INCHOATIVE heads are *v* heads, following a long line of research, including Folli and Harley (2005) and Travis (2010). These *v* heads are categorizers and therefore phase heads according to the DM view of morphosyntax outline in §1.2.1; evidence for the phasal status of category-changing morphemes includes Marvin (2002, 2013) and Newell (2008). The *v* heads spell out the adjectivalized root (*a* + Root) they merge with; the *a* phase head they embed does not spell out the root, since it is the first head to merge with the root (46).

(46) *v* Phase Head, *a*P Spellout Domain



Nominalizing phase heads (the AGENTIVE and ADJUNCTIVE) take a verbalized root encoding an event and return an entity related to that event, either the highest argument (AGENTIVE) or a locative or instrumental adverbial (ADJUNCTIVE). Since they introduce an entity, these are *n* categorizing phase heads that spell out the verbalized root (*v* + Root) they merge with, as in (47).[3]

(47) *n* Phase Head, v_1P Spellout Domain



2.4.3. Non-Phase Head Suffixes

All other affixal heads in Chukchansi are non-phasal, and do not trigger templates. The obligatory final suffixes on verbs are in T, which is generally agreed not to be a phase (Chomsky

[3] A third nominalizing head, the OBJECTIVE /-hana/, does not trigger a template. The objective nominalizer indicates the internal argument of a transitive verb, and like the PASSIVE /-han/, only occurs with transitive roots. It is possible that the objective nominalizer is actually bimorphemic, a combination of the passive Voice head /-han/, which prevents an external argument from merging, and a nominalizer /-a/, which takes the remaining, internal argument. Assuming a similar phasal analysis to the AGENTIVE and ADJUNCTIVE nominals, the nominalizing head *n* in the objective will spell out the verbalized root together with the passive Voice head. Because the spelled out material has more than one vowel (the root vowel + the vowel of the passive suffix), the LH template cannot appear in the internal PWd_{min}; see §2.5.3-2.6 for the lack of templates with multi-vowel material. However, there is no phonological evidence for PWd recursion in objective nominal. I leave the morphosyntactic and phonological structure of the OBJECTIVE for further research.

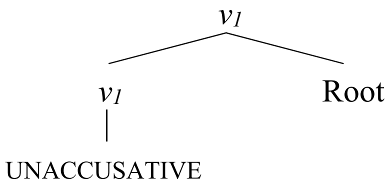
2000, 2001 *inter alia*). Final suffixes on nouns are case markers, which also are not phasal. There are no non-final suffixes on nouns, with the exception of the rare and unproductive plural /-hi-/, which seems to trigger the LH template on the handful of animate nouns it appears with.

Several non-final suffixes appearing on verbs do not trigger templates: REFLEXIVE, PASSIVE, BENEFACTIVE, COMITATIVE, UNACCUSATIVE, PROCESSIVE, and DESIDERATIVE (see Table 3 above). The REFLEXIVE and PASSIVE are Voice heads that suppress one of the arguments of a transitive verb (Harley 2013), so that only one argument remains. With the PASSIVE, the internal argument, e.g., a patient or theme, is left, while with the REFLEXIVE, the remaining argument is both external and internal, i.e., it acts on itself. Voice, unlike *v*, does not involve event semantics, but instead the appearance of arguments in the syntax (Harley 2013). Voice heads are thus not eligible for phase extension by the criterion of event semantics in §1.2.1; Chomsky (2000, 2001) and Den Dikken (2006) also propose that passives are not phasal, though with a different syntax (cf. Legate 2003).

The BENEFACTIVE and COMITATIVE are Appl(icative) heads, which add a non-core argument to the verb as an object. Some Appl heads, "high" applicatives in Pylkkänen (2008), are argued to be phasal (McGinnis 2001), while "low" applicatives are not. The syntax and semantics of applicative suffixes in Chukchansi requires further investigation to determine which type of applicative they are, and whether they show any evidence for phasehood, despite not triggering templates.

There is one other categorizing suffix in Chukchansi: the UNACCUSATIVE *v*. Unlike the template-triggering categorizers above, which merge above a categorized root and spell it out, the UNACCUSATIVE *v* merges directly with an acategorial root, i.e., it is a first-merged categorizing v_1. Because the root is head-adjoined to the UNACCUSATIVE *v*, the UNACCUSATIVE does not spell out the root (48). The account of templates in §2.3, in which the LH-template cannot appear if the root is not spelled out early, correctly predicts that the UNACCUSATIVE never triggers a template.

(48) Unaccusative *v*

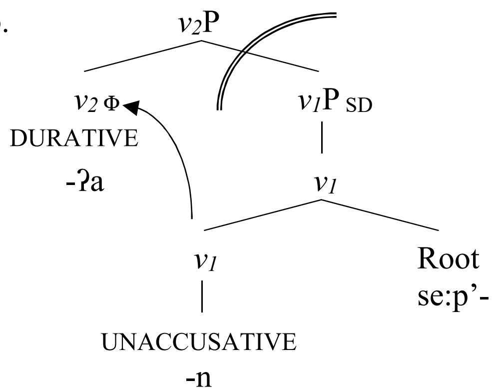


A template is triggered, however, if a higher phase head merges on top of the UNACCUSATIVE and the root, e.g., the DURATIVE v_2 (49); see §2.6.3 for the phonology of this construction.

(49) Durative v_2 + Unaccusative v_1

a. /se:p' n ʔa n'/$_{X0}$ → [[(se.'p'en')]$_{PWd}$ ʔan']$_{PWd}$
tear' UNACC DUR N.PST
"is tearing (intr.)"

b.



I do not have any clear evidence to marshal for a syntactic analysis of phasal status (or lack thereof) of the other two non-final, non-template-triggering suffixes, the DESIDERATIVE and the PROCESSIVE. The DESIDERATIVE, whose semantics is realized is a biclausal structure in many languages, adds an external argument, which desires the event to happen, while the PROCESSIVE, whose semantics is often encoded by a serial verb or converb construction in other languages, does not affect the argument structure of the verb. While the suffixes exponing these heads are phonologically larger than other affixes in Chukchansi (/-maʔʃa-/, /-mewo-/), they do not seem to behave differently than other suffixes (Adisasmito-Smith et al in prep). It is not clear whether these suffixes create a complex event similar to the CAUSATIVE, DURATIVE and DISTRIBUTIVE. They do not seem to modify the actual structure of the event signified by the verbalized root, i.e., they do not contribute to the Aktionsart of the verb. Because of this, I posit that the desiderative and processive heads are not higher v_2 phase heads. While further investigation is needed to determine the phasal status of these heads and the applicatives, it appears relatively certain that all of the template-triggering suffixes are phasal, while (most) non-template-triggering suffixes are not phasal. Chapter Five suggests that in a fleshed-out theory of the syntax-phonology interface like the one proposed in this dissertation, phonological evidence of cyclic spellout can help determine the phasal structure of the syntactic derivation (see Scheer 2008, 2009 for the idea of intermodular argumentation).

2.5. PWd Recursion and LH Iambs

This section builds on the account of the LH template proposed in §2.3, arguing for the specific points in greater detail. I first provide evidence for two of the claims made about Chukchansi phonology: (1) that there is a disyllabic minimality requirement on the internal PWd (§2.5.1), and (2) that the optimal disyllable in Chukchansi is the (LH) iambic foot (§2.5.2). The rest of the section (§2.5.3) works through when the fixed LH template does and does not appear in a parallel OT grammar.

2.5.1. Disyllabic Minimality

First, I posit that Chukchansi has a **disyllabic minimality requirement** on derived, lexical words. Virtually all independent words in Chukchansi are at least two syllables on the surface. A confounding factor is that content words are at least bimorphemic, consisting of a root and an obligatory final suffix, encoding tense or mood for verbs and Case for nouns and adjectives. Most Chukchansi suffixes and all roots have an underlying vowel, so bimorphemic words automatically surface with two syllables.

Two types of words can surface as monosyllables: function words (50), including words formed with the light verb roots /e:-/ 'do' and /xo:-/ 'exist, be', and nouns in the NOMINATIVE Case, about a dozen of which appear in the Chukchansi-English dictionary ((51), all from Adisasmito-Smith 2016).

(50) Monosyllabic Function Words

a.	/e: 'do'	it/ REC	→	[ʔet]	"just did"
b.	/xo: 'be'	n'/ N.PST	→	[xon']	"is there"
c.	/na 1st	ˀ/ NOM	→	[naʔ]	"I"
d.	/k'aj'/		→	[k'aj']	"possibly"
e.	/hew/		→	[hew]	"here"

(51) Monosyllabic Nominative Nouns

a.	/buʔ 'hawk'	Ø/ NOM	→	[buʔ]	"(red-tailed) hawk"
b.	/mos 'sweathouse'	Ø/ NOM	→	[mos]	"sweathouse"
c.	/tuk' 'ear'	Ø/ NOM	→	[tuk']	"ear"
d.	/baw 'shin'	ˀ/ NOM	→	[baw']	"shin"

It is common cross-linguistically for function words to escape word minimality requirements by not forming independent PWds (Selkirk 1995). Acoustic recordings of Chukchansi indicate that monosyllabic function words do not form stress feet and may be parsed as clitics to surrounding words. Specifically, function words have a lower pitch and intensity than other syllables, and never form pitch or intensity peaks, which are the acoustic correlates of Chukchansi stress (Mello 2012, Guekguezian 2016b). If the lack of stress indeed means that monosyllabic function words are prosodically deficient, this would indicate that function words are not evaluated for PWd minimality. To reconcile monosyllabic nouns with a disyllabic minimality requirement, I suggest that the minimality requirement is only on derived words, as Itô and Mester (1992/2003) argue for Japanese. Japanese has monomoraic nouns, but derived word forms such as hypocoristics must be minimally bimoraic; see also Piggott (to appear) for a similar case of words escaping minimality in Turkish. If disyllabic minimality in Chukchansi is only assessed on derived words, then nouns in the unmarked Nominative Case can escape the disyllabic minimum.

I model the disyllabic minimum with a cover constraint DISYLL (Kager 1996). I do not stake a claim to the underlying motivation for the disyllabic minimum; though DISYLL is probably decomposable into independent constraints governing the correspondence between morphological and phonological units (Kager 1996, Downing 2006). However, the disyllabic minimum is not equivalent to a requirement that PWds contain a binary foot (McCarthy and Prince 1986): the minimal binary foot in Chukchansi is a heavy monosyllabic (ˈH), but the minimal PWd is disyllabic. Many other unrelated languages allow monosyllabic (ˈH) Feet but have disyllabic minimal words, including Japanese (Itô 1990, Itô and Mester 1992/2003), Axininca Campa (McCarthy and Prince 1993b), Turkish (Inkelas and Orgun 1994), and Guugu Yimidhirr (Kager 1996). Kager (1996) and Garrett (1999) demonstrate that minimality requirements on PWds are often distinct from requirements that PWds contain a minimal foot. Since heavy monosyllabic feet (ˈH) are licit in Chukchansi, like in the other languages above, a constraint like FOOTBINARITY-σ (McCarthy and Prince 1993) that demands disyllabic feet cannot compel disyllabicity in derived forms. FOOTBINARITY-σ does not make reference to PWds, so it cannot be indexed to the $PWd_{non-max}$, which could be supposed to force only internal PWds in a recursive structure to have disyllabic feet.

2.5.2. Iambic Parsing

The minimality requirement above demands that PWds be disyllabic, but does not say anything about their stress pattern. In this section I claim that the light-heavy (LˈH) foot is the optimal and thus unmarked disyllable of Chukchansi. Therefore, when a verb root is augmented to disyllabicity when it forms its own PWd (see §2.3 above), it surfaces with an (LˈH) foot as a TETU effect (McCarthy and Prince 1994). In Guekguezian (2016a, 2017), I demonstrate that Chukchansi is an iambic language, i.e., words are preferably parsed into iambic feet. While Chukchansi stress patterns can be accounted for with either iambic or trochaic parsing, both phonotactic vowel epenthesis and a statistical study of the lexical inventory of verb roots demonstrate that iambic parsing is correct. In iambic languages, including Chukchansi, the optimal disyllable is (LˈH), which displays the key iambic property of uneven duration (see Hayes 1995 for the Iambic-Trochaic law; see also Prince 1990, Kager 1993, 1995 for the (LˈH) foot as the optimal iamb). I briefly review the evidence from Guekguezian (2016a, 2017) showing that Chukchansi is iambic.

Based on a small acoustic investigation I have conducted with a single speaker (Guekguezian 2016b), Chukchansi has the following stress patterns: the **penult** and any **pre-penult heavy** syllables are stressed, and other syllables (pre-penult light and final) are unstressed. These stressed syllables are all peaks of pitch and intensity relative to surrounding syllables; Mello (2012) shows that pitch and intensity are the acoustic correlates of stress in Chukchansi. The stress patterns in Guekguezian (2016b) are consistent with Mello's (2012) study of primary stress on Chukchansi.

Chukchansi is quantity-sensitive: any non-final heavy syllable is stressed, whether it is in the penult (52a-d), antepenult (52c), or the preantepenult (52d). When an unstressed light syllable precedes a heavy syllable, like [mo.ˈjin] (52a) and [ma.ˈna:] (52b), the two syllables form an (LˈH) feet on an iambic parsing: (mo.ˈjin), (ma.ˈna:). When a heavy syllable is either preceded by another heavy syllable, like [ˈmix] (52c), or is word-initial, like [ˈmon] (52d), this syllable forms an (ˈH) foot: (ˈmix), (ˈmon).

(52) All Heavy Syllables are Stressed:

a. [(mo.ˈ**jin**).hil] "got tired"
b. [(ma.ˈ**na:**).lit] "just teared up"
c. [(mo.ˈ**jin**).(ˈ**mix**).hil] "got tired with X"
d. [(ˈ**mon**).(de.ˈ**mix**).hil] "gambled with X"

As (52) shows, (LˈH) and (ˈH) iambic feet are both well-formed in Chukchansi. (LˈL) iambs, on the other hand, do not appear to occur in Chukchansi. I have been unable to elicit any words with two consecutive non-final light syllables, which would hypothetically form (LˈL) iambs. LL sequences are rare in Chukchansi due to the underlying forms of roots and affixes (see Tables 5-6 below), and any potential surface LL sequences seem to be corrected through lengthening; see Kager's (1993, 1995) account of (LˈL) as the most marked iamb, commonly avoided through iambic lengthening in many unrelated languages (Hayes 1995).

Light penults are also stressed in Chukchansi, i.e., they form pitch and intensity peaks. Word-final syllables always have lowered pitch and intensity relative to the preceding syllables, no matter their place in a phrase or sentence. These two facts have a common explanation: Chukchansi has a prohibition on word-final stress (Prince and Smolensky 1993/2004, Hayes 1995) that causes a rhythmic reversal of the final foot to an ('Lσ) trochee (53). This kind of rhythmic reversal is a common phenomenon in iambic systems; see, e.g., Prince and Smolensky (1993/2004), McCarthy and Prince (1993b).

(53) Light Penults are also Stressed:

a. [(ˈma:).(ˈ**mi**.la)] "blackberry (ACC)"
b. [(ˈmon).(ˈ**de**.hil)] "gambled"
c. [(ʔo.ˈjo:).(ˈ**lo**.taʔ)] "had made X move"
d. [(ˈlo:).lo.(ˈ**lo**.taʔ)] "had made X leave behind"

The prohibition on word-final stress outweighs quantity-sensitivity: word-final CVC syllables are never stressed, even if they are heavy (53b-d). These syllables cannot be light, since word-final consonants are moraic and shorten underlying long vowels; see Archangeli (1991) for moraic codas causing vowel shortening in Yokuts.

While the stress patterns in (52-53) are amenable to both an iambic and a trochaic parsing, phonotactic vowel epenthesis shows that Chukchansi is in fact iambic. Underlying sequences of three consonants cannot fit the CVX syllable maximum, so a high vowel is epenthesized between the first and second consonant: /CCC/ → [CiC.C]; see, e.g., Kisseberth (1970), Kenstowicz and Kisseberth (1979), for an identical pattern in Yowlumne Yokuts. Iambic parsing explains why the epenthetic vowel is placed between the first and second consonants rather than the second and third. The attested forms, with the epenthetic vowel between the first two consonants of the cluster, can be parsed with only well-formed (ˈH) and (LˈH) iambs; hypothetical forms with the epenthetic vowel between the final two consonants would be parsed with an (ˈLL) trochee to obey non-finality ((54), repeated from (7)).

(54) Phonotactic Vowel Epenthesis: /CCC/ → [CiC.C], not [C.Ci.C]

a. /ʔa**ml-t**aʔ/ → [(ʔa.ˈ**mil).t**aʔ] NOT *[(ˈʔa**m).(ˈli.t**aʔ)]
b. /be:**wn-x**a/ → [(ˈbe:).(ˈ**win).x**a] NOT *[(ˈbe**w).(ˈni.x**a)]

Ceteris paribus, Chukchansi prefers outputs with only iambs to those with trochees. In cases where the grammar is free to choose between iambs and trochees, as in epenthesis of a single vowel, it chooses the former, iambic output (55).

(55) Iambic Output ≺ Trochaic Output
  a. [(ʔa.ˈmil).taʔ] ≺ *[(ˈʔam).**<u>(ˈli.taʔ)</u>**]
  b. [(ˈbe:).(ˈwin).xa] ≺ *[(ˈbew).**<u>(ˈni.xa)</u>**]

A trochaic analysis of Chukchansi stress has difficulty accounting for the position of vowel epenthesis in (54): both the attested and unattested outputs contain well-formed (bimoraic) trochees. The attested outputs do not appear to have another advantage over the unattested ones; avoidance of stress clash in *[(ˈʔam).(ˈli.taʔ)] is achieved with the outputs *[(ˈʔam).li.taʔ] or *[ʔam.(ˈli.taʔ)], which parse as many or more syllables than [ʔa.(ˈmil).taʔ]. Choosing the attested output in a trochaic parsing requires an ad-hoc constraint, such as the alignment constraints used in Zoll (1993); in an iambic parsing, the attested output is more well-formed.

The lexical inventory of verb root shapes in Chukchansi also suggests iambic parsing. Roots that tend to result in non-final light-light (LL) syllable sequences, which cannot be faithfully parsed into well-formed iambic feet, are statistically underrepresented in the lexicon; see Hayes 1995 and Kager 1993, 1995 for the ill-formedness of even (LˈL) iambs. While many iambic languages repair LL sequences through vowel lengthening or syncope, these sequences are simply rare in Chukchansi due to the lexical inventory of roots. The underrepresentation of roots that surface with LL sequences in Chukchansi is only motivated under iambic parsing.

To quantify the underrepresentation of LL roots in the lexicon, I labeled and counted all verbs in the Chukchansi dictionary (Adisasmito-Smith in 2016) with exactly two underlying vowels. Entries either clearly derived from already present roots or recently borrowed from Spanish or

English were discarded. The two syllables of the root were classified by CV-sequence into CV, CVC and CVV (ignoring any extra root final consonants) and then by LH-sequence into L (light) and H (heavy). The weight of the second syllable of some two-vowel roots differs depending on following suffixes. I thus only marked syllables as H if they were always heavy; syllables that were sometimes light were marked as L. The bigram probabilities of each root type were derived from the unigram probability of each syllable type and then compared to the observed proportion of root types, giving the observed/expected ratio in Table 5 (the root-internal syllable boundary, which is constant across forms, is added for clarity).

Table 5. Observed vs. Expected Proportion of Two-Vowel Verb Roots by CV- and LH-Sequence

Root Type		Observed (Type Frequency)		Expected Bigram Probability	Observed/ Expected
LH-Sequence	CV-Sequence	Number	Proportion		
LL	CV.CV	12	.111	.228	**.489**
	CV.CVC(C)	8	.074	.135	**.548**
LH	CV.CVV(C(C))	33	.306	.115	**2.661**
HL	CVC.CV	22	.204	.135	**1.511**
	CVV.CV	16	.148	.115	**1.287**
	CVC.CVC(C)	14	.13	.08	**1.625**
	CVV.CVC(C)	2	.019	.068	**.279**
HH	CVC.CVV(C(C))	1	.009	.068	**.132**
	CVV.CVV(C(C))	0	0	.058	**0**

Table 5 shows that roots resulting in better iambs are overrepresented, while roots resulting poor iambs are underrepresented. LL roots, the worst from an iambic perspective, are observed only half as often as expected. LH roots, the best from an iambic perspective, are observed two-and-a-half times more than expected, and HL roots, the next best, one-and-a-half times more. This skew is confirmed by using a contingency table of LH-sequences (Table 6) to run a chi-squared test, where $\chi^2 = 45.634$, showing that the distribution of root types in Chukchansi is not random, at the level of significance $p < .01$.

Table 6. Contingency Table of LH-sequences

	2nd Syllable = L	2nd Syllable = H
1st Syllable = L	LL – 20	LH – 33
1st Syllable = H	HL – 54	HH – 1

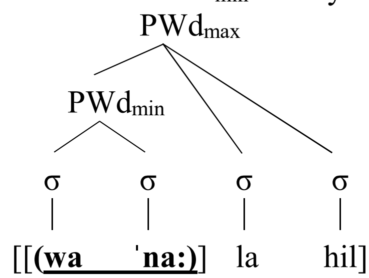
The observed/expected ratios and the chi-squared test strongly suggest that roots forming poor iambs are disfavored in Chukchansi, while roots forming good iambs are favored. Though Chukchansi stress is amenable to both iambic and trochaic parsing, patterns of phonotactic vowel epenthesis and the distribution of lexical verb root shapes only find motivation under iambic parsing; see Guekguezian 2016a, 2017 for a more detailed argument for iambs in Chukchansi. Assuming that Chukchansi prefers to parse words into iambic feet, the (LˈH) template is in fact the **prosodically optimal disyllable**.

2.5.3. Analysis of the (LˈH) Template

I now analyze the appearance of the (LˈH) template on roots with a phase head suffix attached as the presence of PWd recursion (§2.3). When a root composes an internal PWd_{min} by itself, it must meet the **disyllabic minimality requirement** on derived PWds. A root with only one underlying vowel cannot meet disyllabic minimality without alteration, and must epenthesize a second vowel to form two syllables. Because this epenthetic vowel has no input correspondent, it can be more freely selected to obey phonological well-formedness constraints, such as constraints on iambic parsing. The epenthetic vowel is positioned to make the PWd_{min} an **(LˈH) iambic foot**, the optimal disyllable in Chukchansi. The appearance of the (LˈH) template is an effect of **The**

Emergence of The Unmarked (TETU; McCarthy and Prince 1994). For example, when the one-vowel root /wan/ ‘give’ forms an internal PWd due to the phase head suffix /-la-/ ‘causative’, the root is augmented to the (LˈH) disyllable [(wa.ˈna:)] ((56), repeated from (30)).

(56) Internal PWd_{min} = Disyllabic LH Foot



The higher-ranked constraint (DISYLL) compels violation of faithfulness, here, the anti-epenthesis constraint DEP-μ, to yield a TETU effect.

(57) DEP-μ: assign a violation mark to any mora in the output that does not have a corresponding mora in the input. (Keer 1999, Morén 1999, McCarthy 2000)

(58) DISYLL: assign a violation mark for any PWd with fewer than two syllables. (Kager 1996)

The analysis of Chukchansi templatic morphology proceeds as follows; see also Guekguezian (2017). DISYLL demands that PWds contain two syllables; since the underlying material in /wan/ cannot form two syllables, a vowel and its supporting morae are epenthesized to form the second syllable, violating DEP-μ; DEP-V and DEP-SEG are also violated, but I focus here on DEP-μ. DISYLL dominates DEP-μ, favoring the epenthetic candidate; MATCHWORD must also dominate DEP-μ so that PWd recursion can force epenthesis (59).

(59) DISYLL, MATCHWORD >> DEP-μ

/wan/$_{X0}$, /wan-la-it/$_{X0}$	DISYLL	MATCHWORD	DEP-μ
☞ [[(wa.ˈna:)]$_{PWd}$ lat]$_{PWd}$			2
[(ˈwan).lat]$_{PWd}$		1 W	L
[[(ˈwan).]$_{PWd}$ lat]$_{PWd}$	1 W		L

Because Chukchansi words are preferentially parsed into iambs, the resulting disyllable is an (LˈH) foot. Candidates with other disyllables do worse than the (LˈH) disyllable candidate on other constraints high-ranked in Chukchansi, like the STRESS-TO-WEIGHT PRINCIPLE (SWP).

(60) SWP: assign a violation mark for every stressed syllable that is not heavy (Prince 1990, Crosswhite 1998)

An LL disyllable can be parsed into either an (ˈLL) trochee or an (LˈL) iamb, violating SWP in both cases (and IAMB in the case of the trochee). Because an LH foot requires one more mora than an LL foot, SWP dominates DEP-μ to pick the LH output over LL outputs (61).

(61) SWP >> DEP-μ

/wan/$_{X0}$, /wan-la-it/$_{X0}$	SWP	DEP-μ
☞ [[(wa.ˈna:)]$_{PWd}$ lat]$_{PWd}$		2
[[(wa.ˈna)]$_{PWd}$ lat]$_{PWd}$	1 W	1 L
[[(ˈwa.na)]$_{PWd}$ lat]$_{PWd}$	1 W	1 L

An (LˈH) foot is also more harmonic in Chukchansi than an (ˈH)L disyllable, which violates PARSE-σ, or an (ˈH)(ˈH) disyllable, which violates DEP-μ more than the (LˈH) foot.

(62) PARSE-σ: assign a violation mark to any syllable not dominated by a foot. (Prince and Smolensky 1993/2004, McCarthy and Prince 1993b)

No crucial ranking of PARSE-σ and DEP-μ is needed to favor the LH disyllable (63).

(63) PARSE-σ, DEP-μ

/wan/$_{X0}$, /wan-la-it/$_{X0}$	PARSE-σ	DEP-μ
☞ [[(wa.ˈna:)]$_{PWd}$ lat]$_{PWd}$	1	2
[[(ˈwa:).(ˈna:)]$_{PWd}$ lat]$_{PWd0}$	1	3 W
[[(ˈwa:).na]$_{PWd}$ lat]$_{PWd}$	2 W	2

The constraint rankings in (59)-(63) also account for the appearance of the (LˈH) foot with triconsonantal one-vowel roots, like /ʔaml/ 'help' and /be:wn/ 'sew', and roots with one long vowel, like /ma:x/ 'collect' and /be:wn/ (64).

(64) (LˈH) Foot with One-Vowel Roots

a. /ʔaml/$_{X0}$, /ʔaml-e-it/$_{X0}$ → [[**<u>(ʔa.ˈma:)</u>**]$_{PWd}$ let]$_{PWd}$
b. /ma:x/$_{X0}$, /max-la-it/$_{X0}$ → [[**<u>(ma.ˈxa:)</u>**]$_{PWd}$ lat]$_{PWd}$
c. /be:wn/$_{X0}$, /be:wn-e-it/$_{X0}$ → [[**<u>(be.ˈwe:)</u>**]$_{PWd}$ net]$_{PWd}$

The comparative master tableau (65) shows that the (LˈH) forms in (64) are the most harmonic outputs; see Prince (2002) for how to read comparative tableaux. At this point, PARSE-σ is unranked relative to the other constraints.

Roots with one long vowel like /ma:x/ and /be:wn/ form an LH disyllable when they epenthesize a vowel to meet minimality: [(ma.xa:)], [(be.we:)n]. Since the underlying vowel is long and the first surface vowel is short, the underlying vowel must be shortened and a long vowel epenthesized to form the heavy syllable.

(65) (LˈH) Foot with One-Vowel Roots

Input	Winner	Challengers	DISYLL	MATCH WORD	SWP	DEP-μ	PARSE-σ
/ʔaml/, /ʔaml-e-it/	[[(ʔa.ˈma:)]let]	[[(ˈʔa:).ma]let]					2 W
		[[(ˈʔa:).(ˈma:)]let]				3 W	
		[[(ʔa.ˈma)]let]			1 W	2 L	
		[[(ˈʔa.ma)]let]			1 W	2 L	
		[(ˈʔam).let]		1 W		2 L	
		[[(ˈʔam)]let]	1 W			2 L	
/ma:x/, /ma:x-la-it/	[[(ma.'xa:)]lat]	[[('ma:).xa]lat]					2 W
		[[('ma:).('xa:)]lat]				2 W	
		[[(ma.'xa)]lat]			1 W	1 L	
		[[('ma.xa)]lat]			1 W	1 L	
		[('max).lat]		1 W		1 L	
		[[('max)]lat]	1 W			1 L	
/be:wn/, /be:wn-e-it/	[[(be.'we:)]net]	[[('be:).we]net]					W
		[[('be:).('we:)]net]				2 W	
		[[(be.'we)]net]			1 W	1 L	
		[[('be.we)]net]			1 W	1 L	
		[('bew).net]		1 W		1 L	
		[[('bew)]net]	1 W			1 L	

While epenthetic vowels can be freely selected without violating faithfulness constraints besides DEP-V, manipulation of the underlying long vowels in /ma:x/ and /be:wn/ is penalized by faithfulness constraints like LINEARITY, MAX-μ and DEP-μ, or alternatively IDENT-V(LONG). While one-vowel roots with a long vowel can be manipulated to form an LH (66a), multi-vowel roots with a long vowel cannot (66b).

(66) Long Vowels in One- and Multi-vowel Roots

a. One-Vowel: /ma:x/$_{X0}$ → [(ma.'xa:)]$_{PWd}$, *[('ma:).xa]$_{PWd}$

b. Multi-Vowel: /jo:jo/$_{X0}$ → [('jo:).jo]$_{PWd}$ *[(jo.'jo:)]$_{PWd}$

The winner-loser pairs in (66) are mirror images: in (66a), the (L'H) candidate beats the ('H)L candidate, while the ('H)L candidate beats the (L'H) candidate in (66b). The difference lies in the input form of the roots: in the one-vowel root (66a), the long vowel is epenthetic, while in the multi-vowel root (66b), the long vowel corresponds to an underlying short vowel. Underlying material in general is less available for manipulation than epenthetic material, i.e., an epenthetic segment has no input correspondent to be faithful to, while an underlying segment does. This generalization holds of surface long vowels in Chukchansi: a long vowel can be epenthesized, as in the formation of LH disyllable, but an input short vowel can never be lengthened. To model this fact, I use a constraint against lengthening input short vowels, NOLENGTHENING.

(67) NOLENGTHENING: assign a violation mark to any output long vowel that corresponds to a short vowel in the input.[4]

NOLENGTHENING penalizes the (L'H) candidate in (66b), where the input short vowel is lengthened, but not the (L'H) candidate in (66a), where the long vowel is epenthetic. As (68) shows, NOLENGTHENING dominates PARSE-σ to favor the faithful ('H)L candidate in (66b), while PARSE-σ in turn dominates MAX-μ and DEP-μ to favor the prosodically optimal (L'H) candidate in (66a).

(68) One-Vowel Roots → (L'H), Not Multi-Vowel Roots

Input	Winner	Loser	NO LENGTHENING	PARSE-σ	MAX-μ	DEP-μ
/ma:x/, /ma:x-la-it/	[[(ma.'xa:)]lat]	[[('ma:).xa]lat]		2 W	1 L	2 L
/jo:jo/, /jo:jo-la-it/	[[('jo:).jo]lot]	[[(jo.'jo:)]lot]	1 W	2 L	1 W	2 W

[4] NOLENGTHENING is equivalent to the conjunction of IDENT-V(Long) and DEP-μ in the domain of a segment: an epenthetic mora is penalized if it lengthens an input short vowel (see Smolensky 1993, Łubowicz 2002 for local constraint conjunction). Neither IDENT-V(Long) or DEP-μ by itself can capture the Chukchansi facts: while it is never possible to lengthen an input short vowel, it is possible to shorten an input long vowel and to epenthesize a long vowel.

Other constraints against changing input structure prevent the emergence of (L'H) feet when epenthesis does not occur. For example, LINEARITY militates against metathesis in vowel-final roots like /ʧˀedma/ (69).

(69) No Metathesis to Form (L'H)
/ʧˀedma/$_{X0}$ → [('ʧˀed).ma]$_{PWd}$ *[(ʧˀe.'dam)]$_{PWd}$

(70) LINEARITY: assign a violation mark for any output sequence S_1 that is inconsistent with the precedence structure of the input sequence S_2, where S_1 and S_2 are in correspondence. (McCarthy and Prince 1995)

LINEARITY dominates PARSE-σ to favor the faithful ('H)L candidate in (71).

(71) LINEARITY >> PARSE- σ

/ʧˀedma/$_{X0}$, /ʧˀedma-la-it/$_{X0}$	LINEARITY	PARSE-σ
☞ [[('ʧˀed).ma]$_{PWd}$ lat]$_{PWd}$		2
[[(ʧˀe.'dam)]$_{PWd}$ lat]$_{PWd}$	1 W	1 L

While PWd-recursion in multi-vowel roots like /jo:jo/ and /ʧˀedma/ does not result in an LH disyllable, it does result in the penultimate vowel being unstressed in words like (72). The stresslessness of the penultimate vowel provides evidence that these words have PWd recursion.

(72) No Penultimate Stress in Recursive PWds
a. /jo:jo/$_{X0}$, /jo:jo-la-it/$_{X0}$ → [[('jo:).jo]lot] *[('jo:).('jo.lot)]
b. /ʧˀedma/$_{X0}$, /ʧˀedma-la-it/$_{X0}$ → [[('ʧˀed).ma]lat] *[('ʧˀed).('ma.lat)]

MATCHWORD dominates PARSE-σ so that PWd-recursion is preferred over full parsing (73).

(73) MATCHWORD >> PARSE-σ

/ʧˀedma/$_{X0}$, /ʧˀedma-la-it/$_{X0}$	MATCHWORD	PARSE-σ
☞ [[('ʧˀed).ma]$_{PWd}$ lat]$_{PWd}$		2
[('ʧˀed).('ma.lat)]$_{PWd}$	1 W	L

With monophasal verbs, i.e., with no higher phase heads, PWd recursion does not occur. In monophasal verbs, the verbal root and its suffixes, including an obligatory tense or mood suffix (see §2.4 above), form a single PWd. Since all root and obligatory suffixes contain a vowel, the underlying material of the verb always has at least two vowels, and monophasal verbs can form a disyllabic PWd without epenthesis.

Similar to multi-vowel roots that form an internal PWd, monophasal verbs are not rearranged to form an (L'H) foot (74).

(74) No (LH) Foot with Single PWd
/wan-taʔ/$_{X0}$ → [(ˈwan).taʔ]$_{PWd}$

As single PWd verbs like (74) satisfy both DISYLL and prosodic constraints IAMB and FOOTFORM, epenthesis is militated against by low-ranked DEP-μ. When phonotactic vowel epenthesis is necessary to resolve a word-internal consonant cluster, an (LˈH) iamb emerges, satisfying IAMB ((75), repeated from (54a)).

(75) /ʔaml-taʔ/ → [(**ʔa.ˈmil**).taʔ]

The prohibition on word-final stress in Chukchansi, which is responsible for word-final (ˈLσ) trochees in (53) above, applies to forms with a single PWd but does not seem to apply to the internal PWd$_{min}$. I claim that the constraint against final stress in Chukchansi is indexed to maximal PWds: NONFINALITY(PWd$_{Max}$), which results in disyllabic trochees at the right edge of a PWd$_{max}$ but not of an internal PWd$_{min}$.

(76) NONFINALITY(PWd$_{max}$): assign a violation mark for a stressed syllable at the end of a maximal PWd (see Prince and Smolensky (1993/2004) for NONFINALITY(PWd), Itô and Mester (2009b, 2012) for constraints being sensitive to (non-)maximal prosodic units).

A monophasal verb has a single PWd, which is simultaneously minimal and maximal. NONFINALITY(PWd_{Max}) forces the construction of quantity-insensitive trochees at the right edge of a single PWd (53), as well as a PWd_{Max} in a recursive structure. As Chukchansi otherwise parses PWds into quantity-sensitive iambs, NONFINALITY(PWd_{Max}) must dominate SWP and Iamb (77).

(77) NONFINALITY(PWd_{Max}) >> SWP, IAMB

/wan-it/$_{X0}$	NONFINALITY(PWd_{Max})	SWP, IAMB
☞ [(**'wa**.nit)]$_{PWdmin/max}$		2
[(wa.**'nit**)]$_{PWdmin/max}$	1 W	L

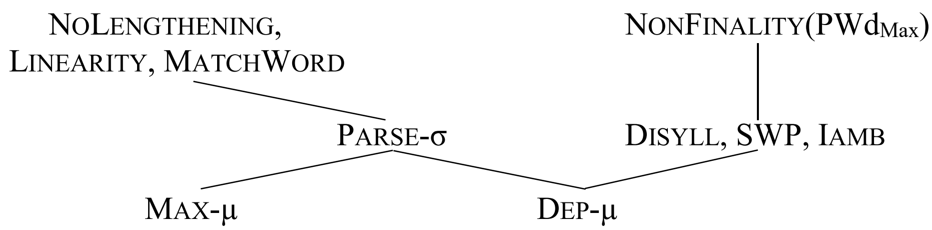
Because NONFINALITY(PWd_{Max}) does not target a PWd_{min}, quantity-sensitive iambs are built at the right edge of the internal PWd (78).

(78) NONFINALITY(PWd_{Max}) >> WSP, IAMB

/wan/$_{X0}$, /wan-la-hil/$_{X0}$	NONFINALITY(PWd_{Max})	WSP, IAMB
☞ [[(wa.**'na:**)]$_{PWdmin}$ ('la.hil)]$_{PWdmax}$		
[[(**'wa**.na:)]$_{PWdmin}$ ('la.hil)]$_{PWdmax}$		2 W

In sum, the presence of the LH template is a **minimality effect**, determined by the number of underlying vowels that form a PWd. Recursive-PWd verbs have an LH template with **one-vowel** (sub-minimal) roots but not with **multi-vowel** (minimal) roots. Single-PWd verbs do not have an LH template even with one-vowel roots, since suffix material provides a second vowel to meet minimality. The Hasse diagram in (79) shows the crucial ranking of constraints that accounts for when the LH template appears. MATCHWORD, DISYLL and SWP dominate DEP-μ, causing the LH template to appear in biphasal verbs with one-vowel roots. NOLENGTHENING, LINEARITY and MATCHWORD dominate PARSE-σ, preventing the LH template from appearing in biphasal verbs with multi-vowel roots. PARSE-σ dominates MAX-μ and DEP-μ, picking the (LH) disyllable instead of an (H)L disyllable in biphasal verbs with roots that have a single, long vowel. Lastly, low-ranked Dep-μ prevents the LH template from appearing in monophasal verbs; other prosodic constraints like Iamb, SWP and NonFinality(PWd_{Max}) determine the prosodic structure of monophasal verbs. SWP can be violated, however, in words that stressed light penults in obedience of NonFinality(PWd_{Max}), like in (53).

(79)



2.6. Against a Stratal OT Analysis

The previous sections demonstrated that a parallel OT model accounts for Chukchansi templatic morphology using independently motivated components of the grammar, including phase-based spellout and prosodic well-formedness constraints. This section argues that one serial OT model, Stratal OT or LPM-OT (Kiparsky 2000, Bermúdez-Otero 2011, 2013), cannot account for Chukchansi templatic morphology except by brute-force stipulation of the templatic forms.

Stratal OT, also known as LPM-OT, is the constraint-based successor to Lexical Phonology and Morphology (LPM; Kiparsky 1982, Kaisse and Shaw 1985, Mohanan 1986). LPM posits distinct levels of morphophonological derivation, from the root outward to the entire word. In an LPM derivation, morphology and phonology are interleaved: first, one or more morphemes are added to the root, then a block of phonological rules apply to the combined structure, followed by the addition of more morphemes. These rules apply cyclically, i.e., they keep applying as long as their environments are present. Further addition of morphemes, for instance, can create more environments for the same cyclic rule to apply. After all the morphology has been added and all cyclic rules have applied, the entire structure include all the words undergoes a final level with post-cyclic rules, i.e., rules that apply only once.

Stratal OT retains the LPM structure of cycles of phonological operation that evaluate larger and larger chunks of material. In Stratal OT, however, each phonological cycle is a parallel OT grammar, rather than a block of ordered rules. The utterance is built up at three separate levels, starting with Stems, then evaluating entire Words and finally putting together the whole utterance by Phrases. Each level is associated with its own constraint ranking, i.e., grammar, and iteration of the phonological derivation. First, a morphological sub-constituent of a word, consisting of the lexical root and Stem-level affixes, is evaluated by the Stem-level grammar. Next, the other affixes of the word together with the output of the Stem-level are evaluated by the Word-level grammar. Finally, all the words that form a phrase are evaluated by the Phrase-level grammar (80).

(80) Stratal OT Model

/Root+Affix(es)/
↓
Stem-Level Grammar
↓
[Stem] → /[Stem]+Affix(es)/
↓
Word-Level Grammar
↓
[Word] → /[Word]+[Word]+…/
↓
Phrase-Level Grammar
↓
[Phrase]

Stratal OT encounters fundamental difficulties in accounting for templatic morphology in Chukchansi because of the contrast between biphasal, templatic verbs and monophasal, atemplatic verbs. In the cyclic syntax-parallel OT model advocated in this dissertation, this contrast is cached out through the presence or absence of PWd recursion. Stratal OT, however, cannot capture this contrast, because all verbs go through the same Stem-level constraint ranking followed by the same Word-level constraint ranking. In order for a Stratal OT grammar to account for the appearance of the template with biphasal verbs, the Stem-level constraint ranking must demand that roots bear a template. However, the Stem-level grammar wrongly predicts that roots of monophasal verbs will also bear templates. This incorrect prediction comes because all roots and Stem-level suffixes are evaluated by the Stem-level grammar first before they enter the Word-level grammar. The Stem-level grammar cannot tell apart monophasal and biphasal verbs. Unlike in the cyclic syntax-parallel phonology model, where a root only gets sent to the phonology early if there is a phase head suffix in the morphosyntax, it is impossible in a Stratal OT model for a root to go through the Stem-level grammar only with biphasal verbs and not with monophasal verbs.

To see how this works in a Stratal OT model of Chukchansi, I illustrate the Stem-level and Word-level constraint rankings necessary to give a one-vowel root like /wan/ an LH template in biphasal verbs. In the Stem-level grammar, DISYLL, IAMB and WSP dominate DEP-μ and NONFINALITY so that a one-vowel root like /wan/ is augmented to an LH disyllable [(wa.'**<u>na:</u>**)] (81).

(81) DISYLL, IAMB, WSP >> DEP-μ, NONFINALITY

/wan+Ø/	DISYLL	IAMB, WSP	DEP-μ	NONFINALITY
☞ [(wa.'na:)]			2	1
[(wa.'na)]		1 W	1 L	1
[('wa.na)]		1 W, 1 W	1 L	L
[('wan)]	1 W		L	1

Once the LH disyllable has been built in the Stem-level grammar, it cannot be undone at the Word-level, even though the combination of all the morphemes can satisfy disyllabicity by themselves. At the Word-level, NONFINALITY dominates in order to capture stress on light penults. The templatic form does not do any worse than an atemplatic output on any of the prosodic well-formedness constraints. An atemplatic output is eliminated by MAX-V, which prevents deletion of the second, epenthetic vowel of the LH disyllable, no matter where this constraint is ranking

(82) NONFINALITY >> WSP, IAMB

/[(wa.'na:)]+la+hil/	DISYLL	NONFINALITY	WSP, IAMB	MAX-V
☞ [(wa.'na:).('la.hil)]			1, 1	
[('wan).('la.hil)]			1, 1	1 W
[(wa.'na:).(la.'hil)]		1 W	L	

These Stem-level and Word-level grammars incorrectly predict that one-vowel roots like /wan/ will be augmented to LH disyllables even in monophasal verbs, since they go through a similar derivation. Because DISYLL, IAMB and WSP dominate DEP-μ and NONFINALITY in the Stem-level grammar, a one-vowel root like /wan/ is augmented to an LH disyllable [(wa.'**<u>na:</u>**)] even in a monophasal derivation. The levels of Stratal OT, e.g., the Stem-level grammar, have no way of distinguishing a monophasal from a biphasal verb.

(83) DISYLL, IAMB, WSP >> DEP-μ, NONFINALITY

/wan+Ø/	DISYLL	IAMB, WSP	DEP-μ	NONFINALITY
☞ [(wa.'na:)]			2	1
[(wa.'na)]		1 W	1 L	1
[('wa.na)]		1 W, 1 W	1 L	L
[('wan)]	1 W		L	1

Again, LH augmentation at the Stem-level cannot be reversed at the Word-level, due to MAX-V (84).

(84) NONFINALITY >> WSP, IAMB

/[(wa.'na:)]+hil/	DISYLL	NONFINALITY	WSP, IAMB	MAX-V
💣 [(wa.'na:).hil]				
☹ [('wan).hil]				1 W
[(wa.'na:).('hil)]		1 W		

The Stratal OT grammar that selects a biphasal verbs with an LH template [wana:lahil] incorrectly selects a monophasal verb with an LH template as well *[wana:hil], which is unattested (85). Since the Stem-level grammar is the same for monophasal and biphasal verbs, and the root (and null verbalizer) goes through the Stem-level grammar in both verbs, the LH template must be present in both monophasal and biphasal verbs.

(85) Stem-Level Grammar → LH Disyllable

	Stem-Level Grammar		Word-Level Grammar	
Monophasal Verb	/wan+Ø/	→ [wana:]	→ /[wana:]+hil/	→ *[wana:hil]
Biphasal Verb	/wan+Ø/	→ [wana:]	→ /[wana:]+la-hil/	→ [wana:lahil]

On the other hand, the constraint rankings necessary to prevent an LH disyllable from occurring in monophasal verbs will also prevent it in biphasal verbs. In the Stem-level grammar of monophasal verbs, DEP-μ dominates DISYLL and NONFINALITY so that a one-vowel root like /wan/ is not augmented to an disyllable [('wan)] (86). Augmentation will also be prevented with biphasal verbs, however, since their roots go through the same Stem-level grammar.

(86) DEP-μ >> DISYLL, NONFINALITY

/wan+Ø/	DEP-μ	DISYLL	NONFINALITY
☞ [('wan)]		1	1
[(wa.'na)]	1 W	L	1
[('wa.na)]	1 W	L	L
[(wa.'na:)]	2 W	L	1

The ranking needed to capture stressing of light penults at the Word-level will prevent LH augmentation from occurring at the Word-level with biphasal verbs. The unaugmented form does as well with prosodic well-formedness constraints as an LH-augmented output, which is eliminated by DEP-μ no matter where it is ranked.

(87) NONFINALITY >> WSP, IAMB

/[('wan)]+la+hil/	DISYLL	NONFINALITY	WSP, IAMB	DEP-μ
💣 [('wan).('la.hil)]			1, 1	
☹ [(wa.'na:).('la.hil)]			1, 1	1 W
[('wan).(la.'hil)]		1 W	L	

The Stratal OT grammar that selects a monophasal verb without an LH template [wanhil] incorrectly selects a biphasal verb without an LH template as well *[wanlahil], which is unattested. Again, since the root in both monophasal and biphasal verbs goes through the same Stem-level grammar, the template will not appear in either verb (88).

(88) Stem-Level Grammar → No LH Disyllable

	Stem-Level Grammar			Word-Level Grammar		
Monophasal Verb	/wan+Ø/	→	[wan]	→ /[wan]+hil/	→	[wanhil]
Biphasal Verb	/wan+Ø/	→	[wan]	→ /[wan]+la-hil/	→	*[wanlahil]

An alternative hypothesis to be considered in a Stratal OT analysis is to include template-triggering suffixes in the input to the Stem-level grammar. Since the template-triggering suffix is superficially what causes the LH template to appear, it might be supposed that this suffix's presence at the Stem-level gives rise to the template. However, this alternative analysis cannot capture the fact that the LH template appears when a triggering-suffixes attaches to one-vowel roots but not multi-vowel roots. First, the fact that only smaller roots bear templates suggests that some sort of minimality effect is at play, as in my analysis in §2.5. However, if a template-triggering suffix is present in the input to the Stem-level grammar, its vowel will satisfy disyllabic minimality. Therefore, no augmentation of the root is necessary, and the LH disyllable does not appear (89).

(89) DISYLL, IAMB, WSP >> DEP-μ, NONFINALITY

/wan+Ø+la/	DISYLL, IAMB, WSP	DEP-μ
💣 [('wan).la]		
☹ [(wa.'na:).la]		2 W

Second, in the absence of the minimality analysis, there is no phonologically common trait of the template-triggering suffixes that would lead an (L'H) foot to appear on the root in their presence but not in their absence. The only possibility for evaluating is that the Chukchansi lexicon stores an alternate Stem form with an (L'H) foot for one-vowel roots but not multi-vowel roots, and that this Stem form is only activated in the context of the template-triggering suffixes. This analysis essentially stipulates that the template appears in the contexts where it appears, and not in the contexts it does not. The generalizations in (20-21) that template-triggers are phase heads, that template-bearing roots have one underlying vowel, and that the template shape is the optimal disyllable are all left unexplained on a Stratal OT account. The Stratal OT model thus can only describe Chukchansi templatic morphology through brute-force stipulation, unlike the cyclic syntax-parallel phonology model I have proposed.

