Root Shape Change in Chukchansi Yokuts as a Phonological Result of Cyclic Spellout

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1. Introduction

This paper proposes a novel interface analysis of a classical problem in phonology: templatic morphology in Yokuts verbs. I propose an account of templates in the Yokuts language Chukchansi as an effect of cyclic spellout from the syntax to the phonology within a word. In this account, templates do not require a distinct phonological mechanism, but instead emerge from the general prosodic structure of Chukchansi combined with cyclic construction of words. This work finds a homology between the inner syntactic domain (the vP) and the inner phonological domain (the templatic Stem) in the Yokuts verb, and suggests that this correspondence may be true more generally—the vP ~ Stem Homology.

1.1. Phenomenon: Root Shape Change (RSC) in Chukchansi Yokuts

The phenomenon this paper investigates is root shape change in the Yokuts language family. I focus on the particular workings of this phenomenon in the Yokuts language Chukchansi, but aim as well to shed light on the very similar phenomena in other Yokuts languages. As a primary source, this paper uses the data collected by me and fellow researchers at California State University, Fresno over a period of approximately five years from two native speakers of Chukchansi, Holly and Jane Wyatt. These data appear in such works as Guekguezian (2011, 2012) and Mello (2012), as well as the Chukchansi Dictionary (Adisasmito-Smith et al. in progress). I supplement these primary data with materials collected and analyzed by Collord (1968) on Chukchansi and Newman (1944) on six Yokuts languages/dialects, including Chukchansi, but focusing on Yowlumne (“Yawelmani” in Newman (1944), and those using him as a data source); I utilize other first-hand materials on Yokuts languages, e.g., Kroeber (1903, 1963), Broadbent (1958), and Gamble (1978), as necessary.

The complicated patterns of verb morphophonology in Yokuts have been the object of keen theoretical study for nearly five decades, beginning with Kuroda’s (1967) pioneering dissertation on Yowlumne phonology. These studies have concentrated on phonotactic conspiracies (Kisseberth 1970, Kenstowicz and Kisselberth 1979) and vowel underspecification and harmony (Archangeli 1984), in addition to the phenomenon at hand of root shape change (Archangeli 1983, 1991, Noske 1985). I follow these previous works in their accounts of how many different surface forms of roots in Yokuts fall out of the predictable interaction of six possible underlying root shapes (Archangeli 1983, 1991) with general constraints on phonotactics, most importantly the CVX syllable maximum (e.g., Kuroda 1967, Kisselberth 1970). The six underlying root shapes characterize the majority of verb roots in Yokuts languages, including Chukchansi. I call these “canonical” roots, as they not only are the most numerous, but also form both the most coherent, basic class in Yokuts verb morphophonology (Newman 1944). Canonical roots have either two or three consonants, a single underlying vowel quality, and one of three fixed shapes, definable either as CV-skeleta in the underlying forms (Archangeli 1983) or as prosodic units in the surface forms (Archangeli 1991). Table (1) illustrates the six types of canonical roots (three shapes with either biconsonantal or triconsonantal roots) with Chukchansi verbs, giving both
underlying forms and surface forms with the vowel-initial suffix /-it/ (‘Recent Past’) and consonant-initial suffix /-taʔ/ (‘Remote Past’).  

Table 1. Canonical Verb Root Types in Yokuts (following Archangeli 1983, 1991)

<table>
<thead>
<tr>
<th>Root Shape (Prosodic Unit, CV-Skeleton)</th>
<th>Biconsonantal Roots</th>
<th>Triconsonantal Roots</th>
</tr>
</thead>
<tbody>
<tr>
<td>σ, CV:C(C)</td>
<td>/ʧiʃ/ ‘cut’</td>
<td>/lihm/ ‘run’</td>
</tr>
<tr>
<td></td>
<td>[ʧiʃ, iʃ-t], [ʧiʃ,taʔ]</td>
<td>[lihm-it], [lihim-taʔ]</td>
</tr>
<tr>
<td>σ⁻µ⁻σ⁻µ⁻, CV:C(C)</td>
<td>/ma:x/ ‘collect’</td>
<td>/be:wn/ ‘sew’</td>
</tr>
<tr>
<td></td>
<td>[ma:.x-it], [max-taʔ]</td>
<td>[bew.n-it], [be:wn-taʔ]</td>
</tr>
<tr>
<td>σ⁻µ⁻σ⁻µ⁻, CV:CVC:C(C)</td>
<td>/pa.na:/ ‘arrive’</td>
<td>/hewe:t/ ‘walk’</td>
</tr>
<tr>
<td></td>
<td>[pa.na-t], [pa.na:-taʔ]</td>
<td>[he.wet-taʔ]</td>
</tr>
</tbody>
</table>

Table (1) highlights surface forms that have undergone predictable processes of vowel shortening and epenthesis in order to satisfy the phonotactic constraint of the CVX syllable maximum. For example, when a root with the underlying shape CVCC or CV:CC attaches to a consonant-initial suffix, a vowel must be epenthesized to avoid an illegal three-consonant cluster, which cannot fit into the CVX syllable maximum (1).

1. /CV(:)CC-CVC/ → [CV(:).CiC.CVC]; *[CVCC,CVC], *[CV:CCVC]
   a. /lihm-taʔ/ → [lihim.taʔ]; *[lihm.taʔ], *[lih:ntaʔ]
   b. /be:wn-taʔ/ → [be:wn.taʔ]; *[bewn.taʔ], *[bew:ntaʔ]

When a root with an underlying long vowel (e.g., CV:C, CV:CC, or CV:CVC:C) attaches to a suffix that results in the long vowel being followed by two consonants, the vowel is shortened, again to accommodate the CVX syllable maximum (2).

2. /(...CV:CCV(...)/ → [(...)CV:CCV(...)]; *[(...CV:CCVCVC(...]), *[(...CV:CV(...)]
   a. /ma:x-taʔ/ → [ma:.x-taʔ], *[max:taʔ], *[ma:.xtaʔ]
   b. /be:wn-it/ → [bewnit], *[be:wnit], *[be:wnit]
   c. /hewe:t-taʔ/ → [he:wet-taʔ]; *[he:wet:taʔ], *[he:we:tttaʔ]

I follow the previous generative research on these two predictable processes of vowel shortening and epenthesis as given, as well as the six underlying verb root shapes. I set aside other processes analyzed in previous research, such as long high vowel lowering, progressive vowel rounding harmony, and vowel deletion to avoid hiatus (e.g., Kuroda 1967, Archangeli 1984). While the analysis developed in this paper does not specifically deal with these processes, it may offer some insight as to how they can be integrated into a general view of Yokuts phonology.

In the presence of several suffixes, canonical roots change shape in ways not predictable from either their underlying shapes or the shape of the suffix (3-6). The surface form of roots is

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1 All data in this section and in the paper as a whole are from current fieldwork on Chukchansi, except where explicitly specified otherwise.

2 Newman (1944:39) mentions that CVC: roots (biconsonantal with a σ⁻µ⁻σ⁻µ⁻ shape) are only “seven or eight percent” as common as all of the other types of canonical roots, and are “actively being leveled out of existence.” This is confirmed by the Chukchansi dictionary (Adisasmito-Smith t.a.), in which only about one percent of all verb roots have a CVC: shape.
usually constant across the underlying root shapes: in (3a-b), the shape is always [CVCV:] regardless of underlying root shape, while in (5a-d), the shape is always [CVCV:(C)]. I give this phenomenon the theory-neutral label of root shape change.

(3) Root Shape Change: [CVCV:] with Causative /-la/-
   a. /ʧʧ-la/ → [ʧʧ.fa:.la.ta?] “had made cut”
   b. /max:x-la/ → [ma.xa:.la.ta?] “had made collect”

(4) Root Shape Change: [CVCV:C] with Causative /-e/-
   a. /lihm:-e/- → [le.he:.m-e-t] “just made run”
   b. /be:wn-e/- → [be.we:n-e-t] “just made sew”
   c. /be.wet-e/- → [be.wet-e-t] “just made walk”

(5) Root Shape Change: [CVCV:(C)] with Agentive /-ʧ/-
   a. /ʧʧ-ʧ/- → [ʧʧ.fa:.ʧi] “cutter-ACC”
   b. /max:x-ʧ/- → [ma.xa:.ʧi] “collector-ACC”
   c. /lihm:-ʧ/- → [le.he:.mʧi] “runner-NOM”
   d. /be:wn-ʧ/- → [be.wen:.mʧ] “sewer-NOM”

(6) Root Shape Change: [CVCV(C)] with Durative /-ʔa/-
   a. /ʧʧʔa/- → [ʧʧ.fa:.ʔan] “is cutting”
   b. /max:xʔa/- → [ma.xa:.ʔan] “is collecting”
   c. /lihmʔa/- → [le.hem:.ʔan] “is running”
   d. /be:wnʔa/- → [be.wen:.ʔan] “is sewing”

Setting aside changes in root vowel quality (e.g., in (3a) and (4a)), the key generalization to be made with root shape change is that the suffix determines the shape of the root it attaches to. Newman (1944) identifies several different “stems” (i.e., root forms having undergone shape change and vowel quality processes) that correspond to certain suffixes; for example, the agentive and durative suffixes above choose the “strong” stem. Root shape change appears to be fully productive; all the canonical root types undergo the change demanded by the suffix, though some within-item optionality is apparent. Roots that do not fit one of the six canonical shapes, on the other hand, never undergo root shape change: such roots as in (7) either appear unchanged next to root shape change-triggering suffixes (8-10), or cannot attach to them at all (11-13).

(7) Non-canonical Root Types
   a. /ʧ’edma/ ‘think’ → [ʧ’ed.ma-t], [ʧ’ed.ma.-ta?]
   b. /hay’k’it/ ‘finish’ → [hay.k’i.t-it], [hay.k’i.t.-ta?]
   c. /yo:yo/ ‘call’ → [yo:.yo-t], [yo:.yo.-ta?]

(8) /ʧ’edma-la/- → [ʧ’ed.ma.lat] “just made think”
(9) /hay’k’it-ʧ’/- → [hay.k’i.tʧ’], [hay.k’i.t.ʧ’] “finisher-NOM/ACC”
(10) /yo:yo-la/- → [yo:.yo.lat] “just made call”
(11) /ʧ’edmaʔa/- → *[ʧ’ed.ma.ʔan]”
(12) /hay’k’it-e/- → *[hay.k’i.tet]
(13) /yo:yoʔa/- → *[yo:.yo.ʔon]”

These non-canonical roots (7) that resist root shape change all contain multiple vowels, often with different qualities, and seemingly impervious prosodic structure. While canonical roots constitute the majority of verb roots in Chukchan, non-canonical roots are also common, and besides their failure to participate in root shape change, are otherwise just as fully integrated into Chukchan morphophonology.
1.2. Proposal: RSC as Interface Effect of Cyclicity, Minimality, and Prosody

The phenomenon of root shape change in Chukchansi Yokuts sketched out above poses major questions about how it works. These questions apply equally to root shape change in other Yokuts languages, and thus to Yokuts as a whole. This paper endeavours to answer the following three major questions about root shape change:

- What is the phonological nature of root shape change?
- What determines which suffixes trigger root shape change?
- What determines which roots change shape and which do not?

These three questions span the phonology, morphology, and syntax of root shape change (henceforth ‘RSC’). The first question concerns both the correct pretheoretical generalizations of RSC in phonological terms and the best analytical account to capture these generalizations. The answer to this first question should determine whether RSC forms its own subsystem of the phonology, or whether it is well-integrated into the phonology as a whole, perhaps even emerging as an epiphenomenon of other phonological structures. An answer to the second question should determine the unique characteristic(s) of RSC-triggering suffixes; the third question is similar to the second, concerning which characteristic(s) of the root determine its participation in RSC. These characteristic(s) of the suffixes and the roots may be due to phonology, morphology, syntax, or perhaps another linguistic sub-system. Again, the answer to these questions must be two-fold: a broader generalization of the common features of the sets of suffixes and of roots must be adduced, as well as a specific mechanism for how the suffixes trigger RSC on the roots. To date, while there have been solid attempts at answering the first question (e.g., Archangeli 1983, 1991), the second and third questions remain broadly unanswered; it is not known why Yokuts RSC occurs in its specific morphological contexts.

In this paper I venture an answer to the questions above: RSC in Chukchansi Yokuts is a phonological consequence of syntactic structure within the word. Specifically, RSC occurs when the syntactic component sends material to the phonological component in cycles: RSC is a cyclic phonological process triggered by cyclicity in the syntax. This paper gives the following answers to the three questions above:

- The phonological nature of RSC is a reduction in prosodic markedness, triggered by minimality requirements.
- Suffixes that trigger RSC are edges of cyclic domains in the syntax, i.e., phase heads.
- Roots that undergo RSC are phonologically minimal: they have one input vowel; roots with more than one vowel are too large to undergo RSC.

RSC typically results in the optimal prosodic structure of Chukchansi Yokuts; as Chukchansi is shown to be a left-to-right iambic language, this optimal structure is an initial (L’H) Foot. RSC-triggering suffixes mark edges of cyclic domains: they are phase heads, which send the syntactic material inside their complements to the phonology in its own cycle (Chomsky 2000, 2001, 2008). RSC-triggering suffixes are all either causal or dynamic heads (= vP phase heads) or deverbal nominalizers (= nP phase heads). These suffixes spell out material in their complements corresponding to phonological roots, which undergo a phonological cycle without affixal material under a realizational view of morphology, in which words are built in the syntax and then spelled out by phonological material (e.g., Halle and Marantz 1993, Marantz 1997).
Because every output to a phonological cycle must form a phonological word (e.g., Selkirk 1984, McCarthy and Prince 1986), phonologically sub-minimal roots get augmented to meet this minimality requirement. When a root with only one underlying vowel attaches to any RSC-triggering suffix, the unmarked (L’H) iamb emerges; RSC is thus a case of “The Emergence of The Unmarked” (TETU; Prince and Smolensky 1994/2003, McCarthy and Prince 1994), in which the unmarked (L’H) iamb emerges from arrangement of epenthetic material required for one-vowel roots to satisfy disyllabic minimality. Only phonological inputs with one underlying vowel are small enough to require this augmentation; since only epenthetic, not underlying prosodic material can be manipulated in Chukchansi to form optimal prosodic structure, RSC does not occur with larger roots, or when roots enter the phonology along with suffixal material.

The account outlined above captures the phenomenon of RSC in Chukchansi Yokuts using independently-needed linguistic structure, including cyclic spellout domains in syntax and prosodic well-formedness and minimality in phonology. Elements needed for the specific analysis of RSC are active in other parts of Chukchansi grammar, including the optimality of the (L’H) iambic foot and the morphological structure of the verb. On the contrary, in previous analyses of RSC in Yowlumne Yokuts (e.g., Archangeli 1983, 1991, Zoll 1993), as well as those of Newman (1944) and Collord (1968), RSC is a separate and rather arbitrary morphological process; the set of suffixes that trigger RSC, as well as the particular shape change triggered by each suffix, is determined on an arbitrary basis. I argue instead that RSC does not form a separate sub-system within Chukchansi, but is tightly integrated into the general syntactic, morphological, and phonological structure of the language. RSC is a principled part of Chukchansi, and likely of all Yokuts languages, and arises rather naturally out of the structural “genius” (Sapir 1921) of the language.

1.3. Overview of Paper

The paper is structured as follows: Section Two investigates the syntactic structure of verb morphology in Chukchansi, concentrating on the difference in the phasal status of RSC-triggering and non-RSC-triggering suffixes. Section Three focuses on the phonological structure of Chukchansi, arguing that it is an iambic language, and that RSC is the appearance of optimal iambic prosody. Section Four accounts for RSC as an effect of cyclic syntactic spellout of words leading to cyclic phonological structure, and proposes that RSC is a minimality effect in the first phonological cycle. Section Five concludes the paper.

2. Syntactic Nature of Root Shape Change: Higher Phase Heads

Section 2 explores the differences in syntactic structure in RSC versus non-RSC contexts. First, the general morphosyntactic structure of Chukchansi verbs is explicated (§2.1). Relying on certain assumptions from theories of syntactic cyclicity, spell-out to the phonology, and the articulation of the verbal domain (§2.2), I propose that all RSC-triggering suffixes are phase heads, while suffixes that do not trigger RSC are not phase heads (§2.3). Because of morphological structure of root and stems in Chukchansi, phase heads (i.e., RSC-triggers) cause the phonological root morph to be spelled out, while non-phase head (i.e., RSC non-triggers) do not cause spell-out of the phonological root morph (§2.4).
2.1. Morphosyntactic Structure of Verbs

Verbs in Chukchansi, as all words in every Yokuts language, are entirely suffixing. While Chukchansi verbs do not agree with any of their arguments, they show Tense-Aspect-Mood (TAM) marking as well as voice-changing operations. All verbs obligatorily have one word-final suffix, and optionally have other suffixes in-between the root and the word-final suffix. Word-final suffixes in matrix clauses indicate one of four tenses (‘remote or narrative past’ /-taʔ/, ‘middle past’ /-hil/, ‘recent past’ /-it/, ‘non-past’ /-n’, -eʔ?) or one of three moods (/-ga/ ‘imperative’, /-xa/ ‘precative’, /-al/ ‘potential’). In addition to these suffixes found in matrix clauses, different suffixes occur in embedded clauses, called “gerundials” in Newman (1944) and Collord (1968), including /-mi/ ‘consequent’, /-taw/ ‘precedent’, /-tin/ ‘purposive’, and /-ʔałʔ/ ‘precative’. These gerundials encode relations of tense (consequent and precedent) or mood (purposive and precative). Only one suffix of this set, either matrix or embedded tense or mood, can ever appear on a given verb, i.e., they are in complementary distribution.

Non-final suffixes on verbs indicate voice, aspect (both viewpoint and situation), and mood. These suffixes can combine without grammatical limit, though generally verbs with multiple non-final suffixes are rare. Moreover, not all combinations of these suffixes are possible. Non-final suffixes occur in a relatively fixed order, though some suffixes can switch places to indicate different scopes (Adisasmoto-Smith et al 2015). The unaccusative suffix /-n-/ always occurs closest to the root; voices tend to occur closer to the root than aspect or mood (14-16).

(14) ale:dʒa- la- wʃ- it
    ‘crazy’ CAUS RFLX RC.PT
    "just made oneself crazy" [ROOT-VOICE-VOICE-TENSE]

(15) xat- han- xo- n’
    ‘eat’ PASS IMPV NPST
    "is being eaten" [ROOT-VOICE-ASPECT-TENSE]

(16) t’ol- on- ʔa- hil
    ‘burn’ UNACC DUR MD.PT
    "was burning (intr.)" [ROOT-VOICE-ASPECT-TENSE]

Deverbal nominalizers (17-18) are also non-final suffixes attaching to verb roots. Deverbal nominalizers are different from embedded tense or mood suffixes (19-20); the former obligatorily take case suffixes and can act as arguments, while the latter never do.

(17) [xata:-ʃʔ-] ‘eat’-AGT = “eater” [ROOT-NMZR]

3 Reduplication (the exponent of the repetitive morpheme) appears to be prefixing in some cases, e.g., the reduplicated form [le-h-lem-an’] “keeps running and running” from the root /lihm/ ‘run’. Since the first copy [le] is smaller than the second copy [lehm], theories of reduplication with a reduplicant morpheme (e.g., McCarthy and Prince 1995) would posit that the first copy is a reduplicant prefix and the second the exponent of the root. Reduplication, however, includes other phonological complexities (vowel lowering, interaction with RSC) that suggest that the story may not be as simple. At any rate, there are no prefixes with fixed segments in any Yokuts language.

4 Collord (1968) includes a passive gerundial /-nu/, which has voice semantics, and unlike other “gerundials,” occurs in matrix clauses with Nominative subjects. This suffix has not been elicited in current fieldwork. Other Yokuts languages do, in fact, have final tense suffixes that also indicate passive voice, e.g., /-it/ ‘passive aorist’ (Newman 1944).
The different semantic content associated with final versus non-final suffixes suggests that the former, obligatory suffixes are higher in the syntactic tree than the latter, optional suffixes. I propose that final suffixes occur in Infl, while non-final suffixes occur between the Infl head and the lexical verb root, somewhere in the extended v domain or just above it. This falls in line with the generally accepted content of the two domains: Infl houses tense and mood content, while the extended v domain contains specification of argument and event structure, i.e., voice and aspect, respectively. An Infl suffix on the verb is obligatory in Yokuts to indicate tense or mood relations, while suffixes in the extended v domain optionally occur, modifying the default argument and event structure of the verb. The following two tables show productive verbal suffixes in Chukchansi Yokuts, both final (obligatory) and non-final (optional).

Table 2. Final Suffixes

<table>
<thead>
<tr>
<th>Morpheme</th>
<th>Function</th>
<th>Abbreviation</th>
<th>Meaning</th>
<th>Semantic Class</th>
</tr>
</thead>
<tbody>
<tr>
<td>-eʔ/-nʔ</td>
<td>Non-Past</td>
<td>NPST</td>
<td>“will X”/“X-es”</td>
<td>Tense</td>
</tr>
<tr>
<td>-it</td>
<td>Recent Past</td>
<td>RC.PT</td>
<td>“just X-ed”</td>
<td>Tense</td>
</tr>
<tr>
<td>-hil</td>
<td>Middle Past</td>
<td>MD.PT</td>
<td>“X-ed (a while ago)”</td>
<td>Tense</td>
</tr>
<tr>
<td>-taʔ</td>
<td>Remote Past</td>
<td>RM.PT</td>
<td>“X-ed (a long time ago)”</td>
<td>Tense</td>
</tr>
<tr>
<td>-ga</td>
<td>Imperative</td>
<td>IMPR</td>
<td>“X!”</td>
<td>Mood</td>
</tr>
<tr>
<td>-xa</td>
<td>Precative</td>
<td>PRC</td>
<td>“please X”/“let X”</td>
<td>Mood</td>
</tr>
<tr>
<td>-al</td>
<td>Potential</td>
<td>POT</td>
<td>“could X”/“might X”</td>
<td>Mood</td>
</tr>
<tr>
<td>-mi</td>
<td>Consequent Gerundial</td>
<td>CSQT</td>
<td>“having X-ed”/“X-ing”</td>
<td>Embedded Tense</td>
</tr>
<tr>
<td>-taw</td>
<td>Precedent Gerundial</td>
<td>PCDT</td>
<td>“to X”/“X-ing”</td>
<td>Embedded Tense</td>
</tr>
<tr>
<td>-tin</td>
<td>Purposive Gerundial</td>
<td>PRPS</td>
<td>“in order to X”/“for X-ing”</td>
<td>Embedded Mood</td>
</tr>
<tr>
<td>-ʔaʃ</td>
<td>Precative Gerundial</td>
<td>PRC.G</td>
<td>“to let X”/“wanting to X”</td>
<td>Embedded Mood</td>
</tr>
</tbody>
</table>

A handful of other suffixes are attested in Collord (1968) and have been found sporadically in current data. These suffixes include the aspectual suffixes ‘progressive perfective’ /-ʔaʔ/ /-iʔ/ /-ʔaʔ/, ‘imperfective’ /-ʔaʔ/, and ‘culminative’ /-ʔaʔ/, the verbalizing suffix ‘acquisitive’ /-naʔ/, and the nominalizing suffixes /-ʔaʔ/ ‘nominative’ and /-ʔaʔ/ ‘dubitative agentive’ (Collord’s terminology). Some of these suffixes may trigger RSC; however, none of them have been elicited enough to be sure of either their phonological or syntactic characteristics.
### Table 3. Non-Final Suffixes

<table>
<thead>
<tr>
<th>Morpheme</th>
<th>Function</th>
<th>Abbreviation</th>
<th>Meaning</th>
<th>Semantic Class</th>
</tr>
</thead>
<tbody>
<tr>
<td>-n-</td>
<td>Unaccusative</td>
<td>UNACC</td>
<td>“ARG1 X ARG2” → “ARG2 X”</td>
<td>Voice</td>
</tr>
<tr>
<td>-e/-la-</td>
<td>Causative</td>
<td>CAUS</td>
<td>“make ARG X”</td>
<td>Voice</td>
</tr>
<tr>
<td>-han-</td>
<td>Passive</td>
<td>PASS</td>
<td>“be X-ed”</td>
<td>Voice</td>
</tr>
<tr>
<td>-wif-</td>
<td>Reflexive/Reciprocal</td>
<td>RFLX</td>
<td>“X oneself”/“X each other”</td>
<td>Voice</td>
</tr>
<tr>
<td>-ʃit-</td>
<td>Benefactive</td>
<td>BEN</td>
<td>“X for ARG”</td>
<td>Voice</td>
</tr>
<tr>
<td>-mix-</td>
<td>Comitative</td>
<td>COM</td>
<td>“X with ARG”</td>
<td>Voice</td>
</tr>
<tr>
<td>-ʔa-</td>
<td>Durative</td>
<td>DUR</td>
<td>“be X-ing”</td>
<td>Aspect</td>
</tr>
<tr>
<td>-e-</td>
<td>Distributive</td>
<td>DST</td>
<td>“X all around”</td>
<td>Aspect</td>
</tr>
<tr>
<td>RED</td>
<td>Repetitive</td>
<td>REP</td>
<td>“keep X-ing”/“X over and over”</td>
<td>Aspect</td>
</tr>
<tr>
<td>-me:we-</td>
<td>Andative</td>
<td>AND</td>
<td>“go while X-ing”</td>
<td>Aspect</td>
</tr>
<tr>
<td>-xo-</td>
<td>Imperfective</td>
<td>IMPV</td>
<td>“be X-ing”</td>
<td>Aspect</td>
</tr>
<tr>
<td>-a-</td>
<td>Inchoative</td>
<td>INCH</td>
<td>“get X”/“become X”</td>
<td>Aspect</td>
</tr>
<tr>
<td>-ta-</td>
<td>Causative-Inchoative</td>
<td>CS-IN</td>
<td>“make ARG (become) X”</td>
<td>Voice + Aspect</td>
</tr>
<tr>
<td>-maʔ[e]-</td>
<td>Desiderative</td>
<td>DESD</td>
<td>“want to X”</td>
<td>Mood</td>
</tr>
<tr>
<td>-i:wi-</td>
<td>Hortative</td>
<td>HORT</td>
<td>“let X!” (with Precative)</td>
<td>Mood</td>
</tr>
<tr>
<td>-xaʔ-</td>
<td>Exclusive</td>
<td>EXCL</td>
<td>“do only X”</td>
<td>Mood</td>
</tr>
<tr>
<td>-ʃ[-]</td>
<td>Agentive</td>
<td>AGT</td>
<td>“X-er”/“(one) who X-es”</td>
<td>Nominalizer</td>
</tr>
<tr>
<td>-ʔhi-y-</td>
<td>Adjunctive</td>
<td>ADJT</td>
<td>“place or instrument for X-ing”</td>
<td>Nominalizer</td>
</tr>
<tr>
<td>-n-</td>
<td>Verbal Noun</td>
<td>NMNZ</td>
<td>“X-ing”</td>
<td>Nominalizer</td>
</tr>
<tr>
<td>-hana-</td>
<td>Nominal</td>
<td>PS.NM</td>
<td>“X-ee”/“(one) who is X-ed”</td>
<td>Voice + Nominalizer</td>
</tr>
</tbody>
</table>

To summarize the above, verbs in Chukchansi have the following structure (21), with optional non-final suffixes in the (extended) v domain and obligatory final suffixes in the Infl domain. The order of non-final and final suffixes therefore falls directly out of the Mirror Principle (Baker 1986): non-final suffixes are closer to root than final suffixes both in syntax and morphology (Figure 1).

(21) \[[\text{ROOT}-(\text{Non-Final*})]_{\text{v-\text{FINAL}}}]_{\text{Infl}}\\
\begin{align*}
& a. \quad \text{Non-Final: Optional, Recursive} \\
& b. \quad \text{Final: Obligatory, Non-recursive}
\end{align*}

6 The inchoative and causative-inchoative suffixes are verbalizers: they attach only to roots that are otherwise used nominally. However, they always include the aspectual meaning of inchoativity: other means are used to indicate the sense of these roots without aspect. For instance, the inchoative [gaye:s-a-t] can only mean “just got better” (with inchoative aspectual force); in order to indicate being good without the inchoative meaning (“is/was good”), the adjectival form [gayis] is used predicatively (i.e., without case concord).
I now turn to suffixes that trigger root shape change (RSC). The first generalization is that only non-final suffixes can trigger RSC. At first glance, however, the property of RSC seems to be (syntactically) arbitrary. RSC triggers include suffixes from the voice, aspect, and nominalization sets; these sets of suffixes all include non-RSC triggers, as well. Table (4) provides a list of non-final suffixes that trigger RSC, as well as those that do not trigger RSC (leaving the repetitive aspect /RED/ suffix aside, as it is unclear what its status is vis-à-vis RSC).

