A GENERATIVE PHONOLOGY OF SAN MATEO HUAVE

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ABSTRACT

A comprehensive analysis of the word-level phonology of the San Mateo dialect of Huave, a language isolate of Mexico, is presented within the framework of lexical phonology (Kiparsky 1982, Halle and Vergnaud 1987), based on the author’s field work as well as data from published sources, chiefly Stairs Kreger and Stairs (1981). Affixes and other morphological processes are shown to fall into three groups (cyclic, non-cyclic and clitic), according to their phonological behavior. Numerous derivational opacities are exhibited and analyzed through ordered rules with both cyclic and non-cyclic modes of application. Other noteworthy phenomena include: a pervasive contrast in consonantal secondary articulation interacting extensively with vowel place features; an autosegmental diminutivization process; reduplication and infixation; an unusually complex system of vowel harmony and vowel copying; and evidence for a lexical-diffusion change in progress in vowel harmony classes.
KEYWORDS: Huave, phonology, diminutives, vowel harmony, derivational opacity
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Huave is a language isolate spoken on the Pacific coast of the state of Oaxaca, Mexico, in four communities, each having its own distinctive dialect: San Mateo del Mar, San Dionisio del Mar, Santa María del Mar and San Francisco del Mar. The San Mateo dialect, also known as ombeayiiüts ‘our (inclusive) speech’, has the most speakers and has been the most extensively studied. The present paper offers a comprehensive analysis of the word-level phonology of this dialect within the framework of derivational generative phonology, with occasional discussion of related dialects and the diachronic processes which have given rise to them.

The phonology of Huave is often intricately conditioned by morphological structure. For this reason, this paper will begin by examining the phonology of simplex (non-derived) words. After this, section 2 briefly introduces the morphology of the language and defines the levels of morphology which are crucial for the remaining discussion. Section 3 discusses in detail the phonology of morphologically complex words (derived forms). Section 4 briefly surveys neutralizations which occur in stressless, open syllables.
Section 5 summarizes the proposed grammar and reviews the arguments for the cyclic rule application and for various rule orderings.

Although the primary purpose of this paper is to provide a solid descriptive and analytical foundation for the study of Huave phonology, many of the phenomena to be discussed may be of general interest to researchers in theoretical phonology and linguistic typology. Particularly noteworthy phenomena include: pervasive contrasts in consonantal secondary articulation (plain vs. palatalized segments) (§1.1.2) which interact extensively with vowel place features (§1.4); a distinction between cyclic and non-cyclic affixes (§2) which correlates neatly with cyclic and non-cyclic application of various rules (§3.1, §3.2); a diminutivization process that manipulates autosegmental [−back] and [+high] features (§3.3); an unusually complex system of vowel harmony and vowel copying rules conditioned not only by vowel features but also by secondary articulation of consonants (§3.4); evidence for a lexical-diffusion change in progress in the vowel harmony system (§3.4.1); and finally, numerous derivational opacities in which non-surface syllabification, stress and other properties control
patterns inexpressible through surface phonotactic constraints (§5 et passim).

Nearly all the data for this study comes from my own field work in the four Huave-speaking communities in the summers of 2004 and 2006. Other sources of data include the dictionary of the San Mateo dialect compiled by Stairs Kreger and Stairs (1981) (= SS) and the grammatical sketch included in the same volume (Stairs and Hollenbach 1981 = SH). Diebold (1961) (= Dd) provides data on borrowings from Spanish, and Pike and Warkentin (1961) (= PW) describes the tonal and prosodic phonology of San Mateo. In addition to these synchronic studies, I have made use of the historical-comparative work of Suárez (1975) (= Su) which includes a reconstruction of Proto-Huave (PH) root forms, morphology, and the development into the four dialects, as well as some details of their phonetics. Other important earlier work includes Stairs and Hollenbach (1969) for the morphology of the San Mateo dialect, Warkentin and Warkentin (1952), a lexicon forming the basis for SS, and the text collection for the San Dionisio dialect published by Radin (1929). Unless otherwise
indicated data is from own field work; forms taken from SS or SH are followed with the spelling in the practical orthography developed by the authors. For reasons of space, not all relevant data could be included in the print version; in the text, an indication in braces of A followed by a number n refers the reader to section n of the electronically published Appendix for further examples and discussion.

1. The phonology of non-derived forms.

1.1. Segmental inventory. For the purpose of exposition, the segments will be divided into those which form syllable nuclei, i.e. vowels, and those which do not, i.e. the ‘non-syllabic’ segments.

1.1.1. Vowel inventory. The vowels, with the proposed distinctive feature values, are shown below:
The surface inventory expands on the underlying inventory in two ways.

First, surface long vowels are derived in closed syllables from sequences of vowel followed by /h/ (§1.3). Second, after palatalized segments the vowel [æ] appears as a surface variant of /a/ (§1.4.1), or of /a/ derived from /e/
(§3.2.4). Third, before non-palatalized codas the vowel [i] develops a centralizing off-glide [ə] (§1.4.2){A1}:

![Table](image)

1.1.2. Underlying inventory of non-syllabic segments. As in such languages as Irish, Russian and Marshallese (Bender 1968), the non-syllabic segments in San Mateo Huave appear in two series defined by a contrast in secondary articulation, plain and palatalized. The one exception is palatal glide /y/ which is always in the palatalized series. The palatalized segments are written here with a following [’]:

![List](image)
(3) p, p’  t, t’  k, k’  kʷ, kʷ’  voiceless stop
b, b’  d, d’  g, g’  voiced stop
ʦ, ʦ’  voiceless
⁴b, ⁴b’  ⁴d, ⁴d’  ⁴g, ⁴g’  ⁴gʷ, ⁴gʷ’  prenasalized stop
⁴ʦ, ⁴ʦ’  prenasalized
s, s’  h, h’  voiceless
ɾ, ɾ’  tap
r, r’  y  w, w’  central
⁴ɾ, ⁴ɾ’  ⁴y  prenasalized continuant
l, l’  lateral
labial  coronal  palatal  velar  labial(ized)  laryngeal
velar
The distinction between plain and palatalized plays a major role in the phonology of the language and imposes numerous phonotactic restrictions (§1.4). The palatalized series will be represented with the features [+high -back] and the plain series with [–high +back], dependents of the DORSAL node in feature geometry. These features are interpreted as secondary gestures of the tongue body (Sagey 1986), where secondary gestures are defined as those creating less constriction of the vocal tract than primary articulation gestures. The feature [–back] is interpreted as tongue body advancement, and [+high] as tongue body raising; [+back] and [–high] indicate here the absence of these gestures.

Although secondary articulation and vowel place are often interdependent, in the sense that surface vowel place can often predict the secondary articulation of adjacent segments, surface contrasts between palatalized and plain consonants can be seen in the pairs below:

(4a)  ok ‘clouds’ ≠ ok’ ‘coyol palm’

(4b)  -to®g ‘navel’ ≠ t’o®g ‘toad’ ≠ t’eo®g ‘it produced fruit’
(4c) $k'ats$ ‘breasts’ $\neq k'ats'$ ‘eye mucus’

(4d) $naka^nts$ ‘red’ $\neq a^nts'$ ‘laziness’ \{A2\}

In a few cases the property of palatalization emerges phonetically through a change in place of articulation: the segments /s’ t’s’/ are realized on the surface as alveopalatal fricatives and affricates [ʃ’ ʧ’] .

(5) **Alveopalatalization:** \(s’ t’s’ \rightarrow [ʃ’ ʧ’] \)

Otherwise, the phonetic realization of palatalization varies greatly depending both on the major place of articulation of the segment in question and its surrounding environment (Suárez 1975:18-26). In general, when a palatalized segment is tautosyllabic with /i/, with which it shares both [+high] and [−back] features, the property of palatalization is not phonetically salient; this is also true, but to a lesser extent, when a palatalized segment is tautosyllabic with /e/, with which it shares [−back] but not [+high]. Otherwise, where a syllable margin (onset or coda) differs in [high] or [back] from an adjacent vowel, transitional vocoids may develop
phonetically. Thus, in addition to steady-state vocalic nuclei [i e o a æ i], a
narrow phonetic transcription would include complex surface nuclei such as
[iə eo ëə iɨ oëi æi] as conditioned by neighboring segments. But from the
perspective of systematic phonology these complex nuclei are derived from
underlying monophthongs and do not figure in underlying representations. 5

Nevertheless, the distinction between plain and palatalized segments is
sometimes entirely neutralized in surface forms, finding surface expression
only in the place of articulation of adjacent vowels and effects on vowel
harmony (§3.4). This is true generally for /h r/, and for labials /p m mb/
when in syllable codas. 6

The tap /ɾ/ has a very restricted distribution, being limited essentially to
intervocalic position in surface forms (SS: xv). In word-initial and -final
position a tap may be pronounced as a trill /r/. The underlying distinction
between stem-final /r/ and /ɾ/ does, however, surface when a vowel-initial
suffix follows, e.g. a-hˈɔr-iw’ ‘they have’ vs. apma-mˈɔr-iw’ ‘they will
ripen’.
The nasal plus stop digraphs /ⁿb d ⁿs ⁿɡ ⁿɡʷ/ and their palatalized variants represent pre-nasalized stops; these behave in all respects as single segments. Although the inventory contains (non-prenasalized) voiced obstruents /b d ɡ/, most surface instances of voiced stops are derived from underlying voiceless stops (§1.3). Only a few words of the native vocabulary require underlying voiced stops, e.g. ʰiⁿb ‘fire’, ʰidóⁿɡ ‘friend (archaic, pejorative)’, ʰadam ‘large’, ʰahpawíw ‘twenty’. In addition the influx of many Spanish loan words containing voiced stops has solidified the underlying status of these segments, as well as introducing the non-native vowel /u/ (Diebold 1961).

1.2. Syllable structure. Syllables conform to the template

\[
(C)(C)V(h)(C):
\]

![Diagram of syllable structure]
The syllable nucleus may be either short /V/ or long /Vh/. The segment /h/ has a dual status phonologically. When incorporated into the syllable rhyme, as in a|p′eh|t′i′w′ ‘they cut’ (pres.), it represents a voiceless second mora of the preceding vowel (the symbol | will be used to denote syllable boundaries). In certain circumstances this mora becomes voiced to give a surface long vowel /Vː/ (§1.3), as in ap′e:d′ ‘s/he cuts’. When in a syllable onset /h/ is non-syllabic, as in han’e ‘who’ or k′eh’ ‘blood’. The syllabic alternations of /h/ are thus reminiscent of more familiar vowel-glide alternations such as /j ~ i, w ~ u/.

Prenasalized stops, being single segments, may freely occupy the onset, as shown by the following forms with reduplicated root syllable:

(7a) a|ⁿd′ak|ⁿd′ak ‘talks too much, gossips’
(7b) ᵐb′es'|ᵐb′es' s′i:g’ ‘firefly’
(7c) a|ⁿgots'|ⁿgots’ o|m’b’ay ‘argues’
Complex onsets on the other hand do not occur in the native vocabulary with the rare exception of prenasalized stop plus /ɾ/, as in *dro-m ‘disappears, gets lost’ or in *g’re’s ‘red snapper’. Onsets are not obligatory: vowel-initial words are not uncommon, although word-internal hiatus, as in a|ïi|g’ ‘spits’ v., or a|ah ‘heats to melting’ is not particularly common and is tolerated only at certain junctures (§3.2.5).

1.2.1. Root structure. According to Suárez (1975), proto-Huave root morphemes were composed of sequences of open syllables (8), but a process of Apocope (9) deleted word-final vowels.

(8) PH *sokolo > sokol ‘corner’
    PH *kamaya > kamiy ‘stove’
    PH *tisîm > t’is’em’ ‘shrimp’

(9) PH *(CV)|CV|CV > (CV)|CVC
Suárez provides evidence for these final vowels not only from internal reconstruction, but also from word lists compiled by two earlier researchers: Antonio Peñafiel in 1886 and 1893 (P) and Francisco Belmar around 1900 (B):

\[(10a)\] P cajoti PH *hóti > -hot’ ‘rain’

\[(10b)\] P cahua PH *kàwa > ka:w ‘moon’

\[(10c)\] B nikindi PH *kìndì > -kìnd’ ‘cold’ \{A5\}

Apocope thus produced closed syllables root-finally. Pre-final syllables in non-derived forms, however, remained open. As a result one typically finds pre-final closed syllables only in derived forms such as reduplicated stems (11a) or inflected words (11b, 11c), or in roots which, judging from comparative evidence, were probably at one time bimorphemic (11d-e, F = San Francisco dialect, D = San Dionisio dialect):

\[(11a)\] a-|la|g-|la|g-iy ‘vibrates’ (< root la|g reduplicated, -ay reflexive)
(11b) mon-|ɠɨn’ ‘drunks’ (< mon- collective, -ɠɨn’ ‘get drunk’)

(11c) ap-|m-i:ts’ ‘will give’
     (< ap- future, -m- subordinator, -i:ts’ ‘give’)

(11d) pot|w’it’ ‘black vulture’
     cf. F patatuk ‘red-headed vulture’ (Yuni Kim, p.c.)

(11e) ҭs’ar|t’it’ (SS nchartit) ‘black ant’
     cf. D sartit (Su) ‘small kind of ant’
     cf. D nʦ’ar-ʦ’ar (Su) ‘locust’ {A6}

1.2.2. Degemination. Geminates are not permitted in surface forms; morpheme-internal geminates are absent, and where two non-syllabic segments which are identical or differ only in secondary articulation become adjacent by morpheme concatenation, the sequence is simplified to a singleton (see also SH:286).

(12a) a-h-hin’ → a|hin’ ‘cooks’ vi.

(12b) a-m’e:m’-m’e:m’ → a|m’e:|m’e:m’ ‘pats’
(12c) \( a\text{-}tsa\text{-}tsa\text{-}ts\text{-}ay \rightarrow a|tsa|\text{tsah}\text|tsiy} \) ‘flaps, flutters’ \{A7\}

More complicated instances of \textsc{degemination} occur when the adjacent consonants differ only in secondary articulation:

(13a) \( mon\text{-}n'e^n\text{ts}' \rightarrow mo|n'e^n\text{ts}' \) ‘boys’

(13b) \( a\text{-}h\text{-}lil'-lil' \rightarrow ah|lil|l'il' \) ‘flies around turning over’

(SS ajlülüel)

(13c) \( a\text{-}k^w\text{i}k'\text{-}k^w\text{i}k' \rightarrow a|k^w\text{i}|k^w'\text{i}k' \) ‘boils’

(13a, 13b) show that a palatalized consonant and its plain counterpart \(/n\text{-}n', l'-l/\) reduce to a single palatalized consonant \(/n', l'/\). (13c) shows that a labialized consonant \(/k^w/\) and a palatalized consonant \(/k'/\) produce a single labial-palatalized consonant \(/k^w'//\).

(14) \textsc{degemination}: \( C_1C_2 \rightarrow C_1 \) where \( C_1 \) and \( C_2 \) are identical segments. Where \( C_1 \) and \( C_2 \) differ only in secondary articulation,
the output preserves the values \([-\text{high } -\text{back}]\) and/or \([+\text{round}]\) of the constituent parts.

In addition when /n/ precedes the prenasalized stops /\textsuperscript{m}b\textsuperscript{m}'/ and /\textsuperscript{n}d\textsuperscript{n}'/,

the stops lose their nasal phase and are reduced to plain voiced stops (15 a-c). But /\textsuperscript{n}g/ after /n/ is unchanged (15d).\textsuperscript{7}

(15a) \(\text{mon-}^\text{m}d\text{'ak} \rightarrow \text{mon}|d|\acute{\text{ak}}\) ‘discussion’ ← ‘talkings’ (SS mondeac)

(15b) \(\text{mon-}^\text{m}b|\text{ol} \rightarrow \text{mon}|b|\acute{\text{ol}}\) ‘helpers’ (SH monbeol)

(15c) \(\text{an-}^\text{m}balas-an \rightarrow \text{an}|b|a|l|a|s|an\) ‘is pot-bellied’ (SH ambalasan)

(15d) \(\text{mon-}^\text{n}gin'\) (unchanged) ‘drunks’

A DENASALIZATION rule applies in these cases to produce plain voiced stops from their prenasalized counterparts:

(16) **DENASALIZATION:** \(\text{m}b(\), \text{nd}(\) → \(b(\), \(d(\) / n ___
1.2.3. **Co-occurrence restrictions on fricatives.** Sequences of voiceless continuants, i.e. adjacent instances of /h s s/, are not permitted in surface forms and are systematically absent morpheme-internally. One consequence is that, because long vowels are always derived from underlying /Vh/, long vowels are never followed by /h/ or /s/, since /V:h V:s/ could be derived only from /Vhh, Vhs/.

In addition, with the exception of the interjections ho: ‘oh!’ and ho:w-a (a type of greeting), and the clearly imitative root -hoh ‘to cough’, there are no clearly native sequences of underlying /hVh/. See §3.4.3 for further discussion.

1.3. **Stress, voicing and tone.** Word stress, voicing of long vowels and obstruents, and tone placement are interrelated phenomena and so are discussed together in the following subsections.

1.3.1. **Stress.** Word-level stress falls on the final syllable if closed, which is the case for most words (17a). For the small set of words (mostly
function words and recent borrowings) which end in an open syllable, stress falls on the penult (17b).

(17a) Stress on final closed syllable

\[
\begin{align*}
&n'i|p'i|lán 'people',
&la|kó|w 'guava',
&mbo|wí|p 'raccoon',
&kah|m'bí|l\ \\
&wasp',
&els'|w'á|k 'monkey' \{A8\}
\end{align*}
\]

(17b) Stress on penult when final syllable is open

\[
\begin{align*}
&n'i|n'e 'child',
&i|kó|ra 'we incl. dual',
&kwá|n'e 'what?' \{A9\}
\end{align*}
\]

This stress pattern is consistent with a number of formal metrical analyses.

Because the choice among these has no effect on the following discussion, I leave aside further discussion of these.

1.3.2. Voicing. Sequences /Vh/ become fully voiced long vowels in closed syllables. A following obstruent coda will also become voiced:

(18a) \[iht' \rightarrow i:d'\] ‘excrement’

(18b) \[n'dohk \rightarrow n\'d:og\] ‘termite’
Categorial voicing does not apply to the fricative /s/ or to the affricates /ʦʰ/, but these segments often show some partial voicing in the same environments that other obstruents are voiced. For example, the spelling *ikoods* instead of standard *ikoots* ‘we incl.’ (often used as a designation for the community as whole) is occasionally seen on murals and signs in San Mateo, suggesting that some speakers are conscious of voiced counterpart to /ʦʰ/.

Non-final syllables containing surface long vowels are exceedingly rare in non-derived forms (18d), although not unusual in derived forms (see §3.1.2, §3.1.3).
1.3.3. **Tone.** San Mateo is the only one of the four dialects of Huave to retain tone as a distinctive phonological property. The tone system was first described by PW, who noted that the tones of a word are determined by its phrasal context as well as by what one would now call the word’s underlying tone or pitch accent. Surface tones include high, low and falling, and because underlying tonal contrasts surface only on syllables which have phrase-level stress, tone is largely a phenomenon of the phrasal phonology. For this reason I omit discussion of tone in this paper; Noyer (1991), Evanini (2006) and Pak (2006) discuss the grammar of tone in detail.

1.4 **Interactions between palatalization and vowel place.** Consonantal secondary articulation and vowel place interact considerably in Huave and drive many of the phonological alternations and distributional restrictions of the language. In this section we consider the phonotactic restrictions in stressed (i.e. final, closed) syllables in non-derived environments; many of these restrictions reappear in alternation in derived environments discussed in section 3. The phonology of open, stressless
syllables is in some respects an independent topic and so will be treated separately in section 4.

In the table below + means that the sequence occurs, and (+) means that the sequence occurs, but rarely. The notation * means that the underlying sequence does not occur. Otherwise the entry shows the altered surface form of the sequence.

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Examples of the possible closed syllables are shown below:
(21) Common closed syllable types \{A11\}

(21a) oC'  \(ok\) ‘clouds’, \(os\) ‘strawberry pear (cactus, Sp pitahaya)’

(21b) eC'  \(en\) ‘penis’, \(e:d\) ‘feather’

(21c) iC'  \(ik\) ‘you sg. (non-subject)’, \(i^d\) ‘type of flute’, \(is\) ‘iguana’,

\(i:d\) ‘excrement’, \(i:g\) ‘pinole (type of flour)’

(21d) aC  \(ak\) ‘right hand’, \(as\) ‘fresh corn on the cob’; \(a:g\) ‘the, this’

(21e) oC  \(o^n\)b ‘egg’, \(o^g\) ‘fruit’, \(o^p\) ‘thatch; leaf’

(21f) C'oC  \(\text{"d’oh} \ ‘\text{orphan}, \ t’o^n\)b ‘throat’, \(\text{yow} \ ‘\text{water}, \ \text{"d’o:g} \ ‘\text{termite},

\(s’o:b\ ‘\text{maraca}’

(21g) CaC  \(k^w\)ts ‘chile’, \(k^w\)ak ‘spider’, \(l^a:m\ ‘river’, \(m^a:t\)s ‘cot’, \(m^w\)bah

‘flower’, \(r^a:w\)ts ‘strainer’, \(s^a:p\) ‘goat; cotton’, \(k^a:w\)

‘month’, \(t^a:g\ ‘hide, leather’

(21h) CoC  \(h^o:w\) ‘hammock’, \(k^o:h\ ‘older brother’, \(l^o:p\ ‘hunger’, \(m^o:k\)

‘beetle’, \(t^o:k\ ‘fig’, \(p^o:b\ ‘palm basket’, \(p^o:w\)g ‘toad’, \(s^o:t\)s

‘mustache, beard’

(21i) CoC'  \(k^o:y\ ‘cottontail rabbit’, \(m^o:n\ ‘weevil’, \(m^o:t\)s ‘fearful

person’, \(n^o:k\) ‘one’, \(s^o:s\) ‘grass, hay’, \(t^o:t\) ‘hip, waist’, \(s^o:l\)s\) ‘scar’
(21j) C'iC'  
\[ ki^\text{m} b \] ‘black drum (fish)’,  
\[ n i k \] ‘nopal (cactus)’,  
\[ li u \] ‘fish’,  
\[ si g \] ‘medicine’

\[ 'j a g u a r', \ m i n 'h a r e', \ 'g\text{\textprime}i s ' 'elbow', \ p i l 'hoe', \ k i : t s ' 'lady-fish', \]

(21k) C'eC' \[ k 'e k \] ‘bird’, \[ n 'e n t s \] ‘child’, \[ 'd 'e k 's e a', 'd ' e n 'sh a d e, p a t i o',\]

\[ p 'e t ' 'dog', \ t s 'e : g ' 'mirror', \ m 'e : d ' 'huipil', \ s 'e : t s ' 'elder, old man', \ t s 'e : b ' 'shark' \]

(21l) C'iC' \[ k 'i t ' 'child', \ 'm 'b 'i p ' 'whiptail lizard', \ n 'i w ' 'tongue', \ 'g 'i s ' \]

\[ 't i c k (a n i m a l)', \ t 'i m ' 'y e s t e r d a y', \ t s 'i y ' 'mouse', \ s 'i : g ' \]

\[ 'c i g a r e t t e' \]

(22) Unusual closed syllable types:

(22a) aC' \[ a n ' 'red mangrove', \ a 't s ' 'laziness' \]

(22b) iC' \[ i t s ' 'ax', \ -i t s ' \sim i h t s ' 'causative suffix' \]

(22c) eC \[ -e r '2 sg. suffix' \]

(22d) C'oC' \[ n 'o l ' 'doll', \ 'm 'b a l 'o y 'my friend', \ p 'i t 'o y 'white-breasted wood wren' \]

(22e) C'iC' \[ m i m 'mother' \]
(23) Closed syllables with vowel change (derived vowel quality shown)

{A12}

(23a) C’aC → C’æC  

\[ k'æts \] ‘breasts’, \[ d'æp \] ‘sardine’, \[ g'æk \] ‘ash, lime’,

\[ p'æcks \] ‘tortilla’, \[ ts'æk \] ‘armpit’, \[ ts'æw \] ‘atole’,

\[ w'æk \] ‘horn’

(23b) C’aC’ → C’æC’

\[ h'æl’ \] ‘cloth, skirt’, \[ b'æs’ \] ‘(finger)nail’, \[ t'æt’ \]

‘father, sir’, \[ yæs’ \] ‘avocado’; \[ w'æ:g’ \] ‘itching skin condition’

(23c) iC → iəC

\[ iə’d \] ‘the north wind’, \[ iəm \] ‘house’, \[ iəs \] ‘flea’, \[ iət \]

‘earth’

(23d) C’iC → C’iəC

\[ m’iak \] ‘butterfly’, \[ m’iəs \] ‘cat’, \[ d’iək \] ‘snake’,

\[ ts’iəp \] ‘turbot’, \[ g'w’iən \] ‘squirrel’, \[ s’iəl \] ‘tree’, \[ t’iəd \]

‘road’, \[ w’iəd \] ‘soil, sand’

As can be seen in the table in (20), the five underlying vowels contrast in non-derived forms only morpheme-initially before /C’, and inversely the only vowel which occurs in all environments is /o/. To obtain the distributional gaps in (20) I will in the following subsections (§1.4.1, §1.4.2)
propose a set of rules, some of which function as morpheme structure constraints, and others of which produce specific changes in non-derived environments. (Later in §3 most of these rules will be shown to operate in derived environments as well.)