More broadly, Stratal OT cannot account for morphophonological phenomena that are due to a contrast between monophasal and biphasal words in terms of their phasal structure, like Chukchansi templates. In Stratal OT, all lexical words go through the same Stem-level constraint ranking, which itself cannot make reference to the phasal derivation of words. A contrast between monophasal and biphasal verbs in Stratal OT must be captured in a similar fashion to any other contrast between Stem classes, for example, through Stem storage (Bermúdez-Otero 2013). This analysis of such a contrast unnecessary duplicates the morphosyntactic contrast in phasal structure; the intuition that the phasal structure of the words is responsible for the contrast is left unaddressed in Stratal OT. In the cyclic syntax-parallel phonology model, on the other hand, it is the phasal contrast itself in languages like Chukchansi that gives rise to the morphophonological contrast. Therefore, the cyclic syntax-parallel phonological model is more parsimonious than Stratal OT, and can capture data similar to Chukchansi in a more elegant fashion.

2.7. Mismatches: MATCHWORD(All) and MATCHWORD(Only)

While the two X_0s that make up a biphasal Chukchansi verb are mapped to two recursive PWds, the first, lower X_0 is not completely isomorphic to the PWd_{min}. Rather, some phonological exponents of an X_0 expected to be in the corresponding PWd under isomorphy are actually **mismatched** for phonotactic reasons, ending up dominated by the "wrong" PWd. Chukchansi displays two types of mismatches: an **undermatch**, where phonological material affiliated with morphemes in the first X_0 is not contained in the minimal PWd, and an **overmatch**, where phonological material affiliated with morphemes not in the first X_0 is contained in the minimal PWd. These mismatches require two mirror-image MatchWord constraints: MatchWord(All), which penalizes undermatches, and MatchWord(Only), which penalizes overmatches. Here I illustrate these constraints, which were introduced in §1.2.3, with data from Chukchansi. In §3.4.2, I give a more detailed exposition of these constraints using data from Creek. In Chukchansi, the phonotactic constraints ONSET and *COMPLEX dominate these two MatchWord constraints, resulting in well-formed Chukchansi syllables.

When triconsonantal roots spelled out in an early phase are followed by a vowel-initial suffix, the root-final consonant is undermatched in order to form an onset. For example, in (90), the final consonant [l] of the root /ʔaml/ is not dominated by PWd_{min}, but instead forms the onset of the following syllable [**l**et].

(90) Onset Undermatch

/ʔam**l**/$_{X0}$, /ʔaml-e-t/$_{X0}$ → [[(ʔa.'ma:)]$_{PWdmin}$ **l**et]$_{PWdmax}$, *[(ʔa.'ma**l**)]$_{PWdmin}$ ***et***]$_{PWdmax}$
'help' 'help'-CAUS-REC
"just made X help"

When biconsonantal roots spelled out in an early phase are followed by the adjunctive phase head suffix /-ʔhij/, the initial consonant /ʔ/ of the suffix is overmatched in order to avoid a complex onset. For example, in (91), [ʔ] forms the coda of PWd_{min} syllable [naʔ], preventing a complex onset in the PWd_{max} syllable *[***ʔh***ij'].

(91) Coda Overmatch

/wan/$_{X0}$, /wan-**ʔ**hij-ˀ/$_{X0}$ → [[(wa.'na**ʔ**)]$_{PWdmin}$ hij']$_{PWdmax}$, *[[(wa.'na:)]$_{PWdmin}$***ʔh***ij']$_{PWdmax}$
'give' 'give'-ADJV-NOM
"giving place" (NOM)

These mismatches require formulations of MATCHWORD constraints that penalize undermatches and overmatches, respectively. I propose the following two MATCHWORD constraints, similar to Elfner's (2012) formulation of MATCHPHRASE$_T$: MATCHWORD(All) demanding that **all** of the exponents of an input X_0 be matched to an output PWd (92) and MATCHWORD(Only) demanding that **only** the exponents of an input X_0 be matched to an output PWd (93). These constraints are specific versions of the MATCHWORD constraint argued for in

§1.3.1; they only demand that the X_0s with the highest copy of the lexical root in a spellout domain be matched to output PWds.

(92) MATCHWORD(All): Suppose there is an X_0 in the input syntactic representation that has the highest copy of a lexical root in a spellout domain and exhaustively dominates a set of morphemes α. Assign a violation mark for every segment that (1) is an exponent of a morpheme in α and (2) is **not** dominated by a PWd in the output phonological representation corresponding to the X_0.

(93) MATCHWORD(Only): Suppose there is an X_0 in the input syntactic representation that has the highest copy of a lexical root in a spellout domain and exhaustively dominates a set of morphemes α. Assign a violation mark for every segment that (1) is an exponent of a morpheme **that is not** in α (2) and is dominated by a PWd in the output phonological representation corresponding to the X_0.

MATCHWORD(All) penalizes **undermatches**, while MATCHWORD(Only) penalizes **overmatches**. I briefly illustrate how these two MATCH constraints are violated. In the undermatch (90), the output segment [l], which is an exponent of a morpheme in the inner X_0, is not dominated by the minimal PWd, which corresponds to the inner X_0. (94) violates MATCHWORD(All) once for the segment [l]. (94) does not violate MATCHWORD(Only), since the minimal PWd does not dominate any segments that are exponents of morphemes not in the inner X_0.

(94) Undermatch: Violates MATCHWORD(All)

Syntax: / ʔ a m l e t/$_{X0}$
/ ʔ a m **l**/$_{X0}$
Phonology: [[(ʔ a 'm a:)]$_{PWd}$ **l** e t]$_{PWd}$

In the overmatch (91), the output segment [ʔ], which is an exponent of a morpheme not in the inner X_0 (i.e., only in the outer X_0), is dominated by the minimal PWd, which corresponds to the inner X_0. (95) violates MATCHWORD(Only) once, for the segment [ʔ]. (95) does not violate

MATCHWORD(All), since every segment that is an exponent of the inner X_0 is dominated by the minimal PWd.

(95) Overmatch: Violates MATCHWORD(Only)

```
Syntax:       /  w  a  n          ʔ   h   i   j  ʔ/X0
              /  w  a  n/X0      /    |   |   | /
                 |  |  |        /     |   |   |/
Phonology:    [[( w  a  'n  a   ʔ)]PWd h   i   j']PWd
```

Both MATCHWORD(All) and MATCHWORD(Only) are dominated by the phonotactic constraints ONSET and *COMPLEX, respectively; these two phonotactic constraints are undominated in Chukchansi, as all surface outputs obey them. In (90), ONSET dominates MATCHWORD(All) to force an undermatch, as illustrated in (96).

(96) ONSET >> MATCHWORD(All)

/ʔam**l**/$_{X0}$, /ʔaml-e-t/$_{X0}$	ONSET	MATCHWORD(All)
☞ [[(ʔa.'ma:)] **l**et]		1
[(ʔa.'ma**l**)] ***et***]	1 W	L

In (91), *COMPLEX dominates MATCHWORD(Only) to force an overmatch (97).

(97) *COMPLEX >> MATCHWORD(Only)

/wan/$_{X0}$, /wan-**ʔ**hij-ʔ/$_{X0}$	*COMPLEX	MATCHWORD(Only)
☞ [[(wa.'na**ʔ**)] hij']		1
[[(wa.'na:)] ***ʔh***ij']	1 W	L

In Chukchansi, MATCHWORD(All) and MATCHWORD(Only) are unranked with respect to one another. As shown in §3.4, these two constraints are crucially ranked in Creek: undermatches are the general case, while overmatches only occur when motivated by other high-ranked constraints.

Therefore, both MATCHWORD constraints are necessary; a single MATCHWORD constraint that only penalizes mismatches in general cannot account for the Creek data.

2.8. Templates and Other Morphology

This section provides more evidence for the above analysis where the LH template arises as a minimality effect in an internal PWd_{min}. This evidence comes from the interactions of phase head suffixes with other areas of Chukchansi morphophonology; these facts are predicted by the PWd recursion account but unmotivated otherwise. First, reduplication prevents the appearance of the (L'H) foot on an eligible root, because the reduplicant provides enough material to satisfy disyllabic minimality for the internal PWd without epenthesis (§2.6.1). Second, roots with four-consonants and one underlying vowel are not rearranged to form an (L'H) foot with a phase head suffix; these roots satisfy minimality independently through phonotactic vowel epenthesis (§2.6.2). Third, when a phase head spells out the unaccusative suffix /-n/ along with the root, the presence of the (L'H) foot depends on the phonological size of the root together with the unaccusative (§2.6.3). Biconsonantal roots with the unaccusative /-n/ do not meet minimality and thus get the (L'H) foot, while triconsonantal roots do meet minimality and thus do not get the (L'H) foot.

2.8.1. Reduplication

Reduplication in Chukchansi, which indicates a repeated action REP(ETITIVE), consists of a CVC syllable prefixed to the root, no matter the size or shape of the root (98).

(98) Reduplicative Forms

a.	/RED	wan	taʔ/	→	[('**wan**).('<u>wan</u>).taʔ]
	REP	'give'	REM		
	"had kept on giving"				
b.	/RED	ma:x	eʔ/	→	[('**max**).('<u>ma.x</u>eʔ)][5]
	REP	'collect'	N.PST		
	"will keep on collecting"				
c.	/RED	waxl	it/	→	[('**wax**).('<u>wax).l</u>it]
	REP	'cry'	REC		
	"just kept on crying"				
d.	/RED	be:wn	eʔ/	→	[('**bew**).('<u>bew).n</u>eʔ]
	REP	'sew'	N.PST		
	"will keep on sewing"				

As predicted by the minimality account of the LH template, when the reduplicant and the root appear in the internal PWd together, they meet disyllabic minimality without epenthesis and do not form an (LH) foot. This is exactly what happens when the REPETITIVE prefix occurs with a phase head suffix such as the CAUSATIVE: no (LH) template appears (99).

(99) Reduplication Blocks Templates

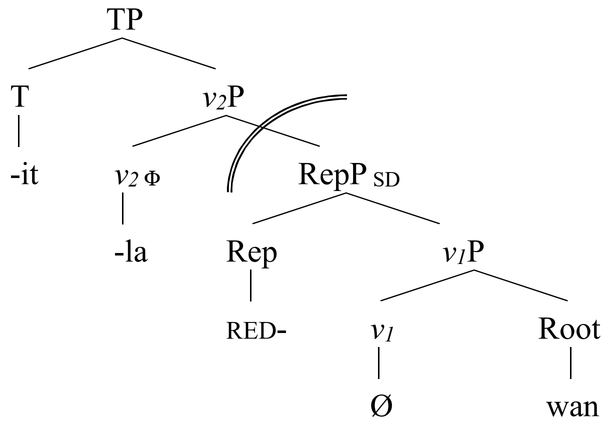
a.	/RED	wan/X_0,	/RED	wan	la	it/X_0	→	[[('**wan**).('<u>wan</u>)]$_{PWd}$ lat]$_{PWd}$
	REP	'give'	REP	'give'	CAUS	REC		
	"just made X keep on giving"							
b.	/RED	waxl/X_0,	/RED	waxl	ʧʼ	Ø/X_0	→	[[('**wax**).('<u>wax)</u>]$_{PWd}$ <u>l</u>iʧʼ]$_{PWd}$
	REP	'cry'	REP	'cry'	AGTV	NOM		
	"one who keeps on crying"							

As expected if the repetitive prefix is spelled out early along with the root, the phase head takes scope over the repetitive. Verbs with both these morphemes have the scope relation [Phase Head [REP]], such as (100), which is [CAUS [REP]], not [REP [CAUS]]. [CAUS [REP]] has the semantics of a

[5] The shortening of the second vowel in [('max).('ma.xeʔ)], which is underlying long, does not seem to have any clear prosodic motivation. This could be a case of back-copying (McCarthy and Prince 1995), in which the vowel of the Base shortens to match the vowel of the Reduplicant, which must be short due to phonotactics.

repetitive action that was caused, as in (99a) "just made X keep on giving," while [REP [CAUS]]] would have the semantics of an action was caused repeatedly, like the unattested "just kept on making X give."

(100) Phase Head has Scope over Repetitive



The reduplicant provides a second syllable for the internal PWd, so that epenthesis and the (L'H) foot are unnecessary for meeting minimality. In fact, Base-Reduplicant Faithfulness (BR-FAITH: McCarthy and Prince 1995) prevents either the Base or the Reduplicant from being arranged to form an optimal (L'H) foot, since this would sacrifice identity between the Base and the Reduplicant. BR-FAITH prevents the Reduplicant from copying less material from the base to form an (L'H) foot. The fact that reduplication blocks the LH template thus provides more evidence for the appearance of the template as being a minimality effect.

2.8.2. Quadriconsonantal Roots

Roots with four consonants always surface with at least two vowels in order to syllabify all the consonants. The second vowel is predictable, and if it is high [i], it can be analyzed as a phonotactic epenthetic vowel. Under this analysis, the underlying forms of such quadriconsonantal roots only have one underlying vowel, like /haj’k’t/ ‘finish’ ((101), from (19e), with the epenthetic vowels highlighted).

(101) Quadriconsonantal Roots with One Underlying Vowel
a. /haj’k’t-hil/ → [haj’.k’**i̲**t.hil]
b. /haj’k’t-eʔ / → [haj’.k’**i̲**.teʔ]

Four-consonant roots like /haj’k’t/ do not form an (L'H) foot when a phase head suffix attaches ((102), from (19f)).

(102) Quadriconsonantal Roots: No Template
/haj’k’t/$_{X0}$, /haj’k’t-la-hil/$_{X0}$ → [[('haj’).('k’**i̲**t)]$_{PWd}$ ('la.hil)]$_{PWd}$

An (L'H) foot cannot be formed in without epenthesizing a second vowel, violating DEP-V more than the non-templatic output, which only epenthesizes one vowel (102) and still parses the internal PWd into well-formed ('H) feet. Hypothetical templatic forms (103) form an initial (L'H) foot by epenthesizing a second, templatic vowel in addition to a phonotactic epenthetic vowel.

(103) Unattested (LH) Templates with Quadriconsonantal Roots
a. /haj’k’t/$_{X0}$, /haj’k’t-lahil/$_{X0}$ → *[[(ha.'j**a̲:̲**).('k’**i̲**t)]$_{PWd}$ ('la.hil)]$_{PWd}$
b. /haj’k’t/$_{X0}$, /haj’k’t-lahil/$_{X0}$ → *[[(ha.'j**a̲**k)]$_{PWd}$ t**i̲**.('la.hil)]$_{PWd}$

The non-templatic output in (102) already meets disyllabic minimality with phonotactic vowel epenthesis, so epenthesizing another vowel is unnecessary. This is similar to roots with two underlying vowels, like /ʧ’edma/ and /jo:jo/; since these roots meet disyllabic minimality automatically, no template is needed. The non-templatic output (102) also satisfies SWP by parsing the internal PWd into well-formed (H) feet, so that there is no prosodic reason for the LH template to appear ((104).

(104) No LH Template with Quadriconsonantal One-vowel Root

/haj’k’t/$_{X0}$, /haj’k’t-la-it/$_{X0}$	DISYLL, SWP	DEP-V
☞ [[('haj’).('k’it)] ('la.hil)]		1
[[(ha.'jik’)] ti.('la.hil)]		2 W
[[(ha.'ja:).('k’it)] ('la.hil)]		2 W

Since quadriconsonantal roots meet minimality with the necessary phonotactic epenthetic vowel, extra epenthesis to create an (L'H) foot is not necessary.

2.8.3. The Unaccusative /-n/

If the appearance of LH templates is a minimality effect, a morpheme intervening between the root and the phase head suffix will not necessarily prevent the template, as long as the intervening morpheme does not make the internal PWd meet minimality. This prediction is borne out: when the unaccusative suffix /-n/ occurs between biconsonantal one-vowel roots and a phase head suffix, the (L'H) foot appears (105); see §2.4 for the syntax of this construction. This phenomenon was first noticed in Yokuts by Newman (1944), who calls it “base-faking” because the /-n/ of the suffix acts like part of the verb root (“base”). The appearance of interaction of the phase head suffix and the root across the intervening unaccusative suffix (105) is similar to Myler’s (to appear) syntactic account of interactions across an intervening morpheme in Nyakusa, Ndebele, and Sanskrit.

(105) LH Template with Unaccusative /-n/ and Biconsonantal Root

a. /ʤul n/$_{X0}$, /ʤul n ʧ’ Ø/$_{X0}$ → [[(ʤo.'lo:)]$_{PWd}$ nuʧ’]$_{PWd}$
‘melt’ UNACC ‘melt’ UNACC AGTV NOM
“one that melts (intr.)”

b. /se:p’ n/$_{X0}$, /se:p’ n ʔa n’/$_{X0}$ → [[(se.'p’en’)]$_{PWd}$ ʔan’]$_{PWd}$
‘tear’ UNACC ‘tear’ UNACC DUR N.PST
“is tearing (intr.)”

Similar to triconsonantal one-vowel roots like /ʔaml/ and /be:wn/, the underlying material in the first X_0 in (105), /ʤul-n/ and /se:p'-n/, has one vowel and three consonants, which is not enough material to meet minimality. Since the minimality requirement is sensitive only to syllable count, not to morphological structure, a second vowel is epenthesized whenever the input cannot meet minimality, no matter whether a suffix is present in addition to the root. Since DISYLL dominates DEP-μ (see (59)), epenthesis is compelled and an (L'H) foot constructed due to SWP (106).

(106) DISYLL >> DEP-μ

/ʤul-n/$_{X0}$, /ʤul-n-ʧ'-Ø/$_{X0}$	DISYLL	SWP	DEP-μ
☞ [(ʤo.'lo:)]$_{PWd}$ nuʧ']$_{PWd}$			2
[(ʤo.'lo)]$_{PWd}$ nuʧ']$_{PWd}$		1 W	1 L
[[('ʤul)]$_{PWd}$ nuʧ']$_{PWd}$	1 W		L

The unaccusative suffix and triconsonantal one-vowel roots together meet minimality through phonotactic epenthesis and the (L'H) foot does not appear, just like with quadriconsonantal roots like /haj'k't/ (107).

(107) No LH Template with Unaccusative and Triconsonantal Roots

a. /ʔodb n/$_{X0}$, /ʔodb n ʧ' i/$_{X0}$ → [[('ʔod).('bin)]$_{PWd}$ ʧ'i]$_{PWd}$
   'open' UNACC 'open' UNACC AGTV ACC
   "one that opens (intr.)"

b. /dal'w' n/$_{X0}$, /dal'w' n ʧ' Ø/$_{X0}$ → [[('dal').wi]$_{PWd}$ niʧ']$_{PWd}$
   'trip' UNACC 'trip' UNACC AGTV NOM
   "one who trips and falls (intr.)"

c. /dal'w' n/$_{X0}$, /dal'w' n xo n'/$_{X0}$ → [[('dal')('win)]$_{PWd}$ xon']$_{PWd}$[6]
   'trip' UNACC 'trip' UNACC DUR N.PST
   "is tripping and falling (intr.)"

[6] (107c) has the /-xo/ allomorph of the durative, which appears when the LH template is not present; when the LH template is present, the /-ʔa/ allomorph of the durative appears (105b). In Collord's (1968) grammar of Chukchansi, /-xo/ and /-ʔa/ are two distinct suffixes, which he shows co-occurring in the same form. My Chukchansi consultant marginally accepts forms with /-ʔa/ and /-xo/ co-occurring in the same word, but prefers only one. More research is needed to determine the morphosyntactic status of /-ʔa/ and /-xo/, i.e., whether they are two different morphosyntactic heads or the same head with a different vocabulary item inserted.

Since the epenthetic vowel [i] in these forms is phonotactically necessary, the internal PWd meets disyllabic minimality without any other augmentation, similar to quadriconsonantal roots. An (L'H) foot cannot be constructed without epenthesizing more vowels (108).

(108) Unattested (L'H) Templates:
a. /ʔodb-n/$_{X0}$, /ʔodb-n-ʧ'-i/$_{X0}$ → *[[(ʔo.'do:).('bin)]$_{PWd}$ ʧ'i]$_{PWd}$
b. /ʔodb-n/$_{X0}$, /ʔodb-n-ʧ'-i/$_{X0}$ → *[[(ʔo.'dib)]$_{PWd}$ ('ni.ʧ'i)]$_{PWd}$

Since the attested output (107a) has well formed ('H) feet and meets disyllabic minimality, DEP-V eliminates the (L'H) challengers (109).

(109) No (LH) Template with Triconsonantal Root + Unaccusative

/ʔodb-n/$_{X0}$, /ʔodb-n-ʧ'-i/$_{X0}$	DISYLL, SWP	DEP-V
☞ [[('ʔod).('bin)] ʧ'i]		1
[[(ʔo.'dib)] ('ni.ʧ'i)]		2 W
[[(ʔo.'do:).('bin)] ʧ'i]		2 W

The behavior of one-vowel roots with the unaccusative suffix provides more evidence that the appearance of the (LH) template is a minimality effect made visible by PWd recursion. Suffixes that cause the template to appear do so because they are phase heads; no special morpheme-specific devices are needed.

2.9. Variations of the Basic Template

Templatic morphology in Chukchansi, like in all Yokuts languages, presents a very complicated picture on the surface. The data of Chukchansi templatic morphology presented in §2.2 omitted several complications, focusing on the regular pattern to facilitate the argument in sections §2.3-5. This section demonstrates that some of the apparent deviations from the regular pattern are actually predictable on closer inspection. These predictable complications include the quality of the second, epenthetic vowel of the template (§2.8.1) and the appearance of an LL template when the durative suffix attaches to biconsonantal root (§2.8.2). Other complications do not seem to be predictable from the grammar of Chukchansi; these include segmental changes on roots (§2.8.3) and irregular or optional templates (§2.8.4).

2.9.1. Epenthetic Vowel Quality

The second, epenthetic vowel of the (LˈH) foot varies in quality depending on the phonological properties of the root; this occurs generally with phase head suffixes. In biconsonantal roots, the second vowel is always low [a], no matter whether the first vowel is short high [i] (110a), long mid [e:] (110b), or low [a] (110c-d). One-vowel verb roots in Chukchansi do not have long high [i:] or short mid [e] vowels; mid vowels are historically derived from long high vowels.

(110) Biconsonantal Roots: Second Vowel is Low

a.	/ʧiʃ/x0	/ʧiʃ	la	it/	→	[[(ʧi.ˈʃ**a:**)]lat]
	‘cut’	‘cut’	CAUS	REC		
	“just made X cut”					
b.	/se:p/	/se:p	ʧʼ	i/	→	[[(si.ˈp**a:**.)]ʧʼi]
	‘tear’	‘tear’	AGTV	ACC		
	“tearer” (ACC)					
c.	/wan/	/wan	ʧʼ	i/	→	[[(wa.ˈn**a:**)]ʧʼi]
	‘give’	‘give’	AGTV	ACC		
	“giver” (ACC)					
d.	/ma:x/	/ma:x	ʔhij	ˀ/	→	[[(ma.ˈx**a**ʔ)]hijʼ]
	‘collect’	‘collect’	ADJV	NOM		
	“collecting place” (nom)					

In triconsonantal roots, the height of the second, epenthetic vowel depends on the height of the first, underlying vowel. If the first vowel is low, the second vowel will be low (111a-b)

(111) Triconsonantal Roots: First Low Vowel → Second Low Vowel

a.	/ʔ**a**ml/	/ʔ**a**ml	e	it/	→ [[(ʔa.ˈm**a:**)]let]
	‘help’	‘help’	CAUS	REC	
	“just made X help”				
b.	/h**a:**tm/	/h**a:**tm	ʧ	ˀ/	→ [[(ha.ˈt**a:**)]miʧˀ]
	‘sing’	‘sing’	AGTV	NOM	
	“singer” (nom)				

The low height of the epenthetic [a] vowel with these roots is a TETU effect of the vowel’s prominence. The epenthetic [a] vowel is always stressed, since it forms the nucleus of the H syllable of the (LˈH) template, and in fact has primary stress in the PWd_{min}. Vowels with a greater degree of stress are ideally as sonorous as possible, i.e., a low vowel (de Lacy 2002a). Since this vowel is epenthetic, it is free to assume the unmarked low vowel height for stressed vowels.

However, if the first vowel is non-low, i.e., high [i] or mid [e:], both vowels will be mid (112a-b). Newman (1944) calls this “strong-assimilation” and notes that it also occurs in two other Yokuts languages, Gashowu and Choynimni (1944:49).

(112) Triconsonantal Roots: First Non-Low Vowel → Both Vowels Mid

a.	/l**i**hm/	/l**i**hm	ʔa	n’/	→ [[(l**e**.ˈh**e**m’)]ʔan’]
	‘run’	‘run’	DUR	N.PST	
	“is running”				
b.	/b**e:**wn/	/b**e:**wn	e	hil/	→ [[(b**e**.ˈw**e:**)]ne.hil]
	‘sew’	‘sew’	AGTV	NOM	
	“sewer” (NOM)				

I suggest that the assimilation between the two vowels results in mid height, i.e., an [e] vowel, as a compromise between the underlying vowel, which is non-low, and the epenthetic vowel, which has primary stress in the PWd_{min} and is optimally as low as possible (de Lacy 2002a). If both vowels were low, the first vowel would be too unfaithful to its UR; if both vowels were high, the second, stressed vowel would have too marked a sonority value. I leave the question of what motivates the assimilation between the two vowels to future research; see Guekguezian (2012) for a sketch of how this could work.

2.9.2. The Apparent LL Template

While §2.2 claimed that the only regular template shape in Chukchansi is (LˈH), before the DURATIVE suffix /-ʔa-/, biconsonantal one-vowel roots appear with what seems to be an (LˈL) iamb (113). These LL forms are also found in Collord (1968), though Newman (1944) and Broadbent (1958) show LH forms for Chukchansi. I have only been able to elicit LL forms.

(113) Apparent LL Foot Template

a.	/ʧiʃ/$_{X0}$,	/ʧiʃ	ʔa	n'/$_{X0}$	→ [[(ʧi.ˈʃa)]ʔan']
	'cut'	'cut'	DUR	N.PST	
	"is cutting"				
b.	/ma:x/$_{X0}$,	/ma:x	ʔa	n'/$_{X0}$	→ [[(ma.ˈxa)]ʔan']
	'collect'	'collect'	DUR	N.PST	
	"is collecting"				

I claim that the apparently deviant LL templates actually falls in line with the claim that only (LˈH) is productive: the CVCV shape is actually (LˈH) with predictable pre-glottal shortening, The absence of a long second vowel in these forms is due to a general Chukchansi restriction against long vowels before [ʔ] and glottalized sonorants, which comes from the coda-philic properties of glottals; see Flynn and Pulleyblank 2001 for the preference for glottalization to occur in the coda. I argue that glottal segments must preferably be linked to a coda position in Chukchansi, which prevents a long vowel from occurring, as a potential V:$C^ʔ$ sequence must either be syllabified with the $C^ʔ$ in onset position as [V:.$C^ʔ$], with the glottal not linked to the coda, or with the $C^ʔ$ in coda position as [V:$C^ʔ$.], with an illegal superheavy syllable.

There are several pieces of evidence that glottal segments ([ʔ] and glottalized sonorants, not ejectives) must occupy the coda at least partially in Chukchansi. There are only seven forms in the Chukchansi-English Dictionary (Adisasmito-Smith 2016) with a glottal stop unambiguously in onset position (after a long vowel or another consonant), out of the hundreds of forms with a glottal stop. Moreover, there are no forms with a glottalized sonorant (e.g., /m' n' l' y' w'/) occurring after a vowel or another consonant; glottalized sonorants must occupy the coda (Niken Adisasmito-Smith and Chris Golston, p.c.). Suffix-initial glottal stops may occur after another consonant, as in (114a-b); however, these forms usually surface either with gemination (114a) or glottalization of the preceding consonant (114b). When underlyingly glottalized sonorants occur in intervocalic position due to syllable size restrictions, one of three things happen. Most typically, glottalization disappears (114c-d); occasionally, the glottalized segment breaks up into a [ʔ.C] cluster with a glottal stop in the coda (Niken Adisasmito-Smith, p.c.), or the glottalized consonant is geminated [C'.C'] (see Newman 1944 and Collord 1968 for corroboration).

(114) Glottals Licensed by Coda Position

a. /diʔʃ/$_{X0}$, /diʔʃ ʔa n'/$_{X0}$, → [(de.'ʔe**ʃ).ʃ**an']
'make' 'make' DUR N.PST
"is making"

b. /lihm/$_{X0}$, /lihm ʔa n'/$_{X0}$, → [(le.'he**m').ʔ**an']
124'run' 'run' DUR N.PST
"is running"

c. /dal'w' it/ → [dal'.**w**it]
'trip' REC
"just tripped"

d. /dal'w' taʔ/ → [da.**l**iw'.taʔ]
'trip' REM
"had tripped"

All three strategies prevent a glottal segment from occupying the onset entirely. If all glottal segments must be linked to the coda in Chukchansi, then the glottal stop in the templatic forms in (113) is actually ambisyllabic (115), and prevents the previous vowel [a] from being long. As a result, the initial foot is the expected (Lˈ H) iamb.

(115) Ambisyllabic Glottal Stop:

a. /ʧiʃ/$_{X0}$, /ʧiʃ-ʔa-n’/$_{X0}$ → [[(ʧi.ˈʃaʔ)]$_{PWd}$ ʔan’]$_{PWd}$

b. /ma:x/$_{X0}$, /ma:x-ʔa-n’/$_{X0}$ → [[(ma.ˈxaʔ)]$_{PWd}$ ʔan’]$_{PWd}$

This analysis of the glottal stop also accounts for why the DURATIVE /-ʔa-/ and the ADJUNCTIVE /-ʔhij-/ cause glottalization of an immediately preceding sonorant consonant ((116), from (10)). Since glottal stops must be licensed by the coda in Chukchansi, the glottalization of the preceding sonorant with the durative is caused by the glottal stop of the durative being linked to the sonorant in the preceding coda (116a). With the ADJUNCTIVE, the glottal stop cannot surface in onset position because of the CVX syllable maximum, and only surfaces as glottalization on the preceding sonorant.

(116) Coda Sonorant Glottalization

a. /ʔaml/$_{X0}$, /ʔaml ʔa n’/$_{X0}$ → [[(ʔa.ˈma**l’**)]$_{PWd}$ **ʔ**an’]$_{PWd}$
‘help’ ‘help’ DUR N.PST
“is helping”

b. /be:wn/$_{X0}$, /be:wn ʔhij ˀ/$_{X0}$ → [[(be.ˈwe**n’**)]$_{PWd}$ hij’]$_{PWd}$
‘sew’ ‘sew’ ADJV NOM
“sewing place” (NOM)

2.9.3. Segmental Changes on Roots

Phase head suffixes often trigger segmental changes on roots, including glottal stop infixation, glottalization of a root consonant, and fronting of the second vowel of the template to [e(:)]. Unlike

PWd recursion, these segmental changes do not seem to fall regularly out of the morphosyntax-phonology interface, and may instead be the result of autosegments associated with certain suffixes (see Newman 1944, Zoll 1993 for Yowlumne). With the causative /-la, -e/, the second syllable of the (LˈH) foot is with certain roots made heavy by a glottal stop coda instead of a long vowel (117); this happens optionally with some roots, obligatorily with others, and never with the rest.

(117) Glottal Stop Coda with Causative

a.	/waʃ/$_{X0}$,	/waʃ	la	taʔ/$_{X0}$	→	[[(wa.ˈʃa**<u>ʔ</u>**)]$_{PWd}$ la.taʔ]$_{PWd}$
	‘tell.story’	‘tell.story’	CAUS	REM		
	“had made X tell a story”					
b.	/ha:tm/$_{X0}$,	/ha:tm	e	it/$_{X0}$	→	[[(ha.ˈta**<u>ʔ</u>**)]$_{PWd}$ met]$_{PWd}$
	‘sing’	‘sing’	CAUS	REC		
	“just made X sing”					

The infixation of the glottal stop into the root may be due to a glottal autosegment /ˀ/ optionally present in the UR of the causative. Alternatively, the glottal stop may simply be another means of forming the (LˈH) foot. Glottal-stop epenthesis violates the faithfulness constraint DEP-C, while long-vowel epenthesis violates the markedness constraint *V:. If DEP-C normally dominates *V: in Chukchansi, then a long vowel, not a glottal stop, is usually epenthesized to form the (L'H) foot. With roots where the glottal stop either always or never appears in the causative, the glottal stop’s appearance may be lexicalized. With roots where the glottal stop’s appearance is optional, noise or stochastic probability, may cause *V: to dominate DEP-C in some iterations of the grammar, leading to glottal stop epenthesis (118). This scenario can be modeled in grammars that incorporate noise or stochastic probability, such as Partial Ordering OT (Anttila 1997), Stochastic OT (Boersma 1997), Noisy Harmonic Grammar (Boersma and Pater 2008) and Maxent Grammar Goldwater and Johnson 2003, Hayes and Wilson 2008).

(118) Long Vowel vs. Glottal Stop Epenthesis

/waʃ/$_{X0}$, /waʃ-la-taʔ/$_{X0}$	DEP-C	*V:
☞ [[(wa.ʃa**:**)]$_{PWd}$ la.taʔ]$_{PWd}$		1
☞ [[(wa.ʃa**ʔ**)]$_{PWd}$ la.taʔ]$_{PWd}$	1	

A different pattern of segmental alterations includes fronting and raising of the epenthetic vowel, which is typically a low central vowel [a] in Chukchansi. With the distributive /-a/, inchoative /-a/ and causative-inchoative /-ta/ suffixes, the second vowel of the LH template is always the mid front vowel [e(:)], even when [a(:)] is expected due to the low root vowel. Following Zoll (1993, 1996), the fronting and raising is due to floating features [+high] and [-back], marked as /^{i}/, which dock to the stressed vowel of the internal PWd (119).

(119) Second Vowel = [**e(:)**]

a. /ʔaml a,^{i} n'/ → [[(ʔa.ˈm**e:**)]lan'] (= [ʔa.m**a^i:**.lan'])
‘help’ DISTR N.PST
“helps lots of X”

b. /gajs a,^{i} taʔ/ → [[(ga.ˈ**je:**)]sa.taʔ] (= [ga.j**a^i:**.sa.taʔ])
‘good’ INCH REM
“just got better”

c. /gajs ta,^{i} taʔ/ → [[(ga.ˈj**e**s)]ta.taʔ] (= [ga.j**a^i:**.sa.taʔ])
‘good’ CS.IN REM
“just made X better”

2.9.4. Irregular and Optional Templates

While I have argued that the apparent LL template in §2.8.2 is actually a regular LH template, there are other deviations from the (LˈH) template that are either irregular or optional. Short-long /CVCV:(C)/ verb roots may lose their final vowel with certain template-triggering suffixes; this is obligatory when the CAUSATIVE attaches to /CVCV:/ roots (120a), and optional when the AGENTIVE attaches to /CVCV:C/ roots (120b).

(120) Apparent CVC(C) Templates

a.	/pana:/$_{X0}$,	/pana:	la	taʔ/$_{X0}$	→ [[('pan)]$_{PWd}$ la.taʔ]$_{PWd}$
	'arrive'	'arrive'	CAUS	REM	
	"had made X arrive"				
b.	/hewe:t/$_{X0}$,	/hewe:t	ʧˀ	Ø/$_{X0}$	→ [[('hiw')]$_{PWd}$ tiʧˀ]$_{PWd}$, [[(he.'we:)]$_{PWd}$ tiʧˀ]$_{PWd}$
	'walk'	'walk'	AGTV	NOM	
	"walker" (NOM)				

I argue that the template in (120), which is either a single syllable or an (ˈH) foot, is not productive in Chukchansi. First, /CVCV:/ roots are extremely rare in Chukchansi: only three have been elicited, composing less than one percent of all roots. Newman (1944) reports that in general in Yokuts these roots are only about "seven or eight percent" as common as other root types, and are "actively being leveled out of existence" (1944:39). Due to their small number and additional aberrant phonological behavior, the templatic forms of these roots are probably lexicalized. Second, the restriction of templatic vowel loss with the agentive to /CVCV:C/ roots, as well as its optionality, suggests that (120) is not a productive process. Moreover, the phonotactics of glottalized segments may be preventing the (LˈH) foot from surfacing here. In both Chukchansi and in Newman's data, the second consonant of CVCC forms like (120) are glottalized if possible; since glottalized segments must occupy the coda, an (LˈH) foot is phonotactically illicit, since the glottalized segment would be in the onset (121).

(121) /hewe:t/$_{X0}$, /hewe:t-ʧˀ, ˀ-Ø/$_{X0}$ → [[('hi**<u>w'</u>**)]$_{PWd}$ tiʧˀ]$_{PWd}$ *[[(he.'**<u>w'</u>**e:)]$_{PWd}$ tiʧˀ]$_{PWd}$

The (LˈH) foot template is optionally absent with the CAUSATIVE suffix. When the template does not occur, the /-la/ allomorph of the CAUSATIVE invariably appears (122).

(122) Template Optionally Absent with the CAUSATIVE

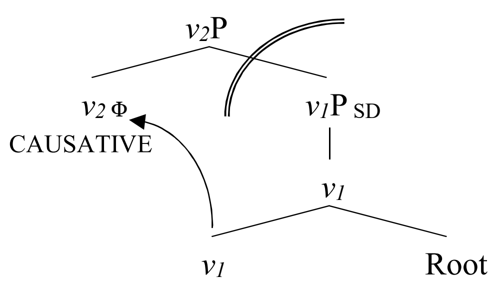
a. /xat/$_{X0}$, /xat la taʔ/$_{X0}$ → [(ˈxat).(ˈla.taʔ)]
   ‘eat’ ‘eat’ CAUS REM
   “just made X eat”
   (cf. [[(ˈxa.ta:)](ˈla.taʔ)]

b. /ha:tm/$_{X0}$, /ha:tm la it/$_{X0}$ → [(ˈha:).(ˈtim).lat]
   ‘sing’ ‘sing’ CAUS REC
   “just made X sing”
   (cf. [[(ha.ˈta:)]met]~[[(ha.ˈtaʔ)]met])

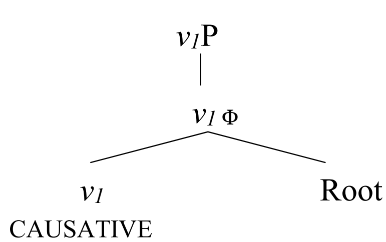
There does not seem to be any syntactic or semantic difference between CAUSATIVE forms with the (LˈH) template and without it. The cyclic syntax-prosodic recursion account predicts that there ought to be a phasal difference. Specifically, forms with the template should be biphasal, where the CAUSATIVE suffix is a v_2 (i.e., it attaches above an already verbalized root (123a)), and thus be syntactic causatives (Hale and Keyser 1993). Forms without the template should be monophasal, where the CAUSATIVE suffix is a v_1 (i.e., it attaches directly to a root (123b)), and therefore be lexical causatives. Further investigation is needed to confirm or disconfirm this prediction.

(123) Syntactic Causatives vs. Lexical Causatives

a. Syntactic Causative = v_2



b. Lexical Causative = v_1



2.10. Conclusion

Chapter Two has illustrated the model proposed in Chapter One: syntactic cyclicity results in prosodic recursion inside the word in Chukchansi Yokuts. Chukchansi displays two consequences of the cyclic syntax-parallel phonology model: (1) a **syntactic contrast** in the phasal structure of a word can result in a **phonological contrast** in PWd structure, and (2) the visible effects of PWd recursion are **determined entirely by the phonology**, not by a diacritic property or prosodic subcategorization requirement of the suffixes (e.g., Archangeli 1983, 1991 for Yowlumne Yokuts). In Chukchansi, PWd recursion gives the appearance of templatic morphology. When a phase head suffix is present, a root with one underlying vowel is augmented to meet disyllabic PWd minimality, and forms the optimal Chukchansi disyllable, a light-heavy (L'H) iambic foot. When minimality is met by underlying material, i.e., when a spelled-out root has more than one vowel or when no phase head suffix is present, augmentation is unnecessary and the (L'H) foot does not appear. Templatic morphology in Chukchansi is thus a completely predictable and regular effect of **prosodic recursion resulting from syntactic cyclicity inside the word**.

3. X_0-PWd Mismatches and Parallel Phonology in Creek

3.1. Introduction

In this chapter I investigate another instance of syntactic cyclicity that results in phonological recursion inside the word. As in Chapters One and Two, an X_0 spelled out at each phase corresponds to a distinct Prosodic Word (PWd), and the PWds are recursive. This chapter expands on and refines the model proposed in Chapter One and illustrated in Chapter Two. Chapter Three makes and defends two major claims: (1) **mismatches** between cyclic X_0s and recursive PWds are regulated by the phonology, and (2) the mapping of X_0s and PWds must occur **in parallel** with other phonological phenomena, including autosegmental docking.

I focus both on X_0-PWd mismatches and on parallel mapping and phonology in Creek; the account builds on the analysis of Martin (2011), which provides all the data in this chapter. Creek, also known as Muskogee, is a Muskogean language of the southeastern United States, spoken primarily in Oklahoma with a smaller community in Florida, where it is known as Seminole. Creek verbs appear to have an internal morphological constituent, the **Stem**, which roughly delimits the domain of regular iambic stress and spread of high tone. The Stem is also the domain of **grades**, or changes to the Stem-final syllable, which encode aspectual semantics (Haas 1940). Grades have two effects on the Stem-final syllable: docking of autosegments, such as tone or nasalization, and vowel lengthening where possible.

I argue that Creek does not have a distinct Stem constituent that exists in the morphology. Rather the "Stem" is an **X_0 in the inner phase** in syntax and an **internal PWd_{min}** in phonology; the X_0 is mapped to the PWd via Match constraints. Unlike Chukchansi, which has a contrast between monophasal and biphasal verbs, all verbs in Creek are biphasal, and would thus be expected to show PWd recursion. However, in some Creek verbs PWd recursion is blocked due to **phonologically-conditioned mismatches** between X_0s and PWds; this contrasts with Chukchansi, where PWd recursion is always present in biphasal verbs.

Creek displays multiple types of such X_0-PWd mismatches. Specifically, phonological constraints cause mismatches between the lower and higher X_0s, on the one hand, and the minimal and maximal PWds, on the other. In the general case of Creek verbs, the final consonant inside the lower X_0 is undermatched, falling outside the minimal PWd to provide an onset for the next syllable (1). However, the first vowel outside the lower X_0 may be overmatched into the minimal PWd in order to fully parse it into binary iambs (2).

(1) Undermatch: material **inside** lower X_0 is **outside** minimal PWd

a. Syntax / w a n a y a ɬ i: s/$_{X0}$[7]
/ w a n a **<u>y</u>**/$_{X0}$

b. Phonology [[(w a n a)]$_{PWd}$ **<u>y</u>** a ɬ i: s]$_{PWd}$

"(s)he will tie it"

(2) Overmatch: material **outside** lower X_0 is **inside** minimal PWd

a. Syntax / a w a n a y **<u>a</u>** ɬ i: s/$_{X0}$
/ a w a n a y/$_{X0}$

b. Phonology [[(a w a) (n a y **<u>a</u>**)]$_{PWd}$ ɬ i: s]$_{PWd}$

"(s)he will tie it to it"

The phonology must be able to tell undermatches and overmatches apart. To do so, I propose that the MatchWord constraint (Selkirk 2009, 2011) mapping X_0s to PWds must be split into two constraints: MATCHWORD(All), penalizing undermatches, and MATCHWORD(Only), penalizing

[7] I follow the orthography in Martin (2011), where orthographic <y> represents the palatal approximant [j]. Similarly, <c> represents [ʧ].

overmatches. The mismatches between X_0s and PWds in Creek also support a model of the syntax-phonology mapping in which the mapping between syntactic and prosodic constituents occurs **in parallel with autosegmental docking**. An overmatch similar to (2) may block PWd recursion with some inputs (3). However, the presence of an autosegment, which lengthens the vowel it docks onto, allows PWd recursion (135).

(3) PWd Recursion Blocked: /awanay/$_{X0}$, /awanayas/$_{X0}$ → [(a.wa).(na.yas)]$_{PWd}$
(4) PWd Recursion Allowed: /awanay/$_{X0}$, /awanayis, ^{HL}/$_{X0}$ → [[(a.wa).(n$\underline{\mathbf{a\!:}^{\mathbf{HL}}}$)]$_{PWd}$ yis]$_{PWd}$

This chapter is structured as follows. §3.2 describes the stress and tone patterns in verbs and proposes that the domain of regular stress and tone in verbs is an internal PWd. §3.3 argues that the morphosyntactic material in this domain is an inner X_0 spelled out in an early phase. §3.4 investigates phonologically-driven mismatches between the inner X_0 and the internal PWd, and proposes two distinct Match constraints to regulate mismatches. §3.5 demonstrates that autosegmental docking must occur in parallel with the X_0-PWd mapping, and §3.6 argues that a phase-based phonological model with an active Phase Impenetrability Condition (PIC; Chomsky 2000, 2001, Samuels 2010) cannot account for the mapping. §3.7 concludes the chapter.

3.2. Stress and Tone Domains: Data and Generalizations

This section investigates the morphophonological structure of the Creek verb. Much of the descriptive literature on Creek (esp. Martin 2011) recognizes two main components in the morphology of verbs: the Stem and the Word. While the Word comprises the entire verb except clitics, the Stem forms a constituent inside the verb. The Stem consists of all prefixes, the root, and certain suffixes that Martin (2011) calls "inner suffixes," including plural patient agreement and prospective aspect. Other suffixes, which Martin (2011) terms "outer suffixes," are outside the Stem, in the Word domain (5). Clitics fall outside the Word.

(5) [prefixes – verb root – inner suffixes] – outer suffixes – clitics
the Stem

(adapted from Martin 2011:96)

I argue in this chapter that the inner constituent is not in fact a Stem, in the sense of a purely morphological entity. Instead, it is both a syntactic constituent—an **X_0 in an early spellout domain**—and a phonological constituent—an **internal PWd_{min}**. The X_0 is mapped to the PWd by MATCHWORD, which demands isomorphy in the syntax-prosody mapping (Selkirk 2009, 2011). However, the morphosyntactic material in the early spellout domain, i.e., the "Stem" of Martin (2011), is not exactly isomorphic to the internal PWd; §3.4 gives a detailed analysis of the non-isomorphy, or mismatches. The internal PWd in Creek, I argue, is the domain of regular iambic stress in verbs, which is marked phonologically by the spread of non-lexical high tone. The final syllable of the internal PWd always carries primary stress, and thus attracts autosegments from outside the early spellout domain. For ease of exposition and comparison with other work, this section uses the term "Stem" as equivalent to the morphological material of the early spellout domain.

3.2.1. Regular Stress and Tone Patterns

Creek stress has been thoroughly described by Haas (1977) and given several subsequent theoretical analyses (e.g., Halle and Vergnaud 1978, 1987; Prince 1983; Hayes 1995). In this section, I follow Martin's (2011) description of stress and his footing, which largely follows these earlier works but uses primary data. Creek parses stress domains into iambic feet from left-to-right.

In nouns, including those derived from verbs, the entire word constitutes the domain of stress (6a-c). In verbs, the Stem constitutes the domain of stress, excluding outer suffixes (6d). I use the symbol '=' to show the boundary between the Stem and outer suffixes. Unless otherwise noted, all Creek data in this section and the chapter as a whole come from Martin (2011).

(6) Iambic Stress in Creek: (Lˈ L) Feet

a.	/ifa/			→	[(i.ˈfa)]	
	'dog'					
	"dog"					Martin (2011:76)
b.	/nokos	oci/		→	[(no.ˈko).(so.ˈci)]	
	'bear'	DIMIN				
	"bear cub"					Martin (2011:76)
c.	/wanay	ita/		→	[(wa.ˈna).(yi.ˈta)]	
	'tie'	INFIN				
	"to tie"					Martin (2011:76)
d.	/wanay	=	as/	→	[(wa.ˈna).y=as]	
	'tie'	=	IMPER[8]			
	"tie!"					Martin (2011:86)

In (6), light syllables receive stress. Nevertheless, Creek is quantity-sensitive: heavy syllables always receive stress, no matter their position. This is generally true for iambic languages, as iambic parsing prefers stress to be accompanied by a durational contrast due to the Iambic/Trochaic Law (Hayes 1995). Long vowels (7a-c) and codas (7d) contribute to weight. All iambic feet are possible in Creek: (Lˈ L), (ˈH) and (Lˈ H).