### Table 4. Non-Final Suffixes: RSC Triggers vs. Non-Triggers

<table>
<thead>
<tr>
<th>Semantic Class</th>
<th>RSC Triggers</th>
<th>Function</th>
<th>RSC Non-Triggers</th>
<th>Morpheme</th>
<th>Function</th>
</tr>
</thead>
<tbody>
<tr>
<td>Voice</td>
<td>-e/-la-</td>
<td>Causative</td>
<td></td>
<td>-n-</td>
<td>Unaccusative</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>-han-</td>
<td>Passive</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>-wiʃ-</td>
<td>Reflexive/Reciprocal</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>-ʃit-</td>
<td>Benefactive</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>-mix-</td>
<td>Comitative</td>
</tr>
<tr>
<td>Aspect</td>
<td>-ʔa-</td>
<td>Durative</td>
<td></td>
<td>-me:we-</td>
<td>Andative</td>
</tr>
<tr>
<td></td>
<td>-e-</td>
<td>Distributive</td>
<td></td>
<td>-xo-</td>
<td>Imperfective</td>
</tr>
<tr>
<td></td>
<td>-a-</td>
<td>Inchoative</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>-ta-</td>
<td>Causative-Inchoative</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Mood</td>
<td>-ʧʔ-</td>
<td>Agentive</td>
<td></td>
<td>-maʔʃ(e)-</td>
<td>Desiderative</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>-i:wi-</td>
<td>Hortative</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>-xaʃ-</td>
<td>Exclusive</td>
</tr>
<tr>
<td>Nominalization</td>
<td>-ʔhiy-</td>
<td>Adjunctive</td>
<td></td>
<td>-n-</td>
<td>Verbal Noun</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>-hana-</td>
<td>Passive Nominal</td>
</tr>
</tbody>
</table>

It is clear from Table (4) that no Mood suffixes trigger RSC, and that most Voice suffixes also do not. Though the Aspect and Nominalization suffixes seem split between triggers and non-triggers, the latter do not trigger RSC for phonological reasons. The suffixes [-xo-] ‘Imperfective’ and [-n-] ‘Verbal Noun’ only attach to roots or stems that cannot undergo RSC for phonological reasons (§1.1 above, §4.3-4 below). Since these suffixes never appear in contexts where RSC is phonologically licit, their status as (non-)triggers is unclear. The suffix [-hana-] ‘Passive Nominal’ is transparently polymorphemic, as it contains the Passive suffix [-han-]; the [-a-] is thus likely a separate nominalizing element (this is Collord’s (1968) analysis, as well).
argue in §2.3.1 below that the ‘Andative’ suffix [-me/-we-] is likely semantically and syntactically different from the other Aspect suffixes. Having clarified this, all of the remaining Aspect and Nominalization suffixes are RSC-triggers; the correct syntactic generalizations for RSC (22) and non-RSC (23) suffixes are shown below:

(22) RSC-­Triggers: Aspect, Nominalization, Causative

(23) RSC-­Non­-­Triggers: Other Voice, Mood, Final (Tense + Mood)

The next matter is to find a syntactic commonality that all and only the RSC-triggers share. I propose that this commonality is phasehood, i.e., the demarcation of the edge of a syntactic domain. Briefly, when any of the Aspect or Causative heads appear, that head assumes phasehood for the verbal domain (the vP). Only heads related to the causal or dynamic properties of the event have the ability to be a vP phase head; these heads occupy a common syntactic position. Other Voice and Mood heads do not interact with causation or dynamicity, and thus cannot be vP phase heads. Nominalizing heads are category-changing n heads, which are also phase heads. Final suffixes cannot be phase heads, as they occupy Infl, a non-phasal projection. A more detailed picture of the phasal status of RSC-triggers and the non-­triggers’ lack of phasehood is provided in §2.2-3.

2.2. Theoretical Background

This section gives a brief background on both phase theory and vP structure. The analysis of RSC-triggers below adopts specific proposals of these theories. The extended domains of categorizing heads (v and n) have phasal status, the highest eligible head of which assumes phasehood (Bošković to appear). The vP has articulated structure, distinguishing between v (verbal) heads that directly encode semantic properties of the event and Voice heads that introduce arguments in the syntax. Verbal heads further distinguish between a lower verbal category indicating properties associated with internal arguments (resultativity, stativity) and a higher verbal category indicating properties associated with external arguments (initiation, dynamicity).

2.2.1. Phase Theory

Phase theory is a Minimalist incarnation of the idea of syntactic cyclicity, i.e., that syntactic derivations proceed in discrete chunks, or ‘cycles’. These cycles are relatively separate domains: typically, a constituent cannot be extracted out of a cyclic domain, and interaction between syntactic objects in different cycles is usually prohibited. Long-distance movement must happen cyclically: constituents cannot be moved wholesale, but must stop at the edges of cyclic domains. In phase theory, a phase head defines the edge of these cyclic domains (i.e., phases). While the specific idea of phase heads in Minimalist Theory is relatively recent (first proposed in Uriagereka 1999), the notion of cyclic domains in syntax has existed for several decades (e.g., islands (Ross 1967), subjacency and the Strict Cycle Condition (Chomsky 1973), extraction domains (Huang 1982), and barriers (Chomsky 1986)). Chomsky (2000, 2001) codifies the cyclic nature of phases, i.e., the impossibility of extracting material out of the phase or interacting with feature from outside the phase, as the Phase Impenetrability Condition (PIC):

(24) Phase Impenetrability Condition (PIC): In phase alpha with head H, the domain of H is not accessible to operations outside alpha (2000) at ZP (the next strong phase) (2001); only H and its edge are accessible to such operations.
The PIC keeps syntactic material inside the phase complement “frozen” for the rest of the derivation, while the phase head itself and any specifiers are still active in the derivation. The “freezing” effect is usually taken to mean the phase complement is spelled out, i.e., sent to the interfaces with phonology and the conceptual system, and thus not available for further manipulation by the syntactic component. A syntactic derivation with multiple phases will be spelled out at multiple points; once completed, each phase domain is sent from the syntax to be pronounced and interpreted (Multiple Spell-out, Uriagereka 1999). As a result, syntactic phases sent to the phonology at multiple points will roughly correspond to different phonological domains. Evidence from many languages, such as Japanese (Ishihara 2003), Persian (Kahnemuyipour 2004), Scottish Gaelic (Adger 2006), and German (Kratzer and Selkirk 2007), as well as English, show that multiple spell-out of syntactic phases determines phrasal stress patterns.

Several works on morphology have also shown phonological consequences of multiple spell-out inside a syntactically complex word (e.g., Marvin 2002, Newell 2008). (Morpho-)phonological material encoding syntactic material inside a phase complement is spelled out prior to material that encodes syntactically higher material; the former, earlier-spelled-out material forms a separate domain in phonology as well as syntax. For instance, word-level stress patterns can be determined by the phasal structure inside a word (see Marvin 2002 for English and Slovenian and Newell 2008 for Cupêño, Turkish, and Ojibwa). This correspondence between syntactic phases and phonological domains is predicted by any theory of morphology where words are built into the syntax and then fed to the (morpho-)phonology (e.g., Distributed Morphology (DM), Halle and Marantz 1993). If the syntactic structure of the word contains cyclic domains, such that part of the syntactic word is sent to the morphophonology prior to the rest, then the phonological structure of the word must contain cyclic domains. Moreover, the cyclic domains in phonology must correspond exactly to those in syntax; Marantz (2000, 2007), Marvin (2002), and Newell (2008) all show evidence of this correspondence.

The exact demarcation of syntactic phases has been debated over the last decade and a half (e.g., Bošković 2002, Legate 2003, Svenonius 2004, Boeckx and Grohmann 2004, 2007). The two major points of contention are: which heads constitute phases, and what material is spelled out by the phase head? Chomsky (2000, 2001, 2008) proposes that, in the clausal domain, transitive vP and CP are phases, while TP and unaccusative and passive VP are not phases; Legate (2003) provides evidence that unaccusative and passive verbs do have phasal status. Marantz (2000) posits that category-defining heads (little v, n, and a) are phase heads, in addition to higher heads. Several authors propose a contextual determination of phasehood; for example, Bošković (to appear) proposes that the highest head in the extended projection of these category-defining heads acts as the phase head. Nissenbaum (2000) argues that complements of phase heads are spelled out, but not phase heads themselves; Abels (2003) supports this view. However, much morphological work on phases posits that phase heads are spelled out with the complement (Marantz 2000, 2007, Marvin 2002). Newell (2008) proposes that category-defining phase heads are spelled out along with their complements, while other phase heads (transitive v, C, D) only spell out their complements.

7 Such a process for determining phasehood seems to encounter a “look-ahead” problem: how does a lower head know that it will end up not functioning as a phase when a higher head is merged later, and what thus stops the lower head from spelling out its complement? Bošković’s solution to this problem remains unclear.
2.2.2. The Articulated vP

It is generally agreed that in most cases, the extended verbal domain (the vP in many systems) constitutes the first phase in the clause (e.g., Chomsky 2000, 2001). The exact demarcation of this inner phase, or which head delineates the phase domain, is uncertain, however (see Boeckx and Grohmann 2004, 2007 for some discussion). The uncertainty comes in part from the lack of agreement over what the verbal head v is or does: in some schemes, v is a category-defining head, i.e., a verbalizer, while in others, it introduces an external argument and assigns Accusative Case (following Burzio 1986). A note in Chomsky (2000, 2001) illuminates the root of the problem, à propos of C but not T being a phase: he reminds the reader that ‘C’ and ‘T’ are convenient cover labels for a more complex, articulated domain of heads, such as proposed by Rizzi (1997) and Cinque (1999). A line of research, including Larson (1988), Hale and Keyser (1993), Kratzer (1996), Travis (2000), and Ramchand (2008), has shown that the same is true of ‘v’: rather than there being only a single verbal head v, there is an articulated verbal domain, including a host of heads specifying and manipulating the event and argument structure of the verb and clause.

I briefly review several proposals as to the articulated structure of the vP. Larson (1988) first proposes a bipartite structure of the vP (“VP” in his terminology), with the higher V head relating to the external argument and lower V head to the internal argument. Hale and Keyser (1993) build on this, where higher V1 expresses agency and dynamicity (actives and unergatives) while lower V2 expresses undergoing and result (unaccusatives). Several works, including Kratzer (1996), Pylkkänen (2002), and Harley (2013), all argue that the V1 position is also bipartite: there must be separate heads for encoding causation and for introducing the external argument. These works propose a head Voice, whose sole function is to introduce the external argument into the syntax, distinct from the v (= V1) head, which expresses the semantics of causation. This creates a tripartite structure for the vP (Voice, higher v, and lower V); as Harley (2013) points out, several other works have proposed tripartite vPs. Ramchand (2008) splits the verbal domain into the semantic parts of the event: the initiation or cause (InitP), the process (ProcP), and the result or telos (ResP), each of which can introduce an argument (‘initiator’, ‘undergoer’, and ‘resultee’, respectively). Travis (2010) sandwiches an Asp(ect) head between the V1 and V2 of Hale and Keyser (1993); Asp indicates inner aspect, specifically (the presence of) transition or culmination, while V1 and V2 encode a preparatory process and consequent state, respectively. In Travis’ (2010) schema, V1 (= higher v) houses several different features, e.g., causation and dynamicity, and different morphemes, such as causatives and inchoatives, can occupy it.

2.2.3. Theoretical Assumptions

For the purposes of this analysis, I make the following assumptions based on the above discussion of theory. The category-defining heads v and n typically have default phasal status (Marantz 2000), but a higher eligible head in the extended domain of these heads inherits phasehood (Bošković to appear). Phase heads spell out only their complements, which are sent to the phonology (Nissenbaum 2000). The extended v domain has an articulated structure; while remaining agnostic about the details of this domain, I assume a distinction between three types of syntactic heads: Voice, which introduces the external argument in the syntax (e.g, Kratzer 1996, Harley 2013), a higher v1 head, which specifies the agency, initiation, and dynamicity of the event, and a lower v2 head, which specifies the result of the event or associated state (Ramchand
2008, Travis 2010, Harley 2013). Either the \( v_1 \) or \( v_2 \) head merges with the lexical, category-free root to form the verb stem (e.g., Halle and Marantz 1993, Marantz 1997, Borer 2003). Heads occupying the \( v_1 \) or \( v_2 \) positions can have different features or semantics, e.g., inchoativity or dynamicity in \( v_1 \) (similar in spirit to Folli and Harley’s (2005) “flavors” of \( v \)). I do not make specific claims, e.g., about the presence or absence of other positions, the encoding of telicity, or the introduction of the internal argument.

I thus assume the following approximate structure of the \( vP \) (25), Figure (2):

\[
(25) \quad [\text{VoiceP} \ \text{ExtArg} \ \text{Voice} \ [v_1P \ v_1 [v_2P \ (\text{IntArg}) \ v_2 \ \sqrt{\]}
\]

Figure 2. Articulation of the \( vP \)

### 2.3. Phase Heads in Chukchansi

In this section, I argue for the phasal status of certain heads in Chukchansi in the verbal and nominal domain. In §2.2.3, I follow Bošković (to appear) that the highest eligible head in a category-defining domain (e.g., nominal or verbal) functions as a phase head. In the nominal domain, there is only one position for the head that defines the lexical root (or verbalized stem) as a noun; all nominalizing heads are thus phasal. In the verbal domain, there are several different positions for material that manipulates argument and event structure. Under the above assumptions, these head positions include Voice, \( v_1 \), and \( v_2 \), from highest to lowest in the tree. I propose that only \( v_1 \), not Voice or \( v_2 \), is an eligible phase head, in Chukchansi and perhaps in general. This follows Chomsky’s (2000, 2001) proposal that only transitive \( v (= v_1) \) is a phase, not passive \( v (= \text{Voice}) \) or unaccusative \( v (= v_2) \), contra Legate (2003). In Chukchansi, the causative and various aspectual suffixes occupy \( v_1 \); other voice-related suffixes are in Voice, \( v_2 \), or Appl (Pylkkänen 2002), while modal suffixes (as well as all Final suffixes) are higher, outside the articulated verbal domain. Under this proposal, the causative, (Situation) Aspect, and nominalization suffixes are all phase heads, while other suffixes are not. This is exactly the division between RSC-triggers and non-triggers (26-27, modified from (22-23) above); therefore, I conclude that all and only phase head suffixes in Chukchansi trigger RSC.

\[
(26) \quad \text{Phase Heads} = \text{RSC-Triggers: Aspect, Nominalization, Causative}
\]
\[
(27) \quad \text{Non-Phase Heads} = \text{RSC-Non-Triggers: Other Voices, Mood, Final (Tense + Mood)}
\]

#### 2.3.1. Verbal Phase Heads

This section illustrates the above proposal that only \( v_1 \) heads can be phase heads in Chukchansi, not Voice or \( v_2 \) heads. Specifically, the highest \( v_1 \) head in the derivation inherits phasehood (Bošković to appear). The causative suffix is a \( v_1 \) head that selects for a \( v_1P \) complement (Harley
aspectual suffixes (inchoative, distributive, and durative) also occur in \(v_1\), as they modify the causal or dynamic properties of the event (as opposed to the resultative or stative properties of \(v_2\)). Other verbal suffixes are not \(v_1\) heads; either they occur in Voice, Appl, or \(v_2\) positions, or they are merged above the verbal domain, in Mood or other heads.

I start out with the structure of the \(v\)P when no non-final suffixes are attached. Most verbs in Chukchansi are active (i.e., unergative or transitive) in the absence of voice suffixes. Active verbs have an external argument in the Nominative Case and an internal argument in the Accusative Case, which can optionally be dropped. Following, e.g., Chomsky (1995) and Kratzer (1996), the \(v_1\) head assigns Accusative Case to the internal argument. (28) illustrates the structure of active verbs, such as [bewneʔ] ‘will sew’.

\[
\begin{align*}
(28) & \quad \text{bewn-eʔ} & \quad \text{na-ʔ} & \quad \text{(gami:ʃaʔan)} \\
& \quad \text{sew-NPST} & \quad \text{I-NOM} & \quad \text{(shirt-ACC)} \\
& \quad \text{“I will sew (a shirt)”}
\end{align*}
\]

According to the theory sketched out above in §2.2.3, the syntactic derivation starts by merging the lexical root with the active \(v\) head (\(v_{\text{ACT}}\)) in \(v_1\) to categorize the root as a verb (and assign Accusative Case). The \(v_{\text{ACT}}\) head, which encodes the semantics of a causal, dynamic event, requires a Voice head to merge on top of it and introduce the external argument. This derivation is illustrated by (29); for the sake of exposition, the internal argument is shown merged with the lexical root (as in Harley 2013), but this is not meant as a specific claim about its position in the derivation.

\[
\begin{align*}
(29) & \quad [\text{VoiceP ExtArg Voice} [v_1P \text{ } v_{\text{ACT}} \sqrt{\text{IntArg}_{\text{ACC}}}]]
\end{align*}
\]

The causative is essentially an additional \(v_{\text{ACT}}\) head merged above this structure, requiring another Voice head on top of it to introduce the causer. While the active sentence (28) has one external argument [naʔ] and one Accusative Case (on [gami:ʃaʔan]), the causative sentence (30) adds an external argument [maʔ] and another Accusative Case (on [nan]). This suggests that the causative suffix essentially is another \(v_{\text{ACT}}\) head, assigning Accusative Case to the argument below it (the causee), and requiring a Voice head to merge above it and introduce an external argument (the causer).

\[
\begin{align*}
(30) & \quad \text{bewe:n-e’n’} & \quad \text{ma-ʔ} & \quad \text{na-n} & \quad \text{(gami:ʃaʔan)} \\
& \quad \text{sew-CAUS-NPST} & \quad \text{you-NOM} & \quad \text{I-ACC} & \quad \text{(shirt-ACC)} \\
& \quad \text{“You will make me sew (a shirt)”}
\end{align*}
\]

The causative has the structure in (31), with another pair of \(v_{\text{ACT}}\) and Voice heads above the active structure in (29). This derivation follows, e.g., Harley (2013), in which the extra \(v_{\text{ACT}}\) head (\(v_0\) therein) encodes the causal semantics of the causative.

\[
\begin{align*}
(31) & \quad [\text{VoiceP Causer Voice} [v_1P \text{ } v_{\text{ACT}} [\text{VoiceP Causee}_{\text{ACC}} \text{ Voice} [v_1P \text{ } v_{\text{ACT}} \sqrt{\text{IntArg}_{\text{ACC}}}]])]
\end{align*}
\]

This analysis of the causative suffix as a \(v_{\text{ACT}}\) head occupying the \(v_1\) position gains support from verbs that are unaccusative by default, like [bohlut] ‘just grew’ in (32). To transitive a such verb (i.e., add an external argument and assign Accusative Case), the causative suffix [-o-] is added (33).\(^8\)

\(^8\) This [-o-] is the /-e/- allomorph of the causative with rounding harmony from the root /bo:hl/.
(32) bohl-ut
   grow-RC.PT  ?e:law-
   “The flowers grew”
   flower-NOM

(33) boho:l-o-t
   grow-CAUS-RC.PT  na-?
   I-NOM  ?e:law-i
   “I grew the flowers”
   flower-ACC

The flowers grew

Parsimony suggests that the suffix [-e]-[-o-] in (33) and (30) is the same syntactically as well as morphologically (both trigger RSC). With both active and unaccusative roots, the causative suffix adds an external argument (introduced by Voice) and an extra Accusative Case; in both situations, it is an (active) \( v_1 \) head. (32) and (33) have the structure in (34) and (35), respectively.

\[
(34) \quad [v_2P \ IntArg \ [v_{\text{UNACC}} \ \checkmark]]
\]

\[
(35) \quad [\text{VoiceP Causer Voice} \ [v_{\text{ACT}} \ [v_2P \ IntArg_{\text{ACC}} \ [v_{\text{UNACC}} \ \checkmark]]]]
\]

In both (31) and (45), the causative is the highest head in the \( v_1 \) position. By assumption, therefore, the causative head has phasal status; I propose that this is why the causative triggers RSC (e.g., [bewe:n] (from /be:wn/) in (30) and [boho:l] (from /bo:hl/) in (33)).

The unaccusative suffix (“medio-passive” in Newman (1944) and Collord (1968)) turns active verbs into unaccusatives; for example, (36) and (37) below exhibit the unaccusative alternation familiar from other languages.

\[
(36) \quad ?odb-it
   open-RC.PT  na-?
   I-NOM  tese:\-i
   “I just opened the door”
   door-ACC
\]

\[
(37) \quad ?odb-in-it
   open-INTS-RC.PT  tese\-
   door.NOM
   “The door just opened”
\]

The assumption made above that the \( v_2 \) position encoding resultative or stative semantics is lower than the \( v_1 \) position encoding causative or dynamic semantics prohibits the hypothetical structure in (38), where the unaccusative head merges on top of the active verb structure. Rather, the \( v_{\text{ACT}} \) head is never merged in a verbal structure with the unaccusative suffix; this suffix, i.e., the \( v_{\text{UNACC}} \) head, is merged in the \( v_2 \) position, and the \( v_1 \) position is left empty ((39), similar to (34) above).

\[
(38) \quad *[v_2P \ v_{\text{UNACC}} \ [v_{\text{ACT}} \ \checkmark \ IntArg]]
\]

\[
(39) \quad [v_2P \ IntArg \ [v_{\text{UNACC}} \ \checkmark]]
\]

The fact that oblique agents marked in the Genitive cannot occur with the unaccusative (unlike with the passive, where they can occur) supports the structure (39), in which no active semantics

\[\text{9 In fact, the causative optionally does not trigger RSC: compare [tʃiə:-la-tə?] (RSC) with [tʃiə:-la-tə?] (no RSC) (‘had made X cut’ from /tʃiə/ ‘cut’), or [lehe:m-e-ta?] (RSC) with [lihim-la-ta?] (no RSC) (‘had made X run’ from /lihm/ ‘run’). With a few verbs, the causative never triggers RSC: [xat-la-ta?] vs. *[xatə:-la-ta?] (‘had made X eat’ from /xat/ ‘eat’). RSC forms in general seem to be preferred, and in some cases are obligatory, but the optionality of RSC seems too widespread to be an irregularity. Possibly, the RSC and non-RSC forms are syntactically distinct, similar to Travis’ (2000, 2010) distinction between ‘lexical’ causatives in \( v_1 \) (her V1) and ‘syntactic’ causatives, which are outside the verbal domain proper; perhaps the former but not the latter can be a verbal phase head. As yet, no syntactic difference has been found between RSC and non-RSC forms of the causatives.}\]
is present in the structure. Several stative verbs, such as /haʃ-w-n/ ‘die’ and /ʔips-n/ ‘be lost’, are also formed with the unaccusative /-n/ suffix; these presumably never have any causal or dynamic semantics, and thus no v1 head. Curiously, some psych-predicates are derived using the unaccusative /-n/ suffix; these presumably never have any causal or dynamic semantics, and thus no v1 head. 

The subject of these verbs is an experiencer, not an active subject; in fact, no active semantics are present in psych-predicates where the experiencer is the subject, as these are stative (e.g., Filip 1996). Here, as well as in (37), the /n/ suffix encodes the vUNACC head in the v2 position, except with an experiencer rather than a theme argument. While the rheme of these psych-predicates (i.e., the source of the hate, like, or annoyance) is marked by the Accusative Case, I suggest that this is not assigned by a v head, but is actually a default non-argument Case (the other oblique Cases, e.g., the locative, the ablative, and the instrumental, have additional semantic content, and cannot be default). As the unaccusative suffix is a v2 head, it does not have phasal status; it also does not trigger RSC.

The other verbal suffixes that affect argument structure (the passive, reflexive/reciprocal, benefactive, and comitative suffixes) also do not occupy v1 position, and are thus not phase heads. Following, e.g., Pylkkänen (2002) and Harley (2013), these suffixes are Voice or Appl heads, which introduce (or prevent) arguments in the syntax. The passive is a Voice head that prevents an overt external argument from merging (Harley 2013); however, active semantics are present due to the v1 head, so that an oblique genitive-marked agent can be expressed (unlike with the unaccusative). A passive sentence has the following structure in the verbal domain ((40); the internal argument raises to Infl, where it receives Nominative Case).

(40)  \[\text{VoiceP (\#ExtArg) VoicePASS [v1P vACT } \sqrt{\text{IntArg}}] \]

The reflexive/reciprocal suffix is also a Voice head, one that coindexes the external and internal arguments, so that they are co-referential. The benefactive and comitative suffixes add semantically oblique arguments (“for” or “to” with the benefactive, “with” with the comitative), marked with the Accusative Case. I consider these suffixes Applicative (Appl) heads, merging with the lower verbal structure (v2P in this account) and introducing an argument in their specifiers, to which they assign Accusative Case (Pylkkänen 2002). As none of these suffixes are v1 heads, I posit that they are not phase heads; these suffixes do not trigger RSC.

As for the aspectual suffixes (the inchoative, causative-inchoative, distributive, and durative), I suggest that they all occupy a higher v1 position above the vACT head, and thus are phase heads. As posited in §2.2.3, v1 heads express meaning concerning the initiation or dynamic process of the event, exactly the parts of the event modified by these aspectual suffixes (as opposed to v2 heads, which concern the resultative state or goal of the event). The inchoative “become X” and causative-inchoative “cause to become X” takes adjectives and adds an initial transition point, the distributive “X a lot” specifies the process as being multiple, spread out, or otherwise enlarged, and the durative “is X-ing” specifies the process as having duration, i.e., not being punctual. The distributive suffix is relatively rare in Chukchansi, and its productivity is unclear; all forms elicited, however, do trigger RSC. Since the distributive alters the dynamic process of the verbal event, I posit that it is a v1 head. The other three aspectual suffixes are also v1 heads, as shown by a more detailed investigation.

The inchoative and causative-inchoative are fully productive in Chukchansi. The inchoative applies to roots denoting states, which surface elsewhere as adjectives (which pattern with nominals in Yokuts). The inchoative turns these adjectives into dynamic verbs, with initial
transitions from non-state to state; e.g., /limk’/ [limik’] “black, dark” (41) becomes [leme:k-a-] “become black/dark, darken,” which specifies a transition from not-dark to dark (42).

(41) sasy-in-ta? leme:k’-a-t
break-INTS-RC.PT dark-INCH-RC.PT
xa:lu? man-aw
limik’-Ø outside-LOC
“The black bowl broke”
“It got dark outside”

The inchoative introduces a dynamic initiation to an otherwise stative predicate; to denote a stative (non-dynamic) meaning, the adjective must be used, not the inchoative. This indicates that the inchoative must be a $v_1$, not a $v_2$ head. The initiation can be caused by an external agent or internally caused; the former is indicated with the causative-inchoative, which introduces an external argument and assigns Accusative Case, the latter with the inchoative, which lacks both. Since these inchoative suffixes are not added to already verbalized stems, they constitute the only $v_1$ head, and thus the phase head. For reasons outlined below in §2.4, I assume that this $v_1$ head does not merge with a lexical root, but instead with an adjectival stem $aP$ ((43) for the inchoative, (44) for the causative-inchoative).

(43) [$v_1P vINCH [aP a √ IntArg]]
(44) [VoiceP ExtArg Voice [$v_1P vINCH [aP a √ IntArgACC]]]'

The durative suffix is also fully productive, and can occur with any verb root. The durative indicates a process that is extended or ongoing, i.e., has duration. Because the durative affects the process of the event, it is a $v_1$ head; I suggest that this head, as well as other aspectual $v_1$ heads that attach to verbs, merges above the $vACT$ head that categorizes the lexical root. Another possibility is that these suffixes spell out features (e.g., [+durative]) in the same $v_1$ head as a [+active] feature. For reasons that will become clear in §2.4, I reject this possibility and instead assume that aspectual suffixes are higher in the syntax than the $vACT$ head (though perhaps in the same overall $v_1$ position) (45).

(45) [VoiceP ExtArg Voice [$v_1P vDUR [v_1P vACT √ (IntArgACC)]]]

Puzzlingly, the durative /-ʔa-/ which triggers RSC, only appears in situations where the phonology allows it to trigger RSC. In situations where RSC is prevented by the phonology, the suffix /-xo-/ occurs instead; /-xo-/ does not immediately appear to differ semantically from /-ʔa-/, and Newman (1944) assumes that these suffixes are semantically identical. This might suggest that the choice between /-ʔa-/ and /-xo-/ is up to the phonology; when RSC can occur in the phonology, /-ʔa-/ is inserted, and when RSC cannot occur, /-xo-/ is inserted. However, Collord (1968) gives data where both /-ʔa-/ and /-xo-/ are attached to the same word, and thus cannot be in complementary distribution; while such data have not been volunteered spontaneously in current fieldwork, they are accepted as grammatical (46-47).

(46) xata- /-ʔa- xo- hil
‘eat’ ?A XO MD.PT
“kept on eating”
Collord (1968:51)

I have not yet checked about other aspectual effects of this suffix, e.g., whether it adds dynamicity to non-dynamic predicates, whether it affects telicity; in general, Aktionsart in Yokuts is unstudied.
These data suggest that /-ʔa-/ and /-xo-/ may not indeed occupy the same syntactic position, and may have different semantics (perhaps with /-ʔa-/ expressing Situation Aspect and /-xo-/ Viewpoint Aspect). More research is needed to uncover what syntactic or semantic differences there may be between /-ʔa-/ and /-xo-/. For now, these are just conjecture based on (46-47).

The one other productive aspectual suffix in Chukchansi is the repetitive “keep X-ing over and over.” This suffix, like the distributive and durative, clearly modifies the dynamic process of the event, and thus is a \( v_1 \) phase head. In Chukchansi, the repetitive aspect is indicated by reduplication, which prevents RSC from occurring for phonological reasons shown in §4.5 below. In Newman’s (1944) data, the repetitive aspect only triggers reduplication with biconsonantal roots; with triconsonantal roots, it appears as an independent suffix /-da-/ and triggers RSC. The repetitive thus falls in line with the other aspectual suffixes in Yokuts.

The other non-final verbal suffixes in Chukchansi are the andative “go while X-ing,” the desiderative “want to X,” the hortatory “let X,” and the exclusive “do nothing but X.” The latter three are modal suffixes, which I posit merge higher than the extended verbal domain, in Infl (following syntactic work on modals in general). At any rate, these suffixes do not alter the initiation or dynamic process of the event, and cannot be \( v_1 \) heads. The andative also does not seem to contribute causal or dynamic semantics to the event, and is likely not a \( v_1 \) head. Where exactly the andative appears in the syntactic derivation is an open question; it may be a higher aspectual head that takes the event as a whole (i.e., the entire \( vP \)) as a complement.