1.4.1. **Onset-nucleus interaction.** The plain vs. palatalized quality of a syllable onset interacts with the place of the following vowel. Specifically, as was shown in (20), onsets must agree in their value for [back] with any following vowel except /o/. The following two rules ensure compliance with this requirement. Where the vowel is back /a i/, it becomes front after a palatalized onset (FRONTING). Where the vowel is front /e i/, a preceding plain consonant becomes palatalized in a rule I will call SOFTENING, a term borrowed from Slavic linguistics to denote secondary palatalization:

\[
\text{(24) FRONTING: } \{a, i\} \rightarrow \{æ, i\} / C' \quad \{A13\}
\]

\[
\text{(25) SOFTENING: } C \rightarrow C' / ___ \{e, i\} \quad \{A14\}
\]
As we will see later (§3.2.1), both of these rules also apply in derived environments, so that, for example, s-i-"bol ‘I fear’ becomes s'ɪⁿ⁷bol by SOFTENING. In non-derived environments, however, the effects of FRONTING can be seen directly where /a/ follows a palatalized consonant, as in the examples (23a) and (23b); for example, FRONTING will change underlying p'ats ‘tortilla’ to p'æts. Otherwise in non-derived environments FRONTING and SOFTENING function simply as morpheme-structure constraints, ensuring that certain underlying sequences are ‘eclipsed’ (Stampe 1972), that is, they will never chosen by the learner since there is always a ‘better’ underlying form (the output of the rule) which can be chosen instead:

(26a) *C'i C'i → C'i FRONTING
(26b) *Ce Ce → C'e SOFTENING
(26c) *Ci Ci → C'i SOFTENING

For example, the surface form k'it' ‘chicken’ could in principle be derived from underlying k'it' where FRONTING changes underlying /i/ to /i/.

Similarly a putative underlying kit' with /k/ instead of /k'/ becomes k'it' by
SOFTENING. But because these underlying forms are ultimately no different from less ‘abstract’ k′it, the learner will choose k′it as the best underlying form.

A second distributional gap involves the feature [round]. Specifically, labialized segments /kʷ kʷ' ɡʷ ɡʷ'/ and the labial glides /w w'/ are systematically absent before the round vowel /o/. In other words, a [+round] onset cannot share this feature with a following nucleus:

(27) LABIAL CO-OCCURRENCE RESTRICTION:

\[
* k^w_o, k^w'_o, *g^w_o, *g^w'_o, *w_o, *w'_o
\]

\[
\begin{array}{c}
\text{* C} \\
\downarrow \\
\text{+round}
\end{array}
\]

This restriction has a number of additional effects in the grammar (§3.4.4), but it is clearly operative at the surface and as a morpheme-structure constraint underlyingly.
1.4.2. **Nucleus-coda interaction.** Other restrictions relate vowel place of the syllable nucleus and the palatalized vs. plain quality of a following coda.

As shown earlier by the words in (23c) and (23d), when /i/ is followed by a plain consonant coda a centering glide /ə/ is inserted before the coda:

\[(28) \quad \text{OFF-GLIDING: } \emptyset \to \text{ə} / \ _ \ _ \ _ \ C \quad \text{(tautosyllabic)} \quad \{\text{A15}\}\]

OFF-GLIDING ensures that underlying \(m‘i\text{k} \) ‘butterfly’, for example, surfaces as [m‘iək], and more generally, it accounts for the systematic absence of /i/ followed immediately by a plain consonant coda. OFF-GLIDING will also be shown to apply in derived environments (see §3.2.2).

The phonetic motivation for OFF-GLIDING is clear: the /ə/ functions as a transitional vocoid between the front high vowel /i/ and a following coda consonant which is neither front nor high. Nevertheless, although OFF-GLIDING has a phonetic basis, two arguments show that it is a phonological
rule. First, in non-derived forms OFF-GLIDING applies only in closed syllables; /i/ in an open syllable followed by a plain consonant has no off-glide:

\[(29a) \quad n’ip’ilan \rightarrow n’i|p’i|lán, \; *n’i|p’i|lán \quad \text{‘people’}\]

\[(29b) \quad s’ikʷi\tilde{w}’ \rightarrow s’i|k|\tilde{w}’w, \; *s’i|k|\tilde{w}’w \quad \text{‘deer’}\]

Second, as discussed later in §3.2.2, surface instances of /iə/ do occur in open syllables, but only in certain morphological contexts as a result of cyclic application of OFF-GLIDING. Thus the rule no longer has a transparent phonological context much less a purely phonetic one.

The second pattern suggestive of a nucleus-coda interaction in (20) is that the syllable type /CaC’/ is systematically absent. Comparative data from the San Francisco (F) dialect show that a sound change occurred in the San Mateo dialect (SMo) which raised the vowel in *CaC’ to produce present-day CiC’ (reconstructed forms from Suárez 1975):
Numerous borrowings from Spanish also show the effects of this raising process. Spanish [ʧnʧy] and sometimes [x l] were phonologized as Huave /ʦ′ʦ′ y s′ l/ in the palatalized series, and where a consonant such as [t] preceded a front vowel, as in Sp chocolate ‘chocolate’, the consonant could also be borrowed as palatalized. After the historical loss of final vowels (9), these consonants came to occupy the coda position and triggered raising:

(30)  SMo him’ ‘crocodile’, F ham < PH *xamɪ, SMo kiʦ’s’ ‘crab’,

F  kantʃ < PH *kánʦɪ, SMo kit’ ‘fish’, F katj < PH *kátɪ,

SMo mis’ ‘canoe’, F maf < PH *màsi {A16}

(31a) cucaracha = *karats’a > *karats’ > karits’ ‘roach’

(31b) rancho = *raʦ’o > raʦ’s’ > rिंʦ’s’ ‘ranch’

(31c) atarraya = *taraya > *tara > tarıy (Dd tərūy) ‘atarraya

(fish net)’

(31d) navaja = *nabas’a > *nabas’ > nabis’ ‘penknife’

(31e) corral = *koral’ > koril’ ‘corral’
(31f) chocolate = *ts’okolat’e > *ts’okolat’ > ts’ikolit’ ‘chocolate’

On the other hand, words such as an’ ‘red mangrove’ and a*ts’ ‘laziness’ (22a) show that this sound change did not in fact affect the few onsetless root syllables of the form *aC’. For this reason the RAISING rule shown below shifts /a/ to /i/ only in syllables with a plain consonant onset as well as a palatalized consonant coda:

(32) RAISING: a → i / C __ C’ (when tautosyllabic) {A18}

RAISING has the effect of eclipsing underlying forms of the type /CaC’/ since the output /CiC’/ is a possible underlying form and will be preferred by the learner.

(33) *CaC’ CaC’ → CiC’ RAISING
Thus *mis’ ‘canoe’, for example, although in principle derivable from underlying *mas’, will be learned as *mis’ since *mis’ is also a possible underlying form. The effects of RAISING in derived environments are discussed in §3.2.3.

2. Morphological overview.

A full description of the morphology of Huave cannot, of course, be given here (see SH), but what follows should be sufficient for understanding the phonological processes which are sensitive to morphological structure.

Because the manner in which rules apply in Huave depends in many instances on morphological constituency the analysis to be proposed requires an explicit theory of morphology-phonology interaction. The model of phonology which will be used here is based on Halle and Vergnaud (1987), expanding on the lexical phonology model of Kiparsky (1982) and Mohanan (1986), the essential characteristics of which will now be introduced.
In Halle and Vergnaud’s approach, affixes are divided into two groups, *cyclic* and *non-cyclic*, and rules are likewise classified as *cyclic*, *non-cyclic* or *both*. Each (sub)constituent of a word derived by a cyclic affix forms a domain for the application of cyclic rules. Non-cyclic affixes however do not create a domain for rule application; instead, the non-cyclic rules apply once to the whole word after all cyclic rules have applied. In addition to these domains, I will propose a further application of rules to the *clitic group* (Nespor and Vogel 1986), a constituent consisting of the word plus any clitics:

(34)
For example, the English word *provinciality* has two cyclic suffixes, whereas *provincializing* has one cyclic suffix (c) and two noncyclic suffixes (nc):

(35) [[[ provinc | ial c | ity c ]] /pɹəvɪn-s-yæl-ɪtɪ/ → [pɹəˈvɪnstɪəlɪtɪ]
    └─────┘  cycle on provinc-ial
    └────────┘ cycle on provincial-ity
    └────────┘ non-cyclic rules on the whole word

(36) [[[ provinc | ial c | iz nc | ing nc ]] /pɹəvɪn-s-yæl-ɪz-ɪŋ/ →
    [pɹəˈvɪnstɪəlɪzɪŋ]
    └─────┘ cycle on provinc-ial
    └────────────┘ non-cyclic rules on the whole word

As shown above, in both words the first cycle occurs on the innermost constituent formed by a cyclic affix, in this case *provinc-ial*. In *provinciality* another cycle occurs in the constituent *provincial-ity*, since *-ity* is also a cyclic affix. In *provincializing* there are no more cyclic affixes so no more
cyclic rules apply. In both words, however, the non-cyclic rules then apply once to the whole word.

Having introduced the model of morphology-phonology interaction assumed here, we now turn to the basic structure of content words (nouns, verbs, adjectives) in Huave. These words consist of a core root morpheme ([§1.2.1]), which may be reduplicated, and is usually expanded by one or more affixes. From the point of view of their phonological effects, these affixes fall into four categories: themes, cyclic affixes, non-cyclic suffixes and clitics, as schematized below:

(37) proclitic # [cyclic prefixes - [[theme - root] - cyclic suffixes ]] + noncyclic suffixes] # enclitic

To assist the reader in parsing complex forms I will use a hyphen (-) to separate themes, cyclic affixes and the root, a plus (+) before noncyclic suffixes, and a hash (#) before and after clitics. The following two words
illustrate various combinations of affixes and the manner in which the rules apply.

In (38) the root -hin- ‘cook’ has a theme vowel prefix a- and a causative suffix -ihts’ forming the transitive verb ahin’i:ts’ ‘to cook’. The prefix n- and the suffix +an mark first person inclusive plural subject, and the proclitic t’a# expresses progressive aspect.

(38)  t’a#n-a-hin’-ihts’+an → t’æ|na|hi|n’ih|ts’æn  ‘we excl. are cooking’ vt.

PROG#1-TH-cook-CAUS+PL
Since there are three cyclic affixes there are three cycles of cyclic rule application to the successively larger constituents \textit{ahin}', \textit{ahin'ihts}' and \textit{nahin'ihts}'. Non-cyclic rules apply once to the whole word \textit{nahin'ihts'+an}, which includes the non-cyclic suffix +an. Finally, clitic group rules apply to the whole word plus the proclitic \textit{t'a#}.

In (39) below, the root \textit{-wahr-} ‘scratch’ is reduplicated and preceded by a theme vowel \textit{a-}. The suffix +\textit{ay} marks reflexive and the third person plural
subject agreement is marked by the suffix -Aw' (surfacing as -eh'; -A- denotes a harmonic vowel, §3.4).

\[(39) \quad a\text{-wahr-wahr}+ay+Aw' \rightarrow a|wa:r|wà:|ra|yéh' \text{ ‘they itch (i.e. experience itching)’}
\]

TH-scratch-scratch+REFL+PL

\[a\text{-wahr-wahr}+ay+Aw'
\]

| | cyclic rules apply to wahr-wahr (cycle 1) |
| | cyclic rules apply to a-wahrwahr (cycle 2) |
| | non-cyclic rules apply to whole word |

The reduplicant and the theme each form cyclic constituents, giving two cycles of cyclic rule application. There are two non-cyclic suffixes (+ay and +Aw’), but there is no cycle on awahrwahray, since +ay is not cyclic.

Instead, the non-cyclic rules apply once to the whole word awahrwahrayAw'.

\[awahrwahr\text{ray}Aw'.\]
The following sections individually review the four proposed affix types.

Affixes in the text are cited in their proposed underlying forms.

2.1. **Theme vowel.** Although some non-verbal words appear as bare roots (e.g. all the words in (21-23)), all verbs and many nouns and adjectives are comprised of a root supplemented by a stem-forming thematic vowel or THEME. The theme is usually a prefix with surface form \( a \)-, but for a small class of stems the theme is suffixal instead, in which case it shows vowel harmony (see §3.4.3). In underlying forms harmonic vowels will be written here with small capital \( a \).

(40) Prefixal Theme: \( a \)-

(40a) \( a - p i h t s \rightarrow a p i : t s \) ‘spreads out’ vt.

\( \text{TH-spread} \)

(40b) \( a - k^{w}i h k \rightarrow a k^{w}i g \) ‘puts down, throws down’ vt.

\( \text{TH-fall} \)
(40c) $a$-$s^e{h}p' \rightarrow as'e:b'$

‘bathes’ vi.

TH-bathe

(41) Suffixal Theme: harmonic -$A$-

(41a) $pihts'$-$A$-$m \rightarrow pihts'io_{m}$

‘spreads out’ vi.

spread-TH-PERS

(41b) $k^wihk'$-$A$-$w \rightarrow k^wihk'i_{w}$

‘falling’ pple.

fall-TH-CONT

(41c) $wa^nts$-$A$-$t \rightarrow wa^nts{a}t$

‘s/he turned (e.g. the head)’ vi.

turn-TH-PRET

As the above examples show, stems with suffixal themes are typically intransitive stems corresponding to transitive stems with prefixal themes.

Not all intransitives have suffixal themes, however (40c).
2.2. Cyclic affixes. Cyclic affixes include both prefixes and suffixes and can be classified by whether they attach directly to the root, to the theme, or more peripherally.

2.2.1. Root-attaching cyclic affixes. The root-attaching affixes include the suffixes -its’ ~ -ihts’ ‘causative/participle’, the infix -ɾᴀ- ‘passive’, and the prefix/ infix (-)h- ‘valence’, all of which modify the argument structure of the root.\(^8\)

(42) Root-attaching suffixes and infixes

\(42a\)  -its’  a-hiy-its’ \(\rightarrow\) ahiy’its’  ‘drives (e.g. a mule)’

TH-walk-CAUS
The infix -ɾᴀ- is positioned immediately to the right of the leftmost mora of the root, hence -ⁿdok- → aⁿdo-ɾᴀ-k ‘one fishes’. The infix/prefix -ʰ- is a prefix to the final syllable of the root. In polysyllabic roots it is thus an infix (to³goy → (a)-toʰ-goy ‘folds’ vt.), but in monosyllabic roots it appears between the theme vowel and the root (aʰ-tsoɾ’ ‘returns’ vi.).
2.2.2. **Theme-attaching cyclic affixes.** The theme-attaching cyclic affixes are always directly adjacent to a theme vowel. When the theme is a prefix (as is typical), these affixes are also prefixes, and include s- ‘1st person’, n- ‘adjectival’, k- ‘intensive adjectival’, n'e- ‘agentive’, m- ‘2/3 possessor’, two ‘subordinating’ affixes n- ~ n'e- (used in the 1st person exclusive) and m- ~ m'e- (used in other persons), and t- ~ t'e- ‘preterite’.²

(43) Theme attaching prefixes

(43a) \( t-a-mo\'g \rightarrow tam\'g \) ‘(s)he passed’ vi.

PRET-TH-pass

(43b) \( s-a-p'eht' \rightarrow sap'\dot{e}d' \) ‘I pick, cut’

1-TH-cut

(43c) \( m-a-\%'g'ay \rightarrow ma\%'g'\'ey \) ‘listen’

SUB-TH-listen

When the theme is a suffix, on the other hand, the theme-attaching affixes are also suffixal. These include the verbal markers -t ‘preterite’, -w (~ -h) ‘progressive/recent/ continuous participle’, -n ‘1st person’, -r ‘2nd person’,
-m ‘default person marker’, as well as two other participial suffixes, -n ‘participle (general)’, -m ‘participle (future)’.

(44) Theme-attaching suffixes

(44a) loₜⁿb-A-w → loₜⁿbōh ‘is standing’

stand-TH-CONT

(44b) waⁿtₚs-A-t → waⁿtₚsát ‘(s)he turned’ vi.

turn-TH-PRET

(44c) al-s'ehk'-A-m → als'ehk'ém ‘is wearing (e.g. a huipil)’

CONT-wear-TH-PERS

(44d) halₜⁿts'-A-n → halₜⁿts'íₚn ‘frayed’

fray-TH-PPLE

2.2.3. Peripheral cyclic affixes. Included in this class are affixes which do not need to attach directly to the thematic vowel, but nevertheless show phonological behavior characteristic of cyclic affixes: al- ‘continuous’, la- ‘recent past’, mon- ‘plural’, an- ‘intensive’ and -er ‘2nd person’: 
2.3. Non-affixal cyclic morphological processes. There also exist non-affixal morphological processes which show the same phonological behavior as the cyclic affixes just reviewed. Of these processes, reduplication of the root has already been introduced in (12). The remaining processes are discussed below.

2.3.1. Diminutive and augmentative. Pairs of stems, one ‘diminutive’ and the other ‘augmentative’, are extremely numerous in Huave. The diminutives generally express not only the idea of smallness but also of politeness or respect; the augmentatives express large size and also in some cases have pejorative force:
(46) augmentative diminutive

(46a) tsalas  ts'il'is'  ‘sticking out’

(46b) ts'al'as'  ts'il'is'  ‘open’

(46c) a-t'ap-t'ap  a-t'iəp-t'iəp  ‘moves or flaps in the wind’

The phonological relationship between the two stems is a regular one and will be discussed in §3.3. Examples such as (46a,b) show that the diminutive is derived from the augmentative, since the process of diminutivization can produce homophonous outputs from distinct augmentative bases: tsalas and ts'al'as' both form the diminutive ts'il'is'.

2.3.2. Morphological depalatalization and shortening. When the prefix/infix -h- marks detransitivization of an inherently transitive root, the root-final consonant, if palatalized, is depalatalized, and the root vowel is shortened if long (SH:333):
2.3.3. Ablaut of the theme vowel. The theme vowel a- when prefixed to the root shows an ablaut conditioned by person agreement. Specifically, when the subject is 2nd person, the theme vowel is raised to /e/. In such cases it will be glossed ‘TH2’:

\[(48a)\]  
\[t'a#m-e\textasciitilde{n}d'ak \rightarrow t'æm'e\textasciitilde{n}d'æk\]  
‘you sg. are saying’  
CONT#SUB-TH2-speak

\[(48b)\]  
\[({^e}d'e) m-e-s'ïg' \rightarrow m'es'ïg'\]  
‘don’t be ashamed’ 2 sg.  
imperative

don’t SUB-TH2-shame  \{A20\}
Raised theme /e/ undergoes further raising to /i/ when word-initial or after /a/:

(49a)  \(i^-n'd'ak \rightarrow i^-n'd'aek\)  ‘you sg. say’

TH2-say

(49b)  \(la-i-tsoh \rightarrow laitsóh\)  (SH laitsoj)  ‘you sg. (just) fought’

REC-TH2-fight

Certain classes of nouns also show allomorphy of the prefixed theme vowel, which appears variously as \(i\)-, \(o\)-, or \(e\)-:

(50a)  \(o-s'i^n{g}'\)  ‘his/her nose’

TH-nose

(50b)  \(s-i^-g'\text{"is}' \rightarrow s'i^n{g}'\text{"is}'\)  ‘my elbow’

1-TH-elbow

(50c)  \(s-e-p'ak' \rightarrow s'ep'ak'\)  ‘my shoulder’

1-TH-shoulder
In circumstances where the theme vowel is already \( i \)- in the 3rd person, the 2nd person theme appears as \( er \)- rather than ablauted /e/ or /i/:

\[(51a) \quad i-ts'ep' \quad \text{(SH ichep)} \quad \text{‘his/her molar teeth’} \]

\[\text{TH-molar}\]

\[(51b) \quad er-ts'ep' \quad \text{(SH erchep)} \quad \text{‘your sg. molar teeth’} \]

\[\text{TH2-molar}\]

2.4. Non-cyclic suffixes. The non-cyclic affixes are all suffixes and attach further to the right than any cyclic affixes which may be present. Five are agreement markers showing vowel harmony: \(+_A s \quad ‘1’\), \(+_A n \quad ‘plural’\), \(+A r \quad ‘1st person inclusive’\), \(+A h s \quad ‘1st person inclusive plural’\) and \(+A w \quad ‘3rd person plural’\):
(52a) t-a-hin'ihts'+as+an → tahin'i:ts'asán ‘we excl. cooked’ vt.

PRET-TH-cook-CAUS-1+PL

(52b) t-a'-mb'íl-ihts'+aw' → ta'mb'i:stålihts'íw’ ‘they turned (something) around’

PRET-TH-turn-CAUS+3PL

The others are +aran ‘indefinite possessor/agent’ and +ay ‘reflexive’:

(53a) s-a'-mb'ol+aran → s'am'b'ólaráñ ‘someone helps me; I am helped’

1-TH-help+INDEF

(53b) a-la%g-la%g+ay → ala%gla%gý ‘vibrates’ vi.