[8] The following morpheme abbreviations also appear in Tables (3-4) in §3.4: 1^{ST} singular = 1S; 1^{ST} plural = 1P; 2^{ND} = 2; 2^{ND} singular = 2S; 2^{ND} plural = 2P; dative = DAT; direct causative = transitive = v_{TRANS}; directional = DIR; durative = DUR; future = FUT; impersonal passive = IM.PASS; imperative = IMPER; indicative = INDIC; indirect causative = CAUS; instrumental = INSTR; interrogative = INTER; intransitive triplural = TRIPL; locative = LOC; middle = intransitive = v_{INTRS}; negative = NEG; PAST = PT; patient = PAT; plural = PL; plural patient/distributive = DISTR; plural/dual = PL/DL; prospective = PROSP; reciprocal = RCPL; reflexive = RFLX; spontaneous = SPON.

(7) Iambic Stress in Creek: (ˈH) and (LˈH) Feet

a. /fo:/ → [(ˈfo:)]
'bee'
"bee" Martin (2011:76-77)

b. /i:kana/ → [(ˈi:).(ka.ˈna)]
'land'
"land" Martin (2011:77)

c. /ca:t = i:/ → [(ˈca:).t=i:]
'be.red' = DUR
"red" Martin (2011:85)

d. /homp = as/ → [(ˈhom).p=as]
'eat' = IMPER
"eat!" Martin (2011:86)

Nouns and verbs contrast with each other when the stress domain ends in a single light syllable. In nouns, a single word-final light syllable is left unfooted (8).

(8) Nouns: Final Light Syllable Unparsed

a. /sokha/ → [(ˈsok).ha]
'hog'
"hog" Martin (2011:77)

b. /tapasso:la/ → [(ta.ˈpas).(ˈso:).la]
'daddy longlegs'
"daddy longlegs" Martin (2011:77)

c. /a wanay ita/ → [(a.ˈwa).(na.ˈyi).ta]
DIR 'tie' INFIN
"to tie to" Martin (2011:76)

In verbs, however, a single Stem-final light syllable is footed by extending stress to the first syllable of the outer suffixes (at least one of which is obligatorily present), rather than leaving the Stem-final syllable unparsed (9).

(9) Verbs: Stress Domain Extended

a. /itkol = i:/ → [(ˈit).(ko.ˈl=i:)], *[(ˈit).ko.l=i:]
'feel.cold' = DUR
"(feeling) cold" Martin (2011:85)

b.	/homp	ip	=	as/	→	[(ˈhom).(pi.ˈp=as)], *[(ˈhom).pi.p=as]
	‘eat’	SPON	=	IMPER		
	“please eat!”					Martin (2011:86)
c.	/a	wanay	=	as/	→	[(a.ˈwa).(na.ˈy=as)], *[(a.ˈwa).na.y=as]
	DIR	‘tie’	=	IMPER		
	“tie it to it!”					Martin (2011:86)

Due to this parsing behavior, verbs like (10), which are segmentally identical but contrast in Stem size, also contrast in stress patterns. In (10a), the plural suffix /-ak/ is part of the Stem, so it gets footed by extending stress to the outer suffix /-i:/ ‘durative’. In (10b), the homophonous impersonal agent suffix /-ak/ is outside of the Stem, and is not footed. This minimal pair demonstrates the necessity of an inner morphological constituent in Creek verbs; in §3.3 I argue this constituent is an early spellout domain in morphosyntax that is mapped to an internal PWd in phonology.

(10) Contrast in Stem Size — adapted from Martin (2011:87-88)

a.	/wanay	**ak** =	i:/		→	[(wa.ˈna).(y-a.ˈk=i:)]
	‘tie’	PL =	DUR			
	“they can tie it”					
b.	/wanay	=	**ak**	i: /	→	[(wa.ˈna).y=a.ki:]
	‘tie’	=	IPSL.AG	DUR		
	“someone can tie it”					

The primary phonetic reflex of stress in Creek is a level high pitch that extends from the first stressed syllable to the last stressed syllable, though there is also a “subtle acoustic correlate of rhythm” (Jack Martin, p.c.). Martin (2011) uses the extent of high pitch in the word as evidence for the footing patterns above: if a high tone /^{H}/ is assigned to all syllables from the first stressed syllable to the final stressed syllable based on the above footing, the pitch patterns of words is accurately captured (see Martin and Johnson 2002 for a detailed account of the tonal patterns of

Creek). For example, in (11), level high pitch extends through the whole word, which can be described phonologically as high tone /^{H}/ on all syllables between the first and last stress.

(11) Stress Domain = High Tone Spread

a.	[(ˈfo^{H}:)]	"bee"
b.	[(ˈi^{H}:).(ka^{H}.ˈna^{H})]	"land"
c.	[(ˈho^{H}m).(pi^{H}.ˈp=a^{H}s)]	"please eat!"

An initial unstressed syllable has slightly lowered pitch; I mark this as mid tone /^{M}/, though nothing hinges on this (12).

(12) Pre-Stress: Slightly Lowered (^{M} Tone)

a.	[(wa^{M}.ˈna^{H}).(yi^{H}.ˈta^{H})]	"to tie"
b.	[(a^{M}.ˈwa^{H}).(na^{H}.ˈy=a^{H}s)]	"tie it to it!"

Any syllables after the final stress have greatly lowered pitch; I mark it with low tone /^{L}/ (13).

(13) Post-Stress: Greatly Lowered (^{L} Tone)

a.	[(ˈca^{H}:).t=i^{L}:]	"red"
b.	[(wa^{M}.ˈna^{H}).y=a^{L}s]	"tie!"
c.	[(ta^{M}.ˈpa^{H}s).(ˈso^{H}:).la^{L}]	"daddy longlegs"

The span of level high tone /^{H}/ provides phonetic evidence for the footing above, and specifically for the Stem as the domain of stress. For example, the contrast in footing of (10) above is shown on the surface as a pitch contrast (14). The only underlying difference between (14a-b) is in the size of the Stem. Since the Stem is larger in (14a), it has a second foot and high tone extends to the end of the PWd. As (14b) has a smaller Stem, it has two unfooted syllables at the end of the PWd, which have low tone.

(14) Stem Size Contrast = Tonal Contrast

a. [(wa^{M}.ˈna^{H}).(ya^{H}.ˈk=i:^{H})] “they can tie it”

b. [(wa^{M}.ˈna^{H}).y=a^{L}.ki:^{L}] “someone can tie it”

Certain outer suffixes invariably have a high tone on one of their syllables, such as /-á^{H}łi:-/ ‘future’; I follow Martin (2011) in marking invariant high tone with an acute accent. When final stress falls before a syllable with invariant high tone, level high tone extends to the final stressed syllable and the following invariant high tone is downstepped, marked by $^{!H}$ in (15). Haas (1977) and Martin (2011) analyze the final regular stress as **primary**, since only this stress triggers downstep, and not previous stresses. There is conflicting evidence for primary stress in Creek. While Martin (2011:76, fn. 2) is not “aware of any phonetic distinction between primary and secondary stress in Creek,” Martin and Johnson (2002:39-40) argue that characterizing final stress as primary, i.e., the “key syllable,” simplifies the description of tone. Jack Martin (p.c.) also notes that syllables with primary stress have at least an impressionistic prominence, though this is difficult to measure. In a sequence of multiple syllables with inherent high tone, each successive one is downstepped (15b). When primary stress falls on a syllable with invariant high pitch, then level high pitch extends to this syllable, and the resulting tone pattern is the same as when the stressed outer suffix syllable does not have high tone (15c).

(15) Tonal Downstep

a. /wanay = áłi: is/ → [(wa^{M}.ˈna^{H}).y=á$^{!H}$.łi^{L}:s]
‘tie’ = FUT INDIC
“s/he will tie it” Martin (2011:86)

b. /wanay = íck áłi: is/ → [(wa^{M}.ˈna^{H}).y=í$^{!H}$c.ká$^{!!H}$.łi^{L}:s]
‘tie’ = 2.SG FUT INDIC
“you will tie it” Martin (2011:87)

c. /a wanay = áłi: is/ → [(a^{M}.ˈwa^{H}).(na^{H}.ˈy=á^{H}).łi^{L}:s]
DIR ‘tie’ = FUT INDIC
“s/he will tie it to it” Martin (2011:86)

Martin analyzes these suffixes as having "inherent stress," but does not treat them as footed (2011:86-7). While I follow his denotation (using an acute accent), there is no clear evidence to decide whether these suffixes indeed have lexically-specified stress, or whether instead they have an underlying high tone linked to one of their vowels. Other morphemes do have lexically-specified tone: most aspectual morphemes are expressed by autosegmental tone, while some nouns have a lexically-specified falling tone on a stressed syllable. Regardless of whether the surface high tone on these suffixes is marked in the input as stress or tone, it must be lexically specified, as it behaves differently from regular iambic stress and level high tone. As the outer suffix /áłi:/ illustrates, stress or high tone in outer suffixes can appear on an odd-numbered light syllable [a] and can be absent from a heavy syllable [łi:] (15a-b).

3.2.2. Grades

The morphophonology of grades provide further evidence for the Stem being a constituent. Grades express aspectual meaning and involve phonological changes to the final syllable of the Stem (Haas 1940). Not only is the grade system fully productive, but graded verbs are in fact much more common than non-graded verbs, which only appear in negative, future, imperative or stative forms (Martin 2011). Grades have two phonological consequences: adding autosegmental content (tones, nasalization, aspiration or fronting) to the Stem-final syllable, and lengthening the Stem-final vowel where possible. Stem-final vowel lengthening is responsible for changes in stress placement.

There are four different grades, each corresponding to a specific aspectual interpretation (see §3.3.2 for the aspectual syntax and semantics of the grades). In addition, Creek has **non-graded** verbs (i.e., the 'Zero' grade in Martin 2011), which Martin (2011) argues are used as a **default** form and have no fixed aspectual interpretation. The **lengthened** grade is formed by lengthening the Stem-final vowel and adding a high tone /^{H*}/ which spreads rightward from the Stem-final vowel. The **aspirating** grade is formed by docking a [spread glottis] feature onto the Stem-final vowel, which Martin analyzes as a coda [h]. The **falling** grade is formed by lengthening and adding falling tone to the Stem-final vowel. The **nasalizing** grade is formed by lengthening, nasalizing and adding rising tone to the Stem-final vowel. Table (1) shows the graded and non-graded forms of three different Stems built on the root /wanay/ 'tie': /wanay=/, /a-wanay=/ "tie to" and /wanay-ak=/ "they tie". Table (1) only shows the grade-specific tones (right-spreading high /^{H*}/, falling /^{HL}/ and rising /$^{HH+}$/); the actual surface tone patterns of the grades interact with regular stress and tone and are described in more detail below.

Table 1. Paradigm of the Grade System (adapted from Martin 2011:83-84)

Verb Form	/wanay=/	/a-wanay=/	/wanay-ak=/
Non-graded (Zero)	[(wa.ˈ***na***).y=as]	[(a.ˈwa).(***na***.ˈy=as)]	[(wa.ˈna).(***ya***.ˈk=i:)]
Lengthened	[(wa.ˈ***na:***^{H*}).y=is]	[(a.ˈwa).(ˈ***na:***^{H*}).y=is]	[(wa.ˈna).(ˈ***ya:***^{H*}).k=is]
Aspirating	[(wa.ˈ***naḁ***).y=is]	[(a.ˈwa).(ˈ***naḁ***).y=is]	[(wa.ˈna).(ˈ***yaḁ***).k=is]
Falling	[(wa.ˈ***na:***^{HL}).y=is]	[(a.ˈwa).(ˈ***na:***^{HL}).y=is]	[(wa.ˈna).(ˈ***ya:***^{HL}).k=is]
Nasalizing	[(wa.ˈ***nã:***$^{HH+}$).y=is]	[(a.ˈwa).(ˈ***nã:***$^{HH+}$).y=is]	[(wa.ˈna).(ˈ***ya:***$^{HH+}$).k=is]

In the graded forms, the Stem-final syllable (highlighted in Table 1) is always heavy, due to a lengthened Stem-final vowel. The added weight causes the Stem-final syllable to have final stress and the outer suffixes to lose stress in Stems like /a-wanay=/ and /wanay-ak=/; compare non-graded (16) with graded (17).

(16) Non-graded: Stress on outer suffix

a. [(a.ˈwa).(***na***.ˈy=as)] "tie it to it!"

b. [(wa.ˈna).(***ya***.ˈk=i:)] "they can tie it"

(17) Graded: No stress on outer suffix

a. [(a.ˈwa).(ˈ***na:***^{H*}).y=is] "s/he is tying it to it"
b. [(wa.ˈna).(ˈ***ya:***^{H*}).k=is] "they are tying it"

The contrast between graded forms of /wanay=/ and /wanay-ak=/ shows that it is the last syllable of the Stem that undergoes grade changes, not the last syllable of the root or any other particular morpheme. The syllable [na] is Stem-final in /wanay=/ (18a), but not in /wanay-ak=/, where [.ya.] is Stem-final (18b).

(18) Grades Operate on Stem-Final Syllable

a. [(wa.ˈ***na:***^{H*}).y=is] "s/he is tying it"
b. [(wa.ˈna).(ˈ***ya:***^{H*}).k=is] "they are tying it"

I now go into more detail on the phonological form of each grade. The most commonly used grade is the **lengthened** ('LGR' in glosses) grade, which indicates eventive aspect (Martin 2011:256). The lengthened grade involves two changes: lengthening the final vowel of the Stem and adding a right-spreading high tone /^{H*}/ that docks onto that vowel and spreads to the end of the word (19). Vowel lengthening is vacuously satisfied if the final vowel of the Stem is already long (19c), or if it is followed by a coda sonorant (19d). This is a Creek phonotactic constraint: a long vowel can only be followed by a coda obstruent, not a coda sonorant, although all codas provide weight.

(19) Lengthened Grade (LGR)

a. /tac = ^{H*} is/ → [(ˈt**a**$^{\mathbf{H}}$**:**).c=i^{H}s]
'cut' LGR INDIC
"(s)he is cutting" Martin (2011:88)

b. /wanay = ^{H*} is/ → [(wa^{M}.ˈn**a**$^{\mathbf{H}}$**:**).y=i^{H}s]
'tie' LGR INDIC
"(s)he is tying it" Martin (2011:83)

c. /ap**o:**k = ^{H*} is/ → [(a^{M}.ˈp**o**$^{\mathbf{H}}$**:**).k=i^{H}s]
‘sit’.TRIPL LGR INDIC
“they (3+) are sitting” Martin (2011:88)

d. /h**om**p = ^{H*} is/ → [(ˈh**o**$^{\mathbf{H}}$**m**).p=i^{H}s]
‘eat’ LGR INDIC
“(s)he is eating” Martin (2011:88)

The right-spreading high tone is downstepped if there is a previous high tone in the word. In (19), the Stem-final vowel is the only stressed vowel, so there is no previous high tone and no downstep. If there is another stressed vowel before the Stem-final vowel, the previous stress or stresses get their own high tone, which triggers downstep of the right-spreading high tone (20a-b). The previous stress before the Stem-final vowel is primary in these LGR forms (Jack Martin, p.c.), which I underline in (20). An unstressed syllable in the same foot as the Stem-final syllable shares downstepped tone as well (20c). The right-spreading high tone stops after an outer suffix syllable with inherent stress or high tone; any outer suffixes syllables after this have low pitch (20d).

(20) Tonal Downstep in the Lengthened Grade

a. /a wanay = ^{H*} is/ → [(a^{M}.ˈwa^{H}).(ˈna:$^{\mathbf{!H}}$).y=i$^{\mathbf{!H}}$s]
DIR ‘tie’ LGR INDIC
“(s)he is tying it to it” Martin (2011:84,89)

b. /is iti pakoc = ^{H*} is/ → [(i^{M}.ˈsi^{H}).(ti^{H}.ˈpa^{H}).(ˈko:$^{\mathbf{!H}}$).c=i$^{\mathbf{!H}}$s]
INST RCPR ‘fold’ LGR INDIC
“(s)he is folding it with it” Martin (2011:89)

c. /ac a wanay = ^{H*} is/ → [(a^{M}.ˈca^{H}).(wa$^{\mathbf{!H}}$.ˈna$^{!H}$:).y=i$^{!H}$s]
1.SG.PA DIR ‘tie’ LGR INDIC
“(s)he is tying me to it” Martin (2011:89)

d. /a wanay = ^{H*} íck is/ → [(a^{M}.ˈwa^{H}).(ˈna$^{\mathbf{!H}}$:).y=í$^{\mathbf{!!H}}$c.ki^{L}s]
DIR ‘tie’ LGR 2SG.AG INDIC
“you are tying it to it” Martin (2011:90)

The **aspirating** grade (glossed ‘HGR’) mainly indicates perfective aspect, though there are few other uses. The aspirating grade is formed in two different ways, depending on the phonological shape of the Stem. The general process involves lengthening the final Stem vowel if possible and docking the feature [spread glottis] (abbreviated as S.G.) onto it. I argue in §3.5.1 that the first mora of the vowel is voiced, while the [spread glottis] feature is linked to the second mora, making it voiceless (21). Lengthening the vowel makes the Stem-final syllable heavy, predictably causing stress to shift to this syllable (21c). The pitch pattern is identical to the non-graded form.

(21) Aspirating Grade (HGR)

a. /ay = $^{S.G.}$ is/ → [(ˈ**aḁ**$^{\mathbf{H}}$).y=i^{L}s]
‘go’.SG HGR INDIC
“(s)he went (today or last night)” Martin (2011:92)

b. /wanay = $^{S.G.}$ is/ → [(wa^{M}.ˈn**aḁ**^{H}).y=i^{L}s]
‘tie’ HGR INDIC
“(s)he tied it (today or last night)” Martin (2011:83,92)

c. /a wanay = $^{S.G.}$ is/ → [(a^{M}.ˈwa^{H}).(ˈn**aḁ**^{H}).y=i^{L}s]
DIR ‘tie’ HGR INDIC
“(s)he tied it to it (today or last night)” Martin (2011:84,92)

This analysis is phonetically indistinguishable from Martin’s analysis, in which the general process of forming the aspirating grade involves shortening the final Stem vowel if possible and infixing a coda [h] after it. In both analyses, the Stem-final syllable is bimoraic, with the first mora linked to a voiced vowel and the second mora being aspirated. I argue against Martin’s shortening+[h] as there is no general process of shortening long vowels before coda [h]. Rather, surface long vowels are allowed before coda [h] in Creek, e.g., in the lengthened grade; compare the HGR form (22a) with the LGR form (22b).

(22) No Shortening in HGR

a. /h**<u>a:</u>**y = $^{S.G.}$ is/ → [(h**aḁ**^{H}).y=i^{L}s]
‘make’ HGR INDIC
“(s)he made it (today or last night)” Martin (2011:92)

b. /w**o̲h̲**k = ^{H*} is/ → [(w**o̲:̲^{H}h̲**).k=i^{L}s]
‘bark’ LGR INDIC
“it is barking” Martin (2011:31)

If the verb Stem ends in a consonant cluster or a geminate, lengthening and docking the [spread glottis] onto the Stem-final vowel does not occur, as it would create an illegal superheavy syllable. Instead, [e^{HL}y] (i.e., the diphthong [ey] with falling pitch) appears to be infixed between the two Stem-final consonants (23). I suggest that this [e^{HL}y] is also an autosegment in the input, a floating [+front] feature. If the Stem ends in a geminate [kk], the [e^{HL}y] splits the two [k]s (23b); if the Stem ends in a geminate consonant other than [kk], the second consonant assimilates to the [y] (23c). The high-pitched portion of the falling pitch is not downstepped after a previous stressed syllable with high tone (23d).

(23) [e^{HL}y] Allomorph of HGR
a. /homp = $^{[+front],HL}$ is/ → [(ho^{M}.m**e̲^{HL}y̲**).p=i^{L}s], *[(hoo̥m).p=is],
‘eat’ HGR INDI
“(s)he ate (today or last night)” Martin (2011:93)
b. /akk = $^{[+front],HL}$ is/ → [(a^{M}.k**e̲^{HL}y̲**).k=i^{L}s], *[(aḁk).k=is]
‘bite’ HGR INDIC
“(s)he bit it (today or last night)” Martin (2011:93)
c. /kiɬɬ = $^{[+front],HL}$ is/ → [(ki^{M}.ɬ**e̲^{HL}y̲).y̲**=i^{L}s], *[(kii̥ɬ).ɬ=is]
‘know’ HGR INDIC
“(s)he learned (today or last night)” Martin (2011:93)
d. /afank = $^{[+front],HL}$ is/ → [(a^{M}.fa^{H}).(n**e̲^{HL}y̲**).k=i^{L}s], *[(a.faḁn).k=is]
‘kiss’ HGR INDIC
“(s)he kissed (today or last night)” Martin (2011:93)

The **falling** grade (‘FGR’ in glosses) indicates resultative stative aspect. The falling grade, like the lengthened grade, involves lengthening of the Stem-final vowel where phonotactically possible, e.g., in (24a-c) but not (24d). In the falling grade, the Stem-final vowel receives falling [^{HL}] tone.

(24) Falling Grade (FGR)

a. /wanay = ^{HL} is/ → [(wa^{M}.ˈn**a:^{HL}**).y=i^{L}s]
‘tie’ FGR INDIC
“(s)he has tied it” Martin (2011:83,94)

b. /a wanay = ^{HL} is/ → [(a^{M}.ˈwa^{H}).(ˈn**a:^{HL}**).y=i^{L}s]
DIR ‘tie’ FGR INDIC
“(s)he has tied it to it” Martin (2011:84,94)

c. /sapakl = ^{HL} is/ → [(sa^{M}.ˈp**a:^{HL}**k).l=i^{L}s]
‘stand’.TRIPL FGR INDIC
“they (3+) are standing” Martin (2011:94)

d. /hoyɬ = ^{HL} is/ → [(ˈho^{HL}y).ɬ=i^{L}s]
‘stand’.SG FGR INDIC
“s/he is standing” Martin (2011:95)

The **nasalizing** grade (glossed as ‘NGR’) indicates expressive aspect. Like the lengthened and falling grades, the nasalized grade lengthens the Stem-final vowel if it does not result in an illegal superheavy syllable, i.e., long vowel and coda sonorant. The Stem-final vowel is nasalized and receives (high-)rising [$^{HH+}$] tone; I claim that the UR of the nasalizing grade is composed of the autosegments [$^{HH+}$] and [+nasal] (25).

(25) Nasalizing Grade (NGR)

a. /wanay = $^{HH+,[+nasal]}$ is/ → [(wa^{M}.ˈnã$^{HH+}$:).y=i^{L}s]
‘tie’ NGR INDIC
“(s)he keeps tying it” Martin (2011:83)

b. /a wanay = $^{HH+,[+nasal]}$ is/ → [(a^{M}.ˈwa^{H}).(ˈnã$^{HH+}$:).y=i^{L}s]
DIR ‘tie’ NGR INDIC
“(s)he keeps tying it to it” Martin (2011:84)

All four grade forms are encoded by tonal or segmental changes on the final Stem syllable, which lengthen the Stem-final vowel if possible. Following Martin (2011), I argue in §3.5 that these changes are the effect of autosegments that dock to the Stem-final vowel. I propose the autosegments are the only exponents of each grade morpheme, and that vowel lengthening in HGR, FGR and NGR is predictable from constraints on autosegmental docking. LGR is analyzed as the combination of a regular high tone /^{H}/ and a floating mora (for affixal morae, see, e.g., Davis and Ueda 2002, 2006, Trommer and Zimmermann 2014). The tone spreading, vowel lengthening and downstep associated with LGR are due to the underlying autosegments and the predictable interaction of tone with the syntax-phonology interface, as argued in §3.5.2. Table 2 compares the UR I propose for each grade with the surface realization described above.

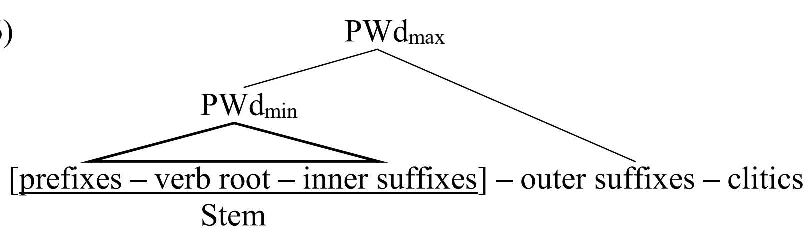
Table 2. Grades = Autosegmental Morphemes

Grade	LGR	HGR	FGR	NGR
UR Autosegment	H, μ	[spread glottis] OR HL, [+front]	HL	HH+, [+nasal]
Surface Realization (with [a])	[a:^{H}…a^{H}]	[aḁ], [Ce^{HL}yC]	[a:^{HL}]	[ã$^{HH+}$]

3.2.3. Proposal: PWd-Recursion

This section shows that the morphosyntactically-defined Stem roughly delimits the domain of regular stress and high level pitch inside the verb. The Stem also is the locus for grade morphology, whose autosegments dock onto the Stem-final vowel. The Stem, a morphological constituent, thus determines the size of the phonological constituent that forms the domain of stress, tone and grades. I propose that this phonological constituent is an **internal PWd in a recursive structure** (26).

(26)



In the recursive PWd analysis, the internal PWd$_{min}$ is exhaustively parsed into iambic feet from left to right. High tone, which associates to stressed syllables, spreads throughout the PWd$_{min}$, including syllables intervening between stresses. Syllables only dominated by the PWd$_{max}$ are not parsed into feet and do not receive stress or high tone unless they are lexically specified to receive it. In the general case, the Stem is isomorphic to the PWd$_{min}$, minus a Stem-final consonant, which forms the onset to the next syllable ((27), modified from (6d,7d)).

(27) Stem = Internal PWd$_{min}$
   a. /wanay=as/ → [[(wa^{M}.ˈna^{H})]$_{PWdmin}$ y=a^{L}s]$_{PWdmax}$
   b. /homp=as/ → [[(ˈho^{H}m)]$_{PWdmin}$ p=a^{L}s]$_{PWdmax}$

Non-Stem material is recruited when needed to fully parse the PWd$_{min}$. This results in absence of PWd-recursion if all the segmental material is parsed inside the PWd$_{min}$, which is thus simultaneously the PWd$_{max}$ ((28), modified from (9)).

(28) PWd$_{min}$ Expands beyond Stem
   a. /homp-ip=as/ → [(ˈho^{H}m).(pi^{H}.ˈp=a^{H}s)]$_{PWdmin/max}$
   b. /a-wanay=as/ → [(a^{M}.ˈwa^{H}).(na^{H}.ˈy=a^{H}s)]$_{PWdmin/max}$

The PWd$_{min}$-final syllable always has primary stress, which triggers downstep on the high tone of an underlyingly stressed syllable outside the PWd$_{min}$ ((29), modified from (15)).

(29) /wanay=ˈaɬi:-s/ → [[(wa^{M}.ˈna^{H})]$_{PWdmin}$ ˈy=a$^{\underline{\mathbf{!H}}}$.ɬi^{L}:s]$_{PWdmax}$

PWd$_{min}$-final primary stress attracts the autosegment of a graded form. As autosegments lengthen the vowel they dock onto, non-Stem material is no longer needed to fully parse the PWd$_{min}$; compare the non-graded forms in (30) with the falling grade forms in (31).

(30) Non-graded Form: PWd$_{min}$ ≥ Stem
   a. /a-wanay=as/ → [(a^{M}.ˈwa^{H}).(***na***^{H}.ˈy=a^{H}s)]$_{PWdmin/max}$
   b. /wanay-ak=i:/ → [(wa^{M}.ˈna^{H}).(***ya***^{H}.ˈk=i^{H}:)]$_{PWdmin/max}$

(31) Graded Form: $\text{PWd}_{\text{min}} \leq$ Stem

a. /a-wanay=$^{\text{HL}}$,is/ → [[(a$^{\text{M}}$.ˈwa$^{\text{H}}$).(ˈ***na:**^{HL}*)]$_{\text{PWdmin}}$ y=is]$_{\text{PWdmax}}$

b. /wanay-ak=$^{\text{HL}}$,is/ → [[(wa$^{\text{M}}$.ˈna$^{\text{H}}$).(ˈ***ya:**^{HL}*)]$_{\text{PWdmin}}$ k=is]$_{\text{PWdmax}}$

§3.4-5 demonstrate in more detail how PWd recursion accounts for the size of the stress and tone domain and the morphophonology of grades, respectively, without appealing to the Stem as a phonological constituent.

3.3. Phasal Syntax and Aspectual Structure of Creek Verbs

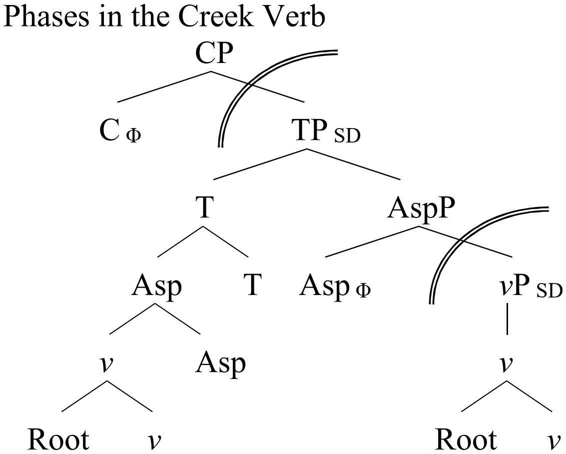
§3.2.3 proposed that the domain of regular stress and level high tone is an internal PWd_{min} in a recursive structure. Under the cyclic syntax-parallel phonology model, this proposal makes two predictions about the syntactic structure of verbs. First, since the inner morphological constituent, or the Stem, closely corresponds to the internal PWd, the Stem must actually be the **X_0 spelled out in the first phase**. Morphemes external to the Stem, i.e., outer suffixes, must be spelled out only at the second phase. Second, all Creek verbs have an internal PWd regardless of their morphological content, unless blocked by the phonology (§3.4.3). Therefore, the higher verbal phase head that spells out the Stem is always present in the syntax, and its phonological exponent must be at the edge of the internal PWd. Unlike in Chukchansi, Creek verbs are always **biphasal**, even in non-graded forms.

This section shows that both these predictions are borne out. Stem-level morphemes, i.e., the root and any prefixes and inner suffixes, encode ***v*P-level** syntactic material, such as transitivity, voice, patient agreement, and locational and directional adverbs. Outer suffixes encode higher, **TP-level** syntactic material, including tense, mood, agent agreement and negation. Grades, which occur morphologically between the Stem and outer suffixes, also occur between *v*P and TP syntactically, in **Asp(ect)P**. The phasehood generated by the verbalizer *v* always extends to Asp in Creek. Asp spells out its complement at the first phase, which includes all the *v*P-level material present, i.e., the entire Stem. Asp and TP-level material, the outer suffixes, are spelled out only at a later phase. The Asp phase head is always present, even when not morphologically marked, and is encoded by autosegments that result in the grade changes at the right edge of the internal PWd. This section argues that (32) is the morphosyntactic structure of the Creek verb, and (33) is the phasal syntax of the Creek clause.

(32) Morphosyntactic Structure of the Creek Verb

a.	[[[Stem]	Grade]	Outer Suffixes]
	‖	‖	‖
b.	[[[[… [*v* Root] … $_{vP}$]$_{SD}$	Asp$_{\Phi}$ $_{AspP}$]	… T … $_{TP}$]

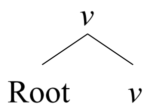
(33) Phases in the Creek Verb



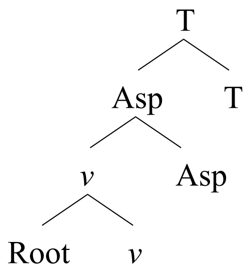
*v*P-level material, i.e., the Stem, occupies the first spellout domain (34a), while grades and outer suffixes occupy the second spellout domain (34b). As §3.4 shows, the two X_0s from the two spellout domains in (34) are mapped onto the recursive PWd structure in (35).

(34) X_0s Spelled out over Two Phases

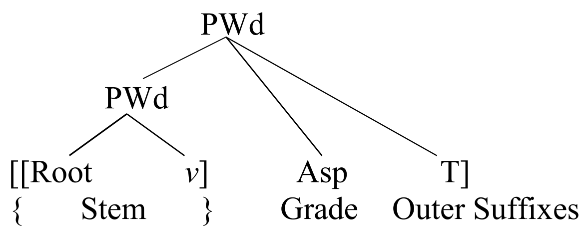
a. X_0 in Phase One = Stem



b. X_0 in Phase Two = Stem + Grade + Outer Suffixes



(35) PWd Recursion in Creek



The rest of this section defends (32-34) as the morphosyntax of the Creek verb.

3.3.1. vP-level vs. TP-level Verb Morphology

I first turn to the proposal that *v*P-level morphology comprises the Stem, while TP-level morphology is expressed by outer suffixes. The isomorphy between the general morphological order {Stem-Grade-Outer Suffixes} and the syntactic hierarchy [[[vP] AspP] TP] is predicted by head movement (Travis 1984) and the Mirror Principle (Baker 1986). However, because Stem material is variously encoded by prefixes and (inner) suffixes, the Mirror Principle cannot be a guideline for the relative syntactic height of prefixes and Stem-external suffixes. Both syntactic evidence from Creek and comparison with cross-linguistically similar syntactic material suggests that all Stem morphemes are lower syntactically than all outer suffixes.

Stem morphemes encode four broad syntactic categories: argument structure, patient agreement, situation aspect, and adverbials. There are a few types of suffixes that deal with **argument structure**. The morphological expression of transitivity is complicated: it can be encoded inherently in the root itself or marked by a suffix directly attached, as §3.3.3 details. Creek distinguishes between intransitives or "middles," which "may be a nonagentive state … or … an agentive event," and transitives or "direct causatives," which are "always eventive and always agentive" (Martin 2011:215). Other voice-related morphemes include the reciprocal, the reflexive, the impersonal passive, which "deemphasizes the role of the subject" (Martin 2011:228), and the indirect causative, which adds a second, causal event to the event signified by the root. The dative and instrumental prefixes are applicatives, and add another object to the verb; the dative can occur with its own set of agreement markers. Several different morphemes agree with the **patient** or the internal argument; these include 1st and 2nd person agreement, on the one hand, and number agreement, on the other.

The spontaneous, the prospective, and the distributive all modify the **event structure** of the verb, as detailed later in this section. Locatives and directionals add an **adverbial** meaning to the verb stem, specifying that the action occurs in a location or with a certain motion. Locatives are the closest prefixes to the root and interact with it idiosyncratically, while directionals are the farthest prefixes from the root and behave transparently. Table 3 shows all the Stem-level morphemes in the Creek; for each morpheme I give both Martin's (2011) terminology and my interpretation of its syntactic class. The autosegmental grade morphemes from Table 2 in §3.2.3 dock onto the last vowel of the Stem-level morphology.

Table 3. Stem = *v*P-level Morphology (adapted from Martin 2011:26-28)

Syntactic Class		UR	Martin's Terminology	Gloss
Argument structure	Transitivity (*v*)	/-k, -Ø/	'middle' = 'intransitive'	v_{INTRS}
		/-y, -ic~Vyc ~iceyc, -Ø/	'direct causative' = 'transitive'	v_{TRANS}
	Voice	/i:-/	'reflexive'	RFLX
		/iti-/	'reciprocal'	RCPL
		/-ho/	'impersonal passive'	IM.PASS
		/-ipeyc/	'indirect (i.e., syntactic) causative'	CAUS
	Applicatives	/is-/	'instrumental'	INSTR
		/im-/	'dative'	DAT
Patient Agreement	Person	/ca-/	'1st sg.'	1S.PAT
		/ci-/	'2nd'	2.PAT
		/po-/	'1st pl.'	1P.PAT
	Number/ Distributivity	/-ho/	'plural/dual'	PL/DL
		/-ic/	'intransitive triplural'	TRIPL
		/-ak/	'plural'	PL
		/RED/	'plural patient or distributive'	DISTR
Event Structure		/-ip/	'spontaneous'	SPON
		/-aha:n/	'prospective'	PROSP
Adverbials	Directional	/a-/	'this way'	DIR
		/iyi-/	'come and X'	
		/iła:-/	'go a short distance and X', 'X back'	
		/ił~łih~łis-/	'go a distance and X'	
	Locative	/a-/	'side'	LOC
		/oh-/	'top'	
		/ak-/	'water or low place'	
		/tak-/	'ground or enclosed space'	

Outer suffixes include agent agreement, which marks the external argument; negation; tense; mood; and the durative, examined later in this section. There are several tense markers, which indicate future tense and a range of past tenses differing in remoteness. Absence of overt tense marking gives present, recent past or generic readings in finite clauses, depending on the aspect of the verb. Mood is the final non-clitic suffix in verbs, and is obligatory in finite clauses; there is a three-way distinction between indicative, imperative and interrogative moods. Table 4 shows the order of outer suffixes in verbs, where the top (agent agreement) is closest to the Stem and the bottom (mood) is furthest. While the relative order of suffixes is rigid, adjacent suffixes often fuse together in portmanteau forms, as shown in §3.3.3. Acute accent in Martin (2011) indicates fixed high tone on that syllable.

Table 4. Verbal Outer Suffixes (adapted from Martin 2011:28-29)

Syntactic Class	UR	Martin's Terminology	Gloss
Agent Agreement	/ay/	'1st singular'	1S.AG
	/íck/	'2nd singular'	2S.AG
	/iy/	'1st plural'	1P.AG
	/á:ck/	'2nd plural'	2P.AG
Negation	/íko/	'negative'	NEG
Tense	/áłi:/	'future'	FUT
	/eys/	'past 1 imperfective'	PT1.IMPF
	/ánk/ PAST2	'past 2'	PT2
	/imáta/ PAST3	'past 3'	PT3
	/ánta/ PAST4	'past 4'	PT4
	/ati:/ PAST5'	'past 5'	PT5'
Durative	/i:/	'durative'	DUR
Mood	/is/	'indicative'	INDIC
	/a/	'interrogative'	INTER
	/as/	'imperative'	IMPER

I illustrate both the structure and meaning of the verb morphemes in Table (3-4) with several examples from Martin (2011) (36); the "=" separates Stems from outer suffixes, as well as words from clitics. Several of these examples end with the switch-reference clitics /=t/ and /=n/, which are extremely common in Creek.

(36) Examples of Stem-level Morphemes and Outer Suffixes

a. /mi:c ip = a:cc áłi: = n/ → [(mi:^{H}).(ci^{H}.ba:^{H}c).ca$^{!H}$.łi:^{L}n]
'do' SPON = 2P.AG FUT = N
"… go ahead and do it [, they say] …" Martin (2011:73, citing (1990a))

b. /ac oh wak ic = ^{HL} = it/ → [(a^{M}.co^{H}).(wa^{H}.ki:^{HL}).cit]
1S.PAT LOC 'lie' v_{TRANS} = FGR = T
"[they] laid hands on me …" Martin (2011:159, citing (1940b))

c. /a: im yaheyk = ^{H} éy is/ → [(a:^{H}).(i^{H}n).(ya$^{!H}$.he$^{!H}$y).ke$^{!H}$ys]
DIR DAT ‘sing’ = LGR 1S.AG INDIC
“I’m singing with [Bill]” Martin (2011:188)

d. /is homp ipeyc = ^{H} éy is/ → [(i^{H}s).(h^{H}om).(pi$^{!H}$.pe$^{!H}$y).ce$^{!H}$ys]
INSTR ‘eat’ CAUS = LGR 1S.AG INDIC
“I am making [the baby] eat with [his/her hand]” Martin (2011:227)

e. /aca:yic = ^{HL} iy ánk is/ → [(a^{M}.ca:^{H}).(yi:^{HL}).ci^{L}.ya^{H}nks]
‘take.care.of’ = FGR 1P.AG PT2 INDIC
“we buried him” Martin (2011:265, citing (1915.1))

f. /iheys ak = ^{H} atí: is/ → [(i^{H}.he^{H}y).(sa$^{!H}$:).ka$^{!H}$.ti:$^{!H}$s]
‘take.wife’ PL = LGR PT5 INDIC
“they both took wives” Martin (2011:273), citing (1915.21))

I now demonstrate that the Stem morphemes are *v*P-level in syntax, and outer suffixes are TP-level. Table 5 shows the morphological categories described above for both the Stem and outer suffixes; the grades encode various viewpoint aspects, as argued below in §3.3.2.

Table 5. Morphological Categories by Structure

Stem = *v*P	Grades = Asp(ect)	Outer Suffixes = TP
Argument structure: *v*, Voice, Appl	Imperfective	Tense
Event structure = Situation Aspect	Neutral	Mood
Patient Agreement	Perfective	Negation
Directional and Locative Adverbials	Resultative	Agent Agreement
	Augmented	Durative

I make no claim about the relative position of syntactic heads expressed by morphemes within either *v*P or TP; I only claim that all outer suffixes (TP-level) are higher in the syntax than all grades (Asp-level), which are in turn higher than all prefixes and inner suffixes, i.e., Stem material (*v*P-level). For some of these morphemes, their location in higher (TP) or lower (*v*P) elements in the syntactic hierarchy is well-supported in the literature. Argument structure information is encoded in the extended verbal domain, *v*P, by little *v*, Voice or Applicative heads (Burzio 1986, Kratzer 1996, Travis 2000, Pylkkänen 2008). Adverbials of motion and location are “VP-level” (=

*v*P-level) adjuncts (Jackendoff 1972, Sportiche 1988, Ernst 2002, *inter alia*). Tense, mood and negation are all higher than the verb phrase, in TP (e.g., Pollock 1989, Chomsky 1991, *inter alia*; some mood-related elements may be even higher, in CP).

While it is uncontroversial that argument structure and adverbial morphemes are *v*P-level and tense, mood and negation morphemes are TP-level, the syntactic positions of agreement on the one hand and aspect on the other are less clear cut. Some agreement morphemes, including agent-oriented pronominal agreement and the impersonal agent morpheme, are outer suffixes, while other agreement morphemes, including patient-oriented pronominal agreement, plural patient agreement and plural marking, are inside the Stem. Durative aspect is expressed by an outer suffix, spontaneous and prospective aspect by Stem-level morphemes, and other aspect by grade morphology between the Stem and the outer suffixes. The rest of the subsection argues that Stem-level agreement and aspect are lower than outer suffix-level agreement and aspect.

Creek has two types of agreement: patient agreement, expressed by Stem-level morphemes, and agent agreement, expressed by outer suffixes (terminology from Martin 2011). In transitive verbs (37), agent agreement always indicates the subject (i.e., the external argument) and patient agreement almost always marks the object (i.e., the internal argument).

(37) Transitives

a.

/**ci**	nafk	H	**éy**	is/	→	[(ci.na:f).keys]
2.PAT	‘hit’	LGR	**1.SG.AG**	INDIC		

“I am hitting you” (NOT “you are hitting me”) (Martin 2011:28)

b.

/**ca**	nafk	H	íck	is/	→	[(ca.na:f).kic.kis]
1.SG.PAT	hit	LGR	**2.SG.AG**	INDIC		

“you are hitting me” (NOT “I am hitting you”) (Martin 2011:28)

Creek is an active-stative or split-intransitive language: whether an intransitive verb takes patient or agent agreement depends on its event structure. As in a split-S language (Dixon 1979), intransitive verbs that take patient agreement tend to be stative or unaccusative and take internal arguments, while intransitive verbs that instead take agent agreement tend to be active or unergative, with external arguments (38).

(38) Split-S Agreement — Martin (2011:171-3)

a. Patient Agreement /(a)ca-/ "1.SG.PA" with Stative/Unaccusative Verbs

i.	[**aca**-honic=i:s]	"I'm awake"
ii.	[**ca**-cafikn=i:s]	"I'm healthy"
iii.	[**ca**-noca:y=is]	"I'm yawning"

b. Agent Agreement /-éy/ "1.SG.AG" with Active/Unergative Verbs

iv.	[halk=**éy**-s]	"I'm crawling"
v.	[i:sk=**éy**-s]	"I'm drinking"
vi.	[yaheyk=**éy**-s]	"I'm singing"

However, Creek also has traits of a fluid-S language (Dixon 1979): patient agreement on unergative verbs indicates that the subject did the action involuntarily, while agent agreement on unaccusative verbs indicates that the subject brought about its situation voluntarily (39).

(39) Fluid-S Agreement — Martin (2011:174)

a. Patient Agreement /(a)ca-/ "1.SG.PA" with Involuntary Subject

i.	[**ca**-lateyk=s]	"I fell"
ii.	[**ca**-hosi:l=is]	"I'm urinating (unable to control it)"
iii.	[**ca**-li:tk-is]	"I'm running (out of control down a hill)"

b. Agent Agreement /-éy/ "1.SG.AG" with Voluntary, "In-control" Subject

i.	[lateyk=**éy**-s]	"I fell down [on purpose]"
ii.	[hosi:l=**éy**-s]	"I'm urinating"
iii.	[i:sk=**éy**-s]	"I'm running"

Table 6 summarizes the matching between arguments and agreement.

Table 6. Agreement and Arguments

Agreement	Transitive Verbs	Intransitive	
		Split-S Usage	Fluid-S Usage
Agent Agreement	Subject (Agent)	Unergative Subject	Voluntary Subject
Patient Agreement	Object (Patient)	Unaccusative Subject	Involuntary Subject

The location of the agreement markers in the syntax is not certain. However, there is evidence suggesting that agent agreement is higher than patient agreement. Subjects of transitives and unergatives are external arguments, while objects of transitives and subjects of unaccusatives are internal arguments. External arguments are higher than internal arguments (Burzio 1986, Larson 1988), both in merging sites (specifier of *v* or Voice vs. complement of *v*+Root) and typical surface position (external, not internal arguments move into the specifier of T, *ceteris paribus*). In transitive clauses with two noun phrases (40), the external argument is marked with the 'subject' case marker ('T' in Martin 2011, not related to Tense) and precedes the internal argument, which is marked with the 'non-subject' case marker ('N').

(40) Transitive Verbs, Agreement, and Subject/Object Marking
ifá-t pó:si lást-i:-n á:ssi:c-ís
dog-T cat black-DUR-N chase.LGR-INDIC
"the dog is chasing the black cat." (Martin 2011:22)

Objects, i.e., internal arguments of transitive verbs marked by patient agreement, undergo liaison with predicates, shown phonetically by voicing on plosives. Subjects, i.e., external arguments of transitive verbs marked by agent agreement, only do so "occasionally" (Martin 2011:73-74; compare (41a-b)).

(41) Liaison with Arguments and Predicates (Martin 2011:73-4)
a. With Objects: Obligatory
ya-**n** **o**:k-iy-ank-in → [jə.**no**:.gɪ.jəŋ.gɪn]
this-OBL say-1PL.AG-PAST2-N
"… we spoke about this …"

b. With Subjects: Optional
cin-ta:**t**___**a**y-as → [ʧɪn.dɑː.**də**.jəs]
you-ATN ‘go’.SG-IMPER
“*You* go!”

Assuming that liaison in Creek only occurs phrase-internally, (41) indicates that objects are always within the same phrase as transitive verbs, while subjects are only optionally in the same phrase as verbs. This contrast suggests that objects are lower than subjects in the syntactic hierarchy, likely in a lower spellout domain, the *v*P; see Kahnemuyipour 2004, Adger 2006, Kratzer and Selkirk 2007 for analysis of syntactically lower arguments phrasing together with verbs. These facts taken together demonstrate that in transitive clauses, the noun phrase marked by agent agreement is always higher in the clause than the noun phrase marked by patient agreement. The syntactic position of agent agreement is thus presumably higher than that of patient agreement.

However, there is no purely Creek-internal syntactic evidence that in intransitive clauses, subjects marked by agent agreement are in a higher surface position than subjects marked by patient agreement (Martin 2011: 383). More investigation into clausal syntax is necessary before a definitive judgment can be made about the surface position of different arguments of the verb, e.g., whether patient-marked arguments (either only subjects or objects as well) move out of the verb phrase. For the purposes of this chapter, I assume that in all clauses, agent agreement is higher than patient agreement; specifically, agent agreement is in TP, while patient agreement is in vP.