To summarize this section, the causative and aspectual suffixes are additional \( v_1 \) heads that merge above the \( v_{\text{ACT}} \) head, and thus function as phases; these suffixes all trigger RSC (or are prevented from doing so for phonological reasons). Other suffixes are either lower, in \( v_2 \) (unaccusative) or Appl (benefactive and comitative), or higher, in Voice (passive and reflexive/reciprocal) or Mood. I have proposed that none of these latter heads are phases; these suffixes also do not trigger RSC. If this proposal about phasehood in the verbal domain is correct, it suggests that RSC is a phonological effect of the phasal status of suffixes. Section 4 below demonstrates that RSC indeed emerges from phase-based spell-out by these suffixes, due entirely to the phonological grammar of Chukchansi (explicated in Section 3).

### 2.3.2. Nominal Phase Heads

If phase heads in the verbal domain trigger RSC, then phase heads in the nominal domain may be expected to do so, as well. This is exactly what happens in Chukchansi: the deverbal nominalizing suffixes (agentive “X-er/one who X-es” and adjunctive “place/instrument for X-ing”) both trigger RSC. Nominalization involves the merging of a category-defining \( n \) head to a verbalized stem (\( v + \) lexical root); following, e.g., Marantz (2000) and Newell (2008), category-defining heads are phase heads. Besides case suffixes, Chukchansi generally lacks productive nominal morphology; these \( n \) heads are therefore always the highest \( n \) head, and thus function as
the phase. Deverbal nominals in Chukchansi, such as the agentive and adjunctive, have the following structure ((48), not distinguishing between \( v_1 \) and \( v_2 \)).

\[
(48) \quad [nP \ n \ [vP \ \sqrt{\_}]]
\]

The RSC-triggering agentive and adjunctive suffixes are \( n \) heads in (48), and therefore are phase heads. Other deverbal nominalizers should also be phase heads, and would be expected to trigger RSC. Indeed, several nominal suffixes of Yokuts in Newman (1944) and Collord (1968) trigger RSC (as argued in §5.1.1); these include various flavors of agentive (consequent, desiderative, and habitual) in Newman, as well as the “dubitative agentive” (Collord), cognate to Newman’s “consequent agentive.” Present fieldwork on Chukchansi has not observed enough of these suffixes to determine if they trigger RSC for current speakers. The passive nominal suffix does not trigger RSC; however, as indicated in §2.1.1 above, this is actually polymorphemic, composed of the passive voice suffix /-han-/ and a nominalizer /-a-/ (other voice suffixes are also occasionally used in nominalization, such as /mix/ ‘comitative’ in [ʔep-mix-iʔ] ‘swim’-COM-NMZR-NOM = “swimsuit”). The presence of the passive suffix (not itself a phase head) before the nominalizing phase head prevents the appearance of RSC in the phonology, as illustrated in §4.4 below.

RSC would also be blocked phonologically when vowel-final (i.e., non-canonical) verb roots attach to the verbal noun suffix (see §4.3). However, I argue that the so-called verbal noun in Yokuts actually is not a deverbal nominalization, but simply a nominalization of the lexical root. The nominalizing \( n \) head merges directly with the lexical root, similar to any other noun; no \( v \) head is merged in the derivation (49).

\[
(49) \quad [nP \ n \ \sqrt{\_}]
\]

Semantically, there is no obvious reason for this nominalization to be derived from a verb. As indicated also by Newman (1944) and Collord (1968), this nominal can indicate both the activity of the root as well as an object associated with it. This flexibility of semantics suggests that the meaning of this nominal is simply computed as an entity associated with the content of the lexical root; I thus re-label the “verbal noun” as a “root nominal.” On the other hand, the agentive and adjunctive nominals must attach to verbalized stems, and not simply to category-less roots. The agentive is always semantically equivalent to the highest argument of a verb, one who initiates (if the verb is active) or merely undergoes (if it is unaccusative) the event denoted by the \( vP \). Without a \( v \) head, this meaning cannot be determined, e.g., simply as an associated entity. The adjunctive indicates an instrument through or place at which the event denoted by the \( vP \) happens, and thus also must merge with a \( vP \) (see (48) above). The root nominal is thus structurally different from deverbal nominalizations; the next section shows why the latter, but not the former, trigger RSC.

---

11 Quite a few animate nouns have plural forms, e.g., [no:no:] ‘man’ ~ [none:(ʔ/h)i] ‘men’ and [p’ay:–] ‘child’ ~ [p’aye:(ʔ/h)i] ‘children’. However, many animate nouns do not have plural forms, e.g., [moke:la–] ‘woman’ ‘women’, inanimate nouns never have plural forms. While the syntax of plurals in Chukchansi has not been explored, e.g., there is no evidence whether or not the plural head is a phase head, plural forms do usually undergo a form of RSC. Whether plural RSC is the same, similar, or completely different from the other forms of RSC explored in this paper merits exploration; this may reveal more about the relation between phasehood and RSC in Chukchansi.
2.4. First-Merged and Later-Merged Phase Heads

I argue in §2.3 that heads occupying the $v_1$ position (encoding causal and dynamic properties) are phase heads in the verbal domain, and that nominalizing $n$ heads are phase heads as well. Moreover, only those suffixes that spell out phase heads trigger RSC. This proposal is largely borne out: the causative, durative, distributive, (causative-)inchoative ($v_1$ heads), agentive and adjunctive ($n$ heads) suffixes all trigger RSC when phonologically possible. However, this argument predicts that, in the absence of a higher RSC-triggering suffix, the default $v_1$ or $n$ categorizing head retains phasal status, and should thus trigger RSC, as well. Specifically, both active (transitive and unergative) verbs and root nominals should undergo RSC; these forms contain a (phonologically null) $v_1$ head and $n$ head, respectively. Neither active verbs nor root nominals, however, do undergo RSC in the absence of a higher phase head suffix. The generalization to account for, then, is why phonologically contentful phasal suffixes trigger RSC, while phonologically null phasal suffixes do not trigger RSC. Alternatively stated, the generalization to analyze is why first-merged phase heads, which merge directly with lexical roots, do not trigger RSC, while phase heads merged later (and thus higher) in the derivation do. The RSC-triggering structure (later-merged, phonologically contentful phase head) is illustrated in (50), the non-triggering structure (first-merged, phonologically null phase head) in (51).

\[
\text{(50)} \quad [xP \ x] \ V = [[\text{Root-Ø}]-x] \\
\text{(51)} \quad [yP \ y] \ V = [\text{Root-Ø}] 
\]

One option is simply to state a constraint that covert heads cannot trigger phonological processes, such as RSC. Initially, this seems plausible: a phonologically null suffix should not be expected to have any influence on the phonology of other morphemes. Section 4, however, demonstrates that RSC results when phonological roots go through a phonological cycle without affixal material, due entirely to the general phonotactics and prosody of Chukchansi. If the syntactic material corresponding to the phonological root is spelled out early, and thus the latter enters the phonology without affixes, RSC emerges, no matter whether the phase head that spells it out is overt or covert. To maintain a coherent account of RSC, therefore, the phonological root cannot go through an early phonological cycle when the phase head is null. One possibility is that only overt heads can be “strong” phases (in the sense of Chomsky 2008), and trigger spell-out: covert heads perhaps are “weak” phases, and do not trigger spell-out. Such an approach suggests that the phonological status of a head (segmentally contentful or zero) can determine its syntactic status (strong or weak phase head). This seems to contradict the commonly assumed “feed-forward” model of syntax-phonology interaction, in which syntax can feed material to the phonology but not vice-versa (Zwicky and Pullum 1986). An alternative position is that only higher or later-merged heads can be “strong” phases, while first-merged heads can only be “weak” phases; there does not seem to be any syntactic reason for such a position.

I instead posit that the phonological root spells out both the lexical root and the categorizing $v_1$ or $n$ head it first merges with. In other words, the phonological root actually corresponds to a syntactic stem, encoding more than one terminal position in the syntax. In such an analysis, the first-merged categorizing head is not phonologically null; rather, it is encoded within the phonological root. This captures the generalization in Chukchansi that all first-merged categorizing heads are not expressed by a separate phonologically contentful suffix, while later-merged heads mostly are. In fact, Chukchansi does not have seem to have default noun- or verb-formative affixes that would correspond to first-merged categorizing heads. Instead, there are
deverbal nominalizers (agentive, adjunctive, passive) and deadjectival verbalizers ((causative)-inchoative), which attach to already categorized stems and encode additional semantic information. I thus propose that most Chukchansi phonological lexical entries (i.e., roots) correspond to syntactic stems, i.e., lexical roots plus first-merged categorizing heads (v, n, or a, all represented by $x$ in Figure (3)).

$$\sqrt{\text{ROOT}} + x$$

Figure 3. Phonological Root = Syntactic Stem /ROOT/

This proposal contradicts the general tenets of Distributed Morphology (DM; Halle and Marantz 1993), where lexical items are roots in both the syntactic and the phonological sense, and bigger constituents cannot be listed in the lexicon. It does, however, fit nicely in Wolf’s (2008) theory of lexical insertion, where syntactic features and lexical roots (= morphemes in Wolf 2008) are in correspondence with phonologically contentful units (= morphs). In this theory, lexical insertion occurs in the phonology, which regulates matters of correspondence between inputs (morphemes) and outputs (pairs of morphemes and morphs). A correspondence theory of lexical insertion easily admits of a phonological root morph corresponding to a syntactic stem.

2.4.1. Root Morphs and Syntactic Stems

This section demonstrates why an analysis where (phonological) root morphs in Chukchansi correspond to syntactic stems (i.e., lexical roots and first-merged categorizing head (v, n, or a)) is likely correct. First, cognate nominal (or adjectival) and verbal roots sometimes differ in their vowel patterns and/or phonological shape (52-58).

(52) /so:nop/ ‘snot’ vs. /sonp/- ‘be snotty’
(53) /dehe:l/- ‘scissors’ vs. /dihl/- ‘cut with scissors’
(54) /hot’on/- ‘flame’ vs. /hot’n/- ‘burn’ (v.)
(55) /k’e:tm/- ‘rich’ vs. /k’e:mx/- ‘get rich’
(56) /je?al/- ‘rain’ (n.) vs. /je?e:l/- ‘rain’ (v.)
(57) /gadya/- ‘hungry’ vs. /gada:y/- ‘be hungry’
(58) /ʔay’ax/- ‘fast’ vs. /ʔay’xa/- ‘hurry’

It is simpler to assume that these are truly different roots phonologically, rather than sharing the exact same phonological root but having different shape-altering affixes that correspond to either the n or v head. Under the former assumption (Figure (4)), there is no reason why cognate verb and noun roots must be phonologically identical. Under the latter assumption (Figure (5)), the otherwise phonologically null categorizing heads would have to express these arbitrary differences in phonology between cognate nouns and verbs. Such an assumption would needlessly complicate the phonology of Chukchansi; I thus take Figure (4) to be the correct structure, not Figure (5).12

---

12 The former assumption, in which the root morph corresponds to the syntactic stem (Figure (4)), seems to predict that cognate nouns and verbs need have no phonological relation whatsoever. This is obviously untrue in Chukchansi; a clearer account of the relation between lexical roots, syntactic stems, and phonological root and
Second, as shown above in §2.3.1, some verbs are unaccusative by default; based on the structure posited in Figures (3-4), these root morphs correspond to both the lexical root and the \( v_{\text{UNACC}} \) head. The active version of these unaccusative verbs requires an overt suffix, the causative, corresponding to the \( v_{\text{ACT}} \) head. Unaccusative verbs have the pattern in (59), while active verbs have the pattern in (60).

(59) Unaccusative: \( \sqrt{} + v_{\text{UNACC}} \rightarrow [\text{ROOT}]; \sqrt{} + v_{\text{ACT}} \rightarrow [\text{ROOT-CAUS}] \)

(60) Active: \( \sqrt{} + v_{\text{ACT}} \rightarrow [\text{ROOT}]; \sqrt{} + v_{\text{UNACC}} \rightarrow [\text{ROOT-UNACC}] \)

Under the assumption that lexical roots alone correspond to root morphs, the \( v_{\text{UNACC}} \) head in (59) and the \( v_{\text{ACT}} \) head in (60) must be zero suffixes. The two types of lexical root would thus need to specify which zero suffix they can attach to, either the active or unaccusative \( v \) head; for example, the root of an unaccusative verb can only attach to a zero \( v_{\text{UNACC}} \) head, not a zero \( v_{\text{ACT}} \) head. Alternatively, lexical roots would have to specify which allomorph of each \( v \) head suffix they attach to, either the phonologically null or contentful form. For example, the root of an unaccusative verb would select the zero allomorph of the \( v_{\text{UNACC}} \) suffix but the contentful allomorph of the \( v_{\text{ACT}} \) suffix. Both of these alternatives require morphological subcategorization on the part of the lexical root for a phonological realization of different categorizing \( v \) heads. I suggest that it at least is no more complicated for the root morph to correspond to the correct head, instead of lexical subcategorizing for it. This forms a rather clear picture of first-merged \( v \) heads: either they are encoded directly by the root morph, or they are spelled out by a specific suffix. No choosing between phonologically null and contentful suffixes is needed; §4.1 shows how this can be modeled in Wolf’s (2008) theory of lexical insertion.

Lastly, some verbs that do not have an extant root morph, such as */haʃw/ “death,” do seem only to encode the lexical root; the active “kill” (\( v_{\text{ACT}} + \text{‘death’} \)) and unaccusative “die” (\( v_{\text{UNACC}} + \text{‘death’} \)) are formed with the overt causative (\( v_{\text{ACT}} \)) and unaccusative (\( v_{\text{UNACC}} \)) suffixes,

---

stem morphs would likely account for both the non-arbitrary relation between cognate nouns and verbs (not predicted by Figure (4)) and their non-identity (not predicted by Figure (5)).
respectively. This gives the following generalizations about possible verb root and stem structures in Chukchansi (61-63):

(61) Root morphs (phonological) typically correspond to syntactic stems (lexical root + a particular categorizing v head).

(62) If the root morph corresponds to one certain v head (e.g., v_{ACT}), the other v head (e.g., v_{UNACC}) must be spelled out by a separate suffix; an additional v head merged above the first v head (e.g., another v_{ACT} forming the causative) must also be spelled out by a separate suffix.

(63) If the root morph only corresponds to the lexical root, both v heads must be spelled out by separate suffixes.

Table (5) shows the three classes of verb root morph: active, where the root morph corresponds to the lexical root and v_{ACT} head (e.g., /se:p/), unaccusative, corresponding to the lexical root and v_{UNACC} head (e.g., /bo:hl/), and non-extant, corresponding to the lexical root (e.g., */haʃw/) (61). The unaccusative forms of active root morphs require a separate v_{UNACC} suffix ([se:p-n-]), while the active forms of unaccusative root morphs require a separate v_{ACT} suffix ([[boho:l]-o-]) (62); the causative forms of active root morphs also need an additional v_{ACT} suffix ([[sip:a]-la-]) (62). Non-extant roots require separate suffixes in both active and unaccusative forms (63). When a separate v_{ACT} suffix occurs, it is the highest v_1 head, assuming phasal status and triggering RSC; a separate v_{UNACC} suffix never triggers RSC because it is a v_2 head.

<table>
<thead>
<tr>
<th>Root Morph</th>
<th>Active (+ v_{ACT})</th>
<th>Causative (+ additional v_{ACT})</th>
<th>Unaccusative (+ v_{UNACC})</th>
</tr>
</thead>
<tbody>
<tr>
<td>/se:p/ 'tear' (tr.)</td>
<td>[[sip:a]-la-] 'make s.o. tear'</td>
<td>[se:p-n-] 'tear' (intr.)</td>
<td></td>
</tr>
<tr>
<td>/bo:hl/ 'grow' (intr.)</td>
<td>[[boho:l]-o-] 'grow' (tr.)</td>
<td>N/A</td>
<td></td>
</tr>
<tr>
<td>*/haʃw/</td>
<td>Active (+ v_{ACT})</td>
<td>Unaccusative (+ v_{UNACC})</td>
<td>N/A</td>
</tr>
<tr>
<td></td>
<td>[haʃaʔw]-e-] 'kill'</td>
<td>[haʃw-n-] 'die'</td>
<td></td>
</tr>
</tbody>
</table>

2.4.2. Phase-Based Spellout: First- vs. Later-Merged Phase Heads

I can now show why only later-merged phase heads trigger RSC, not first-merged phase heads. Later-merged phase heads have the general structure in (64), while first-merged phase heads have the structure in (65) (modified from (50) and (51) above, respectively).

\[
\begin{align*}
\text{Later-merged:} & \quad [x_P \cdot x_P y \cdot \sqrt{v}] = [\text{ROOT}] x \\
\text{First-merged:} & \quad [x_P y \cdot \sqrt{v}] = [\text{ROOT}]
\end{align*}
\]

When a higher v_1 or n head has phasal status (64), it spells out its complement, the verbalized or nominalized stem [x_P y \cdot \sqrt{v}]. This stem [x_P y \cdot \sqrt{v}] corresponds to a root morph, which is inserted into the phonology, before the higher phase head suffix (or any other suffix, for that matter). As §4.2 shows, with certain (phonologically-determined) root morphs, early insertion into phonology without affixal material results in RSC due to general Chukchansi constraints on prosody and (phonological) minimality.
When the categorizing $v_1$ or $n$ head has phasal status (65), it spells out its complement, i.e., just the lexical root. Because the phonological root corresponds to the categorizing $v_1$ or $n$ head in addition to the lexical root, the phonological root cannot be inserted when the former head has not been spelled out. Therefore, when the categorizing $v_1$ or $n$ head is the phase, i.e., in active verbs without higher $v_1$ heads and in root nominals, RSC does not occur because the phonological root is not inserted.

In §4.1.1, I give a detailed account of why this insertion does not happen, using Wolf’s (2008) theory of lexical insertion happening in the phonology.

The RSC-triggering later-merged phase heads all have the structure in (64), while non-triggering first-merged phase heads all have the structure in (65); refer to §2.3 above for more detail. The causative suffix is a higher $v_{\text{ACT}}$ phase head, which merges with active stems to form the causative (66) and unaccusative stem to form the active (67); the verbalized stems in the (higher) $v_{\text{ACT}}$ head’s complement are sent to the phonology (ignoring the Voice projection; see (31), (35) and Table (5) above).

(66) Causative: $[v_1P v_{\text{ACT}} [v_1P v_{\text{ACT}} \sqrt{\text{v}}]] \rightarrow [\text{ROOT}_{\text{ACT}}] (= [v_1P v_{\text{ACT}} \sqrt{\text{v}}])$

(67) Active: $[v_1P v_{\text{ACT}} [v_2P v_{\text{UNACC}} \sqrt{\text{v}}]] \rightarrow [\text{ROOT}_{\text{UNACC}}] (= [v_2P v_{\text{UNACC}} \sqrt{\text{v}}])$

The inchoative and causative-inchoative suffixes are $v_1$ heads that merge with adjectival stems; the phasal $v_{\text{INCH}}$ head spells out the adjectival stem in its complement ((68); see (43-44) above).

(68) Inchoative: $[v_1P v_{\text{INCH}} [\alpha P \alpha \sqrt{\text{v}}]] \rightarrow [\text{ROOT}_{\text{ADJ}}] (= [\alpha P \alpha \sqrt{\text{v}}])$

The other aspectual suffixes (distributive and durative) are also $v_1$ phase heads that merge with verbalized stems and spell them out ((69); see (45) above, as well).

(69) Aspect: $[v_1P v_{\text{DUR/DIST}} [\alpha P v \sqrt{\text{v}}]] \rightarrow [\text{ROOT}_{\text{VRB}}] (= [\alpha P v \sqrt{\text{v}}])$

Deverbal nominalizers (agentive and adjunctive) are $n$ phase heads that merge with verbalized stem and spell them out ((70); see (48) above, as well).

(70) Deverbal Nominalizers $[\alpha P n [\alpha P v \sqrt{\text{v}}]] \rightarrow [\text{ROOT}_{\text{VRB}}] (= [\alpha P v \sqrt{\text{v}}])$

Active verbs corresponding to active root morphs have a $v_{\text{ACT}}$ phase head that merges with the lexical root ((71); see (29) above, as well). Since only the lexical root is in the phase complement, only it is sent to the phonology; §4.1.1 shows that the lexical root by itself is not sufficient to insert the root morph early.

(71) Active Verb: $[v_1P v_{\text{ACT}} [\sqrt{\text{v}}]] \rightarrow [\sqrt{\text{v}}] (= *[\text{ROOT}_{\text{ACT}}])$

Root nominals (i.e., ‘verbal nouns’ in Newman (1944) and Collord (1968); refer to §2.3.2 for discussion) have an $n$ head that merges with the lexical root ((72); see (49) above, as well). Again, only the lexical root is in the phase complement, preventing insertion of the root morph.

(72) Root Nominal $[\alpha P n [\sqrt{\text{v}}]] \rightarrow [\sqrt{\text{v}}] (= *[\text{ROOT}_{\text{NOM}}])$

To summarize, the higher (later-merged) $v_1$ or $n$ phase head sends the stem in its complement to the phonology, resulting in the insertion of the root morph. Section 4 shows that the appearance of the root morph in the phonology without affixal material causes RSC; this is why all higher $v_1$ or $n$ phase heads trigger RSC. A lower (first-merged) $v_1$ or $n$ phase head only sends the lexical root in its complement to the phonology, so that the root morph is not inserted. Any non-phase
heads (e.g., Voice, Mood, \(v_2\)) merged do not alter the phasal structure, and thus cannot cause the root morph to be inserted early; this is why non-phase heads do not trigger RSC.

3. Phonological Nature of Root Shape Change: Optimal (L’H) Foot

In Section 2, I investigated the syntactic properties of root shape change (RSC). In this section, I explore its phonological characteristics, and propose that RSC is the appearance of optimal prosodic structure. I reanalyze Chukchansi as an iambic language (§3.1); evidence for this reanalysis comes from stress patterns (§3.2), placement of epenthetic vowels (§3.3), and the lexical inventory of verb roots (§3.4). RSC generally results in an initial (L’H) Foot, which is optimal in iambic stress systems (§3.1.1); any departures from the (L’H) Foot are due to overriding phonotactic constraints (§3.5).

3.1. Chukchansi Yokuts as an Iambic Language

In this section, I argue that Chukchansi Yokuts is an iambic language, i.e., it parses words into iambic Feet from left to right. This argument rests partly on novel stress data from Chukchansi that display quantity-sensitivity, contra the penultimate stress assumed for Yokuts based on Newman (1944). These new data, collected by the researcher, show that non-final heavy syllables (CV: and CVC) always receive (at least some degree of) stress (73-74). Penultimate light syllables also receive stress, due to constraints preventing final stress as well as sequences of unstressed syllables (74-75).

(73) Stress on Non-Final Heavy Syllables:
   a. [ˈp’a:.ya] ‘child-ACC’
   b. [ˈbok’.to?] ‘had found’
   c. [he. ye:.ma] ‘long ago’
   d. [ʃfi.ʃa:.lat] ‘just made cut’
   e. [ˈk’et.la.’han.ta?] ‘had made be shaved’
   f. [ʔa. ʃe:.dʒa.’law.ʃit] ‘just made oneself crazy’

(74) Stress on Heavy + Light Penults:
   a. [ʃfi.’e:.xa.ʔan] ‘dog-ACC’
   b. [ʃe.ʃe:.le?.hi.yaw] ‘at school’
   c. [ʃun.’ʃu.nut] ‘just shook’
   d. [li.ʃim.’wi.ʃe?] ‘will run with each other’
   e. [ˈbe.ʃin.ha.’na.ʔan] ‘sewn thing-ACC’

(75) Stress on Light Penults:
   a. [ʔa.ʃit] ‘long ago’
   b. [ˈp’i.ʃe?] ‘will light’

These findings mostly agree with Collord’s (1968) and Mello’s (2012) generalizations about Chukchansi stress, though they differ from Newman’s (1944) description of stress in Yokuts as being almost always penultimate. The Chukchansi stress system outlined above can be captured equally well with either moraic trochees or iambic. However, other areas of the phonology show convincingly that an iambic analysis is more explanatory than a moraic trochaic analysis. First, when vowel epenthesis occurs to resolve triconsonantal clusters that cannot be syllabified, the position of the epenthetic vowel always results in a light-heavy (LH), not a heavy-light (HL), syllable sequence. While both an LH and an HL sequence would be phonotactically well-formed, the preference for LH over HL, ceteris paribus, suggests that the former sequence is more...
harmonic than the latter in Chukchansi. An LH sequence fully parses into an optimal (L’H) iambic Foot, while (’H)L is a poorer iambic parse; in a trochaic system, both sequences are equally well-formed. Secondly, the inventory of verb roots in the lexicon is skewed toward shapes that are parsed left-to-right into H or LH sequences. Roots that could be parsed into LL sequences are relatively rare; since LL sequences tend to be disharmonic in iambic but not in trochaic systems, their relative absence in Chukchansi suggests that it is iambic. Finally, the fact that root shape change almost always results in an LH sequence also suggests that LH is a privileged structure in Chukchansi, which again makes perfect sense in an iambic system, but is unexplained in a trochaic system.

I propose that iambs are the fundamental building blocks of prosodic structure in Chukchansi Yokuts. Combined with the CVX (i.e., bimoraic, no clusters) limit on syllable size, this motivates the prosodic and phonotactic structure of Chukchansi. This system of phonological organization operates both at the surface of active, transparent phonology and in the depths of lexical trends. Crucially for the purposes of this paper, iambic structure is also at work in-between the surface and the depths, in the CVCVX(X) (i.e., LH) allomorphs of many roots that show up in root shape change, which I subsequently argue to be an interface effect of the syntactic structure within the verb and the general prosodic structure (i.e., iamb-favoring) of the language. The (L’H) Foot in root shape change, and root shape change as a whole, far from being an autonomous module of Yokuts morphophonology, simply fall out of the general structure of the language.

3.1.1. Background: Iambic Well-Formedness Scale

I make some theoretical assumptions about iambic stress systems. Iambic stress is right-headed (i.e., non-initial), and according to the Iambic-Trochaic Law (e.g., Hayes 1995), grounded in perception, prefers to be uneven, with the stressed unit (the syllable) longer in duration than the unstressed. This gives the light-heavy (L’H) Foot as the optimal Foot from the above point of view; the stressed ’H syllable is longer than the unstressed L syllable (Hayes 1995). Kager (1993, 1995) also has (L’H) being the optimal iambic foot, though his reasoning is different. The (L’H) Foot in Kager’s view is an optimal iambic configuration, in that its stressed mora is in the middle of the Foot [µ’µµ], avoiding both crosslinguistically-marked mora lapse (*[’µµµ] or *[µµ’µ]) and a final stressed element (*[µ’µ]), as well an initial stressed element *[µµ] (not strictly iambic). Prince (1990) also agrees with Kager (1993, 1995) and Hayes (1995) that (L’H) is the optimal Foot in an iambic system, according to principles of Grouping Harmony and preference for stressed element to branch (i.e., be bimoraic); (’H) and (L’L) are less well-formed iambs. The three possible iambic Feet have the following metrical structure (Figure (6)).

---

There is debate over the relative well-formedness of (H) and (L'L) Feet in iambic systems. For Prince (1990) and Hayes (1995) both (H) and (L'L) Feet depart equally from the optimal (L'H), since both Feet are even. For Kager (1993, 1995), on the other hand, the (H) Foot is more well-formed than the (L'L) Foot, as the (L'L) Foot has final prominence, which is cross-linguistically ill-formed at all levels: Word (e.g., Prince and Smolensky 1993), Foot, and Syllable (Kager 1995, Hyde 2007). The Chukchansi Yokuts data support Kager’s (1993, 1995) tripartite hierarchy of iambic well-formedness: (L'H), the optimal Foot, is the target of root shape change and vowel epenthesis, while both (L'H) and (H) Feet, but not (L'L), are good stress Feet. Moreover, the inventory of root shapes in the lexicon overwhelmingly favor those that are easily parsed into (H) or (L'H) Feet (i.e., without violating Faithfulness), while shapes that would be parsed into (L'L) Feet are conspicuously underattested. These data favor an iambic system in which (L'H) is the most well-formed foot and (L'L) the least, with (H) in-between (76).

(76) Iambic Well-formedness Scale: (L'H) < (H) < (L'L)


<table>
<thead>
<tr>
<th>L'H (most well-formed = optimal)</th>
<th>'H</th>
<th>L'L (least well-formed)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Root Shape Change Epenthesis</td>
<td>*DISHARMONIC</td>
<td>*DISHARMONIC</td>
</tr>
<tr>
<td>Stress Feet</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Lexical Root Shape</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

While I do not suggest that Prince (1990) and Hayes (1995) are wrong in the relatively equal well-formedness of (L'L) and (H) Feet cross-linguistically, I do claim the evidence shows that (H) Feet are more harmonic than (L'L) Feet in Chukchansi. This is due to the above dispreference for final prominence in prosodic units, e.g., the constraints NON-FINALITY(Ft) or NON-FINALITY(σ) (Hyde 2007; see also Kager 1995). I use the constraint NON-FINALITY(Ft) to penalize (L'L) Feet, in which the stressed mora is Foot-final.

