THE SEGMENTS AND TONES OF

SOYALTEPEC MAZATEC

by

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ABSTRACT

THE SEGMENTS AND TONES OF

SOYALTEPEC MAZATEC

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This dissertation describes the segments and tones of Soyaltepec Mazatec, an Oto-Manguean language of southern Mexico virtually undescribed in the literature with the exception of Pike (1956). The preliminary work done by Pike and subsequent analyses by Goldsmith (1990) and Pizer (1994) are reviewed giving evidence that the system is complex and not easily explained. Documentation of the segments of the language as well as a more complete documentation of the tonal system has significance for language preservation, comparative Oto-Manguean studies and phonological theories of tone. This paper presents original field data gathered by the author during visits to Oaxaca, Mexico, and describes the phonetic and phonological patterning for segments and tones, as well as presenting an analysis for the tone sandhi.

The author's research reveals that Soyaltepec Mazatec contains 17 consonant phonemes and 5 vowel specifications which contrast for nasality. The phonological processes that occur are described as well as the intricacies of the co-occurrence of phonemes within the syllable which are shown to be vital in determining the nature of the syllable onsets. Four levels of tone are confirmed to occur lexically as well as five rising and two falling tones. The tonal processes include the transfer of tones between morphemes as well as the spread of a low register to the end of a phonological domain. These processes are autosegmental in nature; however, because the language makes use of four levels of tone, the one-dimensional tonal

representations which are traditionally used are expanded using Register Tier Theory (RTT). Although RTT has not been widely adopted, it is shown to be not only useful but necessary as a framework to describe four distinct levels of tone while still allowing the flexibility of independent feature spreading which accounts for the processes that occur in a straightforward, insightful and predictive manner.

It has been suggested that Mesoamerican tone languages do not fit nicely into the typical tonal typology that divides tone languages into African and Asian types. Soyaltepec Mazatec has the inventory of an Asian tone language with tones which are strongly attached to their lexical TBU while at the same time exhibiting processes that are African. It has contour tones that are sequential in nature, floating tones, downstep and widespread spreading. Furthermore, tone is important both in the lexicon and in the grammar of the language. All of these characteristics are prototypical of African systems. Soyaltepec Mazatec does not fit into either tonal classification; it is a combination of the two. The traditional tonal bicameral typology should not be viewed as rigid, exclusive categories. Un-analyzed tonal languages need to be investigated without typological presumptions.

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CHAPTER 1

INTRODUCTION

1.1 Overview

The purpose of this dissertation is to describe the basic phonology of both the segmental and tonal systems of Soyaltepec Mazatec, an Oto-Manguean language of southern Mexico, and to demonstrate the benefits of using Register Tier Theory (RTT) to describe the tonal system. Furthermore, looking at the tonal characteristics of Soyaltepec Mazatec will call into question the value of dividing tonal typology into African-type tone languages and Asian type tone languages.

Soyaltepec Mazatec is worthy of study for several reasons. First, it is an under-documented language. There is no recent work analyzing the language and the only article specifically about Soyaltepec Mazatec[1] available that contains primary data together with analysis of the tone system dates from the 1950's (Pike 1956). There is no work which specifically presents a detailed examination of the segments of this language. Second, from the data available it is evident that the tone system is complex. It involves four levels of tone as well as several significant contour tones and is rich in tone sandhi. Analysis of complex tone systems, specifically those with four levels of tonal contrast, contours and sandhi, is underrepresented among linguistic literature. Third, the Soyaltepec Mazatec data available has been used to demonstrate the sequential nature of contour tones (Biber 1981, Goldsmith 1990); however, some of Pike's data and analysis seems to indicate unitary tonal processes as well. An analysis of Pike's data by Pizer (1994) highlights this contradictory behavior.[2] Unitary tonal behavior is surprising and difficult to explain in a system in which the contours are composed of sequences.

[1] Soyaltepec Mazatec data also appears in Gudschinsky (1959) and Kirk (1966) which list cognate sets for Proto-Mazatec. Each work also briefly summarizes the segmental information for each language it mentions. Regino (1993) also provides some language data but it is not very detailed, especially regarding tones.

[2] A full summary of Pizer's work appears in Chapter 2.