The last category to look at is aspect, which affects the temporal structure of the event (“situation aspect”) or what temporal portion of the event is relevant to the sentence (“viewpoint aspect”). Besides the grades, which all encode aspect, there are three inner suffixes (Stem-level) and one outer suffix that do so as well. I follow the general consensus of the temporal and aspectual literature that situation aspect is encoded in the extended verbal projection (*v*P), while viewpoint aspect is in an AspP projection above the *v*P but below tense, which is in TP ((42); see, e.g., Carstens and Kinyalolo 1989, Speas 1991, Ouhalla 1991, Travis 2010). I argue that Stem-internal aspectual morphemes are in *v*P and mark situation aspect, while the durative outer suffix is in TP. Grades, which occur between the Stem and outer suffixes in morphological order, are between *v*P and TP in the syntax as well, in AspP (42). §3.3.2 provides evidence that the grades primarily encode viewpoint aspect.

(42) Morphosyntax of Aspect and Tense

a.	Syntax:	[[[Situation Aspect = *v*P]	Viewpoint Aspect = AspP]	Tense = TP]
		‖	‖	‖
b.	Morphology:	Inner Suffixes	Grades	Outer Suffixes

The three aspectual inner suffixes are the distributive /RED/, the spontaneous /ip/ and the prospective /ahan/. The durative /i:/, on the other hand, is an outer suffix. The distributive, which expresses multiplicity of the internal argument, is identical morphologically and semantically similar to plural patient agreement, which I have argued is inside *v*P. The spontaneous has several uses, which Martin (2011:251-4) labels ‘casual’, ‘let’s’, ‘spontaneous’, ‘because’, ‘already’, and ‘polite’; other authors label it “middle voice” (Nathan 1977:123) or “mediopassive” (Hardy 1988), suggesting a relationship with argument structure. Martin suggests that most of the readings of spontaneous aspect are related to a central meaning of doing something casually, easily, freely or spontaneously. This meaning is essentially a modification of the manner of the event; manner modification is either inside or adjoined to *v*P. The prospective ‘going to’ is used to indicate “intention or prediction” (Martin 2011:270), in contrast to the future /-a^{H}ɬi:-/ ‘will’, which is used for “promises, pledges, or proposals” (2011:270). The prospective can cooccur with grades and past tense suffixes, unlike the future, which is in complementary distribution with other tenses.

The ability to cooccur with overt past tense and grades suggests that the prospective is lower than TP, though I am uncertain whether it is inside *v*P or is a lower Asp projection.

While Stem-internal aspect morphemes are all either inside *v*P or slightly above it, the Stem-external durative is higher than *v*P. Verbs in the durative have various interpretations, including states (43a), abilities (43b) and habits (43c), all of which express properties of the subject. Durative verbs are also used as "participles" (Martin 2011:249) modifying nouns (43d).

(43) Duratives

a. /lokc i: s/ → [(ˈlok).ci:s]
   'ripe' DUR INDIC
   "it's ripe"

b. /ca hic i: s/ → [(ˈca.hi).ci:s]
   1SG.PAT 'look' DUR INDIC
   "I [can] see"
   i. cf. no ability reading in non-durative form: [hi:c-ey-s] "I am looking at it"

c. /oponay ^{H} i: s/ → [(o.ˈpo).(ˈna:).yis]
   'speak' LGR DUR INDIC
   "s/he speaks"

d. paka:na lokc-i:
   peach ripe-DUR
   "a ripe peach"

Martin (2011:249) offers "some [morphosyntactic] evidence that duratives are a type of verbal noun," which is compatible with its often stative semantics; see also Martin 2011:264: "participles [in the durative] seem to behave like nominalized forms of verbs." In addition to their participial usage, durative verbs pattern with nouns in occurring with an auxiliary in the falling grade [o^{HL}:s] and the question marker [-ti]. If the durative is indeed a nominalizer, it must occur outside the extended verbal domain, since it attaches outside *v*P-level morphemes, and embeds events with the eventive grade (LGR) in its habitual usage (43c). I suggest that the nominal characteristics of durative verbs arise because duratives are non-finite verb forms, like the other verbal nouns of

Creek. Specifically, I posit that the durative is non-finite tense, as it occurs in complementary distribution with tense morphemes and can be followed by the indicative mood suffix (43a-c). The durative also has modal uses, like an ability reading (43b) and a conditional-like reading (44).

(44) Conditional Use of Durative

/acc	H	ay	i:	s/	→	[(a:c).ca.yis]
'wear'	LGR	1SG.AG	DUR	INDIC		

"I could/would wear it"

The uses and distribution of the durative suggest that it is higher than *v*P, probably a TP-level head or possibly a nominalizer, depending on which of its uses, participial or modal, is more basic. Aspect morphology outside the Stem is thus higher than aspect morphology inside the Stem.

3.3.2. Grades and Viewpoint Aspect

I now argue that grades appear between Stem-internal (*v*P) and Stem-external (TP) material in the syntax, just as they do in the morphology. I propose that grades are Asp heads and primarily express viewpoint aspect. Viewpoint aspect relates the event denoted by *v*P to the time being talked about in speech, reference time (Smith 1991). Viewpoint aspect determines how much of the event is being referred to, or "in focus." With imperfective viewpoint, the reference time (RT) is a subset of event time (ET), so that a middle portion of the event is in focus, and the event is viewed as ongoing (45). With perfective viewpoint, ET is a subset of RT, so that the entire portion of the event is in focus, and the event is viewed as completed (46).

(45) Imperfective:

```
RT:                      --------------------------
ET:          -----------------------------------------------------------
```

(46) Perfective:
RT: --
ET: --------------------------

Tense then relates RT to utterance time (UT), i.e., the present moment in matrix clauses. For example, past tense indicates that RT precedes UT, so that the portion of the event in focus has ended; see Hornstein 1990 for this 'neo-Reichenbachian' account of tense and aspect.

I propose that the grades, including the zero grade, correspond to specific viewpoint aspects, encoded by heads in Asp. In addition to perfective and imperfective viewpoints, grades also express neutral (Smith 1991) and resultative (Pancheva 2003) viewpoints. These viewpoint aspect heads determine the situation aspect of the *v*P they embed, either as a necessary result of their viewpoint or as a requirement of the particular viewpoint head in Creek. Table 7 shows the correspondences between grade morphology and aspect; the rest of the section provides further evidence for these correspondences.

Table 7. Grades and Aspect

Grade (Martin's (2011) Aspect)	Viewpoint Aspect (= Asp)	Situation Asp (= *v*P)
Lengthened (Eventive)	Neutral	Dynamic
Aspirated (Perfective)	Perfective	
Falling (Resultative Stative)	Resultative	Telic (Result State)
Nasalized (Expressive)	Imperfective	Augmented
Zero (Default)		Unspecified

The aspirating grade encodes perfective aspect and therefore indicates that the event is completed within reference time (Martin 2011:247). It has two major uses depending on the type of clause it appears in, both of which indicate completion of an event. In matrix ("main") clauses, the aspirating grade "indicates that an event was completed today or last night" (Martin 2011: 247).

In embedded ("chained") clauses, the aspirating grade "show[s] that an event is successfully completed prior to another ('and then')" (Martin 2011:246; (47) abridged from Martin).

(47) Aspirating Grade Forms = Perfective Viewpoint

a. /wanay = [S.G.] is/ → [(wa^{M}.ˈnḁa^{H}).y=i^{L}s]
'tie' = HGR INDIC
"(s)he tied it (today or last night)"

b. /homp = HL,[+front] is/ → [(ho^{M}.me^{HL}y).p=i^{L}s]
'eat' = HGR INDIC
"(s)he ate (today or last night)"

c. /akk = HL,[+front] is/ → [(a^{M}.ke^{HL}y).k=i^{L}s]
'bite' = HGR INDIC
"(s)he bit it (today or last night)"

d. /a:-ohh-**aht-**it im-pona:y-ati:-s/
DIR-LOC-'come'.SG.HGR-T DAT-talk.LGR-PAST5-INDIC
"(he_i) **came up to** (him_j) and spoke to (him_j)"

I argue that in both cases, the event is completed within reference time; however, the temporal interpretation of reference time differs between embedded and matrix clauses. Present tense in Creek is unmarked, as in (48). Present tense identifies the right edge of the interval reference time (RT), which is a time interval, as utterance time (UT), the present moment in matrix clauses. I propose that the leftward reach of the reference time interval from the present is contextually determined in Creek, but can only stretch as far into the past as the night before speech time.

(48) Perfective (HGR) in Matrix Clauses: "completed today or last night"

UT: Last night/earlier today Present Moment
RT: ---
ET: ---------------------------

In embedded clauses, UT is typically dependent on the time of the matrix class for its interpretation. I posit that in Creek embedded clause UT is identified with the left edge of the interval reference time. With perfect viewpoint, then, the event of the embedded clause is thus completed before the visible portion of matrix clause event, giving the reading that the embedded event is completed prior to the matrix event (49).

(49) Perfective (HGR) in Embedded Clauses: "completed prior to matrix event"

```
                                              ------------------------    RT (Matrix)
                                              (←---)-----------(---→)     ET (Matrix)
   UT (Embedded):                             |
   RT (Embedded):       -------------------------------
   ET (Embedded):             ---------------
```

Martin (2011:84 fn2) analyzes non-graded or 'Zero-grade' verbs as a default when no other specific aspect is appropriate, covering both "unrealized events" and states. Non-graded verbs occur in four situations: with the durative /-i:/, the imperative /-as/, the future tense /-áłi:/ and the negative /-íko/. I posit that non-graded verbs encode imperfective viewpoint. The durative /-i:/ with non-graded forms always has a stative reading ((50), (a-b) repeated from (43)), even with roots or stems that are typically dynamic (50b-c).

(50) Duratives with Non-graded Verbs (Martin 2011:249)

a. /lokc-i:-is/ → [(ˈlo^{H}k).ci:^{L}s] "it's ripe"

b. /ca-hic-i:-is/ → [(ˈca^{M}.hi^{H}).ci:^{L}s] "I [can] see"

  i. cf. LGR form [hi:c-ey-s] "I am looking at it"

c. /kiłł ay i: is/ → [(ˈki^{H}ł).ła.yi:^{L}s]
'learn' 1S.AG DUR INDIC
"I know"

  i. cf. LGR form [(ki^{H}:ł).łis] "I am learning"

I suggest that the stative reading in (50c) comes from a combination of the durative itself, which has nominal or modal semantics, and imperfective viewpoint, which imposes homogeneous structure (i.e., without sub-parts) on the events it embeds; this is somewhat similar to the use of the progressive in other languages (Smith 1991). Other viewpoint aspects, such as the perfective (HGR) and neutral (LGR), prevent a stative reading, which can therefore only occur with imperfective viewpoint; again, see Smith 1991 for the cross-linguistic affinity between stative predicates and imperfective viewpoint.

In the imperative, non-graded verbs (51a) contrast with verbs in the aspirated grade, i.e., perfective viewpoint (51b). The former have durative uses, while the latter have "momentaneous" or punctual uses, as expected if they have imperfective and perfective viewpoint, respectively.

(51) Imperfective vs. Perfective Imperatives (Martin 2011:291)

a. /nafk as/ → [(ˈna^{H}f).ka^{L}s]
'hit' IMPER
"beat him/her!"

b. /nafk $^{HL,[+front]}$ as/ → [(na.ˈfe^{HL}y).ka^{L}s]
'hit' HGR IMPER
"smack it!" (once, briefly)

The future always occurs with non-graded forms, in contrast to the *v*P-level prospective suffix /-aha:n/, which can occur with different grades and tenses (52). The future is used for "promises, pledges, […] proposals […] and statements about what will or shall be" (Martin 2011:270).

(52) Future /áłi:/ with Non-graded Verbs
/wanay áłi: is/ → [(wa^{M}.ˈna^{H}).ya$^{H\text{-}}$.łi^{L}:-s]
'tie' FUT INDIC
"(s)he will tie it"

The negative has present tense interpretation with the zero grade, but future tense interpretation with the aspirating (HGR) grade (53).

(53) Negative /-íko/ with Non-graded and HGR Verbs (Martin 2011:282-3)

a. /nis íko is/ → [(ni^{M}.ˈsi^{H}).ko^{L}s]
'buy' NEG INDIC
"(s)he is not buying it, did not buy it (just now)"

b. /nis $^{\text{S.G.}}$ íko is/ → [(ˈnii̥^{H}).si$^{!H}$.ko:^{L}s]
‘buy’ HGR NEG INDIC
“(s)he will not, would not (in the future) buy it”

What viewpoint aspect future non-graded forms have is unclear from Martin (2011). The interaction of viewpoint aspect and the negative forms is equally unclear; indeed, the contrast in graded forms leads to an “unexpected” contrast in tense, not viewpoint (Martin 201:282). This is clearly a matter for further research. Regardless, viewpoint aspect must be present in the syntax and semantics of these forms.

The lengthened grade (LGR), which denotes what Martin (2011) calls “eventive” aspect, can encode both “ongoing action[s]” (Martin 2011:242, glossed as English present progressives (54a-c)) and “punctual event[s]” (Martin 2011:242) that have occurred very recently (54d).

(54) Lengthened Grade Forms

a. /wanay $^{H*,\mu}$ is/ → [(wa^{M}.ˈna^{H}:).y=i^{H}s]
‘tie’ LGR INDIC
“(s)he is tying it”

b. /tac $^{H*,\mu}$ is/ → [(ˈta^{H}:).c=i^{H}s]
‘cut’ LGR INDIC
“(s)he is cutting”

c. /apo:k $^{H*,\mu}$ is/ → [(a^{M}.ˈpo^{H}:).k=i^{H}s]
‘sit’.TRIPL LGR INDIC
“they (3+) are sitting”

d. /calatk $^{H*,\mu}$ is/ → [(ca^{M}.la^{H}:t).k=i^{H}s]
‘fall’ LGR INDIC
“I fell (a second ago)”

Martin proposes that LGR indicates a “successful change or process—an actual happening as opposed to a state” (2011:242). This indicates that every LGR verb has at least started, i.e., both an initial point and at least some part of the ensuing event have taken place. The final point may or may not have taken place, as LGR can express both ongoing and completed events; this indicates that LGR cannot be imperfective aspect, which never gives completion readings. Rather, LGR encodes **neutral** aspect (Smith 1991): the initial point and at least some internal part of ET occur within RT, while nothing is asserted about the ending. In the present tense, RT ends at UT, so the action is either ongoing at the moment of speech or has just started and finished (55).

(55) Neutral Viewpoint: Ongoing or Completed Event

```
RT:     ---------------------------------------------------------
ET:               ----------------------(---------------------------)
```

Viewpoint aspect can have an effect on the situation aspect of the event it takes as a predicate. Since neutral and perfective viewpoints both require a specific initial point, they cannot embed a stative predicate; a stative eventuality is an undifferentiated interval with no initial point. Roots or "stems that are interpreted as states in the durative stative aspect" (Martin 2011:243, 246), i.e., imperfective viewpoint, have an "inceptive state" interpretation with neutral viewpoint (56) and a "punctual, completed change of state" interpretation with perfective viewpoint (57), i.e., they become inchoatives.

(56) Statives (Imperfective) vs. Neutral Inchoatives

a.	/lokc	i:	is/	→ [(ˈlo^{H}k).ci^{L}:s]	vs. /lokc	$^{H,\mu}$	is/	→ [(ˈlo^{H}:k).ci^{H}s]
	'ripe'	DUR	INDIC		'ripe'	LGR	INDIC	
	"it's ripe"				"it's getting ripe"			
b.	/pinkal	i:	is/	→ [(pi^{H}n).(ka^{H}.li^{H}:s)]	vs. /pinkal	$^{H,\mu}$	is/	→ [(pi^{H}n).(ka$^{!H}$:).li$^{!H}$s]
	'scared'	DUR	INDIC		'scared'	LGR	INDIC	
	"(s)he is scared"				"(s)he is getting scared"			

(57) Statives (Imperfective) vs. Perfective Inchoatives

/la:n	it/	→ [(ˈla^{H}:).ni^{H}t]	vs. /la:n	$^{S.G.}$	it/	→ [(ˈlaḁ^{H}).ni^{L}t]
'yellow'	T		'yellow'	HGR	T	
"it was yellow"			"it turned yellow"			

The inchoative readings are forced by neutral and perfective viewpoint, which require an initial point, and therefore a dynamic eventuality, i.e., an event that starts within reference time (see e.g., Parsons 1990, Travis 2010 for inchoatives being dynamic). The fact that the lengthened and aspirated grade can only occur with events and not states is therefore due to their aspectual content. States in fact commonly get inchoative readings with perfective viewpoint cross-linguistically (Smith 1991). Unlike inchoatives in neutral viewpoint, which have an in-progress reading, inchoatives in perfective viewpoint have a completed reading, since the change of state has finished with reference time.

The falling grade, which encodes "resultative stative" aspect, also involves changes of state. While the neutral and perfective viewpoints focus on the change of state event itself, the resultative stative focuses on the "state resulting from [the] event", which is often "portrayed as short in duration" (2011:244). The verbs most commonly used with the resultative stative aspect indeed have dynamic inchoative interpretations in neutral aspect (58).

(58) Inchoatives (Neutral) vs. Result States

a.	/leyk	H	is/ → [(ˈle^{H}y).k=i^{H}s]	vs.	/leyk	HL	is/ → [(ˈle^{HL}y).k=i^{L}s]
	'sit'	LGR	INDIC		'sit'	FGR	INDIC
	"s/he is sitting down"				"s/he is sitting"		
b.	/acc	H	is/ → [(ˈa^{H}:c).c=i^{H}s]	vs.	/acc	HL	is/ → [(ˈa^{HL}:c).c=i^{L}s]
	'wear'	LGR	INDIC		'wear'	FGR	INDIC
	"s/he is putting on (clothes)"				"s/he is wearing"		
c.	/kiɬɬ	H	is/ → [(ˈki^{H}:ɬ).ɬ=is]	vs.	/kiɬɬ	HL	is/ → [(ˈki^{HL}:ɬ).ɬ=i^{L}s]
	'learn'	LGR	INDIC		'learn'	FGR	INDIC
	"s/he is learning"				"s/he knows"		

In the neutral aspect forms in (58), the dynamic change-of-state is visible within reference time; in the resultative stative forms, only the result state is visible. Presumably, both the neutral and resultative forms in (58) have the same situation aspect, in which a dynamic event culminates and ushers in a result state. However, the different viewpoints "see" different parts of the event. In the resultative stative forms in (58), the result state holds throughout the reference time interval; this is the **resultative** viewpoint proposed in Pancheva (2003), which takes telic eventualities (including inchoatives) and places their result states within the whole of reference time (59).

(59) Resultative Viewpoint:
RT: -------------------------------------
ET: Change-of-State--------------------Result State-----------------------

The nasalizing grade encodes "expressive" aspect, a "greater degree or sustained event or state" (Martin 2011:95). The greater degree reading typically obtains of "stems describing quantity or degree" or "properties" (2011:248; (60a)). "More active" verbs get a sustained action reading; however, there is a contrast between stems with instantaneous ("punctual") situation aspect, like /nafk-/ 'hit', and stems with durative situation aspect, like /apiy-/ '(3+) go'. With expressive aspect, instantaneous stems get a reading of "repetition over a sustained period" (60b), while durative stems get a "prolonged event" reading (60c) (2011:248).

(60) Situation Aspects with Expressive Martin (2011:248)

a.	/hiɬ	HH+,[+nasal]	i:	t/	→ [(ˈhĩ:ᴴᴴ⁺).ɬi:t]
	'good'	NGR	DUR	T	
	"very"				
b.	/nafk	HH+,[+nasal]	t/		→ [(ˈnãᴴᴴ⁺:f).kiᴸt]
	'hit'	NGR	T		
	"kept beating and beating"				
c.	/apiy	HH+,[+nasal]	i:	t/	→ [(aᴹ.ˈpĩᴴᴴ⁺:).yiᴸt]
	'go'.TRIPL	NGR	1P.AG	T	
	"we kept going"				

Because the expressive aspect gives different readings depending on the situation aspect of the Stem it embeds, the expressive must take situation aspect as an argument and be syntactically higher than the *v*P that constructs the Stem's situation aspect. The expressive aspect cannot be only a viewpoint aspect, however, since repetition, prolongation, and increased degree affect only the eventuality itself and not reference time. I suggest that expressive situation aspect occurs with imperfective viewpoint aspect (61). Cross-linguistically, the imperfective viewpoint occurs with prolonged or sustained event intervals; Martin's (2011:248) English glosses "keep/kept X-ing" also suggest imperfective viewpoint. This is another area in need of further research.

(61) Expressive Situation + Imperfective Viewpoint

```
a.  RT:                                     --------------------------
    ET (Expressive):             -   -   -   -   -   -   -   -   -   -   -   -   -
    Instantaneous vP                                    -
b.  RT:                                     --------------------------
    ET (Expressive):             ----------------------------------------------------
    Durative vP                  ____________________________________________________
```

In sum, while some of the grades influence the situation aspect of the event in *v*P, it is clear that all of the grades take the whole event *v*P in their scope and yield a reference time with some or all of the event in focus. There is no material in the syntax higher than grades that deals with eventualities; rather, higher heads manipulate the times or worlds that the event takes place in. The grades are thus between all the lower, *v*P-level material and all the higher, TP-level material; following, e.g., Carstens and Kinyalolo (1989), Speas (1991) and Ouhalla (1991), the grades appear in the Asp projection.

3.3.3. Phasehood in the Creek Verb

So far this section has argued that the three main morphological parts of the Creek verb, the Stem, the Grade, and the outer suffixes, correspond to three levels in the syntactic hierarchy: *v*P, AspP and TP, respectively ((62), repeated from (32)).

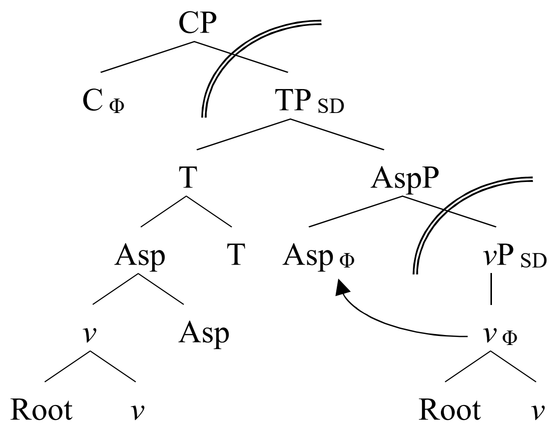
(62) Morphosyntactic Structure of the Creek Verb

a. [[[Stem] Grade] Outer Suffixes]
|| || ||
b. [[[… [*v* Root] … $_{vP}$]$_{SD}$ Asp$_{\Phi}$ $_{AspP}$] … T … $_{TP}$]

I now lay out the consequence of the morphosyntactic structure (62) for phase-based spellout. According to the theory of phasehood adopted in §1.2.1, the categorizing head *v* merges with the root to verbalize it, and generates a phase; the root is head-adjoined to *v*, and is not in the latter's complement spellout domain (Marantz 2001, 2007, Embick 2010, Kastner 2016). In Creek, *v*'s phasehood extends to the highest head in the extended verbal projection through head movement (see Den Dikken 2007, Bošković 2014 for similar accounts). Creek verbs must be built through head movement, since all verbal morphology is linearized in the same position at the end of the clause.

In Creek, the highest verbal head is viewpoint aspect (Asp), which takes an eventuality as an argument and relates it to a time argument (i.e., reference time) that it introduces (see Wurmbrand 2014, Bošković 2014 for corroboration of Asp being the highest head within the verbal domain). Asp yields only the time argument to be manipulated by higher heads, which can no longer see the eventuality; therefore Asp is the highest verbal head, i.e., it "closes the lexical VP domain" (Bošković 2014). When merged into the derivation, Asp inherits the phasehood of the lower *v* head and spells out its complement, the rest of the extended verbal projection (i.e., all *v*P-level material; see Hinterhölzl 2006, Bošković 2014 for other cases of Asp being phasal). The next phase head is C (Chomsky 2000, 2001, *inter alia*), which spells out TP. This phasal structure of the Creek verb is illustrated in ((63), repeated from (33)), with two phase heads, Asp (inherited from *v*) and C, and two spellout domains, *v*P and TP; the arrow from *v* to Asp shows phase extension.

(63) Phases in the Creek Verb



Research in DM argues that morphemes in the same spellout domain are able to interact in non-transparent ways at the interfaces (Marantz 2001, 2007, Embick 2010), e.g., they can have non-compositional semantics (allosemy; Marantz 2013a) and exhibit non-phonologically-conditioned allomorphy. This is not contradictory to the parallel phonological derivation I argue for, since I assume that only phonologically-conditioned allomorphy takes place in the phonology proper. In Chapter Four I propose that the input to parallel phonology contains both morphemes and morphs; I suggest that non-transparent, non-phonologically motivated morphological interaction within a spellout domain occurs after spellout but before the phonology proper (Arregi and Nevins 2012). This is borne out in Creek for the phasal structure in (63), as morphemes within the same spellout domain can interact non-transparently at the interface, including roots and *v*P-level material, on the one hand, and Asp and TP-level material, on the other.

Roots in Creek can choose the morphological realization of both *v* and patient number agreement/distributivity. The same root often occurs in both middle and transitive forms, i.e., the root can attach to either a middle *v* or a transitive *v*. There are two dimensions along which roots and the *v* categorizer interact: (1) whether middle *v*, transitive *v* or both are marked by an overt morpheme, and (2) which allomorph of transitive *v*, /-y-/, /-ic-/, /-Vyc-/, or /-iceyc-/, the root selects; the overt middle suffix is /-k-/ (Table 8).

Table 8. Root-determined Morphology with Middle vs. Transitive *v* (Martin 2011: pp.)

Type of Root	Middle *v*		Transitive *v*	
	UR	Gloss	UR	Gloss
Both overtly marked	/wana-**k**/	'tied'	/wana-**y**/	'tie (one)'
	/fac-**k**/	'full'	/fac-**ic**/	'fill'
	/ha:-**k**/	'ring', 'sound'	/ha:-**y**-**ic**/	'play (an instrument)'
	/ley-**k**/	'(one) sit'	/ley-**c**/	'seat (one)'
	/lit-**k**/	'run'	/lit-**iceyc**/	'run off', 'make (one) run'
Only **transitive** *v* overtly marked	/il/	'(one) die'	/il-**i:c**/	'kill (one)'
	/hic/	'see'	/hic-**eyc**/	'show'
	/isk/	'drink'	/isk-**oyc**/	'give a drink'
Only **middle** *v* overtly marked	/hoc-**k**/	'pounded'	/hoc/	'pound'
	/palat-**k**/	'(3+) spill'	/palat/	'spill (3+)'
	/i:h-**k**/	'hide'	/i:h/	'conceal'

A similar situation holds for the distributive and number agreement with the patient; both categories are often expressed using identical morphology. Roots choose how to phonologically express plural patient agreement or distributivity: either by root suppletion (64a), reduplication (64b), or the suffixes /-ho/ (64c), /-ic/ (64d) or /-ak/ (64e).

(64) Root Choice of Plural Patient Agreement and Distributivity

a.	/cot-k/	'(one) small'	Suppletion:	/**lopoc**-k/	'(two+) small'
b.	/hat-k/	'(one) white'	Reduplication:	/hat-**ha**-k/	'(two+) white'
c.	/a-y/	'(one) go'	/-ho/:	/a-**ho**-y/	'(two) go'
d.	/som-k/	'(one) be lost'	/-ic/:	/som-**ic**/	'(three+) be lost'
e.	/ca:t/	'red'	/-ak/:	/ca:t-**ak**/	'(two+) red'

While there are some principles governing both the overtness or choice of allomorph of *v* and the morphological expression of plural theme agreement/distributivity, a root's behavior along these two dimension is phonologically unpredictable. Because of this, Martin (2011) takes these voices to be part of the root; I instead argue that the root chooses what Vocabulary Items of *v* and theme agreement are present in the input to phonology. When morphemes interact in non-phonologically motivated ways for the purposes of Vocabulary Insertion, these morphemes must be within the same spellout domain (e.g., Embick 2010, Harley and Tubino-Blanco 2013; Bobaljik and Wurmbrand 2013). The fact that Creek roots select for specific suffix forms inside the *v*P suggests that roots and *v*P-level suffixes are inside the same phase.

If *v*'s phasehood percolates to the higher verbal head Asp, which then spells out all other *v*P-level material, Asp morphology would not be expected to depend on *v*P-level material for its interpretation or vice-versa.[9] This prediction is borne out: Asp marking (grades) and *v*P material (the Stem) interact transparently at the interfaces: different grade forms of the same Stem have predictable, compositional semantics, and the choice of graded form of the Stem is determined entirely by phonology (see §3.2 and §3.5 for details). On the other hand, Asp and TP-level material, including negation, tense and agreement, often do not interact transparently at the interfaces. Negation, future tense and agreement morphology undergo a great deal of morphophonological interaction, including phonologically unpredictable portmanteau forms (65).

(65) Portmanteau Forms in TP-level Morphology

a.	/ay-áłi:/	1S.AG-FUT	→	[á:łi]
b.	/ay-íko/	1S.AG-NEG	→	[áko]
c.	/íko-i:/	NEG-DUR	→	[íko:]
d.	/íko-ati:/	NEG-PAST5	→	[íka:ti:]

[9] Since higher copies of the root and *v*P-level material are present in the higher spellout domain with Asp and T, it might be supposed that *v*P- and TP-level material indeed could interact at the interfaces. However, these higher and lower copies are identical for the purposes of morphophonology and semantics, and thus can only have one interpretation (unlike, e.g., quantification items, whose copies can have different scope relations). Work on phase-based locality restrictions on interface interaction assumes that two items must be in the same spellout domain in order to have opaque interactions, e.g., semantic non-compositionality (Embick 2010, Bobaljik and Wurmbrand 2013, Marantz 2013a).

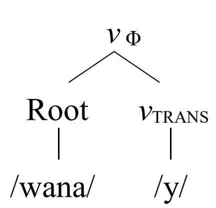
Certain tenses "strongly favor" specific grades: Past2 (yesterday to several weeks ago) and Past3 (several weeks to a year or so ago) usually occur in the falling grade, while the other past tenses usually occur in the lengthened grade. There does not seem to be a particular semantic reason why different past tenses select for different viewpoint aspects; rather this selection is an instance of non-transparent interaction between material in the same phase (T and Asp). As briefly described in §3.3.2, Asp and negation /-íko/ also interact non-transparently: negatives have future tense meaning with the aspirating grade (perfective viewpoint) and present meaning with the zero grade (imperfective viewpoint). These non-transparent interactions provide evidence that Asp and all TP-level material are in the same phase.

I illustrate the phasal syntax defended above with the derivation of the verb [(wa.na:^{HL}).yis] "s/he has tied it" (66). [(wa.na:^{HL}).yis] has 3rd person singular agreement and present tense, both of which are morphologically null in Creek.

(66) /wana y ^{HL} is/ → [(wa.na:^{HL}).yis]
'tie' v_{TRANS} RES INDIC (+3SG+PRES)
"s/he has tied it"

The derivation begins when v_{TRANS} /-y/ merges with the root 'tie' /wana/ through head-adjunction (67); for the sake of clarity, I omit the external and internal arguments and Voice. While *v* is a phase head, spellout does not occur at this point in the derivation.

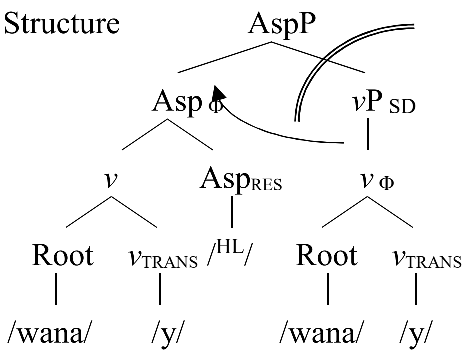
(67)



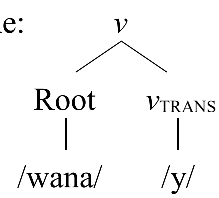
Since there is no other *v*P material to enter the derivation, resultative Asp is merged with *v*P. The head-adjoined root and *v* then head-move to Asp, leaving lower copies. Since resultative Asp is an event-semantic head, i.e., it deals with an eventuality, phasehood extends from v_{TRANS} to Asp. The material in its complement, i.e., the lower copies of the root and *v*, are spelled out (68).

(68) First Phase of [(wa.na:$^{\text{HL}}$).yis]

a. Phasal Structure

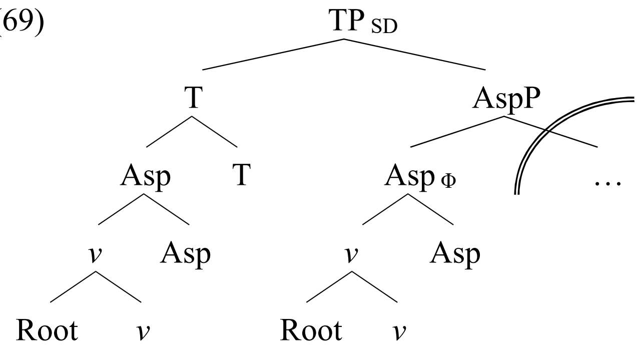


b. X_0 One:



Present tense (morphologically null in Creek) and indicative mood /-is/ are merged in T, and the external argument also moves up to the Spec of T to value T's phi features, resulting in [3$^{\text{rd}}$.sg.] agreement on the verb (also null) and the subject clitic /-t/ on the external argument (69). Since tense and mood only manipulate times or worlds, not eventualities, they are not eligible for phase extension and phasehood remains on Asp.

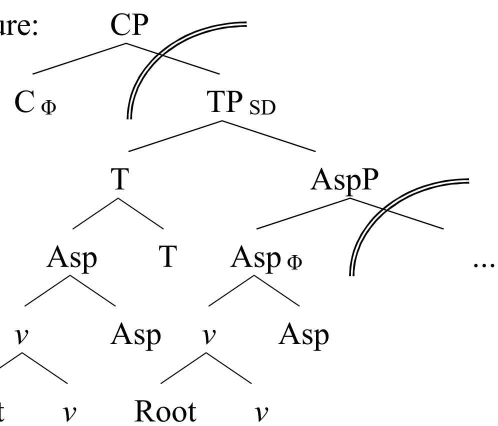
(69)



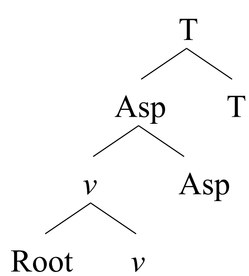
A C phase head is then merged, which spells out its complement TP and the highest adjoined head of the verb in T_0 (70). I do not stake a definite claim on the fine structure of the left periphery in Creek. For simplicity, I assume that mood and tense suffixes are both TP-level heads, and the phase head C is merged above them; alternatively, the mood suffix is low in the CP domain, and a higher C head inherits phasehood.

(70) Second Phase of [(wa.na:^{HL}).yis]

a. Phasal Structure:



b. X_0 Two:



The C phase head may be expressed morphologically by clitics, which include various discourse- and information-structure elements, sentential adverbials and conjunctions, and switch-reference markers on subordinate clauses (Martin 2011: 96-7, 360-3). Clitics behave differently phonologically from outer suffixes, which suggests that they have a position outside the entire phonological word (Martin 2011: 96-97). If clitics are outside the entire phonological word, this is evidence that they are outside the spellout domain of the C phase head.

3.4. Mismatches between Syntax (X_0) and Phonology (PWd)

§3.2 has argued that the domain of regular stress and level high tone in verbs, roughly corresponding to a morphological constituent Stem (Martin 2011) is an internal PWd_{min} in a recursive structure. §3.3 has argued that the Stem is in fact an inner, *v*P-level X_0 spelled out at an early phase. As proposed in Chapter One and illustrated in Chapter Two for Chukchansi, the inner X_0 in Creek is matched to an internal PWd, a consequence predicted by the cyclic syntax-parallel phonology model. Phonological requirements can cause a mismatch, however, between X_0s and PWds, so that either some material from **the lower X_0 is outside the minimal PWd (an undermatch; (71a))**, or some material from **the higher X_0 is inside the minimal PWd (an overmatch; (71b))**.

(71) X_0-PWd Mismatches

a. Undermatch: / h o m p i c k a ɬ i: s/$_{X0}$
/ h o m **p**/$_{X0}$
[[(ˈh o m)]$_{PWd}$ **p** i c k a ɬ i: s]$_{PWd}$

b. Overmatch: / n i s **i c** k a ɬ i: s/$_{X0}$
/ n i s/$_{X0}$
[[(n i ˈs **i c**)]$_{PWd}$ k a ɬ i: s]$_{PWd}$

Distinguishing between these two types of mismatch requires two separate versions of MATCHWORD: MATCHWORD(All), which penalizes undermatches, and MATCHWORD(Only), which penalizes overmatches.

3.4.1. X_0-PWd Matches in Creek

I begin this section with a brief illustration of how recursive PWds determine the domain of regular stress and level high tone in Creek verbs. As §3.3 has demonstrated, all verbs in Creek are spelled out over two phases; the X_0s with the highest copy of the root in a phase are the only ones relevant for the syntax-prosody mapping. For example, the verb [(aˌwa)(naˈya)kałi:s] (72a) is spelled out over two phases, with (72b) as the highest X_0 in the first spellout domain (*v*P) and (72c) as the highest X_0 in the second (TP).

(72) Biphasal Verbs in Creek

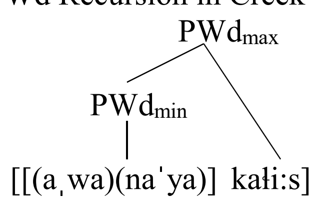
a. /a wana y ak ałi: s/ → [(aˌwa)(naˈya)kałi:s]
DIR 'tie' v_{TRANS} PL FUT INDIC
"they will tie it to it"

b. Highest X_0 in Phase One (*v*P): /a-wana-y-ak/$_{X0}$

c. Highest X_0 in Phase Two (*v*P + TP): /a-wana-y-ak-ałi:-s/$_{X0}$

The two X_0s in (72) are mapped onto the recursive PWd structure in (73) by the constraint MATCHWORD; the *v*P-level material is dominated by the internal PWd_{min}.

(73) PWd Recursion in Creek



The *v*P-level material, i.e., the "Stem," is exhaustively parsed into iambic feet, while TP-level material is typically unparsed. As this section proposes, *v*P-level material forms an internal PWd_{min}, and the phonological grammar of Creek chooses to exhaustively parse PWd_{min} but not parse material only in PWd_{max}. The full parsing of only the PWd_{min} can be modeled by indexing PARSE-σ to PWd_{min}. Itô and Mester (2009b, 2012) argue that constraints referencing a prosodic unit can be indexed to a minimal or maximal instance of that unit in a recursive structure. PARSE-σ can be formulated to reference the PWd, since an unparsed syllable, i.e., a syllable not dominated by a Foot, is in fact dominated directly by a PWd (74). The indexed version, PARSE-σ/PWd_{min}, penalizes unfooted syllables inside a PWd_{min} (75).

(74) PARSE-σ: assign a violation mark to a syllable immediately dominated by a PWd. (see Prince and Smolensky 1993/2004)

(75) PARSE-σ/PWd_{min}: assign a violation mark to any syllable immediately dominated by a PWd_{min}.

PARSE-σ demands full footing of syllables in a PWd, which can result in the construction of multiple feet in order to parse all syllables. Multiple feet violate ENDRULE constraints (Prince 1983, McCarthy 2003), which require that the head foot of a PWd be the first foot (ENDRULE-L) or the last foot (ENDRULE-R) in the PWd. If both ENDRULE constraints dominate PARSE-σ, then the head foot must be both the first and last foot, and therefore the only foot, preventing exhaustive parsing (McCarthy 2003, Gouskova 2003). ALIGN-HEADFOOT constraints, which are gradient instead of categorial, have similar effects.

(76) ENDRULE Constraints (Prince 1983, McCarthy 2003)
   a. ENDRULE-L: Assign a violation mark if the head foot is preceded by another foot in the PWd
   b. ENDRULE-R: Assign a violation mark if the head foot is followed by another foot in the PWd

Because the PWd_{min} is exhaustively parsed and its head foot is final, PARSE-σ/PWd_{min} and ENDRULE-R dominate ENDRULE-L

(78). The attested output (77a) respects PARSE-σ/PWd_{min} and ENDRULE-R, unlike unattested outputs that either do not fully parse the PWd_{min}, violating PARSE-σ/PWd_{min} (77b), or have a non-final head foot, violating ENDRULE-R (77c). Structures violating constraints in (77) are highlighted.

(77) PWd_{min} Exhaustively Parsed, Head Foot Final

a. Attested in Creek: [[**(aˌwa)**(naˈya)]$_{PWdmin}$ kałi:s]$_{PWdMax}$

b. Unattested (Unparsed PWd_{min} Syllables): *[[(aˈwa)**naya**]$_{PWdmin}$ kałi:s]$_{PWdMax}$

c. Unattested (Head Foot Non-Final): *[[(aˈwa)**(naˌya)**]$_{PWdmin}$ kałi:s]$_{PWdMax}$

(78) PARSE-σ/PWd_{min}, ENDRULE-R >> ENDRULE-L

/a-wana-y-ak/$_{X0}$, /a-wana-y-ak-ałi:-s/$_{X0}$	PARSE-σ/PWd_{min}	ENDRULE-R	ENDRULE-L
☞ [[(aˌwa)(naˈya)]$_{PWdmin}$ kałi:s]$_{PWdMax}$			1
[[(aˈwa)(naˌya)]$_{PWdmin}$ kałi:s]$_{PWdMax}$		1 W	L
[[(aˈwa)naya]$_{PWdmin}$ kałi:s]$_{PWdMax}$	2 W		L

(77a) violates the general constraint PARSE-σ for the two unfooted syllables [ka.łi:s] that are only in the PWd_{max}. The unattested output (79) fully parses the PWd_{Max} at the expense of violating ENDRULE-R for constructing a foot that follows the head foot of the PWd. ENDRULE-R must dominate the general PARSE-σ constraint.

(79) Unattested in Creek (Head Foot Non-Final): *[[(aˌwa)(naˈya)]$_{PWdmin}$ **(kaˌłi:s)**]$_{PWdMax}$[10]

---

[10] ENDRULE-R is not violated if the head foot of the PWd_{max} is distinct from the head foot of the PWd_{min}, so that each head foot is final in its PWd (1).

(1) Unattested in Creek (Two Head Feet): *[[(aˌwa)(naˈya)]$_{PWdmin}$ (kaˈłi:s)]$_{PWdmax}$

In (1), the head foot of the PWd_{max} (kaˈłi:s) must have one more level of stress than the head foot of the PWd_{min} (2)

```
(2)              X
        X        X
      X    X         X
```

(80) ENDRULE-R >> PARSE-σ

/a-wana-y-ak/$_{X0}$, /a-wana-y-ak-ałi:-s/$_{X0}$	ENDRULE-R	PARSE-σ
☞ [[(aˌwa)(naˈya)]$_{\text{PWdmin}}$ kałi:s]$_{\text{PWdMax}}$		2
[[(aˌwa)(naˈya)]$_{\text{PWdmin}}$ (kaˌłi:s)]$_{\text{PWdMax}}$	1 W	L

The unattested output (81) satisfies PARSE-σ/PWd$_{min}$ and both ENDRULE constraints by mismatching the first X_0 and the PWd$_{min}$ so that the PWd$_{min}$ is only a single foot. MATCHWORD(All) must thus dominate ENDRULE-L to select the attested output (77a), in which more of the exponents of the morphemes in the lower X_0 are dominated by the internal PWd than in (81).

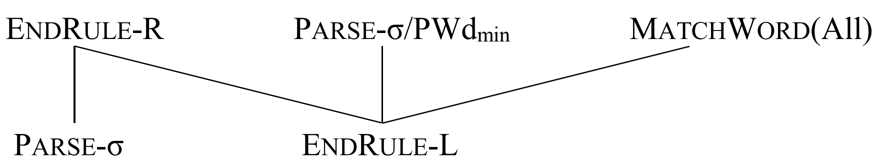
(81) Unattested in Creek (Big Mismatch): *[[(aˈwa)]$_{\text{PWdmin}}$ **<u>nayak</u>**ali:s]$_{\text{PWdMax}}$

(82) MATCHWORD >> ENDRULE-L

/a-wana-y-ak/$_{X0}$, /a-wana-y-ak-ałi:-s/$_{X0}$	MATCHWORD	ENDRULE-L
☞ [[(aˌwa)(naˈya)]$_{\text{PWdmin}}$ kałi:s]$_{\text{PWdMax}}$	1	1
[[(aˌwa)]$_{\text{PWdmin}}$ nayakałi:s]$_{\text{PWdMax}}$	5 W	L

The Hasse diagram in (83), combined with PWd recursion as an optimal mapping of copies spelled out over multiple phases, accounts for the size of the stress domain in Creek verbs without positing the existence of a separate, purely morphological Stem constituent.

(83)



*[[(aˌwa)(naˈya)]$_{\text{PWdmin}}$ (kaˈłi:s)]$_{\text{PWdmax}}$

However, this causes a problem for the mapping of high tone. Downstep in Creek always goes from left to right, i.e., a higher tone cannot follow a downstepped tone. But more prominent stress is associated with higher tone in Creek (see §3.5.2), so that the stressed syllable of the head foot must not have a lower tone than another syllable in the same PWd. Any tonal pattern reflecting the two-head-foot output in (3a-b) violates one of these properties of Creek, which I show in §3.5 are undominated constraints.

(3) Ill-Formed Tonal Patterns of Unattested Output (Two Head Feet)

a. Unattested in Creek (Head Foot of PWd$_{max}$ has Downstep): *[[(aˌwa^{H})(na^{H}ˈya^{H})]$_{\text{PWdmin}}$ (ka$^{!H}$ˈ**<u>łí$^{!H}$s</u>**)]$_{\text{PWdmax}}$

b. Unattested in Creek (Higher Tone Follows Downstep): *[[(aˌwa$^{!H}$)(na$^{!H}$ˈ**<u>ya$^{!H}$</u>**)]$_{\text{PWdmin}}$ (**<u>ka^{H}ˈłí^{H}s</u>**)]$_{\text{PWdmax}}$

3.4.2. Proposal: MATCHWORD(All) and MATCHWORD(Only)

While the two X_0s that make up a Creek verb are mapped to two recursive PWds, the first, lower X_0 is not completely isomorphic to the PWd_{min}. Rather, some phonological exponents of an X_0 expected to be in the matching PWd under isomorphy are actually **mismatched**, ending up dominated by the "wrong" PWd. I illustrate two types of mismatch between X_0s and PWds in Creek. In the general case of mismatch in Creek, phonological material affiliated with morphemes in the first X_0 is not contained in the minimal PWd: an **undermatch**. For example, in (84), the consonant /y/ of the morpheme 'v_{TRANS}' is in the first X_0 but is outside PWd_{min}.

(84) /wana **y**/$_{X0}$, /wana y as/$_{X0}$ → [[(waˈna)]$_{PWdmin}$-**y**-as]$_{PWdmax}$
'tie' v_{TRANS} 'tie' v_{TRANS} IMPER
"tie it!"

This undermatch is required to provide an onset for the final syllable [yas]. Onsets are obligatory in Creek, so an input consonant in between two vowels must be the onset of the second syllable, not the coda of the first syllable. The undermatch is not specific to v_0 morphemes: when the v_0 morpheme is null, the final root consonant is syllabified outside of the minimal PWd (85a). When another *v*P-level morpheme follows v_0, that morpheme's final consonant is syllabified outside of the minimal PWd (85b).

(85) Other Undermatches

a. /hom**p**/$_{X0}$, /homp as/$_{X0}$ → [[(ˈhom)]$_{PWd}$ **p**as]$_{PWd}$
'eat' 'eat' IMPER
"eat!"

b. /a wana y a**k**/$_{X0}$, /a wana y ak ałi: is/$_{X0}$ → [[(aˌwa)(naˈya)]$_{PWd}$ **k**ałi:s]$_{PWd}$
DIR 'tie' v_{TR} PL DIR 'tie' v_{TR} PL FUT INDIC
"they will tie it to it"

With certain inputs, the general case of undermatch would violate high-ranked phonological constraints on prosodic structure, including PARSE-σ/PWd_{min}, FTBIN and DEP-μ. In order to satisfy these constraints, phonological material affiliated with morphemes outside the first X_0 is contained in the minimal PWd: this is **an overmatch**. For example, in (86a), the vowel [a] of the morpheme /-áłi:/ 'future' is in the second X_0 but is inside the PWd_{min}. This mismatch is required to fully parse the syllables of the PWd_{min} without using degenerate feet (86b) or lengthening an input short vowel (86c).