(77) NON-FINALITY(Ft): Assign one violation mark for a stress occurring over the final mora of a foot

---

14 (L'L) Feet are also penalized by a general dispreference for stressed light syllables, e.g., the constraint Stress-to-Weight Principle (SWP; Prince 1990, Crosswhite 1998).
Because NON-FINALITY(Ft) favors (L'H) Feet over (L'L) Feet, an (L'H) Foot is constructed instead of an (L'L) Foot either when higher-ranking faithfulness constraints are not violated, or when markedness constraints ranked even higher force these faithfulness constraints to be violated. I propose that the latter ranking of Markedness over Faithfulness allows the unmarked (L'H) Foot to emerge in RSC.

3.2. Iambic Stress

This section presents new stress data on Chukchansi Yokuts, and shows that the generalizations found are mostly the same as those in previous studies of Chukchansi stress, Collord (1968) and Mello (2012), apart from inconsistencies about primary versus secondary stress. These three studies all dispute Newman’s (1944) account of (almost) exclusively penultimate stress in Yokuts. Chukchansi stress can mostly be accounted for with iambic (’H) and (L’H) Feet; a dispreference for poor (L’L) iambs and final consonant extrametricality results in a final (’LL) trochee in certain words.

3.2.1. Stress Generalizations

I begin by presenting data from a new study of Chukchansi Yokuts stress that I conducted on two separate occasions. While there are a few inconsistencies in the data, most of the words show the following patterns (78-80); apparent departures from these patterns almost always involve words where multiple stresses would be expected, but one of the stresses was not transcribed. Stress was never transcribed on syllables that were not expected to have stress. Disyllabic words are always stressed on the penultimate syllable (78).

(78) [‘p’a:.ya] [‘bok’.to?] [‘ʔa.lit] [‘p’i.fe?]

Trisyllabic words also have stress on the penultimate syllable (79-80); a heavy initial syllable is also stressed (80).

(79) [he.’ye:.ma] [ʧi.’a:.lat]
(80) [‘ʧe:.’xa.ʔan] [‘yun.’fu.nut]

Longer words show the same patterns as in (79-80): the penultimate syllable is stressed, as are all heavy syllables before the penult (81).

(81) [‘k’et.la.’han.ta?] [‘le.:’le?.’hi.yaw] [li.’him.’wi.ʃe?]
[‘a.’le.:ʤa.’law.fit] [‘be.’wi.ha.’na.ʔan]

No consistent distinction between primary and secondary stresses was found: often, the penultimate syllable seemed to have primary stress, but sometimes a prepentultimate syllable did. I set degrees of stress aside for now, as these are not crucial for any of the analysis below, though a consistent generalization should be found in the future.

Based on these data, the correct generalizations of Chukchansi stress are as follows (82-85):
(82) Penultimate syllables are always stressed, whether CV (a), CVC (b), or CV: (c)
      [li.'him.'wi:feʔ]  ['łe:.'leʔ. hi.yaw]  ['be:. win.ha.'naʔan]
   b. ['bok'.toʔ]  ['k̩et.la.'han.taʔ]  ['ʔa.'le:.dʒa.'law.fit]  [he.'ye: ma]
   c. ['p'a:ya]  ['fi.'fa:.lat]

(83) Final syllables are never stressed, neither CV (a) not CVC (b) (no final CV: syllables exist)
   a. *[he.ye:.'ma]
   b. *[ʔa.'lit]  *[ˈbok'. 'toʔ]  *[ˈje:.xa. 'ʔan]
      *[ʔa.'le:.dʒa.'law. 'fit]

(84) All heavy pre-penultimate syllables are stressed, both CVC (a) and CV: (b)
   a. ['yun.'fu:nu]  [li.'him.'wi:feʔ]  ['k̩et.la.'han.taʔ]
      ['łe:.'leʔ. hi.yaw]  ['be:. win.ha.'naʔan]
   b. ['je:.xa.ʔan]  ['łe:.'leʔ. hi.yaw]  ['ʔa.'le:.dʒa.'law.fit]
      ['be:. win.ha.'naʔan]

(85) No pre-penultimate CV syllables are ever stressed
   a. *[li.'him.'wi:feʔ]  *[k̩et.'la.'han.taʔ]  *[ʔa.'le:.dʒa.'law.fit],
      *[be:. win.'ha.'na.ʔan]

This system is quantity-sensitive: all heavy syllables receive stress, with non-finality forcing stress on light penultimate syllables to avoid a two-syllable lapse. I now show that Chukchansi stress is amenable to analysis with iambic Feet, built left-to-right (as in the vast majority of iambic systems; see, e.g., Hayes 1995). Chukchansi stress Feet are preferably (H) or (LH), and these are constructed left-to-right, so that the first Foot is always strictly word-initial.

(86) [ˈp’a:.ya]  [ˈbok’.toʔ]  [(he.’ye:].ma]
    [(fi.’fa:.lat]  [(k̩et).(la.’han.taʔ)]  [(ʔa.’le:.)(dʒa.’law.fit]  

A strict observance of non-finality (i.e., no stress on a final syllable), however, causes placement of a final (LL) trochee if the penult is light, in order to avoid these last two syllables being unstressed (assuming that the final consonant is extrametrical, as (’LH) Feet are likely impossible in any language).

(87) [ˈʔa.liʔt]  [ˈp’i:feʔ]  

Many words with three or more syllables begin in (H) or (LH) iambs and end in a final (LL) trochee.

(88) [ˈje:.(xa.ʔa)n]  [ˈle:.(leʔ):(hi.ya)w]  [ˈyun.)(fu.nu)t]
    [(li.’him).(wi:feʔ)]  [(be:.)(win).ha.(na.ʔa)n]

3.2.2. Comparison with Previous Accounts

The above generalizations seem to be at odds with Newman’s (1944) description of Yokuts stress as almost exclusively penultimate. On the other hand, these generalizations agree almost

Newman (1944:28) does note that certain suffixes (which he terms “auxiliaries”) are outside of the stress domain, and that “a few three-syllable nouns having a strong [i.e., long] vowel in the first syllable ... are stressed on the antepenult”, e.g., Wikchamni [ˈne:.pa.ʔi] “wife’s brothers.”
entirely with Collord’s (1968) description of Chukchansi stress. However, Collord (1968) distinguishes primary from secondary stress:

“Primary stress ... is on the penultimate syllable ... a secondary stress is found on the closed [i.e., heavy] syllables (non-penult) ... non-penultimate open [i.e., light] syllables are weakly stressed.”

(Collord 1968:14)

Disregarding the distinction between primary and secondary stress, Collord’s findings agree with the generalizations above (82-85), except that he finds a secondary stress on final heavy syllables. He notes, however, that final heavy syllable have low pitch, as do final light syllables, while pre-penultimate heavy syllables have medium or high pitch. This probably indicates that final heavy syllables do not actually have stress; this may be supported by the extreme rarity of final long vowels in Chukchansi, which is unexpected if final vowels can be stressed on the surface. Lack of final stress also prevents describing CVCVC words as *[L’H], which would be extremely odd given what is known about stress systems (89).

(89) ?[?a.’lit], ?[p’i.’je?] Kroeber (1907:182) also indicates that stress in Yaudanchi is “partly dependent on quantity of vowels,” and that long vowels are almost always accented. Kroeber also reports that “unsuffixed words without long vowels most frequently are accented on the penult, sometimes on the antepenult” (1907:182), but does not indicate whether the stressed antepenults are always closed (he does not make a distinction in this study between open and closed syllables). Mello (2012) finds in his study of mostly disyllabic and trisyllabic Chukchansi words that stress is generally penultimate, but shifts to an antepenult with a long vowel (CV:), and is thus quantity-sensitive. While his generalizations give the same stress patterns as the new study does for most words (90), they drop one of the stresses in some trisyllabic words (91-92).

(90) [p’a:.ya] [bok’.to?] [?a.lit]
[p’i.fe?] [he.’ye:ma] [fi.’fa:.lat]
(91) [je:.xa.?an] instead of [je:. xa.?an]
(92) [yun.’fu.nut] instead of [yun.’fu.nut]

Mello’s study has some methodological issues (e.g., usage of non-Chukchansi phonemes in nonce words), as well as making several untenable conclusions, such as that codas are never moraic, and that long vowels cannot occur before the antepenult. Mello’s findings can nevertheless harmonize with Collord’s and the new study’s, if his generalization is about primary stress: I suggest that Mello’s actual finding is that penults in general have primary stress, but a preceding long vowel can attract primary stress away from the penult. This would follow from the fact that long vowel rimes (V:) are often inherently more prominent than short vowel + coda rimes (VC), as shown by, e.g., Zoll (1996), Gordon (2004, 2006), and O’Connor (2011). Nevertheless, the penult always has a secondary stress, as do closed (CVC) syllables before the penult; likely Mello did not observe these secondary stresses, perhaps since stresses in

16 Mello’s (2012) study consulted the same Chukchansi speakers as the new study.
consecutive syllables may be difficult to correctly transcribe (as I can attest in the new study). A close study of Mello’s pitch tracks and intensity data suggest that these secondary stresses are real. If this is true, then the difference between Collord’s and Mello’s generalizations may be a difference in position of primary stress between the speakers they consulted; the footing will be the same for both speakers. Alternatively, perhaps Collord (1968) could not have made Mello’s generalization about long-vowel syllables (CV:) vs. closed syllables (CVC); for Collord, these are structurally identical. Ignoring primary vs. secondary stress distinctions (which are irrelevant for the purposes of this study), the generalizations from the new study in §3.2.1 do not conflict with Collord’s or Mello’s findings. I therefore assume the footing in forms (86-88) above, remaining agnostic about which stresses are primary and secondary.

### 3.2.3. OT Analysis of Stress

This section shows that Chukchansi stress is amenable to an iambic parsing analysis. Iambic parsing requires ranking IAMB and PARSE-σ over TROCHEE (e.g., Prince and Smolensky 1993/2004, McCarthy and Prince 1993).

(93) IAMB: assign a violation mark to any Foot with the rightmost syllable unstressed.

(94) TROCHEE: assign a violation mark to any Foot with the leftmost syllable unstressed.

(95) PARSE-σ: assign a violation mark to any syllable not dominated by a Foot.

According to the formulation of these constraints, (L’L), (’H), and (L’H) are all possible Iambic feet (i.e., they do not violate IAMB). For the moment, I ignore the relative well-formedness of different iambic Feet adopted in the section above, as well as the matter of non-finality. The ranking of IAMB and PARSE-σ over TROCHEE correctly foots all data with a heavy penult, repeated from (86):

(96) [⟨ˈp’aː⟩.]ya  [⟨ˈbok’⟩.]toʔ]  [(he.’ ye:) .ma]  [(ʧi.’ fa:).lat]

Table 7. IAMB, PARSE-σ >> TROCHEE: (L’H)X

<table>
<thead>
<tr>
<th>/heye:ma/</th>
<th>IAMB</th>
<th>PARSE-σ</th>
<th>TROCHEE</th>
</tr>
</thead>
<tbody>
<tr>
<td>F (he.’ ye:).ma</td>
<td>*</td>
<td>*</td>
<td></td>
</tr>
<tr>
<td>he.(’ ye:).ma</td>
<td>** W</td>
<td>L</td>
<td></td>
</tr>
<tr>
<td>he.(’ ye:.ma)</td>
<td>* W</td>
<td>*</td>
<td>L</td>
</tr>
</tbody>
</table>

Table 8. IAMB, PARSE-σ >> TROCHEE: (L’H)(L’H)X

<table>
<thead>
<tr>
<th>/ʔale:dʒa-la-wʃ-ʃit/</th>
<th>IAMB</th>
<th>PARSE-σ</th>
<th>TROCHEE</th>
</tr>
</thead>
<tbody>
<tr>
<td>F (ʔa.’le:).(dʒa.’law).ʃit</td>
<td>*</td>
<td>**</td>
<td></td>
</tr>
<tr>
<td>ʔa.(’le:).dʒa.( ’law).ʃit</td>
<td>*** W</td>
<td>L</td>
<td></td>
</tr>
<tr>
<td>ʔa.(’le:dʒa).( ’law).ʃit</td>
<td>* W</td>
<td>** W</td>
<td>L</td>
</tr>
</tbody>
</table>
In order to place a final (LL) trochee on a word with a light penult, IAM\(B\) must be dominated by other constraints (data repeated from (87-88)).


For example, the input /ʔalit/ could hypothetically receive any of the following iambic parsings below (98), instead of its actual trochaic parsing [(ˈʔa.li)t]:

(98)   [(ʔa.ˈli:t)]   [(ʔa.ˈli:ʃ)]   [(ʔa.ˈli)t]

Each of these iambic output candidates must be eliminated by a constraint that both dominates IAM\(B\) and is not violated by the winning candidate [(ˈʔa.li)t]. [(ʔa.ˈli:t)] has an (LˈH) Foot whose stressed syllable is made heavy by a moraic coda, which violates *\(C_\mu\) (Morén 1999). [(ʔa.li)t] satisfies *\(C_\mu\) by leaving the final consonant extrametrical and thus not moraic, which violates PARSE-SEG(FIN) (Elfner to appear).

(99)   *\(C_\mu\): assign a violation mark to a consonant dominated by a mora.

(100) PARSE-SEG(FIN): assign a violation mark to a PWd-final segment not dominated by a syllable.

*\(C_\mu\), which only [(ʔa.ˈli:t)] violates, must dominate both PARSE-SEG(FIN) and IAM\(B\), which only [(ˈʔa.li)t] violates.

Table 9. *\(C_\mu\) >> PARSE-SEG(FIN), IAM\(B\): (ˈLL)

<table>
<thead>
<tr>
<th>/ʔalit/</th>
<th>*(C_\mu)</th>
<th>PARSE-SEG(FIN)</th>
<th>IAM(B)</th>
</tr>
</thead>
<tbody>
<tr>
<td>(ˈʔa.li)t</td>
<td>*</td>
<td>*</td>
<td>*</td>
</tr>
<tr>
<td>(ʔa.ˈli:ʃ)</td>
<td>* W</td>
<td>L</td>
<td>L</td>
</tr>
</tbody>
</table>

The (LˈH) Foot of [(ʔa.ˈli:t)] is formed by lengthening the final vowel. This violates a constraint against lengthening input vowels, which I call NOLENGTHENING (abbreviated as NOLENG).

(101) NOLENGTHENING: assign a violation mark to a long (bimoraic) vowel in the output corresponding to a short (monomoraic) vowel in the input.

NOLENGTHENING penalizes vowel lengthening specifically; it differs from DEP-\(\mu\) in only penalizing epenthetic morae attached to vowels with an input correspondent, not those attached to epenthetic vowels. NOLENGTHENING differs from IDENT-V(LONG) in only penalizing vowel lengthening, not vowel shortening. This formulation is crucial to the analysis, as a separate constraint penalizing mora epenthesis in general (DEP-\(\mu\)) is also needed, but is ranked below NOLENGTHENING. While adding such a constraint into CON instead of relying only on more justified ones (e.g., IDENT-V(LONG) and DEP-\(\mu\), Keer 1999, McCarthy 2000) may seem ad-hoc, it captures the generalization in Chukchansi that input short vowels are never lengthened under any circumstances, while input long vowels may be shortened (to avoid trimoraic syllables) and epenthetic long vowels may appear in the context of RSC (see §3.5, §4.2 below). In fact,
NoLengthening is essentially 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 (104).

(102) Ident-V(Long): assign a violation mark to an output vowel that differs in length from its input correspondent
(103) Dep-μ: assign a violation mark to a mora in the output without an input correspondent
(104) (Ident-V(Long) & Dep-μ)Seg: assign a violation mark to an output vowel, attached to a mora without an input correspondent, that differs in length from its corresponding input vowel (= NoLengthening)

NoLengthening, which penalizes [ʔaˈliːt], must dominate Iamb.

Table 10. NoLengthening >> Iamb: (‘LL)

<table>
<thead>
<tr>
<th>/ʔalit/</th>
<th>NoLeng</th>
<th>Iamb</th>
</tr>
</thead>
<tbody>
<tr>
<td>ʕaˈliːt</td>
<td>*</td>
<td>*</td>
</tr>
<tr>
<td>ʔaˈliːt</td>
<td>* W</td>
<td>L</td>
</tr>
</tbody>
</table>

Lastly, [ʔaˈliːt] obeys Iamb with an (L ‘L) Foot, which violates Non-Finality(Ft), as shown above in §3.1.1; thus, Non-Finality(Ft) must dominate Iamb as well.

Table 11. Non-Finality(Ft) >> Iamb: (‘LL)

<table>
<thead>
<tr>
<th>/ʔalit/</th>
<th>Non-Finality(Ft)</th>
<th>Iamb</th>
</tr>
</thead>
<tbody>
<tr>
<td>ʕaˈliːt</td>
<td>*</td>
<td>*</td>
</tr>
<tr>
<td>ʔaˈliːt</td>
<td>* W</td>
<td>L</td>
</tr>
</tbody>
</table>

A longer input with a potentially light penult, such as /ˈʃeːxaʔan/, could potentially avoid a final (‘LL) trochee by leaving the last two syllables unparsed [(ˈʃeː).xaʔan]. Since Parse-σ is dominated by Iamb, another constraint is needed to penalize [(ˈʃeː).xaʔan] and favor the surface form [(ˈʃeː).(ˈxaʔan)]; *Lapse (e.g., Selkirk 1984, Kager 1993) is such a constraint.

(105) *Lapse: assign a violation mark to any sequence of two unstressed syllables.

Table 12. *Lapse >> Iamb: (‘H)‘LL

<table>
<thead>
<tr>
<th>/ˈʃeːxaʔan/</th>
<th>*Lapse</th>
<th>Iamb</th>
</tr>
</thead>
<tbody>
<tr>
<td>ˈʃeː.(ˈxaʔan)</td>
<td>*</td>
<td></td>
</tr>
<tr>
<td>[(ˈʃeː).xaʔan]</td>
<td>* W</td>
<td>L</td>
</tr>
</tbody>
</table>

Because Iamb still outranks Parse-σ and Trochee, non-final Feet are always iambic, either (‘H) or (L ‘H). A hypothetical input that would faithfully map to an LL sequence before the penult is needed to determine the relative ranking of NoLengthening, Non-Finality(Ft), and *Lapse. Such a form has not been elicited, and would likely be vanishingly rare due to the skew of the lexicon away from roots that map to LL sequences, as shown below in §3.4.
The careful reader will have noted that the stress data above, while amenable to an iambic analysis, also admit of an analysis with moraic trochees. Moraic trochees would place stress on all heavy syllables (H), as well as on the penult in a final LL sequence (LL). Words with only (H) or (LL) Feet (e.g., *[ʔa.li], [ˈʃeː.ˈxa.ʔan]*) would be footed identically to the iambic analysis, while words with (L’H) Feet would be replace these with (’H) Feet (106).

(106) Trochaic Analysis: [he.ˈyeː].ma] [fi.ˈʃa].lat] [ˈkʼet].la.ˈhan.tə?] [ʔa.ˈleː].dəa.ˈlaw].ʃit] [li.ˈhim].ˈwi.ʃe]?

Evidence for Chukchansi Yokuts being iambic and not trochaic comes from other parts of the phonology, including epenthesis, the lexical root inventory, and root shape change.

3.3. Epenthesis

The above analysis of Chukchansi Yokuts stress suggests that it may be an iambic language; however, it is also possible to analyze Chukchansi as a quantity-sensitive trochaic language. This section shows evidence from patterns of vowel epenthesis for Chukchansi being iambic, not trochaic. As has been shown for Yowlumne Yokuts in, e.g., Kissberth (1970), Kenstowicz and Kissberth (1979), clusters of three consonants do not exist on the surface in Chukchansi, since three consonants cannot fit in the margins of two consecutive syllables without forming an illegal tautosyllabic cluster. In a string of three consonants, a high vowel is epenthesized in-between the first and second consonant: /CCC/ → [CiCC]. In Archangeli (1983, 1991), the position of the epenthetic vowel is due to iterative syllabification. In OT, a single syllabification algorithm is impossible; GEN offers many possible syllabifications, and it is up to the constraints to decide between these options. Zoll (1993) proposes two alignment constraints, ALIGN-R(Morph,σ) and ALIGN-R(Template,σ), that correctly predict the position of the epenthetic vowel. However, these constraints do not capture a bigger generalization: epenthesizing the vowel between the first and second consonants creates an optimal Yokuts prosodic structure, namely an initial (L’H) iamb. For example, when the root /lihm/ ‘run’ attaches to the suffix /-taʔ/ ‘remote past’, the result is [(li.ˈhim).taʔ], with an initial (L’H) Foot, not *[(ˈlih).ˈmi.taʔ], with an initial (’H) Foot followed by an (’LL) trochee (107). The general pattern is shown in (108).

(108) /CVCCCV.../ → [(CV.ˈCi.CV...], *[(CV).(Ci.CV...]

The main situation in which CCC clusters occur is when one-vowel roots with three consonants /CVCC/ attach to consonant-initial suffixes: /CVCC+CV.../, as with /lihm-ʔaʔ/ → [li.ˈhim.taʔ] above (107). The main question this poses is why the epenthetic vowel occurs between the first and second consonant rather than the second and third, i.e., why /lihm+ʔaʔ/ surfaces as [li.ˈhim.təʔ], not *[(ˈlih.mi.taʔ)]. Both output candidates have exactly one violation of faithfulness (DEP-V), and are equally harmonic phonotactically (all syllables conform to the Yokuts CV(X) syllable canon). Under an iambic analysis, the reason is immediately clear: [(li.ˈhim).taʔ] is parsed into an optimal iambic (L’H) Foot, but [(ˈlih).(ˈmi.taʔ)] contains a trochaic (’LL) Foot, as well as a sub-optimal (’H) iamb. The above ranking of IAMB over TROCHEE (Tables (7-8)), as well as over PARSE-σ (which dominates TROCHEE: Tables (7-8)) chooses [(li.ˈhim).taʔ] over [(ˈlih).(ˈmi.taʔ)].
Table 13. IAMB >> PARSE-σ >> TROCHEE: Initial (L’H)

<table>
<thead>
<tr>
<th>/lihm+ta?/</th>
<th>IAMB</th>
<th>PARSE-σ</th>
<th>TROCHEE</th>
</tr>
</thead>
<tbody>
<tr>
<td>(li.’him).ta?</td>
<td>*</td>
<td>*</td>
<td>*</td>
</tr>
<tr>
<td>(’lih).(mi.ta)?</td>
<td>* W</td>
<td>L</td>
<td>L</td>
</tr>
</tbody>
</table>

The same ranking accounts for epenthesis that repairs other three consonant clusters, as in (109).


Table 14. IAMB >> PARSE-σ >> TROCHEE: Initial (L’H)

<table>
<thead>
<tr>
<th>/ʔale:ʤa-la-wʃ-taʔ/</th>
<th>IAMB</th>
<th>PARSE-σ</th>
<th>TROCHEE</th>
</tr>
</thead>
<tbody>
<tr>
<td>(ʔa.’le:).ʤa.(la.’wiʃ).taʔ</td>
<td>**</td>
<td>**</td>
<td>**</td>
</tr>
<tr>
<td>(ʔa.’le:).ʤa.(law).(ʃi.ta)?</td>
<td>* W</td>
<td>* L</td>
<td>* L</td>
</tr>
</tbody>
</table>

The data of epenthesis in longer consonant clusters are conflicting. For example, an input four-consonant cluster can be syllabified with two epenthetic vowels and an initial (L’H) iamb (110) or only one epenthetic vowel and an initial (’H) iamb (111). An input five-consonant cluster must be syllabified with two epenthetic vowels, which are always positioned to create an initial (L’H) iamb (112-113).


The choice between (110) and (111) depends on the ranking of DEP-V and IAMB, which (110) violates more than its rival candidate (two epenthetic vowels instead of one, an (LL) trochee), and *Cµ and PARSE-σ, which (111) violates more than its rival candidate (two codas instead of one, a final unparsed syllable). As shown above in Table (9), *Cµ dominates IAMB, while Tables (13-14) above show that IAMB dominates PARSE-σ. The choice between (110) and (111) thus rests on the relative ranking of DEP-V and *Cµ. Vowel shortening in Chukchansi (114) shows that DEP-V must dominate *Cµ, as vowels are never epenthesized to prevent coda consonants (see, e.g., Zoll (1993) for Yokuts in general).

(114) /se:p-taʔ/ ‘tear’-RM.PT → [(se:p).taʔ] < *[(se:).(pi.ta)].

Table 15. DEP-V >> *Cµ: No Epenthesis to Prevent Coda Consonants

<table>
<thead>
<tr>
<th>/se:p-taʔ/</th>
<th>DEP-V</th>
<th>*Cµ</th>
</tr>
</thead>
<tbody>
<tr>
<td>(se:p).taʔ</td>
<td>*</td>
<td>*</td>
</tr>
<tr>
<td>(se:).(pi.ta)?</td>
<td>* W</td>
<td>L</td>
</tr>
</tbody>
</table>

Since DEP-V dominates *Cµ, the pattern in (116), not in (115), is always expected to occur:

35
Some other force must sometimes favor the opposite pattern, resulting in [(li. 'him).('ʃi.ti)t]. While space does not permit me to show the details, I believe this alternative pattern can be modeled by Iterative Footing in Harmonic Serialism (see Pruitt 2010). More data are necessary to show whether the [(li. 'him).('ʃi.ti)t] pattern or the [(di. 'ʔiʃ.ti)t] pattern is more prevalent.

While an iambic analysis of Chukchansi simply captures the position of epenthesis in the above situations, a trochaic analysis of Chukchansi stress cannot easily do so. Trochaic stress does not favor [(lih).('mi.ta)ʔ] over *[(lih).mi.taʔ] (or the *CLASH-avoiding parses *[(lih).mi.taʔ] or *[lih.(mi.ta)ʔ]), as both candidates contain good bimoraic trochees. Picking the former candidate over the latter ones would require another, likely ad-hoc, constraint, such as the alignment constraint used in Zoll (1993). Under the iambic analysis, the selection of [(li. 'him).taʔ] (and the other cluster-repairing outputs shown above) is a TETU effect: when the grammar can freely choose between an iambic or a trochaic (i.e., poorly iambic) structure, it chooses the iambic one. Moreover, in this structure, the optimal (L'H) iamb surfaces at the left-edge of the root, a phenomenon that shows up consistently in Chukchansi. Stress and vowel epenthesis together suggest that Chukchansi is iambic at the surface, i.e., it prefers to parse words into iambic Feet.

The complete ranking of constraints so far is shown in the Hasse diagram below (Figure (7)):

```
      DEP-V
       |   *C_{µ}
       |   NO_LENGTHENING, NON-FINALITY(Ft), *LAPSE
       |   PARSE-SEG(FIN)
       |   IAMB
       |   PARSE-σ
       |
       |
  Figure 7. Stress + Epenthesys Constraint Ranking
           TROCHEE
```

---

17 If Feet are constructed serially from left to right (generally true in iambic languages; see Hayes 1995), then the first Foot constructed is word-initial. If epenthesis and Footing can happen serially (as in Elfner to appear), then after the first Foot is constructed, epenthesis occurs both to repair a consonant cluster and to improve the harmony of the Foot. I sketch out a possible HS derivation of [(li. 'him).('ʃi.ti)t] and [(li. 'him).('ʃit).taʔ] below; after the first step (construction of an initial Foot), a vowel is epenthesized so as to make that Foot an optimal (L'H) iamb (assuming only one coda mora is possible per syllable and that coda morae are available “for free”).

- /lihm-ʃit/ → ('lih,mʃ).tit → (li.'him,ʃ).tit → (li.'him,ʃ,ʃi.ti)t → (li.'him,ʃ,ʃi.ti)t

---

Table 16. DEP-V >> *C_{µ}:

<table>
<thead>
<tr>
<th>/diʔ-'ʃit/</th>
<th>*C_{µ}</th>
<th>DEP-V</th>
</tr>
</thead>
<tbody>
<tr>
<td>P ('diʔ_{µ}.('ʃi).tit</td>
<td>*</td>
<td></td>
</tr>
<tr>
<td>(di. 'ʔiʃ.('ʃi.ti)t</td>
<td>* W</td>
<td>L</td>
</tr>
</tbody>
</table>
3.4. Lexical Root Inventory

More evidence that Chukchansi Yokuts is an iambic language comes from the inventory of verb root shapes in the lexicon. This section gives evidence suggesting that verb root shapes that are not easily parsed into good iambs are highly underrepresented in the lexicon. This relative lack of poorly iambic forms in the lexicon may be the result of active iambic parsing in the grammar, which seeps into the lexicon through optimization of input forms. Such an “iambic bias” is completely unexpected if Chukchansi is a trochaic language.

Setting the foundation for this argument requires establishing what makes a root a “good iamb.” A well-established line of thought in phonological literature posits that input have no prosodic structure (i.e., no syllables or Feet). Because of the relatively simple and strict phonotactics of Chukchansi (syllables are either CV or CVX), and the absence of prefixes, the prosodic structure of the output of an input root is relatively stable across forms. The prosodic structure of output root forms depends on whether the first segment of the suffix directly attached is a consonant or a vowel. For example, when a /CVC/ root attaches to a /-V…/ suffix, the output form starts with a light (L) syllable [CV.C-V…] (115), while when it attaches to a /-C…/ suffixes, the output starts with a heavy (H) syllable [CVC.-C…] (116).

\[ (115) \ /p'ʃ-eʔ/? \text{ ‘light’-NPST} \rightarrow [p'iʃ.eʔ] \]
\[ (116) \ /p'ʃ-taʔ/? \text{ ‘light’-RM.PT} \rightarrow [p'iʃ.taʔ] \]

Root inputs can be separated into those that are always parsed into an initial (H) or (LH) iamb and those that are not, due to an initial LL sequence. The difference between root types is essentially the difference between the initial (two) vowels. A root whose first vowel is long parses into an initial (H) Foot no matter what material follows; even if a coda consonant shortens the long vowel in the output, that syllable is still heavy. If the first vowel is short, then the second vowel determines the root type. If the second vowel is long, the initial sequence is always LH, resulting in an (LH) Foot; if it is short, the initial sequence is LL, unless a consonant cluster follows, creating a second closed (heavy) syllable. An LL sequence would require either a poor iambic (L'L) Foot, an (LL) trochee not motivated by non-finality, or unparsed syllables; none of these solutions are optimal. If there is no second root vowel, the initial sequence varies; usually it is H or LH (parsing into good iambic Feet), but in the case of a /CVC/ root attached to a V-initial suffix, the choice between an LL or LH sequence (i.e., between a good or bad iamb) depends on what further suffix material follows. VC sequences that always are mapped onto a closed (and thus, heavy) syllable due to a following root CV sequence, pattern with underlying long vowels (V:). Below is a table of the four possible root types (H, LH, LL, and L).