TH-shake-shake+REFL

2.5. Clitics. The most peripheral formatives are the clitics, which have the loosest phonological association with the word.
2.5.1. Proclitics. Some proclitics are variants of free-standing words, including \( t'a\# \) ‘progressive’ (< auxiliary \( t'e\#g'al \)) and \( t'i\# \) ‘in’ (< preposition \( t'i\#l \)).

\[
(54a) \quad t'a\#a-\text{dahp} \rightarrow t'e\#dá:b \quad \text{‘it is burning’}
\]
\[\text{PROG}\#\text{TH-burn}\]

\[
(54b) \quad t'i\#t'iht \rightarrow t'i\#t'i:td \quad \text{‘in the road’}
\]
\[\text{in}\#\text{road}\]

The clitics \( sa\# \) (used in the 1st person) and \( ap\# \) (used elsewhere) attach to the subordinate form of the verb to form predicates with future tense meaning, and, as Suárez (1975) notes, probably derive from the root \(-p'- \) ‘to go’ (cf. \( s-a-p' \) → \( sîp' \) ‘I go’ SH \( sîp \), \( a-p' \) → ‘(s)he goes’ SH \( üp \)):

\[
(55a) \quad sa\#a-\text{kip} \rightarrow sanak'î:ab \quad \text{‘I will accompany’}
\]
\[\text{FUT}\#\text{SUB-TH-accompany}\]

\[
(55b) \quad ap\#m-a-\text{d'ilk'il'aw} \rightarrow apmar'd'ilk'ild'aw' \quad \text{‘they will return’}
\]
\[\text{FUT}\#\text{SUB-TH-return+3PL}\]
2.5.2. Enclitics. The enclitics are easily recognized because unlike suffixes they are never stressed:

\[(56a)\) \(m'aw\#an \rightarrow m'ǽwan \quad \text{‘all’}\]

\[(56b)\) \(l'ahw\#a \rightarrow l'ǽ:wa \quad \text{‘the one that; how many’} \{A21\}\]

3. Phonological alternations in derived forms.

The rules discussed in §1, including Syllabification (6), Stress (7), Voicing (19), Softening (25), Fronting (24), Degemination (14), Denasalization (16), Raising (32), and Off-gliding (28), apply in derived forms as well as in non-derived forms; a variety of other rules to be discussed are also required.

3.1. Stress and voicing in derived forms.

3.1.1. Stress. As already introduced in §1.3.1, stress falls on the word-final syllable if it is closed, otherwise on the penult. Stress assignment
rules apply both cyclically and non-cyclically in derived forms, as shown below:

\[(57) \begin{array}{c}
t-\left[\left[c, a-hîn\right]-\text{hîts}\right]+\text{as}+\text{án} \quad \text{we excl. cooked (something)}
\end{array}\]

\text{PRET-TH-cook-CAUS+1+PL}

\[(58) \begin{array}{c}
a-hîn'
\end{array}\]

\text{cycle 1 on constituent created by affixation of theme}

\text{ahìn'-hîts'}

\text{cycle 2 on constituent created by affixation of hîts'}

\rightarrow \text{ahìn'í:ts' by (19)}

\text{t-ahìn'í:ts'}

\text{cycle 3 on constituent created by affixation of t-}

\text{tahìn'í:ts'+as+án}

\text{non-cyclic STRESS}

\text{tahìn'í:ts'asán}

\text{(other rules)}

On the first cycle stress is assigned to the final syllable in \text{ahìn'}. On the second cycle stress is reassigned and shifts to the new final syllable,
producing *ahin’-áhts* (cf. English *próvince, províncial*). The third cycle does not change the location of stress since *t*- does not add any syllables. I assume that non-cyclic stress rules do not shift the location of stress, but can add additional stresses (Halle 1990). Thus non-cyclic stress adds a word-final stress in *tahin’í:ts*’+*as*+á*n*, but does not delete the stress on /i:/ that was assigned on the last cycle (cf. English *províncial*+iz+ing).

However, when non-cyclic suffixation adds only a single syllable, the stress assigned cyclically will be adjacent to the stress assigned non-cyclically. In this case a rule of STRESS CLASH DELETION eliminates the pre-final stress:

\[(59) \ [c t-[c a-haw]] + as_{nc} \quad \text{‘I saw’} \]

PRET-TH-see+1

*a-háw*  cycle 1 on constituent created by affixation of theme

*t-aháw*  cycle 2 on constituent created by affixation of *t-*

*t-aháw+ás*  non-cyclic STRESS

*tahawás*  non-cyclic STRESS CLASH DELETION
When the stresses are not adjacent, the final one becomes the primary stress of the word and the preceding stress is demoted to a secondary stress, as in *tahin'*:ts'asán.*

The evidence for the cyclic application of stress will be presented later, since it depends on the application of rules also to be introduced later which are conditioned by stressed or unstressed syllables (§3.2.4, §3.2.5).

### 3.1.2. Voicing.

As was shown in §1.3.2, voicing of long vowels occurs in closed syllables in non-derived forms, and a following stop is also voiced (19). In derived forms the generalization is that a non-final long vowel (and following stop) is voiced only if it was in a closed syllable at the end of some cycle, regardless of whether the syllable is closed in the surface form. In other words, VOICING (19) applies cyclically. For example, in *sakats'í:ts'ayon* ‘we excl. make ourselves wet’ the third syllable /ts'í:/ is open (60), but the vowel is fully voiced because the syllable was closed at the end of the first cycle (61), at which point VOICING applied:
In (61) above VOICING in the surface open syllable is correlated with surface secondary stress. But this is not always the case, as can be seen in forms derived from the root *p'a- ‘to sit down’:

\[(62)\]  
\[p'a-a-t\text{-}er+a_{n} \rightarrow p'a|d'a|r\text{ón} \text{ (SH peaadearon)} \text{ ‘you pl. sat down’}\]
Here /t/ is voiced on the second cycle when it is in the coda: \( p'a:t \rightarrow p'a:d \).

The cyclic suffix -\( er \) triggers the third cycle, in which /d/ is resyllabified as an onset. Finally, the non-cyclic rules apply to the whole word, including the non-cyclic suffix +\( \_an \). The fully voiced initial syllable does not have secondary stress, having lost its stress on cycle 3.

To summarize briefly, I have shown that voicing of long vowels appears not only in syllables which are closed in surface forms, but also in syllables which were closed during cyclic syllabification but subsequently opened by...
resyllabification. These data provide evidence that both VOICING (19) and SYLLABIFICATION must be cyclic rules.

3.1.3. Devoicing. Not all vowels which are voiced cyclically remain voiced on the surface, however. In particular, long vowels (and following obstruents) are systematically devoiced when immediately pretonic:

(64) **PRETONIC DEVOICING:** \( \text{V} \rightarrow \text{Vh} / _{-} \text{C V} \)

(65) **OBLISTRUENT DEVOICING:** \([-\text{son}] \rightarrow [-\text{voice}] / [-\text{voice}] _{-} \)

Compare the following:

(66a) \( s-a-ehp' \rightarrow sa|\acute{e}:b' \) \( \text{‘I smoke’ vt.} \)

(66b) \( s-a-ehp'^{+an} \rightarrow sa|eh|pˈén \) \( \text{‘we excl. smoke’ vt.} \)

In \( sa\acute{e}:b' \) the root vowel is voiced in a closed syllable and the final obstruent also voiced. But in \( saehpˈén \) stress shifts to the final syllable, making the
root syllable pretonic. Pretonic devoicing changes /e:/ to /eh/, and

Obstruent devoicing changes /hb'/ to /hp'/:

(67) s-a|\acute{e}:b' cycle 2 rules
    sa|\acute{e}:b'+\acute{\eta}n non-cyclic Syllabification (and Vowel
        Harmony §3.4.2)
    sa|eh|b'+\acute{\eta}n non-cyclic Pretonic devoicing (64)
    sa|eh|p'+\acute{\eta}n non-cyclic Obstruent devoicing (65)

In addition, the incorrect derivation of p'a:d'arón (shown below in 68) shows that Pretonic devoicing cannot be cyclic, and so must be non-cyclic. If Pretonic devoicing were cyclic, then the first syllable of this word would incorrectly be devoiced on the third cycle, giving incorrect

*p'ah'tarón:

(68) p'a:d'-á'r cycle 3 rules
    *p'ah|t'-á'r cycle 3 Pretonic devoicing (incorrect)
    *p'ah|t'a|r+ón non-cyclic rules
But because Pretonic Devoicing is non-cyclic, it does not in fact apply until after the non-cyclic suffixes are added, at which point the first syllable of p'a:d'arón is no longer pretonic and so escapes devoicing:

(69)  p'a:d'-ár  cycle 3 Syllabification, Stress

p'a:d'a|r+ón  non-cyclic Syllabification and Stress

(inapplicable)  non-cyclic Devoicing

In sum, while Voicing (19) is demonstrably cyclic, Pretonic Devoicing (64) cannot be cyclic and is non-cyclic only. These rules together ensure that the only long syllable nuclei which are voiced are ones which are in closed syllables at the end of some cycle and not pretonic in the surface form.

3.1.4. Voicing and reduplication. The action of both Voicing (19) and Pretonic Devoicing (64) can be observed in reduplicated stems with long vowels.
In *tsa:r* *tsá:r* both syllables are closed in the surface form and so both long vowels are fully voiced by the VOICING rule (19). But suffixed reduplicants (71c, 71d) show a slightly more complicated behavior:

\[(71a)\]  \(a\)-mih\(^{*}\)ts' \(\to\) a|mí:"*ts' 'pulls'  

\[(71b)\]  \(a\)-mih\(^{*}\)ts'-mih\(^{*}\)ts' \(\to\) a|mí:"ts'|mí:"ts' 'pulls repeatedly'  

\[(71c)\]  \(a\)-mih\(^{*}\)ts'-mih\(^{*}\)ts'+Aw' \(\to\) a|mí:"ts'|míh|"*ts'íw'  

'\(\text{they pull repeatedly}'  

\[(71d)\]  \(a\)-mih\(^{*}\)ts'-mih\(^{*}\)ts'+ay+Aw' \(\to\) a|mí:"ts'|míh|"*ts'a|yéh'  

'\(\text{they pull themselves repeatedly}'

In the unreduplicated verb \(a\)-mí:"ts' (71a) and the reduplicated verb \(a\)-mí:"ts'-mí:"ts' (71b) the long vowel is in a surface closed syllable and hence voiced. When the reduplicated verb has a monosyllabic suffix, as in \(a\)-
m̃iː'ʦ'ː-mih'nʦ'ː-iːw' (71c), the pretonic vowel is devoiced, as shown on the left below:

(72)  mih'nʦ'-mih'nʦ'  mih'nʦ'-mih'nʦ'  REDUPLICATION
       m̃iː'ʦ'ː|m̃iː'ʦ'ː  m̃iː'ʦ'ː|m̃iː'ʦ'ː  cycle 1

SYLLABIFICATION,

STRESS, VOICING

(19)

a-|m̃iː'ʦ'ː|m̃iː'ʦ'ː  a-|m̃iː'ʦ'ː|m̃iː'ʦ'ː  cycle 2 rules

a|m̃iː'ʦ'ː|m̃iː|'ʦ'+iːw'  a|m̃iː'ʦ'ː|m̃iː|'ʦ'+a|y+éh'  non-cyclic STRESS,

SYLLABIFICATION

a|m̃iː'ʦ'ː|mih'|'ʦ'+iːw'  —  non-cyclic

PRETONIC

DEVOICING (64)

But as shown on the right above, when the reduplicated stem is suffixed by more than one syllable the long vowel is not pretonic, and devoicing does
not occur, even though the long vowel is in an open syllable:

\[ a|m\dot{i}:'ts'|m\dot{\dot{i}}:ts'a|y\acute{e}h'. \]

As already discussed in §3.1.3, as a consequence of Pretonic Devoicing (64) fully voiced long vowels are normally not found in open syllables pretonically. The single exception to this generalization occurs when Degemination (14) opens a syllable containing a long vowel:

\[(73a) \ a-m'ehm'-m'ehm' \rightarrow a|m'e:|m':m' \quad \text{‘pats (e.g. on the head)’} \]

\[(73b) \ a-ts'ahts'-ts'ahts' \rightarrow a|ts'a:|ts':ts' \quad (\text{SS achaachaach}) \]

\[ \quad \text{‘moistens greatly’} \]

This shows that Degemination must follow Devoicing in a counterfeeding relationship:
(74) \(m'ehm'-m'ehm'\)  REDUPLICATION

\(m'e:m'\mid m'\dot{e}:m'\)  cycle 1 Syllabification, Stress, Voicing

(19)

\(a\mid m'e:m'\mid m'\dot{e}:m'\)  cycle 2 rules

—  non-cyclic DEVOICING (64)

\(a\mid m'e:\mid m'\dot{e}:m'\)  non-cyclic DEGEMINATION (14)

If DEGEMINATION were to apply first, it would feed DEVOICING, producing incorrect \(^{*}am'ehm'e:m\). In addition, VOICING (19) must precede DEGEMINATION, since sequences of obstruents differing only in voice do not degeminate:

(75a)  

\(a\text{-}taht\text{-}taht \rightarrow a\mid t\dot{a}:d\mid t\dot{a}:d\)  ‘shakes’

cf. \(a\text{-}tsahts\text{-}tsahts+A\text{'w}' \rightarrow a\mid tsa:\mid tsah\mid ts\dot{i}w'\)  ‘they flap, flutter’

(75b)  

tsoht'-tsoht'-A\text{-}m \rightarrow tso:d\mid ts\dot{oh}\mid t'\dot{i}m\)  ‘protruding’

(SS tsoodtsojtiüm)
For example in *ata:dtá:d* VOICING applies cyclically and bleeds

DEGEMINATION:

\[(76) \text{ taht-taht } \quad \text{Reduplication} \]

\[
\begin{align*}
\text{taht-|táht} & \quad \text{cycle 1 Syllabification, Stress} \\
\text{ta:d-|tá:d} & \quad \text{cycle 1 VOICING (19)} \\
a-|\text{ta:d}|tá:d & \quad \text{cycle 2 rules} \\
\_ & \quad \text{non-cyclic DEGEMINATION (14)}
\end{align*}
\]

If VOICING were to apply after DEGEMINATION then incorrect *ata:tá:d* would be produced. The correct ordering occurs automatically, however, because VOICING applies cyclically while DEGEMINATION is non-cyclic and so occurs after all cyclic rule applications.

The derivation of *ata:dtá:d* in (77) without DEGEMINATION can be compared with that of *atsa:tsahši:wx ‘they flap, flutter’, where VOICING does not affect affricate /ts/, and so nothing prevents DEGEMINATION from applying:
\begin{equation}
(77) \quad \text{Reduplication}
\end{equation}

\begin{align*}
tsa:ts-\mid tsâ:ts & \quad \text{cycle 1 Syllabification, Stress, Voicing (19)} \\
\text{a-} \mid tsa:ts \mid tsâ:ts & \quad \text{cycle 2 rules} \\
a \mid tsa:ts \mid tsa:ts \mid ts+\dot{\text{i}}w' & \quad \text{non-cyclic Syllabification, Stress, Harmony} \\
\quad \quad \quad \quad \text{§3.4.1), etc.} \\
a \mid tsa:ts \mid tsa:h \mid ts+\dot{\text{i}}w' & \quad \text{non-cyclic Devoicing (64)} \\
a \mid tsa:h \mid ts+\dot{\text{i}}w' & \quad \text{non-cyclic Degemination (14)}
\end{align*}

3.1.5. **Summary.** To review the results so far, we have seen that

Syllabification (6), Stress (7), and Voicing (19) apply cyclically, while

Syllabification, Stress, Pretonic Devoicing (64), Obstruent

Devoicing (65) and Degemination (14) apply non-cyclically. Since

Voicing also applies in non-derived forms such as bare nouns with long

vowels (e.g. ʰiː ʰˈmedicine’, ʰaːb ‘drum’ in (21)), Voicing must apply non-

cyclically, too. The rules and crucial orderings are shown below:
(78) Cyclic: SYLLABIFICATION (6)  
  Stress (7)  
  Voicing (19)  

Non-cyclic: SYLLABIFICATION (6)  
  Stress (7)  
  Voicing (19)  
  Pretonic Devoicing (64)  
  Obstruent Devoicing (65)  
  Degemination (14)

This completes the discussion of stress and voicing in derived forms. In the next section we turn to interactions between palatalization and vowel place in derived forms.

3.2. Vocalic alternations in derived forms.

3.2.1. Fronting and Softening. As discussed earlier (§1.4.1), in non-derived forms the non-round back vowels /a i/ become front vowels /æ
i/ after palatalized consonants by FRONTING (24). This rule applies in derived forms as well. For example, the vowel of the cyclic causative suffix, underlingly /i/ (as in 89a), is fronted to /i/ following a palatalized consonant in (79b, 79c):

\[(79a) \quad a-la^g\text{-}ihts'\text{-}w' \rightarrow a|l|a|\text{g}i|h|t|s'|w' \quad \text{‘they move’ vt.} \]

TH-move-CAUS+3PL

\[(79b) \quad a-l'i\text{-}ts'\text{-}ihts' \rightarrow a|l|i|t|s'|:ts' \quad \text{‘hurts’ vt.} \]

TH-hurt-CAUS

\[(79c) \quad t-a-hi\text{-}n'\text{-}ihts' \rightarrow t|a|h|i|n'|:ts' \quad \text{‘s/he cooked’ vt.} \]

TH-cook-CAUS

FRONTING is cyclic in its application, but because the evidence for this depends on its interaction with VOWEL HARMONY, this matter is discussed after VOWEL HARMONY is introduced in §3.4.1.

SOFTENING (25), which palatalizes plain consonants before front vowels (§1.4.1), also occurs in derived forms:
Unlike FRONTING, SOFTENING does not appear to apply cyclically.

3.2.2. **OFF-GLIDING.** As discussed earlier (§1.4.2), OFF-GLIDING (28) inserts a centralizing glide /a/ between /i/ and a following tautosyllabic plain consonant. In derived forms, OFF-GLIDING operates both cyclically and non-cyclically.

Cyclic application of OFF-GLIDING can be seen in syllables whose coda consonant is resyllabified cyclically as an onset, so that in the surface form the environment for OFF-GLIDING is no longer present:
(81) OFF-GLIDING before a cyclic suffix

\[ t'a\#n-a^{-mb}i^l-ihts' \rightarrow t'a|na^{-mb'i}\hat{\imath}:ts' \]

‘I am turning (something) over’ vt.

PROG#1SUB-TH-turn-CAUS

In (82) OFF-GLIDING applies on the first cycle, before /l/ is resyllabified as the onset to the syllable created by the causative suffix -ihts':

(82) \( a^{-mb'i}l \) \hspace{1cm} \text{cycle 1 SYLLABIFICATION, STRESS} \\
\( a^{-mb'i}ol \) \hspace{1cm} \text{cycle 1 OFF-GLIDING (28)} \\
\( a^{-mb'i}\hat{\imath}l-ihts' \) \hspace{1cm} \text{cycle 2 SYLLABIFICATION, STRESS} 

Non-cyclic SYLLABIFICATION can also remove the environment which allowed OFF-GLIDING to apply:

(83) OFF-GLIDING before a non-cyclic suffix

(83a) \( w'i't'\#-r+\tilde{a}n \rightarrow w'i|t'i\hat{\imath}r\ddot{\imath}n \) \hspace{1cm} ‘you pl. rise’

rise-TH-2+PL
(83b) $iρ^{-m}b+An \rightarrow i|'i|ω|mban^{10}$

‘you pl. go’

2-TH2-go+PL

(83c) $a-h'i+Aw' \rightarrow a|h'i|ω|riw'$

‘they have’

TH-have+3PL

\{A22\}

In $\text{w'i}rôn$ (83a), for example, /$ɛ$/ is in the coda on the last cycle, allowing

OFF-GLIDING to apply, but the /$ɛ$/ is then re-syllabified as the onset to the

non-cyclic suffix +on:

(84) $\text{w'i}-r$

cycle 2 (on -r)

$\text{w'i|t'i-r}$

cycle 2 Syllabification, Stress

$\text{w'i|t'i-ɔ-r}$

cycle 2 OFF-GLIDING (28)

$\text{w'i|t'i|r+ɔn}$

non-cyclic Syllabification, Stress,

\text{Harmony (§3.4.1)}

Cyclic OFF-GLIDING also interacts with non-affixal cyclic morphological

processes (§2.3). MORPHOLOGICAL DEPALATALIZATION (§2.3.2) in

intransitive stem formation can trigger OFF-GLIDING:
\[(85a)\] \(a\text{-t'il} \to a|t\text{'il} \)  ‘stabs’  (SH atil)

\[(85b)\] \(a\text{-h-t'il} \to ah|t\text{'iəl} \)  ‘is stabbed’  (SH ajtiül)

The transitive root \(-t'il\) \((85a)\) forms an intransitive stem \(-h-t'il\) by

prefixation of \(h\)- and MORPHOLOGICAL DEPALATALIZATION of the root-final

\(\l/\) \((85b)\). This puts the vowel \(i/\) in a syllable closed by a plain consonant

\(\l/\), triggering OFF-GLIDING.

Infixation of \(-ra\)- ‘passive’ (§2.2.1) can remove the surface environment for

OFF-GLIDING. In the pairs below the first word is non-infixed and shows

ordinary OFF-GLIDING in a closed syllable. The second word has the infix

\(-ra\)- and the environment for OFF-GLIDING is not met in the surface form:
The derivation of \( na^n{d'}{iərám} \) ‘favorite’ is shown below:

\[
\begin{align*}
(86a) & \quad a^{-n}{d'}{im} \rightarrow a|^{n}{d'iəm} \quad \text{‘likes’} \\
& \quad \text{TH-like} \\
(86a') & \quad n-a^{-n}{d'i-ra-m} \rightarrow na|^{n}{d'iə|rám} \quad \text{(SH nandiüram)} \quad \text{‘favorite’} \\
& \quad \quad \quad \leftarrow \text{‘being liked’} \\
& \quad \text{ADJ-TH-like-PASS-like} \\
(86b) & \quad a-k'i{hp} \rightarrow a|k'i:əb \quad \text{‘accompanies’} \\
& \quad \text{TH-accompany} \\
(86b') & \quad a-k'i-ra-{hp} \rightarrow a|kərá:b \quad \text{(SH aquiüraab)} \quad \text{‘lives with’} \quad \leftarrow \text{‘is accompanied’} \\
& \quad \text{TH-accompany-PASS-accompany}
\end{align*}
\]

The derivation of \( na^n{d'iərám} \) ‘favorite’ is shown below:

\[
\begin{align*}
(87) & \quad a^{-n}{d'ím} & \quad \text{cycle 1 SYLLABIFICATION, STRESS} \\
& \quad a^{-|n}{d'iəm} & \quad \text{cycle 1 OFF-GLIDING (28)} \\
& \quad a|^n{d'iə-ra-m} & \quad \text{cycle 2 infixation of -ra- (§2.2.1)} \\
& \quad a|^n{d'iə|-rá-m} & \quad \text{cycle 2 SYLLABIFICATION, STRESS} \\
& \quad \quad n-a|^n{d'iə|rám} & \quad \text{cycle 3 (on n-)}
\end{align*}
\]
In sum, OFF-GLIDING (28) must apply cyclically since it can make reference to pre-surface syllabification. In addition, non-cyclic applications of OFF-GLIDING occur in non-derived forms such as \( m'ik \rightarrow m'isk \) ‘butterfly’ (23c, 23d), as well as in cases to be introduced later (§3.4.1) in which VOWEL HARMONY creates /i/ before a plain consonant coda.

3.2.3. RAISING. §1.4.2 introduced the rule of RAISING (32) which shifts /a/ to /i/ before a palatalized coda after a plain consonantal onset.