(86) Overmatch

a. /a wana y/$_{X0}$, /a wana y **á**łi: s/$_{X0}$ → [[(aˌwa)(naˈy**a**)]$_{PWdMin}$ łi:s]$_{PWdMax}$
DIR 'tie' v_{TR} DIR 'tie' v_{TR} FUT INDIC
"s/he will tie it to it"

b. Unattested Undermatch (Degenerate Foot): *[[(aˌwa)**(ˈna)**]$_{PWdMin}$ yałi:s]$_{PWdMax}$

c. Unattested Undermatch (Vowel Lengthening): *[[(aˌwa)(ˈn**a:**)]$_{PWdMin}$ yałi:s]$_{PWdMax}$

The grammar of Creek favors undermatches in general but allows overmatches in certain situations. This presents a problem for the formulation of MATCHWORD in Selkirk (2009, 2011). In Selkirk's (2009, 2011) original proposal of MATCHWORD, a syntactic unit of a certain size (e.g., a 'word' = X_0) must be mapped to a prosodic unit of the same size (e.g., a PWd). The formulation of MATCH constraints in Selkirk (2011) refers to the edges of the constituents, and demands that the edges of syntactic and prosodic constituents correspond.

(87) Edge-based Matching (based on Selkirk 2011)

a. MATCH(X_0, PWd): The left and right edges of an X_0 in the input syntactic representation must correspond to the left and right edges of a PWd in the output phonological representation.

b. MATCH(PWd, X_0): The left and right edges of a PWd in the output phonological representation must correspond to the left and right edges of an X_0 in the input syntactic representation.

Elfner (2012) points out that this formulation does not give a precise definition to the term "edge." In fact, since correspondence must be between objects of some kind, this formulation could easily be read to require edge diacritics like /#/ or /-/, which are deprecated in current phonological theory (e.g., Selkirk 1984, Nespor and Vogel 1986). Elfner gives a more precise formulation of MATCH (specifically, MATCHPHRASE$_T$, "T" for "terminal node") that refers to exhaustive domination of terminal nodes; she defines "exhaustive domination" as "dominat[ing] **all** and **only** […] terminal nodes" (Elfner 2012:27; emphasis mine). Exhaustive domination allows MATCH to demand complete overlap of syntactic and phonological units without referring to edges as objects.

(88) MATCHWORD$_T$: Suppose there is a syntactic word (X_0) in the syntactic representation that exhaustively dominates a set of one of more terminal nodes α. Assign a violation mark if there is no phonological word (PWd) in the phonological representation that exhaustively dominates **all and only** the phonological exponents of the terminal nodes in α.

(adapted from MATCHPHRASE$_T$ in Elfner 2011:28)

Neither Elfner's nor Selkirk's formulations of MATCHWORD can distinguish between undermatches and overmatches, as in (89), repeated from (71). In Selkirk's formulation, the right edges of the inner X_0 and the internal PWd do not correspond to each other in either of (89a-b), so that both undermatches and overmatches violate both MATCHWORD constraints. In Elfner's, the inner PWd fails to dominate either **all** (undermatch; 89a) or **only** (overmatch; 89b) the exponents of the terminal nodes of the inner X_0, so that both (89a-b) violate MATCHWORD$_T$.

(89) Undermatches and Overmatches Both Violate MATCHWORD

a. Undermatch:
```
/ h o m p   i c k a ɬ i: s /X0
/ h o m p/X0 | | | | | | |
  | | |  \   | | | | | | |
[[ ('h o m)]PWd p i c k a ɬ i: s ]PWd
```

b. Overmatch:

```
/  n  i  s        i  c  k  a  ɫ  i:  s  /X0
/  n  i  s/X0    /  /   |  |  |  |   |
   |  |  |      /  /    |  |  |  |   |
[[ (n i  'ｓ i   c)]PWd  k  a  ɫ  i:  s  ]PWd
```

More seriously, these formulations of MATCHWORD can neither encourage mismatches to be minimal nor distinguish between the minimal mismatches and a lack of match. A hypothetical output where the inner X_0 has no associated internal PWd (90) does not violate either formulation of the MATCHWORD constraints more than the undermatch or overmatch in (89). This is because these versions of the MATCHWORD constraints are categorical and assessed by X_0-PWd pair: even a minimal mismatch of edges or failure to dominate all and only the terminal node exponents violates the constraints as much as the absence of a match. In fact, the lack of match with respect to the inner X_0 and the internal PWd (90) satisfies MATCH(PWd, X_0) because there is only one PWd, whose edges correspond to those of the outer X_0.

(90) Hypothetical Lack of Match

Lack of Match:

```
/  h  o  m  p  i  c  k  a  ɫ  i:  s  /X0
/  h  o  m  p/X0|  |  |  |  |  |   |
   |  |  |  |  |  |  |  |  |  |   |
[[ ('h o  m)('p i  c) (k  a  ɫ  i:  s) ]PWd
```

(91) shows that an Elfnerian MATCHWORD$_T$ constraint does not distinguish between different types of mismatch or lack of match. When a perfect match is eliminated by a phonological constraint like ONSET, MATCHWORD$_T$ cannot select the attested undermatch instead of an overmatch or no match. (91) also shows that Selkirk's constraint MATCH(PWd, X_0) actually favors no match over the imperfect matches, which are harmonically bounded by no match.

(91) MATCHWORD Constraints Fail

Input	Outputs			ONSET	MATCH WORD$_T$	MATCH (X_0, PWd)	MATCH (PWd, X_0)
/homp/$_{X0}$, /hompickałi:s/$_{X0}$	☹	[[hom].**p**ic.ka.łi:s]	Undermatch		1	1	1
	💣	[[hom.p**ic**].ka.łi:s]	Overmatch		1	1	1
	💣	[hom.pic.ka.łi:s]	No Match		1	1	L
		[[homp].ic.ka.łi:s]	Perfect Match	1 W			

What is needed is a formulation of MATCHWORD that both encourages minimal mismatches and distinguishes between undermatch, overmatch and lack of match. In order to do so, I use the two MATCHWORD constraints proposed in Chapter One and illustrated for Chukchansi in Chapter Two. I split Elfner's single MATCH constraint into two constraints: MATCHWORD(All) demanding that **all** of the exponents of an input X_0 be matched to its corresponding output PWd and MATCHWORD(Only) demanding that **only** the exponents of an input X_0 be matched to its corresponding output PWd.

(92) MATCHWORD(All): Suppose there is an X_0 in the input syntactic representation that has the highest copy of a lexical root in a spellout domain and exhaustively dominates a set of morphemes α. Assign a violation mark for every segment that (1) is an exponent of a morpheme in α and (2) is **not** dominated by a PWd in the output phonological representation corresponding to the X_0.

(93) MATCHWORD(Only): Suppose there is an X_0 in the input syntactic representation that has the highest copy of a lexical root in a spellout domain and exhaustively dominates a set of morphemes α. Assign a violation mark for every segment that (1) is an exponent of a morpheme **that is not** in α (2) and is dominated by a PWd in the output phonological representation corresponding to the X_0.[11]

[11] Because this definition of MATCHWORD demands domination of segments, one might wonder what happens to autosegments. I propose that the output material that must be dominated can be adjusted to make different MATCHWORD constraints. For example, §3.4.3 introduces the constraint MATCHWORD(All)/σ, which demands that output syllables, not segments be dominated. Similarly, versions of the MATCHWORD constraints can be formulated that demand domination of output features, not segments; this would encourage matching of autosegments to their proper PWd. However, Creek consistently overmatches aspectual autosegments (§3.5); it is important that this mismatch is not penalized by the same version of MATCHWORD that normally prevents overmatching of segments.

MATCHWORD(All) penalizes **undermatches**, while MATCHWORD(Only) penalizes **overmatches**. The locus of violation in both these constraints is the individual mismatched segment. The more segments are mismatched, the more MATCHWORD(All) and (Only) are violated. A complete lack of match violates MATCHWORD for every segment; I detail the violations below. These two MATCHWORD constraints are similar in spirit to Selkirk's (2011) two MATCH constraints, MATCH(X_0, PWd) demanding that an input X_0 be matched to an output PWd (syntax-phonology faithfulness) and MATCH(PWd, X_0) demanding that an output PWd be matched to an input X_0 (phonology-syntax faithfulness). As shown by, e.g., Selkirk (1995) and Werle (2009), both types of faithfulness are empirically motivated. However, the two revised constraints in (92-93) differ from Selkirk's (2011) constraints in that only the revised constraints can both tell apart overmatches and undermatches and encourage mismatches to be minimal.

I illustrate how these two MATCHWORD constraints are violated. In the following schemata, the X_0 dominates terminal nodes α and the corresponding PWd dominates segments of morphs that are exponents of α. For ease of exposition, I show the segments /abc/ in the input of the vocabulary items that expone α and correspond to output exponents [abc] dominated by PWds. (94) illustrates a perfect match between the output exponents [abc] of the terminal nodes α and the PWd corresponding to the X_0 dominating α; (94) satisfies both MATCHWORD(All) and MATCHWORD(Only).

(94) Perfect Match: No Violation

```
Input = Syntax:          /  a  b  c  /X0
                            |  |  |
Output = Phonology:  [  a  b  c  ]PWd
```

In the minimal undermatch (95), the output segment [c] is an exponent of α, but is not dominated by the PWd corresponding to the X_0 containing α. (95) violates MATCHWORD(All) once for the segment [c]. (95) does not violate MATCHWORD(Only), since the PWd does not dominate any segments that do not expone α.

(95) Minimal Undermatch: Violates MATCHWORD(All) Once

Syntax: / a b **c** $/_{X0}$

Phonology: [a $b]_{PWd}$ **c**

In the minimal overmatch (96), the output segment [d] is an exponent of a morpheme not in α, is dominated by the PWd corresponding to the X_0 dominating α. (96) violates MATCHWORD(Only) once, for the segment [d]. (96) does not violate MATCHWORD(All), since every segment exponing α is dominated by the PWd. Crucially, if the output segment [d] were epenthetic and did not have an input correspondent or morphological affiliation, it would not be an exponent of a morpheme not in α. An epenthetic segment thus does not violate MATCHWORD(Only)

(96) Minimal Overmatch: Violates MATCHWORD(Only) Once

Syntax: / a b $c/_{X0}$ **d**

Phonology: [a b c **d** $]_{PWd}$

These two MATCHWORD constraints discourage excessive mismatching because they assign violation marks to mismatched segments. For example, in (97) three segments are overmatched, i.e., are exponents of morphemes outside the X_0 and are dominated by the corresponding PWd. Because (97) has three violations of MATCHWORD(Only) and (96) only one, MATCHWORD(Only) favors the smaller mismatch.

(97) Excessive Overmatch: Violates MATCHWORD(Only) Three Times

```
Syntax:       /  a  b  c/X0  d  e  f
                 |  |  |    /  /  /
Phonology:    [  a  b  c  d  e  f]PWd
```

MATCHWORD(All) and (Only) are both violated simultaneously in (98), where the segment [a] (inside the X_0, outside the PWd) is undermatched while the segment [d] (outside the X_0, inside the PWd) is overmatched.

(98) Double Mismatch: Violates MATCHWORD(All) Once, MATCHWORD(Only) Once

```
Syntax:       /  a  b  c/X0  d
               /    |  |    /
Phonology:    a  [  b  c  d  ]PWd
```

If there is no output PWd at all corresponding to an input X_0 (99), MATCHWORD(All) is violated for every output segment that is an exponent of a morpheme in the X_0, since there is no corresponding PWd to dominate them. A lack of match is thus unlikely to surface using these MATCHWORD constraints, because of its multiple violations.

(99) Lack of Match: Violates MATCHWORD(All) Three Times

```
Syntax:       /  a  b  c/X0
                 |  |  |
Phonology:       a  b  c
```

If a biphasal input with two X_0s has a single PWd in the output, the violations depend on the which X_0 the PWd corresponds to. Because there is only a single PWd, either one of the X_0s does not correspond to a PWd or both X_0s correspond to the same PWd. If the PWd corresponds to the lower X_0, as in (100a), MATCHWORD(Only) is violated three times for the segments [def] that are exponents of morphemes not in X_{0a} but are dominated by the PWd_a. MATCHWORD(All) is also violated six times for all the segments [abcdef], since they are exponents of morphemes in the higher X_{0b} but are not dominated by a corresponding PWd_b. If the PWd corresponds to the higher X_{0b}, as in (100b), MATCHWORD(All) is violated three times for the segments [abc], since they are exponents of morphemes in X_{0a} but are not dominated by a corresponding PWd_a. However, MATCHWORD(Only) is not violated by (100b) because there are no segments dominated by PWd_b that are exponents of morphemes not in X_{0b}. If the PWd corresponds to both the lower X_{0a} and the higher X_{0b}, as in (100c), MATCHWORD(Only) is violated three times for the segments [def], since they are exponents of morphemes not in X_{0a} but are dominated by a corresponding PWd_a. MATCHWORD(All) is not violated by (100c) be1cause all the exponents of both X0a and X_{0b} are dominated by corresponding PWds. Due to the different violation profiles, a single PWd in the output cannot corresponds only to the lower X_0 with a biphasal verb.

(100) Cyclic Syntax but Single PWd:

a. PWd Corresponds to Lower X_{0a}:
Violates MATCHWORD(All) Six Times, MATCHWORD(Only) Three Times,

```
Syntax:       /  a  b  c      d  e  f/X0b
              /  a  b  c/X0a  |  |  |
                 |  |  |      |  |  |
Phonology:    [  a  b  c      d  e  f]PWda
```

b. PWd Corresponds to Higher X_{0b}: Violates MATCHWORD(All) Three Times

```
Syntax:       /  a  b  c      d  e  f/X0b
              /  a  b  c/X0a  |  |  |
                 |  |  |      |  |  |
Phonology:    [  a  b  c      d  e  f]PWdb
```

c. PWd Corresponds to both X_{0a} and X_{0b}: Violates MATCHWORD(Only) Three Times

```
Syntax:       /  a  b  c      d  e  f/X0b
              /  a  b  c/X0a  |  |  |
                 |  |  |      |  |  |
Phonology:    [  a  b  c      d  e  f]PWda,b
```

In comparison with

(91) above, where the MATCHWORD constraints cannot distinguish between undermatches, overmatches, and lack of matches, the two MATCHWORD constraints proposed in (92-93) can distinguish between all of them (101). Moreover, these MATCHWORD constraints penalize minimal mismatches less than excessive mismatches and lack of matches. When a perfect match cannot be realized due to phonological constraints, the resulting mismatch is preferably minimal. Crucially, the ranking of MATCHWORD constraints with respect to each other and to phonological constraints like ONSET determines the particular output PWd structure chosen to reflect a biphasal input.

(101) All Mismatches Distinguished using Two MATCH Constraints

Input		Outputs		ONSET	MATCH WORD(Only)	MATCH WORD(All)
/homp/$_{X0a}$, /hompickałi:s/$_{X0b}$	☞	[[hom]$_a$.**p**ic.ka.łi:s]$_b$	Undermatch			1
		[hom.pic.ka.łi:s]$_b$	No Match			4 W
		[[hom.p**ic**]$_a$.ka.łi:s]$_b$	Overmatch		2 W	L
		[hom.pic.ka.łi:s]$_{a,b}$	No Match		7 W	L
		[[homp]$_a$.ic.ka.łi:s]$_b$	Perfect Match	1 W		L

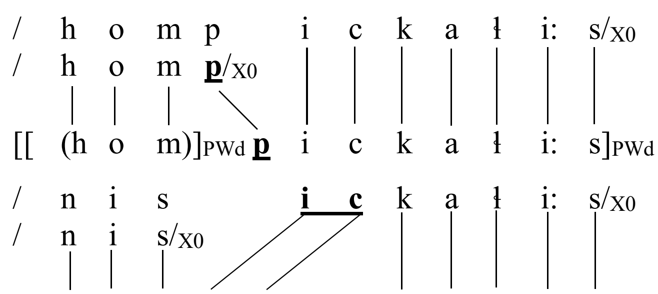
3.4.3. MATCHWORD(All) and (Only) in Creek

The rest of §3.4 shows how MATCHWORD(All) and MATCHWORD(Only) model the two types of mismatch in Creek: **undermatch and overmatch**. The two MATCH constraints are crucially ranked with respect to phonological constraints, including ONSET, PARSE-σ, F(OO)TBIN(ARITY), and DEP-μ. I repeat the mismatches in Creek from (71) as (102).

(102) X_0-PWd Mismatches

a. Onset Undermatch:

b. Footing Overmatch:



[[(n i s i c)]$_{PWd}$ k a ł i: s]$_{PWd}$

I start with the general mismatch in Creek, the undermatch, in which the final consonant of the inner X_0 is not dominated by the PWd_{min}, as illustrated in (102a). The consonant [p] must be parsed as a syllable onset, as ONSET is undominated in Creek. All single intervocalic consonants are parsed as onsets, not codas, shown by the fact they never make the previous syllable heavy. The attested output in (102a) violates MATCHWORD(All) for the segment [p], since [p] is an exponent of the syntactic material in the inner X_0 but is not dominated by the PWd_{min}. An unattested output with a perfect match (103) satisfies MATCHWORD(All) by parsing [p] into the PWd_{min}.

(103) Unattested Perfect Match: /homp/$_{X0}$, /hompickałi:s/$_{X0}$ →
*[[(homp)]$_{PWdMin}$.***ic***.ka.łi:s]$_{PWdMax}$

However, the perfect match comes at the cost of the onsetless syllable [ic]. ONSET must dominate MATCHWORD(All) to pick the mismatch (102a) over the perfect match (103).

(104) ONSET >> MATCHWORD(All)

/homp/$_{X0}$, /hompickałi:s/$_{X0}$	ONSET	MATCHWORD(All)
☞ [[(hom)]$_{PWdMin}$ **p**ic.ka.łi:s]$_{PWdMax}$		1
[[(homp)]$_{PWdMin}$.***ic***.ka.łi:s]$_{PWdMax}$	1 W	L

When a mismatch occurs in order to provide an onset, it is always the final consonant of the inner X_0 that is mismatched. A different possible repair that Creek does not use is an overmatch of the first vowel of the outer X_0 that is not also in the inner X_0. While both mismatches allowed the final consonant in the first X_0 to be parsed as an onset, one does so by undermatching ([y] in (105a)) and the other by overmatching ([a:] in (105b)).

(105) Onset-providing Mismatches: /wanay/$_{X0}$, /wanaya:łi:s/$_{X0}$[12]

a. Undermatch (Attested in Creek): [[(wa.na)]$_{PWdmin}$.**y**a:.łi:s]$_{PWdmax}$
b. Overmatch (Unattested in Creek): *[[(wa.na).(y**a:**)]$_{PWdmin}$.łi:s]$_{PWdmax}$

The undermatch (105a) violates MATCHWORD(All) because of [y], while the overmatch (105b) violates MATCHWORD(Only) because [a:]. Because the undermatch is the actual surface form in Creek, MATCHWORD(Only) dominates MATCHWORD(All). Again, a single MATCHWORD constraint cannot distinguish between the two mismatches.

(106) MATCHWORD(Only) >> MATCHWORD(All)

/wanay/$_{X0}$, /wanaya:łi:s/$_{X0}$	MATCHWORD(Only)	MATCHWORD(All)
☞ [[(wa.na)]$_{PWdMin}$.**y**a:.łi:s]$_{PWdMax}$		1
[[(wa.na).(y**a:**)]$_{PWdMin}$.łi:s]$_{PWdMax}$	1 W	L

In the general case, the mismatch of X_0s and PWds results in an undermatch, modeled by MATCHWORD(Only) dominating MATCHWORD(All). However, in cases where the inner X_0 is odd-parity and cannot be fully parsed into binary iambic feet by itself, an undermatch would result in either poor foot structure or a faithfulness violation. In order to faithfully parse the internal PWd_{min} into binary iambic feet, material from outside the inner X_{0i} is moved into the PWd_{min}, resulting in an overmatch. More precisely, it is the first vowel outside the inner X_0 that is overmatched, satisfying the parsing constraints PARSE-σ/PWd_{Min} and FTBIN without unneeded faithfulness violations ([a] in (107a)). The overmatch violates MATCHWORD(Only) because of the segment [a]. However, undermatches in which the final consonant of the inner X_0 is mismatched (the first [s] in (107b-c)) are prosodically ill-formed. Either the syllable [ni] of PWd_{Min} is unparsed, violating PARSE-σ/PWd_{Min} (107b), or it is parsed into a degenerate foot, violating FTBIN (107c).

[12] The vowel /a:/ is a portmanteau of the first person singular agent agreement marker, typically /-ay-/, and the first vowel of the future /-ałi:-/ (see §3.3.3).

(107) Mismatches with Odd-parity Inner X_0: /nis/$_{X0}$, /nisáłi:s/$_{X0}$

a. Overmatch (Attested in Creek): [[(ni.s**a**)]$_{PWdMin}$.łi:s]$_{PWdMax}$

b. Undermatch 1 (Unattested in Creek): [[**ni**]$_{PWdMin}$.**s**a.łi:s]$_{PWdMax}$

c. Undermatch 2 (Unattested in Creek): [[**(ni)**]$_{PWdMin}$.**s**a.łi:s]$_{PWdMax}$

The constraints against unparsed syllables in PWd_{Min} and degenerate Feet, PARSE-σ/PWd_{Min} and FTBIN, must dominate MATCHWORD(Only).

(108) PARSE-σ/PWd_{Min}, FTBIN >> MATCHWORD(Only)

/nis/$_{X0}$, /nisáłi:s/$_{X0}$	PARSE-σ/ PWd_{Min}	FTBIN	MATCHWORD (Only)	MATCHWORD (All)
☞ [[(ni.s**a**)]$_{PWdMin}$.łi:s]$_{PWdMax}$			1	
[[(**ni**)]$_{PWdMin}$ .sa.łi:s]$_{PWdMax}$		1 W	L	1 W
[[**ni**]$_{PWdMin}$ .sa.łi:s]$_{PWdMax}$	1 W		L	1 W

Vowel lengthening, which violates DEP-μ, can allow an undermatch to satisfy PARSE-σ/PWd_{Min} and FTBIN (109). However, it is the overmatch that surfaces, not the undermatch, because DEP-μ dominates MATCHWORD(Only).

(109) Mismatches with Odd-parity Inner X_{0i}: /nis/$_{X0}$, /nisałi:s/$_{X0}$

Undermatch 3 (Unattested in Creek): [[(n**i:**)]$_{PWdMin}$.**s**a.łi:s]$_{PWdMax}$

(110) DEP-μ >> MATCHWORD(Only)

/nis/$_{X0}$, /nisáłi:s/$_{X0}$	DEP-μ	MATCHWORD(Only)	MATCHWORD(All)
☞ [[(ni.s**a**)]$_{PWdMin}$.łi:s]$_{PWdMax}$		1	
[[(n**i:**)]$_{PWdMin}$ .sa.łi:s]$_{PWdMax}$	1 W	L	1 W

When the inner X_0 only contains a single vowel, like /nis/$_{X0}$, only an overmatch can satisfy the prosodic well-formedness and faithfulness constraints in ((108-110). With a larger odd-parity inner X_0, e.g., /a-wanay/$_{X0}$, however, an undermatch can satisfy these constraints if enough material is undermatched, in this case the three segments [nay] (111b). Nevertheless, a small overmatch that only mismatches one segment [a] (111a) is chosen over the big undermatch with an odd-parity inner X_0. This contrasts with the general case above (105), where an onset undermatch is selected above an overmatch.

(111) Mismatches with Odd-parity Inner X_{0i}: /awa**<u>nay</u>**/$_{X0}$, /awanay***á***łi:s/$_{X0}$
  a. Small Overmatch (attested in Creek): [[(a.'wa).(na.'y***a***)]$_{PWdmin}$ łi:s]$_{PWdmax}$
  b. Big Undermatch (unattested in Creek): [[(a.'wa)]$_{PWdmin}$ **<u>na.y</u>**a.łi:s]$_{PWdmax}$

The ranking of MATCHWORD(Only) above MATCHWORD(All) wrongly favors the large undermatch (111b) over the small overmatch (111a). With one exception analyzed in §3.5.2, Creek only allows undermatches of a single consonant; undermatches of more material do not surface. In the formulation of the two MATCHWORD constraints given above, the material that must be faithfully mapped from X_0 to PWd is the segment. I propose that more specific versions of MATCHWORD constraints are possible that specify the kind of phonological element to be matched. The version needed is MATCHWORD(All)/σ; Creek can undermatch a consonant, but not a whole syllable. The affiliation of a syllable with a morpheme, i.e., syntactic terminal node, is determined by that syllable's head, i.e., nucleus; see de Lacy 2002a,b for the nucleus being the head, i.e., "designated terminal element," of a syllable. I provide the definitions of MATCHWORD(All)/σ and MATCHWORD(Only)/σ below.

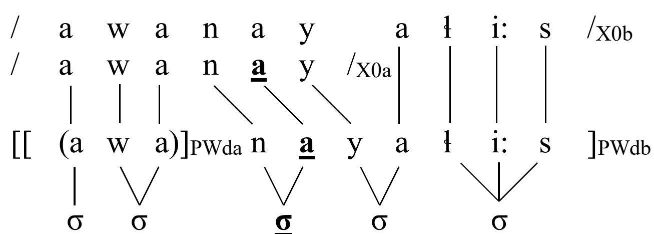
(112) MATCHWORD(All)/σ: Suppose there is an X_0 in the input syntactic representation that has the highest copy of a lexical root in a spellout domain and exhaustively dominates a set of morphemes α. Assign a violation mark for every syllable (1) whose head (= nucleus) is an exponent of a morpheme in α and (2) that is **not** dominated by a PWd in the output phonological representation corresponding to the X_0.

(113) MATCHWORD(Only)/σ: Suppose there is an X_0 in the input syntactic representation that has the highest copy of a lexical root in a spellout domain and exhaustively dominates a set of morphemes α. Assign a violation mark for every syllable (1) whose head (= nucleus) is an exponent of a morpheme **that is not** in α and (2) that is dominated by a PWd in the output phonological representation corresponding to the X_0.

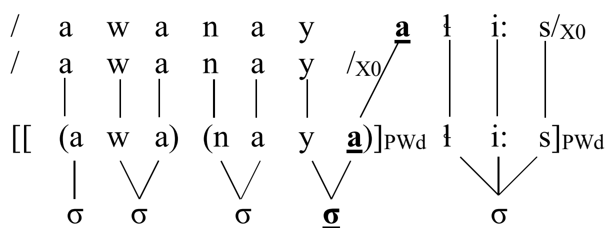
The unattested undermatch (114a), from (111b), violates MATCHWORD(All)/σ once, for the syllable [.na.]. The nucleus of this syllable, [**a**], is an exponent of a morpheme in the lower X_{0a}, but the syllable is not dominated by the corresponding internal PWd_a. The attested overmatch (114b), from (111a), does not violate MATCHWORD(All)/σ: every syllable whose nucleus is an exponent of a morpheme in the lower X_{0a}, i.e., [.a.], [.wa.] and [.na.], is dominated by the corresponding internal PWd_a. The syllable [.ya.] is overmatched in (114b), since it is dominated by the internal PWd_a but its nucleus [**a**] is an exponent of a morpheme that is not in the lower X_{0a}. A syllable overmatch thus violates MATCHWORD(Only)/σ but not MATCHWORD(All)/σ.

(114) Syllable Mismatches

a. Unattested Undermatch:



b. Attested Overmatch:



Ranking MATCHWORD(All)/σ over both MATCHWORD(Only) and MATCHWORD(Only)/σ favors the overmatch (111a) over the syllable undermatch (111b). The Creek data provide no argument for the mutual ranking of MATCHWORD(Only) and MATCHWORD(Only)/σ.

(115) MATCHWORD(All)/σ >> MATCHWORD(Only), MATCHWORD(Only)/σ

/awanay/$_{X0}$, /awanayáɬi:s/$_{X0}$	MATCH WORD (All)/σ	PARSE-σ/ PWd$_{Min}$, FTBIN	MATCH WORD (Only)	MATCH WORD (Only)/σ
☞ [[(a.'wa).(na.'y***a***)]$_{PWdmin}$ ɬi:s]$_{PWdmax}$			1	1
[[(a.'wa)]$_{PWdmin}$ **na**.ya.ɬi:s]$_{PWdmax}$	1 W		L	L

The output of an odd-parity inner X_0 can also satisfy prosodic well-formedness and faithfulness constraints by parsing all the material from both X_0s into a single PWd (116). Because the single PWd is simultaneously minimal and maximal, parsing it exhaustively into binary feet satisfies PARSE-σ/PWd$_{Min}$ and FTBIN without vowel lengthening. This challenger displays a lack of match, i.e., no prosodic recursion for a biphasal input (116). The overmatch attested with an odd-parity inner X_0 must be selected over this lack of match.

(116) Mismatches with Odd-parity Inner X_0: /nis/$_{X0}$, /nisaɬi:s/$_{X0}$
Lack of Match (Unattested in Creek): [(ni.sa).(ɬi:s)]$_{PWdmin/max}$

The single output PWd in (116) can either correspond to the higher X_{0b} or both X_0s. If the single PWd corresponds only to the higher X_{0b}, (116) violates MATCHWORD(All)/σ once for the syllable headed by the first [i], exponing the vowel of /nis/X_{0a}. If the single PWd corresponds to both X_0s, (116) violates MATCHWORD(Only) four times for the segments [áɬi:s] that expone morphemes outside of X_{0a}. Since MATCHWORD(All)/σ dominates MATCHWORD(Only), the overmatch is selected over the lack of match.

(117) MATCHWORD(All)/σ >> MATCHWORD(Only)

/nis/$_{X0a}$, /nisáɬi:s/$_{X0b}$	MATCHWORD(All)/σ	MATCHWORD(Only)
☞ [[(ni.s**a**)]$_{PWda}$.ɬi:s]$_{PWdb}$		1
[(ni.s**a).(ɬi:s**)]$_{PWdb}$		4 W
[(n**i**.sa).(ɬi:s)]$_{PWda,b}$	1 W	L

In some cases of footing overmatch, there is not enough material outside of the inner X_0 to fall outside of the internal PWd_{min}. In these cases, PWd recursion is prevented (118): a single PWd dominates all of the material [as] outside the first X_0, in order to exhaustively parse the PWd_{min}, which is in thus case also the PWd_{max}.

(118) PWd Recursion Blocked

/a	wanay/$_{X0}$,	/a	wanay	as/$_{X0}$	→	[(a.'wa).(na.'yas)]$_{PWdmin/max}$
DIR	'tie'	DIR	'tie'	IMPER		

"tie it to it!"

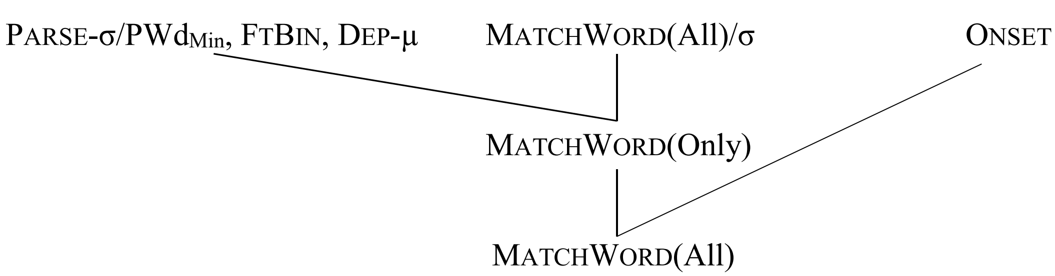
The constraint ranking responsible for regulating footing overmatches (120) prevents PWd recursion in (118). There is only a single PWd in the output; because MATCHWORD(All)/σ is ranked above MATCHWORD(Only), as adduced in (115), the single PWd must correspond to both X_0s, not only to the higher X_{0b}. (118) is chosen because it satisfies parsing constraints that also dominate MATCHWORD(Only); these constraints are violated by onset undermatches.

(119) PWd Recursion Blocked

/awanay/$_{X0a}$, /awanayas/$_{X0b}$	MATCHWORD (All)/σ	PARSE-σ/PWd_{Min}, FTBIN	MATCHWORD (Only)
☞ [(a.'wa).(na.'y***as***)]$_{PWda,b}$			2
[[(a.'wa).na]$_{PWda}$ **y**as]$_{PWdb}$		1 W	L
[[(a.'wa).('na)]$_{PWda}$ **y**as]$_{PWdb}$		1 W	L
[[(a.'wa)]$_{PWda}$ n**a**.yas]$_{PWdb}$	1 W		L
[(**a**.'w**a**).(n**a**.'yas)]$_{PWdb}$	3 W		L

The ranking of constraints established so far is shown in the Hasse diagram in (120).

(120)



Since MatchWord(Only) and Onset dominate MatchWord(All), the onset undermatch is the general case in Creek (121). However, phonological constraints like Parse-σ/PWd$_{Min}$, FtBin and Dep-μ dominate MatchWord(Only) and can compel a footing overmatch. An overmatch of a single segment is also preferable to an undermatch of a full syllable, as MatchWord(All)/σ dominates MatchWord(Only).

(121) Crucial Constraint Rankings

Input	Winner	Losers	Match Word (All)/σ	*Phon*	Match Word (Only)	Match Word (All)
/homp/$_a$, /hompickáłi:s/$_b$	[[(hom)]$_a$ **p**ickałi:s]$_b$	[[(hom)(**pic**)]$_a$ kałi:s]			W	L
		[[(homp)]$_a$ **ic**kałi:s]		W		L
/wanay/$_a$, /wanayá:łi:s/$_b$	[[(wana)]$_a$ **y**a:łi:s]$_b$	[[(wana)(y**a:**)]$_a$ łi:s]			W	L
		[[(wanay)]$_a$ **a:**łi:s]		W		L
/nis/$_a$, /nisáłi:s/$_b$	[[(nis**a**)]$_a$ łi:s]$_b$	[(nis**a)(łi:s**)]$_{a,b}$			W	
		[[(**ni**)]$_a$ sałi:s]$_b$		W	L	W
		[[**ni**]$_a$ sałi:s]$_b$		W	L	W
		[[(n**i:**)]$_a$ sałi:s]$_b$		W	L	
		[(n**isa**)(łi:s)]$_b$	W		L	W
/awanay/$_a$, /awanayáłi:s/$_b$	[[(awa)(nay**a**)]$_a$ łi:s]$_b$	[(awa)(nay**a)(łi:s**)]$_{a,b}$			W	
		[[(awa)(**na**)]$_a$ yałi:s]$_b$		W	L	W
		[[(awa)(n**a:**)]$_a$ yałi:s]$_b$		W	L	W
		[[(awa)**na**]$_a$ yałi:s]$_a$		W	L	W
		[[(awa)]$_a$ n**a**yałi:s]$_b$	W		L	W
		[(**a**w**a**)(n**a**ya)(łi:s)]$_b$	W		L	W
/awanay/$_a$, /awanayas/$_b$	[(awa)(nay**as**)]$_{a,b}$	[[(awa)(**na**)]$_a$ yas]$_b$		W	L	W
		[[(awa)(n**a:**)]$_a$ yas]$_b$		W	L	W
		[[(awa)**na**]$_a$ yas]$_b$		W	L	W
		[[(awa)]$_a$ n**a**yas]$_b$	W		L	W
		[(**a**w**a**)(n**a**yas)]$_b$	W		L	W

All three the MatchWord constraints in (121) are necessary: if MatchWord constraints are used that cannot tell overmatches, undermatches and lack of matches apart, there is no way to ensure that the undermatch is the general case (122).

(122) Single MatchWord Constraint Insufficient

Input	Output	PARSE-σ/PWd$_{Min}$, FTBIN, DEP-μ	ONSET	MATCH WORD
/wanay/$_{X0}$, /wanaya:łi:s/$_{X0}$	☹ [[(wa.na)]$_{PWd}$.**<u>y</u>**a:.łi:s]$_{PWd}$			1
	💣 [[(wa.na).(y**<u>a:</u>**)]$_{PWd}$.łi:s]$_{PWd}$			1
	[[(wa.nay)]$_{PWd}$.***a:***.łi:s]$_{PWd}$		1	
/awanay/$_{X0}$, /awanayáłi:s/$_{X0}$	☹ [[(awa)(nay**<u>a</u>**)]łi:s]			1
	💣 [[(awa)]**<u>na</u>**yałi:s]			1
	[[(awa)(na)]yałi:s]	1		1
	[[(awa)(na:)]yałi:s]	1		1
	[[(awa)na]yałi:s]	1		1

3.5. Parallelism in the Syntax-Prosody Mapping

§3.4 has provided evidence that constraints on parsing and syllable structure, such as ONSET, PARSE-σ/PWd$_{Min}$ and FTBIN, interact with MATCHWORD constraints. This section shows that constraints on autosegmental docking also interact with MATCHWORD constraints in the graded forms of verbs. First, the docking of an autosegment can allow PWd recursion to happen where it would normally be blocked by parsing constraints. Second, an autosegment can force a larger-than-normal undermatch between the inner X_0 and the PWd$_{min}$. These two interactions between autosegments and X_0-PWd matching in turn suggest that the model of syntax-prosody mapping inside the word must be parallel in two ways. First, many purely phonological constraints, including constraints on **autosegmental docking**, are evaluated in parallel with mapping constraints like MATCHWORD. Second, the **entire syntactic output** is mapped to phonology in parallel.

3.5.1. LICENSE and Complex Autosegments

I first look at three of the four grades: aspirated (HGR), falling (FGR) and nasalized (NGR); the lengthened grade (LGR), which works slightly differently from the other grades, is analyzed in §3.5.2. §3.2.2 has described the forms of graded verbs in detail; grades have the following forms under the recursive PWd account, using the *v*P /wana-y/ 'tie' (123).

(123) Grades and Recursive PWds

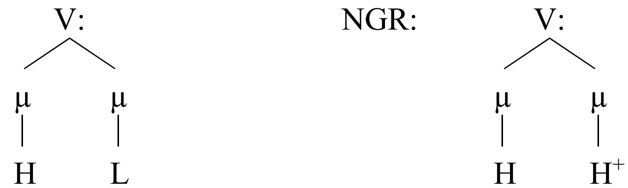
a. HGR:	/wana	y/$_{X0}$,	/wana	y	$^{S.G.}$	is/$_{X0}$	→	[[(wa.n**<u>aa̤</u>**)]yis]
	'tie'	v_{TRANS}	'tie'	v_{TRANS}	HGR	INDIC		
	"s/he tied it (earlier today or last night)"							
b. FGR:	/wana	y/$_{X0}$,	/wana	y =	^{HL}	is/$_{X0}$	→	[[(wa.n**<u>a:^{HL}</u>**)]yis]
	'tie'	v_{TRANS}	'tie'	v_{TRANS}	FGR	INDIC		
	"s/he has tied it"							
c. NGR:	/wana	y/$_{X0}$,	/wana	y =	$^{[+nasal],HH+}$	is/$_{X0}$	→	[[(wa.n**<u>ã:$^{HH+}$</u>**)]yis]
	'tie'	v_{TRANS}	'tie'	v_{TRANS}	NGR	INDIC		
	"s/he keeps tying it"							

The autosegments of the aspect morphemes dock onto the final vowel affiliated with the inner X_0, and make the final PWd_{min} syllable heavy. The autosegments /^{HL}/ (FGR) and /$^{[+nasal],HH+}$/ (NGR) make the syllable heavy by lengthening the vowel they dock onto when possible, i.e., not before coda sonorants. The autosegment /$^{S.G.}$/ (HGR) does so by adding a [spread glottis] feature. I argue that it is phonologically optimal for these autosegments to make the syllable they dock onto heavy; there is no reason to assume a floating mora (Davis and Ueda 2002, 2006, Trommer and Zimmermann 2014) in the UR of these grades. The contour tones /^{HL}/ and /$^{HH+}$/ are composed of two individual tones (/^{H}/ + /^{L}/ and /^{H}/ + /$^{H+}$/, respectively). In order for each individual tone to be linked to its own TBU, i.e., its own mora, the segments the contour tone docks to must be bimoraic, i.e., either a long vowel or a short vowel and sonorant coda (124a) (Gordon 2001, Zhang 2004).

In fact, lexical falling /^{HL}/ tone in nouns is also always linked to a stressed, bimoraic rime (124b-c).

(124) Contour Tones Prefer Bimoraic Rimes

a. FGR: NGR:



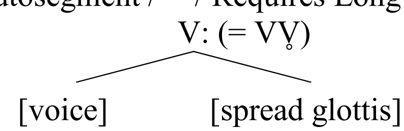
b. [('c**a^{HL}:**s).('ca$^{!H}$k).wa^{L}] "red-headed woodpecker"

c. [('**an^{HL}**).(ła$^{!H}$.'wa$^{!H}$)] "wilderness" (Martin 2011: 81-2)

In Martin's (2011) analysis, the autosegment /$^{S.G.}$/ appears to shorten any long vowel it docks onto. I posit that the vowel the autosegment /$^{S.G.}$/ docks to is actually long /V:/, but the second half of the vowel is voiceless, so the surface appearance is [VV̥] or [Vh]. Specifically, the [spread glottis] feature (Lombardi 1991) docks onto the root node of vowel. But as Creek has no purely voiceless nuclei, part of the vowel must still be voiced. To accommodate both the [voice] feature (phonetically necessary in Creek) and the [spread glottis] feature (the grade autosegment), the vowel must be long, i.e., bimoraic (125).

(125) Autosegment /$^{S.G.}$/ Requires Long Vowel

HGR:



The grade autosegments always dock to the final, i.e., primary stressed vowel. It is crosslinguistically common for strong positions, such as primary stress, to license marked material. I model this using the LICENSE framework (Zoll 1996, Walker 2001, 2005, 2011), which demands that marked features be licensed by a strong position (127a). In Creek, vowels with multiple autosegments, e.g., contour tones and contrasting laryngeal features, are marked and must be licensed by primary stress. Because primary stress falls on the final syllable of the internal PWd_{min} (§3.4.1), which is ideally also the final syllable of inner X_0 material, the autosegments of the grades dock onto the final syllable of this material (126). I argue in the remainder of this section that autosegmental docking allows for an X_0-PWd undermatch, the default syntax-prosody mapping of words in Creek.

(126) Complex Autosegments Licensed by Primary Stress
  a. LICENSE(F, S-Pos): Feature [F] is licensed by association to strong position S. (Walker 2005)
  b. LICENSE(Complex, HeadPWd): Complex autosegments (e.g., contour tones and contrasting laryngeal features) are licensed by association to primary stress.

A second LICENSE constraint captures the generalization above: when two different autosegments attach to the same segmental material, including the contour tones ^{HL} and $^{HH+}$ (124) and vowels with contrasting laryngeal features [voice] and [spread glottis] (125), the material they dock to must be bimoraic (Gordon 2001, Zhang 2004), either a long vowel or a short vowel + sonorant (127).

(127) Complex Autosegments Licensed by Bimoraic Syllables
  LICENSE(Complex, $\sigma_{\mu\mu}$): Complex autosegments (e.g., contour tones and contrasting laryngeal features) are licensed by association to a bimoraic syllable. (Gordon 2001, Zhang 2004)

Vowel lengthening is compelled by autosegmental docking. For example, when the input has the floating ^{HL} tone of FGR forms, LICENSE(Complex, $\sigma_{\mu\mu}$) demands that the vowel it docks onto be long. Because LICENSE(Complex, $\sigma_{\mu\mu}$) dominates DEP-μ, the vowel is lengthened (128). LICENSE(Complex, HeadPWd), which cannot be ranked relative to the other two constraints, forces the floating ^{HL} tone to dock to primary stress.

(128) LICENSE(Complex, $\sigma_{\mu\mu}$) >> DEP-μ

/wanay/$_{X0}$, /wanayis,^{HL}/$_{X0}$	LICENSE(Complex, HeadPWd)	LICENSE(Complex, $\sigma_{\mu\mu}$)	DEP-μ
☞ [[(wa.na**:**^{HL})]yis]			1
[[(wa.n**a**$^{\mathbf{HL}}$)]yis]		1 W	L
[[(wa.na)]yi**:**^{HL}s]	1 W		1

3.5.2. LICENSE and MATCH Constraints Evaluated in Parallel

The presence of an autosegment in the input in Creek influences the syntax-prosody mapping, i.e., it can determine the type of X_0-PWd mismatch in the biphasal verb. This influence is due to the parallel evaluation LICENSE constraints on docking autosegments with MATCHWORD constraints on the syntax-prosody mapping. More precisely, the LICENSE constraints compel vowel lengthening when an input autosegment docks; vowel lengthening alters the parsing options for the PWd_{min} and thus affects how the PWd_{min} is matched to its corresponding X_0. The availability of vowel lengthening when an autosegment docks contrasts with the non-graded footing overmatch described in §3.4.3 above. In non-graded verbs, vowel lengthening is not available to save the undermatched output, which is generally preferred due to the ranking of MATCHWORD(Only) above MATCHWORD(All). For example, when an odd-parity root like /nis/ 'buy' forms the inner X_0, it cannot be exhaustively parsed into binary iambs, and requires an overmatch in the zero grade (129). Vowel lengthening is blocked in non-graded forms because DEP-μ outranks MATCHWORD(Only), and LICENSE(Complex, $\sigma_{\mu\mu}$) does not come into play because there is no autosegment (130).

(129) Zero Grade Footing Overmatch

/nis/$_{X0i}$, /nis**a̲**łi:s/$_{X0j}$ → [[(ni^{M}.s**a̲**^{H})]$_{PWdmin}$ łi:^{L}s]$_{PWdmax}$, *[[(ni:^{H})]$_{PWdmin}$ sa^{L}.łi:^{L}s]$_{PWdmax}$

(130) Footing Overmatch: DEP-μ >> MATCHWORD(Only)

/nis/$_{X0}$, /nisáłi:s/$_{X0}$	LICENSE (Complex, $\sigma_{\mu\mu}$)	DEP-μ	MATCH WORD(Only)	MATCH WORD(All)
☞ [[(ni.s**a**)] łi:s]			1	
[[(n**i:**)] sa.łi:s]		1 W	L	1 W

However, in a graded form like the FGR (131), the input autosegment lengthens the vowel it docks onto because LICENSE(Complex, $\sigma_{\mu\mu}$) dominates DEP-μ. Vowel lengthening allows the PWd_{min} to be exhaustively parsed using only segmental material from the inner X_0. The graded form therefore is an undermatch, which is the general case in Creek as MATCHWORD(Only) dominates MATCHWORD(All) (132).

(131) Autosegments Prevent Footing Overmatch
/ni**s**/$_{X0i}$, /nis ^{HL} imáta is/$_{X0j}$ → [[(ni:^{HL})]$_{PWdmin}$ **s**i^{L}.ma^{H}ts]$_{PWdmax}$
'buy' 'buy' FGR PAST3 INDIC
"s/he bought it (several weeks to a year or so ago) Martin (2011:258)

(132) Footing Overmatch Prevented: LICENSE(Complex, $\sigma_{\mu\mu}$) >> DEP-μ

/nis/$_{X0}$, /nisimátas, ^{HL}/$_{X0}$	LICENSE (Complex, $\sigma_{\mu\mu}$)	DEP-μ	MATCH WORD(Only)	MATCH WORD(All)
☞ [[(n**i:**^{HL})] si.máts]		1		1
[[(ni.s**i:**^{HL})] máts]		1	1 W	L
[[(ni.s**i**^{HL})] máts]	1 W	L	1 W	L

The interaction between autosegmental docking and X_0-PWd mapping provides evidence for **phonological parallelism.** Specifically, the Creek grade system necessitates an analysis in which autosegmental docking, governed by LICENSE constraints, occurs in parallel with the syntax-prosody mapping, governed by MATCH constraints. The autosegment is attracted to the vowel that has primary stress, which is determined by the size of the PWd_{min}. However, the size of the PWd_{min} is itself determined by X_0-PWd mapping in conjunction with parsing constraints; vowel lengthening that results from autosegmental docking affects parsing, and therefore helps determine the size of the PWd_{min}.

The argument proceeds as follows. In the absence of an autosegment, i.e., in the zero grade, PWd recursion is blocked (133).

(133) PWd Recursion Blocked

/a-wanay/$_{X0}$, /a-wanay-as/$_{X0}$ → [(a^{M}.'wa^{H}).(na^{H}.'ya^{H}s)]$_{PWdmin/max}$

/awanay/$_{X0}$, /awanayas/$_{X0}$	LICENSE (Complex, $\sigma_{\mu\mu}$)	DEP-μ	MATCH WORD(Only)	MATCH WORD(All)
☞ [(a.'wa).(na.'y***as***)]$_{PWd}$			1	
[[(a.'wa).(na:)]$_{PWd}$ <u>**y**</u>as]$_{PWd}$		1 W	L	1 W

However, the presence of an input autosegment allows PWd recursion with an otherwise identical input. The autosegment compels the vowel it docks onto to lengthen, allowing the inner X_0 material to be exhaustively parsed without including material from outside the inner X_0 (134). Since the latter material is then outside the PWd_{min}, a recursive PWd structure is built.