Table 17. Root Type Structure

<table>
<thead>
<tr>
<th>First Vowel?</th>
<th>Second Vowel?</th>
<th>Root Type</th>
</tr>
</thead>
<tbody>
<tr>
<td>Long (or always Closed)</td>
<td>Does not Matter</td>
<td>H</td>
</tr>
<tr>
<td>Short</td>
<td>Long (or always Closed)</td>
<td>LH</td>
</tr>
<tr>
<td>Short</td>
<td>Short</td>
<td>LL</td>
</tr>
<tr>
<td>None</td>
<td>None</td>
<td>L</td>
</tr>
</tbody>
</table>

According to the account of surface stress given above, LH and H roots are always parsed with a good initial iamb, (H) or (LH). L roots usually end up with a good iamb, but occasionally get
parsed without one, while LL roots are sometimes parsed with, but often without, a good iamb. This suggests the following possible scale of relative root type well-formedness in Chukchansi.

(117) Possible Root Well-formedness Scale: H, LH \(<\) L \(<\) LL

If this scale (based on an iambic analysis of Chukchansi stress) is correct, LL roots might be expected to be less common than the other root types in the Chukchansi lexicon. L roots might also be expected to be less common than H or LH roots, though more common than LL roots. By labeling and counting verb roots in the Chukchansi dictionary (Adisasmito et al. in progress), I have gained a preliminary perspective on whether this scale is correct. This involved eliminating repeated entries, derived entries (analyzable as a root plus suffix(es)), and loanwords from Spanish or English. This also required correcting several verb roots that have been mislabeled in the dictionary, as shown either by other forms in the Chukchansi corpus or direct elicitation. Table (18) below shows the revised count of Chukchansi verb root types.

Table 18. Verb Roots by Type and Number of Consonants

<table>
<thead>
<tr>
<th>Number of Consonants</th>
<th>Root Type</th>
<th>Number of Roots</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>H</td>
<td>2</td>
</tr>
<tr>
<td>2</td>
<td>L</td>
<td>82</td>
</tr>
<tr>
<td></td>
<td>H</td>
<td>52</td>
</tr>
<tr>
<td></td>
<td>LL</td>
<td>12</td>
</tr>
<tr>
<td></td>
<td>LH</td>
<td>3</td>
</tr>
<tr>
<td>3</td>
<td>L</td>
<td>106</td>
</tr>
<tr>
<td></td>
<td>H</td>
<td>38</td>
</tr>
<tr>
<td></td>
<td>LL</td>
<td>6</td>
</tr>
<tr>
<td></td>
<td>LH</td>
<td>51</td>
</tr>
<tr>
<td>4</td>
<td>H</td>
<td>19</td>
</tr>
<tr>
<td></td>
<td>LL</td>
<td>4</td>
</tr>
<tr>
<td></td>
<td>LH</td>
<td>7</td>
</tr>
</tbody>
</table>

Setting aside the rare one-consonant roots, clear patterns emerge. For verb roots, LL roots are highly underrepresented in both two-consonant and three-consonant roots: only 12 of the former and 6 of the latter occur, compared to 82 and 106 L and 52 and 38 H, respectively. The seeming anomalous lack of two-consonant LH roots (only 3 are attested, compared to 51 three-consonant LH roots) is actually very principled; roots ending in a long vowel are vanishingly rare in Chukchansi (less than one percent of the lexicon), so /CVCV:/ roots are penalized by whatever force militates against this structure. Having accounted for the lack of /CVCV:/ roots, the rarity of LL verb roots is glaringly apparent; while the other root types are fairly common, LL is restricted, comprising less than six percent of Chukchansi verb roots. Moreover, several roots have been accidentally mislabeled as LL (due to incorrect transcription of a long vowel). When checked, these roots are actually H or LH; it is quite possible that more of the small number of LL roots have been mistranscribed (as transcription and lexical collection is an arduous process). At any rate, it is probable that LL verb roots occur much less in the lexicon than would be expected by chance, though statistics would have to be run to confirm this.
On the other hand, L roots are very common in Chukchansi, comprising about half of all verb roots. This could be due to the simple structure of L roots, being either /CVC/ or /CVCC/. Also, L verb roots usually get parsed with an initial (L'H) or (H) Foot, as shown by the roots /wil/ ‘say’ and /hadm/ ‘cross’. /wil/ has an (H) Foot before a consonant (118) and an (LL) Foot before a vowel (119). /hadm/ has an (L'H) before a consonant (120) and an (H) before a vowel (121).

\begin{verbatim}
(118) /wil-taʔ/ → [('wil).taʔ]
(119) /wil-it/ → [('wi.li)t]
(120) /hadm-taʔ/ → [(ha.'dim).taʔ]
(121) /hadm-it/ → [('had).mit]
\end{verbatim}

While two-consonant L roots do not always form a good iamb, the final-stress-avoiding trochee is a common parse in Chukchansi. A non-final LL sequence is never formed with L roots, due to the shape inventory of non-final suffixes. Even two-consonant L roots are thus better iamb-formers than LL roots; at any rate, the data from the lexicon show a clear skew away from LL roots, supporting the actual root well-formedness scale below (122):

\begin{verbatim}
(122) Actual Root Well-formedness Scale: H, LH, L ≺ LL
\end{verbatim}

As with epenthesis, this dispreference for LL sequences makes no sense if Chukchansi is trochaic, but perfect sense if it is iambic.

3.5. Root Shape Change = Optimal Foot

Chukchansi Yokuts displays iambic properties both at the surface level (stress and epenthesis patterns) and in the lexicon. Chukchansi prefers (L'H) and (H) feet to (L'L) feet; this preference has been shown in parsing words into Feet and in influencing the inventory of root shapes. The (L'H) Foot, moreover, is optimal in an iambic system (Prince 1990, Kager 1993, 1995, Hayes 1995), more well-formed than both (H) and (L'L). This preference for (L'H) Feet is displayed in the position of vowel epenthesis, which forms a word-initial (L'H) Foot. I now show that root shape change is another instance of this preference; specifically, I argue that all root shape change is to the (L'H) Foot, or equivalently, root shape change results in the appearance of an optimal (L'H) Foot at the left edge of the word (see §3.3 above for discussion of left-to-right parsing and the emergence of initial (L'H) Feet). I propose that root shape change in Chukchansi Yokuts is thus simply the emergence of the unmarked prosodic pattern, not a special morphophonological construction requiring abstract prosodic structure or subcategorization.

3.5.1. Root Shape Change is always (L'H)

This section begins by reviewing the data of root shape change. In Chukchansi, there are eight different suffixes that cause root shape change: the causative /-la-/ and /-e-/; the agentive /-ʃ/-, the adjunctive /-ʔhiy/-; the durative /-ʔa-/; the inchoative /-a-/; the causative-inchoative /-ta/-; and the distributive /-e-, -a-/. The last three suffixes also cause the second vowel of the verb root to change to [e]. I repeat some of the data from §1.1, with the stress Foot added to the surface form (123-134), and supplement them with data using the other RSC suffixes (125-129).
Having parsed the surface forms into stress feet, one thing immediately stands out: the initial Foot of all these forms is an (L’H) iamb. I propose that this is no accident: root shape change always results in an initial (L’H) Foot. Another important generalization is that only roots with one underlying vowel undergo root shape change with the above suffixes. In roots with multiple underlying vowels, these vowels do not get altered to compose an initial (L’H) Foot, so they receive the footing that results from the most faithful parsing ((130-132); illustrated again by footing the data from §1.1).

With one-vowel roots, a second vowel is epenthesized to create the heavy stressed syllable of the (L’H) Foot; this is what gives the root material the appearance of changing its shape. With biconsonantal roots, like /xat/, /ʧʃ/, /sɛp/, and /max/ above, the (L’H) form epenthesis vowel [a(:)] always appears between the suffix and the last root consonant. I show this below in the forms from above, with the root material bolded and underlined (133).

In Newman’s (1944) analysis of some of these forms (and thus those following his data), the [a(:)] belong to the suffix; [a:la] and [a:ʃ] are just allomorphs of /la/ and /ʃ/ after biconsonantal roots. Newman does analyze the [a:] in other forms as part of the “a-umlauted strong” (i.e., LH) form. Collord (1968) likewise associates the [a:] with the suffix in some of these forms. In such an analysis, the underlying root vowel always surfaces as short to form the first syllable of the (L’H) Foot (134); Newman and subsequent analyses have thus considered this a “weak” form (Newman) or L root shape change (Archangeli 1983, 1991).

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The causative suffix [-la-] appears to resist stress; impressionistically, there seems to be stress on the following syllable, but I am not sure whether this is the correct generalization, nor how to account for it.
Guékguezian (2011) argues that the [a(:)] in these forms is not part of the suffix; in this reanalysis, the surface forms of the suffixes are always the same with biconsonantal and triconsonantal roots, and both biconsonantal and triconsonantal roots have “disyllabic” (i.e., LH) shapes. Guékguezian (2012) accounts for the constant quality of this vowel by analyzing it as epenthetic, and thus free to assume the unmarked value of [a:] (see de Lacy 2002 for [a:] being the least marked stressed vowel). What is important is that the [a:] is epenthesized in order to provide material for the initial (L'H) Foot; whether the [a:] is a part of the surface exponent of the root or the suffix is immaterial, as is the target shape of the root. Regardless of the amount of material in the root (i.e., whether it has two or three consonants), the (L'H) Foot appears with all RSC-triggering suffixes. Guékguezian’s (2011, 2012) reanalysis unifies the behavior of biconsonantal and triconsonantal stems before, and dispenses with the need for L root shape change in these forms.

Biconsonantal roots appear to surface as LL, not LH, before the durative suffix /-ʔa-/ in Chukchansi. In Newman (1944), these forms have an initial LH in all dialects, including Chukchansi; the initial LH form also is found in Broadbent’s (1958) Chukchansi word list. However, in Collord (1968) and currently elicited data, these forms have an initial LL (135-136):

(135) /fɪːʔa-n'/ ‘cut’-DUR-NPST → [fɪ.ʃa.ʔan’] “is cutting”
(136) /ma:x-ʔa-n'/ ‘collect’-DUR-NPST → [ma.xa.ʔan’] “is collecting”

I posit that these forms actually do begin with an LH, due to a preference in Chukchansi for glottal stops to occupy the coda at least partially when possible (see Howe and Pulleyblank 2001 for the preference for glottalization to occur in the coda). In these forms, I propose the glottal stop is actually ambisyllabic (137):

(137) Ambisyllabic Glottal Stop: [(ma.'xa?),ʔan’], [(fɪ.'ʃa?),ʔan’]

There is evidence that the glottal stop must occupy the coda (at least partially) in Chukchansi. First, when triconsonantal roots appear with the durative suffix, their final consonant is glottalized, if possible (138-139). This glottalization is different from the behavior of suffixes with a floating glottal stop in Newman (1944), where the second consonant, not the third, is glottalized. In these durative forms, the glottalization can easily be accounted for by linking the glottal stop of the suffix (in the onset) onto the preceding coda, glottalizing the root consonant.

(138) /lihm-ʔa-n'/ → [le.'he:m'),ʔan’]
(139) /be:wn-ʔa-n'/ → [be.'we:n'),ʔan’]

Such an analysis could include the object nominalization suffix as an RSC-trigger (this suffix is given in Collord (1968:67) as /-aʃ/). In my data set, as well as in the Chukchansi dictionary, this suffix is only found attached to the verb root /xat/ ‘eat’, resulting in the object nominal [xa.ʃa], [xa.ta:.ʃi] “food” (Collord in fact only gives one example beside this: [hat.ma.:ʃi] “song”-ACC, from /ha:tm/ ‘sing’). This suffix is cognate to the habitual agentive suffix /-ʔ...as-/ of Yowlumne (Newman 1944), a suffix with a floating glottal, which, as I suggest in §5.1.1, also triggers RSC. Attempted elicitation of the object nominalization suffix with other roots has been unsuccessful; to indicate an object of a verb, Chukchansi speakers prefer to nominalize the passive form. For now I ignore this suffix, though the syntactic analysis in §2 suggests that it would trigger RSC.
Second, apart from the two pronominal forms \[na:ʔa-(k'/n)] ‘we.EXCL.NOM-(DU/PL)’ and \[ma:ʔa-(k'/n)] ‘you.NOM-(DU/PL)’ (which are elsewhere transcribed as [naʔa(k’/n)] and [maʔa(k’/n)]), only five forms in the dictionary show a long vowel before a glottal stop (140):

(140) Forms with \[V:\?\]
   a. \[ja.ʃa:ʔ-an\] ‘eye-ACC’
   b. \[ʃe:ʔal-\] ‘rain’
   c. \[p’a.ye:ʔi-\] ‘children’
   d. \[ʧe:ʔam-\] ‘vegetables’
   e. \[ha.ʔe:ʔi-\] ‘clothes’.

The ubiquity of both the glottal stop and long vowels in Chukchansi leaves the paucity of their occurrence in the order \[V:\?\] unexplained without a principled phonological reason. If glottal stops prefer to occupy the coda, then they would disallow preceding long vowels due to the CVX syllable maximum. Likewise, there is only one lexical root example of a glottal stop occurring after another consonant and thus clearly in onset position: /hidʔan’- ‘another’. Suffix-initial glottal stops may occur after another consonant, as in [(de.’e).ʔan’] ‘is making’; however, these are often pronounced with gemination in place of the glottal stop, e.g., as [de’e:ʔan’]. I posit that the handful of forms with glottal stops in the onset alone are exceptional, and that, in general, glottal stops must at least partially occupy the coda. I suggest in §5.1.1 below that this is also true of glottalized sonorants in Yokuts, which display similar coda-philic properties (non-occurrence after long vowels and consonants, disappearance post-vocalically in many forms, as well as geminate pronunciation).

The only other possible cases of root shape change in Chukchansi are with LH verb roots. Biconsonantal LH roots /CVCV:/ lose their final vowel before the causative (141).

(141) /pana:-la-taʔ/ ‘arrive’-CAUS-RM.PT \[→\] [('pan).la.taʔ] ‘had made X arrive’

As indicated in §3.4, biconsonantal LH roots are extremely rare in Chukchansi, only three of which have been elicited, composing less than one percent of all roots. In fact, for Yokuts in general, Newman reports that these roots are only about “seven or eight percent” as common as all of the other types of roots, and are “actively being leveled out of existence” (1944:39). Due to their small number and additional aberrant phonological behavior, these roots must be irregular, as is their final vowel loss with the /-la-/ suffix.

Triconsonantal LH root /CVCV:C/ optionally lose their final vowel as well with some RSC suffixes, including the agentive /-ʧ/-/. However, the LH form can also occur (142).

(142) /hewe:t-ʧ^-Ø/ ‘walk’-AGT-NOM \[→\] [('hiw).tiʧ] or [(he.’we:).tiʧ] ‘walker’ (NOM)

While LH forms are always acceptable, the option of a monosyllabic form (L root shape change) is mysterious. In Newman (1944), this form occurs in other Yokuts languages with a floating glottal stop, inducing glottalization on the second consonant if possible. In §5.1.1, I propose that apparent L root shape change in Newman is due to a phonotactic restriction on glottalized segments. Specifically, a preference for glottalized segments to occupy the coda prevents the LH shape from occurring when the glottal autosegment docks. More research is necessary to check if this floating glottal is also present in Chukchansi words such as (142). At any rate, the restriction of this form to triconsonantal LH roots, as well as its optionality, suggests that the L root shape
change in (142) is not a productive process. The appearance of an initial (L'H) Foot, i.e., optimal prosodic structure, is thus the only productive root shape change in Chukchansi.

### 3.5.2. LH Root Shape Change is Grammatical

Having accounted for the appearance of other possible cases of RSC in Chukchansi, I investigate whether LH RSC truly is a productive process, or, like the other cases, is epiphenomenal or grammatically restricted. Evidence that RSC is, indeed, productive comes from the large proportion of Chukchansi morphemes that trigger it. Out of a total of twenty-one (21) non-final suffixes that attach to verb roots, seven trigger RSC, or a third of the total. These suffixes are not restricted to one semantic type or syntactic category, as shown in Section 2, and thus RSC cannot simply result either from a single abstract syntactic head shared by all suffixes, or from a semantically or syntactically distinct lexical entry of the same root concept. Moreover, RSC occurs with all canonical root types, and is not restricted to one or two types. RSC is freely productive with these suffixes in Chukchansi and occurs very commonly in elicited speech, spontaneous speech, and narrative. The relatively large percentage of RSC-triggering suffixes, their robustness across root types, the varied nature of these suffixes, and their productivity together show that LH RSC cannot be considered an isolated process in Chukchansi (as argued above for other apparent cases of RSC). Rather, LH RSC is an active part of Chukchansi grammar, and the only productive RSC in Chukchansi.

RSC, furthermore, must be an actual grammatical change, and cannot be an epiphenomenon of phonotactics. RSC-triggering suffixes in Chukchansi do not form any coherent phonological grouping: some consist of a single vowel (143) or a single consonant (144), some begin in a glottal stop (145), and some in a coronal consonant (146). These distinctions are largely orthogonal to the syntactic distinction between voice, aspect, and nominalization.

- (143) /-a/- ‘inchoative’, /-e/- ‘distributive’, /-e/- ‘causative’
- (144) /-ʧ/- ‘agentive’
- (145) /-ʔa/- ‘durative’, /ʔhiy/- ‘adjunctive’
- (146) /-la/- ‘causative’, /-ta/- ‘causative-inchoative’

These RSC-triggering suffixes have various CV sequences (/C/, /V/, /CV/, /CCVC/), which cause different prosodic organization of preceding material, due to the strict CVX syllable phonotactics. There is no apparent reason that this phonologically disparate group of suffixes should conspire to give rise to optimal prosodic structure (i.e., the initial (L'H) Foot of RSC). Therefore, the appearance of the optimal Foot cannot be a purely phonological change, but must involve some extra element. In Section 4, I propose that this element is phonological cyclicity, triggered by phase-based spellout.

### 4. Root Shape Change as First-Cycle Phonology: Minimality + Prosodic Unmarkedness

Section 2 showed that root shape change (RSC)-triggering suffixes are phase heads; Section 3 demonstrated that RSC is phonologically the appearance of optimal Chukchansi prosodic structure, an initial (L'H) Foot. In Section 4, I propose that optimal prosody is a consequence of

20 Here I count the two distinct allomorphs of the causative morpheme, /-la-/ and /-e-/ as the same suffix. /-e/- exclusively triggers LH RSC, while /-la-/ optionally does not.
phonological cyclicity, triggered by phase-based spellout of the phonological root by RSC-triggering suffixes (§4.1). When sufficiently small phonological root morphs go through a phonological cycle without affixal material, these roots get augmented to meet phonological minimality; the added material is arranged to form an unmarked (L’H) Foot, satisfying prosodic well-formedness constraints (§4.2). Larger inputs to the phonology, including both roots by themselves and roots with affixal material, resist both augmentation and rearrangement of input structure, and thus do not change shape to form (L’H) Feet (§4.3-4). This analysis of RSC makes two correct predictions that other accounts do not predict (§4.5).

4.1. Phase-Based Spellout = Cyclic Phonology

This section demonstrates how root shape change (RSC) emerges as a minimality effect when phonological roots with only one underlying vowel go through the phonological grammar without affixes in the first cycle of the derivation. I propose that the construction of the optimal (L’H) Foot results from epenthesis that is necessary to construct a disyllabic Prosodic Word (PWd) out of sub-minimal material. The requirement that phonological outputs, i.e., PWds, contain at least two syllables is present on every output, regardless of the stage of the derivation. Since prior spell-out of the lexical root and its categorizing head by a phase head sends the corresponding phonological root morph to the grammar before affixal material, only the root material is available to the grammar. Because two syllables must be present in the corresponding output, with phonologically small roots, i.e., those with only one underlying vowel, additional material must be added to create a disyllabic PWd. Due to “The Emergence of The Unmarked” (= TETU; Prince and Smolensky 1993/2004, McCarthy and Prince 1994), this material is organized into the prosodically optimal LH sequence, rather than more marked LL, HL, or HH sequences. Later, when a higher phase head spells out the rest of the syntactic features of the word, the affixes that are inserted to encode them join the output of the root cycle, which go through a second cycle together to make the surface word output. The analysis thus relies on the following assumption about the Homology of Cyclicity in the syntax and the phonology (147):

(147) Homology of Cyclicity: if syntactic material (A) is spelled out before other material (B), its phonological exponents (a) also enter the phonology before the latter’s (b).

Syntax: A >> B → Phonology: a >> b

The only necessary seriality in the phonological derivation is due to cyclic spellout from the syntax and Homology of Cyclicity. Whether the syntactically and thus phonologically complex word goes through a parallel or serial derivation in these two cycles is not essential to the analysis, which works in both parallel OT and Harmonic Serialism, mutatis mutandis. For ease of exposition, I show the phonological derivation of RSC using parallel OT, but nothing hinges on this. I schematize the whole derivation below in Figure (8).

<table>
<thead>
<tr>
<th>Cycle One</th>
<th>Cycle Two</th>
</tr>
</thead>
<tbody>
<tr>
<td>Input: /ROOT/</td>
<td>Input: [RSC]-/SUFFIXES/</td>
</tr>
<tr>
<td>Output: [RSC]</td>
<td>Output: [[RSC]-SUFFIXES]</td>
</tr>
</tbody>
</table>

Figure 8. Derivation of RSC: Two Cycles
The input to the second phonological cycle crucially includes the output of the root from the first cycle, [RSC], not the underlying form /Root/. This assumption follows the principle of Phonological Persistence of Dobler et al. (2011). Phonological Persistence prevents the repeat lexical insertion of the phonological root from the syntax.

(148) **Phonological Persistence:** In the computation of phonology, there is a tendency to retain the phonological form that has been previously mapped to each individual phase constituent during later computation. (Newell under review)

One apparent problem for this view of cyclic construction of words in the phonology is head-movement (Travis 1984). Head-movement of verb roots upward into the extended v and Infl domains accounts for the formation of morphologically complex verbs, as well as their surface position in many languages. If some syntactic material, e.g., the verbalized stem, is spelled out in an earlier phase, one may wonder how the root ends up in the same surface position as its affixes. Rather than assuming a strictly morphological operation of lowering, for which surface position provides no evidence in Chukchansi, I assume that the verbalized stem (root and first-merged, categorizing v head) continues to head-move up into Infl. Under the copy theory of movement, the stem will still leave copies of itself below in every head that it has occupied. I propose that these lower copies can be spelled out, inserted, and sent to the phonology if their syntactic material matches a lexical item. The previously spelled out phonological material will undergo phonological operations within the word, but the surface position of the word as a whole will not be determined until the whole word is spelled out. Eventually, all the verbal material moves up to the Infl head, where it is spelled out to the phonology at the CP phase and thus receives its linear position as a complete word. Figure (9) shows how early spell-out of the lower copies is consistent with a single linear position of the whole word.

![Figure 9. Early Spell-out of Lower Copies](image)

Figure (9) shows why Homology of Cyclicity (147) and Phonological Persistence (148) are necessary to the cyclic account of RSC (or any cyclic account of morphology that relies on syntactic phases). At the completion of the first phase, the lexical root and categorizing head <x> are spelled out and inserted into the phonology as /X+√/. Homology of Cyclicity demands that /X+√/ goes through a phonological cycle before the rest of the word (heads <y> and <z>) are inserted into the phonology. At the completion of the second phase, all the heads are spelled out, including both <y> and <z>, which were not spelled out at the first phase, along with <x> and the lexical root, which have head-moved upwards while their copies were previously spelled out. Phonological Persistence demands that, when the syntactic material /√+x+y+z> enters the
phonology, the output of the first cycle, \([X+\sqrt{\ ]}\), continues in the derivation with /Y+Z/ are lexically inserted, rather than /X+\sqrt{\ ]/ being inserted again. In other words, Homology of Cyclicity eliminates the phonological derivation (149) that could result from the syntactic derivation in Figure (9), while Phonological Persistence eliminates the derivation (150). Together, these principles require the consistently cyclic derivation (151).

(149) Wrong Derivation: Phase 1 → Phase 2 → /Z+Y+X+\sqrt{\ ]/ → [Z+Y+X+\sqrt{\ ]]
(150) Wrong Derivation: Phase 1 → [X+\sqrt{\ ]} → Phase 2 → /Z+Y+X+\sqrt{\ ]/ → [Z+Y+X+\sqrt{\ ]]
(151) Right Derivation: Phase 1 → [X+\sqrt{\ ]} → Phase 2 → /Z+Y+/[X+\sqrt{\ ]/ → [Z+Y+[X+\sqrt{\ ]]]

4.1.1. Lexical Insertion

The cyclic derivation above (151) correctly predicts cyclic phonological structure when the phonological root is lexically inserted into the phonology before affixes. In §2.4, I proposed that the phonological root morph corresponds to both the lexical root and its first-merged categorizing head, the verbalized stem; in (151), the root morph is \([X+\sqrt{\ ]}\). When an inner phase head is merged above the categorizing head, either a vP-level phase head (e.g., causative, durative) or a nominalizing phase head (e.g., agentive, adjunctive), the verbalized stem is within the phase complement, and thus spelled out to phonology (Nissenbaum 2000). Since the whole verbalized stem corresponds to the phonological root, the latter is inserted and goes through a phonological cycle. However, this poses the question of what happens when the categorizing head itself has phasal status, and only the lexical root is sent to the phonology. I propose that the lexical root by itself does not allow the root morph to be inserted in the phonology.

Following Wolf (2008), lexical insertion occurs in the same module as the phonology proper, where phonologically contentful morphemes (i.e., morphs in Wolf 2008) are inserted corresponding to syntactic features and lexical roots (i.e., morphemes). Wolf’s constraint schema DEP-M(F) penalizes outputs with a morph corresponding to a feature F not present in the input morphemes, while the constraint schema MAX-M(F) does the opposite, penalizing outputs that lack a morph corresponding to a feature F in the input morphemes. When the categorizing vACT head that is spelled out by the root morph (152) is the phase head, it only sends the lexical root (its complement) to the phonology (153).

(152) \[v'_{\text{vP}}v_{\text{ACT}}\sqrt{\ ]}\] in Syntax corresponds to [ROOT] in Phonology
(153) \[v'_{\text{vP}}v_{\text{ACT}}\sqrt{\ ]}\] spells out \[\sqrt{\ ]\] to Phonology

To prevent the root morph from being inserted when the lexical root alone is spelled out, the constraints DEP-M(vACT) and MAX-M(ROOT) are required:

(154) DEP-M(vACT): assign a violation mark for an output morph corresponding to a vACT morpheme not present in the input.
(155) MAX-M(ROOT): assign a violation mark for an input lexical root morpheme without a corresponding output morph.

If DEP-M(vACT) outranks MAX-M(ROOT), then an input to the phonology with only a lexical root morpheme will not result in insertion of the corresponding root morph, which therefore does not go through a phonological cycle by itself.
Table 19. **DEP-M**(v<sub>ACT</sub>) >> **MAX-M**(ROOT): No Early Insertion of Root Morph

<table>
<thead>
<tr>
<th>'open'</th>
<th>DEP-M(v&lt;sub&gt;ACT&lt;/sub&gt;)</th>
<th>MAX-M(ROOT)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ø</td>
<td></td>
<td>!</td>
</tr>
<tr>
<td>['open'+v&lt;sub&gt;ACT&lt;/sub&gt;] /ʔodb/ [(ʔo.'do:).b]</td>
<td>!</td>
<td></td>
</tr>
</tbody>
</table>

Lexical insertion of the root morph waits until the next phase (CP), at which point the active v head has been spelled out as well, so the root morph inserted encodes all its corresponding syntactic material. At the CP phase, other morphemes are present (e.g., the Infl head), which are also inserted as suffix morphs; in §4.4 below I show that the phonology prevents RSC from occurring with multi-morphemic inputs. RSC thus cannot occur when the categorizing v head has phasal status and spells out the lexical root.

This account seems to run into a problem with the unaccusative suffix /-n-/i/. The merger of the unaccusative v head with the lexical root prevents the active v head from being merged; in fact, it is not clear how the active v head could be merged at all and the verb remain semantically unaccusative. If there is no active v head in the derivation, this would presumably prevent the root morph, which partially encodes this categorizing head, from being inserted. I propose that the root morph is spelled out as a last resort: even though the active v feature is not present in the input to phonology, the root morph must be inserted for the affixal morphs (spelled out at the CP phase) to attach to. A phonological constraint against a word with affixes but no root is very plausible; indeed, it is not clear how a phonological content word could be root-less. If a root morph is indeed required, then the morph that spells out the lexical root will be inserted. I briefly show how this imperfect insertion could be modeled with the cover constraint **HAVE-ROOT**:

(156) **HAVE-ROOT**: assign a violation mark for an output with only affixal material.