This rule also operates in derived environments. Non-cyclic applications of RAISING can be seen in the reflexive suffix +ay, which changes to +iy after a plain consonant:

\[
\begin{align*}
(88a) & \quad s-a-hor-hor+ay \rightarrow sa|hor|ho|ri\dot{y} \quad \text{‘itch’} \\
(88b) & \quad a-tsahts-tsahts+ay \rightarrow a|tsa:|tsah|ts\dot{y} \quad \text{‘flutters, flaps’ vi.} \\
(88c) & \quad a-la\%g-la\%g+ay \rightarrow a|la\%g|la|\%gy\dot{y} \quad \text{‘vibrates’ vi.}
\end{align*}
\]

RAISING also applies in the harmonic suffix +aw’ ‘3rd person plural’ when VOWEL HARMONY (§3.4.1) produces the alternant +aw':
(89a) \( a-h'iər+aw' \rightarrow a-h'iər+aw' \rightarrow a|h'iə|ɾiw' \) ‘they have’

(89b) \( a^{-)*ts'om+aw' \rightarrow a^{-)*ts'om+aw' \rightarrow a|^*ts'o|mɨw' \) ‘they paint’

\{A23\}

More evidence for RAISING comes from verb stems which have undergone MORPHOLOGICAL DEPALATALIZATION (§2.3.2). Recall that this
detransitivizing process prefixes \( h^{-} \), shortens the stem vowel, and
depalatalizes the final consonant of the stem; in some cases this will remove
the environment for RAISING (the symbol \( \Rightarrow \) denotes a morphological
derivation):

(90a) \( a-kal' \rightarrow a-kil' \) ‘waits for, expects’ vt.

(90a') \( a-kal' \Rightarrow a-h-kal \) ‘is waited for, is expected’ vi. (SS ajcal)

(90b) \( a-nahp' \rightarrow a-ni:b' \) ‘sells’ vt.

(90b') \( a-nap' \Rightarrow a-h-nap \) ‘is sold’ vi. \{A24\}
For example, as shown in (90a) underlying *a-kal’ becomes *akil’ by RAISING.

In (90a’) on the other hand, MORPHOLOGICAL DEPALATALIZATION changes the stem-final */l’/ to plain */l/, preventing RAISING from applying. The underlying vowel */a/ thus appears on the surface in *ahkal.

We now turn to arguments for the cyclic application of RAISING. Earlier it was proposed that RAISING (32) applies only to syllables that have an onset, on the basis of vowel-initial words such as *aⁿʦ’ ‘laziness’ and an’ ‘red mangrove’ in which */a/ does not change to */i/. Nevertheless, the following examples show that in derived forms RAISING is not constrained in this way:

(91a)  a-t’ → ɨt’          ‘eats’ vt.
(91b)  a-ɦʦ’ → ɨ:ʦ’          ‘gives’
(91c)  a-w’ → ɨw’          ‘is lent’ (SS üw)

In the subsyllabic roots -t’ ‘eat’, -ɦʦ’ ‘give’ and -w’ ‘be lent’, the theme vowel, having its normal value */a/ in this environment, forms a syllable with the palatalized consonant of the root. The changes in (91) appear to
result from a cyclic rule of RAISING which differs slightly from non-cyclic RAISING (32). Specifically, in cyclic RAISING an /a/ shifts to /ɨ/ before a palatalized coda regardless of whether there is a preceding plain consonant or not:

\[(92) \text{cyclic RAISING: } a \rightarrow i / \_ C' \text{ (when tautosyllabic)} \{A25\}\]

But because cyclic rules do not apply to non-derived forms, cyclic RAISING will not apply to \(an'\) or \(a^nʦ'\) for example. Compare the derivation of \(a^nʦ'\) ‘laziness’ and \(ɨ \_ t'\) ‘eats’:

\[(93) \begin{array}{ccc}
 a-t' & a^nʦ' & \text{underlying} \\
 át' & — & \text{cycle 1 SYLLABIFICATION, STRESS} \\
 ťt' & — & \text{cycle 1 RAISING (92)} \\
 — & áⁿʦ' & \text{non-cyclic SYLLABIFICATION, STRESS} \\
 — & (inapplicable) & \text{non-cyclic RAISING (32)}
\end{array}\]

Whereas in \( \acute{ɪt} \) the theme vowel triggers a cycle, allowing cyclic RAISING (92) to apply, in monomorphemic \( a^n\acute{ɪ}s \) there is no cyclic rule application. Since non-cyclic RAISING (32) requires a preceding onset, \( a^n\acute{ɪ}s \) is unaffected when it passes through the non-cyclic rules.

More explicit evidence that RAISING (92) must be cyclic is that it can be conditioned by pre-surface syllabification. For example, non-cyclic syllabification can move a stem-final coda into the onset of a syllable formed by a non-cyclic affix:

\[
\begin{align*}
(94a) & \quad a-kal' + A w' \rightarrow a|ki|l'iw' \quad \text{‘they wait’} \\
(94b) & \quad t-a-tan' + A s \rightarrow ta|ti|n'is \quad \text{‘I asked’} \quad \{A26\}
\end{align*}
\]

Consider the derivation of \( tatin'is \) ‘I asked’:
Non-cyclic syllabification puts stem-final /n′/ in the onset of the final syllable, removing it from the coda. So RAISING must apply cyclically while /n′/ is still in the coda.

A more indirect argument for cyclic RAISING comes from the non-application of the rule before certain cyclic suffixes. Recall from §3.2.2 that words such as aᵐᵇⁱˢˡ-ʰᵢᵗˢ ’turns over’ vt. show that OFF-GLIDING (28) applies cyclically before the affixation of -ʰᵢᵗˢ ‘causative’. Pairs such as the following suggest that RAISING could apply in the same way:

(96a)  a-ʰⁱʸ  ‘walks, goes’
(96a’)  a-ʰⁱʸ-ʰᵢᵗˢ  ‘drives (e.g. an animal)’ ← ‘makes walk’
If RAISING were to apply cyclically we might expect *atsiⁿb’i:ts’ ‘lets loose’, for example. But this incorrect form will result only if the first cycle occurs on atsaⁿb’ and not on tsaⁿb’-i:ts’, and this depends on the internal structure of the causative:
The correct bracketing is shown on the right above. The first cycle occurs on the constituent formed by affixation of -ihts’ and so root-final /mb’/ syllabifies as an onset and is never in a coda. Raising (92) thus never applies. In the incorrect bracketing on the left the first cycle occurs on the constituent formed by the theme vowel, and the /mb’/ is in a coda causing Raising to apply incorrectly.
So while causatives such as \textit{a-hiy-its‘} ‘drives’ have their first cycle on the theme vowel, causatives such as \textit{atsa’mb’-i:ts‘} have their first cycle on the causative suffix:

\begin{align*}
(99a) \quad & [\text{a-hay}-\text{ihts‘}] \rightarrow a|h|y:ts‘ \quad \text{‘drives’} \\
(99b) \quad & [\text{a-[}t\text{sa’mb’-ihts‘}]] \rightarrow a|\text{tsa}|m'b:ts‘ \quad \text{‘turns over’ vt.}
\end{align*}

This difference in bracketing is not merely ad hoc but is in fact supported by independent evidence. Whereas stems such as (99a) have corresponding non-causative stems without \textit{-ihts‘} (as in 96a, 96b), stems of type (99b) do not have transparent non-causative counterparts. Instead, the roots that appear in causatives of this type have a companion intransitive formed with a suffixal (not prefixal) theme vowel:\footnote{A29}

\begin{align*}
(100a) \quad & \text{tsa’mb’-i:} -m \quad (\text{SS tsambiüm}) \quad \text{‘is loosed, freed; slips away’} \\
(100b) \quad & \text{har’-i:} -n \quad \text{‘destroyed’ pple.} \\
(100c) \quad & \text{ka’mb’s-} -i: -m \quad (\text{SS canchiüm}) \quad \text{‘gathers, joins, gets together’ vi.}
\end{align*}
Whereas *ahîyi:ts* ‘drives’ (99a) is plausibly derived from *ahîy* ‘walks’, there is no verb *a-tsi’m*b’ as a derivational predecessor to *a-tsa”m*b’-i:ts’ ‘turns over’ (99b), suggesting that there is in fact no cycle on [a-tsa”m*b’] since this is not a constituent. RAISING (92) thus never has an opportunity to apply and *a-tsa”m*b’-i:ts’ surfaces with /a/ as its root vowel.

In sum, RAISING (92) is demonstrably cyclic in its application: it can apply in closed syllables which are later opened by resyllabification (94, 95), but it fails to apply before vowel-initial suffixes on the first cycle since there is never a closed syllable in these forms (97, 98). In addition, unlike non-cyclic RAISING (32), cyclic RAISING (92) does not require a preceding plain consonant to apply. As expected, cyclic applications of RAISING do not apply to non-derived forms such as *a”ts* ‘laziness’ (93), leaving them intact.

3.2.4. E-LOWERING. Unlike RAISING (32, 92) and OFF-GLIDING (28), the rule of E-LOWERING applies only cyclically, in derived environments.

This rule lowers a stressed /é/ to /á/ in a closed syllable after a plain
consonant, which becomes palatalized (while the /a/ later becomes /æ/ by Fronting (24)):

(101) E-LOWERING (cyclic): \( C\acute{\epsilon}C'(\) → \( C'\acute{\epsilon}C'(\) \) \{A30\}

The following examples illustrate E-LOWERING:

(102a) \( w'\text{it'}\text{-A-t-er} \rightarrow w'\text{t}i\text{t}i\text{a}|t'\acute{\text{ar}} \) ‘you sg. rose’

\( \text{rise-TH-PRET-2} \)

(102b) \( ap\#wa^\text{ts-A-m-er} \rightarrow ap|wa|^\text{tsa}|m'\acute{\text{ar}} \) ‘you sg. will turn (your head)’

\( \text{FUT#turn-TH-PERS-2} \)

(102c) \( t\text{-e-t'} \rightarrow t'\acute{\text{at}}' \) ‘you sg. eat’ vt.

\( \text{PRET-TH2-eat} \)

(102d) \( ap\#m-e-h\text{ts}' \rightarrow ap|m'\acute{\text{a}}:\text{ts}' \) ‘you sg. will give’

\( \text{FUT#SUB-TH2-give} \)

(102e) \( t\text{-e-}^\text{m}b+\text{An} \rightarrow t'\acute{\text{a}}|\text{m}b\text{án} \) ‘you pl. went’

\( \text{PRET-TH2-go+PL} \)
In (102a) and (102b) E-LOWERING occurs when a plain consonantal suffix -t or -m is followed by the 2nd person agreement suffix -er. On the third cycle this suffix is stressed and its vowel lowers to /a/, palatalizing the preceding consonant:

\[(103) \quad w’i|t’í-t \quad wa|’tsá-m \quad \text{cycle 2 SYLLABIFICATION, STRESS}\]

\[\quad w’i|t’í-at \quad — \quad \text{cycle 2 OFF-GLIDING (28)}\]

\[\quad w’i|t’i|a|t-ér \quad wa|’tsa|m-ér \quad \text{cycle 3 SYLLABIFICATION, STRESS}\]

\[\quad w’i|t’i|a|t’-ár \quad wa|’tsa|m’-ár \quad \text{cycle 3 E-LOWERING (101)}\]

\[\quad w’i|t’i|a|t’á|ér \quad ap#wa|’tsa|m’á|ér \quad \text{other rules, including FRONTING (24)}\]

In (102c-e) the affected vowel is the ablauted theme vowel /e/ which appears in the 2nd person (§2.3.3). The environment for E-LOWERING is met...
when this /e/ attaches to a subsyllabic root and is prefixed by a plain consonant, as in $t$-$e$-$t'$ $\rightarrow$ $t'$-$á$-$t'$ (102c) or $t$-$e$-$^{mb}$-$á$-$n$ $\rightarrow$ $t'$-$á$-$m$-$b$-$án$ (102e):

\[
\begin{array}{ccc}
(104) & é-t' & é-\^{mb} & \text{cycle 1 rules} \\
&t$-$é$t' & t$-é$$^{mb} & \text{cycle 2 SYLLABIFICATION, STRESS} \\
t'$-$á$t' & t'$-á$$^{mb} & \text{cycle 2 E-LOWERING (101)} \\
t'$-$át$t' & t'$-á$|$^{mb}$$+á$n & \text{non-cyclic SYLLABIFICATION, STRESS}
\end{array}
\]

The example $t'a^{mb}$-$án$ is especially interesting because after E-LOWERING takes place the non-cyclic rules shift the stress to the final syllable and resyllabify the former coda /$^{mb}$/ as an onset, removing the surface conditions for E-LOWERING. This establishes that E-LOWERING must be a cyclic rule.

It can also be shown that E-LOWERING applies only to stressed syllables:
(105) $t\text{-}er\text{-}b\text{o}l \rightarrow t\text{'e}r\text{|}b\text{ól}$ (SS termbol) ‘you were afraid’

PRET-2TH-fear

In $t\text{'e}r\text{|}b\text{ól}$ there is no E-LOWERING in the initial stressless syllable /teɾ/
even though $t\text{-}$ is a cyclic affix:

(106) $t\text{'e}r\text{|}b\text{ól}$ cycle 2 STRESS and SYLLABIFICATION

(inapp.) cycle 2 E-LOWERING (101)

$t\text{'e}r\text{|}b\text{ól}$ non-cyclic SOFTENING (25)

The cases of E-LOWERING just reviewed have all involved environments
created by cyclic affixes (cyclic prefixes $m\text{-}$, $t\text{-}$ and the cyclic suffix -er). No
synchronic evidence suggests that there is a non-cyclic application of

E-LOWERING.\{A31\}
The ordering between E-LOWERING and SOFTENING (25) is a crucial one. If SOFTENING were to apply first, E-LOWERING would be unable to apply, as shown in the (incorrect) derivation of $t'áť'$ ‘you sg. eat (something)’:

(107) $é-t'$ cycle 1 SYLLABIFICATION and STRESS

$t-ét'$ cycle 2 SYLLABIFICATION and STRESS

*$t'ét'$ SOFTENING (25)

(inapplicable) E-LOWERING (101)

Because E-LOWERING is triggered only by a preceding plain consonant, if SOFTENING were to apply first it would prevent E-LOWERING from applying.

This ordering is, however, unproblematic, since no evidence suggests that SOFTENING is cyclic in the first place, and E-LOWERING is cyclic only. Non-cyclic application of SOFTENING will therefore automatically follow cyclic application of E-LOWERING as required.
In sum, E-LOWERING (101) must be a cyclic rule: it applies only in closed, stressed syllables, but its environment can be obscured by later (non-cyclic) syllabification; it also crucially precedes non-cyclic SOFTENING (25).

3.2.5. Elision and Hiatus. When two vowels come to be adjacent by affixation, in some cases rules of elision delete one of the vowels. This section introduces these rules and also those circumstances in which hiatus is preserved.

The first and most general observation is that hiatus is freely permitted between a theme vowel and a root morpheme. Elision never occurs in this environment, and all manner of vocalic sequences are permitted. The examples below show hiatus after /i/ (108), /e/ (109) and /a/ (110) in this environment:

\[
(108a) \quad i\text{-}i^{\nu}d' \rightarrow i|i^{\nu}d' \quad \text{‘you sg. play the } i^{\nu}d' \text{ (flute)’}
\]

TH2-flute
\( (108b) \quad i\text{-}im' \rightarrow i\text{̄}m' \quad \text{`you sg. weigh'} \)

TH2-weigh

\( (108c) \quad m\text{-}i\text{-}ak \rightarrow m'i\text{̄}ak \quad \text{`your/his/her right hand'} \)

PERS-TH-right.hand

\( (109a) \quad s\text{-}e\text{-}ik' \rightarrow s'e\text{̄}k \quad \text{`my liver'} \)

1-TH-liver

\( (109b) \quad t\text{-}e\text{-}ehp' \rightarrow t'e\text{̄}b' \quad \text{`you sg. smoked'} \)

PRET-TH2-smoke

\( (109c) \quad t\text{-}e\text{-}ol' \rightarrow t'e\text{̄}ól' \quad \text{`you mixed' vt.} \)

PRET-TH2-mix

\( (110a) \quad s\text{-}a\text{-}ah \rightarrow sa\text{̄}h \quad \text{`I heat up' vt.} \)

1-TH-heat

\( (110b) \quad a\text{-}im' \rightarrow a\text{̄}̃m' \quad \text{`weighs'} \)

TH-weigh

\( (110c) \quad a\text{-}ol' \rightarrow a\text{̄}ól' \quad \text{`mixes' vt.} \)

TH-mix
All the above cases involve hiatus before a stressed vowel, but the following examples demonstrate that hiatus may occur before a stressless vowel as well:

(111a)  $s\text{-}e\text{-}i\text{ts}'w'ak \rightarrow s'e\text{|}i\text{ts}'|w'\acute{e}k$  ‘my monkey’

1-TH-monkey

(111b)  $m\text{-}i\text{-}ak+\text{hts} \rightarrow m'i|a|ká:ts$  ‘our incl. right hands’

PERS-TH-right.hand+INCL1PL  \{A32\}

In derived environments producing hiatus not at the theme-root boundary, elision sometimes takes place. The most general rule of elision deletes any vowel after /e/:

(112)  ELISION-1 (cyclic):  $V \rightarrow \emptyset / e \; ___$

This rule is observed principally in two circumstances. First, in the preterite and subordinate forms of reflexives and some intransitives the
subordinating prefixes $m'e$, $n'e$- and the preterite prefix $t'e$- appear before the theme vowel /a/, which then deletes:

(113a) $m'e$-$a$-$k'ahʦ'+ay \rightarrow m'e|k'ah|ʦ'āy$ ‘that he may learn’

$\text{SUB-TH-teach+REFL}$

(113b) $t'e$-$a$-$kohts'+$a$s+ay$+$on \rightarrow t'e|kòː|ʦ'a|yón$ ‘we incl. cut (past) ourselves’

$\text{PRET-TH-cut-1+REFL+PL}$ {A33}

ELISION-1 also operates between the agentive prefix $n'e$- and a following theme vowel:

(114a) $n'e$-$a$-$ol'$+$ay \rightarrow n'e|o|l'āy$ ‘knot’ ← ‘self-tying thing’

$\text{AGENT-TH-tie+REFL}$

(114b) $n'e$-$a$-$rahr \rightarrow n'e|rāːr$ ‘hot’ adj.

$\text{AGENT-TH-hot}$
RAISING (92), E-LOWERING (101), and ELISION-1 (112) combine to create some complex alternations seen in forms of the verb -t’ ‘to eat’:

(115) transitive intransitive

(115a) $a-t' \rightarrow ɨt'$ $a-t' \rightarrow ɨt'$ ‘eats’

TH-eat TH-eat

(115b) $t-a-t' \rightarrow ɨt'$ $t'e-a-t' \rightarrow ɨt'$ (SH tet) ‘(s)he ate’

PRET-TH-eat PRET-TH-eat

(155c) $m-a-t' \rightarrow ɨt'$ $m'e-a-t' \rightarrow ɨt'$ (SH met) ‘that (s)he eat’

SUB-TH-eat SUB-TH-eat

In the atemporal (present) tense (115a) the underlying forms are not different and $a-t'$ undergoes RAISING as expected to produce $ɨt'$, cf. (93) above. The remaining forms — preterite (115b) and subordinate (115c) — are differentiated by the usual allomorphy of the prefix: $t$- and $m$- for the transitives and $t'e$- and $m'e$- for the intransitives. The derivation of the two preterite forms above, contrasted with the form $t'āt'$ ‘you sg. ate’ vt., is shown below:
(116) \( t\text{-}a\text{-}t' \quad t'e\text{-}a\text{-}t' \quad t\text{-}e\text{-}t' \) underlying form

\( \acute{a}\text{-}t' \quad \acute{a}\text{-}t' \quad \acute{e}\text{-}t' \) cycle 1 SYLLABIFICATION,

STRESS

\( \acute{i}\text{-}t' \quad \acute{i}\text{-}t' \quad — \) cycle 1 RAISING (92)

\( t\acute{\text{i}}t' \quad t'e\text{-}\acute{i}t' \quad t\acute{\text{e}}t' \) cycle 2 SYLLABIFICATION,

STRESS

\( — \quad — \quad t'\acute{\text{a}}t' \) cycle 2 E-LOWERING (101)

\( — \quad t'e\text{-}t' \quad — \) cycle 2 ELISION-1 (112)

‘(s)he ate’ vt. ‘(s)he ate’ vi. ‘you sg. ate’ vt.

SH tütet SH tet SH teat

ELISION-1 triggered by /e/ applies before both unstressed and stressed vowels. The remaining rules of elision apply only when the adjacent vowels are unstressed.