(134) PWd Recursion Allowed by Autosegment

/a-wanay/$_{X0}$, /a-wanay-^{HL}-is/$_{X0}$ → [[(a^{M}.'wa^{H}).('na:^{HL})]$_{PWdmin}$ yi^{L}s)]$_{PWdmax}$

It is the parallel evaluation of the entire syntactic input and all constraints, crucially including the LICENSE constraint on autosegments, that allows PWd recursion. An output where PWd recursion is blocked must lengthen the vowel that the autosegment docks onto, or it will violate LICENSE(Complex, $\sigma_{\mu\mu}$). A non-recursive output with vowel lengthening violates DEP-μ as much a recursive PWd output with vowel lengthening; the choice of output is then up to lower-ranked MATCH WORD(Only), which picks the recursive PWd form, i.e., the undermatch (135).

(135) PWd Recursion Allowed

/awanay/$_{X0}$, /awanayis,^{HL}/$_{X0}$	LICENSE (Complex, $\sigma_{\mu\mu}$)	DEP-μ	MATCH WORD(Only)	MATCH WORD(All)
☞ [[(a.'wa).(na:$^{\boldsymbol{HL}}$)]$_{PWd}$ <u>**y**</u>is]$_{PWd}$		1		1
[(a.'wa).(na.'y***i:***$^{\boldsymbol{HL}}$***s***)]$_{PWd}$		1	1 W	L
[(a.'wa).(na.'y***i***$^{\boldsymbol{HL}}$***s***)]$_{PWd}$	1 W	L	1 W	L

3.5.3. Syllable Undermatches in LGR Forms

I now turn to the lengthened grade (LGR) forms, which lengthen the final vowel of the inner X_0 and spread high tone to the right edge of the PWd_{max}. Inner X_0s that can be parsed into a single foot (minus the final consonant) have a recursive PWd structure similar to the other three graded forms: the final vowel of the PWd_{min} is lengthened, and the final consonant of the inner X_0 is undermatched to provide an onset to the next syllable (136).

(136) LGR Forms with One Foot: Onset Undermatch

a. /wana y/$_{X0}$, /wana y $^{H,\mu}$ is/$_{X0}$ → [[(wa^{M}.ˈna:^{H})]$_{PWdmin}$ **y**i^{H}s]$_{PWdmax}$
   ‘tie’ v_{trans} ‘tie’ v_{trans} LGR INDIC
   “s/he is tying it”

b. /nis/$_{X0}$, /nis $^{H,\mu}$ is/$_{X0}$ → [[(ni:^{H})]$_{PWdmin}$ **s**i^{H}s]$_{PWdmax}$
   ‘buy’ ‘buy’ LGR INDIC
   “she is buying it”

However, LGR forms whose inner X_0 cannot be parsed into a single foot show a different pattern: a **syllable undermatch**. While the ^{H} tone and mora of LGR still dock to the final vowel of the inner X_0, this vowel is stressless, and primary, PWd_{min}-final stress falls on the vowel before it ((137), Jack Martin, p.c.). The final vowel of the inner X_0 is thus undermatched and falls outside of the corresponding PWd_{min}, along with its flanking consonants. The default ^{H} tone associated with stress spreads from the first stressed to final, primary stress, i.e., the second vowel of (137); the default ^{H} tone causes the ^{H} tone of LGR to be downstepped.

(137) LGR Forms with Multiple Feet: Syllable Undermatch[13]
/a-wa**<u>na-y</u>**/$_{X0}$, /a-wana-y-$^{\mathbf{H,\mu}}$-is/$_{X0}$ → [[(a^{M}.ˈwa^{H})]$_{PWdmin}$ **<u>na:$^{!H}$.y</u>**i$^{!H}$s]$_{PWdmax}$
DIR-'tie'-v_{trans} DIR-'tie'-v_{trans}-LGR-INDIC
"(s)he is tying it to it"

The syllable undermatch in (137) violates MATCHWORD(All)/σ. Competing outputs that with an onset undermatch do worse than (137) on tonal constraints, so that the syllable undermatch surfaces. Specifically, the LGR ^{H} tone can only spread rightward, not leftward, from the final vowel of the inner X_0; the stressed syllables preceding this vowel must have a different ^{H} tone. Two adjacent ^{H} tones violate the OCP and are disallowed in Creek, triggering downstep of the tone on the right. However, since the ^{H} tone on the final vowel of the inner X_0 is downstepped, it cannot have PWd_{min}-primary stress, since primary stress in Creek must carry the highest tone in the word. Therefore the inner X_0-final vowel is undermatched to avoid receiving primary stress. As demonstrated in this section, tonal and autosegmental docking constraints must interact with the syntax-prosody mapping. Moreover, both X_0s must be present in the input to correctly capture the placement of the internal PWd. §3.6.2 argues that this cannot be captured in a cyclic phonological model where the X_0 from the first spellout domain is phonologized first.

I now illustrate this account in more detail. LGR is expressed by ^{H} tone, which is not a complex autosegmental structure, in contrast to the contour tones and contrastive voicing features that surface in the other grades. LICENSE(Complex, $\sigma_{\mu\mu}$) cannot be used to lengthen the vowel that the ^{H} tone docks onto, as short vowels in open syllables often have high tone in Creek. I posit that the LGR morpheme includes an autosegmental mora as well as ^{H} tone, and that it docks to the immediately preceding vowel; since LGR expresses the Asp phase head that embeds the highest

[13] I assume that as elsewhere in Creek, primary stress is PWd_{min}-final, so that the last vowel of the inner X_0 is outside the PWd_{min} and unfooted (137). While the main diagnostic for primary stress in this and other Creek words is the extent of regular ^{H} tone spread, there is a slight prominence on primary-stressed syllables that is absent on other syllables (Jack Martin, p.c.).

*v*P projection, the immediately preceding vowel will always be the last vowel of the inner X_0. The ^{H} tone and floating mora cannot simply dock to primary stress, since in LGR forms with a big undermatch like (137), the last vowel of the inner X_0 is unstressed.

The ^{H} tone of LGR is the only tone in Creek that spreads unboundedly. I use an alignment constraint, ALIGN-R(LGR) to capture the generalization that the ^{H} tone spreads unboundedly rightward but not leftward.

(138) ALIGN-R(LGR): assign a violation mark for every syllable intervening between LGR and the right edge of the PWd_{max}.

ALIGN-R(LGR) is opposed by a constraint demanding that unstressed syllables not have ^{H} tone; this can be formulated as a prominence constraint as in de Lacy (2002a), or, in analogy with the WEIGHT-TO-STRESS PRINCIPLE, as the TONE-TO-STRESS PRINCIPLE (see, e.g., Anttila and Bodomo 1996, de Lacy 2002a,b, Blumenfeld 2004, van Oostendorp 2005). This relies on Martin's (2011) analysis, where only ^{H} tone is phonologically present and ^{L} tone is a default phonetic "filler."

(139) TONE-TO-STRESS PRINCIPLE (TSP): assign a violation mark to a syllable with (^{H}) tone that does not have stress. (Anttila and Bodomo 1996, de Lacy 2002a,b, Blumenfeld 2004, van Oostendorp 2005)

TSP is normally respected in Creek, since unstressed outer suffixes do not have ^{H} tone unless it is lexically specified. ALIGN-R(LGR) dominates TSP, however, so that the ^{H} tone of LGR spreads rightward onto unstressed outer suffixes.

(140) Right-spreading LGR ^{H} Tone

/wana-y/$_{X0}$, /wana-y-$^{H,\mu}$-is/$_{X0}$	ALIGN-R(LGR)	TSP
☞ [[(wa^M.ˈna:^{H})]y**<u>i</u>**$^{\mathbf{H}}$s]		1
[[(wa^M.ˈna:^{H})]y**<u>i</u>**$^{\mathbf{L}}$s]	1 W	L

With LGR forms with multiple feet that have a syllable undermatch (137), competing outputs with an onset undermatch must be eliminated ((141); footing and tone from Martin 2001:90-91, Jack Martin p.c.). Tonal constraints in Creek dominate MATCHWORD(All)/σ in order to select the syllable undermatch.

(141) Competing Outputs of /a-wana-y/$_{X0}$, /a-wana-y-$^{H,\mu}$-is/$_{X0}$

a. Syllable Undermatch (Attested in Creek)

H ꜝH

[[(a.ˈwa)]$_{PWdmin}$ n**a:**.yis]$_{PWdmax}$

b. Onset Undermatch 1 (Unattested in Creek)

H

[[(a.ˈwa)(ˈn**a:**)]$_{PWdmin}$ yis]$_{PWdmax}$

c. Onset Undermatch 2 (Unattested in Creek)

H H

[[(a.ˈwa)(ˈn**a:**)]$_{PWdmin}$ yis]$_{PWdmax}$

d. Onset Undermatch 3 (Unattested in Creek)

H ꜝH

[[(a.ˈwa)(ˈn**a:**)]$_{PWdmin}$ yis]$_{PWdmax}$

ALIGN-R(LGR) penalizes spreading the LGR tone any further leftward of the vowel it docks onto, i.e., it cannot spread into the PWd_{min}. In fact, leftward spreading in general is prohibited in Creek; inherently stressed or high-toned syllable outside the PWd_{min} never spread their tone to the left. ALIGN-R(LGR) dominates MATCHWORD(All)/σ to prevent leftward spreading (141b).

(142) LGR ^{H} Tone Spreads Rightward, not Leftward

/a-wana-y/$_{X0}$, /a-wana-y-$^{H,\mu}$-is/$_{X0}$	ALIGN-R(LGR)	MATCHWORD(All)/σ
☞ H ꜝH [[(a.ˈwa)] (ˈn**a:**).yis]	1	1
H [[(a.ˈw**a**)(ˈna:)] yis]	2 W	L

Since the LGR ^{H} tone cannot spread leftward, this forces the appearance of another ^{H} tone throughout the footed syllables in the PWd_{min}. Consecutive ^{H} tones in Creek are never allowed, so that the ^{H} tone on the right is downstepped; downstep is invariably left-to-right in Creek. Consecutive identical elements are banned by the Obligatory Contour Principle (Goldsmith 1976), or OCP (141c). The OCP dominates MatchWord(All)/σ in order to downstep the LGR ^{H} Tone.

(143) OCP: assign a violation mark to any two consecutive identical elements (e.g., ^{H} tone)

(144) LGR ^{H} Tone Downstepped

/a-wana-y/$_{X0}$, /a-wana-y-$^{H,\mu}$-is/$_{X0}$	OCP	MatchWord(All)/σ
☞ H ꜜH [[(a.ˈwa)] (ˈn<u>**a:**</u>).yis]		1
<u>**H H**</u> [[(a.ˈwa)(ˈna:)] yis]	1 W	L

If the LGR ^{H} Tone is downstepped but the vowel it docks onto is properly matched inside the PWd_{min}, then primary stress (which falls on this vowel) will have a downstepped tone (141d). There is a cross-linguistic principle that more prominent positions tend to be affiliated with more prominent material (de Lacy 2002a,b). This principle is surface true in Creek: the syllable with the most prominence, primary stress, is always affiliated with the most prominent, i.e., highest tone. In (141d), on the other hand, primary stress is affiliated with the downstepped tone, which is not the most prominent. I formulate a constraint $\text{Head}_{PWd}/^{H}$ penalizing this marked structure.

(145) $\text{Head}_{PWd}/^{H}$: assign a violation mark for the head of a PWd (i.e., primary stressed syllable) that is not affiliated with the most prominent (i.e., highest) tone in that PWd.

The attested big undermatch satisfies HEAD$_{PWD}$/^{H} by shifting the PWd$_{min}$ one syllable leftward so that primary stress precedes the vowel with the downstepped LGR ^{H} tone (141a). In Creek, HEAD$_{PWD}$/^{H}Tone dominates MATCHWORD(All)/σ to select the syllable-sized undermatch.

(146) No Downstepped Tone on Primary Stress

/a-wana-y/$_{X0}$, /a-wana-y-$^{H,\mu}$-is/$_{X0}$	HEAD$_{PWD}$/^{H}	MATCHWORD(All)/σ
☞ H $^{!}$H | /\\ [[(a.ˈwa)] (ˈn**<u>a:</u>**).yis]		1
H $^{!}$H | /\\ [[(a.ˈwa)(ˈn**<u>a:</u>**)] yis]	1 W	L

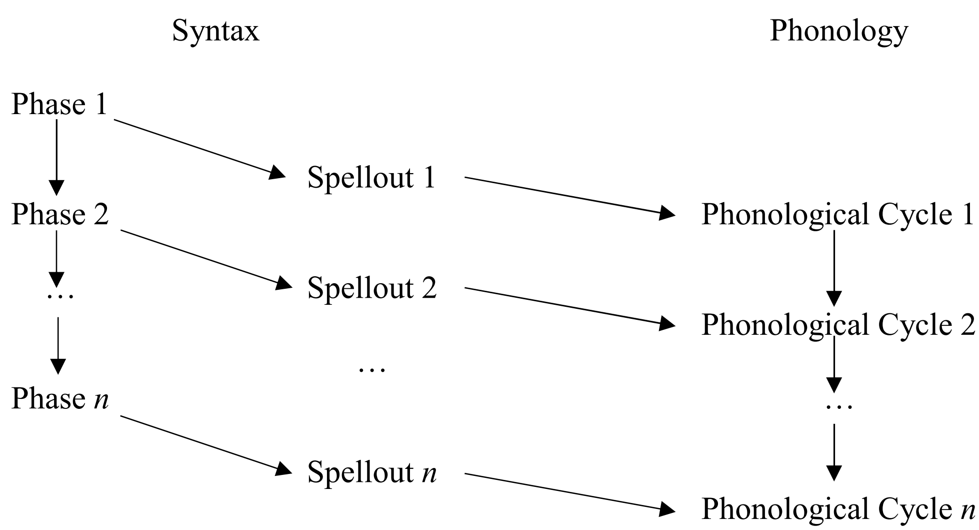
The addition of the single ^{H} tone of the LGR morpheme thus results in a larger-than-normal, syllable-sized undermatch. I show in §3.6 that a strong version of phase-based phonology (Samuels 2010) cannot capture the syllable undermatch.

3.6. Against Phase-Based Phonology with PIC

The preceding section showed that the grade system of Creek can be accounted for in a parallel OT model in which the cumulative material spelled out from syntax is evaluated in a single, parallel step that includes both construction of prosodic structure and docking of autosegments. The section argues against a competing approach to the morphosyntax-phonology interface, phase-based phonology. A cyclic model in which the output of each phase is evaluated by the phonology in turn (Pak 2008, Scheer 2008, 2012, Samuels 2010) cannot account for the Creek data. The Creek data show that a strong version of phase-based phonology in which the Phase Impenetrability Condition (PIC; Chomsky 2000, 2001) holds in phonology as well as syntax cannot be empirically correct. Specifically, a phase-based phonological account of Creek requires feet built in an earlier cycle to be altered or deleted in a later cycle. However, alteration or deletion of prosodic structure violates the PIC in phonology, which prevents material built at an earlier cycle from being altered or deleted later. This section supports Newell's (2014) argument that there is no PIC in phonology, as well as Šurkalović's (2015) proposal that faithfulness to the output of an earlier phonological phase is violable, in the form of Phase-Phase faithfulness constraints. The section may also be amenable to D'Alessandro and Scheer's (2015) claim that for any given phase head, the PIC is optional in either phonology, syntax, or both.

Several models have been proposed of a phase-based phonological model (e.g., Marvin 2002, 2013, Newell 2008, 2014, Pak 2008, Scheer 2008, 2012, Samuels 2010, Šurkalović 2015). In a phase-based phonological model, the phonology operates on each spelled-out phase in turn. For example, in (147), the spellout of the first phase is the input to the first phonological cycle. The output of this first cycle is joined by the spellout of the next phase to form the input to the next phonological cycle. The phonology operation goes through a new cycle after every spellout from syntax.

(147) Model of Phase-Based Phonology



Crucially, after each phase has been phonologized, it is either completely unalterable or resistant to alteration. Some phase-based phonological models allow limited changes of an early cycle's output at a later cycle; these include Dobler et al. (2011) and Newell (2014), who formulate the principle of Phonological Persistence, and Šurkalović (2015), who proposes Phase-Phase Faithfulness constraints. Other, stronger versions of phase-based phonology propose that the output of one phonological cycle is completely unable to be changed at a later phase; for instance, Samuels (2010) argues that the PIC is active in phonology and prevents changes to the output of earlier phonological cycles. The patterns in Creek demonstrate that a strong version of phase-based phonology cannot be correct.

In a phase-based phonological model of Creek, the parsing patterns of biphasal verbs are modeled as follows. The *v*P-level material spelled out at the first, early phase is evaluated in one phonological cycle. Asp and the TP-level material spelled out at the second, later phase is added to the output of the first phonological cycle; together, this material is evaluated in a second phonological cycle. The PIC in phonology prevents alteration or deletion of the segmental and prosodic material in the output of the first cycle. I illustrate the application of phonological operations at each cycle in an OT grammar for ease of comparison with the parallel analysis above (§3.4-5). While most phase-based phonological models do not utilize OT, nothing in the argument presented here relies on couching the phonology in OT.

The first problem for the PIC in phonology is resyllabification of the final consonant of *v*P-level material, equivalent to the onset undermatch ((148); §3.4). The strictest possible conception of the PIC would prevent resyllabification; the Creek data show that this conception is untenable.

(148) /a-wana-y-a**k**/$_{X0}$ → [(aˌwa)(naˈya**k**)]+/ałi:-s/$_{X0}$ → [(aˌwa)(naˈya).**k**ałi:s]

To capture the fact that preferably all and only the *v*P-level material is parsed into stress feet, a phase-based phonological model builds stress feet over all the material at the first cycle (see Newell 2008 for different languages assigning stress at different cycles). In an OT model of phase-based phonology, PARSE-σ and ENDRULE-R dominate ENDRULE-L (or equivalently, an ALIGN constraint) to exhaustively parse the segmental material in the first cycle (149).

(149) Cycle One: PARSE-σ, ENDRULE-R >> ENDRULE-L

/a-wana-y-ak/$_{X0}$	PARSE-σ	ENDRULE-R	ENDRULE-L
☞ [(a.ˌwa).(na.ˈyak)]			1
[(a.ˈwa).(na.ˌyak)]		1 W	L
[a.wa.(na.ˈyak)]	2 W		L
[(a.ˈwa).na.yak]	2 W		L
[a.wa.na.yak]	4 W		L

At the second cycle, no more feet can be constructed as TP-level material is preferably left unparsed in Creek. In an OT model, ENDRULE-R dominates PARSE-σ to prevent any further feet from being built. The PIC prevents feet built at Cycle One from being altered or deleted in Cycle Two. The final [k]. which is a syllable coda in the output of the first cycle, becomes a syllable onset in the output of the second cycle. This must be captured in a phase-based model by resyllabification (equivalent to the onset undermatch), triggered in an OT model by ONSET (150).

(150) Cycle Two: ENDRULE-R >> PARSE-σ; ONSET

[(aˌwa)(naˈya**k**)]+/ałi:-s/$_{X0}$	ENDRULE-R	ONSET	PARSE-σ
☞ [(a.ˌwa).(na.ˈya).ka.łi:s]			2
[(a.ˌwa).(na.ˈyak).**a**.łi:s]		1 W	2
[(a.ˌwa).(na.ˈya).(ka.ˌłi:s)]	1 W		L

Resyllabification after prosodic domains are built is generally assumed to be possible to account for this common type of mismatch between cycles and syllables (e.g., Hayes 1995, Scheer 2008, 2012). Under the strictest conceivable version of the PIC in phonology, however, resyllabification violates the PIC, since material evaluated in the first phonological cycle is manipulated in a later phonological cycle. Because of the ubiquity of resyllabification across cyclic phonological domains, this strictest version of the PIC cannot hold.

A slightly-watered down PIC that allows resyllabification is still too strict to account for the alteration of a foot built in an earlier cycle, equivalent to a footing overmatch ((151); §3.4). Specifically, the final foot built in Cycle One must be expanded to incorporate a following vowel in Cycle Two. A version of the PIC where prosodic structure cannot be altered is untenable in the face of the Creek data.

(151) /wana-y-ak/$_{X0}$ → [(wa.ˌna).(ˈyak)]+/ałi:-s/$_{X0}$ → [(wa.ˌna).(ya.ˈk**a**).łi:s]

The ranking of PARSE-σ and ENDRULE-R over ENDRULE-L, adduced above (

(78), produces exhaustive parsing of the first cycle. The last syllable is made heavy by the final consonant [k], which allows it to be parsed into a binary iambic foot. The constraints FTBIN and IAMB capture the fact that all feet in Creek are binary iambs. Degenerate feet never surface in Creek due to FTBIN and IAMB; therefore, the final consonant [k] cannot be an appendix to the word, but must be in a syllable coda to form a final (H) foot (152).

(152) Cycle One: PARSE-σ, FOOTFORM

/wana-y-ak/$_{X0}$	PARSE-σ	FTBIN	IAMB
☞ [(waˌna).(ˈyak)]			
[(wa.ˈna).(ˈya).k]		1 W	
[(wa.ˈna).yak]	1 W		

At the second cycle, the final [k] is resyllabified due to ONSET. In order for the final foot to form a binary iamb and obey FTBIN and IAMB, the following vowel must be incorporated into this foot. Because this foot must be an iamb, stress shifts off of the syllable [ya] and onto the newly-parsed syllable [ka] (153).

(153) Cycle Two: ONSET, FootForm

[(wa͵na).(ˈyak)]+/ałi:-s/$_{X0}$	ONSET	FTBIN	IAMB
☞ [(wa͵na).(ya.ˈka).łi:s]			
[(wa.ˈna).(ˈya.ka).łi:s]			1 W
[(wa.ˈna).(ˈya).ka.łi:s]		1 W	
[(wa͵na).(ˈyak).a.łi:s]	1 W		

The winning output satisfies both ONSET and the parsing constraints FTBIN and IAMB by altering the final foot of the first cycle (ˈyak). In the output of the second cycle, this foot has been altered to (ya.ˈka), with expansion of the right edge of the foot and stress shift. An even moderately strict version of the PIC in phonology should prevent a foot built at an earlier cycle from being so altered at a later cycle. The fact that prosodic structure alteration at a later cycle is necessary in a phase-based analysis of Creek strongly suggests that the PIC cannot be active in phonology.

An alternative phase-based phonological analysis of (151) involving an "abstract vowel" as a placeholder for first-cycle stress would also violate the PIC. In this analysis, a version of which is proposed in Martin (2011:85), the inner X_0 always ends in an "abstract vowel" at the first vowel, which the following vowel "replaces" at the next cycle. More precisely, the output of the first cycle is exhaustively parsed with binary iambs, and final regular stress falls on a vowel at the end of the first cycle material (represented as1 *i̲*, following Martin (154)). At the next cycle, the following vowel of the outer X_0 replaces [*i̲*] and inherits its stress, leading to stress on a normally-unstressed outer suffix (154).

(154) /wana-y-ak*i̲*/$_{X0}$ → [(wa.͵na).(ya.ˈk*i̲*)]+/ałi:-s/$_{X0}$ → [(wa.͵na).(ya.ˈk**a̲**).łi:s]

While this derivation obeys the relevant constraints ONSET, FTBIN and IAMB, it requires the segmental features of the final vowel of the first cycle to be deleted at the second cycle. Deletion of first-cycle segmental material violates the PIC; since segmental deletion is necessary in the phase-based model to avoid prosodic alteration, the PIC cannot hold in Creek phonology.

Further still, relaxing the PIC to account for either segmental deletion or prosodic alteration nevertheless cannot capture the syllable undermatched LGR forms analyzed in §3.5.2. In a phase-based phonological model, the derivation of LGR forms requires deletion of a previously built foot, which is incompatible with a phonological PIC. The input to the first phonological cycle, i.e., the output of the first syntactic phase, does not include the grade morphology, according to the syntactic analysis in §3.3. In fact, it would be difficult in a syntactic analysis to have the input to the first cycle include grades. The Asp head, which has different content for each grade, would have to be spelled out by a higher phase head that is still below all the other overt outer suffix material in TP. Leaving aside the possibility of this "mystery" covert phase head, the input to and thus output of the first phonological cycle are identical in graded (155) and non-graded forms (151). In the graded LGR form, however, the final foot constructed at the first cycle must be erased at the second cycle.

(155) /wana-y-ak/$_{X0}$ → [(wa.ˌna).(ˈyak)]+/^{H*},μ-is/$_{X0}$ → [(wa.ˈna^{H}).**<u>ya:</u>**$^{\mathbf{!H}}$.ˈki$^{!H}$s]

The first cycle of (155), in which the input material is exhaustively parsed into binary iambs, is identical to (151). In the second cycle, the input includes the autosegmental high tone /^{H*}/ of LGR, which spreads rightward to either the end of the word or another underlying high tone. The LGR high tone docks onto the last vowel of the first cycle. The tonal constraints of Creek cause this vowel be unstressed, forcing deletion of the final foot built in the first cycle. ALIGN-R(LGR) demands that the LGR tone spread rightward, not leftward. The previous stressed syllable must thus have its own ^{H} tone; because of the OCP, the second, LGR ^{H*} tone must be downstepped. Downstepped tone in Creek does not occur on primary stress, which is captured by HEAD$_{PWD}$/^{H}; since ENDRULE-R is high-ranking, the rightmost foot has primary stress. These constraints conspire to erase the foot onto which the LGR ^{H*} tone docks (156).

(156) Cycle Two: Tonal Constraints Cause Foot Deletion

[(waˌna).(ˈyak)]+/^{H*},μ-is/$_{X0}$	ALIGN-R(LGR)	OCP	HEAD$_{PWD}$/^{H}	ENDRULE-R
☞ H ꜝH [(wa.ˈna).ya:.kis]				
H ꜝH [(wa.ˈna).**(ˌya:)**.kis]				1 W
H **ꜝH** [(wa.ˌna).(ˈya:).kis]			1 W	
H H [(wa.ˌna).(ˈya:).kis]		1 W		
H [(wa.ˌna).(ˈya:).kis]	1 W			

Erasing the previously-built foot (ˈyak) is antithetical to a phonological PIC, which prevents previously-built structure from being altered, much less deleted. A strong version of phase-based phonology with a PIC cannot account for the Creek parsing patterns at all. Weakening the phase-based phonological model by getting rid of the PIC in phonology (Newell 2014) allows the Creek patterns to be captured, as does making the PIC hold with some phase heads and not others (D'Alessandro and Scheer 2015). However, equipping the phase-based phonological model with the ability to delete previously-built prosodic structure renders the model difficult to constrain. Without constraints on the ability of later cycles to destroy the structure of earlier cycles, a phase-based model of phonology overgenerates possible grammars. In general, destruction of phonological structure at a later cycle is prevented in phase-based models by mechanisms like the Principle of Phonological Persistence (Dobler et al. 2011) or Phase-Phase faithfulness constraints (Šurkalović 2015). The Creek pattern requires these mechanisms to be violable, and thus forces phase-based models to constrain the possibilities of violating them.

On the other hand, the two Match constraints in the parallel phonological model advocated in this dissertation constrain mismatching of syntactic and prosodic constituents. These constraints demand that violations of syntax-prosody isomorphy be minimal. Phonological operations that rely on prosodic structure are therefore constrained in scope as well, and must broadly take into account the syntactic derivation and its spellout. Chapter Four illustrates the possible grammars generated by the Match constraints in the parallel phonological model, and shows that the model neither undergenerates nor overgenerates grammars greatly.

3.7. Conclusion

Chapter Three refined the cyclic syntax-parallel phonology model using data from Creek. Creek, like Chukchansi, maps biphasal verbs to recursive PWds. However, Creek also displays a variety of mismatches between cyclic X_0s and PWds to satisfy constraints on syllable structure, footing, and autosegmental docking. An account of these mismatches requires two refinements of the model. First, MATCHWORD constraints come in two types to distinguishes different mismatches: MATCHWORD(All), which penalizes **undermatches**, and MATCHWORD(Only), which penalizes **overmatches**. Second, MATCHWORD constraints interact not only with prosodic constraints, but also with **autosegmental docking** constraints like LICENSE. Finally, Creek and Chukchansi both provide evidence for the “parallel phonology” part of the model: PF maps the entire syntactic output to prosodic units in **parallel**, rather than in different cycles.

4. A Typology of Prosodic Effects of Multiple Spellout

4.1. Introduction

Chapters Two and Three demonstrated that verbs spelled out over multiple cycles display PWd recursion in Chukchansi Yokuts and Creek. In Chukchansi, there is a contrast between monophasal verbs, which do not show PWd recursion, and biphasal verbs, which do. Creek verbs, which are always biphasal, display PWd recursion unless prevented by the phonology. While Chukchansi and Creek show that syntactic cyclicity can result in prosodic recursion, this does not necessarily happen in all languages. In this chapter, I investigate languages that diverge from Chukchansi and Creek in the prosodic effects of syntactic cyclicity. More broadly, I look at the possible range of language variation in the phonological results of syntactic cyclicity, specifically in the case of multiphasal verbs, and how the cyclic syntax-parallel phonology model can capture this variation.

Many languages have morphologically complex verbs that express higher verbal v_2 heads (e.g., syntactic causatives, situation and viewpoint aspect) and T heads (e.g., tense, mood, subject agreement). According to the model of syntax adopted in this dissertation, these verbs will be spelled out over two cycles, similar to those in Chukchansi and Creek. However, biphasal verbs do not seem to display PWd recursion in every language; rather, a there is a range of different prosodic possibilities for multiphasal verbs. The difference lies in the mapping of syntax to prosody: the phonological grammar of a given language, including syntax-prosody mapping constraints like MATCHWORD, determines the output prosodic structure of multiphasal verbs.

Chapter Four examines the typology of different ways that syntactic cyclicity inside the word can affect PWd structure. In OT, constraints can be freely reranked in different grammars; different rankings of constraints can select different outputs from the same input (Prince and Smolensky 1993/2004). Therefore, positing the existence of specific constraints, even in the context of a single language, predicts that a language should exist for every possible ranking of these constraints. A **factorial typology** can be generated from a set of OT constraints by investigating every possible ranking of the constraints and then determining the range of possible outputs that can be selected from the same input. Since languages can have different constraint rankings, multiphasal verbs can have different prosodic structures in different languages, even if they share the same morphosyntactic derivation.

In order to see what possible output prosodic structures can be chosen from a multiphasal input, and thus what possible language variation is predicted by the cyclic syntax-parallel phonology model, I look at the factorial typology generated by three types of constraints. These constraints regulate (1) syntax-prosody mapping, (2) morphological exponence, and (3) prosodic well-formedness. The typology is strikingly similar to Selkirk's (1995) typology of function words adjacent to lexical words; see also Anderson's (2005) typology of clitics. For a multiphasal verb in the input to phonology, there are four possible prosodic structures that can result from different rankings of those constraints (Table 1a-d). This chapter shows that each output in Table 1 is attested in natural language.

Table 1. Typology of Multiphasal Verbs /Root-v_1/$_{X0}$, /Root-v_1-v_2-T/$_{X0}$

Prosodic Output:	Attested in:	Prosodic Output	Attested in:
a. Single PWd cf. Internal Clitic	Saisiyat, Armenian	b. Consecutive PWds cf. PWd Clitic	Purépecha
PWd | [Root-v_1-v_2-T] [makθiʔæl] [gerkatsnem]		PPh PWd PWd | | [Root-v_1] [-v_2-T] [piré] [xatí]	
c. Recursive PWd cf. Affixal Clitic	Chukchansi, Creek, Cupeño, Ojibwe	d. Two Recursive PWds	Turkish
PWd_{max} PWd_{min} | [[Root-v_1] -v_2-T] [[(wana:)] lat]		PWd_{max} PWd_{min} PWd_{min} | | [[Root-v_1] [-v_2-T]] [[gidecek] [tim]]	

The chapter is structured as follows. §4.2 precisely defines the input representation to phonology of a cyclically-spelled out morphosyntactic word. §4.3 reviews the constraints needed to evaluate pairs of these inputs and output prosodic structures. Using this input representation and set of constraints, §4.4 gives a factorial typology of output representations based on different rankings of the constraints used in Chapters One-Three. This section then compares the predicted typology with the attested typology, illustrating possible output representations with actual languages. §4.5 deals with two empirical issues for the typology: (1) verbal resumption, which is predicted but seemingly not attested, and (2) PWd-sized morphemes, i.e., in which each morpheme is its own PWd, which is attested but seemingly not predicted. §4.6 concludes the chapter.

4.2. Input Representations

Determining the possible output prosodic representations of multi-cyclic verbs requires a precise definition of the input representations of these verbs to phonology. In this section, I lay out the exact structure of the input representation. In the cyclic syntax-parallel phonology model proposed for sentences in Cheng and Downing (2012, 2016), which I adapt to the word level in Chapter One and defend in §3.5, the phonology does not operate until the syntactic derivation has finished. The input to phonology is composed of the cumulative material spelled out from syntax over multiple phases. For multiphasal verbs, every X_0 spelled out across different phases is present in the phonological input. The preceding three chapters have assumed that the input representations contain phonological material organized into (at least) three X_0s, all of which contain the phonological exponents of the Root and v_1, as in (1). The phonological exponents, or **morphs**, are distinct from the morphosyntactic information encoded by the different heads, or **morphemes**, which are spelled out from syntax (see Halle and Marantz 1993 *inter alia* for the distinction between morphs and morphemes).

(1) Input Representation to Phonology (Chapters One-Three)

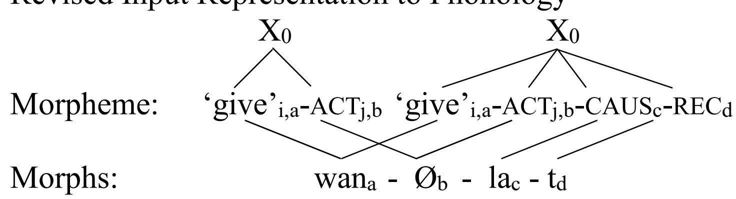
/wan-Ø/$_{X0}$,	/wan-Ø-la/$_{X0}$,	/wan-Ø-la-(i)t/$_{X0}$
'give'-ACT	'give'-ACT-CAUS	'give'-ACT-CAUS-REC

"just made X give"

There are several issues pertinent to defining the exact input representations. First, to what extent do the representations consist of syntactic vocabulary (e.g., the label X_0), and to what extent do they consist of phonological vocabulary (e.g., segments with phonological features, like /lihm/)? In other words, how is the input divided into **morphemes** and **morphs**? Second, do these representations contain all the syntactic material in the two phases, or is only some of the material from each phase transferred? Third, in what sense are the two copies of /lihm/ ‘run’ identical to each other? In sum, these issues deal with how the syntactic representation that is spelled out is “translated” into the phonological input representation.

I argue in this section that **both syntactic morphemes and phonological morphs** are present in the input to phonology, as in (2). Each morpheme is in correspondence to a single morph; crucially, identical copies spelled out at different phases count together as a single morpheme, and so correspond to only one morph. At every phase, all the X_0 and its copies are spelled out, so in a biphasal verb with three morphemes, there are three X_0s in the phonological input. Since the MATCHWORD constraints only demand that the X_0 with the highest copy of the lexical root in each phase be mapped to a PWd, I only show the highest X_0s in the two phases in the diagrams below (e.g., (2)). The X_0s in the input only dominate morphemes, not morphs. Therefore, distinct X_0s can dominate copies of the same morpheme, while these copies correspond to just one morph.

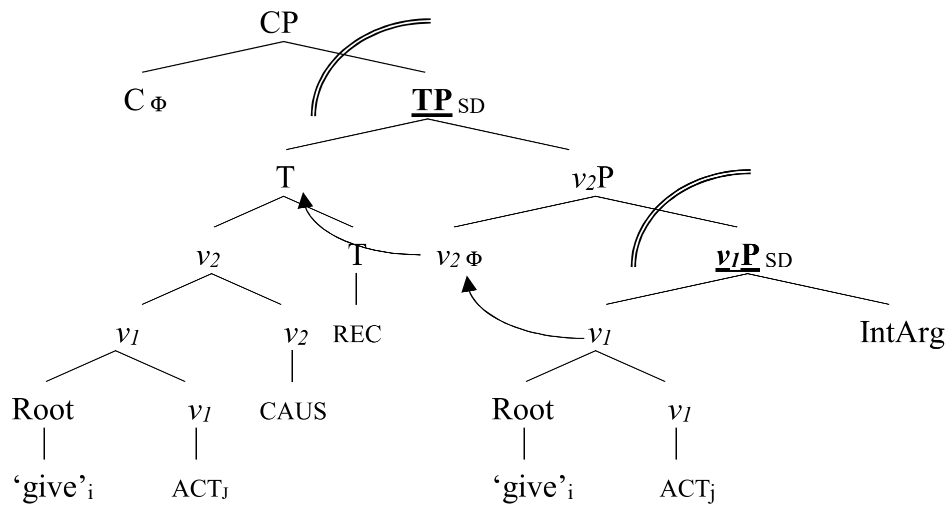
(2) Revised Input Representation to Phonology



The mapping of a syntactic representation to a phonological representation, i.e., phonologization, involves several different processes. These include **linearization**, which takes hierarchically-arranged items and imposes a linear order upon them; **vocabulary insertion**, which inserts morphs in place of phonologically contentless morphemes; **chain reduction** or **copy pronunciation**, which determines which part of a syntactic chain of identical copies gets pronounced; and **prosodic construction**, which maps syntactic constituents to prosodic constituents. All of these processes have been argued to be sensitive to phonological constraints: linearization (Agbayani and Golston 2010, Agbayani, Golston and Ishii 2015), copy pronunciation (Franks 1998, Bošković and Nunes 2007, Hsu 2016) and vocabulary insertion (Wolf 2008). However, in order to isolate the interaction of the syntax-prosody mapping with other phonological constraints, I make the simplifying assumption that the processes of linearization, vocabulary insertion and chain reduction are not affected by phonology. The following analysis thus assumes that the constraints governing these three phonologization processes are undominated. A fuller account of the syntax-phonology interface would investigate the interaction of these other phonologization constraints and the rest of the grammar, and likely reveal their mutual influence. I leave this substantial task to future research.

The presence of phonological material in the input to phonology can be illustrated by the Chukchansi biphasal verb [[wana:]lat] "just made X give," repeated from Chapter Two (3). In this verb, the v_2 phase head /-la/ 'CAUSATIVE' sends its complement, v_1P to the phonology, including lower copies of the verbalized root (root + v_1) /wan-Ø/ 'give'-'ACTIVE' to the phonology. Before being transferred, the verbalized root head-moves to v_2 and then to T; the entire verb /wan-Ø-la-(i)t/ 'run'-ACTIVE-CAUSATIVE-RECENT.PAST is then sent to the phonology by the C phase head.

(3) Syntax of biphasal verb with v_2



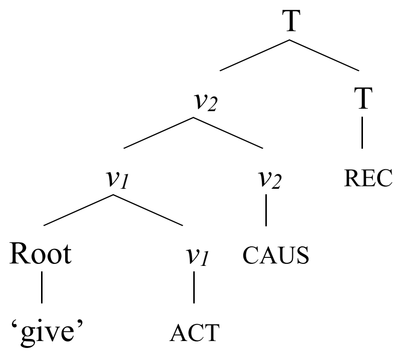
I now go through the details of linearization, vocabulary insertion and copy pronunciation that produce the input representation to phonology.

4.2.1. Linearization, Vocabulary Insertion and X_0 Structure

Following Baker's (1988) Mirror Principle, the default **linear order** of morphemes in a complex X_0 formed by head movement is the reverse of the hierarchical order of their merging sites. That is, more deeply embedded material (like the root) precedes less deeply embedded material (like the causative and tense morphemes). For example, the highest X_0 in the syntactic derivation (3), made of the root 'run' and three functional heads v_1, v_2, and T that have been successively adjoined, is linearized with the root at the left edge, and the T morpheme at the right edge (4).

(4) Complex X_0 Formed by Head Movement

a. Syntactic Hierarchy:



b. Linear Order: 'give'-ACT-CAUS-REC

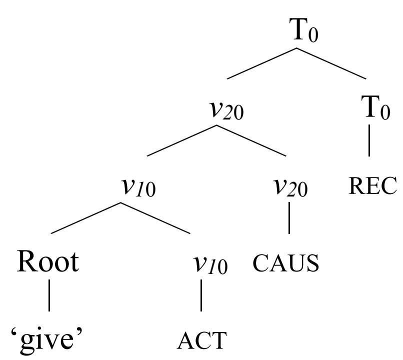
Vocabulary insertion adds phonologically contentful morphs to the abstract morphological structure. In a parallel grammar that includes both syntax-phonology mapping and purely phonological constraints, the input must include both morphs and morphemes. Morphs are necessary so that faithfulness constraints can evaluate the identity or difference between output phonological structure and input phonological structure. Morphemes are necessary since syntax-phonology mapping constraints depend on syntactic constituency like X_0 structure, which only holds of morphemes, not morphs. I adapt Wolf's (2008) serial OT model of correspondence between morphemes and morphs to a parallel OT grammar, similar to the model proposed in Walker and Feng (2004). The morphs in the input are inserted pre-phonologically based on the lexical entry of the morpheme. In the input, every morph corresponds to a morpheme and every morpheme to a morph, though this is not necessarily true in the output. For example, the linearized morphemes in (5a) correspond to the morphs in (5b); the morphs are in the same linear order as the morphemes.

(5) Complex X_0 after Vocabulary Insertion

a.	Morphemes:	‘give’$_a$	-ACT$_b$	-CAUS$_c$	-REC$_d$
b.	Morphs:	wan$_a$	-Ø$_b$	-la$_c$	-(i)t$_d$

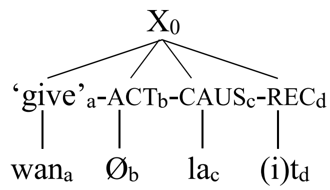
While the preceding processes generate phonological structure in the input in the form of linearized morphs, some **syntactic structure** still must be present in the input representation in order to be mapped to prosodic structure in the phonological output representation. Specifically, for MATCH constraints to work, phonology must be able to “see” what the X_0s, XPs and CPs are in the input so that the constraints can match them to PWds, PPhs and IPhs, respectively (Selkirk 2009, 2011). The input representation must be organized into, e.g., different X_0s, each of which contain the morphemes whose heads make up that X_0 in the syntax. For example, the input representation of /wan-Ø-la-(i)t/ must contain the highest adjoined X_0 (6), which is spelled out at the TP phase.

(6) Complex Adjoined X_0



While each segment of this adjoined X_0 except the root is itself technically an X_0, I argue that the only X_0 that the phonology can see is the maximal one. Otherwise, if every X_0 segment in the syntactic representation were preferentially matched to a PWd, then an adjoined X_0 would ideally be mapped to a prosodic structure with a proliferation of PWds. Instead, only the whole adjoined X_0 is visible to the phonology, not its internal adjunction structure, which is “flattened” by linearization. The X_0 contains the morphemes that compose it in the syntax; the morphs are only indirectly related to the X_0 structure (7).

(7) X_0 in Input to Phonology
a. Input Morphemes:
b. Input Morphs:

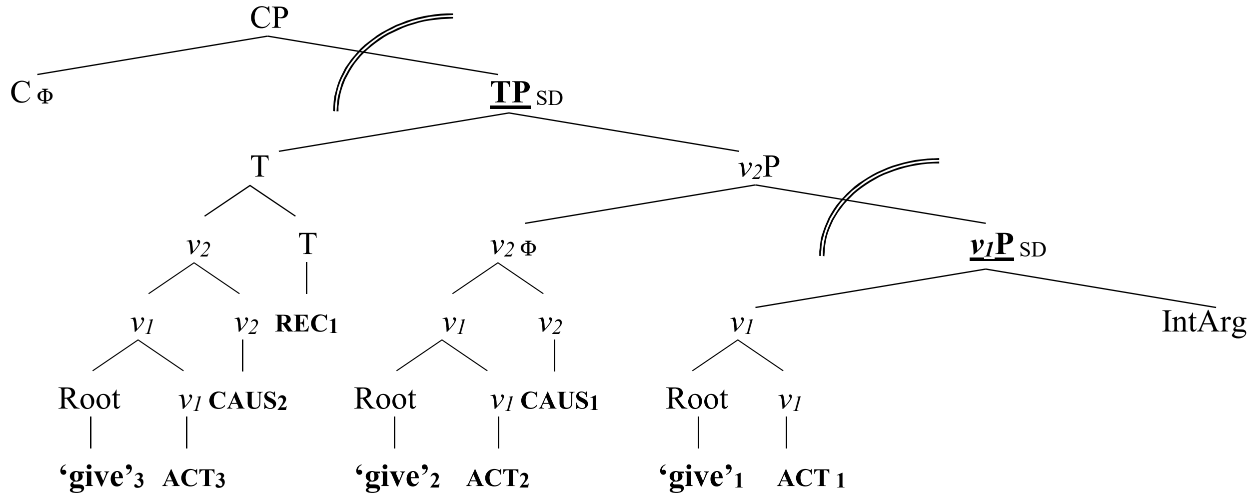


The output of a complex X_0 formed by head movement in the syntax thus has an input representation to the phonology like (7) above: linearized morphemes are contained in an X_0 and in correspondence with morphs that share their linear order.

4.2.2. Chain Reduction and Identical Copies

The next question to investigate is how many X_0s with the structure in (7) are present in the input, and what morphemes each X_0 dominates. In the model of syntax adopted in Chapter One, head movement leaves lower copies. Lower copies are spelled out at an earlier phase, while the higher copies that have head-moved are spelled out at a later phase. For example, in the syntactic derivation of /wan-Ø-la-(i)t/ ‘give’-ACTIVE-CAUSATIVE-RECENT.PAST (8), there are three copies of the root and v_1: one in the base-generated position, a second head-moved to v_2, and a third head-moved to T. The lowest copy is in the v_1P spellout domain, while the higher two copies are in the TP spellout domain.

(8) Copies in /wan-Ø-la-t/



The input to phonology consists of all the material transferred by syntax, e.g., the material spelled out in v_1P and TP in (8). Since both of these spellout domains contain at least one X_0 containing the verbalized root, multiple X_0s will be present in the input to phonology of a multiphasal verb. Moreover, these X_0s will contain identical copies of morphemes, e.g., the Root 'run' and v_1 ACTIVE in (8). The presence of multiple X_0s containing identical copies in the input raises the question of how the phonology treats these copies, and how the chain of identical copies in syntax is altered in the transfer to phonology.

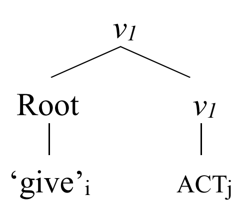
In copy pronunciation, the highest copy of a chain in a phase has priority over all the other, lower copies in that phase (Nunes 2004). While the highest copy in a phase is typically the one that surfaces, phonological constraints can force a lower copy in a phase to be present in the phonological output (Hsu 2016). Hsu (2016) uses the constraint HIGHESTCOPY to model the strong cross-linguistic tendency for only the highest copy in a phase to surface in the output. While HIGHESTCOPY can interact with other constraints in the grammar, this makes it considerably harder to isolate the interaction of MATCHWORD with these constraints. Instead of using HIGHESTCOPY to model the preference for the highest copy in a phase to surface, I make the two MATCHWORD constraints sensitive to the X_0 with the highest copy of a lexical root in a spellout domain, formulated in §1.3.2. As illustrated in §2.3 for Chukchansi, this formulation of MATCHWORD captures the generalization that only one PWd in a recursive structure is present for each spellout domain, rather than for each adjoined head in the syntax.

(9) MATCHWORD(All, Only): Suppose there is an X_0 in the input syntactic representation that has **the highest copy of a lexical root in a spellout domain** and exhaustively dominates a set of morphemes α. Assign a violation mark for every segment that (1) is an exponent of a morpheme that ***{is/is not}*** in α and (2) ***{is/is not}*** dominated by a PWd in the output phonological representation corresponding to the X_0.

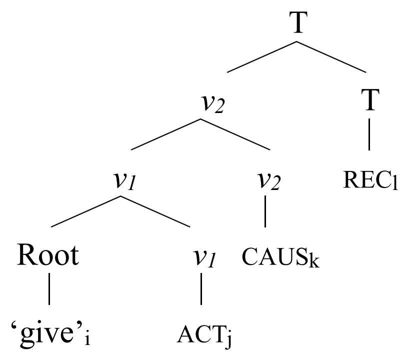
In (8), the highest copies of the chain of the lexical root are in v_1 in the v_1P spellout domain and in T in the TP spellout domain. While all three X_0s—v_1, v_2 and T—are spelled out and thus present in input to phonology, only the highest X_0s transferred at v_1P and TP—v_1 and T, respectively—are mapped to PWds by MATCHWORD (10). The adjoined head in v_2 is transferred at TP (11), but because there is a higher copy of the root 'give' in the TP spellout domain in T (10b), v_2 is not mapped to a PWd. Since the presence of v_2 (11) in the phonological input is irrelevant to the syntax-prosody mapping, I omit it from discussion in the rest of the chapter.