If **HAVE-ROOT** outranks **DEP-M**(v<sub>ACT</sub>), then the root morph corresponding to the lexical root morpheme is inserted, even though it also corresponds to the active v head not present in the input morphemes. 21

Table 20. **HAVE-ROOT** >> **DEP-M**(v<sub>ACT</sub>): Root Morph Insertion with Unaccusative

<table>
<thead>
<tr>
<th>'open'-v&lt;sub&gt;UNACC&lt;/sub&gt;-RC.PT</th>
<th><strong>HAVE-ROOT</strong></th>
<th><strong>DEP-M</strong>(v&lt;sub&gt;ACT&lt;/sub&gt;)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ø [‘open’+v&lt;sub&gt;ACT&lt;/sub&gt;]-[v&lt;sub&gt;UNACC&lt;/sub&gt;]-[RC.PT] /ʔodb-n-it/ [(ʔo).(bi.ni)t]</td>
<td>!</td>
<td>*</td>
</tr>
<tr>
<td>[v&lt;sub&gt;UNACC&lt;/sub&gt;]-[RC.PT] /n-it/ [('nit)]</td>
<td>!</td>
<td></td>
</tr>
</tbody>
</table>

In Table (20), the root morph /ʔodb/, corresponding to the lexical root ‘open’ and the active v₁ head, is inserted to allow the affixal morphs to surface. Even though there are two different v heads encoded by morphs in the output, the phonology does not care about this. Since the lexicon

21 A potential problem is that under the above assumptions, it is just as likely for the noun root morph to be spelled out as the verb root morph. Perhaps an OO constraint could resolve this in the verb root’s favor, but that seems ad-hoc. I consider this an area for further investigation
does not contain a morph corresponding only to the lexical root morpheme ‘open’, a perfect match between morphemes and morphs is not possible for this input.22

This “last-resort” insertion of a root morph to spell out a lexical root without an active \( v \) head does not pose a problem for my earlier account of when an active \( v \) phase head spells out a lexical root in its complement. At the stage of phonology after spellout of the first (= \( vP \)) phase, only the lexical root has been spelled out. Since the full word is not ready to be built yet, as there is no suffix morph that can be inserted, HAVE-ROOT does not force insertion of the root morph.

4.2. Root Shape Change: Minimality with One-Vowel Roots

Since I have shown that phase-head suffixes send the root morph to go through an early phonological cycle by itself, I now show why this results in root shape change (RSC). RSC is a minimality effect: when a phonological input is sufficiently small in Chukchansi, it undergoes RSC. More precisely, I posit that Chukchansi enforces a disyllabic minimum on Prosodic Words, so that a phonological input with only one vowel requires a second, epenthetic vowel to comprise two syllables. Because this vowel is epenthetic, it can be “molded” by the phonology to reduce markedness (TETU); in the case of RSC, prosodic markedness is reduced to form the optimal (L’H) Foot.

4.2.1. Disyllabic Minimality + Foot Structure

Phonological minimality is often invoked as an output condition: outputs must be of a certain size, or contain a certain amount of structure, in order to surface. Work on the Prosodic Hierarchy, including Selkirk (1984) and Nespor and Vogel (1986), posits that a Prosodic Word (PWd), i.e., an output phonological word, must contain a Stress Foot. This constraint arises from the model of the Prosodic Hierarchy, where the category PWd immediately dominates the category Foot, and the constraint Headedness, which is argued to be inviolable (Selkirk 1996).

(157) \textsc{Headedness}: assign a violation mark for any category \( n \) that does not dominate a category \( n-1 \); e.g., assign a violation mark for a PWd that does not dominate a Foot. (adapted from Selkirk 1996)

Inviolable Headedness requires all phonological outputs (PWds) to minimally contain a Stress Foot. Headedness thus requires PWds to have enough phonological material to support a Foot. It is thus commonly assumed that a minimal PWd in a language is that language’s minimal Foot, i.e., the smallest allowable Foot in the language. However, in many languages, minimal PWds are not equivalent to minimal Feet; in quite a few of these languages, the minimality requirement is that PWds must contain at least two syllables. Cross-linguistic evidence for a disyllabic minimality requirement includes Japanese hypocoristics (e.g., Itô 1990, Itô and Mester 1992), Axininca Campa reduplication (e.g., McCarthy & Prince 1993), and Turkish stems (e.g., Inkelas and Orgun 1994). Kager (1996) argues that the disyllabic requirement in these language is distinct from the requirement that PWds contain a Foot, since the above languages allow heavy

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22 This approach suggests that with unaccusative roots (§2.3), where the root morph corresponds to the lexical root plus the unaccusative \( v_2 \) head, the active version (spelled out with the causative \( v_1 \) suffix) should only undergo early spellout of the root morph if the unaccusative \( v_2 \) head is spelled out as well. This is in fact the structure that §2.4.2 posits: the unaccusative \( v_2 \) head is merged first and the active \( v_1 \) head is then merged on top of it (sending unaccusative \( v \) and lexical root to the phonology). This is likely correct, given that the active \( v_1 \) head is higher in the syntax than the unaccusative \( v_2 \) head (see also Ramchand 2008, Travis 2010).
monosyllabic (H) Feet. Kager demonstrates that Guugu Yimidhirr, which also allows monosyllabic Feet, has the same requirement that PWds be minimally disyllabic (1996). Garrett (1999) cites several languages of unrelated families that have disyllabic minimal requirement requirements, many of which allow monosyllabic Feet. Garrett moreover observes that in general, minimal requirements are distinct from a requirement that a PWd contain a Foot, i.e., PWd minimal requirement is not reducible to Headedness. This distinction is further expanded on in Downing (2005, 2006), who proposes that minimal requirement, including disyllabicity, are conditions on homology between morphological and phonological structure. The proposal that minimal Feet are distinct from minimal PWds perfectly characterizes RSC in Chukchansi, which, like the languages above, allows heavy monosyllabic (H) Feet but, as I propose, requires disyllabicity on phonological outputs, resulting in (L'H) Feet.23

I do not adopt a particular proposal as to the nature of the disyllabic minimal requirement; in the analysis below I use a single constraint to enforce this requirement, but I assume that independent principles on the correspondence between morphological and phonological units, such as those proposed in Kager (1996) or Downing (2006), are responsible for this. This single constraint is not a prosodic template, but a general condition on the size of possible words. Kager points out that the disyllabicity requirement only enforces minimal requirement, not strict or maximal disyllabicity (1996:4). In this way disyllabicity is properly a constraint on minimal requirement and not a template; as McCarthy and Prince note, “disyllabicity is not an absolute requirement of shape-invariance, like familiar templates, but only a lower bound” (1993:138). I formulate this minimal requirement as the cover constraint DISYLL:

\[(\text{DISYLL: assign a violation mark for any PWd with fewer than two syllables.})\]

Again, DISYLL is not reducible to the conjunction of Headedness and Foot-Binarity, a requirement that Feet be binary either in terms of morae or syllables (McCarthy and Prince 1986). In Chukchansi, as well as in the languages cited above, Feet are minimally bimoraic, i.e., (H) or (LL), but PWds are minimally disyllabic. If these languages even have a constraint demanding that Feet be disyllabic in their grammar, this constraint must be ranked sufficiently low to allow (H) Feet to surface. Such a constraint would thus almost assuredly not be ranked high enough to force a disyllabic minimum on PWds. Instead, the relatively high ranking of DISYLL ensures that all PWds are minimally disyllabic, which I posit spurs RSC.

It may seem debatable whether the output of a root alone in the first cycle of an RSC derivation constitutes a PWd. I adopt the null assumption that there is just one grammar, i.e., ranking of constraints, which applies to all inputs and produces all outputs in Chukchansi; every input, including roots by themselves, is subject to the same constraints (and ranking thereof). These constraints include those responsible for parsing syllables into Feet and Feet (and stray syllables) into PWds. As the grammar requires surface outputs to constitute a PWd, so it demands that any outputs of an intermediate cycle constitute a PWd, as well. Thus, DISYLL will be active (and have the same ranking relative to other constraints) in all cycles, no matter what their morphological

---

23 In fact, two types of words in Chukchansi seem to escape the disyllabic minimum and surface as monosyllables: function words and nouns. Function words in Chukchansi do not necessarily form PWds: monosyllabic function words, in fact, do not form separate stress Feet, and seem to be parsed as clitics to surrounding function words (Selkirk 1995). Chukchansi has a handful of CVC nouns, which surface as monosyllabic in the Nominative case. I suggest these nouns escape the disyllabic minimum due to high-ranking constraints enforcing Noun Faithfulness (Smith 2001).
moraic is. Cyclicality in the phonology, in other words, is not “built-in” under this analysis but is merely an open possibility resulting from cyclic spell-out of the syntax, which feeds the phonology. This account of phonological cyclicality differs from Stratal OT (Kiparsky 2000) and from any other theory of phonology in which different inputs can be subject to different grammars, depending on lexical or morphological information.

### 4.2.2. RSC with L Roots

I now show how DISYLL can capture the augmentation of one vowel roots to the optimal (L’H) Foot in RSC. I start with L roots (§3.4), e.g., /wan/ ‘give’ and /jawg/ ‘buy’. When L roots attach to RSC-triggering suffixes, the result is an initial (L’H) iamb (159-160):

(159) RSC with L Roots: /wan-ʧ''-i/ → [(wa.'na:].ʧ''i]
(160) RSC with L Roots: /jawg-ʧ''-Ø/ → [(fa.'wa:].giʧ’]

I posit that these outputs are constructed in two parts, corresponding to the material spelled out in the syntax by the nominalizing phase head corresponding to /-ʧ''-/ (i.e., the lexical root and the categorizing feature, which correspond to the root morph), and the material spelled out later in the derivation (i.e., the suffixes themselves). The derivation proceeds as follows:

(161) RSC Derivation: /wan/ → [(wa.'na:)] → [(wa.'na:)]-ʧ''-i/ → [(wa.'na:].ʧ''i]
(162) RSC Derivation: /jawg/ → [(fa.'wa:].g) → [(fa.'wa:].g)-ʧ''-Ø / → [(fa.'wa:].giʧ’]

I assume that the second vowel in the output of the first cycle is always long, since it surfaces as long in forms that allow it (161-162), in contrast to forms like [wa.naj’] and [fa.wagʧ’i], where the long vowel predictably shortens to accommodate the coda consonant). In order for the long vowel to appear in the output of the first cycle, the final consonant must be left unparsed: [fa.wa.g]. The ranking of *Cµ >> PARSE-SEG(FIN), demonstrated in §3.2.3 above, picks [(fa.'wa:].g] over the competing (L’H) output *[(fa.'wagµ)]

Table 21. *Cµ >> PARSE-SEG(FIN): (L’H) Formed with Long Vowel

<table>
<thead>
<tr>
<th>/jawg/</th>
<th>*Cµ</th>
<th>PARSE-SEG(FIN)</th>
</tr>
</thead>
<tbody>
<tr>
<td>fa.'wa:.g</td>
<td>*</td>
<td>L</td>
</tr>
<tr>
<td>(fa.'wagµ)</td>
<td>* W</td>
<td></td>
</tr>
</tbody>
</table>

I propose that in RSC forms, only morae are epenthesized, not a vowel. The input vowel, i.e., its segmental feature geometry, including the [+vocalic] root node, spreads to the second syllable when morae are inserted and attached to the vowel. While the morae of the long vowel in RSC are epenthetic, the quality of the vowel is underlying. This accounts for why the quality of the long vowel in the second, heavy syllable is identical to that of the underlying vowel. If this long vowel were completely epenthetic, one would expect a more constant vowel quality, as is found with the consistently high epenthetic vowel that breaks up three consonant clusters. Linking of the new morae to the underlying vowel quality follows Archangeli’s (1983, 1991) analysis of the same facts in Yowlumne. I thus assume the derivation on the left, not the one on the right.24

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24 Guekguezian (2012) accounts for the constant quality [a:] of the epenthetic second vowel in biconsonantal root RSC forms like [(fi.'ja:].la-ta?] from /ʧʧ/ and [(si.'pa-?).hɪy] from /se:p/ as an effect of sonority: stressed vowels prefer to be more sonorous, i.e., lower, and [a] is the most sonorous vowel (de Lacy 2002). Guekguezian (2012) in
Adopting the derivation on the left, the only departure from faithfulness when L roots undergo RSC is the epenthesis of two morae to create the (L'H) Foot, violating $\text{DEP-}\mu$. $\text{DEP-V}$, which is ranked above *$C_\mu$ in §3.2.3, cannot select a form like *[('faw_\mu)g] instead of [(f'a.'wa:)g].

I can now demonstrate how the demand for two syllables in the output, driven by $\text{DISYLL}$, causes the epenthesis of these two morae to create the optimal (L'H) Foot. A disyllabic output can have one of four forms: LL, LH, HL, and HH. The ranking of markedness constraints in Chukchansi render LH the best disyllabic output. $\text{NON-FINALITY(Ft)}$ and IAMB favor an LH sequence (parsed as (L'H)) over an LL sequence (parsed as (L'L) or (LL)). An HL sequence, parsed as ('H)L, violates $\text{PARSE-}\sigma$, while an HH sequence, parsed as ('H)(H), violates $\text{DEP-}\mu$ more than LH.

Generally in Chukchansi, an (L'H) Foot is constructed either when higher-ranking faithfulness constraints are not violated (resulting in an (LL) or (H) Foot instead), or when markedness constraints ranked even higher force these faithfulness constraints to be violated. The latter ranking of Markedness over Faithfulness allows the unmarked (L'H) Foot to emerge; (L'H) Foot construction in RSC is a TETU effect. The relevant faithfulness constraint includes $\text{DEP-}\mu$, which is the only constraint violated by the RSC derivation of LH from L roots. The markedness constraint forcing violation of $\text{DEP-}\mu$, i.e., mora epenthesis, is $\text{DISYLL}$; without epenthetic morae, a disyllabic output cannot be constructed.

<table>
<thead>
<tr>
<th>/ja_\mu wg/</th>
<th>$\text{DISYLL}$</th>
<th>$\text{DEP-}\mu$</th>
</tr>
</thead>
<tbody>
<tr>
<td>*'$('ja_\mu.'wa:_\mu).g'</td>
<td>* W</td>
<td>* L</td>
</tr>
<tr>
<td>*'$('ja_\mu.wa_\mu).g'</td>
<td>* W</td>
<td>* L</td>
</tr>
</tbody>
</table>

Epenthesis of only one mora to create an LL disyllabic output is penalized by $\text{NON-FINALITY(Ft)}$ (which (L'L) Feet violate) and IAMB (which (LL) Feet violate). $\text{NON-FINALITY(Ft)}$ and IAMB thus outrank $\text{DEP-}\mu$, favoring the (L'H) Foot, which epenthesizes more morae.

<table>
<thead>
<tr>
<th>/ja_\mu wg/</th>
<th>$\text{NON-FINALITY(Ft)}$</th>
<th>IAMB</th>
<th>$\text{DEP-}\mu$</th>
</tr>
</thead>
<tbody>
<tr>
<td>*'$('ja_\mu.'wa:_\mu).g'</td>
<td>* W</td>
<td>* L</td>
<td></td>
</tr>
<tr>
<td>*'$('ja_\mu.wa_\mu).g'</td>
<td>* W</td>
<td>* L</td>
<td></td>
</tr>
</tbody>
</table>

The fact argues that the epenthetic vowel always has a lowering effect, as in triconsonantal root RSC forms like [(le.'he:].m-e-tj from /lihm/. The difference between the biconsonantal and triconsonantal forms is in the output domain of root vowel harmony.
PARSE-σ penalizes epenthesis of two morae to create an HL disyllable, footed as (H)L. DEP-µ does not favor (H)L over (LH); DEP-µ, in fact, eliminates an HH disyllable, footed as (H)(H), which epenthesizes more morae than (LH) while not improving on markedness.

Table 24. PARSE-σ, DEP-µ: RSC with L Roots

<table>
<thead>
<tr>
<th>/ʃaˈwɑː/</th>
<th>PARSE-σ</th>
<th>DEP-µ</th>
</tr>
</thead>
<tbody>
<tr>
<td>a (ʃaˈ.wɑː).g</td>
<td>* W</td>
<td>**</td>
</tr>
<tr>
<td>(ʃaˈwɑː).ga</td>
<td>** W</td>
<td>*** W</td>
</tr>
</tbody>
</table>

Biconsonantal L roots, such as /wan/ undergo the same augmentation to (L'H) under this ranking (see §3.2.3 above for justifying the rankings of NON-FINALITY(Ft), IAMB, and PARSE-σ).

Table 25. RSC with Biconsonantal L Roots

<table>
<thead>
<tr>
<th>/waˈn/</th>
<th>DISYL</th>
<th>NON-FINALITY(Ft)</th>
<th>IAMB</th>
<th>PARSE-σ</th>
<th>DEP-µ</th>
</tr>
</thead>
<tbody>
<tr>
<td>a (waˈ.nə).i</td>
<td>* W</td>
<td>* L</td>
<td>**</td>
<td></td>
<td></td>
</tr>
<tr>
<td>(waˈ.nə).a</td>
<td>* W</td>
<td>* L</td>
<td>*** W</td>
<td></td>
<td></td>
</tr>
<tr>
<td>(waˈ.nə)</td>
<td>* W</td>
<td>* L</td>
<td>**</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

4.2.3. RSC with H Roots

The same ranking produces RSC with H roots, such as /maːx/ (163) and /beːwn/ (164), which also undergo augmentation to LH.

(163) RSC with H Root: /maːx-ʧ-i/ → [(maˈ.xaː).ʧi]
(164) RSC with H Root: /beːwn-ʧ-Ø/ → [(beˈ.weː).nʧ]

I again assume that the (L'H) Foot is constructed when the root morph enters the phonology by itself. However, since H roots can create surfaceable Chukchansi Feet out of their underlying two morae, I also assume that the derivation of the (L'H) Foot is as faithful as possible, so as not to wrongly predict a wider scope of change from H to LH structure. More precisely, I assume that only one mora is epenthized, and that one of the underlying root morae forms the long second vowel of the heavy syllable, as in the derivation on the left.

UR: /beːwn/ /beːwn/

Output (LH): μ μ μ μ μ μ

Figure 11. H → LH RSC [be.weː:n] [be.weː:n]
Temporarily setting aside the alteration of the underlying moraic association in this derivation, the above ranking of DISYLL, NON-FINALITY(Ft), and IAMB over DEP-µ results in epenthesis of a mora to create an (L'H) Foot instead of an ('H), ('LL) or (L'L) Foot.

Table 26. RSC with Biconsonantal H Roots

<table>
<thead>
<tr>
<th>/maːɪjµ.&quot;x/</th>
<th>DISYLL</th>
<th>NON-FINALITY(Ft)</th>
<th>IAMB</th>
<th>PARSE-σ</th>
<th>DEP-µ</th>
</tr>
</thead>
<tbody>
<tr>
<td>*</td>
<td></td>
<td>*</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>(maːɪjµ).&quot;x</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>(maːɪjµ).x</td>
<td>*</td>
<td>*</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>(maːɪjµ).xa</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>(maːɪjµ).xa</td>
<td>*</td>
<td>*</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Table 27. RSC with Triconsonantal H Roots

<table>
<thead>
<tr>
<th>/beːɪjµ.&quot;wn/</th>
<th>DISYLL</th>
<th>NON-FINALITY(Ft)</th>
<th>IAMB</th>
<th>PARSE-σ</th>
<th>DEP-µ</th>
</tr>
</thead>
<tbody>
<tr>
<td>*</td>
<td></td>
<td>*</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>(beːɪjµ).&quot;we</td>
<td>*</td>
<td>*</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>(beːɪjµ).we</td>
<td>*</td>
<td>*</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>(beːɪjµ).we</td>
<td>*</td>
<td>*</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>(beːɪjµ).we</td>
<td>*</td>
<td>*</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

DISYLL must be the constraint that dominates DEP-µ and forces epenthesis to create an (L'H) Foot, instead of a monosyllabic form with an ('H) Foot. If a constraint that penalizes ('H) but not (L'H) Feet were ranked above DEP-µ, mora epenthesis would be wrongly predicted across the board in Chukchansi to form (L'H) Feet. Such a constraint is UNEVEN-IAMB (see Prince 1990, Hayes 1995).

(165) UNEVEN-IAMB: Assign one violation mark to any Foot where the stressed binary branch is equal in duration to the unstressed binary branch.

DEP-µ must be ranked above UNEVEN-IAMB to allow faithful derivation with H roots in non-RSC contexts, creating ('H) Feet.

Table 28. DEP-µ >> UNEVEN-IAMB: ('H) Foot in non-RSC Context

<table>
<thead>
<tr>
<th>/beːɪjµ.&quot;wn-it/</th>
<th>DEP-µ</th>
<th>UNEVEN-IAMB</th>
</tr>
</thead>
<tbody>
<tr>
<td>*</td>
<td>*</td>
<td>L</td>
</tr>
<tr>
<td>(beːɪjµ.&quot;weːɪjµ).nit</td>
<td>* W</td>
<td>L</td>
</tr>
</tbody>
</table>

DISYLL does not penalize the (comparatively) faithful output [(beːɪjµ."weːɪjµ).nit], which has two syllables; this allows lower-ranked DEP-µ to eliminate the RSC candidate [(beːɪjµ."weːɪjµ).nit] in the non-RSC context.
I now return to the alteration of the underlying moraic association in Figure (11). The derivation /beː;ũw/.wn/ → [([be_µ,we;ũµ]).n] in (164) involves delinking the mora of the first vowel and relinking it to the second vowel. This alteration of mora links violates a constraint against altering input mora associations. Following Morén (1999), the constraint DEP-µ-LINK militates against epenthesizing associations between morae and vowels and MAX-µ-LINK against deleting these associations. MAX-µ-LINK is the crucial constraint in this analysis.

(166) MAX-µ-LINK: assign a violation mark to any input association between a mora and a vowel with no correspondent in the output.

MAX-µ-LINK penalizes the deletion of the link between the second mora and the underlying vowel in /beː;ũw/.wn/ → [([be_µ,we;ũµ]).n]. In order to eliminate the HL challenger in (167), which does not violate MAX-µ-LINK, the constraint PARSE-σ from Tables (26-27) above must dominate MAX-µ-LINK. To eliminate the HH challenger in (168), DEP-µ must also dominate MAX-µ-LINK.

(167) Challenger with Unparsed Syllable: *([be_µ,we;ũµ]).n
(168) Challenger with Too Many Epenthetic Morae: *([be_µ,we;ũµ]).n

Table 29. PARSE-σ, DEP-µ >> MAX-µ-LINK: (L’H) Foot in RSC

<table>
<thead>
<tr>
<th>/beː;ũw/.wn/</th>
<th>PARSE-σ</th>
<th>DEP-µ</th>
<th>MAX-µ-LINK</th>
</tr>
</thead>
<tbody>
<tr>
<td>abc</td>
<td>*</td>
<td>*</td>
<td>*</td>
</tr>
<tr>
<td>(be;ũµ).we;ũµ.n</td>
<td>** W</td>
<td></td>
<td>L</td>
</tr>
<tr>
<td>(be;ũµ).we;ũµ.n</td>
<td>* W</td>
<td>*</td>
<td>L</td>
</tr>
</tbody>
</table>

4.3. Multi-Vowel Roots: No RSC

Having shown how roots with one vowel undergo RSC when going through the phonology on their own, this section accounts for why roots with more than one vowel resist RSC. As shown in §1.1 and §3.5, roots that do not have a UR shape that faithfully maps to L, H, or LH do not undergo RSC ((169-171), repeating the footed data from (130-132)).

(169) No RSC: /ʧ”edma-la-t/ ‘think’-CAUS-RC.PT → [’ʧ”ed.(’ma.la).t]
(170) No RSC: /hayk’it-ʧ’/ ‘finish’-AGT-NOM/ACC → [’hay.(’k’i.ti)ʧ’]
(171) No RSC: /yo:yo-la-t/ ‘call’-CAUS-RC.PT → [’yo:(’yo.la)t]; *[’yo:(’yo).lat]

The roots /ʧ”edma/, /hayk’it/, and /yo:yo/ do not have one of the canonical shapes L, H, or LH (§1.1 and §3.4). Non-canonical roots do not undergo RSC when attached to suffixes that trigger RSC with canonical roots, such as the causative /-la-/ or -e-/ or the agentive /-ʧ”-/). Because these roots have (at least) two underlying vowels, their faithful output candidates are disyllabic, and thus do not violate DISyll. The choice been the faithful output and the (L’H) output is therefore left to lower-ranked DEP-µ, which eliminates an RSC candidate whose (L’H) Foot is formed by epenthesizing morae (172).

---

25 Ranking DEP-µ over MAX-µ-LINK wrongly predicts that the input /beː;ũw/ta/, with the three-consonant cluster /wn/ should have the output *[be_µ,we;ũ;µ].ta?], which only epenthesizes one mora, not the actual winner [be_µ,we;ũ;µ].ta], which epenthesizes two morae. I believe the correct solution will involve an HS derivation where epenthesis and footing happen serially, as suggested in §3.3.
(172) RSC Challengers: *[(ʧ'e.'de:).ma], *(ha.'ya:).k'it]

Table 30. DEP-µ: No RSC with Multi-Vowel Roots

<table>
<thead>
<tr>
<th>/ʧ'e_dmaµ/</th>
<th>DISYLL</th>
<th>DEP-µ</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>.Physics ('ʧ'e_dµ).maµ</td>
<td></td>
<td>*</td>
</tr>
<tr>
<td>('ʧ'e_dµ.'de:µµ).maµ</td>
<td></td>
<td>** W</td>
</tr>
</tbody>
</table>

Table 31. DEP-µ: No RSC with Multi-Vowel Roots

<table>
<thead>
<tr>
<th>/haµ_yk'iµt/</th>
<th>DISYLL</th>
<th>DEP-µ</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>.Physics ('haµ_yµ).k'iµt</td>
<td></td>
<td>*</td>
</tr>
<tr>
<td>(haµ.'ya:µµ).k'iµt</td>
<td></td>
<td>** W</td>
</tr>
</tbody>
</table>

NOLENGTHENING prevents an (L'H) Foot from being formed by lengthening an input short vowel (173).

(173) RSC Challengers: *[(ʧ'e.'da:).m], *(ha.'yi:).k't

As shown by the constraint ranking in §3.3 above, NOLENGTHENING dominates PARSE-σ, to favor the faithful candidate over the (L'H) candidates in (173).

Table 32. NOLENGTHENING >> PARSE-σ: No RSC with Multi-Vowel Roots

<table>
<thead>
<tr>
<th>/ʧ'e_dmaµ/</th>
<th>NOLENGTHENING</th>
<th>PARSE-σ</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>.Physics ('ʧ'e_dµ).maµ</td>
<td></td>
<td>*</td>
</tr>
<tr>
<td>('ʧ'e_dµ.'da:µµ).m</td>
<td></td>
<td>* W</td>
</tr>
</tbody>
</table>

Table 33. NOLENGTHENING >> PARSE-σ: No RSC with Multi-Vowel Roots

<table>
<thead>
<tr>
<th>/haµ_yk'iµt/</th>
<th>NOLENGTHENING</th>
<th>PARSE-σ</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>.Physics ('haµ_yµ).k'iµt</td>
<td></td>
<td>*</td>
</tr>
<tr>
<td>(haµ.'yi:µµ).k't</td>
<td></td>
<td>* W</td>
</tr>
</tbody>
</table>

This ranking also prevents the derivation /yo:µµ.yoµ/ → [(yoµ.'yo:µµ)], which does not violate DEP-µ.

Table 34. NOLENGTHENING >> PARSE-σ: No RSC with /CV:CV/ Roots

<table>
<thead>
<tr>
<th>/yo:µµ.yoµ/</th>
<th>NOLENGTHENING</th>
<th>PARSE-σ:</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>.Physics ('yo:µµ).yoµ</td>
<td></td>
<td>*</td>
</tr>
<tr>
<td>(yoµ.'yo:µµ)</td>
<td></td>
<td>* W</td>
</tr>
</tbody>
</table>

Triconsonantal LH roots (/CVCV:C/), which are canonical roots (§1.1, §3.4), appear with an (L'H) Foot in both RSC (174) and non-RSC (175) contexts in Chukchansi.
(174) LH Roots in RSC Contexts
a. /hewe:t-e/-t/ ‘walk’-CAUS-RC.PT → [(he.’we:).tet]
b. /gomo:ʧ”-?a-n/ ‘hug’-DUR-N.PST → [(go.'moʧ’).ʔon’]
c. /bala:f-ʧ”--runtime ‘crawl’-AGT-NOM → [(ba.'la:).ʧʧ’]

(175) LH Roots in Non-RSC Contexts
a. /hewe:t-eʔ/ ‘walk’-N.PST → [(he.’we:).teʔ]
 b. /gomo:ʧ”-ga/ ‘hug’-IMPR → [(go.'moʧ’).go]
c. /bala:f-it/ ‘crawl’-RC.PT → [(ba.'la:).ʧʧ]

Since there is no actual change in shape of LH roots, I adopt the null hypothesis that these roots do not undergo RSC. Rather, their underlying structure parses faithfully into optimal (L’H) Feet, so there is no need for alterations in structure (i.e., faithfulness violations) to produce prosodic well-formedness. LH roots satisfy both iambic well-formedness constraints and the disyllabicity requirement without violating moraic faithfulness. While the behavior of biconsonantal LH roots (i.e., /CVCV:/) is less predictable, Chukchansi only has three such roots, so their errant behavior in RSC contexts (including vowel deletion and glide epenthesis) is likely a lexicalized irregularity rather than a productive process. The paucity of /CVCV:/ roots is likely due to a dispreference for roots ending in long vowels (see §3.4), as these cause considerably structural problems in Yokuts; Newman makes a similar observation (1944:39).