First, the vowel /a/ deletes before stressless /a/ or /e/, or, more generally, a vowel deletes before a non-high stressless vowel:
(117) **ELISION-2 (cyclic):** \( V \rightarrow \emptyset / \_ \_ \_ [V \text{-high}] \) (stressless)

(118a) \( la-er-k'ahts'+aran \rightarrow l'er|k'è|ts'e|rán \) ‘someone (recently) taught you’

REC-TH2-teach+INDEF

(118b) \( la-a-ts'eh't'+ay \rightarrow la|ts'eh|t'áy \) ‘(s)he has just cut self’

REC-TH-cut+REFL \{A34\}

But before high vowels /a/ does not delete and hiatus is tolerated:

(119) \( la-i-h'i"ts \rightarrow la|i|h'iə"ts \) (SH laijiünts) ‘you (recently) cried’

REC-TH2-cry

Nor does /a/ delete before a stressed vowel:

(120) \( la-a^{-m}b \rightarrow la|á^m)b \) ‘(s)he (recently) went’

REC-TH-go
Nor does /a/ delete before a vowel which was stressed on the cycle when la-attached, even though the vowel is unstressed in the surface form:

\[(121) \quad la-a^m b+iw' \rightarrow la|a|^m bîw' \quad \text{‘they (recently) went’}\]

\[
\text{REC-TH-go+3PL}
\]

\[
\begin{array}{ll}
\hat{a}^m b & \text{cycle 1 SYLLABIFICATION and STRESS} \\
la|\hat{a}^m b & \text{cycle 2 SYLLABIFICATION and STRESS} \\
(\text{inapplicable}) & \text{cycle 2 ELISION-2 (117)} \\
la|a|^m b+iw' & \text{noncyclic rules}
\end{array}
\]

This shows that ELISION-2 is a cyclic rule and precedes the non-cyclic rules which move the stress to the final syllable in \(laa^mbîw'\). In addition, it is clear that ELISION-1 (112) must precede ELISION-2 (117) since the former bleeds the latter. For example, deleting the /a/ in /t'e-at'/ by ELISION-1 prevents that /a/ from deleting the /e/ by ELISION-2. On this basis, we conclude that ELISION-1 is also cyclic.
The final rule of elision (122) applies between the proclitic $t’a#$ ‘progressive’ and a verb beginning with stressless /a/ (123), but not verbs beginning with /i/ or /e/ or stressed /a/ (124). This rule is clearly non-cyclic, as it applies in the clitic group domain:

(122) ELISION-3: $a \rightarrow \emptyset / \_ \_ \# a$ (stressless)

(123) a. $t’a#-s’ehp’ \rightarrow t’a|s’\text{'b’}$

PROG#TH-bathe

‘is bathing’

b. $t’a#-\text{‘}dahp \rightarrow t’a|\text{‘}d\text{‘}b$

PROG#TH-burn

‘is burning’

(124) a. $t’a#-i-m’ay \rightarrow t’a|i|m’\text{‘}y$ (SH teaimeay) ‘is sleeping’

PROG#TH2-sleep

b. $t’a#-r-m’b’ol \rightarrow t’a|er|m’b’ol$

PROG#TH2-fear

‘you sg. are fearing’
c. $t'a\#a^{-m}b+_Aw' \rightarrow t'a'|^m b\acute{i}w'$ (SH teambüw) ‘is going’

PROG#TH-go

Note finally the contrast between $la-a^{-m}b\acute{i}w'$ — where /a/ does not delete because Elision-2 (117) applies cyclically (121) and is thus sensitive to pre-surface stresses — and $t'a\#a^{-m}b\acute{i}w'$ (124c) — where Elision-3 (122) applies non-cyclically, and thus is indifferent to pre-surface stresses:

(125) $la-a^{-m}b+_Aw'$ $t'a\#a^{-m}b+_Aw'$

$\acute{a}^{-m}b$ $\acute{a}^{-m}b$ cycle 1

$la-\acute{a}^{-m}b$ — cycle 2

(inapp.) — cycle 2 Elision-2 (117)

$la|a^{-m}b+\acute{i}w'$ $a|^m b\acute{i}w'$ non-cyclic rules

— $t'a\#a|^m b\acute{i}w'$ cliticization

(inapp.) $t'a|^m b\acute{i}w'$ clitic group Elision-3 (122)
3.2.6. **Summary.** It will be helpful to pause and review the rules proposed for vocalic alternations up to this point. These are displayed below with the orderings established in this section:
| (126) Cyclic: | Syllabification (6) | ㄱ ㄱ ㄱ |
| Stress (17) | ㅣ ㄱ ㅣ ㅣ ㄱ |
| Morph. Depal. (§2.3.2) | ㄱ ㅣ ㅣ ㅣ ㅣ |
| E-lowering (101) | ㄱ ㅣ ㅣ ㅣ ㅣ ㅣ |
| Raising (92) | ㅣ ㅣ ㅣ ㅣ ㅣ ㅣ |
| Fronting (24) | ㅣ ㅣ ㅣ ㅣ ㅣ ㅣ |
| Off-gliding (28) | ㅣ ㅣ ㅣ ㅣ ㅣ ㅣ |
| Elision-1 (112) | ㅣ ㅣ ㅣ ㅣ ㅣ ㅣ |
| Elision-2 (117) | ㅣ ㅣ ㅣ ㅣ ㅣ ㅣ |
| Non-cyclic: | Syllabification (6) | ㅣ ㅣ ㅣ ㅣ ㅣ ㅣ |
| Stress (17) | ㅣ ㅣ ㅣ ㅣ ㅣ ㅣ |
| Raising (32) | ㅣ ㅣ ㅣ ㅣ ㅣ |
| Fronting (24) | ㅣ |
| Off-gliding (28) | ㅣ |
| Softening (25) | ㅣ |
| Clitic group: | Syllabification (6) |
| Elision-3 (122) |
| Fronting (24) |
3.3. **Diminutive formation.** As mentioned earlier the formation of diminutive stems from their augmentative counterparts follows a regular phonological pattern. Diminutives are formed from only a subset of the possible roots types, as shown below:

(127) Diminutive Formation \{A36\}

<table>
<thead>
<tr>
<th>root</th>
<th>diminutive</th>
<th>example</th>
</tr>
</thead>
<tbody>
<tr>
<td>C’aC(aC’)</td>
<td>C’iC(iC’)</td>
<td>ts’al’as’</td>
</tr>
<tr>
<td>C’aC</td>
<td>C’iəC</td>
<td>-t’ap-t’ap</td>
</tr>
<tr>
<td>CiC’</td>
<td>C’iC’</td>
<td>-wits’-wits’</td>
</tr>
<tr>
<td>CoC’</td>
<td>C’eC’</td>
<td>-”dohk’</td>
</tr>
<tr>
<td>CoC(oC)</td>
<td>C’eC’(eC’)</td>
<td>-p’ots</td>
</tr>
<tr>
<td>CaC(aC)</td>
<td>C’iC’(iC’)</td>
<td>tsalas</td>
</tr>
</tbody>
</table>

3.3.1. **Diminutive Formation Process.** It is easily seen that the vowels of the diminutives are always front vowels, either /e/ (if the augmentative
root contains /o/) or /i/ otherwise. With the exception of the /C’əC/ type, as in at’əpt’əp ‘rustles, moves in the wind’ dim., the consonants of the diminutives are all palatalized. These two facts together suggest that **DIMINUTIVE FORMATION** involves a replacement of [±low] and [±back] by [±high] and [−back] respectively, and that the replacement operates from left-to-right in such a way that the final consonant in the /C’əC/ type remains unchanged. The following rules produce the required changes:

(128) **DIMINUTIVE FORMATION:**

1. Replace a [±low] feature at the left edge by [±high]
2. Replace a [±back] feature at the left edge by [−back]

The diagrams below illustrate the action of **DIMINUTIVE FORMATION** on examples of the roots types which it applies to:
(129a)  
\[ +\text{low} \implies_1 +\text{hi} \]
\[ \\text{ts}'\text{al} '{\prime} \quad \text{ts}'\text{i} \text{lis}' \]

\[ \to \text{ts}'\text{i} \text{lis}' \text{ (by FRONTING (24))} \]

(129b)  
\[ +\text{low} \implies_1 +\text{hi} \]
\[ \text{t'} \text{ a} \text{ p} \quad \text{t'} \text{ i} \text{ p} \]
\[ -\text{bk} +\text{bk} \quad -\text{bk} +\text{bk} \]

\[ \to \text{t'}\text{i} \text{p} \text{ (by FRONTING (24))} \]

(129c)  
\[ +\text{bk} -\text{bk} \implies_2 -\text{bk} \]
\[ \text{w i} \text{ ts'} \quad \text{w} \text{i} \text{ts}' \]

(129d)  
\[ +\text{bk} -\text{bk} \implies_2 -\text{bk} \]
\[ "\text{dohk'} \quad "\text{d'ehk'} \]

(129e)  
\[ +\text{bk} \implies_2 -\text{bk} \]
\[ \text{p o} \text{ ts} \quad \text{p'ets'} \]

(129f)  
\[ +\text{low} \implies_1 +\text{hi} \quad +\text{hi} \]
\[ \\text{tsalas} \quad \text{tsi} \text{lis} \quad \text{ts}'\text{i} \text{lis}' \]
\[ +\text{bk} +\text{bk} \implies_2 -\text{bk} \]
Note that in (129b) the root $t'ap$ changes to $t'iəp$, and not to, say, $t'ip'$, because **DIMINUTIVE FORMATION** replaces a [+back] feature only at the left edge of the stem. Since $t'ap$ has a [−back] feature at its left edge, no changes take place and the final /p/ remains unpalatalized. **FRONTING** (24) shifts /i/ to /i/ and feeds **OFF-GLIDING** (28) which shifts /i/ to /iə/.

3.3.2. Stems which do not undergo **DIMINUTIVE FORMATION**. The following root types do not form diminutives, and speakers consider hypothetical diminutives formed from them to be ungrammatical:

(130)  $C'IC'$, $C'eC'$, $C'iəC$, $C'oC$, $C'oC'$

The proposed processes of **DIMINUTIVE FORMATION** give a very straightforward answer to the question of why these root types do not form diminutives: they turn out to be the root types for which the rules of **DIMINUTIVE FORMATION** have a vacuous result. Note that none of the root types in (130) contains a low vowel, so first part of the process in (128) — the replacement of [+low] by [+high] — will not apply. Moreover, all of the
root types in (130) begin with a palatalized consonant, so the second part of (128) — replacement of a [+back] feature at the left edge with [−back] — will also be inapplicable.

3.4. **Vowel harmony.** Certain suffixes show harmonic alternations conditioned by the vocalic quality and final consonant of the stem to which they attach. The rules of vowel harmony differ in part depending on whether the harmonic suffix is cyclic or non-cyclic.

3.4.1. **Non-cyclic harmony.** Non-cyclic suffixes $+_{as}$ ‘1’, $+_{an}$ ‘plural’, $+_{ar}$ ‘1st person inclusive’, $+_{ahts}$ ‘1st person inclusive plural’ and $+_{aw}$ ‘3rd person plural’ show vowel harmony alternations of essentially two kinds: a *palatal* harmony producing /i/ after stems ending in palatalized consonants, and a *labial* harmony producing /o/ after certain roots containing the vowel /o/.
Aside from exceptions to be discussed in §3.4.3, the harmony of a non-cyclic suffix is determined by the preceding syllable, as shown below (see also SH:287-290):

<table>
<thead>
<tr>
<th>(131)</th>
<th>preceding</th>
<th>harmony</th>
</tr>
</thead>
<tbody>
<tr>
<td>syllable</td>
<td>vowel</td>
<td>example</td>
</tr>
<tr>
<td>(131a)</td>
<td>-iC'</td>
<td>a → æ</td>
</tr>
<tr>
<td>(131b)</td>
<td>-eC'</td>
<td>i</td>
</tr>
<tr>
<td>(131c)</td>
<td>C'aC'</td>
<td>i</td>
</tr>
<tr>
<td>(131d)</td>
<td>aC'</td>
<td>i</td>
</tr>
<tr>
<td>(131e)</td>
<td>-CoC'</td>
<td>i</td>
</tr>
<tr>
<td>(131f)</td>
<td>-C'oC'</td>
<td>i</td>
</tr>
<tr>
<td>(131g)</td>
<td>-iC'</td>
<td>i</td>
</tr>
<tr>
<td>(131h)</td>
<td>-iC</td>
<td>a</td>
</tr>
</tbody>
</table>
The above data admit several important generalizations. First, the value /a/ has a heterogeneous distribution, occurring after stems ending in plain consonants (131i-m, except some containing /o/, as in 131n, discussed below) as well as stems ending in /iC/ (131a). Inversely, the harmonic vowel is /i/ when the preceding consonant is palatalized (131b-g), except when the preceding rhyme itself contains /i/ (131a). In that case the vowel is systematically /a/ (becoming /æ/ by FRONTING (24)).

(131i) -ioC a $s$-a*-d'iəm+$An \rightarrow sa'd'iəmán 'we want'

(131j) C'aC a a-k'ahw+$Ahts \rightarrow ak'æhwá:ts 'we incl. split' vt.

(131k) -aC a m-i-ka"bah+$Ar \rightarrow m'ika"bahár 'our incl. dual
town'

(131l) C'oC a s-a*-ts'om+$An \rightarrow sa"ts'omán 'we excl. paint'

(131m) -oC a m-i-sots+$Ahts \rightarrow m'isotsá:ts 'our incl.
mustaches'

(131n) -oC o i*-dok+$An \rightarrow i*dokón 'you sg. fish'
These facts suggest that /a/ is the default value for the harmonic vowel and the other harmonic values /i/ and /o/ are derived by specific rules. Before considering these rules, however, we will first examine certain important ordering relations between VOWEL HARMONY and other rules. First, stems formed with the causative suffix -i(h)ts' fronted to -i(h)ts' behave just like ordinary stems with /i/ in having harmonic /a/ → [æ]:

(131a) \( a^{-h}i{n}^h+\text{Aw} \to a|hi|n|i|h|ts'æw' \) ‘they cook’ vt.

(131b) \( s-a-hiy-its'+An \to sa|hi|yi|ts'æn \) ‘we incl. drive (an animal)’

(131c) \( a-t'ep'-its'+Aw \to a|t'e|p'i|ts'æw' \) ‘they raise, lift onto’ {A38}

This establishes that FRONTING (24) must precede VOWEL HARMONY, so that the vowel /i/ of the causative suffix becomes /i/ before VOWEL HARMONY takes place:
(134) $a|t'e|p'-\text{ts}'$  cycle 2 STRESS and SYLLABIFICATION

$a|t'e|p'-\text{ts}'$  cycle 2 FRONTING (24)

$a|t'e|p'|\text{ts}'+\text{aw}'$  noncyclic STRESS and SYLLABIFICATION

$a|t'e|p'|\text{ts}'+\text{aw}'$  non-cyclic VOWEL HARMONY

$a|t'e|p'|\text{ts}'+\text{aw}'$  non-cyclic FRONTING (24)

But FRONTING also applies after VOWEL HARMONY, changing the /a/ in $+\text{aw}'$ to [æ] after a palatalized consonant, giving $at'ep'\text{ts}'\text{æw}'$. This establishes that FRONTING must apply both cyclically (before VOWEL HARMONY) and again non-cyclically (after VOWEL HARMONY).

Second, when the harmonic vowel is followed by a plain consonant (i.e. in all the non-cyclic harmonic suffixes except $+aw'$ '3 pl.'), OFF-GLIDING (28) applies when the harmonic vowel is /i/:

(135a) $m-a-%g'a+y+an \rightarrow ma|^g'a|y\text{ɪn}$  ‘that you pl. listen’

SUB-TH-listen+PL
Because Vowel Harmony feeds Off-gliding (28), the epenthetic /ə/ cannot in these cases be underlying. This solidifies the claim that Off-gliding is an active process in the language:

Finally, in the 3rd person plural suffix +aw' when the harmonic vowel is /a/ the form undergoes Raising after stems ending in plain consonants. This shows that Vowel Harmony precedes (and feeds) non-cyclic Raising (32):
Let us now return to formulating the rules of VOWEL HARMONY that derive the /i/ and /o/ alternants. The fact that all the root types which end in palatalized consonants trigger harmonic /i/ except those root types which contain /i/ is a rather unexpected and puzzling pattern. In fact, the San Dionisio dialect (siglum D) and Santa María dialect (siglum SMa) differ in this regard from the San Mateo dialect, showing the expected harmonic /i/ after such stems:

(137a)  \[ t-a-haw+\text{Aw}' \rightarrow ta|ha|w+\text{áw}' \rightarrow ta|ha|wiw' \quad \text{‘they saw’} \]

(137b)  \[ a-\text{dim}+\text{Aw}' \rightarrow a|\text{di}\text{́}m+\text{áw}' \rightarrow a|\text{di}\text{́}m\text{́}w' \quad \text{‘they want, like’} \]

\{A39\}

(138a)  \[ \text{D } tahi^{\text{m}}b+\text{í}s \quad \nexists \text{ SMo } tah^{\text{́}}i^{\text{m}}b^{\prime}+\text{á}s \quad \text{‘I swept’} \]

\[ \text{cf. also SMa } mahi^{\text{m}}b+\text{í}s \quad \text{‘we incl. sweep’} \]

(138b)  \[ \text{D } ta^{\text{m}}biy+\text{í}s \quad \nexists \text{ SMo } ta^{\text{́}}biy+\text{á}s \quad \text{‘I killed’} \quad \{A40\} \]
The historical reasons for this difference are not known, but clearly the San Mateo pattern is the more complex one and requires some stipulation in the grammar. The San Dionisio rule is in fact quite simple:

(139) San Dionisio Palatal Harmony

\[
\begin{array}{c}
C \\
\hline
V \\
\hline
\text{DORS}
\end{array}
\]

This rule spreads the vowel place features [high] and [back] of a preceding consonant — which are dominated by the organizing node DORSAL — onto a following vowel, producing [+high –back] /i/ after a palatalized consonant.

The San Mateo situation differs from the San Dionisio one in one crucial respect: no spreading takes place when the triggering palatalized consonant shares all its vocalic features with the preceding vowel /i/, that is, when they are both [+high] and [–back]. Structurally this situation is distinctive in that the two segments will share a single fused DORSAL node:
In all other root types ending in a palatalized consonant the preceding vowel will differ in either [high] or [back] from the following consonant, and the sharing of (one of the) features can occur only at the terminal level, for example:
The rule of **San Mateo Palatal Harmony** is therefore constrained to apply only if the triggering palatalized consonant and preceding vowel do not share a DORS node:

(142) **San Mateo Palatal Harmony**

\[
\begin{align*}
(141b) & \quad \text{V} & \quad \text{C} & \quad \text{-}iC'\text{-} \\
& \quad \text{DORS} & \quad \text{DORS} \\
& \quad \quad \quad \quad +\text{high} \\
& \quad \quad \quad \quad +\text{back} & \quad -\text{back}
\end{align*}
\]

A second puzzling property of San Mateo harmony involves the stems which trigger the rule of **Labial Harmony** introducing /o/ as the harmonic vowel. As shown in (131e,f,l), stems where /o/ is either preceded or followed by a palatalized consonant do not take /o/ in their suffix. Moreover only a
subset of root types /CoC/ take /o/ (131n); the remainder take default /a/ (131m). Compare the following:

(143) Labial Harmony Triggered

(143a)  a-hⁿgot+ohts → ahⁿgo|tó:ts  ‘we incl. arrive’

(143b)  a-tsok-tsok+ohts → a|tsok|tso|kó:ts  ‘we incl. spit’

(143c)  t’a#tsoh+ow’ → t’a|tso|hów’  ‘they are fighting’  \{A41\}

(144)  No Labial Harmony Triggered

(144a)  a-ⁿtsor+aw’ → aⁿtso|ríw’  ‘they bark’

(144b)  a-ol+aw’ → a|o|líw’  ‘they mix’ vt.

(144c)  a-hlop+ahts → ah|lo|pá:ts  ‘we incl. float’  \{A42\}

At first glance there seems to be no pattern as to which stems trigger LABIAL HARMONY and which do not. Indeed, there is even some variation between speakers and individual vacillation in judgments about certain stems:
However, a careful examination of the data leads to the following generalization:

(146) **San Mateo Labial Harmony:**

/CoC/ stems ending in dorsal consonants or /h/ have labial harmony; other /CoC/ stems do not.

In data I have collected directly from speakers, aside from the variants shown in (145), only the following cases are clear exceptions to this generalization:
Moreover, of the vacillating cases in (145), it turns out that five of these have a derivationally related stem with a suffixal theme vowel /o/: 

(148a) a-lop ‘soaks’ vt.  
lop-o-m ‘soaks’ vi. 

(148b) a-to-h-koᵐᵇ ‘dulls’ vt.  
an-tokoᵐᵇ-o-n ‘very dull(ed)’ pplo.

(148c) a-solop ‘sprinkles’ vt.  
solop-o-m ‘sprinkle’ vi. 

(148d) a-hᵒⁿts ‘scratches, draws a line’  
an-hᵒⁿts-o-n tʰ国立 ‘they go in a group’

(148e) a-to-h-loⁿts ‘blisters’ vi.  
toloⁿts-o-n ‘blistered’ pplo.

The suffixal theme vowel is also harmonic, but follows a different pattern (§3.4.2), and in that type, LABIAL HARMONY regularly follows all stems ending in /oC/. Apparently, then, some speakers retain LABIAL HARMONY
for some of the stems in (145) because of the behavior of the roots they contain in derivationally related stems.

It appears, then, that we are dealing with a change in progress in the language. In the Santa María dialect, not only /CoC/ stems (149a), but also some, although not all, /C'oC/ stems have LABIAL HARMONY:

\[(149a) \text{ SMa } t-a-m^g+ós = \text{ SMo } t-a-m^g+ós \quad \text{‘I passed’ vi.} \]
\[(149b) \text{ SMa } m-a-t's'om+ós \quad \text{‘we incl. paint’} \]
\[\neq \text{ SMo } s-a-t's'om+án \quad \text{‘we excl. paint’} \]
\[(149c) \text{ SMa } m-a-b'ol+ós \quad \text{‘we incl. help’} \]
\[\neq \text{ SMo } t'a#b'ol+t'w' \quad \text{‘they help’} \]
\[(149d) \text{ SMa } m-a-s'om+ás \quad \text{‘we incl. find’ vt.} \]
\[\approx \text{ SMo } t-a-s'om+ás \quad \text{‘I found’ vt.} \]
\[(149e) \text{ SMa } m-a-gan'ow+ás \approx \text{ SMo } s-a-gan'ow+á:ts \quad \text{‘we incl. drink’} \]

{A44}
So although formerly the rule of LABIAL HARMONY may have applied to all stems ending in /oC/, the class of LABIAL HARMONY-triggering stems has been gradually restricted in its scope. The restriction is less advanced in Santa María, where only some /C'oC/ stems no longer have LABIAL HARMONY, but is more advanced in San Mateo, where LABIAL HARMONY now applies ordinarily only to /CoC/ stems ending in dorsals and /h/.

Nevertheless, in San Mateo a few stems retain LABIAL HARMONY, either as a marked option (147) or because they have derivationally related stems have harmonic /o/ in a suffixal theme vowel (148).

The change shows hallmarks of lexical diffusion; specifically, the effect of the change is discrete (Labial Harmony class shifts to non-Labial Harmony class), but the change applies gradually to increasingly larger phonological classes (e.g. first to /C'oC/ stems, then to all labial-final and coronal-final stems), while temporarily leaving certain forms unchanged (Kiparsky 1995). Further evidence that LABIAL HARMONY is not always controlled by phonological conditions, but is sometimes simply a ‘marked’ option, will be presented below in §3.4.3.
3.4.2. **Cyclic vowel harmony.** Cyclic harmony controls the quality of the theme vowel in the restricted class of stems for which the theme vowel is a suffix instead of a prefix (§2.1). The pattern observed is slightly different from that seen in non-cyclic harmony, as shown below:

<table>
<thead>
<tr>
<th>Preced harmonic</th>
<th>-ing root vowel</th>
<th>Example</th>
<th>Gloss</th>
</tr>
</thead>
<tbody>
<tr>
<td>(150a) C'iC'</td>
<td>i</td>
<td>w'it'-i-</td>
<td>'rise'</td>
</tr>
<tr>
<td>(150b) C'eC'</td>
<td>e</td>
<td>s'ehk'-e-</td>
<td>'go out (fire), be extinguished'</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>(SS xejquem)</td>
</tr>
<tr>
<td>(150c) C'aC'</td>
<td>a</td>
<td>^g'ahn'-a-</td>
<td>'burn' vi.</td>
</tr>
<tr>
<td>(150d) CaC</td>
<td>a</td>
<td>wa^ts-a-</td>
<td>'turn (the head)' vi.</td>
</tr>
<tr>
<td>(150e) CoC</td>
<td>o</td>
<td>lo^m-b-o-</td>
<td>'stand up' vi.</td>
</tr>
<tr>
<td>(150f) Cay</td>
<td>a</td>
<td>^bay-a-</td>
<td>'be scared, amazed'</td>
</tr>
<tr>
<td>(150g) Coy</td>
<td>o</td>
<td>tsoy-o-</td>
<td>'go down, subide (swelling)'</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>(SS tsoyom)</td>
</tr>
</tbody>
</table>
Consider first the stems (150a-e). These stems have two properties in common. First, the harmonic vowel is identical to the root vowel: \( w'it\prime-i \), \( s'ehk\prime-e \), \( s'g'ahn\prime-a \), \( wa^n'ts-a \), \( lo^m'b-o \). Second, if the first consonant of the root is palatalized, the second one is also palatalized (150a-c), and likewise if the first consonant of the root is plain, the second one is also plain (150d, 150e). Now note that roots ending in \([-\text{cons}] /y/ \), such as \( ^m\text{bay}- \) and \( ^ts\text{oy}- \) (150f, 150g), also have a harmonic vowel that is a copy of the root vowel: \(^m\text{bay}-a \), \(^ts\text{oy}-o \). In this respect they behave differently from similar roots which end in \([+\text{cons}] \) segments, such as \( sahr\prime-i \) and \( soh\prime d\prime-i \). Finally, the last three stems (150h-j), although having different root vowels, all have the same harmonic vowel /i/. Thus, these last three invite attention as the special case requiring a specific rule, shown below:
(151) **Cyclic Harmony-1**

\[
\begin{array}{ccc|c|}
C & V & [+\text{cons}] & V \\
\mid & \mid & \mid & \\
DORS & DORS & DORS & \\
\mid & \mid & \\
+\text{back} & \text{DORS} & -\text{back} & \\
\end{array}
\]

Cyclic Harmony-1 spreads the palatalizing features \([-\text{back}]\) and \([+\text{high}]\) of a root-final \([+\text{cons}]\) segment onto the harmonic vowel, producing \(/i/\), if the root-initial \(/CV/\) sequence shares the value \([+\text{back}]\). Thus the harmonic value for roots \(sahr\text{'}\), \(soh\text{'}d\text{'}\) and \(pihts\text{'}\) is \(/i/\). The other root types in (150a-g) are unaffected by Cyclic Harmony-1 for various reasons. For \(w\text{'}it\text{'}\), \(s\text{'}ehk\text{'}\) and \(\text{`}g\text{'}w\text{'}ahn\text{'}\) the root-initial segment is not \([+\text{back}]\); for \(wa\text{'}ts\text{'}\) and \(lo\text{'}mb\text{'}\) the root-final segment is not \([-\text{back}]\); and for \(tsoy\text{'}\) and \(\text{`}bay\text{'}\) the root-final segment is \([-\text{cons}]\) \(/y/\).