In this dissertation I provide fresh, organized data which demonstrates the segments and tones that occur and I reinforce the evidence in favor of the sequential nature of the contour tones in Soyaltepec Mazatec. I show that traditional single tiered autosegmental phonology is inadequate in describing the processes that occur. I demonstrate how an appropriate phonological representation of tone, in this case RTT, can be used advantageously to explain and predict the complex behavior which occurs in this language. Finally, as the tonal systems of the Americas are, according to Yip (2002), among the least studied of the world's tonal systems, this dissertation helps to fill that void by further documenting an understudied language and providing organized, systematic data for anyone interested in further study of a complex Mesoamerican tone system.

The remainder of this chapter is laid out as follows. §1.2 provides background information about the language and the sociolinguistic situation in which it exists. §1.3 addresses the specific research questions that will be explored. §1.4 discusses the methodology employed to collect data. §1.5 introduces the basic phonological theory that will be used to discuss tone in this dissertation. In §1.6 traditional tonal typology is discussed. Finally in §1.7 the organizational structure of the dissertation is described.

1.2 Background and Sociolinguistic Situation

The basic background and sociolinguistic information about the language includes its physical location, linguistic characterization and social context. Soyaltepec Mazatec is spoken primarily in the Soyaltepec Municipio which is located in the Tuxtepec District of the State of Oaxaca, Mexico. It is one of the 177 languages listed as Oto-Manguean[3] in the 16th edition of the Ethnologue (Lewis 2009). Soyaltepec Mazatec is further classified under the sub-variety Popolocan which lists 17 languages under the names Chocho-Popolocan (8), Ixcatecan (1) and Mazatecan (8). The Ethnologue indicates that there are 27,600 speakers of Soyaltepec Mazatec as of 2005 with 2000 monolinguals.

Mazatec languages can be found in the bottom center of Figure 1-1 Map of Mexican languages in the area entitled Southern Central Mexico. The South Central Mexico section is enlarged on the following

[3] Refer to appendix A for a diagram of the Oto-Manguean language family.

page in Figure 1-2. Soyaltepec is number 161 which is located at the upper right of the enlargement, around the northeastern edges and islands of the reservoir created by the Miguel Aleman dam.