(10) Highest Copies Transferred from Syntax

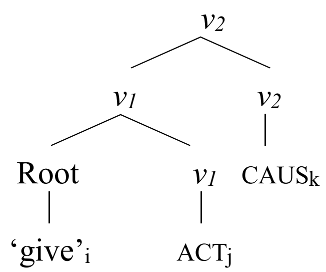
a. v_1 (v_1P spellout domain):



b. T (TP spellout domain):

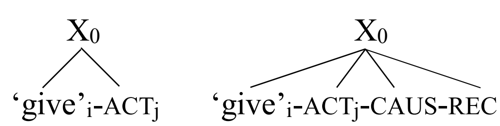


(11) Lower Copy in a Phase: not Mapped to PWd



Chains spanning multiple phases result in multiple copies in the input to phonology, like the multiple copies of the root and v_1 in (10). The input of the biphasal verb in (8) contains the two X_0s in (10), both of which have a copy of the root 'give' and v_1 ACT (12).

(12) Input:



In most circumstances, only one phonological exponent of multiple morphosyntactic copies surfaces in the output of the phonology, even if the copies are spelled out over multiple phases. For example, in successive-cyclic wh-movement in English, only the highest copy of the wh-word in the whole derivation surfaces; copies in lower phases do not surface (13).

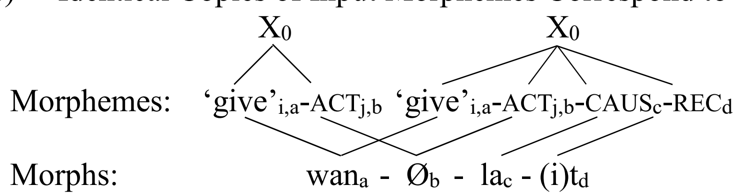
(13) Successive-Cyclic Wh-Movement, One Copy:
[CP **Who** does [TP$_{SD}$ John think [CP that ~~**who**~~ [TP$_{SD}$ Bill wants [TP$_{SD}$ ~~**who**~~ to read the paper?]]]]]

While languages vary in which copy gets pronounced, typically the highest or the lowest, it is cross-linguistically uncommon for multiple copies to surface. As in (13), the typical case is that one copy surfaces, usually the highest copy in overt wh-movement languages like English, and the lowest in wh-in-situ languages like Mandarin and Turkish. However, a structure like (13) is spelled out over several phases, more than one of which transfer a copy of /who/. The input to phonology of (13) has multiple copies of /who/. In order for only one morph, i.e., a phonological string, [who] to surface, the phonology must "know" that these copies in its input are a single morpheme, i.e., an abstract morphosyntactic head, and that each copy is not its own morpheme. Because all the copies of a morpheme that have been spelled out are essentially one morpheme, then optimally only one morph should surface as their exponent.

Identical copies of morphemes in the syntax form a chain (Chomsky 1993) and are fundamentally a single unit. The identity of morphosyntactic copies is not "having the same feature specification," like the two /p/'s in the input of "paper" /**p**eɪ**p**ɚ/ in (13), which are nonetheless distinct segments. Rather, identity of morphosyntactic copies means that all the copies together are "the same, singular morpheme." Separate instances of phonological material cannot be identical in this way; even two elements in correspondence that have the same feature specification are really "two" units, as in Agreement-by-Correspondence (Rose and Walker 2004).

I adapt Wolf's (2008) model of correspondence between morphemes and morphs to capture the identity of morphosyntactic copies without stipulating that any input phonological material is "identical" to other phonological material (see also Walker and Feng's (2004) similar Ternary Morphology-Phonology model). In order to focus on the syntax-prosody mapping, I have assumed that vocabulary insertion, i.e., insertion of morphs that correspond to morphemes, is not sensitive to phonological factors. I also assume that morphs are present in the input, which allows phonological input-output faithfulness to operate in a parallel grammar. As argued above, identical morphosyntactic copies together are a single morpheme. Therefore, identical morphosyntactic copies correspond to a single input morph (14).

(14) Identical Copies of Input Morphemes Correspond to a Single Input Morph



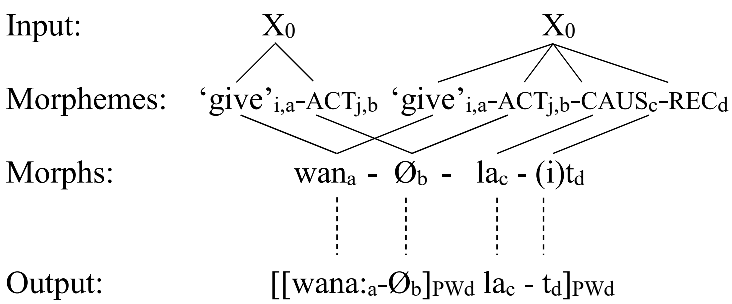
Just as there is only one input morph corresponding to each morpheme, likewise only one output morph should correspond to an input morpheme in the optimal situation. Insertion of more than one output morph corresponding to a single input morph violates a morphological faithful constraint INTEGRITY-M (Walker and Feng 2004, Wolf 2008); this constraint was introduced in Chapter One and used in the account of PWd recursion in Chukchansi in §2.3. INTEGRITY demands that a single input element only correspond to a single output element, and thus penalizes splitting of input elements. Since I assume that each input morpheme has a corresponding morph, I refine Wolf’s (2008) FAITH-M constraints to regulate correspondence relations between input morphemes-morph pairs and output morphs. INTEGRITY-M thus penalizes splitting of input morpheme-morph pairs into multiple output morphs.

(15) INTEGRITY-M: assign one violation mark for any input morpheme-morph pair (including coindexed copies of a morpheme) that corresponds to more than one output morph.

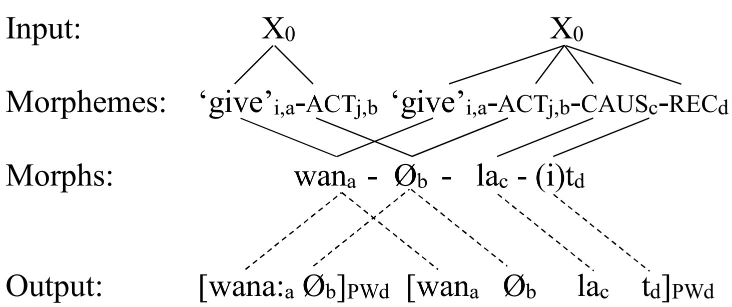
For an input with multiple copies of a morpheme, like the biphasal input in (12), INTEGRITY-M penalizes outputs with multiple morphs corresponding to multiple copies of one morpheme and its single corresponding morph. A recursive PWd output like (16a) has only one morph in the output corresponding to each input morpheme-morph pair, and satisfies INTEGRITY-M. A consecutive PWd output like (16b), with multiple morphs in each PWd corresponding to a single input morpheme-morph pair, violates INTEGRITY-M. The two PWds in the output of (16b) will preferably be linearized according to the position of their matching X_0s in the syntactic hierarchy, in which the first X_0 is lower than the second X_0.

(16) Output Reflections of Multiple Input Copies

a. Single Output Morph Satisfies INTEGRITY-M



b. Multiple Output Morphs Violate INTEGRITY-M



Outputs like (16b) with multiple output morphs might seem unmotivated, but as shown in §4.3, they do satisfy constraints on the syntax-prosody mapping and prosodic well-formedness. §4.5.1 explores why such outputs nevertheless do not seem to be attested.

In the tableaux and some of the examples in the rest of this chapter, I give the phonological inputs in the abbreviated form as in (17), with copies underlined, but still assuming that the input representations actually look like (14).

(17) Input: $\{\underline{\text{wan}_{give}}\text{-}\underline{\text{Ø}_{act}}\}_{X0}$, $\{\underline{\text{wan}_{give}}\text{ -}\underline{\text{Ø}_{act}}\text{-la}_{caus}\text{-(i)t}_{rec}\}_{X0}$

4.3. Basic Constraints

The next step toward investigating the typology of outputs of a multiphasal input like (14-17) is to look at the relevant constraints and see how they penalize possible outputs. Relevant constraints include constraints on morphological exponence, like INTEGRITY-M, explored above in §4.2.2; constraints on the syntax-prosody mapping, here MATCHWORD(All) and MATCHWORD(Only); and constraints on output prosodic well-formedness. In the following section I define the latter two types of constraints and determine how they assign violations to different possible outputs of a multiphasal input.

4.3.1. Prosodic Well-formedness Constraints

I first look at constraints on output prosodic well-formedness. There are three relevant constraints here: NONRECURSIVITY, EXHAUSTIVITY (both from Selkirk 1995) and EQUALSISTERS (Myrberg 2013). NONRECURSIVITY penalizes recursive prosody, EXHAUSTIVITY level-skipping, and EQUALSISTERS unequal daughter nodes.

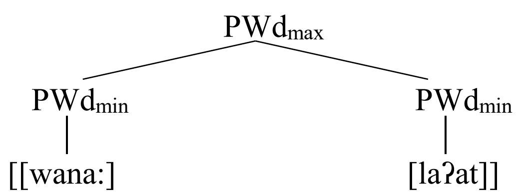
(18) NONRECURSIVITY: assign a violation mark for every prosodic constituent of type C_i that is immediately dominated by another prosodic constituent of type C_j, $j = i$. (adapted from Selkirk 1995)

(19) EXHAUSTIVITY: assign a violation mark for every prosodic constituent of type C_i that is immediately dominated by another prosodic constituent of type C_j, $j > i + 1$. (adapted from Selkirk 1995)

(20) EQUALSISTERS: assign a violation mark if the immediate daughter nodes of a prosodic category are not instances of the same prosodic category. (Myrberg 2013)

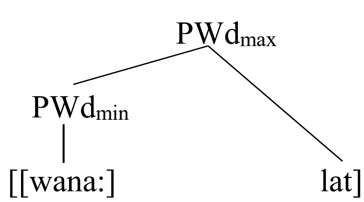
Different output representations violate different prosodic well-formedness constraints, parallel to Selkirk's (1995) typology of clitic structures; see also Anderson's (2005) typology of clitics. An output with two recursive PWds violates NONRECURSIVITY (21), since the maximal PWd immediately dominates two minimal PWds. Because the formulation of NONRECURSIVITY in (18) assigns violations to the dominated, lower prosodic unit and not the dominating, higher one, (21) violates it twice, since there are two minimal PWds, with a single maximal PWd dominating both of them. All PWds in the following examples are minimally disyllabic.

(21) Two Recursive PWds: Violates NONRECURSIVITY Twice



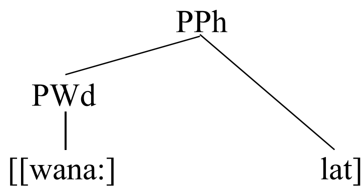
An output with one recursive PWd (22), structurally identical to Selkirk's (1995) Affixal Clitic, only violates NONRECURSIVITY once, since there is only one minimal PWd nested inside the maximal PWd. However, it also violates EQUALSISTERS, since only one of the immediate daughter nodes of the maximal PWd is a PWd and the others are not PWds (either feet or syllables).

(22) Recursive PWd = Affixal Clitic: Violates NONRECURSIVITY and EQUALSISTERS Once



An output that has a single PWd followed by material not dominated by a PWd (23), structurally identical to Selkirk's (1995) Free Clitic, violates EQUALSISTERS, since one of the immediate daughter nodes of the PPh is a PWd and the other daughter node, i.e., the clitic, is a syllable, which is lower than a PWd on the Prosodic Hierarchy. (23) also violates EXHAUSTIVITY once, since the clitic syllable or foot is immediately dominated by a PPh.

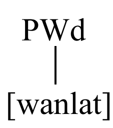
(23) Free Clitic: Violates EQUALSISTERS and EXHAUSTIVITY Once



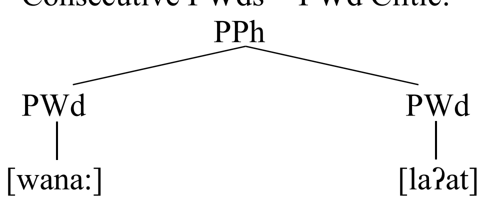
Two output prosodic structures satisfy all three prosodic well-formedness constraints above: an output with a single PWd containing all morphological material (24a), structurally identical to Selkirk's (1995) Internal Clitic, and an output with two consecutive PWds without recursion (24b), structurally identical to Selkirk's PWd Clitic. In both of these outputs, there is no PWd-recursion, satisfying NONRECURSIVITY; all material is dominated by a PWd, satisfying EXHAUSTIVITY; and the two daughters of PPh in (24b) are both PWds, satisfying EQUALSISTERS.

(24) Outputs Satisfying Prosodic Well-formedness Constraints

a. Single PWd = Internal Clitic:



b. Consecutive PWds = PWd Clitic:



4.3.2. MATCHWORD

I next turn to the syntax-prosody mapping constraint, MATCHWORD. Chapters Two and Three argued for two different MATCHWORD constraints: MATCHWORD(All) and MATCHWORD(Only). MATCHWORD(All) and MATCHWORD(Only) both distinguish between overmatches and undermatches and encourage minimal mismatching. I repeat these constraint definitions from §1.2.3, §2.7 and §3.4.2 here.

(25) MATCHWORD(All): Suppose there is an X_0 in the input syntactic representation that has the highest copy of a lexical root in a spellout domain and exhaustively dominates a set of morphemes α. Assign a violation mark for every segment that (1) is an exponent of a morpheme in α and (2) is **not** dominated by a PWd in the output phonological representation corresponding to the X_0.

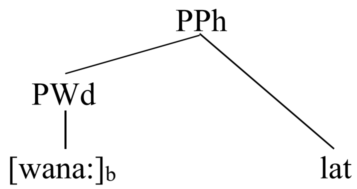
(26) MATCHWORD(Only): Suppose there is an X_0 in the input syntactic representation that has the highest copy of a lexical root in a spellout domain and exhaustively dominates a set of morphemes α. Assign a violation mark for every segment that (1) is an exponent of a morpheme **that is not** in α (2) and is dominated by a PWd in the output phonological representation corresponding to the X_0.

MATCHWORD(All) penalizes outputs in which a PWd does not dominate all the output exponents of the morphemes in the corresponding X_0. For example, with the biphasal input (27), MATCHWORD(All) is violated by an output where the PWd corresponding to {$\underline{\text{wan}_{give}}$-$\underline{Ø_{act}}$-la$_{caus}$-(i)t$_{rec}$}$_{X0b}$ does not contain all the output segments [wanlat]. MATCHWORD(All) looks at both the X_0s of a biphasal input—the inner X_{0a} and the outer X_{0b}—and evaluates whether all their exponent segments are contained in a corresponding PWd. For the inner X_{0a}, MATCHWORD(All) is violated by a free clitic (28a) and an internal clitic (28b) whose single PWds do not correspond to the X_{0a}.

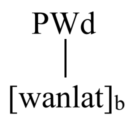
(27) {$\underline{\text{wan}_{give}}$-$\underline{Ø_{act}}$}$_{X0}$, {$\underline{\text{wan}_{give}}$ -$\underline{Ø_{act}}$-la$_{caus}$-(i)t$_{rec}$}$_{X0}$

(28) Outputs Violating MATCHWORD(All) for X_{0a}: all of [wan] not contained in PWd_a

a. Free Clitic:



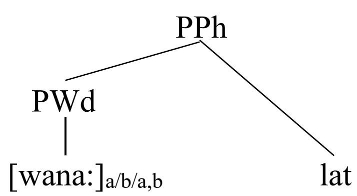
b. Internal Clitic:



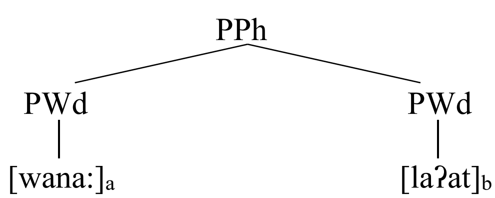
For the outer X_{0b}, MATCHWORD(All) is violated by all free clitics, no matter which X_0 their single PWd [wana:] corresponds to (29a); a PWd clitic with the second PWd_b [laʔat] (29b); and an internal clitic whose single PWd does not correspond to the X_{0b} (29c).

(29) Outputs Violating MATCHWORD(All) for X_{0b}: all of [wanlat] not contained in PWd_b

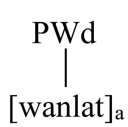
a. Free Clitic:



b. PWd Clitic:

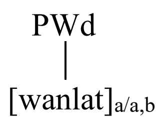


c. Internal Clitic:



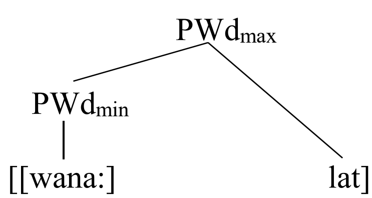
MATCHWORD(Only) penalizes outputs in which a PWd dominates an output exponent of a morpheme from a different X_0. For example, with the biphasal input (27), MATCHWORD(Only) is violated by an output where the PWd corresponding to $\{\underline{\text{wan}_{\text{give}}}\text{-}\underline{\text{Ø}_{\text{act}}}\}_{X0a}$ contains output segments [lat], which are not exponents of the morphemes in X_{0a}. For the inner X_{0a}, MATCHWORD(Only) is violated by internal clitics whose single PWds correspond to the smaller X_{0a} (30).

(30) Output Violating MATCHWORD(Only) for X_{0a}: part of [lat] contained in PWd_a
Internal Clitic:

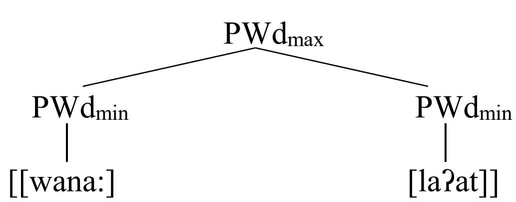


Several outputs with at least two PWds satisfy both MATCHWORD constraints. In these outputs, the PWd corresponding to the smaller X_{0a} contains exactly [wan] (not counting epenthetic segments), satisfying MATCHWORD(All), and the PWd corresponding to the bigger X_{0b} contains exactly [wanlat], satisfying MATCHWORD(Only). Such outputs include recursive PWds, with either one (31a) or two (31b) PWd_{min}s.

(31) Outputs Satisfying MATCHWORD Constraints
a. Recursive PWd = Affixal Clitic



b. Two Recursive PWds



4.4. Typology

The three types of constraints detailed above—morphological exponence, prosodic well-formedness and syntax-prosody mapping—evaluate the possible output representations corresponding to a multiphasal input representation. In this section, I compute the basic factorial typology that results from taking a multiphasal input representation and evaluating possible outputs with every possible ranking of these constraints. The tableau (32) shows the possible outputs of a multiphasal input, and the constraints which each output violates.

(32) Violation Tableau of Prosodic Structures

{wan$_{give}$-Ø$_{act}$}$_{X0a}$, {wan$_{give}$-Ø$_{act}$-la$_{caus}$-(i)t$_{rec}$}$_{X0b}$			MATCH WORD (All)	MATCH WORD (Only)	NON RECURSIVITY	EQUAL SISTERS	EXHAUSTIVITY	INTEGRITY-M
a.	[wana:]$_{PWda}$ lat	Free Clitics	6			1	1	
b.	[wana:]$_{PWdb}$ lat		6			1	1	
c.	[wana:]$_{PWda,b}$ lat		3			1	1	
d.	[wanlat]$_{PWda}$	Internal Clitics	6	3				
e.	[wanlat]$_{PWdb}$		3					
f.	[wanlat]$_{PWda,b}$			3				
g.	[wana:]$_{PWda}$ [laʔat]$_{PWdb}$		3					
h.	[[wana:]$_{PWda}$ [laʔat]$_{PWd}$]$_{PWdb}$				2			
i.	[[wana:]$_{PWda}$ lat]$_{PWdb}$				1	1		
j.	[wana:]$_{PWda}$ [wanlat]$_{PWdb}$							1
k.	[[wana:]$_{PWda}$ [wanlat]$_{PWd}$]$_{PWdb}$				2			1

Five of the candidates in (32) are harmonically bounded by another candidate: the free clitics (32a-c), the internal clitic (32d) and the recursive form with two morphs of the root (32k). The free clitic forms and one internal clitic (32a-d) are harmonically bounded by another internal clitic (32e) and the PWd clitic (32g). All these forms violate MATCHWORD(All), but the internal clitics (32a-c) also violate NONRECURSIVITY for the minimal PWd and EXHAUSTIVITY for the cliticized material, while (32d) also violates MATCHWORD(Only). (32j) harmonically bounds (32k): (32j-k) both violate INTEGRITY-M for multiple output morphs of the identical morpheme {wan_{give}}, but (32k) violates NONRECURSIVITY in addition. The internal clitic (32e) and the PWd clitic (32g) appear to have identical violation profiles of these constraints. I suggest that the internal clitic (32e), which does not have a PWd_a corresponding to the X_{0a}, may also violate a simple version of MATCHWORD that demands every X_0 have a corresponding PWd. The PWd clitic (32g) would not violate this constraint, so I assume that a grammar with MATCHWORD(All) at the bottom will selected the PWd clitic, not the internal clitic. I leave a fuller analysis to future research.

All of the five other outputs (32f-i) can be chosen by a particular ranking of the relevant constraints. Using the software OT-Help 2 (Staubs et al. 2010), I have confirmed this and calculated the different rankings that choose each of the outputs (32f-i) for the multiphasal input (32). The constraint MATCHWORD(Only) is only violated by a harmonically bounded candidate, so I omit it from the typological discussion below. The typology generated by the possible rankings of the constraints above predicts that (32f-i) are possible output representations in natural language. If so, we expect to find each of these five outputs attested in various languages.

I now survey each of the possible outputs and give examples of languages instantiating them. In order for a language to be relevant, it must have multiphasal verbs with input representations similar to (32). If it does, the prosodic structure of the output multiphasal verbs must be determined as well. Since both the phasal and the prosodic structure of verbs is unclear for many languages, I make the following assumptions to figure out their structure in the absence of previous analysis. A verb is multiphasal if it contains a v_2 affix, which include syntactic causatives and viewpoint aspect. Morphemes lower than the highest v_2 affix in the verb have lower copies in the X_0 spelled out at the first phase (33a), while the highest v_2 affix and any higher morphemes only have a single copy, in the X_0 spelled out at the second phase (33b).

(33) Multiphasal Input:

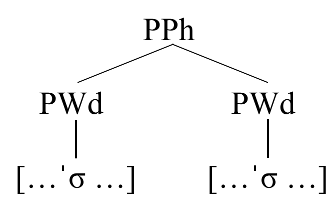
a. First X_0: $\{\text{Root-}v_1\text{-}\ldots\}_{X0}$

b. Second X_0: $\{\text{Root-}v_1\text{-}\ldots\text{-}v_2\text{-}\ldots\}_{X0}$

Figuring out the PWd structure of an output representation requires looking for phonological domains that could reasonably be PWd-sized. These could be domains for, e.g., stress assignment or long-distance harmony. Stress is typically culminative in a PWd, i.e., a PWd should have a single primary stress. Multiple primary stresses are then diagnostic of multiple, non-overlapping PWds. For example, a PWd clitic form with consecutive PWds could look like (34a), with each PWd having a single primary stress. Multiple primary stresses in a multiphasal verb would thus be diagnostic for consecutive PWds. An affixal clitic form with a recursive PWd, on the other hand, might look like (34b), with a single primary stress. The presence of an internal PWd_{min} could come from the position of primary stress, like in Creek, or an internal domain for a requirement normally made on PWds, e.g., minimality, like in Chukchansi.

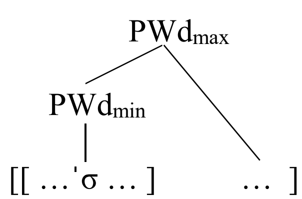
(34) Prosodic Structure of Output:

a. Consecutive PWds = PWd Clitic



e.g., $[\text{piˈré}]_{PWd}$ $[\text{xaˈtí}]_{PWd}$

b. Recursive PWd = Affixal Clitic



e.g., $[[\text{(leˈhe:)}]_{PWd}\ \text{met}]_{PWd}$

I now look at each of the output prosodic structures from (32f-i), and illustrate them with languages where they are attested.

4.4.1. Recursive PWd = Affixal Clitic

An output with a recursive PWd (32i), an affixal clitic in Selkirk (1995), is attested in Chukchansi (Chapter Two) and Creek (Chapter Three). Multiphasal inputs in Chukchansi (35a) and Creek (36a) result in recursive PWd outputs (35b) and (36b), respectively; the PWd structure determines the stress patterns of the outputs.

(35) Chukchansi
  a. Input: {$\underline{\text{wan}_{\text{give}}}$-$\underline{\text{Ø}_{\text{act}}}$}$_{\text{X0}}$, {$\underline{\text{wan}_{\text{give}}}$-$\underline{\text{Ø}_{\text{act}}}$-$\text{la}_{\text{caus}}$-$\text{t}_{\text{rec}}$}$_{\text{X0}}$
  b. Output: [[(wa.na:)]$_{\text{PWd}}$ lat]$_{\text{PWd}}$ "just made X give"

(36) Creek
  a. Input: {$\underline{\text{wana}_{\text{tie}}}$-$\underline{\text{y}_{\text{trans}}}$}$_{\text{X0}}$, {$\underline{\text{wana}_{\text{tie}}}$-$\underline{\text{y}_{\text{trans}}}$-$^{\text{HL}}{}_{\text{result}}$-$\text{is}_{\text{indic}}$}$_{\text{X0}}$
  b. Output: [[(wa.na:$^{\text{HL}}$)]$_{\text{PWd}}$ yis]$_{\text{PWd}}$ "s/he has tied it"

Cupeño (Uto-Aztecan: California) and Ojibwe (Algonquian: Eastern Canada) also map multiphasal inputs to a recursive PWd (Newell 2008, Newell and Piggott 2014). (37) presents the ranking of constraints in a language in which a multiphasal input is mapped to a recursive PWd output. The two MATCHWORD constraints and INTEGRITY-M must dominate NONRECURSIVITY, so that the recursive winner is preferred to non-recursive challengers. NONRECURSIVITY must in turn dominate EQUALSISTERS in order to select the winner with a single minimal PWd over the challenger with two minimal PWds.

(37) Recursive PWd = Affixal Clitic[14]

Input	Winner	Challengers	MWd (All)	MWd (Only)	Int-M	Non Rec	Eq Sis
{<u>wan</u>}$_{X0}$, {<u>wan</u>-la-t}$_{X0}$	[[wana:]$_{PWd}$ lat]$_{PWd}$	[[wana:]$_{PWd}$ [laʔat]$_{PWd}$]$_{PWd}$				2 W	1 L
		[wana:]$_{PWd}$ [wanlat]$_{PWd}$			1 W	1 L	1 L
		[wanlat]$_{PWd}$		1 W		1 L	1 L
		[wana:]$_{PWd}$ [laʔat]$_{PWd}$	1 W			1 L	1 L

4.4.2. Single PWd = Internal Clitic

Single PWd or internal clitic outputs of multiphasal verbs are attested in many languages. In such a language, a multiphasal verb (with a v_2 affix) has the same prosodic structure as a monophasal verb (without a v_2 affix). There is no special prosodic signaling of verbs with syntactic causative or viewpoint aspect (v_2) affixes. For example, Standard Western Armenian (Indo-European: SW Asia) and Saisiyat (Austronesian: Taiwan) have the syntactic causative affixes /-atsn/ and /pak-/, respectively, which I assume are v_2 affixes (38-39). Neither /-atsn/ nor /pak-/ affect the prosodic structure of the verb: in forms both with the v_2 affixes (38b-39b) and without (38c-39c), there is a single, PWd-final stress, which is regular in both Armenian and Saisiyat. If the Armenian biphasal verb had an internal PWd domain corresponding to the lower X_0 in (38b), ['jerk], it would have stress in addition to the PWd_{max}-final stress. Moreover, since the [j] in ['jerk] would be in PWd-initial position, it would surface, as the PWd-initial [j] does in (38d). The attested form (38b) only has a stress on the PWd_{max}-final syllable, and the [j] does not surface.

(38) Standard Western Armenian: Biphasal Input → Single PWd
- a. Input: {<u>jerk$_{sing}$</u>-<u>Ø$_v$</u>}, {g$_{indic}$-<u>jerk$_{sing}$</u>-<u>Ø$_v$</u>-atsn$_{caus}$-e$_{them}$-m$_{1Sg}$}
- b. Output: [ger.kats.'nem]$_{PWd}$ "I make X sing"
- c. Verb without v_2: [ger.'kem]$_{PWd}$ "I sing"
- d. Verb without v_2: [jer.'kem]$_{PWd}$ "let me sing"

[14] Every PWd in each candidate in this tableau has been augmented to disyllabicity.

(39) Saisiyat: Biphasal Input → Single PWd[15]

a. Input: {θiʔæl$_{\text{eat}}$-Ø$_{\text{act}}$}$_{\text{X0}}$, {m$_{\text{ActorFocus}}$-pak$_{\text{caus}}$-θiʔæl$_{\text{eat}}$-Ø$_{\text{act}}$}$_{\text{X0}}$
b. Output: [mak.θi.'ʔæl]$_{\text{PWd}}$ "make X eat"
c. Verb without v_2: [θi.'ʔæl]$_{\text{PWd}}$ "eat"

(personal fieldwork)

(40) demonstrates the constraint ranking in a language with a single PWd. Since the winning output violates MATCHWORD(Only), the constraints MATCHWORD(All), INTEGRITY-M, EQUALSISTERS and NONRECURSIVITY must dominate MATCHWORD(Only). [mak-] in (39b) and (40) is a portmanteau prefix of the prefixes /m-/ and /pak-/ from the second, TP phase.

(40) Single PWd = Internal Clitic

Input	Winner	Challengers	MWD (All)	INT-M	EQ SIS	NON REC	MWD (Only)
{θiʔæl}$_{\text{X0}}$, {m-pak-θiʔæl}$_{\text{X0}}$	[mak.θi.'ʔæl]$_{\text{PWd}}$	[[mak]$_{\text{PWd}}$ [θi.'ʔæl]$_{\text{PWd}}$]$_{\text{PWd}}$				2 W	1 L
		[mak [θi.'ʔæl]$_{\text{PWd}}$]$_{\text{PWd}}$			1 W	1 W	1 L
		[mak.θi.'ʔæl]$_{\text{PWd}}$ [θi.'ʔæl]$_{\text{PWd}}$		1 W			1 L
		[mak]$_{\text{PWd}}$ [θi.'ʔæl]$_{\text{PWd}}$	1 W				1 L

4.4.3. Two Recursive PWds

It is difficult to tell apart outputs with two recursive PWds (32h, repeated as 41a) from outputs with two consecutive PWds (32g, repeated as 41b).

(41) Outputs with Two PWds

a. Recursive: [[wana:]$_{\text{PWd}}$ [laʔat]$_{\text{PWd}}$]$_{\text{PWd}}$
b. Non-Recursive: [wana:]$_{\text{PWd}}$ [laʔat]$_{\text{PWd}}$

[15] The stress pattern in (39) is also compatible with a recursive, non-consecutive PWd analysis: [mak [θi'ʔæl]]. In the absence of positive evidence for PWd recursion, I assume the single PWd analysis.

In order to do so, one must determine whether the entire output is a single PWd_{max} distinct from the two smaller PWds. In both cases, the first phase morphological material (verbalized root and any affixes below the highest v_2) forms its own PWd, while the morphological material only in the second phase (the highest v_2 and any higher affixes in T) forms its own PWd as well. Languages with two consecutive PWds in a multiphasal verb include Turkish (Turkic: SW Asia) and Purépecha (Isolate: West Central Mexico). The consecutive PWds in Turkish form a recursive structure in which both PWds are dominated by a maximal PWd. On the other hand, there is no evidence in Purépecha for the presence of recursion and a maximal PWd, as demonstrated in §4.4.3.

In Turkish (Newell 2008, building on Kornfilt 1996), biphasal verbs have two stress domains, i.e., PWds: the first including the verbalized root and a participial suffix, and the second including a copula with tense and agreement suffixes. I follow Newell (2008) in analyzing the copula in these constructions as a little *v* phase head, more precisely a v_2 according to the criteria in Chapter One. The copular v_2 spells out the material it merges with, the verb root and a participial suffix with aspectual information. This early-spelled-out material forms a PWd, while the higher material only spelled out at a later phase forms another PWd; as I argue below, the entire biphasal verb also composes a maximal PWd (42). Turkish also has monophasal verbs in which no aspectual or copular suffix (i.e., v_2 phase head) appears; monophasal verbs consist of a single PWd (43).

(42) Biphasal Input → Recursive, Consecutive PWds
  a. Input: $\{\underline{\text{gid}}_{\text{go}}\text{-}\underline{\text{ecek}}_{\text{fut}}\}_{\text{X0}}$, $\{\underline{\text{gid}}_{\text{go}}\text{-}\underline{\text{ecek}}_{\text{fut}}\text{-}\underline{\text{i}}_{\text{cop}}\text{-ti}_{\text{past}}\text{-m}_{\text{1sg}}\}_{\text{X0}}$
  b. Output: $[[\text{gidecék}]_{\text{PWd}}\ [\text{tim}]_{\text{PWd}}]_{\text{PWd}}$ “I would have gone”

(43) Monophasal Input → Single PWd
  a. Input: $\{\text{gid}_{\text{go}}\text{- ti}_{\text{past}}\text{-m}_{\text{1sg}}\}_{\text{X0}}$
  b. Output: $[\text{gittím}]_{\text{PWd}}$ “I went”

(adapted from Newell 2008)

I argue that the output in (42) has two PWd_{min}s and that they are in a recursive structure with a PWd_{max}. The evidence for two PWd_{min}s comes from "slow formal speech," in which the two PWds are "pronounced separately … with main stress on [each] final syllable" (Newell 2008:75). This is only possible if the material only in the second phase, [tim], forms its own PWd. In languages with one recursive PWd, the affixal clitic outside the minimal PWd is never pronounced as its own PWd, even in the slowest, most careful speech. For example, in Chukchansi, the affixal clitic [lat] in (44) can never be pronounced separately from the minimal PWd [(wa.na:)].

(44) Affixal Clitics never Split in Careful Speech
[[(wa.na:)]$_{PWd}$ lat]$_{PWd}$; *[(wa.na:)]$_{PWd}$ [lat]$_{PWd}$

PWd recursion is shown by vowel harmony, whose domain must includes material from both minimal PWds. For example, in (42), the past tense suffix /ti/ is underlyingly unspecified for height and rounding /tI/, like most suffixes in Turkish, and can surface as [ti], [ty], [tɯ] or [tu], depending on the root vowel. Even when /tI/ is parsed into a different PWd_{min} than the root, it harmonizes with the root vowel, e.g., it surfaces as [ti] in (42b) in harmony with the underlying [i] in the root [gid]. The domain of vowel harmony in Turkish must be a maximal PWd containing both minimal PWds, since harmony does not apply to other elements in a PPh.

(45) demonstrates the constraint ranking in a language with two recursive PWds. Since the winning output violates NONRECURSIVITY twice, more than any other candidate, both MATCHWORD constraints, INTEGRITY-M and EQUALSISTERS must dominate NONRECURSIVITY.

(45) Two Recursive PWds

Input	Winner	Challengers	MWd (All)	MWd (Only)	Int-M	Eq Sis	Non Rec
{gid-ecek}$_{X0}$, {gid-ecek-i-ti-m}$_{X0}$	[[gidecék]$_{PWd}$ [tim]$_{PWd}$]$_{PWd}$	[[gidecék]$_{PWd}$ tim]$_{PWd}$				W	L
		[gidecék]$_{PWd}$ [gidecektím]$_{PWd}$			W		L
		[gidecektím]$_{PWd}$		W			L
		[gidecék]$_{PWd}$ [tím]$_{PWd}$	W				L

4.4.4. Two Consecutive PWds = PWd Clitic

Some languages with two consecutive PWd do not appear to have PWd recursion with a higher PWd$_{max}$. Purépecha (or P'urhépecha) has a two-way contrast between verbs with the progressive aspectual suffix and those without it (Pérez 2006). Verbs with the progressive suffix /-xa/ have two stress domains, one consisting of the root and other material before the progressive and the other consisting of the progressive and following suffixes. Pérez (2006) shows that stress domains in Purépecha have a single stress on the peninitial syllable. Verbs without the progressive suffix have only a single stress domain. I interpret these data as follows: the progressive aspectual suffix /-xa/ is a v_2 phase head, and each stress domain is a PWd (Eric Zyman, p.c.). Because Progressive verbs are biphasal and have consecutive PWds (46), while non-progressive verbs are monophasal and consist of a single PWd (47). There is no evidence for PWd recursion in Purépecha, since the two stresses in (46) are equally prominent. Prosodic recursion typically results in different levels of prominence in the minimal prosodic units (Itô and Mester 2007, 2009a-b).

(46) Biphasal Input → Consecutive, Non-recursive PWds

a. Input: {pire$_{sing}$}$_{X0}$, {pire$_{sing}$-xa$_{prog}$-Ø$_{pres}$-ti$_{indic+3}$}$_{X0}$

b. Output: [piré]$_{PWd}$ [xatí]$_{PWd}$ "s/he is singing"

(47) Monophasal Input → Single PWd

a. Input: {pire$_{sing}$-sïn$_{pres}$-ti$_{indic+3}$}$_{X0}$

b. Output: [pirésïndí]$_{PWd}$ "s/he sings"

(adapted from Pérez 2006)

In languages like Purépecha that map multiphasal inputs to two consecutive PWds, MATCHWORD(All) is only violated by the winner and must be ranked below the other constraints: NONRECURSIVITY, MATCHWORD(Only), EQUALSISTERS and INTEGRITY-M (48).

(48) Two Consecutive PWds = PWd Clitic

Input	Winner	Challengers	MWD (Only)	INT-M	EQ SIS	NON REC	MWD (All)
{pire}$_{X0}$, {pire-xa-ti}$_{X0}$	[piré]$_{PWd}$ [xatí]$_{PWd}$	[[piré]$_{PWd}$[xatí]$_{PWd}$]$_{PWd}$				2 W	1 L
		[[piré]$_{PWd}$ xati]$_{PWd}$			1 W	1 W	1 L
		[piré]$_{PWd}$ [piréxati]$_{PWd}$		1 W			1 L
		[piréxati]$_{PWd}$	1 W				1 L

Free reranking of the constraints in §4.2.2-4.3 predicts the typology of languages in (49); the languages (49a-d) are attested.

(49) Predicted vs. Attested Typology

Output Prosodic Structure	Attested Languages
a. Single Recursive PWds = Affixal Clitic [[wana:]$_{PWd}$ lat]$_{PWd}$	Chukchansi, Creek, Cupeño, Ojibwe
b. Single PWd = Internal Clitic [mak.θi.'ʔæl]$_{PWd}$	Armenian, Saisiyat
c. Two Recursive PWds [[gidecék]$_{PWd}$ [tim]$_{PWd}$]$_{PWd}$	Turkish
d. Two Consecutive PWds = PWd Clitic [piré]$_{PWd}$ [xatí]$_{PWd}$	Purépecha
e. Multiple Morphs [Root-v_1]$_{PWd}$ [Root-v_1-v_2-T]$_{PWd}$	???

§4.5.1 below investigates why the predicted language (49e) with multiple morphs corresponding to identical copies of a morpheme does not seem to be attested.

4.5. Issues for the Typology

This chapter has investigated the typology generated by the cyclic syntax-parallel phonology model adopted and defended in this dissertation. §4.4 has shown that this typology is at the very least reasonable; most of the possibilities predicted are attested. This section explores some empirical challenges for the typology, and puts forward possible avenues for meeting these challenges while retaining the fundamental structure of model. These challenges include outputs of multiphasal verbs that are predicted by the typology but seemingly not attested, such as verbal resumption (§4.5.1), and outputs that are not predicted by the typology but seemingly attested, such as morphemes that each form their own internal PWd_{min} (§4.5.2). This section suggests that all these issues are likely amenable to a solution in the cyclic syntax-parallel phonology model.

4.5.1. Multiple Morphs = Verbal Resumption

A major question for the typology investigated in §4.4 is the prediction of outputs with multiple morphs of the same morpheme, i.e., repetition of the first phase verb material consisting of the verbalized root (Root+v_1) and any morphemes lower than the v_2 phase head. An output with multiple morphs of the same morpheme violates INTEGRITY-M; therefore, if INTEGRITY-M is ranked the lowest of the relevant constraints, this output should surface. For example, an input-output pair like (50), repeated from (16b), violates INTEGRITY-M because the output (50b) has two morphs [wan] corresponding to the identical copies of the root ‘give’, which cumulatively count as a single morpheme.

(50) Multiphasal Input → Multiple Morphs

a. Input: X_0 X_0

Morphemes: ‘give’$_{i,a}$-ACT$_{j,b}$ ‘give’$_{i,a}$-ACT$_{j,b}$-CAUS$_c$-REC$_d$

Morphs: wan$_a$ - Ø$_b$ - la$_c$ - t$_d$

b. Output: [wana:$_a$ Ø$_b$]$_{PWd}$ [wan$_a$ Ø$_b$ la$_c$ t$_d$]$_{PWd}$

In the input (50a), there is only one morpheme and one morph each of the root and v_1, with identical copies counting as a single morpheme (§4.2.2). However, there are two distinct X_0s in the input, each containing a copy of the root and v_1 morphemes. Adherence to MATCHWORD requires that the PWds matching each X_0 dominate all the output phonological material belonging to the morphemes in that X_0. Therefore in order to satisfy MATCHWORD, each PWd must dominate the output morphs of the root, without overmatching or undermatching. The output in (50b) does so while satisfying prosodic well-formedness constraints: it has consecutive, non-recursive PWds, satisfying NONRECURSIVITY and EQUALSISTERS, and does not have PWd-external material directly dominated by a PPh, satisfying EXHAUSTIVITY. Multiple morphs of the same morpheme are predicted to occur in a language where INTEGRITY-M is ranked below all the other constraints relevant to multiphasal inputs (51).

(51) Verbal Resumption: INTEGRITY-M Lowest Ranked

Input	Winner	Challengers	MWD (All)	MWD (Only)	EQ SIS	NON REC	INT-M
{wan}X0, {wan-la-t}X0	[wana:]PWd [wanlat]PWd	[[wana:]PWd [laʔat]PWd]PWd				2 W	1 L
		[[wana:]PWd lat]PWd			1 W	1 W	1 L
		[wanlat]PWd		1 W			1 L
		[wana:]PWd [laʔat]PWd	1 W				1 L

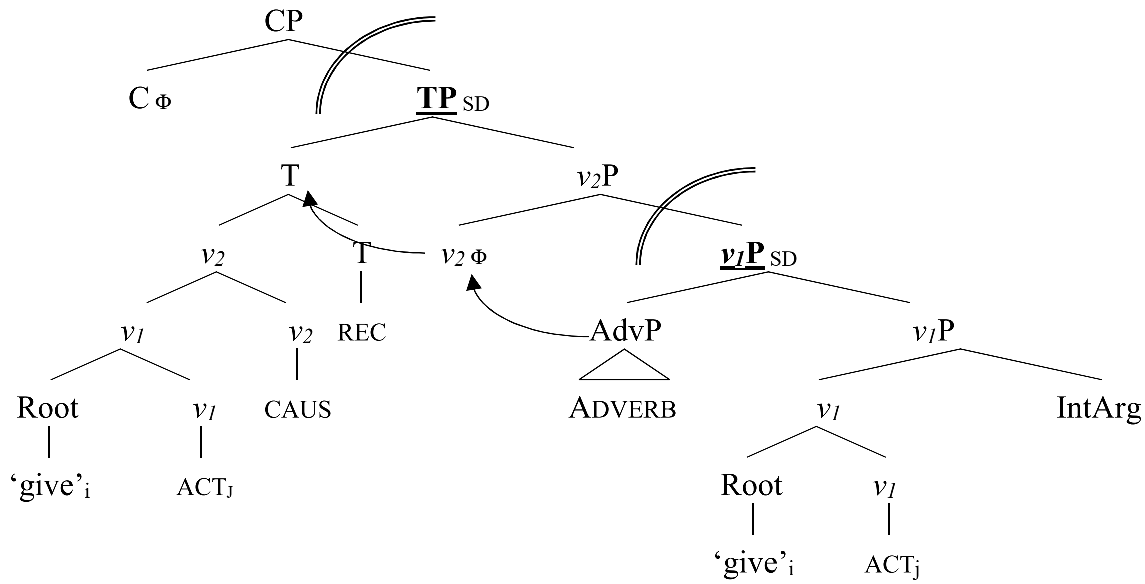
I now clarify why I call an output with multiple morphs of the same morpheme **verbal resumption**. The smaller PWd in (50) dominating only the morphs of the verbalized root is matched to the lower X_0 in v_IP. This PWd would thus be expected to be in a linear position associated with the lower position of the X_0 in the clausal hierarchy. The pronunciation of the verbalized root PWd in the linear position associated with v_IP would give the appearance of resumption, as this PWd's phonological material is a repetition of the verbalized root within the other PWd at a different position in the sentence. This is similar to the phenomenon of resumptive pronouns, in which a full DP is resumed by a coindexed pronoun in a different position, e.g,. a relative clause, in which no overt pronoun is expected to appear ((52), with the full DP and resumptive pronoun highlighted).

(52) ?Here is **the neurosurgeon** who I met **her** yesterday.

A hypothetical example of verbal resumption is as follows. In the syntax of a multiphasal verb with an AdvP adjoined to v_IP, the adverb intervenes between the heads T and v_I (53a). Assuming the linear position of elements is automatically calculated based on their hierarchical positions in the syntax, the adverb will be linearized in between the lower X_0 in v_IP and the higher X_0 in TP (53b). If both morphs corresponding to the morphosyntactic copies in the two X_0s are present in the output, the morph in the lower PWd will be to the right of the adverb, in a different linear position than the PWd with all the verbal suffixes added, which is to the left of the adverb.

(53) Multiphasal Verb with v_1P-Adverb

a. Hierarchical Positions:



b. Linear Positions: [‘give’-ACT$_j$-CAUS-REC ADVERB ‘give’-ACT$_j$]

The resulting lower copy pronunciation of first phase material would constitute a case of verbal resumption, similar to resumptive pronouns and other function words. This contrasts with the case of two consecutive PWds, or a PWd clitic, with a single output morph for each morpheme, like in Purépecha above ((54), repeated from (46)).

(54) $\{\underline{\text{pire}}_{sing}\}_{X0}$, $\{\underline{\text{pire}}_{sing}\text{-xa}_{prog}\text{-Ø}_{pres}\text{-ti}_{indic+3}\}_{X0}$ → $[\text{piré}]_{PWd}\,[\text{xatí}]_{PWd}$

In (54), the first PWd would not necessarily be expected to occupy a different linear positions from the second PWd. The verbalized root morph in its own PWd corresponds to both copies of the morphemes in the two distinct X_0s. The linear position of this PWd could be determined in one of two ways: either by the syntactic position of the higher copy in the higher X_0, assuming the higher copy has priority over the lower, or by the syntactic position of the lower X_0 that is matched to the PWd. It is conceivable that different languages could choose either the lower or higher syntactic position to determine the linear order of the verbalized root PWd in a PWd clitic structure like (54). However, in verbal resumption, the verbalized root PWd will always have the linear position associated with the lower X_0.

I have not found any attested cases of verbal resumption like (53b). A qualifying case would have two instances of the verbalized root morphology pronounced at different places in the sentence. The verbalized root would be in two different PWds, one with tense and aspect morphology affixed and the other without. As far as I am aware, no such case exists in natural language. Reduplication of the verbalized root might seem to constitute a case of verbal resumption, since there are typically two phonologically identical morphs, the Base and the Reduplicant, such as in examples from Chukchansi (55a) and Saisiyat (55b) (both from personal fieldwork).

(55) Reduplication = Identical Morphs

a. /RED wan hil/ → [wan.wan.hil]
REP 'give' MID
"kept giving and giving"

b. /RED liβoʔ Vn/ → [li.βo.li.βo.ʔon]
REP 'mess up' PAT.FOC
"keep messing up" (patient focus)

Reduplication is different from verbal resumption in three ways. First, a Reduplicant is affixed to its Base, and they are often in the same PWd. For example, in (55), the Reduplicant is in the same PWd as the Base. In verbal resumption, however, the two identical morphs of the first phase material are in separate PWds and can be linearized in different positions. Second, reduplication very often involves partial copying, not total copying; sometimes this happens with the same reduplicative morphology, like in both Chukchansi (56a) and Saisiyat (56b).