In all the types unaffected by Cyclic Harmony-1 the harmonic vowel is obtained from the root vowel by a kind of *vowel copy*. This can be obtained by the generalized spreading rule shown below (see also Halle 1995):
This rule has the effect of spreading all possible dependent features of the first vowel onto the second (harmonic) vowel. Consider first \(w'it'-i:\)

\[
\begin{array}{ccc}
V & C & V \\
\hline
i & C' & i \\
- & DORS & -bk +hi \\
\end{array}
\]

harmonic vowel \([-\text{back} +\text{high}]\)

Here CYCLIC HARMONY-2 is able to spread the entire DORS node to the harmonic vowel, which then becomes /i/. Consider next \(\text{mbay}-a\) and \(\text{mgw'ahn'}-a-:\)

\[
\begin{array}{ccc}
V & C & V \\
\hline
\end{array}
\]
Here the intervening palatalized segment /y/ or /n′/, being [-back] and [+high], blocks spreading of [+back] and [-high] from the root vowel. But because non-syllabic segments are not specified for [low] nothing will block the root vowel’s [+low] feature from spreading. Since /a/ is the only low vowel, the harmonic value must become /a/ (later becoming [æ] by Fronting (24)).

For s′ehk′e- the root vowel’s values [-low] and [-back] can spread; I assume that [-high] is supplied to the harmonic vowel as a default value:
Finally for *wa*ⁿᵗˢ-a- and *lo*ⁿᵇ-o- the intervening consonant presents no opacity to spreading and the harmonic vowels are again copies of the root vowel:

(156a)  \[ a \quad C \quad a \]

\[
\begin{array}{ccc}
\text{V} & \text{C} & \text{V} \\
\text{DORS} & \text{DORS} & \text{DORS} \\
\end{array}
\]

harmonic vowel \([+\text{low} +\text{back} -\text{high}]\)
In sum, the unusual pattern of harmony seen in suffixal themes can be derived by two rules. The first and more specific of these is CYCLIC HARMONY-1 (151) which provides harmonic /i/ to a special subset of root types. The second rule, CYCLIC HARMONY-2 (152), is a completely general rule of vowel copy which wherever possible spreads all root vowel features onto the harmonic suffix. {A45}

### 3.4.3. Complications.

There are several suffixes and a few stems which lack a round vowel but nevertheless are followed by harmonic suffixes with /o/. The suffixes include +ay ‘reflexive’ (157) and the suffixal theme
vowel -A- in general, regardless of its surface quality (158). The most common stem in this category is i-n’t’er’eh’- ‘all (of)’ (159) which presumably triggers LABIAL HARMONY because it was borrowed from Spanish entero with final /o/.

\[(157a)\ a-mih^n ts’+ay+Ah ts \rightarrow amì’n ts’ayó:ts \quad \text{‘we incl. pull ourselves’}\]

\[(157b)\ t-a-koh ts’+ay+An \rightarrow takò:ts’ayón \quad \text{‘we excl. cut ourselves’}\]

\[(158a)\ lo^m b-A-h+As \rightarrow lo^m bohós \quad \text{‘I am assuming a standing position’}\]

\[(158b)\ w’it’-A-t+As \rightarrow w’it’iətós \quad \text{‘I turned (e.g. my head)’ vi.}\]

\[(158c)\ m^bay-A-t+os \rightarrow m^bayatós \quad \text{‘I was frightened’}\]

\[(159)\ s-i-n’t’er’eh+Ah ts \rightarrow s’in’t’er’ehó:ts \quad \text{‘all of us incl.’}\]

This variety of LABIAL HARMONY could be analyzed in phonological terms as a floating [+round] feature at the right edge of the triggering morphemes, or as a morphophonological rule triggered by morphemes specially marked to trigger the rule. I leave this question open.
Further complications arise when LABIAL HARMONY occurs in the 3rd person plural suffix +Aw′. The expected outcome /ow′/ does not in general surface but changes to /oh′/:

\[(160a)\] \(t\ymbols{a}a-o^mb+Aw′ \rightarrow t\ymbols{a}o^mb+ów′ \rightarrow t\ymbols{a}o^mbóh′\) ‘they are laying eggs’

\[(160b)\] \(wa^nʦ-A-t+Aw′ \rightarrow w\ymbols{a}tsa|t+ów′ \rightarrow w\ymbols{a}tsa|tóh′\) ‘they turned’ vi.

\[(160c)\] \(a-h^ŋgot+Aw′ \rightarrow ah^ŋgo|t+ów′ \rightarrow ah^ŋgo|tóh′\) ‘they arrive, come’

This change appears to be a response to a general dispreference for mid vowels followed by [+round] codas. In derived environments /ew′/, ow′/ codas are not tolerated and the final /w′/ is debuccalized to /h′/:

\[(161)\] **DEBUCCALIZATION(-1):**  
\[w′ \rightarrow h′ / \{e, o\} \] (tautosyllabic)  \{A46\}
A curious exception to DEBUCCALIZATION-1 occurs after stems ending in /h/. Here the suffix /ow′/ is tolerated:

(162a)  \text{a-tsoh+Aw′ → a|tso|hów′} \quad \text{‘their toys’}

(162b)  \text{i-n’ter’e|h+Aw′ → in’t’e|r’e|hów′} \quad \text{‘all of them’}

This effect results from the general constraint on syllables of the form /hVh/ (§1.2.3), which blocks the application of DEBUCCALIZATION-1.

After stems ending in a palatalized segment the suffix /ow′/ is replaced by /eh′/. The most frequent of these are stems ending in reflexive +ay, which as we have seen is specially marked to trigger LABIAL HARMONY:

(163a)  \text{a-wahr-wahr+ay+Aw′ → a|wahr|waː|ra|y+ēh′} \quad \text{‘they itch’}

\text{TH-scratch-scratch+REFL+3PL}

(163b)  \text{t’a#-a-mb’iy+ay+Aw′ → t’a|mb’i|ya|y+ēh′} \quad \text{‘they are beating each other’}

\text{PROG#TH-beat+REFL+3PL}
What is special about this environment is that it is the only case in which a syllable of the form /C'oC'/ arises in a derived form. In this circumstance /o/ is not tolerated and is fronted to /e/:

(164) C'O'C' FRONTING:  o \rightarrow [−back] / C' \_ C'  (tautosyllabic)

The non-cyclic part of the derivation of *awa:rwà:rayéh* ‘they itch’ is shown below:

(165)  

\[
\begin{align*}
\text{STRESS and SYLLABIFICATION} & \quad a|wa:r|wà:|r+a|y+\acute{a}w' \\
\text{LABIAL HARMONY} & \quad a|wa:r|wà:|r+a|y+ów' \\
\text{C'O'C' FRONTING (164)} & \quad a|wa:r|wà:|r+a|y+éw' \\
\text{DEBUCCALIZATION-1 (161)} & \quad a|wa:r|wà:|r+a|y+éh'
\end{align*}
\]

The final complexity relating to LABIAL HARMONY arises in stems ending in [+round] segments (in practice /w/). Recall from §1.4.1 that a LABIAL COOCCURRENCE RESTRICTION (27) prohibits a [+round] nonsyllabic
segment followed by a [+round] vowel. In a derived form this situation arises only when a stem ending in /w/ is followed by a suffix beginning with /o/. Normally this will not occur in San Mateo because stems ending in /w/ do not trigger LABIAL HARMONY:

\[(166a)\]  \(m\-i\-sow+\_A\:ts \rightarrow m\:'isowá:ts\)  ‘our incl. pig’

\[(166b)\]  \(m\-i\-how+\_Aw' \rightarrow m\:'ihowáw' \rightarrow m\:'ihowíw'\)  ‘their hammock’

There are, however, two circumstances in which the sequence /w(\textw)/ can be generated. The first occurs in verb stems formed with the progressive/recent past suffix -w, which attaches to the suffixal theme vowel. Consider the following sets of forms (SH:362-67):
(167)

<table>
<thead>
<tr>
<th>‘turn’ vi.</th>
<th>‘stand’ vi.</th>
<th>‘stand’ vi. dim.</th>
<th>‘rise’</th>
</tr>
</thead>
<tbody>
<tr>
<td>$wa^n\text{ts-}a-n$</td>
<td>$lo^n b\cdot \hat{\text{o}}-n$</td>
<td>$l'e^n b'\cdot \hat{\text{e}}-n$</td>
<td>$w'it'\cdot \hat{\text{i}}-\hat{o}-n$</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>$wa^n\text{ts-}a-n+\hat{\text{o}}\hat{n}$</td>
<td>$lo^n b\cdot o-n+\hat{\text{o}}\hat{n}$</td>
<td>$l'e^n b'\cdot e-n+\hat{\text{o}}\hat{n}$</td>
<td>$w'it'\cdot i-\hat{o}-n+\hat{o}n$</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>$wa^n\text{ts-}\hat{\text{a}}-m$</td>
<td>$lo^n b\cdot \hat{\text{o}}-m$</td>
<td>$l'e^n b'\cdot e-m$</td>
<td>$w'it'\cdot i-\hat{o}-m$</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>$wa^n\text{ts-}a-m+oh'$</td>
<td>$lo^n b\cdot o-m+oh'$</td>
<td>$l'e^n b'\cdot e-m+oh'$</td>
<td>$w'it'\cdot i-\hat{o}-m+oh'$</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>$wa^n\text{ts-}\hat{\text{a}}-w$</td>
<td>$lo^n b\cdot \hat{\text{o}}-h$</td>
<td>$l'e^n b'\cdot e-h$</td>
<td>$w'it'\cdot i-\hat{o}-w$</td>
</tr>
<tr>
<td>$wa^n\text{ts-}a-h+\hat{o}s$</td>
<td>$lo^n b\cdot o-h+\hat{o}s$</td>
<td>$l'e^n b'\cdot e-h+\hat{o}s$</td>
<td>$w'it'\cdot i-\hat{o}-h+\hat{o}s$</td>
</tr>
<tr>
<td>$wa^n\text{ts-}a-h+\hat{o}w'$</td>
<td>$lo^n b\cdot o-h+\hat{o}w'$</td>
<td>$l'e^n b'\cdot e-h+\hat{o}w'$</td>
<td>$w'it'\cdot i-\hat{o}-h+\hat{o}w'$</td>
</tr>
</tbody>
</table>

The forms in the second row with $+\hat{o}n$ show the regular application of (marked) LABIAL HARMONY after stems formed with a suffixal theme vowel, cf. (158). The forms in the fourth row with $-\hat{o}h'$ show the results of LABIAL HARMONY followed by DEBUCCALIZATION-1 (161), cf. (160). Complications
begin in the following row, where we note that /h/ alternates with /w/.

Specifically, /h/ appears after mid vowels and /w/ elsewhere. This is the distribution expected from DEBUCCALIZATION-1 (161); from this we can conclude that the underlying form of this suffix is -w and -h is derived:

(168) \[ \begin{align*}
waⁿʦ-Å-w & \quad loⁿb-Å-w & \text{underlying form} \\
waⁿʦ-a & \quad loⁿb-ō & \text{cycle 1 HARMONY-2: VOWEL COPY (152)} \\
waⁿʦá-w & \quad loⁿbó-w & \text{cycle 2 STRESS and SYLLABIFICATION} \\
- & \quad loⁿbó-h & \text{cycle 2 DEBUCCALIZATION-1 (161)}
\end{align*} \]

In the last two rows of (167) -w- does not appear at all, and -h- occurs in all stems, even those such as \(waⁿtsa\)- and \(wît'ë(ə)\)- which have -w- in the 3sg progressive form. Nevertheless, it is clear that if -w- were to occur in this environment in these stems it would precede harmonic -ō-, leading to a violation of the LABIAL COOCCURRENCE RESTRICTION (27). Instead, in these forms /w/ is debuccalized to /h/ when it occurs to the left of /o/:

(169) \[ \text{DEBUCCALIZATION-2: } w \rightarrow h / \_\_ o \]
Compare the derivation of $wa^{nts}ahów$ ‘they are turning’ vi., $lo^{nbhów}$ ‘they are standing’ vi. and $lo^{nbhós}$ ‘I am standing’ vi.:

(170) $wa^{nts-A-w+Aw'}~lo^{nb-A-w+Aw'}~lo^{nb-A-w+As}$ underlying form

$$
\begin{array}{ccc}
wa^{nts-a} & lo^{nb-o} & lo^{nb-o} \\
\text{cycle 1 VOWEL COPY} \\
\end{array}
$$

(152)

$$
\begin{array}{ccc}
wa^{ntsá-w} & lo^{mbó-w} & lo^{mbó-w} \\
\text{cycle 2 STRESS and SYLLAB.} \\
\end{array}
$$

(161)

$$
\begin{array}{ccc}
wa^{ntsa|w+Áw'} & lo^{nbo|h+Áw'} & lo^{nbo|h+Ás} \\
\text{non-cyclic STRESS and SYLLAB.} \\
\end{array}
$$

$$
\begin{array}{ccc}
wa^{ntsa|w+ów'} & lo^{nbo|h+ów'} & lo^{nbo|h+ós} \\
\text{non-cyclic LABIAL HARMONY} \\
\end{array}
$$

$$
\begin{array}{ccc}
wa^{ntsá|h+ów'} & — & — \\
\text{non-cyclic DEBUCC.-2} \\
\end{array}
$$

(169)

$$
\begin{array}{ccc}
\text{(blocked)} & \text{(blocked)} & — \\
\text{non-cyclic DEBUCC.-1} \\
\end{array}
$$

(161)
The derivation of $lo^{m}bohós$ shows that DEBUCCALIZATION-1 (161) applies cyclically, since after non-cyclic suffixation of $+_A$s the /w/ would no longer be tautosyllabic with the preceding /o/ and the rule could not then apply. Moreover DEBUCCALIZATION-2 (169) must precede DEBUCCALIZATION-1, since the former rule introduces the /h/ which blocks the latter rule from applying: once $wa^{ntsawów'}$ becomes $wa^{ntsahów'}$, then $wa^{ntsahów'}$ cannot further change to $*wa^{ntsahóh'}$ without violating the constraint on /hVh/ syllables.

In the verb stems $p'a-A$- ‘lie down’ and its diminutive $p'i-A$-, DEBUCCALIZATION-2 (169) interacts with PRETONIC DEVOICING (64) and DEGEMINATION (14). Consider the derivations of $p'ahó$ ‘we incl. dual lie down’ (SH peajor) and ‘we incl. plural lie down’ dim. (SH piüjoots):
Here DEBUCCALIZATION-2 and PRETONIC DEVOICING must precede DEGEMINATION, since the former two rules create the geminate /hh/ which is simplified to /h/ by DEGEMINATION.
The second circumstance in which /w(’o/) is derived by the grammar occurs in inflected numbers. As shown below, numbers may be inflected with agreement suffixes to give forms meaning, for example ‘one of them’:

\[(172a) \quad nop + Aw’ \rightarrow no|póh’ (SH nojop) \quad \text{‘one of them (people)’} \]
\[\text{one+3PL} \]

\[(172b) \quad nok’+Aw’ \rightarrow no|k’iw’ (SH noiquiw) \quad \text{‘one of them (round/square objects)’} \]
\[\text{one+3PL} \]

The stems for the numbers two, three and four end in /w/ but nevertheless are marked to trigger LABIAL HARMONY:\[^{12}\]

\[(173a) \quad ihpiw’+Aw’ \rightarrow ihpiw’+ow’ \rightarrow ihpi|wéh’ \quad \text{‘two of them’} \]
\[\text{two+3PL} \]

\[(173b) \quad m-i-arohpiw’+Aw’ \rightarrow m’i|a|roh|piw’+ow’ \quad \text{‘three of them’} \]
\[\text{three+3PL} \]
\[\rightarrow m’i|a|roh|pi|wéh’ \]
These words ending in /w′eh′/ show that stems ending in /w′/ behave like stems ending in /y/ which have the surface form /yeh′/ for y+Aw′ (165); crucially they do not behave like stems ending in /w/ which have /how′/ for w+Aw′ (170). This result follows if /C′OC′/ FRONTING (164) precedes DEBUCCALIZATION-2 (169), as shown below:

(174)  \[ \text{ih} | \text{pi} | w′+Aw′ \]  non-cyclic SYLLABIFICATION and STRESS

\[ \text{ih} | \text{pi} | w′+ow′ \]  LABIAL HARMONY

\[ \text{ih} | \text{pi} | w′+éw′ \]  C′OC′ FRONTING (164)

(inapplicable)  DEBUCCALIZATION-2 (169)

\[ \text{ih} | \text{pi} | w′+éh′ \]  DEBUCCALIZATION-1 (161)

If the order were reversed the incorrect form *ihpih′ew′ would be generated.\{A47}\}

To summarize the preceding two sections, DIMINUTIVE FORMATION (128) applies cyclically, while vowel harmony rules apply both cyclically (151,
152) and non-cyclically (142, 146) with slightly different effects. A number of other rules interact crucially with harmonic processes; the necessary orderings are reviewed below:
(175) Cyclic: Syllabification (6)

Diminutive Form. (128)

Cyclic Harmony-1 (151)

Cyclic Harm.-2: Vowel Copy (152)

Debuccalization-1 (161)

Fronting (24)

Off-gliding (28)

Non-cyclic: Syllabification (6)

Palatal Harmony (142)

Labial Harmony (143, 146)

CoC’ Fronting (164)

Debuccalization-2 (169)

Debuccalization-1 (161)

Raising (32)

Pretonic Devoicing (64)

Fronting (24)

Off-gliding (28)

Degemination (14)
4 Neutralizations in stressless syllables.

The final set of phenomena to be considered involves neutralizations occurring specifically in stressless, open syllables. For reasons of space, and because many of these show variation depending on such factors as speaker’s age, style, and rate of speech, I provide here only a brief sketch of the facts as I currently understand them. The ordinary possibilities for open syllables in non-derived forms are:

\[
\begin{array}{cccccc}
176 & a & o & i & e & i \\
\_ & + & + & (+) & + & + \\
C'\_ & C'e \sim C'ae & (+) & * & + & + \\
C\_ & + & + & (+) & * & *
\end{array}
\]

A number of these gaps have clear explanations. The vowel /i/ occurs chiefly as a result of RAISING (32, 92) in syllables closed by a palatalized consonant, but in open syllables, Proto-Huave *i shifted to /e/ in San
Mateo (Suárez 1975), leaving a synchronic gap. Similarly, /C'i/ becomes /C'i/ by FRONTING (24), and /Ci/ and /Ce/ become /C'i/ and /C'e/ by SOFTENING (25).

Open syllables derived from /C'a/ have a complicated surface distribution. Before a plain consonant, /C'a/ in an open syllable undergoes FRONTING (24) to /C'æ/ in both non-derived environments, as in s'æ|r̂yw' ‘hog-nosed skunk’, as well as in derived environments, as in a-|ⁿd'æ|k-̂yw' (← a-ⁿd'ak-aw') ‘they say’ or i-|m'æh|ts-án (← i-m'ahts-an) ‘your pl. hearts’. But before palatalized consonants an open (and therefore unstressed) syllable /C'æ/ (derived by FRONTING from /C'a/) often changes to /C'e/, as in a-n'æy-̂yw' → aⁿ'e|ŷw' ‘their possession’.

\[
(177) \text{Atonic Raising: } \quad \text{æ} \to e / C' \quad | \quad C'_{\text{A50}}
\]

This rule seems to apply more often in fast speech and for younger speakers; in careful speech, older speakers often do not raise /æ/ to /e/. Nevertheless, in roots where the syllable never surfaces as stressed and so is always
potentially subject to ATONIC RAISING, the reanalysis of underlying /C'a.C'/ to /C'e.C'/ has already occured in some words (e.g. ts'e|ts'áts' ‘Pacific screech owl’, reported as ts'ats'ats' by Suárez), while others appear in contemporary speech as doublets (e.g. s'æ|w'e|l'æt ~ s'e|w'e|l'æt ‘creature believed to live in the moon’). {A51, A52}

The four additional rules shown in (178) appear to specifically target open syllables in immediate posttonic position:

(178a) POSTTONIC RAISING: \( \ae \rightarrow [-\text{low}] / \check V C' \) __

(178b) PRE-RHOTIC RAISING: \( \ae \rightarrow [-\text{low}] / \_ \_ . r \)

(178c) POSTTONIC DEPALATALIZATION: \( C' \rightarrow C / \check V \_ \_ V \)

(178d) POSTTONIC UNROUNDING: \( V \rightarrow [-\text{round}] / \check V C \) __

POSTTONIC RAISING, for example, appears when the yes-no question clitic \( \#a \) is attached to a word-final stressed syllable, and is raised to /e/ after a palatalized consonant, as in ík'e la:v'dóh if'ê:b'\#e ? ‘Have you already bathed?’ {A53} PRE-RHOTIC RAISING applies word-medially when stressless
/æ/ precedes /ɛ/, as for example when the indefinite subject suffix -aran follows a stem ending in a palatalized consonant, as in m-ɪ-pʼakʼ+aran → mʼɪ[pʼæ|kʼɛ]rán ‘someone’s shoulder’.\{A54, A55\} POSTTONIC

DEPALATALIZATION occurs after a word-medial vowel with secondary stress:
here a palatalized consonant is normally depalatalized, as in a-lʼiŋ-'
lʼiŋʼ+ay+<' → a[lʼiŋʼ|lʼi|ŋæ|yéhʼ ‘they vibrate’ vi., where /ŋ/ depalatalizes to /ŋ/ after stressed /ɪ/.\{A56\} Finally, POSTTONIC

UNROUNDING unrounds /o/ to /a/ in immediate posttonic environments.
The effect of this rule can be seen in verbs stems which trigger LABIAL HARMONY but which have two non-cyclic suffixes, entailing that the first of these suffixes will be stressless and posttonic:

\[179a\] t-\( ^{n} \)dok+\( ^{s} \)as+\( ^{n} \)an → ta|\( ^{n} \)dò|ko|són → ta|\( ^{n} \)dò|ka|són

‘we excl. fished’

\[179b\] lo\( ^{m} \)b-A-t+\( ^{s} \)as+\( ^{n} \)an → lo|\( ^{m} \)bò|to|són → lo|\( ^{m} \)bò|ta|són

‘we excl. stood up’

\[179c\] la-\( ^{n} \)wʼitʼ-A-\( ^{w} \)+\( ^{s} \)as+\( ^{n} \)an → la|\( ^{w} \)wʼi|tʼiɔ|ho|són → la|\( ^{w} \)wʼi|tʼiɔ|ha|són

‘we excl. recently rose’ \{A57, 58\}
The penultimate syllable in the verbs above undergoes LABIAL HARMONY but is unrounded posttonically.\textsuperscript{14}[A59, 60] The action of POSTTONIC UNROUNDING can also be seen in the adaptation of many borrowings from Spanish, e.g. Sp herido = \textit{arída} (Dd \textit{àrídà}) ‘wound’, Sp oso = \textit{ósa} (Dd \textit{ósà}) ‘bear’, etc.\textsuperscript{62}

5. Summary.

5.1. Rule Summary. The complete listing of ordered rules (stated informally) can now be presented:

\textbf{Cyclic:} \textbf{SYLLABIFICATION} (6)

\textbf{STRESS} (17): Final syllable if closed, otherwise penultimate.