4.4. Multi-Morph Inputs: No RSC

This section explains why RSC does not occur in the absence of the triggering suffixes. As demonstrated in §2.3-4 and §4.1.1, without an intermediate phase head suffix (e.g., an event-specifying morpheme in the extended v domain, such as the causative or the durative, or a deverbal nominalizer, such as the agentive), root morphs are not inserted into the phonological cycle until the next highest phase in the syntactic computation. For verbs, this is the CP phase (see, e.g., Chomsky 2000, 2001); as verb-final suffixes are Infl heads, these suffixes are spelled out along with all the lower verbal heads, which have head-moved up to Infl with the root. At this point, all the morphs corresponding to the fully-inflected verb are inserted into the phonology, the suffixes along with the root. The input to this phonological cycle always has more than one vowel, including at least the vowel of the root and the vowel of the obligatory final suffix (the Infl head). Because this input contains more than one vowel, its output can meet the minimality requirement of two syllables without epenthesizing morae. In other words, the same rankings that prevent RSC with multi-vowel inputs consisting only of a root also prevent RSC with multi-vowel inputs consisting of more than one morph. The tableaux below demonstrate this, using the constraint ranking adduced in §4.2-3 and shown in the following Hasse Diagram (Figure 12).

\[ \text{DISYLL, NON-FINALITY(\text{FI})}, \text{IAMB} \quad \text{NOLENGTHENING,} \]
\[ \quad \text{DEP-\( \mu \)} \quad \text{PARSE-\( \sigma \)} \]

Figure 12. RSC Constraint Ranking

56
I leave out candidates that violate IAMB below, as these do not better satisfy any of the higher-ranked constraints.

Table 35. No RSC with Multi-Morpheme Inputs (L Roots)

<table>
<thead>
<tr>
<th></th>
<th>DISYLL, NOLENGTHENING, NON-FINALITY(Ft)</th>
<th>PARSE-σ</th>
<th>DEP-μ</th>
<th>MAX-μ-LINK</th>
</tr>
</thead>
<tbody>
<tr>
<td>/wa.n-ta/?</td>
<td></td>
<td>*</td>
<td>*</td>
<td></td>
</tr>
<tr>
<td>(wa.n.ta)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>(wa.na.ta)</td>
<td></td>
<td>*</td>
<td>** W</td>
<td></td>
</tr>
</tbody>
</table>

Table 36. No RSC with Multi-Morpheme Inputs (L Roots)

<table>
<thead>
<tr>
<th></th>
<th>DISYLL, NOLENGTHENING, NON-FINALITY(Ft)</th>
<th>PARSE-σ</th>
<th>DEP-μ</th>
<th>MAX-μ-LINK</th>
</tr>
</thead>
<tbody>
<tr>
<td>/li.hm-i.t/</td>
<td></td>
<td>*</td>
<td>*</td>
<td></td>
</tr>
<tr>
<td>(lihm.mi)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>(lih.m.mi)</td>
<td></td>
<td>*</td>
<td>** W</td>
<td></td>
</tr>
</tbody>
</table>

Table 37. No RSC with Multi-Morpheme Inputs (H Roots)

<table>
<thead>
<tr>
<th></th>
<th>DISYLL, NOLENGTHENING, NON-FINALITY(Ft)</th>
<th>PARSE-σ</th>
<th>DEP-μ</th>
<th>MAX-μ-LINK</th>
</tr>
</thead>
<tbody>
<tr>
<td>/ma.x-ta/?</td>
<td></td>
<td>*</td>
<td>*</td>
<td>* W</td>
</tr>
<tr>
<td>(ma.x.ta)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>(ma.xa.ta)</td>
<td></td>
<td>*</td>
<td>** W</td>
<td>* W</td>
</tr>
</tbody>
</table>

Table 38. No RSC with Multi-Morpheme Inputs (H Roots)

<table>
<thead>
<tr>
<th></th>
<th>DISYLL, NOLENGTHENING, NON-FINALITY(Ft)</th>
<th>PARSE-σ</th>
<th>DEP-μ</th>
<th>MAX-μ-LINK</th>
</tr>
</thead>
<tbody>
<tr>
<td>/be.wn-i.t/</td>
<td></td>
<td>*</td>
<td></td>
<td></td>
</tr>
<tr>
<td>(bewn.ni)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>(bewn.wi)</td>
<td></td>
<td>*</td>
<td>* W</td>
<td>* W</td>
</tr>
</tbody>
</table>

In §2.3.2, I posited that the passive nominal suffix [-hana-] is composed of the passive Voice head /-han-/ and the nominalizing n head /-a-/ As the n head is phasal (see §2.3.2), it sends the passive Voice head and the verbalized stem to the phonology, where they can both be inserted. Since the passive Voice head has a vowel, the input to the phonology has two vowels, and thus a faithful (non-augmented) output satisfies DISYLL. As in Tables (35-38), this sufficiently large, multi-morphemic input does not undergo RSC. In general, multi-morphemic inputs at any stage are large enough to prevent RSC, even if they do not comprise the entire word (but see §4.5 for an exception with the unaccusative suffix).

4.5. Correct Predictions

The above analysis of RSC as an interaction of cyclicity, minimality, and prosodic well-formedness makes two correct empirical predictions about RSC in Chukchansi. First, when
Table 40

identical optimization. Dominates against rearranging material to form the Root. I give the following examples of reduplicated verbs, which all denote repetitive aspect; the first copy is bolded, while the second copy is underlined (176-179).

(176) /RED-yix-taʔ/ REP-‘aim’-RM.PT → [yix.yix.taʔ]
(177) /RED-goːb-eʔ/ REP-‘gather’-N.PST → [goː.go(beʔ)]
(178) /RED-waxl-it/ REP-‘cry’-RC.PT → [wax.wax_lit]
(179) /RED-beːw-n-eʔ/ REP-‘sew’-N.PST → [bew.bew_neʔ]

Reduplication in Chukchansi involves several complications, including unpredictable vowel shortening (177) and occasional vowel quality changes. These phenomena require a separate treatment of their own; for now, I focus on the failure of RSC to occur when an RSC-triggering suffix occurs together with reduplication (180-181):

(180) /RED-goːb-la-t/ REP-‘gather’-CAUS-RC.PT → [goː.go(b).lot]
a. *[goː.go.b.o:lot], *[goː.go.b.o:lot] “just made X keep gathering and gathering”
(181) /RED-waxl-ʧ­-Ø/ REP-‘cry’-AGT-NOM → [wax.wax_liʧ]
a. *[wax.wa.xaː.liʧ], *[wax.ʃal.wa.xaːliʧ] “who keeps crying and crying”

If reduplication occurs in the same cycle as RSC, i.e., the reduplicant morph (or whatever input element triggers reduplication) is inserted into the phonology along with the root morph, the reduplicated output will necessarily contain two syllables, satisfying DISYLL. Since reduplication by itself makes the output meet minimality, epenthesis cannot occur to make (L'H) Feet instead of (H) Feet. DEP-μ must dominate PARSE-σ, to favor the winner of the first cycle, [’(go)b.go.b], over a fully parsing challenger that has an (L’H) Foot, [’(go).b(o.ːb):].

Table 39. DEP-μ >> PARSE-σ: No RSC with Reduplication

<table>
<thead>
<tr>
<th>/RED-goːμb/</th>
<th>DISYLL</th>
<th>DEP-μ</th>
<th>PARSE-σ</th>
</tr>
</thead>
<tbody>
<tr>
<td>ʧ (goːμb)</td>
<td>ʧ goːμ.b</td>
<td>*</td>
<td>*</td>
</tr>
<tr>
<td>(goːμ.iboːμμ),goːμ.b</td>
<td>** W</td>
<td>*</td>
<td></td>
</tr>
<tr>
<td>(’goːμb),(goːμ.iboːμμ)</td>
<td>*** W</td>
<td>L</td>
<td></td>
</tr>
</tbody>
</table>

In fact, Base-Reduplication Faithfulness (BR-FAITH; McCarthy and Prince 1995) militates against rearranging material to form (L’H) Feet if this makes the copies less similar. If BR-FAITH dominates PARSE-σ, identity between the copies is preserved at the expense of prosodic optimization. Again, DEP-μ outranking PARSE-σ prevents massive epenthesis to create two identical (L’H) Feet.

Table 40. No RSC with Reduplication

<table>
<thead>
<tr>
<th>/RED-goːμb/</th>
<th>BR-FAITH</th>
<th>DEP-μ</th>
<th>PARSE-σ</th>
</tr>
</thead>
<tbody>
<tr>
<td>ʧ (goːμb)</td>
<td>ʧ goːμ.b</td>
<td>*</td>
<td>*</td>
</tr>
<tr>
<td>(goːμ.iboːμμ),b</td>
<td>** W</td>
<td>*</td>
<td>L</td>
</tr>
<tr>
<td>(goːμ.iboːμμ)(goːμ.iboːμμ)</td>
<td>**** W</td>
<td>L</td>
<td></td>
</tr>
</tbody>
</table>
Assuming the Reduplicant morph corresponds to the repetitive aspect head, the RSC-triggering phrase head must send the repetitive head to phonology along with the verbalized stem; thus, the repetitive aspect head must be in the complement of the phase head. As I follow Boskovic’s (to appear) account that only the highest eligible phase head in the extended v domain has phasal status, the repetitive v₁ head must be below other v₁ phase heads, e.g., the causative (182). The repetitive v₁ head is also below the deverbal nominalizing n heads, e.g., the agentive (183).

(182) RSC-Trigger with Repetitive: [v₁P vACT [v₁P vREP [vP v √]]]
(183) RSC-Trigger with Repetitive: [nP n [v₁P vREP [vP v √]]]

When the repetitive v₁ head is the highest v₁ head in the extended v domain, it has phasal status (following §2.3.1 above). Therefore, the repetitive head would be expected to trigger RSC when it sends the verbalized stem [vP v √] in its complement to the phonology before it, itself, is sent at a higher phase. This would predict that the root morph would undergo RSC first, and then reduplication would occur later to expose the repetitive head; this derivation is not correct (184).

(184) Wrong Reduplication Derivation: /waxl/ → [wa.xa:.l] (RSC) → /RED-[wa.xa:.l]-it/ → *[wa.xal.wa.xa:.lit] or *[wa.wa.xa:.lit] (cf. actual [wax.wax.lit])

While it is just a conjecture at this point, I suggest that reduplication may not actually expose the repetitive suffix, but rather is a different way to satisfy the disyllabic minimality requirement. Reduplication would then be a special type of RSC required by the repetitive phase head. Such an analysis requires exploration of what phase heads contribute to the phonology, and specifically of the vexing question of whether phase heads are spelled out with their complements (see, e.g., Nissenbaum 2000 and Marantz 2000). Other RSC-related phenomena in Chukchansi and other Yokuts languages, as well as similar phenomena in unrelated languages, also require such exploration (see §5 for more discussion). The suggested derivation is given below (185).

(185) Right Reduplication Derivation: /waxl/ → [wax.wax.l] (RSC) → [wax.wax.l]-/it/ → [wax.wax.lit]

Another prediction made by this account is that when a suffix besides the root morph is spelled out, RSC will occur with this suffix if it does not automatically augment the output of the first phonological cycle to disyllabicity. This second prediction is also borne out: when the vowelless morph /-n-/ corresponding unaccusative v head is sent to the phonology along with the root morph, an (L'H) Foot is formed. I give an example of this phenomenon below; Newman (1944) also displays this phenomenon in different Yokuts languages, which he calls “base-faking,” since the /-n-/ acts like part of the verb root (= “base”) with biconsonantal roots.

(186) RSC with Unaccusative: /t’ul-n-ʔa-n’/ ‘burn’-UNACC-DUR-N.PST → [(t’o’.lon’).ʔan’]
(187) RSC with Unaccusative: /yot’-n-ʧ-Ø/ ‘stretch’-UNACC-AGT-NOM → [(yo.t o’).niʧ’]

In (186), the vowel lowering that predictably occurs in RSC with triconsonantal roots happens here with a biconsonantal root plus the suffix consonant. In other words, the root and suffix together act like one root for the purposes of RSC. Because this input, even though bi-morphemic, does not constitute enough material to create two syllables without augmentation,
Disyll compels mora epenthesis to meet minimality. As with one-vowel roots above, the epenthetic morae are arranged to create an (L'H) Foot, the optimal disyllabic structure.

Table 41. RSC with Unaccusative Suffix

<table>
<thead>
<tr>
<th>/t’uµl-n/</th>
<th>DISYLL</th>
<th>NON-FINALITY(Ft)</th>
<th>DEP-µ</th>
</tr>
</thead>
<tbody>
<tr>
<td>(t’oµ,‘loµµ).n</td>
<td>* W</td>
<td>* L</td>
<td>**</td>
</tr>
</tbody>
</table>

These two phenomena predicted by the cyclic minimality account of RSC are unexpected under an account of RSC as LH template imposition, subcategorization for an LH Foot, or selection of an LH allomorph of the root. Reduplication is not expected to prevent the occurrence of LH under these accounts; for RSC to occur at all, the LH-enforcing constraint must dominate DEP-µ. Because of this ranking, the actual output, [(’gob).go:b] cannot win; either BR-FAITH is ranked below DEP-µ, so that the non-identical candidate [(’gob).(go.’bo:)] wins, or it is ranked above, so that the LH-copying output [(go.’bo:).(go.’bo:)] wins.

Table 42. LH-IAMB >> DEP-µ: Wrongly Predicts RSC with Reduplication

<table>
<thead>
<tr>
<th>/RED-goµb/</th>
<th>LH-IAMB (RSC)</th>
<th>DEP-µ</th>
<th>BR-FAITH</th>
</tr>
</thead>
<tbody>
<tr>
<td>(goµ,boµµ).(goµ,’bo:µµ)</td>
<td>****</td>
<td></td>
<td></td>
</tr>
<tr>
<td>(goµ,boµµ).(goµ,’bo:µµ)</td>
<td>***</td>
<td></td>
<td>*</td>
</tr>
<tr>
<td>(goµµ).goµµ.b</td>
<td>* L</td>
<td>* W</td>
<td></td>
</tr>
</tbody>
</table>

Under accounts where RSC is a requirement on the root by an adjacent suffix, RSC is not expected to occur with the unaccusative suffix /-n-. First, the unaccusative suffix is not root material, so it is not expected to undergo root shape change. Second, the unaccusative suffix disrupts adjacency between the root and the RSC trigger. Any account of RSC that relies on either of these two assumptions, i.e., that RSC is strictly a requirement on the root, or that RSC involves the triggering suffixes subcategorizing for an adjacent root, wrongly predicts that the unaccusative suffix should disrupt RSC.

5. Conclusion

This paper has proposed an account of root shape change (RSC) in Chukchansi Yokuts based on the cyclic structure of words. This cyclic structure results from the presence of syntactic domain-delimiting elements, i.e., phase heads, in words that undergo RSC. These word-internal phase heads, which send inner parts of words (syntactic stems = phonological roots) to the phonology early, are absent in words that do not undergo RSC (Section 2). Due to the iambic parsing of words in Chukchansi, in which (L’H) is the optimal Foot (Section 3), phonological root morphs that go through an earlier phonological cycle appear with an (L’H) Foot to satisfy disyllabic minimality. In this analysis of RSC, no special morphological or phonological mechanism is necessary; rather, RSC emerges from general, independently necessary properties of Chukchansi syntax and phonology.
5.1. Comparison w/ Previous Accounts

This account of Yokuts root shape change utilizes independently necessary theoretical apparatus, including phase-based spellout (e.g., Chomsky 2000, 2001), disyllabic minimality (e.g., Kager 1996), and the scale of iambic well-formedness (e.g., Kager 1993, 1995). These tools have been used to analyze many separate phenomena in unrelated languages, and are not at all specific to Yokuts or cross-linguistic phenomena of root shape change. As such, this analysis falls in line with the program of Generalized Template Theory (e.g., McCarthy and Prince 1994, 1995), which strives to account for the appearance of fixed morphophonological shape using general principles of prosodic well-formedness and relations between morphological and prosodic constituents. Root shape change is simply another manifestation of the iambic nature of Yokuts and its resulting preference for LH sequences. Moreover, this account is free from morphological arbitrariness: suffixes that trigger root shape change share the syntactic property of being phase heads. Root shape change does not form an isolated sub-system in Yokuts, but rather fits in tightly with the overall morphosyntactic and prosodic picture of the language family, and even falls out naturally from its structure.

The overall principled nature of the account above contrasts with previous accounts of this phenomenon, which lack principled explanation in parts of their analysis. Prior analyses of Yokuts root shape change, including Archangeli (1983, 1991) and Zoll (1993), concentrate on the shapes themselves and their integration into the broader matter of phonotactics and syllabification. These accounts have succeeded in forming correct generalizations for both the canonical shapes of Yokuts verb roots and the phonotactic constraints on Yokuts syllables. However, the place of these shapes within the grammar of Yokuts has not been thoroughly investigated; instead, the shapes have been accounted for by imposition of prosodic templates by both roots and suffixes. The assumption has been that roots “choose” a preferred template, but certain suffixes can override this with a template of their own choosing. Russell (1999) works out a possible mechanism for template choice, in which the template provided in the input to the phonology is decided in a prior morphological component. There is a great deal of arbitrariness in this account of template choice: no principled means has been offered to determine which suffixes can impose a template upon roots, much less why a certain suffix chooses its particular template. Instead, the set of template-imposing suffixes, as well as the set of the templates themselves, is determined on a purely descriptive basis.

I believe that the lack of principled explanation in the broader position of root shape change is due partly to a lack of the full empirical generalizations involved; the collection of new primary data from Chukchansi Yokuts has helped remedy this. This lack involves both the paucity of stress data on Yokuts and a too superficial analysis of Newman’s data on shape change. An analysis of stress patterns reveals that Chukcansi Yokuts is iambic; this finding is supported by familiar patterns of epenthesis, as well as a deep investigation of the lexicon, in which the inventory of root shapes is skewed away from roots that would form poor (L’L) iambs. A closer look at Newman’s data, in addition, shows that the only productive process of root shape change in Yokuts derives (L’H) iambs, unless overridden by phonotactic constraints on glottalized segments (see §5.1.1). This finding is supported by primary data from root shape change in Chukchansi, which only actively results in (L’H) iambs. With these two generalizations, the place of root shape change within the broader prosodic structure of Yokuts is clear: root shape change is prosodic optimization. Thus, it is unnecessary not only for the grammar to impose templates arbitrarily, but moreover for templates to exist at all. Rather, root shape change is
properly analyzed as the emergence of unmarked structure in contexts determined by the cyclic composition of words.

5.1.1. (L'H) = Only Productive RSC in other Yokuts Languages

In §3.5.1, I argue that the only productive RSC in Chukchansi Yokuts is to the (L'H) Foot. I tentatively posit that this finding is likely true for the other Yokuts languages in Newman (1944), as well as in Gamble’s (1978) grammar of Wikchamni Yokuts. Newman (1944) analyzes RSC in Yokuts as dynamic processes of change on the root vowels, each process associated with suffixes that require it (Gamble 1978 follows this analysis). Analyses based on Newman’s data described these suffixes as imposing a shape template on the roots. Archangeli (1983) proposes that root shape change-triggering suffixes impose one of the three possible root templates (L, H, and LH) upon roots, displacing the underlying root template. However, Newman (1944) notes that H shape change is mostly confined to suffixes that are either “in rare use” (1944:51), not “freely productive” (1944:110), or “extremely rare” (1944:159). The one other example of H shape change is the durative in Choynimni, Gashowu and Wikchamni, which forms “morphological cleavages” [i.e., forms restricted to certain root types] (1944:51) and displays multiple irregularities; in Appendix B, I suggest that these do not constitute an active, productive process of H RSC. Newman (1944) gives quite a few suffixes that he analyzes as L RSC (the “weak” stem), many of which are productive. Some of these suffixes are reanalyzed as LH RSC in §3.5.1 (following Guekguezian 2011, 2012). All other L triggering suffixes in Newman (1944), with one exception, have the form /ʔ…V/, with an initial vowel and a floating glottal autosegment that prefers to attach to the second consonant of the root.\(^{26}\) I tentatively suggest that the appearance of the L rather than the LH shape is due purely to a phonotactic preference for glottalized segments to occupy the coda (see Howe and Pulleyblank 2001), similar to the analysis of the LL forms before the glottal stop in §3.5.1. This phonotactic constraint prevents the LH shape from occurring when the glottal autosegment docks. Only LH RSC is grammatically productive in any Yokuts language, as §3.5.1 shows for Chukchansi. Appendix B lists all the RSC-triggering suffixes found in Newman (1944) and Gamble (1978).

5.2. Implications for Yokuts

The account of root shape change may shed light on two related phenomena in Yokuts. The first phenomenon is long high vowel lowering; many Yokuts analysts (starting with Newman (1944) and continuing through, e.g., Kuroda (1967), Archangeli (1984), and Zoll (1993)) have assumed that long high vowels /iː uː/ are predictably lowered to [eː oː] through the grammar. Hockett (1967) and Blevins (2003) show that Newman’s data do, however, contain surface instances of long high vowels [iː uː]; this is true of the new data on Chukchansi, as well (188).

\[(\text{188})\]  
\[
\{\text{?oyi:sə-n'}\} \text{“will be happy”}; \{\text{huː [e-t]}\} \text{“just drove”}; \{\text{huː yaʔ}\} \text{“caterpillar sp.”}; \{\text{miː:səʔ}\} \text{“mass” (from Sp. [miːsa])}
\]

The correct generalization is that long high vowels are only lowered in canonical verb roots and in root shape change (Guekguezian 2011). Guekguezian (2012) relates the lowered long vowels in root shape change with triconsonantal inputs (189-190) to the appearance of the low vowel

\^{26} The suffix [-la-] also triggers L root shape change with /CVCV:/ roots, as shown for Chukchansi in §3.5.1. As suggested above in that section, /CVCV:/ are a small minority in Yokuts and display irregular behavior.
may be possible that autosegmental
complements (e.g., Nissenbaum 2000), some morphological manifestations of phase theory
§
In fact, the triggers and non
non
satis
"ghost segments" in Yowlumne
being related to the cyclic spellout somehow.
material seem to be
glottal, essentially a
also accounts for the glottalization of the second consonant by certain suffixes with a floating
that accompany the RSC
Previous analyses of Yokuts have modeled these segmental changes with floating autosegments that sometimes accompany root shape change. These include umlaut of the second, long vowel with the (causative-)inchoative and distributive suffixes (193-194) and the optional appearance of a glottal stop in the second, heavy syllable in some causative forms (195-196).

If prosodic unmarkedness can emerge in the first cycle of a root shape change derivation, it is not unreasonable that segmental unmarkedness can also do so. Since the second, long vowel in a root shape changed form involves epenthetic morae, perhaps this epenthetic material must be less marked than underlying material. This would account for the lowering in (189-192), as well as its absence in (188). The appearance of lowering in canonical roots outside of root shape change contexts is more puzzling, but may indicate that these forms are derived serially as well, though perhaps not in separate cycles. Another possibility is that these roots are different than non-canonical roots in their underlying forms; specifically, these roots may not have all their morae attached to the underlying vowel. The fixed surface shape of these roots in non-root shape change contexts may be due to the prosodic well-formedness of (H) and (L'H) Feet in Yokuts; depending on the number of unattached morae in the root input, either an (H) or an (L'H) Foot will always be formed. This would require a more specific account of the derivation of outputs in the second (non-RSC) phonological cycle.

The second phenomenon that this account may shed light on is the appearance of segmental changes that sometimes accompany root shape change. These include umlaut of the second, long vowel with the (causative-)inchoative and distributive suffixes (193-194) and the optional appearance of a glottal stop in the second, heavy syllable in some causative forms (195-196).

Previous analyses of Yokuts have modeled these segmental changes with floating autosegments that accompany the RSC-triggering suffix (e.g., Archangeli 1984, Zoll 1993). Newman (1944) also accounts for the glottalization of the second consonant by certain suffixes with a floating glottal, essentially an autosegment. In Yokuts, all suffixes that appear to have autosegmental material seem to be RSC-triggers (see Secion 5.1.1 above); this points toward the autosegments being related to the cyclic spellout somehow. Hansson (2005) also reanalyzes the so-called “ghost segments” in Yowlumne RSC-triggering suffixes as regular consonants that get deleted to satisfy syllable phonotactics (rather than being supported by vowel epenthesis, as happens with non-RSC-triggering suffixes). This difference in the behavior of consonants between RSC-triggers and non-triggers are also likely due to cyclic spellout.

In fact, these two matters point to the controversy in phase-based spellout acknowledged in §2.2.1 above: while most syntactic theories posit that phase heads are not spelled out with their complements (e.g., Nissenbaum 2000), some morphological manifestations of phase theory assume that at least some phase heads are indeed spelled out with their complements (Marantz 2000, Marvin 2002, Newell 2008). While this account of RSC follows the former position, it may be possible that autosegmental, but not segmental, material from phase heads is spelled out

[189] /lihm-ʃ-Ø/ ‘run’-AGT-NOM → [læ.he: miʃ]
[190] /t’u1-n-ʔa-n’/ ‘burn’-INTR-DUR-N.PST → [t’o.lon’.ʔan’]
[191] /ʃiʃ-ʃ-i/ ‘cut’-AGT-ACC → [ʃiʃ.ʃai: ʃi]
[192] /t’u1-ʔa-n’/ ‘burn’-DUR-N.PST → [t’u1.ʔa.an’]

(193) /gays-a-t/ ‘good’-INCH-RC.PT → [ga.ye: sat]
(194) /fawg-e-n’/ ‘buy’-DIST-N.PST → [ʃa.wè: gen’]
(195) /waʃ-la-taʔ/ ‘tell.a.story’-CAUS-RM.PT → [waʃa2.la.taʔ]
(196) /holoʃ-e-t/ ‘sit’-CAUS-RM.PT → [ho.løʃ.fot]
with their complements. CV-slots from phase heads may also be spelled out, or at least influence the first phonological cycle; this would account for different repairs for consonant clusters (Hansson 2005), as well as the behavior of root morphs with the glottal autosegments followed by vowel-initial suffixes (see §5.1.1). Proposing a principled mechanism to instantiate this suggestion is well beyond the scope of this paper. However, there may be good cross-linguistic evidence for the cooccurrence of auto-segmental material and CV-skeletal influence with cyclic-based prosodic change similar to root shape change in Yokuts.

5.3. Implications outside Yokuts

I conclude this paper by considering the potential for the above proposal to extend to other languages. Several other language families display similar phenomena to root shape change, in which verb roots alter their prosodic structure in the presence of certain syntactic material. These include the stems, or verb root shapes, in Sierra Miwok (e.g., Freeland 1951, Broadbent 1964), a group of Penutian languages related to the Yokuts family. The unrelated Muskogean and Semitic language families also have different root shapes to indicate certain syntactic content. In Muskogean languages such as Choctaw/Chickasaw and Creek, various aspects are denoted by “grades,” i.e., root-internal change (e.g., Ulrich 1986, Munro & Willmon 2009, Martin 2011). The different grades include both autosegmental elements, including floating glides, glottals, and nasals, as well as the imposition of prosodic structure; this prosodic structure often takes the form of an (L’H) iamb at the right edge of the verb root. The well-known binyanim (internally-changed root allomorphs) of the Semitic languages also feature a combination of segmental alteration and prosodic shape imposition (e.g., McCarthy 1979, Ussishkin 2000, Arad 2003, Tucker 2010, Kastner 2014). The different binyanim indicate differences in event structure, including causativity and dynamicity, as well as active versus passive voice; intriguingly, the former, which at first glance seem to be $v_1$ heads, provide the prosodic changes as well as affixal material, while the latter, which indicate Voice, only influence vowel changes.

The major difference between root shape change in Yokuts and the prosodic root changes in the above-mentioned language families is the multiplicity of options in the latter. In Yokuts, I have argued that root shape change is emergence of the optimal (L’H) iamb; there is only one changed form possible. In the other language families, several different prosodically changed forms exist. I nevertheless believe that these are both instantiations of the same more general phenomenon, which I tentatively suggest is the coincidence of inner syntactic and phonological cycles, the “$vP$~Stem Homology.” The $vP$ is the inner syntactic phase of the clause, and constitutes the first cyclic domain of clausal syntax; the Stem is the inner phonological cycle, the domain of processes such as prosodic modification, ablaut, and other modifications that are not generally predictable across a grammar (see, e.g., Chomsky and Halle 1968, Kiparsky 1982). I tentatively propose that Chukchansi represents a special version of the general case in which these inner cycles in syntax and phonology correspond.