(56) Partial Reduplication

a. /RED gomo:ʧ˺ hil/ → [gom.go.moʧ.hil]
REP 'hug' MID
"kept giving and giving"

b. /RED kiʂka:at -Vn/ → [kiʂ.kiʂ.ka:.a.tan]
REP 'read' PAT.FOC
"keep reading" (patient focus)

Third, and most important, there are major differences between the morphological context of reduplication, on the one hand, and of multiphasal verbs, on the other. Reduplication is typically associated with a specific semantic meaning, e.g., repetitive or progressive aspect. In terms of syntax, reduplication is associated with a head encoding this meaning, i.e., a Reduplicant morpheme. Verbal resumption should not express any meaning, and does not encode a syntactically independent morpheme; instead, it is a by-product of the syntactic derivation.

The lack of resumption of a verbalized root in natural language is possibly related to the fact that **attested resumptive elements are always functional**, e.g., resumptive pronouns. In fact, as far as I am aware, all instances of multiple copy pronunciation (Franks 1998, Bošković and Nunes 2007) involve functional, not lexical elements. As I show below, verbal resumption with a functional element is indeed attested; it is only verbal resumption with a lexical element that does not to my knowledge exist. To capture this asymmetry between the availability of functional versus lexical material for resumption, I posit that GEN, the operation that generates an open number of output candidates from a single input, contains a constraint against multiple copy pronunciation of lexical roots, INTEGRITY-M(Root) ((57); see Urbanczyk 1996 for indexing faithfulness constraints to roots).

(57) INTEGRITY-M(Root): assign one violation mark for any input **lexical root** morpheme-morph pair, including identical copies as a single morpheme, that corresponds to more than one output morph.

Because INTEGRITY-M(Root) is part of GEN and not CON, which evaluates the output candidates, it is never violated. More specifically, output candidates are never created that violate INTEGRITY-M using lexical roots, while output candidates can be created that violate INTEGRITY-M using functional heads, i.e., resumptive elements.

It may appear odd to posit that a more specific version of a general constraint is inviolable but the general constraint itself is not. I suggest that the inclusion of INTEGRITY-M(Root) but not INTEGRITY-M in GEN may be due to the combination of two functional pressures: the tendency of greater faithfulness to roots and the general scarcity of resumption. While INTEGRITY-M is violated in several cases cross-linguistically by the insertion of multiple identical morphs for a single morpheme (Walker and Feng 2004, Wolf 2008), violations do not seem terribly common. This perhaps indicates a strong functional pressure against inserting identical morphs for a single morpheme. This is a separate issue from cases of multiple exponence in which two distinct morphs are inserted for a single morpheme, which is somewhat more common that double insertion of a identical morph. If this functional pressure is even stronger against inserting two identical root morphs for a single root morpheme, violations of INTEGRITY-M(Root) may simply be extremely rare, as opposed to grammatically impossible. I leave this as a matter for future research, especially of an experimental nature.

I have posited that inclusion of INTEGRITY-M(Root) in GEN is responsible for the lack of verbal resumption of a lexical morph in natural language. While resumption of a functional morph does violate the general constraint INTEGRITY-M, this constraint is violable and can be dominated by other constraints. A resumptive output that inserts a functional morph rather than a lexical morph should therefore be attested.

Verbal resumption with a functional morph does seem to be attested, as Kandybowicz (2015) argues for Asante Twi. In Twi, verbs in the simple past tense head-move to T, and thus out of the lower spellout domain AspP (equivalent to v_1P in the model proposed in Chapter One). In all other tenses and aspects, the verb stays in AspP. When the verb head-moves to T and no other material is present in the AspP spellout domain, a semantically vacuous light verb [yɛ] ("'do', 'make', 'be'", Kandybowicz 2015:243) is inserted after the verb (58). [yɛ] cannot be inserted in other contexts, e.g., when an overt Asp morpheme blocks head-movement of the verb to T (59a) or overt material is present in the AspP spellout domain (59b).

(58) Verbal [yɛ]-Insertion in Twi

a. Kofi saa *(yɛ)
Kofi dance.PST *yɛ*
"Kofi danced"

b. Dua no shii *(yɛ)
tree the burn.PST *yɛ*
"The tree burned"

Kandybowicz (2015: 244)

(59) No [yɛ]-Insertion

a. Kofi a-sa (*yɛ)
Kofi PRF-dance *yɛ*
"Kofi has danced"

Kandybowicz (2015: 244)

b. Kofi bɔɔ (*yɛ) Ama (*yɛ)
Kofi kick.PST *yɛ* Ama *yɛ*
"Kofi kicked Ama"

Kandybowicz (2015: 245)

Kandybowicz argues that verbal [yɛ]-insertion is necessary to avoid "prosodic vacuity," or transfer of an empty spellout domain. Indeed, [yɛ] is only inserted when the AspP spellout domain is otherwise empty. Kandybowicz suggests that inserting [yɛ] allows AspP to be matched to a PPh and thus satisfies MATCHPHRASE (Selkirk 2009, 2011). Kandybowicz (2015:267) posits that [yɛ] is an impoverished or default lower copy of the root morpheme spelled out so that the AspP spellout domain can be phonetically realized. In this way, Kandybowicz tacitly assumes what this dissertation makes explicit: lower copies of morphosyntactic material are transferred at earlier phases, and can affect pronunciation. A model of the syntax-phonology interface in which a lower/earlier copy cannot be seen by the phonology cannot accommodate Kandybowicz' analysis.

I suggest that [yɛ] does not violate INTEGRITY-M(Root) because it corresponds to the lower copy of verbalizer v_1 (equivalent to Asp in Kandybowicz' analysis), which is a functional element normally null in Twi (60).[16]

(60) Functional Verbal Resumption in Twi

a. Input: X_0 X_0

Morphemes: 'dance'$_{i,a}$-$v_{1j,b}$ 'dance'$_{i,a}$-$v_{1j,b}$-v_{2c}-PAST$_d$

Morphs: sa$_a$ - [Ø$_b$, yɛ$_b$] - Ø$_c$ - μ$_d$

b. Output: [yɛ$_b$]$_{PWd}$ [sa$_a$ Ø$_b$ Ø$_c$ μ$_d$]$_{PWd}$

Pronunciation of [yɛ] as a lower copy violates the general INTEGRITY-M constraint, which must be dominated by MATCHPHRASE. Inviolable INTEGRITY-M(Root) prevents the lexical root from being pronounced to satisfy MATCHPHRASE; the constraint HEADEDNESS requires a PPh to dominate overt phonological material, and is also inviolable (Nespor and Vogel 1986, Selkirk 1995). (61) shows that these two inviolable constraints together with MATCHPHRASE dominating INTEGRITY-M models the appearance of [yɛ] when there is no other lower phase material present.

[16] Alternatively, as Kandybowicz (2015) suggests, [yɛ] is a impoverished or default functional morph that is late-inserted for the lower copy of the root morpheme in the post-syntactic morphological component of the DM model (Bonet 1991, Halle and Marantz 1993, Marantz 1994, Halle 1997). Because this impoverished/default morph is semantically- and phonologically-blanched, it may be able to escape a violation of INTEGRITY-M(Root). No evidence is available to distinguish which analysis is empirically correct.

(61) Appearance of [yɛ]

a. No Other v_IP Material: [yɛ] Surfaces

{{Kofi}X0 {sa$_{dance}$-Ø,yɛ$_v$-μ$_{past}$}X0}XP {{sa$_{dance}$-Ø,yɛ$_v$}X0}XP	INTEGRITY-M(Root)	HEADEDNESS	MATCH PHRASE	INTEGRITY-M
☞ ([Kofi]$_{PWd}$ [saa]$_{PWd}$)$_{PPh}$ ([yɛ]$_{PWd}$)$_{PPh}$				1
([Kofi]$_{PWd}$ [saa]$_{PWd}$)$_{PPh}$			1 W	L
([Kofi]$_{PWd}$ [saa]$_{PWd}$)$_{PPh}$ (Ø)$_{PPh}$		1 W		L
([Kofi]$_{PWd}$ [saa]$_{PWd}$)$_{PPh}$ ([sa]$_{PWd}$)$_{PPh}$	1 W			1

b. Other v_IP Material Present: No [yɛ]

{{Kofi}X0 {bɔ$_{kick}$-Ø,yɛ$_v$-μ$_{past}$}X0}XP {{bɔ$_{kick}$-Ø,yɛ$_v$}X0 {Ama}X0}XP	INTEGRITY-M(Root)	HEADEDNESS	MATCH PHRASE	INTEGRITY-M
☞ ([Kofi]$_{PWd}$ [bɔɔ]$_{PWd}$)$_{PPh}$ ([Ama]$_{PWd}$)$_{PPh}$				
([Kofi]$_{PWd}$ [bɔɔ]$_{PWd}$)$_{PPh}$ ([yɛ]$_{PWd}$ [Ama]$_{PWd}$)$_{PPh}$				1 W
([Kofi]$_{PWd}$ [bɔɔ]$_{PWd}$)$_{PPh}$ ([bɔ]$_{PWd}$ [Ama]$_{PWd}$)$_{PPh}$	1 W			1

The Twi example suggests that verbal resumption may be attested, as long as the resumptive material is functional, not lexical. Since verbal resumption is predicted by the typology in §4.4 and, more broadly, by the cyclic syntax-parallel phonology model advocated in this dissertation, Twi may be an answer for a potential objection to the typology and the model. More research is still required to see whether there are indeed any cases of verbal resumption involving a lexical element, and thus whether INTEGRITY-M(Root) is a violable constraint.

4.5.2. Morpheme-Sized PWds = Multiple PWd Clitics

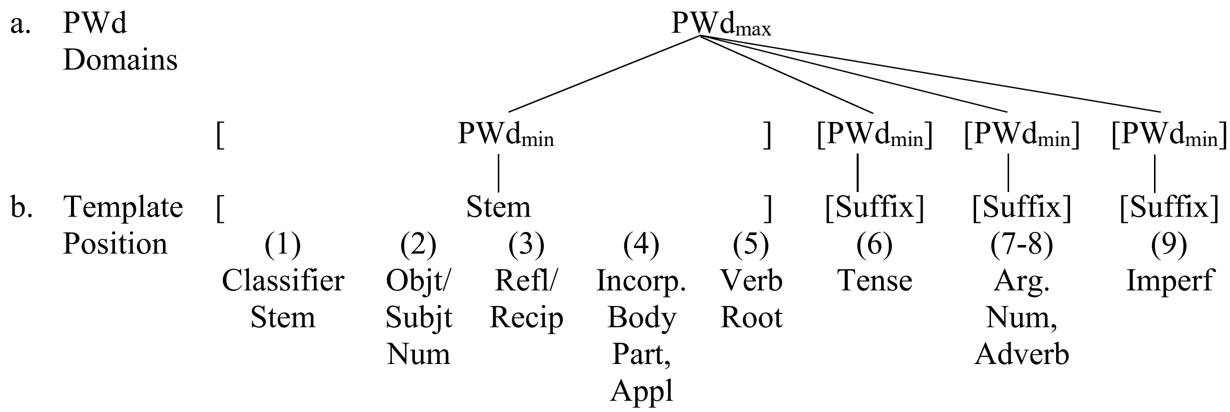
The typology generated in §4.4 also predicts that any PWd should match closely to a spellout domain, with any deviations due to high-ranking phonological constraints. Specifically, a PWd should contain either all the morphological material of a spellout domain, e.g., [lehe:] and [lehe:met] in (62b), or just the morphological material uniquely transferred in a particular spellout domain, e.g., [met] (62c). What is not predicted is internal PWd$_{min}$s matched to individual morphemes in the same spellout domain, e.g., the morpheme-sized PWds [me] and [ʔit] in the TP spellout domain in Chukchansi (62d). (62d) is problematic for the typology because MATCHWORD constraints seek to map all the morphemes of a complex X_0 to a PWd, not just one of the morphemes. The mapping can be sensitive to spellout domains, but not to intermediate X_0s inside a spellout domain.

(62) Spellout Domains and Internal PWd_{min}s

a.	Input: $\{\underline{wan_{give}}\text{-}\underline{Ø_{act}}\}_{X0}, \{\underline{wan_{give}}\text{-}\underline{Ø_{act}}\text{-}la_{caus}\text{-}(i)t_{rec}\}_{X0}$	
b.	Recursive PWd = Affixal Clitic:	$[[wana:]_{PWd}\ lat]_{PWd}$
c.	Consecutive PWds = PWd Clitic:	$[wana:]_{PWd}\ [lat]_{PWd}$
d.	Morpheme-Sized PWds = Multiple PWd Clitics:	$[wana:]_{PWd}\ [la]_{PWd}\ [ʔit]_{PWd}$

However, languages with morpheme-sized PWds do seem to be attested; one such language is Murrinhpatha (Northern Australia; Mansfield 2015, to appear). In Murrinhpatha, the prefixes and the verb root, which Nordlinger (2010) calls the Stem, form a single PWd_{min} together. However, each suffix also appears to form its own PWd_{min}. The Stem PWd is "built around two core elements" (Mansfield 2015:11). At the left edge of the Stem PWd is a "Classifier Stem," which inflects for person, number and tense, and typically "modifies the motion vector, transitivity or Aktionsart" of the verb (Mansfield 2015:11). At the right edge is a "Lexical Stem" or verb root, which carries the root meeting of the verb. Optional pronominal and argument structure prefixes and incorporated nouns referring to body parts can come between these elements. Suffixes encode tense, argument number, adverbial elements and imperfective aspect; Mansfield (2015) considers the imperfect marker, which can be one of seven different light verbs, to be a serial verb element (63).

(63) Prosodic Domains in the Murrinhpatha verb template



Mansfield 2015, following Nordlinger 2010

I assume that the morphological material of the Stem originates in the first, v_1P spellout domain, since it encodes event and argument structure (64). The suffix material is higher, originating within the second, TP spellout domain, as it encodes tense and viewpoint aspect. There does not, however, seem to be a reason governing the appearance of some agreement marker in the Stem (position (2) in (63)) and others outside (positions (7-8)); Mansfield (2015) suggests this is because the Murrinhpatha verb has formed diachronically from two separate verbs.

(64) Spellout Domains in Murrinhpatha Verb

a. v_1P: {Class.Stem-…-Verb Root}$_{X0}$

b. TP: {Class.Stem-…-Verb Root-Tense-Arg.Num/Adverb-Imperf}$_{X0}$

The main evidence for Murrinhpatha suffixes forming their own PWds comes from variable ordering of the tense suffixes. For example, the past tense morph /-d̠a/ can suffix to right of any of the PWd$_{min}$s in (63): the Stem PWd$_{min}$ (65a), the argument number PWd$_{min}$ (65b), and the imperfective PWd$_{min}$ (65c).

(65) Variable Ordering of Tense Suffix

a.

[[puɖene	jitʲ]$_{PWd}$	**[d̪a]$_{PWd}$**	[nime]$_{PWd}$	=[paɖi]$_{PWd}$]$_{PWd}$
3PAUC.TURN.PST	'explain'	PST	PAUC.M	=IMPF

"they were explaining it"

b.

[[paɖe	kut]$_{PWd}$	[nime]$_{PWd}$	**[d̪a]$_{PWd}$**	=[paɖi]$_{PWd}$]$_{PWd}$
3PAUC.BE.PST	'collect'	PAUC.M	PST	=IMPF

"they were collecting it"

c.

[[pube	ʈal	ʈal]$_{PWd}$	[nime]$_{PWd}$	=[paɖi]$_{PWd}$	**[d̪a]$_{PWd}$**]$_{PWd}$
3PAUC.BASH.PST	'chop'	RED	PAUC.M	IMPF	PST

"they were chopping (wood)"

modified from Mansfield (2015:4)

Following Bickel et al's (2007) analysis of a similar variable ordering pattern among prefixes in Chintang (Tibeto-Burman), Mansfield (2015) proposes that the variation is an effect of the tense morph attaching to different PWds. In his analysis, the tense morph [d̪a] subcategorizes for a preceding PWd (McCarthy and Prince 1993), but does not specify which PWd it attaches to. [d̪a] may therefore attach to the right edge of the Stem PWd$_{min}$ [puɖene-jitʲ] in (65a), the argument number PWd$_{min}$ [nime] in (65b), or the imperfective PWd$_{min}$ [paɖi] in (65c).

While Mansfield (2015) posits that each suffix forms its own PWd$_{min}$ in addition to the Stem PWd$_{min}$, this is not clear to me, as only the Stem PWd$_{min}$ seems to be a domain for stress assignment or minimality effects. The imperfective marker, which can be one of seven different forms cognate to classifier stems, including [paɖi], does seem to be a PWd$_{min}$: [paɖi] and other imperfective markers can be pronounced with a preceding pause and their own stress, unlike non-PWd affixes such as the classifier Stem [puɖene] or the verb root [jitʲ] in (65a). The tense suffix [d̪a] and the number suffixes, e.g., [nime], on the other hand, do not clearly seem to be their own separate PWds, especially as it attaches to the right edge of another PWd. Evidence for the PWd-hood of the other suffixes could come from the lack of regressive nasal place assimilation of /m/, which Mansfield (2015) argues occurs across morpheme boundaries (66a) but not across PWd boundaries (66b). If this process is blocked between two suffixes, it would constitute evidence that a PWd boundary intervenes between them, and thus that each suffix is a PWd. More data are needed to determine whether assimilation is allowed or blocked in this situation.

(66) Regressive Nasal Place Assimilation

a. /ŋa**m** **d̪**ap/ → [na**n̪d̪**ap]$_{\text{PWd}}$
1SG.POKE 'shut'
"I closed it"

b. /kaɖi kum d̪a/ → [[kaɖikumku**m**]$_{\text{PWd}}$ [**d̪**a]$_{\text{PWd}}$]$_{\text{PWd}}$
3SG.BE.PAST 'swim'+RED PST
"he was swimming"

Assuming that each suffixes is indeed its own PWd, this poses a problem for the typology in §4.4. The attested output with morpheme-sized PWds, like (67b), does actually satisfy both MATCHWORD(All) and MATCHWORD(Only). (67b) satisfies MATCHWORD(All) and MATCHWORD(Only): the PWd_{min} [puɖene-jit^j] dominates all and only the segments of the morphs /puɖene-jit^j/ corresponding to the morphemes of the lower X_0 {3PAUC.TURN.PST-'explain'}, and the PWd_{max} [puɖene-jit^j-d̪a-nime-paɖi] dominates all and only the segments of the morphs /puɖene-jit^j-d̪a-nime-paɖi/ corresponding to the morphemes of the higher X_0 {3PAUC.TURN.PST-'explain'-PST-PAUC.M-IMPF}. The other PWd_{min}s, [d̪a]$_{\text{PWd}}$, [nime]$_{\text{PWd}}$ and [paɖi]$_{\text{PWd}}$, do not violate either MATCHWORD constraint, since the constraints can be satisfied by one PWd matching each X_0. However, (67b) violates NONRECURSIVITY four times, once for each PWd_{min}. (67b) also violates MATCHPWD-X_0(Only) three times, since none of the PWds [d̪a], [nime] or [paɖi] have a unique matching X_0 that only contains the morphemes {PST}, {PAUC.MASC} or {IMPF}, respectively. A hypothetical output with two recursive PWds, i.e., PWds that are not morpheme-sized (67c), also satisfies both MATCHWORD constraints. (67c), however, only violates

NONRECURSIVITY twice, and only violates (67c) once, for the PWd [d̪a-nime-paɖi]. The hypothetical output (67c) thus harmonically bounds the attested output (67b).

(67) Morpheme-Sized PWds in Murrinhpatha

a. Input: X_0 X_0

Morphemes: 3PC.TURN.PST$_{i,a}$-'explain'$_{j,b}$ '3PC.TURN.PST$_{I,a}$-'explain'$_{j,b}$-PST$_c$-PC.M$_d$-IMPF$_e$

Morphs: puɖene$_a$ - jit$^j{}_b$ - d̪a$_c$ - nime$_d$ - paɖi$_e$

b. Morpheme-Sized PWds: [[puɖene-jit^j]$_{PWd}$ [d̪a]$_{PWd}$ [nime]$_{PWd}$ [paɖi]$_{PWd}$]$_{PWd}$

c. Two Recursive PWds: *[[puɖene-jit^j]$_{PWd}$ [d̪a-nime-paɖi]$_{PWd}$]$_{PWd}$

Another constraint is needed to favor the morpheme-sized PWd mapping in (a). Alignment constraints between morphological and phonological categories are one possibility (McCarthy and Prince 1993). Specifically, I posit a constraint ALIGN-R(Suffix, PWd), or ALIGN-SUFFIX, which demands that every suffix be PWd-final; an ANCHOR constraint can do the same work.

(68) ALIGN-R(Suffix, PWd): assign a violation for every suffix whose right edge is not aligned with the right edge of some PWd.

While ALIGN and MATCH constraints are generally seen as competing approaches to syntax-prosody mapping (Selkirk 2009, 2011), this particular ALIGN constraint is not used to create prosodic structure. Rather, this constraint simply demands that suffixes be right-edge tropic. Instead of every suffix competing to be at the right edge of the word and only one being aligned, this constraint can be satisfied completely if every suffix is at the right edge of its own PWd. ALIGN-SUFFIX must dominate NONRECURSIVITY to favor the attested output (67b), in which each suffix is its own PWd, over outputs with one or two recursive PWds (69).

(69) Morpheme-Sized PWds

{puɖene-jitʲ }$_{X0}$, {puɖene-jitʲ-d̪a-nime-paɖi}$_{X0}$	MATCH WORD (All)	ALIGN-SUFFIX	NON RECUR SIVITY	MATCH PWD-X_0 (Only)
☞ [[puɖenejitʲ]$_{PWd}$ [d̪a]$_{PWd}$ [nime]$_{PWd}$ [paɖi]$_{PWd}$]$_{PWd}$			4	3
[[puɖenejitʲ]$_{PWd}$ d̪animepaɖi]$_{PWd}$		2 W	1 L	L
[[puɖenejitʲ]$_{PWd}$ [d̪animepaɖi]$_{PWd}$]$_{PWd}$		2 W	2 L	1 L

Adding ALIGN-SUFFIX and a converse constraint demanding that prefixes be left-edge-tropic, ALIGN-PREFIX, increases the predicted typology of possible output PWd structures. These affixal ALIGN constraints can lead to the creation of PWd boundaries at different morpheme boundaries. Because of this, prefix and suffix alignment constraints weaken the power of the cyclic syntax-parallel phonology model. Instead of making the strong claim that phase-based spellout and MATCHWORD constraints together determine **all** the morphosyntactic influence on PWd structure, a model with morpheme alignment constraints must make the weaker claim that they only determine **some** of the influence. This makes the model harder to falsify, which is unwelcome. I leave to it to future research to determine if morpheme-sized PWds can be modelled without alignment constraints.

4.6. Conclusion

This chapter has explored the wider implications of the cyclic syntax-parallel phonology model proposed and illustrated in the previous chapters. This chapter has made two contributions to the model. First, both the input representations to phonology of multiphasal verbs (§4.2) and the constraints evaluating these verbs (§4.3) have been defined with greater precision. Second, the typology of possible outputs of multiphasal verbs has been generated using these inputs and constraints. The predicted typology closely matches the attested typology of multiphasal verbs

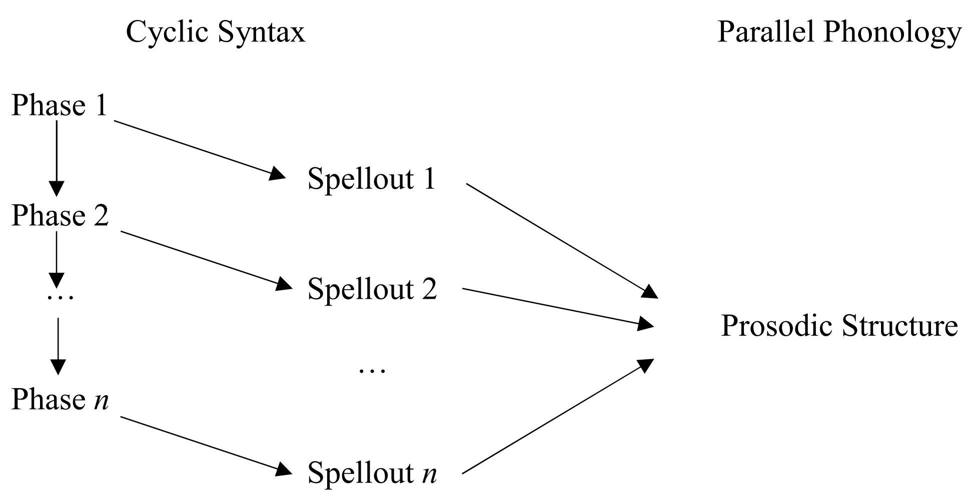
(§4.4). Apparent exceptions to the typology, including verbal resumption and morpheme=PWd correspondence, are likely amenable to an analysis in the cyclic syntax-parallel phonology model (§4.5). Further research can explore these apparent exceptions in more detail to fine-tune the model.

5. Conclusion

5.1. Review of Cyclic Syntax-Parallel Phonology Model

In this dissertation, I investigated the effects of a cyclic, phase-by-phase syntactic derivation of morphologically complex words (e.g., Marantz 2001, 2007, Marvin 2002) on the prosodic structure of those words. The dissertation put forward an answer to the question of what happens in a parallel phonological model like Optimality Theory (Prince and Smolensky 1993/2004) when syntax transfers morphological material to the phonology, i.e., "spells it out," multiple times. Using the Match Theory (Selkirk 2009, 2011) approach to the syntax-prosody interface, PWd recursion (e.g., Itô and Mester 2007, 2009a-b) is an expected result of multiple spellout inside the word in a parallel phonological grammar. PWd recursion resulting from multiple spellout is attested in unrelated languages. Moreover, PWd recursion in these languages provides empirical support for a model (1) of the syntax-phonology interface in which phonology evaluates all the material spelled out over different phases in parallel (Cheng and Downing 2012, 2016).

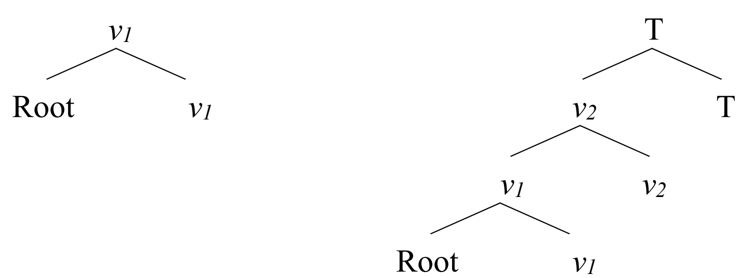
(1) Cyclic Syntax-Parallel Phonology Model



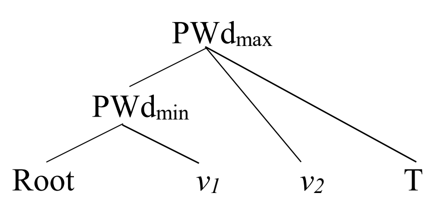
This dissertation investigated the cyclic syntax-parallel phonology model in the empirical domain of morphologically complex verbs with tense, aspectual and mood morphology. I proposed that multiple spellout in morphologically complex verbs results when a higher verbal phase head v_2 appears in the derivation. While the v_2 phase heads in both languages have event semantics, they differ in exactly what event-semantic heads delineate spellout domains: in Chukchansi, v_2 heads are those that create complex events, while in Creek, v_2 heads encode viewpoint aspect. The material in the complement of v_2, including the verbalized root (Root + v_1), is spelled out early as an X_0 at the first phase. Assuming that head movement occurs in the narrow syntax and leaves copies, the verbalized root is also spelled out later at a higher phase as an X_0 together with the heads v_2 and T (2a). In order to match the highest copies of the verbalized root in each spellout domain to distinct PWds while only inserting one exponent, PWd recursion results (2b). The presence of v_2 in the syntax can both induce PWd recursion and determine the extent of morphological material that constitutes the inner PWd_{min}.

(2) PWd Recursion Induced by v_2 Head

a. X_0 One X_0 Two



b.



Chapter Two illustrated the cyclic syntax-parallel phonology model in Chukchansi Yokuts; in Chukchansi, multiple spellout inside the word results in PWd recursion. Chukchansi shows a contrast between biphasal verbs, which have a v_2 phase head, and monophasal verbs, which do not. In biphasal verbs, the verbalized root is spelled out twice, within two separate X_0s (3a), while in monophasal verbs, the verbalized root is only spelled out once (3b). The contrast in spellout between biphasal and monophasal verbs leads to a phonological contrast: the verbalized root in biphasal verbs occupies an internal PWd_{min} in a recursive structure (4a), while monophasal verbs only have a single PWd (4b). Due to a disyllabic minimality requirement on PWds and iambic parsing, the verbalized root appears with an (Lˈ H) foot template (4a). A Stratal OT model (Kiparsky 2000, Bermúdez-Otero 2011, 2013) cannot account for the phonological contrast between biphasal and monophasal verbs without stipulation.

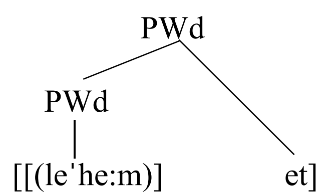
(3) Biphasal Verbs vs. Monophasal Verbs

a. $\{lihm_{Root}\text{-}Ø_{v1}\}_{X0}$, $\{lihm_{Root}\text{-}Ø_{v1}\text{-}e_{v2}\text{-(i)}t_{T}\}_{X0}$

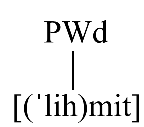
b. $\{lihm_{Root}\text{-}Ø_{v1}\text{-(i)}t_{T}\}_{X0}$

(4) PWd Recursion and (Lˈ H) Template

a.



b.



Chapter Three refined this model with an account of biphasal, PWd-recursive verbs in Creek. I proposed that the domain of regular iambic stress in Creek verbs (Haas 1977, Martin 2011) is a PWd_{min} matched to a lower X_0 spelled out early by a v_2 viewpoint aspect head. The morphological material of lower X_0, however, is **mismatched** to the PWd_{min}: in the general case, it is undermatched to provide an onset (5a), but parsing requirements can force an overmatch (5b).

(5) Creek X_0-PWd Mismatches

a. {hom**p**}$_{X0}$, {homp-ick-ałi:-s}$_{X0}$ → [[(ˈhom)]$_{PWd}$ **p**ic.ka.łi:s]$_{PWd}$

b. {nis}$_{X0}$, {nis-**ic**k-ałi:-s}$_{X0}$ → [[(niˈs**ic**)]$_{PWd}$ ka.łi:s]$_{PWd}$

The v_2 head is encoded by autosegments, which compel lengthening of the vowel they dock onto. Vowel lengthening allows for the preferred undermatch to surface; this can also allow PWd recursion (6a) where it is otherwise blocked, i.e., in the absence of autosegments (6b). On the other hand, the OCP prevents identical autosegments from surfacing next to each other, which can force a larger-than-normal undermatch (6c).

(6) Autosegments and X_0-PWd Mismatches

a. {awanay}$_{X0}$, {awanay-^{HL}-is}$_{X0}$ → [[(aˈwa)(ˈna:^{HL})]$_{PWd}$ **y**is]$_{PWd}$

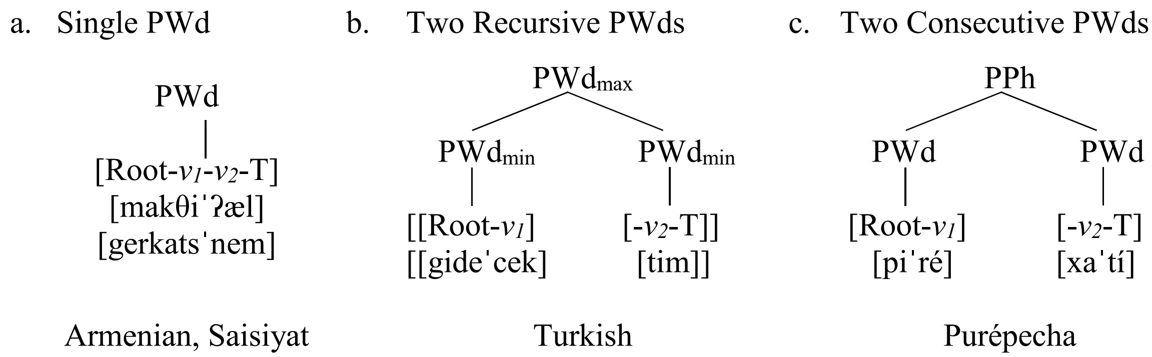
b. {awanay}$_{X0}$, {awanay-as}$_{X0}$ → [(aˈwa)(naˈy**as**)]$_{PWd}$

c. {awanay}$_{X0}$, {awanay-$^{H,\mu}$-is}$_{X0}$ → [[(aˈwa^{H})]$_{PWd}$ **na$^{!H}$y**i$^{!H}$s]$_{PWd}$

The interaction of autosegments and PWd structure showed that (1) autosegmental phonology and the syntax-prosody matching apply in **parallel**, and (2) the combined spellouts of all phases are also evaluated in **parallel**. A phase-based phonological model (Samuels 2010) with a strict Phase Impenetrability Condition (PIC; Chomsky 2000, 2001) cannot account for the Creek mismatches.

Chapter Four looked at the typological implications of the cyclic syntax-parallel phonology model. Reranking of the relevant constraints predicts other effects of multiple spellout on PWd structure beside the PWd recursion in (2): a single PWd (7a), two recursive PWds (7b) and two consecutive PWds (7c). The predicted typology, which is similar to Selkirk's (1995) typology of function words cliticized to lexical words, matches the attested typology closely.

(7) Typology of Prosodic Effects of Multiple Spellout



Chapter Four then examined cases where the predicted typology and attested typology appear to diverge: verbal resumption, which is predicted but not attested, and morpheme-sized PWds, which are attested but not predicted. These cases seem to be amenable to an account under the proposed model with minor additions.

This dissertation made several different contributions to the linguistic enterprise. First, complex empirical patterns of verbal morphophonology in Chukchansi and Creek were given straightforward accounts appealing to general properties of the syntax-phonology interface, rather than stipulating language-particular morphological idiosyncrasies. Second, further empirical support was provided for several existing proposals, including phase-by-phase derivation of words (Marvin 2002, Newell 2008), Match Theory (Selkirk 2009, 2011), recursion of PWds (Itô and Mester 2007, 2009a-b, 2012), phase extension (den Dikken 2007, Gallego 2010, Bošković 2014), and phonological influence on the syntax-phonology mapping (Bošković and Nunes 2007, Wolf 2008, Werle 2009, Elfner 2012, Agbayani, Golston and Ishii 2015, Cheng and Downing 2016, Hsu 2016). In addition, it refined the constraints of Match Theory to more accurately model syntax-prosody mismatches by distinguishing undermatches and overmatches and encouraging minimal mismatches. Third, it put forward a coherent, testable model of syntax-phonology interaction inside the word, similar to Cheng and Downing's (2012, 2016) sentence-level model. This model can be used to investigate existing and novel claims about the influence of morphosyntax on PWd structure; conversely, the model can be tested and refined through examination of more empirical patterns.

5.2. Avenues for Future Research

This dissertation proposed that words spelled out over multiple phases have multiphasal inputs to phonology; phonology then maps these inputs to prosodic structures, including PWd-recursion. This proposal makes two broad predictions. First, spelling out a word over multiple phases should have discernable prosodic effects, subject to a given language's phonology. Secondly, recursive PWd structure in morphologically complex words that is not due to purely phonological factors should be an effect of multiple spellout, setting aside lexical compounding (Itô and Mester 2007). These predictions can therefore be used as diagnostics for both syntactic and prosodic structure within words. If the syntax of a word in a certain language is multiphasal, the prosodic structure predicted by that language's constraint ranking should be present as well. Vice-versa, if a word shows the prosodic structure that results from multiphasal syntax in a given language, the prosodic structure is diagnostic of a word-internal phase head. This is **intermodular argumentation** in the sense of Scheer (2008, 2009): evidence from one module of the language faculty, either phonology or syntax, can be used to adjudicate between structures in the other module in the absence of evidence from within that module.

More specifically, if multiphasal inputs result in PWd recursion in a certain language, then the presence of PWd recursion in a specific morphological context suggests the presence of a word-internal phase head. In the same vein, if it is already established that a specific morpheme is a word-internal phase head, then that morpheme should trigger PWd recursion *modulo* the constraint ranking of a language. The next steps of research continuing this exploration can use the typology of prosodic structures from Chapter Four, especially PWd recursion, as a window into the structure of phasehood inside words. Investigations into phasehood can then be tested by looking for their prosodic effects. There are at least two broad avenues for further research: (1) investigating other cases of PWd-recursive verbs to gain a more precise picture of the phasehood in the verbal domain, and (2) exploring the possibility of multiple phases inside morphologically complex nouns and their effect on prosodic structure.

One place to look for PWd recursion in morphologically complex verbs is non-concatenative, templatic morphology, similar to the (LˈH) template in Chukchansi Yokuts. Outside of the Yokuts languages, there are two language groups with pervasive templatic morphology: Sierra Miwok (Penutian: California) and the Semitic family. Verbs in Southern Sierra Miwok, for instance, have four distinct stem forms (Broadbent 1964). Stem 1 is lexically-specified and is the morphologically default form (Table 1). The other three forms, Stems 2-4, have fixed prosodic templates that are filled by the segmental material of the root and the epenthetic segments [ʔ h ɨ u] if needed. Stems 3 and 4 are always disyllabic, while Stem 2 is disyllabic for most roots. The fact that the prosodic templates are disyllabic suggests that Stems 2-4 are internal PWd_{min}s subject to disyllabic minimality, as in Chukchansi.

Table 1. Templates in Southern Sierra Miwok (adapted from Broadbent 1964: 38)

Stem Form	Stem 1 (Default)	Stem 2	Stem 3	Stem 4
Template Shape	Lexically-specified	(CV)CVC-	CVC:VC-	CVCCV-
‘catch’	[lo:t-]	[lot-]	[lot:uʔ-]	[lotʔu-]
‘come’	[ʔɨn:-]	[ʔɨnɨh-]	[ʔɨn:ɨʔ-]	[ʔɨnʔɨ-]
‘appear’	[lak-h-]	[lakɨh-]	[lak:ɨh-]	[lakhɨ-]
‘bump into’	[kowta-]	[kowat-]	[kow:at-]	[kowta-]
‘ask’	[hasu:l-]	[hasul-]	[has:ul-]	[haslu-]

Bye and Svenonius (2010) argue that the Stem forms in Southern Sierra Miwok are triggered by aspectual morphemes that have autosegmental content, such as floating morae linked to consonant nodes. They propose that the specific forms of the templates arise from the interaction of the autosegmental content with Sierra Miwok phonotactics. Further investigation can reveal whether a PWd-recursion account can simplify Bye and Svenonius' (2010) analysis of the autosegmental morphemes. If Sierra Miwok Stems are amenable to a PWd-recursion account, this would provide evidence that aspectual morphemes in Sierra Miwok are phasal, since they trigger PWd-recursion. Sierra Miwok would then be another language with phasal aspectual morphemes, lending further support to the proposal that aspectual heads can inherit the phasehood of a first-merged *v* categorizer.

Semitic languages, e.g., Hebrew, Arabic and Aramaic, are infamous for their non-concatenative verb morphology, including both fixed prosodic templates and vocalic patterns superimposed on consonantal roots. Verbs in a given Semitic language may appear in a number of different prosodic templates, into which the consonants of the root and vowels of affixes are arranged. However, much work argues that the different templates are actually the result of autosegmental affixes, including floating morae (see, *inter alia*, McCarthy 1993 for Modern Standard Arabic, Ussishkin 2000 and Kastner 2016 for Modern Hebrew, and Tucker 2010 for Iraqi Arabic). On this account, there is often only one "templatic" requirement: that verbs be disyllabic (McCarthy 1993, Ussishkin 2000). In Modern Hebrew, for example, Ussishkin argues that verbs are maximally disyllabic, which accounts for syncope when prefixes like /yi-/ (8a.iii) and /hi-/ (8b.iii) are added.

(8) Disyllabic Maximality in Modern Hebrew

a. /g-m-r/ ‘finish’

i. [gamar] “he finished”
ii. [gomer] “finish” (masc. sg.)
iii. [yi-gmor] “he will finish”

b. /g-d-l/ ‘grow’

i. [gadal] “he grew” (intransitive)
ii. [gidel] “he raised”
iii. [hi-gdil] “he enlarged”

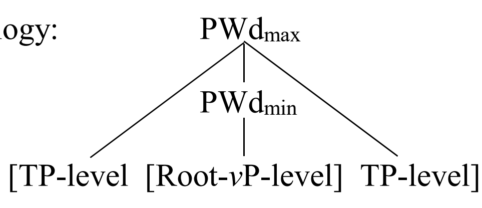
Ussishkin (2000:51)

The morphological content of the templates consists of the verb root and various morphemes, some autosegmental, that manipulate the event and argument structures of the verb (e.g., Arad 2003, Tucker 2010, Kastner 2016). On the other hand, morphemes outside the template encode tense, mood and agreement. There thus seems to be a correlation between *v*P-level morphosyntax and templatic morphophonology, on the one hand, and TP-level morphosyntax and non-templatic morphophonology, on the other. If this correlation is on the right track, Semitic verbs may admit of a similar analysis as Creek, where templatic material composes a PWd_{min} in phonology and an inner X_0 in syntax. Semitic verbs with templatic morphology would then have the rough syntactic and phonological structures in (9).

(9) Templatic Morphology in Semitic

a. Syntax: $\{Root+vP\text{-}level\}_{X0}$, {Root+*v*P-level+TP-level}

b. Phonology:

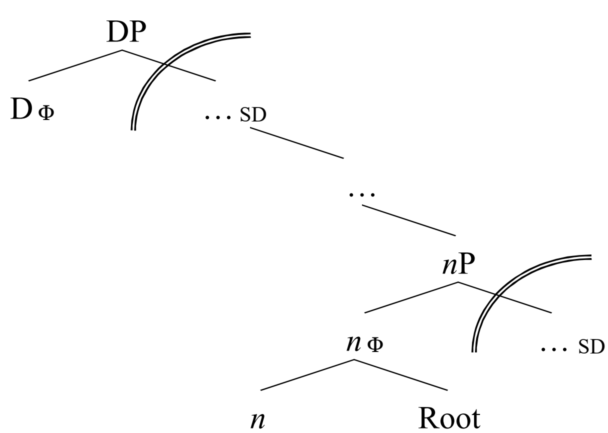


Supposing templatic morphology in at least some Semitic languages is a direct or indirect result of multiple spellout resulting in PWd recursion (9), the phase structure of the templatic verb could then be examined in further detail. Because of the wealth of research on verbal morphosyntax in

Semitic languages, e.g., Marantz (2001), Arad (2003), Borer (2005), Tucker (2010), Kastner (2016), *inter multa alia*, this would enable a fine-grained investigation of phases inside verbs.

The phasal structure of the extended noun phrase has in general been less explored than phases in the verb phrase and the clause. Early work in phase theory argued that D is a phase head (e.g., Svenonius 2004). On the opposite end of the extended noun phrase, the little *n* that merges with the root is also argued to be a phase head due to its status as a categorizer (e.g., Marantz 2001, 2007). The relation between these two phase heads, *n* at the bottom of the extended noun phrase and D at the top, is in need of further investigation. The phasal status of the material in between these two heads also requires more exploration; this material includes heads encoding number, gender, quantification, and the like ((10); see Szabolcsi 1994, Bhattacharya 1999, Wood 2003, Borer 2005, Bošković 2005, *inter alia*, for the structure and sequencing of heads in the extended noun phrase).

(10) Phases in the Extended Noun Phrase: a Starting Point



The structure in (10) invites several questions. Does head movement extend the phasehood of the *n* categorizer upward, as this dissertation argued happens with the *v* categorizer in verbs? If so, how far can the phasehood extend: all the way to D, or to an intermediate head? Is D the only head above *n* with phasehood, or are there intermediate phase heads? Current research is exploring these questions: Bošković (2013, 2014, 2016) proposes that the phasehood of the lexical category N, equivalent in DM to the *n* categorizer, extends to the highest head in its extended projection. Syed (2017) and Syed and Simpson (to appear) argue that there is a phase head, Q(uantification), in the middle of the extended noun phrase in Bangla.

The model proposed in this dissertation predicts that the phasal structure of morphologically complex nouns should have visible effects on their PWd structure. In particular, the presence of a phase head in the middle of the extended noun phrase is predicted to trigger PWd recursion in some languages. In contrast, if no intermediate phase head ever appears in between *n* and D, morphologically complex nouns that do not encode D heads would never be expected to display PWd-recursion. There is evidence from Chukchansi that suggests the former approach may be correct. Chukchansi nouns do not have determiner (D_0) morphology, and so do not include a D phase head. While the vast majority of nouns are unmarked for number, a handful of animate nouns form plurals with the suffix /-hi/. These plural forms always begin in a fixed (LˈH) foot, regardless of the singular form (11). Since a fixed (LˈH) foot in Chukchansi verbs is due to the presence of a phase head suffix, this strongly suggests that the plural suffix /-hi/ is an intermediate phase head between categorizing *n* and D, and that /-hi/ spells out the nominalized root at an early phase.

(11) Chukchansi Templatic Plural Nouns

a.	/no:no	hi	ˀ/	→	[(noˈne:)hiʔ]
	‘man’	PLUR	NOM		
	“men” (NOM)				
b.	/p’a:j	hi	ˀ/	→	[(paˈje:)hiʔ]
	‘child’	PLUR	NOM		
	“children” (NOM)				

Since templatic plurals are restricted to a small number of animate nouns, the patterns in (11) may be lexicalized and not productively derived. However, if templatic plurals in Chukchansi are found to be productive and generalize to other nouns or nonce words, this would give evidence for the phasehood of the plural head in Chukchansi. Further research into PWd recursion in morphologically complex nouns can shed light on the phasal structure of the extended noun phrase.

5.3. Summary and Words on the Interface

This chapter reviewed the cyclic syntax-parallel phonology model advocated in the dissertation and suggested further research based on the model. §5.1 recapitulated the main insights and contributions of each of the preceding chapters, including the refinements of the model and its predictions for how human language can vary in the syntax-phonology mapping inside the word. §5.2 suggested specific avenues of research for the model. These include exploring other cases of PWd recursion in verbs and investigating the phasal structure of morphologically complex nouns and its potential prosodic effects. More generally, §5.2 discussed the utility of the cyclic syntax-parallel phonology model as a **diagnostic** for both the phasal derivation and the prosodic structure of words. Because the model predicts a close but not deterministic relationship between a word's phasal derivation on the one hand and its prosodic composition on the other, it can be used to discover and clarify one type of structure based on the other. In other words, knowledge about a language's morphosyntax can reveal new facts about its phonology, and vice-versa; this is in the same vein as Scheer's (2008, 2009) idea of intermodular argumentation, where one module of the language faculty can adjudicate between analyses of another module.

As parting words, I expand on the idea of the cyclic syntax-parallel phonology model as a diagnostic and leave the reader with a few comments on the interface of syntax and phonology.

The syntax-phonology interface centers on the translation of hierarchical relations between abstract items into a linear order of segments that are partially grounded in the muscles of the vocal tract or the hands and in the auditory or visual systems. The linearity of time constrains the **externalization** of syntactic representations to the sensorimotor system (Chomsky 1993, 2000, 2001). Phonology mediates externalization and imposes linearity on the hierarchical structure of syntax, thereby distorting the structure and leaving only some syntactic relations visible or audible.

The loss of syntactic information in externalization parallels similar translations in other realms of human knowledge, such when a cartographer transforms a three-dimensional globe into a two-dimensional map, or projection, of the Earth. A given projection can only preserve certain properties of the spherical Earth, such as the size of continents, their shapes, or the distances between them, by distorting other properties. A projection that endeavors for maximal faithfulness to the actual geography of the Earth's surface must sacrifice either legibility or complete coverage. The cyclic syntax-parallel phonology model likewise captures the impossibility of a language preserving all its syntactic properties in phonologization. When syntax displaces some morphemes of a word across a phase boundary and transfers identical copies of the morphemes at distinct phases, phonology cannot recapitulate all of this syntactic derivation in one output phonological representation. Rather, each language's phonology chooses which syntactic relations to represent faithfully and which to distort. In Chukchansi and Creek, phonology preserves the **syntactic cyclicity** of biphasal verbs through **prosodic recursion**; other languages convey cyclic derivation through other prosodic means or erase it entirely. The cyclic syntax-parallel phonology model offers an account of language variation in the syntax-prosody mapping of words that relies on universal properties of syntactic cyclicity and of phonological constraints evaluated in parallel.

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