\textbf{MORPH. DEPALATALIZATION} (§2.3.2)

\textbf{DIMINUTIVE FORMATION} (128)

\textbf{CYCLIC HARMONY-1} (151)

\textbf{CYCLIC HARMONY-2: VOWEL COPY} (152)
DEBUCCALIZATION-1 (161): w(’) → h(’) / {e, o} ___ (tautosyllabic)

E-LOWERING (101): CéC(’) → C’ēC(’)

RAISING (92): a → i / ___ C’ (when tautosyllabic)

FRONTING (24): {a, i} → {æ, i} / C’ ___

VOICING (19): Vh → V: / ___ C (tautosyllabic);

[-son –cont] → [+voice] / V: __

OFF-GLIDING (28): Ø → ø / i ___ C’ (tautosyllabic)

ELISION-1 (112): V → Ø / e ___

ELISION-2 (117): V → Ø / ___ [V –high] (stressless)

Non-cyclic: SYLLABIFICATION (6)

STRESS (7): Final syllable if closed, otherwise penultimate.

PALATAL HARMONY (142)

LABIAL HARMONY (143, 146)

C’OC’ FRONTING (164): o → [–back] / C’ ___ C’ (tautosyllabic)

DEBUCCALIZATION-2 (169): w → h / ___ o

DEBUCCALIZATION-1 (161): w(’) → h(’) / {e, o} ___ (tautosyllabic)
Raising (32): \( a \rightarrow i / C \_ C' \) (tautosyllabic)

Softening (25): \( C \rightarrow C' / \_ \) [−back]

Voicing (19): \( Vh \rightarrow V : / \_ C \) (tautosyllabic):

\([-\text{son} -\text{cont}] \rightarrow [+\text{voice}] / V: \_\)

Pretonic Devoicing (64): \( V: \rightarrow Vh / \_ CV\)

Obstruent Devoicing (65): [−son] \( \rightarrow [−\text{voice}] / [−\text{voice}] \_\)

Fronting (24): \( \{a, i\} \rightarrow \{æ, i\} / C' \_\)

Off-gliding (28): \( Ø \rightarrow ø / i \_ C \) (tautosyllabic)

Degemination (14)

Denasalization (16): \( m'b(\'), nd(\') \rightarrow b(\'), d(\') / n \_\)

Pre-rhotic Raising (178b): \( æ \rightarrow e / \_ . r\)

Atonic Raising (177): \( æ \rightarrow e / C' \_ . C' \) (optional or fast speech)

Posttonic Unrounding (178d): \( o \rightarrow a / \_ VC \_\)

Alveopalatalization (5): \( \{s', \ts', ^ts'\} \rightarrow \{f', \tʃ', ^ʃʃ'\}\)

Posttonic Depalatalization (178c): \( C' \rightarrow C / \_ \_ V\)

Clitic group: Syllabification (6)

Elision-3 (122): \( a \rightarrow Ø / \_ \# a \) (stressless)
Fronting (24): \{a, i\} \rightarrow \{\ddot{ae}, i\} / C' ___

Posttonic Rising (178a): æ → e / \ddot{V}C' ___

5.2. Derivational opacities. As detailed in (78, 126, 175) a large number of crucial ordering relations obtain among these rules. Because space does not permit a full review of them here, I will concentrate on orderings which produce derivational opacities, that is, generalizations which cannot be made by reference to surface structure phonotactic conditions alone.

5.2.1. Opacities created by resyllabification. Several ordering relations involve rules which require reference to non-surfacing syllabification. For example the cyclic rules Voicing (19), Off-GLIDING (28), E-LOWERING (101) and Raising (92) apply only to closed syllables. But subsequent resyllabification may open the relevant syllables, obscuring the rule’s environment. In the examples below the segments of the underlying form which form the syllable triggering the rule are enclosed in parentheses; note that these do not correspond to syllables in the surface
forms. After each example a phonotactically well-formed but ungrammatical alternative ‘candidate’ output is provided:

(180a) cyclic VOICING (19) before resyllabification

\[(p'a-t)-er+AN \rightarrow p'a_d'd'a|rón, *p'ah|t'a|rón \quad \text{‘you pl. sat down’}\]

\[ (= 62, 63) \]

(180b) cyclic OFF-GLIDING (28) before resyllabification

\[ w'\!i(t'-A-r)+AN \rightarrow w'i|t'i2|rón, *w'\!i|t'i|rón \quad \text{‘you (pl.) rise’} \]

\[ (= 83a, 84) \]

(180c) cyclic E-LOWERING (101) before resyllabification

\[ (t-e-m)b+AN \rightarrow t'a^m|bán, *t'e|m|bán \quad \text{‘you pl. went’} \]

\[ (= 102e, 104) \]

(180d) cyclic RAISING (92) before resyllabification

\[ t-a-(tan)+AS \rightarrow ta|t|n'íos, *ta|ta|n'íos \quad \text{‘I asked’} \quad (= 94b, 95) \]

Similarly, DEGEMINATION can lead to resyllabification and derivational opacity:
(181) cyclic VOICING (19) and non-cyclic PRETONIC DEVOICING (64) before non-cyclic DEGEMINATION (14)

\[ a-(m'ehm')-m'ehm' \rightarrow a|m'\hat{e}|m'e:m', \ *a|m'eh|m'e:m' \ 'pats' \]

(= 73a, 74)

As with all cases of opacity, the changes occurring in the underlying form cannot be due solely to surface phonotactics. For example, in (180a) and (181) long vowels unexpectedly appear in open syllables on the surface; ordinarily open syllables have only the devoiced /Vh/ alternant no matter where they occur in the word:

(182a) \[ t-a-l'ihp'its'+As+An \rightarrow ta|l'\bar{h}|p'\hat{i}|ts'\hat{a}|s\acute{a}\hat{n} \ 'we incl. put a little bit on, dabbed' \]

*\[ ta|l'\hat{e}|b'\hat{i}|ts'\hat{a}|s\acute{a}\hat{n} \]

(182b) \[ la-m-a-tohko^m_b-Aw' \rightarrow la|ma|toh|ko|^m\hat{b}\acute{w}' \ 'they have already dulled (e.g. my machete)' \]

*\[ la|ma|to\hat{h}|ko|^m\hat{b}\acute{w}' \]
Similarly, as a result of the ordering in (180b) the off-gliding nucleus /iə/ unexpectedly appears in surface open syllables; ordinarily /i/ followed by a heterosyllabic plain consonant has no off-glide, as shown in (29). Indeed it is only as a result of resyllabification that long vowels or /iə/ appear in open syllables.

In (180c, 180d) the changes /e → a/ and /a → i/ cannot be conditioned by surface structure syllabification because open syllables with /e/ and /a/ are also well-formed on the surface.

5.2.2. Opacities induced by stress clash deletion. In some derivations cyclic E-LOWERING and ELISION-2 refer to stress properties which are removed by the loss of stress under stress clash:

(183a) cyclic E-LOWERING (101) before noncyclic STRESS

$$t-e^{m}b+An \rightarrow t'_{\overline{a}}^{m}bán, \ast t'e^{m}bán \quad \text{‘you pl. went’ (}=102e, 104)$$
(183b) cyclic ELISION-2 (117) before noncyclic STRESS

\[ la-a^{-mb+\hat{w}'} \rightarrow la|a|^{mb\hat{w}'} , \,*la|^{mb\hat{w}'} \text{ ‘they (recently) went’} \]

\[ (= 121, 125) \]

In (183a) /e/ lowers to /æ/ under stress, but this stress is subsequently deleted because it is adjacent to the word-final stress added later. In (183b) the /a/ of the prefix la- does not delete before stressed /a/ in áᵐᵇ, but when stress shifts to the final syllable the form la|a|^{mb\hat{w}'} shows unexpected surface hiatus.

5.2.3. **Counterbleeding orders.** Finally, certain counterbleeding orders create interesting effects:

(184a) cyclic E-LOWERING (101) before non-cyclic SOFTENING (25)

\[ t-e-t' \rightarrow t'ât', \,*t'ët' \text{ ‘you sg. ate’} \]

\[ \text{cf. } t'e-a-t' \rightarrow t'ët' \text{ ‘s/he ate’ vi. (}= 115b, 116) \]
(184b) **DEBUCCALIZATION-2** (169) before **POSTTONIC UNROUNDING**

(178d)

\[ \text{la-}*\text{w}i\text{t'}*\text{a-w}\text{+as+an} \rightarrow \text{la-}*\text{w}i\text{t'}*\text{a}\text{ha}s\text{ôn}, \]  

\[ *\text{la-}*\text{w}i\text{t'}*\text{a}\text{wa}s\text{ôn} \]

\[
\text{‘we excl. recently rose’} \ (= 179c)
\]

In \textit{t-e-t’} ‘you sg. ate’ in (184a), if **SOFTENING** (25) were to apply first, then \textit{t’et’} would be produced and **E-LOWERING** (101) — which applies only after a plain consonant — would incorrectly fail to apply; cf. phonotactically well-formed \textit{t’et’} ‘s/he ate’ vi. where there is no E-LOWERING. In (184b) **DEBUCCALIZATION-2** (169) must change \textit{/wo/ to /ho/} before **POSTTONIC UNROUNDING** (178d) changes the \textit{/o/ to /a/}. The alternative  

\[ \text{\textit{la-}*\text{w}i\text{t'}*\text{a}\text{wa}s\text{ôn}}, \text{with surface /wa/}, \]  

would be phonotactically fine but is ungrammatical.

**5.3. Conclusion.** In sum, the grammar proposed here, aside from correctly deriving the surface forms and numerous surface-opaque generalizations, has in addition the advantage of linking many rule ordering relations to the difference between cyclic and non-cyclic rule applications,
which is in turn correlated with a clear-cut distinction between cyclic and non-cyclic affixes and to the morphological structure of complex words.

Fruitful avenues of future research will include studying not only the (often subtle) differences between the San Mateo dialect and its neighbor dialects, but also changes in the grammar of younger speakers, many of whom increasingly rely on Spanish for complex communicative tasks and no longer fully control the intricate phonology of older speakers.
REFERENCES


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A.1. Figure 1 shows the first and second formant values for various vowels pronounced by an adult male speaker. The utterance tokens studied included 122 different words pronounced in closed, stressed syllables with coronal or velar coda consonants. For simplicity, syllables with labial codas were excluded since the palatalized/plain contrast is ordinarily neutralized here on the surface (§1.1.2). The notation C means a non-palatalized consonant and the notation C’ means a consonant with secondary palatalization. Formant measurements were made at vowel midpoint using Praat software; the error bars show 95% confidence intervals.

As can be seen in Figure 1, for this speaker surface [æ] is significantly more front than [a]. Similar results were obtained for two other speakers. On this basis I conclude that although previous studies have not recognized a surface distinction between [a] and [æ] the phonetic data support this categorization. Nevertheless, because the distribution of [æ] is entirely predictable, in phonological representations I will henceforth always write
/a/ unless the difference between the front and back allophones of this segment is directly relevant to the discussion.

Figure 1 also shows that the off-glide in [ia] is considerably more front than unambiguously central [a] and [i], but not as front as front [e]. Thus it could be transcribed as either [ə] (as here) or as a backed version of [e], i.e. [ë] (as Suárez 1975 writes). Finally [i] is of about the same height as mid [e] and [o], and so might equally be construed as [ɔ]; for example, PW write [ʌ], whereas Stairs and Hollenbach (1969) instead write [ɨ]. Because [i] behaves phonologically as [+high] (see §1.4.2), I will analyze this segment phonologically as /i/ in what follows.

A.2. Additional minimal pairs
   a.  n’ol ‘why’ ≠ n’ol’ ‘doll’
   b.  “d’o:g ‘termite’ ≠ a”d’o:g’ ‘cuts’ v.
   c.  ahot’ ‘it rains’ ≠ ahot ‘digs’ v.
   d.  aol ‘beats’ v.  ≠ aol’ ‘hitches, ties’ v.

A.4. For example, SS write anood, alood, and atsood for ano:d’ ‘snatches, uproots’, alo:d’ ‘makes a hole in’, and atso:d’ ‘squeezes, crushes out’, where anooid, alooid and atsooid would be the expected spelling for a final /d’/.

A.5. Effects of historical apocope

   a. B ashewy  PH *na-sìyi > na-s’ey  ‘man’
   b. P guieje  PH *kèhe > k’eh’  ‘blood’
A.6. Closed syllable resulting from historical reanalysis

a. \textit{sam}|piy, \textit{cf. F sanapay} ‘coyote’

\textit{cf. piy} ‘hooded skunk’

A.7. Degemination


(SSachaachaach)

b. \textit{al-lats-a-m} $\rightarrow$ \textit{a|la|tsam} ‘is spread out’ (SH alatsam)

A.8. Stress on final closed syllable

\textit{lol}|ᵑɡán} ‘type of large ant’, \textit{ka|wák} ‘sapodilla’, \textit{s’a|ríw} ‘western hog-nosed skunk’, \textit{ka|h’ól} ‘black mangrove’, \textit{g’i|n’y} ‘banana’, \textit{ts’i|p’ín} ‘tomato’, \textit{s’e|w’e|lát} ‘creature believed to live in the moon’

A.9. Stress on penult when final syllable is open

\textit{há|n’e} ‘who?’, \textit{s’i|k’e} ‘I’, \textit{k’ó|ta} ‘sidekick, friend’ (pejorative)
A.10. VOICING (formal statement):

a. 

```
   RHYME
     /\  \\
    V   V  C
   /   +voice
   /\  -voice
```

b. 

```
   RHYME
     /\  \\
    V   V  [-son]
   /   +voice
   /\  -voice  -cont
```

A.11. Common closed syllable types (additional examples)

a. oC  

```
ok  ‘coyol palm’,  om  ‘sweet potato vine’
```

b. C'oC  

```
t’sok  ‘ant’,  t’oŋ  ‘toad’,  yoŋ  ‘mange’,  l’ow  ‘corn cooked
to make atole’
```

c. CaC  

```
haw  ‘chin’,  ”tsah  ‘chewing gum’,  nal  ‘great lead tree (Sp
tepeguaje)’,  wa:l  ‘sugar-apple (Sp anona)’,  tsak  ‘thigh;
elephant ear tree (Sp guanacaste)’,  na:b  ‘drum’,  sat5
```
‘spine’, kaw ‘macaw sp. (Sp guacamayo)’, lal ‘immature flathead mullet (fish sp., Sp lisa)’

d. CoC  
nots ‘one’, poh ‘turtle’, kos ‘malaria’, pop ‘lungs’, sow ‘pig’, hot ‘sharpening stone’, kop ‘black sapote (type of persimmon)’, kow ‘stone for grinding grain (Sp metate)’, mow ‘lubber grasshopper (Sp chapulin), ”dok ‘type of fish net (Sp atarraya)’, ”dop ‘small carved container or cup (Sp jícara de apaxtle)’, ”don ‘popollote (fish sp.)’, ro:b ‘Orion’

e. CoC’  

f. CiC’  
'fish', tip' ‘wart’, nis' ‘girl’, kiy ‘salty lowland’, him'

crocodile'
g. C'eC' k'eh' ‘blood’, d'el’ ‘membrane’, k'e:d’ ‘type of shirt’, n'eh'
‘he, she, it’, ts'ep' ‘type of woven basket without
handles', s'em'b' ‘pumice’, ts'ep' ‘molar tooth’, l'es'
’dolphin’, g'es’ ‘mourning dove’, t'en' ‘cherry’, t'el'
‘turkey’
h. C'iC' l'il' ‘pastel tree lizard’, ts'il’ ‘needle; black mojarra (fish),
n'in' ‘sand fly’, n'it' ‘palm tree’, m'il’ ‘flathead mullet
(fish’), k'il’ ‘orange-fronted parakeet’, w'in' ‘hawksbill
turtle’, s'ik’ ‘me’, s'is’ ‘mosquito’, k'is' ‘little’, h'iw'
‘breast’, p'il’ ‘monkeypod tree’

A.12. a. C'aC → C'æC  k'æt ‘rod used to separate threads in a loom’,
    s'æk ‘kind of sea turtle (Sp tortuga carey)’

b. C'aC' → C'æC'  m'b'æy ‘corn cob’, ts'æt’ ‘shin’
c. C'iC → C'iæC  b'iæb’ ‘fire’, tiæk ‘hill’, ts'iæk ‘silver mojarra (fish
sp.)’, p'iaw ‘snook (fish sp., Sp róbalo), s'iæm
‘false katydid (Sp chapulín verde), t’iəl ‘in’,

ts’iəŋ ‘periwinkle’, w’iəl ‘gray fox’

A.13. FRONTING (formal statement):

\[ \sigma \]

\[
\begin{array}{c}
C \\
\longrightarrow \\
V \\
\end{array}
\]

\[-\text{back} \quad +\text{back} \quad +\text{back} \quad -\text{round}\]

A.14. SOFTENING (formal statement):

\[
\begin{array}{c}
C \\
\longrightarrow \\
V \\
\end{array}
\]

\[+\text{back} \quad -\text{back}\]

A.15. OFF-GLIDING (formal statement):

\[\text{RHYME}\]

\[
\begin{array}{c}
V \\
\longrightarrow \\
C \\
\end{array}
\]

\[+\text{high} \quad -\text{back} \quad \emptyset \quad +\text{back}\]
A.16. Historical reflexes of PH \( \text{CaC}_1 \)

SMo \( \text{nis}^{\prime} \) ‘girl’, F \( \text{naf} < \text{PH *nas}^{\prime} \) ‘name’, F \( \text{nat}^{\prime} < \text{PH *nat}^{\prime} \)

*\( \text{nati} \), SMo \( \text{tit}^{\prime} \) ‘cocoplum’, F \( \text{tjf} < \text{PH *tats}^{\prime} \), SMo \( \text{kin}^{\prime} \) ‘honey

bee’, F \( \text{kan}^{\prime} < \text{PH *ka:m}^{\prime} \)

A.17. Raising in borrowings from Spanish

a. \( \text{altar} = *\text{artal} \) (metathesized) > \( \text{artil}^{\prime} \) ‘altar’

b. \( \text{caballo} = *\text{kawayo} > *\text{kaway} > \text{kawiy} \) ‘horse’

c. \( \text{costal} = *\text{kostal}^{\prime} > \text{kostil}^{\prime} \) ‘sack’

d. \( \text{macho} = *\text{mas}^{\prime}o > *\text{mas}^{\prime} > \text{mits}^{\prime} \) ‘male’

A.18. RAISING (formal statement):

\[
\begin{array}{c}
\sigma \\
\downarrow \\
C \\
\downarrow \\
+\text{back} \\
\downarrow \\
+\text{low} \\
\downarrow \\
V \\
\downarrow \\
+\text{high} \\
\end{array}
\]

\[
\begin{array}{c}
\downarrow \\
C \\
\downarrow \\
-\text{high} \\
\end{array}
\]
A.19. The prefix/infix -h- is labeled ‘valence’ because it sometimes transitivizes intransitive stems and sometimes intransitivizes transitive stems.

A.20. Ablaut of the theme vowel in the 2nd person

a. \( t-e-im \rightarrow t'e\text{ím} \) ‘you sg. groaned’

PRET-TH2-groan

A.21. Stressless enclitic

a. \( a-kil'+aw\#an \rightarrow akil'i\text{w'an} \) ‘they are just waiting’

TH-wait+3PL#only

A.22. OFF-GLIDING before a non-cyclic suffix

a. \( s-a-n'i\#g+\text{an} \rightarrow sa|n'i\text{w}|g\text{án} \) ‘our (excl.) home’

1-TH-home+PL
A.23. RAISING of +aw' derived by VOWEL HARMONY from +Aw' 

a. \( m-i-sow + Aw' \rightarrow m-i-sow + Aw' \rightarrow m'i|so|iw' \) ‘their pig’

b. \( o^m bas + Aw' \rightarrow o^m bas + aw' \rightarrow o|bas|iw' \) ‘their heads’

A.24. MORPHOLOGICAL DEPALATALIZATION bleeds RAISING

a. \( a-tan' \rightarrow a-tin' \) ‘asks, requires, collects’ vt.

a'. \( a-tan' \Rightarrow a-h-tan \) ‘is required, collected’ vi. (SS ajtan)

A.25. cyclic RAISING (formal statement):

```
       o
      / \    
     V   C
   /   |    
+back \-high +high

   +low
```

A.26. Resyllabification of RAISING-triggering coda by non-cyclic suffixation

a. \( s-a-nahp' + an \rightarrow sa|nih|p'íən \) ‘we excl. buy’

b. \( a-nahp' + ay \rightarrow a|nih|p'ey \) ‘it sells’ vi. (Sp ‘se vende’)

A.27. Absence of RAISING before the causative suffix

a. \(a-m^b\text{ay}-i:ts'\) ‘frightens’ vt.
b. \(s-a-n^d\text{ar'}-i:ts'\) ‘I erase, cross out’ vt.
c. \(s-a-sahr'-i:ts'\) ‘I disturb, disperse’ vt.

A.28. But these roots, unlike those in (100) and A27, do have non-causative stems with prefixal themes (\(i-m^b'\) ‘already’, \(a-si:d'\) ‘leans’ vi., \(a-wiy\ o-m^b\text{as}\ ‘accuses, slanders’), making them prima facie counterexamples to this correlation. But the relationship between the two stems in these cases is apparently not transparent enough to allow the non-causative stems to be the bases for the causatives. Specifically, \(i-m^b'\) functions as an auxiliary verb; \(a-si:d'\) has a long vowel but \(a-sa't'-i:ts'\) does not, and \(a-wiy\) does not occur alone but always in a fixed expression with the object \(o-m^b\text{as}\).

A.29. Intransitive stems with suffixal theme vowel whose causative counterparts fail to undergo RAISING

a. \(m^b\text{ay'-á-m}\) ‘is scared’
b. "dahr'-iɔ-m  'disperses, dissolves' vi.

c. sahr'-iɔ-m  'disperses, is disturbed' vi.