I end by offering some broad ideas about how this homology in general might work. Much research indicates that the $vP$ is a boundary or barrier in syntax, including the Minimalist theory of phases. Further work on the articulated $vP$ corroborates this, indicating that the extended $v$ domain constitutes an inner cycle; for example, Travis (2000, 2010) posits that an Event Phrase at the edge of the $vP$ delimits the “syntactic” word. In Travis’ account, following Hale and Keyser’s (1993) theory of (lexical)-syntax, $vP$-internal structure is “lexical,” while $vP$-external structure is “productive.” This is tantalizingly parallel to classic lexical phonology, in which the
internal Stem constituent is affected by lexical processes, while the external Word constituent is affected by productive processes. I suggest that the highest \( v_1 \) head in the extended \( v \) domain, i.e., the \( vP \) phase head, may not only spell out the material inside the \( vP \) domain, but may also be a “save point” for the lexicon. The inner syntactic domain of the \( vP \) may be a lexically storable entity, while material outside this domain cannot be lexically stored. This may account for the often unpredictable and sometimes non-compositional nature of the \( vP \), including its ability to form idioms, the effects of \( vP \)-internal material on aspect, and the possibility of forming a lexical item spread out across the \( v \) domain (as I have argued for phonological root morphs in Chukchansi, which encode both active or unaccusative \( v \) heads and lexical roots). If the \( vP \) domain can be lexically stored, the inner phonological domain that spell out the \( vP \) ought also to be lexically stored. Conditions on this storage may include forming specific prosodic structure, or perhaps the appearance of specific segmental changes. Perhaps the difference between Chukchansi and languages with several options for verb root shapes is that root shape change in Chukchansi is fully active and productive, while in other languages, different changes, all of which may improve prosodic markedness using different strategies, can be stored and affiliated with different \( vP \) phase heads. Root shape change in Chukchansi Yokuts would thus represent the predictable end of the \( vP \)-Stem homology, and form a simplest case of the correspondence between inner syntactic and phonological domains.

**Appendix A: Sample Derivations**

Below, I sketch out complete sample derivations of root shape changed (RSC) and non-RSC forms of the following words, using the roots /ma:x/ (212-213) and /lihm/ (214-215).

(197) No RSC: /ma:x-taʔ/ → [([max).taʔ]
(198) RSC: /ma:x-la-t/ → [(ma.'xa:).lat]
(199) No RSC: /lihm-taʔ/ → [(li.'him).taʔ]
(200) RSC: /lihm-e-t/ → [(le.'he:).met]

The non-RSC forms have the syntactic structure in (216), the RSC forms in (217); the verbal phase head is bolded and underlined, and the complement it spells out is shown as well.

(201) No RSC: [\text{InflP Infl}_{RM, PT} [vIP \text{FACT \checkmark}]] → [\checkmark]
(202) RSC: [\text{InflP Infl}_{RC, PT} [vIP \text{FACT \checkmark}]] → [vIP \text{FACT \checkmark}]

In (216), since only the lexical root is spelled out early, the phonological root morph is not inserted (see §2.4.1, §4.1.1 above for details). In (217), the verbalized stem (lexical root + categorizing \( v \) head) is spelled out early, and the phonological root morph is inserted. Based on this, the cyclic derivations of the words in (212-215) are shown below (218-221).

(203) No RSC: /ma:x-taʔ/ → [([max).taʔ]
(204) RSC: /ma:x/ → [(ma.'xa:)] → [(ma.'xa:)]-la-t/ → [(ma.'xa:).lat]
(205) No RSC: /lihm-taʔ/ → [(li.'him).taʔ]
(206) RSC: /lihm/ → [(le.'he:).m] → [(le.'he:).m]-e-t/ → [(le.'he:).met]

I sketch out the phonological derivations below, using the full constraint ranking adduced in §3 and §4 (Figure (13)). In each tableau, only the relevant constraints (i.e., those violated by at least one of the output candidates) are shown. No candidates that violate the strict CVX syllable maximum are shown (the CVX-enforcing constraints are inviolable).
**Figure 13. Full Constraint Ranking**

TROCHEE, MAX-µ-LINK

(207) 

/ma:x-ta?/ → [(max).ta?]

Table 42. Shortening, No Final Stress: DEP-V >> *Cµ, NOLENGTHENING >> PARSE-SEG(FIN), PARSE-σ, MAX-µ-LINK

<table>
<thead>
<tr>
<th>/ma:x-ta?/</th>
<th>DEP-V</th>
<th>*Cµ</th>
<th>NOLENGTHENING</th>
<th>PARSE-SEG(FIN)</th>
<th>PARSE-σ</th>
<th>MAX-µ-LINK</th>
</tr>
</thead>
<tbody>
<tr>
<td>⟨max⟩.ta?</td>
<td>*</td>
<td>*</td>
<td>*</td>
<td>*</td>
<td>*</td>
<td>*</td>
</tr>
<tr>
<td>⟨max⟩.⟨ta⟩?</td>
<td>*</td>
<td>*</td>
<td>W</td>
<td>*</td>
<td>L</td>
<td></td>
</tr>
<tr>
<td>⟨max⟩.⟨ta⟩µ</td>
<td>** W</td>
<td>L</td>
<td></td>
<td>L</td>
<td></td>
<td></td>
</tr>
<tr>
<td>⟨ma⟩.⟨xi.ta⟩?</td>
<td>* W</td>
<td>L</td>
<td></td>
<td>*</td>
<td>L</td>
<td>L</td>
</tr>
</tbody>
</table>

(208) /ma:x/ → [(ma.‘xa:)]

Table 43. H → (L’H) RSC: DISYLL, NON-FINALITY(Ft) >> DEP-µ >> PARSE-σ >> MAX-µ-LINK

<table>
<thead>
<tr>
<th>/ma:x/</th>
<th>DISYLL</th>
<th>NON-FIN(Ft)</th>
<th>DEP-µ</th>
<th>PARSE-σ</th>
<th>MAX-µ-LINK</th>
</tr>
</thead>
<tbody>
<tr>
<td>⟨ma⟩.‘xa:</td>
<td>*</td>
<td>*</td>
<td>*</td>
<td>*</td>
<td></td>
</tr>
<tr>
<td>⟨ma⟩:xa</td>
<td>*</td>
<td>*</td>
<td>*</td>
<td>W</td>
<td>L</td>
</tr>
<tr>
<td>⟨ma⟩:⟨xa⟩</td>
<td>** W</td>
<td>*</td>
<td>W</td>
<td>L</td>
<td></td>
</tr>
<tr>
<td>⟨ma⟩:x</td>
<td>* W</td>
<td>*</td>
<td>W</td>
<td>L</td>
<td>*</td>
</tr>
<tr>
<td>⟨ma⟩:⟨x⟩</td>
<td>*</td>
<td>*</td>
<td>W</td>
<td>L</td>
<td>L</td>
</tr>
</tbody>
</table>

(209) [(ma.‘xa:)]-/la-t/ → [(ma.‘xa:).lat]

Table 44. No Final Stress: *Cµ, NOLENGTHENING >> PARSE-SEG(FIN), PARSE-σ

<table>
<thead>
<tr>
<th>(ma.‘xa:)-/la-t/</th>
<th>*Cµ</th>
<th>NOLENGTHENING</th>
<th>PARSE-SEG(FIN)</th>
<th>PARSE-σ</th>
</tr>
</thead>
<tbody>
<tr>
<td>⟨ma⟩.‘xa:).lat</td>
<td>* W</td>
<td>*</td>
<td>W</td>
<td>L</td>
</tr>
<tr>
<td>⟨ma⟩.‘xa:.(‘la:)t</td>
<td>* W</td>
<td></td>
<td>*</td>
<td>L</td>
</tr>
<tr>
<td>⟨ma⟩.‘xa:.⟨lat⟩µ</td>
<td>* W</td>
<td></td>
<td>L</td>
<td>L</td>
</tr>
</tbody>
</table>
Table 45. Epenthesis: IAMB >> PARSE-σ, TROCHEE

<table>
<thead>
<tr>
<th>/lihm-taʔ/</th>
<th>IAMB</th>
<th>PARSE-σ</th>
<th>TROCHEE</th>
</tr>
</thead>
<tbody>
<tr>
<td>(li.'him).taʔ</td>
<td>*</td>
<td>*</td>
<td></td>
</tr>
<tr>
<td>(lih).(mi.taʔ)</td>
<td>* W</td>
<td>L</td>
<td>L</td>
</tr>
</tbody>
</table>

(210) /lihm-taʔ/ → [(li.'him).taʔ]

Table 46. L → (L'H) RSC: DISYLL, NON-FINALITY(Ft), *Cᵅ, IAMB >> PARSE-SEG(FIN), DEP-µ

<table>
<thead>
<tr>
<th>/lihm/</th>
<th>DISYLL</th>
<th>NON-FIN(Ft)</th>
<th>*Cᵅ</th>
<th>IAMB</th>
<th>PARSE-SEG(FIN)</th>
<th>DEP-µ</th>
</tr>
</thead>
<tbody>
<tr>
<td>(le.'he:).m</td>
<td></td>
<td></td>
<td>*</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>(le.he).m</td>
<td></td>
<td></td>
<td>* W</td>
<td>*</td>
<td>L</td>
<td></td>
</tr>
<tr>
<td>(le.'hemᵣ)</td>
<td></td>
<td></td>
<td>* W</td>
<td></td>
<td>L</td>
<td></td>
</tr>
<tr>
<td>(le.'he).m</td>
<td></td>
<td></td>
<td>* W</td>
<td></td>
<td>L</td>
<td></td>
</tr>
<tr>
<td>(lihᵣ).m</td>
<td></td>
<td></td>
<td>* W</td>
<td></td>
<td>L</td>
<td></td>
</tr>
</tbody>
</table>

(211) /lihm/ → [(le.'he:).m]

Table 47. No Final Stress: *Cᵅ, NOLENGTHENING >> PARSE-SEG(FIN), PARSE-σ

<table>
<thead>
<tr>
<th>(le.'he:).m-/e-t/</th>
<th>*Cᵅ</th>
<th>NOLENG</th>
<th>PARSE-SEG(FIN)</th>
<th>PARSE-σ</th>
</tr>
</thead>
<tbody>
<tr>
<td>(le.'he:).me.t</td>
<td></td>
<td></td>
<td>*</td>
<td>*</td>
</tr>
<tr>
<td>(le.'he:).(me:t)</td>
<td></td>
<td>* W</td>
<td>*</td>
<td>L</td>
</tr>
<tr>
<td>(le.'he:).(metᵣ)</td>
<td></td>
<td>* W</td>
<td>L</td>
<td>L</td>
</tr>
</tbody>
</table>

(212) [(le.'he:).m/-e-t] → [(le.'he:).met]

Appendix B

I proposed in §3.5.1 that the only productive form of root shape change (RSC) in Chukchansi is an initial (L'H) Foot; §5.1.1 posits that this may be true of all Yokuts languages. To support this position, this appendix lists all the suffixes that trigger some form of RSC found in Newman’s (1944) study of six Yokuts languages: Chawchilla (abbreviated as ‘Chaw’), Choynimni (‘Choy’), Chukchansi (‘Chuk’), Gashowu (‘Gash’), Wikchamni (‘Wik’), and Yowlumne (‘Yawelmani’ in Newman; ‘Yaw’). I also give a list of all the possible RSC-triggering suffixes found in Gamble’s (1978) grammar of Wikchamni; while the evidence from RSC given by Gamble is less clearly always to the (L'H), it may also be amenable to an (L'H) reanalysis.

The list includes the following information for each suffix: Newman’s (and Gamble’s) gloss or meaning, the underlying form (UR), the probable syntactic class (based on §2.3), the type of root for which the suffix triggers RSC (‘2-C’ = biconsonantal, ‘3-C’ = triconsonantal), the exact pattern of RSC found, my prosodic interpretation of the RSC, and the language(s) in which this form occurs (rare and unproductive forms or forms restricted to one root type are italicized; productive forms across multiple root types in multiple languages are bolded). The types of RSC patterns found include LH (CVCV:(C)), H (CV:C(C)), Glottal (CVC’(C)-V (§5.1.1 posits that
glottalization prevents LH), L (CVC(C)), and RED (reduplication: C1VC2-C1VC2). Information on vowel quality changes (lowering or /e/-umlaut) is not provided, since it is not addressed in the above account. The table is organized by the ‘Prosody’ column (i.e., my interpretation of the RSC pattern) to illustrate how the data interact with the above analysis of Chukchansi RSC.

Table 48. List of RSC-triggering suffixes in Newman (1944)

<table>
<thead>
<tr>
<th>Gloss</th>
<th>UR</th>
<th>Syntactic Class</th>
<th>Root Type</th>
<th>RSC Pattern</th>
<th>Prosody</th>
<th>Language</th>
</tr>
</thead>
<tbody>
<tr>
<td>Causative</td>
<td>la</td>
<td>v₁</td>
<td>2-C</td>
<td>CVC</td>
<td>L</td>
<td>All</td>
</tr>
<tr>
<td>Continuous</td>
<td>le</td>
<td>v₁ or View</td>
<td>CVC(V:)C</td>
<td>CVCiC</td>
<td>L</td>
<td>Chaw, Yaw</td>
</tr>
<tr>
<td>Desiderative</td>
<td>(h)əfín, (h)əfín</td>
<td>Mood</td>
<td>All</td>
<td>CVC(C)</td>
<td>L</td>
<td>Wik, Chaw</td>
</tr>
<tr>
<td>Agentive</td>
<td>‗...if‘</td>
<td>n</td>
<td>CVCV:C</td>
<td>CVC'C</td>
<td>Glottal</td>
<td>Choy, Gash, Yaw</td>
</tr>
<tr>
<td>Consequent</td>
<td>‗...a</td>
<td>v₁ + n</td>
<td>All</td>
<td>CVC'(C)</td>
<td>Glottal</td>
<td>Chaw, Chuk, Gash, Yaw</td>
</tr>
<tr>
<td>Auxiliary</td>
<td>‗...e:xo:</td>
<td>v₁ or View</td>
<td>All</td>
<td>CVC'(C)</td>
<td>Glottal</td>
<td>Yaw</td>
</tr>
<tr>
<td>Contemporaneous</td>
<td>‗...in'ay</td>
<td>Tense</td>
<td>All</td>
<td>CVC'(C)</td>
<td>Glottal</td>
<td>Yaw</td>
</tr>
<tr>
<td>Desiderative</td>
<td>?...ana:</td>
<td>Mood + n</td>
<td>3C</td>
<td>CVC'C</td>
<td>Glottal</td>
<td>Yaw</td>
</tr>
<tr>
<td>Habitual</td>
<td>‗...a:s</td>
<td>v₁ + n</td>
<td>All</td>
<td>CVC'C</td>
<td>Glottal</td>
<td>Yaw</td>
</tr>
<tr>
<td>Consequent</td>
<td>a:</td>
<td>v₁ + n</td>
<td>CVC(C)</td>
<td>CV:C(C)</td>
<td>H</td>
<td>Yaw</td>
</tr>
<tr>
<td>Auxiliary</td>
<td>a:</td>
<td>v₁ or View</td>
<td>3-C</td>
<td>CV:Ci/C</td>
<td>H</td>
<td>Chaw</td>
</tr>
<tr>
<td>Consequent</td>
<td>‗...a</td>
<td>v₁ or View</td>
<td>All</td>
<td>CV:C(C)</td>
<td>H</td>
<td>Chaw, Choy, Gash, Yaw</td>
</tr>
<tr>
<td>Future</td>
<td>Ø</td>
<td>Tense</td>
<td>CV:CC</td>
<td>CVCa:C</td>
<td>H</td>
<td>Choy, Gash</td>
</tr>
<tr>
<td>Adjunctive</td>
<td>¿</td>
<td>n</td>
<td>2-C</td>
<td>CVCa:</td>
<td>LH</td>
<td>Yaw</td>
</tr>
<tr>
<td>Adjunctive</td>
<td>(ʔ/h)iy</td>
<td>n</td>
<td>All</td>
<td>CVCV:(C)</td>
<td>LH</td>
<td>All but Chaw</td>
</tr>
<tr>
<td>Agentive</td>
<td>¿</td>
<td>n</td>
<td>All</td>
<td>CVCV:(C)</td>
<td>LH</td>
<td>All but Chaw</td>
</tr>
<tr>
<td>Causative</td>
<td>e(ʔ), i</td>
<td>v₁</td>
<td>3-C</td>
<td>CVCV:(ʔ)C</td>
<td>LH</td>
<td>All</td>
</tr>
<tr>
<td>Causative</td>
<td>la</td>
<td>v₁</td>
<td>2-C</td>
<td>CVCa:</td>
<td>LH</td>
<td>Chaw, Chuk, Wik, Yaw</td>
</tr>
<tr>
<td>Causative-</td>
<td>(l)sa:</td>
<td>v₁</td>
<td>All</td>
<td>CVCa:(C)</td>
<td>LH</td>
<td>Yaw</td>
</tr>
<tr>
<td>Repetitive</td>
<td>(ʔ)a(?</td>
<td>v₁ + n</td>
<td>All</td>
<td>CVCa:C</td>
<td>LH</td>
<td>Choy, Wik</td>
</tr>
<tr>
<td>Desiderative</td>
<td>wal(i)</td>
<td>Mood</td>
<td>3-C</td>
<td>CVCa:C</td>
<td>LH</td>
<td>Choy, Gash</td>
</tr>
<tr>
<td>Durative</td>
<td>?a</td>
<td>v₁</td>
<td>All</td>
<td>CVCV:(C)</td>
<td>LH</td>
<td>All</td>
</tr>
<tr>
<td>Habitual</td>
<td>?mut'</td>
<td>v₁ + n</td>
<td>All</td>
<td>CVCa:(C)</td>
<td>LH</td>
<td>Gash</td>
</tr>
<tr>
<td>Passive Adjunctive</td>
<td>(h)nel</td>
<td>Voice + n</td>
<td>All</td>
<td>CVCV:(C)</td>
<td>LH</td>
<td>Yaw</td>
</tr>
<tr>
<td>Passive Nominal</td>
<td>(ʔ)han'a</td>
<td>Voice + n</td>
<td>CVC(C)</td>
<td>CVCa:(C)</td>
<td>LH</td>
<td>Choy, Wik</td>
</tr>
<tr>
<td>Reflexive</td>
<td>(i)wsel</td>
<td>Voice + n</td>
<td>All</td>
<td>CVCV:(C)</td>
<td>LH</td>
<td>Yaw</td>
</tr>
<tr>
<td>Repetitive</td>
<td>da</td>
<td>v₁</td>
<td>3-C</td>
<td>CVCa:C</td>
<td>LH</td>
<td>All but Chuk</td>
</tr>
<tr>
<td>Repetitive</td>
<td>Ø</td>
<td>v₁</td>
<td>2-C</td>
<td>C1VC2-C1VC2</td>
<td>RED</td>
<td>All but Chuk</td>
</tr>
</tbody>
</table>

27 Newman further specifies all ‘adjunctive’ forms as ‘consequent’; because this is redundant information, I omit it.
Zeroing in on the bolded forms (productive across multiple root types in multiple languages), the picture largely matches the account of Chukchansi RSC in this paper. The syntactic classes of the RSC-triggers are either \( v_1, n \), or \( v_1 + n \) (the passive nominal in Choynimni and Wikchamni has likely been reanalyzed as a single suffix with the \( n \) as the phase head, rather than separate Voice and \( n \) suffixes, as argued for the passive nominal Chukchansi in §2.3.2). The RSC forms are almost always LH, or else of a form (Glottal, RED), that prevents LH. The only suffix that seems to defy the above analysis is the desiderative in Wikchamni and Yawelmani; further analysis may account for it similarly, or it may remain an irregularity.

Table 49. Productive, Common RSC-Triggering Suffixes in Multiple Yokuts Languages

<table>
<thead>
<tr>
<th>Gloss (Languages)</th>
<th>Syntactic Class</th>
<th>UR</th>
<th>Prosody</th>
</tr>
</thead>
<tbody>
<tr>
<td>Causative</td>
<td>( v_1 )</td>
<td>la</td>
<td>L, LH</td>
</tr>
<tr>
<td>Desiderative (Wik, Yaw)</td>
<td>Mood</td>
<td>(h)aṭin, (h)aṭin</td>
<td>L</td>
</tr>
<tr>
<td>Consequent Agentive (Chaw, Chuk, Gash, Yaw)</td>
<td>( v_1 + n )</td>
<td>?...a</td>
<td>Glottal</td>
</tr>
<tr>
<td>Consequent Agentive (Choy, Wik)</td>
<td>( v_1 + n )</td>
<td>(?a(?))</td>
<td>LH</td>
</tr>
<tr>
<td>Adjunctive</td>
<td>( n )</td>
<td>(?/h)iy</td>
<td>LH</td>
</tr>
<tr>
<td>Agentive</td>
<td>( n )</td>
<td>ꞟ</td>
<td>LH</td>
</tr>
<tr>
<td>Durative</td>
<td>( v_1 )</td>
<td>ꞟa</td>
<td>LH</td>
</tr>
<tr>
<td>Passive Nominal (Choy, Wik)</td>
<td>Voice + ( n )</td>
<td>(?han'a)</td>
<td>LH</td>
</tr>
<tr>
<td>Repetitive</td>
<td>( v_1 )</td>
<td>Ø</td>
<td>da RED</td>
</tr>
</tbody>
</table>

The durative aorist in Choynimni, Gashowu, and Wikchamni is worthy of special mention for its host of irregularities. An H shape is triggered when the durative plus aorist attach to L and LH roots; with H roots, an LH shape is triggered instead. In Choynimni and Wikchamni, biconsonantal L and LH roots are reduplicated, in addition to the H shape. In Choynimni and Gashowu, when the durative plus aorist attach to /CVC:C/ roots, they combine to assume the portmanteau forms /-uʃ/ and /-iʃ/, respectively, in which the durative suffix /-ʔa/- is not clearly present. A null suffix is used with the reduplicated H forms to express the durative aorist in Choynimni (Newman 1944) and the durative present in Wikchamni (Gamble 1978). In Newman’s (but not Gamble’s) Wikchamni data, the durative /-ʔa/- plus future /-d/ always triggers an LH shape, regardless of root type. Because of these irregularities, I suggest that these forms are likely memorized as paradigms, not a productive RSC process.

Table 50. Durative Aorist Forms by Root Type and Dialect (Newman 1944)

<table>
<thead>
<tr>
<th>Root Type</th>
<th>Wikchamni</th>
<th>Choynimni</th>
<th>Gashowu</th>
</tr>
</thead>
<tbody>
<tr>
<td>/CVC/ (L)</td>
<td>[C(_1)V:C(_2)VC(_1)C(_2)-a-(่วย)] (H+Red)</td>
<td>[C(_1)V:C(_2)VC(_1)VC(_2)-Ø] (H+Red)</td>
<td>[CVC-ʔa-ʃ] (H)</td>
</tr>
<tr>
<td>/CVCV:/ (LH)</td>
<td>[C(_1)V:C(_2)VC(_1)C(_2)-a-(ective)] (H+Red)</td>
<td>[C(_1)V:C(_2)VC(_1)VC(_2)-Ø] (H+Red)</td>
<td>[CVC-ʔa-ʃ] (H)</td>
</tr>
<tr>
<td>/CVCC/ (L)</td>
<td>[CVCC-a-ʃ] (H)</td>
<td>[CVCC-a-ʃ] (H)</td>
<td>[CVCC-a-ʃ] (H)</td>
</tr>
<tr>
<td>/CVCC:C/ (LH)</td>
<td>[CVCC-a-ʃ] (H)</td>
<td>[CVCC-u-ʃ] (H)</td>
<td>[CVCC-i-ʃ] (H)</td>
</tr>
<tr>
<td>/CV:C/ (H)</td>
<td>[CVVC:-ʔa-ʃ] (LH)</td>
<td>[CVVC:-ʔa-ʃ] (LH)</td>
<td>[CVVC:-ʔa-ʃ] (LH)</td>
</tr>
<tr>
<td>/CV:CC/ (H)</td>
<td>[CVVC:C-a-ʃ] (LH)</td>
<td>[CVVC:C-a-ʃ] (LH)</td>
<td>[CVVC:C-a-ʃ] (LH)</td>
</tr>
</tbody>
</table>
Most RSC-triggering suffixes in Gamble’s (1978) Wikchamni data are also to LH. However, there are a few additional wrinkles that need to be ironed out: e.g., how the durative paradigm is derived, why the passive aorist (Voice + Tense) triggers RSC (it does not appear to be a phase head), and what is responsible for a handful of RSC processes that operate on reduplicated roots, multi-vowel roots, and stems (multi-morphemic inputs). Table (51) lists suffixes that trigger RSC on canonical roots; Table (52) looks at RSC on reduplicated roots, multi-vowel roots and stems. The tables are listed mostly as in Table (48) before, except that surface forms (SR) are given to show by vowel lowering, which only occurs in H RSC.

Table 51. List of RSC-triggering suffixes in Gamble (1978)

<table>
<thead>
<tr>
<th>Gloss</th>
<th>UR</th>
<th>Syntactic Class</th>
<th>Root Type</th>
<th>SR</th>
<th>Prosody</th>
</tr>
</thead>
<tbody>
<tr>
<td>Passive Aorist</td>
<td>it</td>
<td>Voice + Tense</td>
<td>3-C</td>
<td>CVC.C-it</td>
<td>L</td>
</tr>
<tr>
<td>Durative ?a</td>
<td>vi</td>
<td>CV(C:)</td>
<td>CVC(V:)C</td>
<td>CVC:C.a(-/d)</td>
<td>H</td>
</tr>
<tr>
<td>Durative ?a</td>
<td>vi</td>
<td>CV(C:V:)</td>
<td>C1V:C1aC2-a-σ/Ø</td>
<td>H + RED</td>
<td></td>
</tr>
<tr>
<td>Causative da</td>
<td>vi</td>
<td>2-C</td>
<td>CV(C:)C-da-</td>
<td>1-σ</td>
<td></td>
</tr>
<tr>
<td>Consequent Agentive</td>
<td>?a</td>
<td>v1 + n</td>
<td>2-C</td>
<td>CV.Ca-a-</td>
<td>2-σ</td>
</tr>
<tr>
<td>Desiderative ?h</td>
<td>vi</td>
<td>Mood</td>
<td>CV(:)C</td>
<td>CVC.Ca-?h</td>
<td>2-σ</td>
</tr>
<tr>
<td>Passive Aorist</td>
<td>it</td>
<td>Voice + Tense</td>
<td>2-C</td>
<td>CV(C):CV-t</td>
<td>2-σ</td>
</tr>
<tr>
<td>Adjunctive (?/h)iya</td>
<td>n</td>
<td>All</td>
<td>CV.CV(:/(/h)iya-</td>
<td>LH</td>
<td></td>
</tr>
<tr>
<td>Causative i</td>
<td>vi</td>
<td>3-C</td>
<td>CV.CV(:/i)-</td>
<td>LH</td>
<td></td>
</tr>
<tr>
<td>Causative-Inchoative ya</td>
<td>vi</td>
<td>All</td>
<td>CV.Ce(:/)-ya-</td>
<td>LH</td>
<td></td>
</tr>
<tr>
<td>Consequent Agentive</td>
<td>?a</td>
<td>v1 + n</td>
<td>3-C</td>
<td>CV.Ca?C-a-</td>
<td>LH</td>
</tr>
<tr>
<td>Desiderative ?h</td>
<td>vi</td>
<td>Mood</td>
<td>3-C +</td>
<td>CV.Ca(3-C)-?h</td>
<td>LH</td>
</tr>
<tr>
<td>Durative ?a</td>
<td>vi</td>
<td>CV:C</td>
<td>CV.Ca:-a-σ/Ø</td>
<td>LH</td>
<td></td>
</tr>
<tr>
<td>Durative ?a</td>
<td>vi</td>
<td>CV:CC</td>
<td>CV.CV:C-a-σ/Ø</td>
<td>LH</td>
<td></td>
</tr>
<tr>
<td>Inchoative a</td>
<td>vi</td>
<td>All</td>
<td>CV.Ce(:/)-a-</td>
<td>LH</td>
<td></td>
</tr>
<tr>
<td>Neutral Agentive</td>
<td>?h</td>
<td>n</td>
<td>All</td>
<td>CV.CV(:/a/C)-?h</td>
<td>LH</td>
</tr>
<tr>
<td>Passive Aorist</td>
<td>it</td>
<td>Voice + Tense</td>
<td>3-C</td>
<td>CV.Ca:C-it</td>
<td>LH</td>
</tr>
<tr>
<td>Passive Nominal</td>
<td>?han’a</td>
<td>Voice + n</td>
<td>All</td>
<td>CV.Ca(C)-han’a-</td>
<td>LH</td>
</tr>
<tr>
<td>Repetitive da</td>
<td>vi</td>
<td>3-C</td>
<td>CV.CaC-da-</td>
<td>LH</td>
<td></td>
</tr>
<tr>
<td>Repetitive Ø</td>
<td>vi</td>
<td>2-C</td>
<td>C1V:C1aC2-</td>
<td>RED</td>
<td></td>
</tr>
</tbody>
</table>

Table 52. RSC with Reduplicated Roots, Multi-vowel Roots, and Stems

<table>
<thead>
<tr>
<th>Root/Stem</th>
<th>Future</th>
<th>Durative</th>
<th>Verbal Noun</th>
<th>Agentive</th>
</tr>
</thead>
<tbody>
<tr>
<td>C1V(:)C2C1VC2-</td>
<td>C1VC2V:C1iC2</td>
<td>C1VC2V:C1C2-</td>
<td>C1V(:)C1aC2</td>
<td>C1VC2V:C1VC2-?h</td>
</tr>
<tr>
<td>CVCCiC</td>
<td>CVCCaC</td>
<td>CV:CaC</td>
<td>CV:C</td>
<td>CV:C</td>
</tr>
<tr>
<td>CV(:)CVC-</td>
<td>CVCV:C:CiC</td>
<td>CV:C:CaC</td>
<td>CV:C</td>
<td>CV:C</td>
</tr>
<tr>
<td>CV(:)CVC-CVC-</td>
<td>CVCVC:CaC</td>
<td>CV:C:CaC</td>
<td>CV:C</td>
<td>CV:C</td>
</tr>
</tbody>
</table>
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Bošković, Željko. to appear. Now I’m a phase, now I’m not a phase: On the variability of phases with extraction and ellipsis. Ms., University of Connecticut.