A.30. E-LOWERING (cyclic; formal statement)

A.31. Nevertheless, historical evidence shows that the process of E-LOWERING (101) was once active even in non-derived forms. For example, borrowings from Spanish with vowel /e/ show that E-LOWERING applied after the general loss of word-final vowels (§1.4.2): Sp mecha = m'áts' 'wick' (SS meach), Sp sartén = s'ort'án ‘frying pan’ (SS xortean), Sp panela = pan'ál ‘brown sugar’ (SS paneal), Sp machete = mats'át' ‘machete’, Sp chechén = ts'ets'án ‘poison ivy’ (SS chechan).
A.32. Hiatus before a stressless vowel

a. $m-i\text{-}on\text{'}iw' \rightarrow m'i|o|n'iw'$
   ‘his/her/its/your sg. tongue’

   PERS-TH-tongue

b. $m-i\text{-}on\text{'}iw'+Ahts \rightarrow m'i|o|n'iw'|w\text{'æ}ts$
   ‘our incl. tongues’

   PERS-TH-tongue+INCL1PL

A.33. Examples of ELISION-1

a. $t'e-a-k\text{'}ir \rightarrow t'e|k\text{'}ir\text{'e}r$
   ‘(s)he ran’

   PRET-TH-run

b. $t'e-a-o\text{'g} \rightarrow t'e\text{'g}$
   ‘it produced fruit’

   PRET-TH-fruit

A.34. Examples of ELISION-2

a. $la\text{-}er\text{-}\text{'}b\text{'}ol \rightarrow l'er\text{'}b\text{'}ol$ (SH lermbeol)
   ‘you were (recently) afraid’

   REC-TH2-fear
b. \( la-a-h'\text{tsop nit'} \rightarrow lah|\text{tsóp nit'} \)

\( \text{REC-TH-rise day} \)

\( \text{the sun has just risen} \)

A.35. Examples of ELISION-3

a. \( t'a\#a-\text{mb+Aw'} \rightarrow t'a|\text{mbówiw'} (\text{SH teambůw}) \)

\( \text{PROG#TH-go+3PL} \)

\( \text{they are going} \)
A.36. Diminutive Formation

<table>
<thead>
<tr>
<th>root</th>
<th>diminutive</th>
<th>example</th>
</tr>
</thead>
<tbody>
<tr>
<td>C'aC'(aC') C'iC'(iC')</td>
<td>-kʷ'ahts'</td>
<td>-kʷ'ihts'</td>
</tr>
<tr>
<td>CoC' C'eC'</td>
<td>-ⁿts'ohl'</td>
<td>-ⁿts'ehl'</td>
</tr>
<tr>
<td>CoC(oC) C'eC'(eC')</td>
<td>-sohno⁀</td>
<td>-s'ehn'e⁀g⁀'</td>
</tr>
<tr>
<td>CaC(aC) C'iC'(iC')</td>
<td>-palat</td>
<td>-p'il'it'</td>
</tr>
<tr>
<td></td>
<td>-lats</td>
<td>-l'its'</td>
</tr>
</tbody>
</table>
A.37. Harmonic /a/ after stems ending in /iC/ 

a. ap'iw'+aw' → ap'iw'áw' → ap'iw'áw' ‘they remove seeds’

b. t-a-li'g'-li'g'+as → tal'ig'li'g'ás → tal'ig'li'g'á só ‘I moved, shook’ vt.

A.38. Fronting feeding Vowel Harmony 

a. a-l'a'g'-its'+aw' → a|l|x'g'i|ts'éw' ‘they straighten’ vt.

b. a-ts'ik'-hhs'+aw' → a|ts'i|k'ih|ts'éw' ‘they hoist a bundle with the body’

A.39. Vowel Harmony feeding non-cyclic Raising 

a. la-a-ka's+aw' → la|ka|'ts+áw' → la|ka|'tsíw' ‘they (recently) turned red’

A.40. San Mateo vs. Santa María harmony after stems in /iC/ 

a. SMa mok'ik+i:á s ‘we incl. laugh’

≠ SMo tak'ik'+á s ‘I laughed’
b. SMa maⁿdilil+ição  ‘we incl. return’

≠ SMo aⁿd'ilil'+á:ts  ‘id.’

A.41. Labial Harmony Triggered

a. s-َا-sًاg+on → sa|osomalgón  ‘we excl. dye’ vt.

A.42. No Labial Harmony Triggered

a. a-َا-ho|^ts+aw' → a|hosaltsiw'  ‘they scratch’

b. a-solo|^p+aw' → a|solo|^píw'  ‘they sprinkle’ vt.

A.43. Variation in application of LABIAL HARMONY

a. la-hpos+îw'  ‘they go pale’, but reported as -o- in SS

b. a-ton-ton+îw'  ‘they go to pieces, fall apart’, but reported as -o- in SS

c. m'i-poh+ó:ts ∼ +á:ts  ‘our turtle’ (varies by speaker)

A.44. Santa María vs. San Mateo LABIAL HARMONY

a. SMa ma-a-so'oh+ó:s  ≠ SMo a-so'oh+á:ts  ‘we incl. relax’
A.45. Besides the suffixal theme vowel, two other cyclic affixes show harmonic behavior. First, the causative suffix \(-i(h)ts'\) usually shows a variant \(-o(h)ts'\) after roots with the vowel /o/: \(a-mo'g-ots'\) ‘passes’ vt., \(a-tok-o:ts'\) ‘makes something drip’, \(a-tsop-ots'\) ‘stains’ vt. (Participial uses of \(-its'\), such as \(na-ol-its'\) ‘mixed’ and \(a-ro'ⁿ-its'\) ‘is hung’, do not show this labial harmony, however.) The one exception \(akow-its'\) ‘uses for the first time, breaks (something) in’ cannot have the suffix with /o/ since the resultant form \(*akow-ots'\) violates the Labial Cooccurrence Restriction (27).

Second, the infix \(-rA-\) follows a pattern similar to that of the suffixal theme vowel: \(a-t'i-r'i-p'\) ‘is shown’, \(a-h'e-r'e-p'\) ‘gets a haircut’, \(a-ha-ra-w\) ‘is eclipsed, eaten up’, \(a-s'o-ra-m\) ‘is met’, \(a-ⁿdo-ro-k\) ‘is fished’. Usually the infix has a copy of the preceding vowel as expected by Cyclic Harmony-2 (152), but the default value /a/ appears after some roots with vowel /ia/ (\(n-aⁿ-d'iⁿ-ra-m\) ‘favorite’) and most (but not all) roots with vowel /o/, in a pattern reminiscent of non-cyclic Labial Harmony.
A.46. DEBUCCALIZATION(-1) (formal statement):

<table>
<thead>
<tr>
<th>V</th>
<th>C</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>‡</td>
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<tr>
<td>Place</td>
<td>Place</td>
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<td>Dors</td>
<td>Lab</td>
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</tbody>
</table>

A.47. The form ihpiór ‘the two of us incl.’ (from ihpiw'+Ar) presents further complexities. Here C'OC' FRONTING (164) is not operative, since the suffix ends in a plain consonant. However after /i/ and before /o/ it appears that /w/ is deleted entirely instead of debuccalized. The surface form has hiatus with no trace of /w/: ih|pi|ór.

A.48. FRONTING in open syllables

a. a-|k'|xh|w-á:ts  ‘we incl. split (something) in two’

b. o-h|p'x|k-íw'  ‘eight’
A.49. ATONIC RAISING (variable application)

a. $a-k'a^n'd'-\text{w}' \rightarrow a-k'æ^n'd'-\text{w}' \rightarrow a|k'e|\text{r}'d\text{'}\text{w}'$  
   ‘they cover, plaster’

b. $s-a-p'as'-\text{í}ɔn \rightarrow s-a-p'æs'-\text{í}ɔn \rightarrow sa|p'e|s'íɔn$  
   ‘we excl. weigh’

c. $m-i-p'ak'-\text{í}w' \rightarrow m-i-p'æk'-\text{í}w' \rightarrow m'i|p'e|k'íw'$  
   ‘their shoulders’

d. $sa-n-a-yar'-\text{í}ɔn \rightarrow sa-n-a-yær'-\text{í}ɔn \rightarrow sa|na|yɛ|r'íɔn$  
   ‘we excl. will catch, get’

e. $s-a-m'ay'-\text{í}ɔn \rightarrow s-a-m'æy'-\text{í}ɔn \rightarrow sa|m'e|yĩɔn$  
   ‘we excl. sleep’

f. $a-k'a^n'd'-\text{í}:츠 \rightarrow a|k'æ|\text{r}'d\text{'}:츠$  
   ‘we incl. cover, plaster’

g. $a-h-t'an'-\text{í}w' \rightarrow ah|t'æ|n'íw'$  
   ‘they fall’

h. $a-kr\text{'}at'-\text{á}y \rightarrow a|kr'æ|t'áy$  
   ‘divorces’

A.50. ATONIC RAISING (formal statement):

$[-\text{back}] \rightarrow [-\text{low}] / C' __ | C'$
A.51. **ATONIC RAISING** (reanalysis complete)

a. \( ^{v}T's'e\|l' \text{ál}' \), cf. SS nchaleail ‘the evil eye’

b. \( w'e\|r' \text{é}^{nd}' \), *\( w'\text{æ}\|r' \text{æ}^{nd}' \), cf. SS wearreand ‘hanging to one side’

**ATONIC RAISING** (reanalysis in progress)

c. \( s'\text{æ}\|w'e\|l' \text{é}t \sim s'e\|w'e\|l' \text{é}t \) ‘creature believed to live in the moon’

d. \( Ts'\text{æ}\|k' \text{ét}' \sim Ts'e\|k' \text{ét}' \) ‘jacket’ (< Sp chaqueta)

e. \( h'\text{æ}\|g' \text{é}n \sim h'e\|g' \text{é}n \) ‘bent, folded’

f. \( l'\text{æh}\|k' \text{áen} \sim l'e\|k' \text{áen} \) ‘open’

g. \( Ts'\text{æh}\|p' \text{áen} \sim Ts'\text{eh}\|p' \text{áen} \) ‘hot, burning (courage)’

A.52. In addition, open syllables of the type /C'o/ are rare in non-derived forms, and of the four clear cases I know of, two have variant forms without /C'o/: \( s'o\|w' \text{í}y \sim s'e\|y' \text{é}y \) ‘very much’, \( a\|T's'o\|p' \text{ál} \sim a\|T's'\text{æ}\|p' \text{ál} \) ‘(hair) ribbon’

(SS anchopal, anchapal), \( s'o\|d' \text{íy} \) ‘Jews’ (< Sp judíos, SS xodiy),

\( n'e\|s'o\|w'a\|d' \text{íy} \sim d' \text{ík} \) ‘sloughed-off snake skin’ (SS nexowandüy ndiüc).
A.53. POSTTONIC RAISING of clitic #a to /e/ after /C'/

a. ... mat'ów naw'í:g'#e? ‘... in order to read?’

b. ... ʧ'áw popól'#e? ‘... foam atole?’

c. ... f'et'êt'#e ‘... my father?’

d. ... i'v'dokón t'i'ém'#e? ‘... you pl. fished for shrimp?’

e. ... nap'éw'#e ‘... daughter-in-law?’

vs. POSTTONIC RAISING of clitic #a inapplicable after /C/

f. i'v'd'óm#a? ‘Do you sg. want?’

g. i'v'd'óm ao'g kawák#a? ‘Do you sg. want a sapodilla fruit?’

h. ... t'i'l t'i:ød#a? ‘... in the road?’

i. ... para mara'gy y nah'ít#a? ‘... to do work for him?’

j. ... f'ek'ál#a? ‘... (to) my son?’

k. f'ow'íy i'v'd'óm m'etsóh#a? ‘Do you like playing very much?’

A.54. PRE-RHOTIC RAISING after /C'/

a. nit'+aran → m'|t'e|rán ‘someone’s name’

b. o-t'éy'+aran → o|t'é|g'ẽ|rán ‘someone’s abdomen’
c.  \textit{o-wis'+aran} \rightarrow \textit{o\,|\,wì\,|\,s'e\,|\,rán}  \\
\textit{‘someone’s hand’}

d.  \textit{o-n'iw'+aran} \rightarrow \textit{o\,|\,n'i\,|\,w'e\,|\,rán}  \\
\textit{‘someone’s tongue’}

vs. no \textbf{PRE-RHOTIC RAISING} after /C/

e.  \textit{m-i-noh+aran} \rightarrow \textit{m\,|\,i\,|\,nò\,|\,hà\,|\,rán}  \\
\textit{‘someone’s spouse’}

f.  \textit{s-a-m'b'ol+aran} \rightarrow \textit{sa\,|\,m'b'ò\,|\,la\,|\,rán}  \\
\textit{‘someone helps me’}

g.  \textit{o-mal+aran} \rightarrow \textit{o\,|\,mà\,|\,la\,|\,rán}  \\
\textit{‘someone’s head’}

**A.55.** \textbf{PRE-RHOTIC RAISING} can be seen in one other environment shown in (a) below. Here cyclic \textbf{E-LOWERING} lowers /e/ to /a/ in \textit{-wa'tsam'ar}, but non-cyclic rules shift stress to the final syllable. The /a/ becomes /æ/ by \textbf{FRONTING} and then optionally raises to /e/, giving \textit{ap#wa'tsam'erón}:

\begin{itemize}
  \item a.  \textit{ap#wa'tls-\textsc{a}-m-ɛɾ+an} \rightarrow

  \textit{ap\,|\,wa\,|\,tsa\,|\,m'ɛ\,|\,rón} \sim \textit{ap\,|\,wa\,|\,tsa\,|\,m'ɛ\,|\,rón}  \\
  \textit{‘you pl. will turn’ vi.}
\end{itemize}
b. \(wa|^\text{tsa}|m-\acute{e}r\) \(wa|^\text{tsa}|m-\acute{e}r\) cycle 3 Stress and Syllabification

\(wa|^\text{tsa}|m\acute{a}\acute{r}\) \(wa|^\text{tsa}|m\acute{a}\acute{r}\) cycle 3 E-lowering (101)

— \(wa|^\text{tsa}|m|\acute{a}|r+\acute{\text{o}}n\) non-cyclic Stress, Syllab.

Harmony

\(wa|^\text{tsa}|m\acute{\text{e}}\acute{r}\) \(wa|^\text{tsa}|m\acute{\text{e}}|r+\acute{\text{o}}n\) non-cyclic Fronting (24)

— \(wa|^\text{tsa}|m|\acute{e}|r+\acute{\text{o}}n\) (optional) non-cyclic Pre-Rhotic Raising (178b)

In non-suffixed \(wa|^\text{tsa|m}\acute{\text{e}}\acute{r}\) (at left above), however, Pre-Rhotic Raising does not apply and the final vowel remains /\(\text{æ}/\) under stress.

A.56. Posttonic Depalatalization

a. \(a\text{-soh}^d^\prime+ay+a\text{w}^\prime\) \(a|\text{sò}|^d\acute{\text{x}}|\text{yéh}'\) ‘they undress’ vi.

b. \(t\text{-a}^-\text{ts}^\prime\text{ehl}'+\text{a}s+\text{a}n\) \(ta|^\text{ts}^\prime\text{è}|\text{x}|s\acute{\text{n}}\) ‘we excl. inclined’ vt.

c. \(l\text{a}^-\text{a}^-\text{k}^\prime\text{at}'+\text{a}y+a\text{w}^\prime\) \(l\text{a}|k^\prime\text{x}|t\acute{\text{x}}|\text{yéh}'\) ‘they divorce’ vi.

d. \(t\text{-a}^-\text{tan}'+\text{a}s+\text{a}n\) \(t\text{a}|\text{ñ}|n\acute{\text{x}}|s\acute{\text{n}}\) ‘we excl. asked for’ vt.
A.57. Posttonic Unrounding

(a) \( t-a-mo^g+as+an \rightarrow ta|m|o|\bar{g}|o|s\bar{on} \rightarrow ta|m|o|\bar{g}|a|s\bar{on} \)

‘we excl. passed’ vi.

(b) \( t'a|^m|\bar{b}-a-w+as+an \rightarrow t'a|\bar{l}|o|^m|b\bar{ö}|h|o|s\bar{on} \rightarrow t'a|\bar{l}|o|^m|b\bar{ö}|h|a|s\bar{on} \)

‘we excl. are standing up’

(c) \( t-a-so^g+as+an \rightarrow ta|\bar{s}|o|\bar{g}|o|s\bar{on} \rightarrow ta|\bar{s}|o|\bar{g}|a|s\bar{on} \)

‘we excl. dyed’

A.58. The underlying quality of the vowel is crucial in the derivation of

\( lawit'it'e\bar{h}as\bar{on} \) (179c) since the /o/ triggers DEBUCCALIZATION-2 prior to being unrounded:

\[
\begin{align*}
\text{w'i|t'i-w} & \quad \text{cycle 2 STRESS and SYLLABIFICATION} \\
\text{w'i|t'i-\bar{w}} & \quad \text{cycle 2 OFF-GLIDING (28)} \\
\text{la-|w'i|t'\bar{e}w} & \quad \text{cycle 3}
\end{align*}
\]
\[ la|w'|t'i\partial|w+A|s+\acute{n} \]  non-cyclic STRESS and SYLLABIFICATION

\[ la|w'|t'i\partial|w+o|s+\acute{n} \]  non-cyclic LABIAL HARMONY

\[ la|w'|t'i\partial|h+o|s+\acute{n} \]  non-cyclic DEBUCCALIZATION-2 (169)

\[ la|w'|t'i\partial|h+a|s+\acute{n} \]  non-cyclic POSTTONIC UNROUNDING (178d)

A.\textnumero59. The non-cyclic part of the derivation of \( ta^d\text{"}d\text{"}kas\text{"}n \), for example, is shown below:

\[ ta|d\text{"}d\text{"}|k+A|s+\acute{n} \]  STRESS and SYLLABIFICATION

\[ ta|d\text{"}d\text{"}|k+o|s+\acute{n} \]  LABIAL HARMONY

\[ ta|d\text{"}d\text{"}|k+a|s+\acute{n} \]  POSTTONIC UNROUNDING (178d)

A.\textnumero60. Although forms such as \( ta^d\text{"}d\text{"}kas\text{"}n \) are generally preferred by older speakers, and are the only forms reported in earlier literature, many speakers also accept or prefer the type \( ta^d\text{"}d\text{"}kas\text{"}n \) with unrounding of both the posttonic /o/ and the following stressed /o/. Doublets such as the following are not uncommon:
a. taⁿdòkasón ~ taⁿdòkasán ‘we excl. fished’
b. tamòⁿgasón ~ tamòⁿgasán ‘we excl. passed’
c. loⁿbòtasón ~ loⁿbòtasán ‘we excl. stood up’
d. tasòⁿgasón ~ tasòⁿgasán ‘we excl. dyed’

For these speakers it appears that unrounding of the posttonic vowel entails unrounding of following vowels where these are linked to the same [+round] feature:

\[
\begin{array}{cccccccc}
t & a & n & d & o & k & o & s & o & n \\
C & V & C & V & C & V & C & V & C
\end{array}
\]

[+round]

In other words, these speakers do not tolerate [+round] linked to non-adjacent vowels where the intermediate vowel could, at least potentially, be an anchor for [+round] as well. When [+round] is delinked from the intervening stressless /o/, to satisfy locality conditions (Archangeli and
Pulleyblank 1994) it must also be delinked from the following /o/, even though this /o/ is stressed.

A.61. Absence of Unrounding in pretonic position

a. $a|^{ts}o|r|w'$
   ‘they bark’

A.62. As shown below (a-i), in those borrowings in which word-final vowels are not deleted, a final (and hence posttonic) /o/ becomes /a/ (except in completely unassimilated words); but pretonic /Co/ is almost always unchanged (j-q):

**Posttonic Unrounding in Borrowings**

a. Sp herido = aríada (Dd àrídà) ‘wound’

b. Sp oso = ósa (Dd ósà) ‘bear’

c. Sp toro = tóra (Dd tórà) ‘bull’

d. Sp apellido = peída (SS peída) ‘surname’

e. Sp arado = erída (SS erada) ~ aríada (Dd àrádà) ‘plow’
f. Sp cuñado = *koniáda* (SS coniada) ‘sibling-in-law’

g. Sp anisado = *nisáda* (KS nisada) ‘anisette’

h. Sp enero = *enéra* (Dd ènérà) ‘January’

i. Sp lado = *láda* (KS lada) ‘side’

vs. No **UNROUNDING** in Pretonic Position in Borrowings

j. Sp común = *komón’* (SS comoen), *komón* (Dd còmón) ‘common’

k. Sp todavía = *todabíy, tobíy* (Dd tôdàbíy, tôbíy) ‘still’

l. Sp chapopote = *ts’apopót* (SS chapopot) ‘tar, asphalt’

m. Sp chocolate = *ts’ikolüt’* (SS chicolüt) ‘chocolate’

n. Sp morado = *n’e-moráda* (SS nemorada) ‘purple, bruised’

o. Sp costal = *kost’il’* (SS costüil) ‘sack, bag’

p. Sp domingo = *domíyɡ* (KS doming) ‘Sunday’

q. Sp coraje = *koráha* (SS coraja) ‘courage’
I know of three exceptions in words which otherwise show evidence of phonological adaptation: Sp cotorra = *katór* (SS cator), ‘parrot’, Sp estropajo = *estrapáhe* (Dd èstràpáhè) ‘vegetable sponge’, Sp soplador = *saplidor* (SS saplidor) ‘blower’. Some native Huave words also show pretonic /a ~ o/ alternations e.g. aⁿʦ′opal ~ aⁿts′apal ‘hair ribbons’, suggesting that here there is also some additional process of unrounding at play.
FIGURE 1

Formant values for vowel midpoints for an adult male speaker
NOTES

1 Foremost among the individuals I would like to acknowledge are of course the many speakers of Huave who shared their time and knowledge with me, and without whose assistance this study would have been impossible. Second, I would like to thank in particular my companions in field work, especially Yuni Kim, Marjorie Pak, Keelan Evans, and Maurizio Gnerre.

2 Although in San Mateo the term Huave (supposedly of Zapotec origin) is now widely perceived as pejorative, I will continue to use it since there is no other term to refer to all the dialects as a group.

3 In this paper Roman type is used for reconstructed forms (indicated by *), for Spanish words as sources for borrowings, and for data taken from other authors. Italic type, or segments enclosed in slashes / /, is used for phonological representations, while phonetic (surface) forms are given in [ ]. Italicized words cited alone (not in the context of a derivation) are equivalent to phonological surface forms except that, unless directly
relevant to the discussion, the surface phones [ʃ ʧ ʃ̃ æ] are represented with their phonological sources /s' ts' ſ' a/.


4 In this respect Huave resembles Modern Irish, in which the expression of the contrast between palatalized and velarized consonants varies considerably in its phonetic salience depending on the vocalic environment (Ní Chiosáin and Padgett 2001).
5 The practical orthography proposed in SS seems to suggest a phonological distinction between /i/ and /iː/ (written as ü vs. üe), but this difference is not contrastive in the speech of my consultants.{A3}

6 Underlying coda coronals retain a contrast between palatal and plain, but the phonetic distinction is minute and sometimes ignored in previous descriptions.{A4}

7 The word moŋ'its' ‘young people’ (SS monguich) is not an exception; because the stem in question is k'its’ ‘little’ (not *ŋ'its’), this plural form is simply irregular.

8 The labels of these affixes are primarily for convenience: the label may not express all the morphosyntactic functions which the affix has.{A19}

9 The allomorphs t'e-, m'e-, and n'e- are used in reflexives and in some intransitives; otherwise the allomorphs t-, m- and n- are used. See §3.2.5.

10 In ir'ioɔm'bán the theme vowel has its ablauted form /i/ in the 2nd person (§2.3.3) but also an ‘additional’ 2nd person prefix ir-. Normally only the ablaut of the prefixed theme vowel marks 2nd person, but in three verbs there is an additional prefix. The roots -m'b ‘to go’ and -t ‘to eat’ vi. have an
extra prefix *er-* ~ *ir-* and the root *in* (→ *iın*) ‘to come’ has instead *ew-* ~ *iw-* (SH:377).

11 There is also no RAISING (92) in *a-ṃb'-ıb's* ‘finishes, wears out’ vt., *a-sat'-ı:ts* ‘leans’ vt., and *a-wa(y)-ı:ts* ‘lies, deceives’.{A28}

12 SH, p. 370, report *ihpię́h*, *m'iarohipię́h* (ijpüéj and mi-arojpüéj), for (173a) and (183b), with no /w'/, but speakers I consulted clearly pronounced /w'/ in these words.

13 This change was apparently not complete in the early 20th century: an older speaker reported to me that long ago one heard pronunciations such as [dIk] for *d'ek* ‘sea’ and [pit] or [pit] for *p'et* ‘dog’.

14 Interestingly, being stressless is not a sufficient condition for unrounding: pretonic and pre-pretonic stressless round vowels are freely permitted, as in *lɔ̃mbò|tə|sön* ‘we excl. stood up’ and *a|söh|lɔ|pàːts* ‘we incl. sprinkle’ vt. {A61}