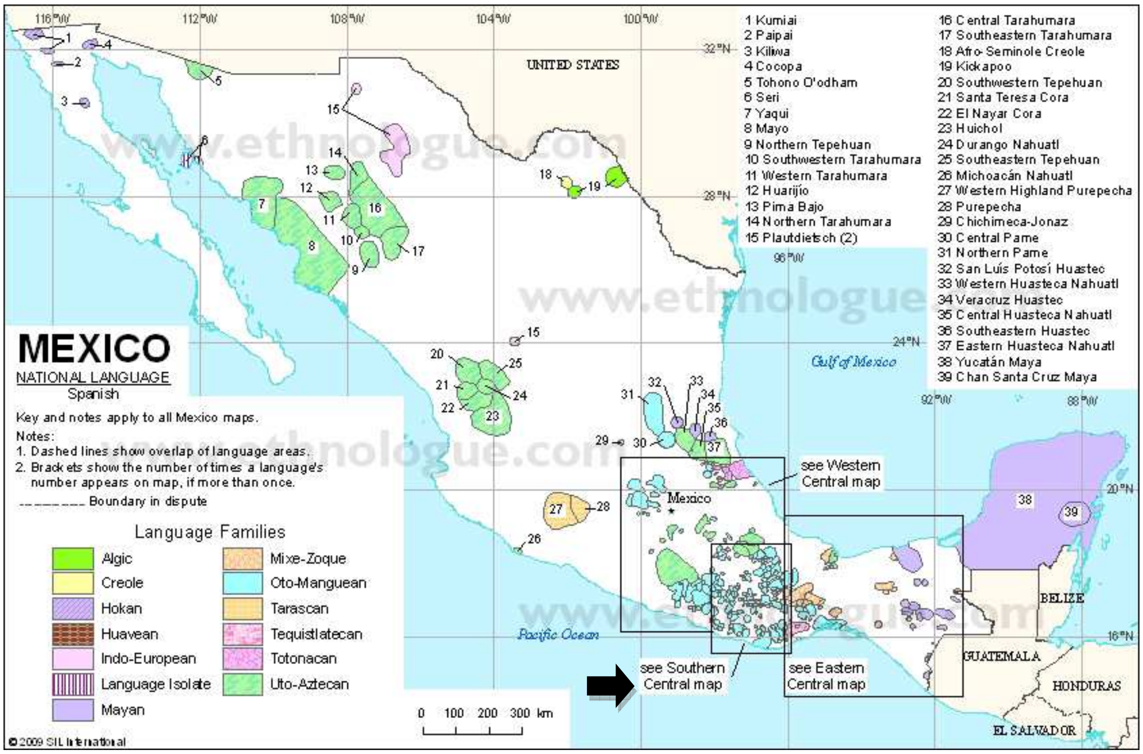


Figure 1-1 Map of Mexican languages (Lewis 2009)

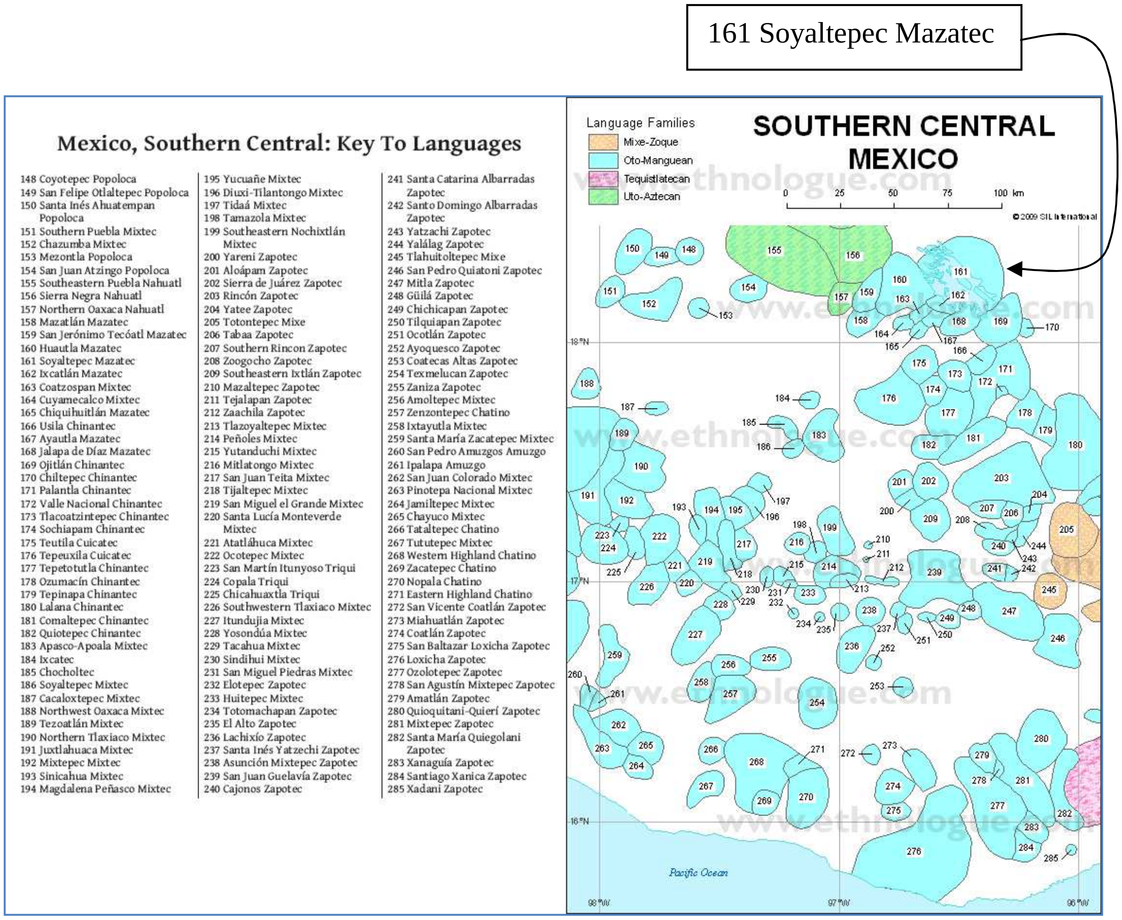


Figure 1-2 South central Mexico (Lewis 2009)

In addition to Soyaltepec Mazatec, several other varieties of Mazatec can be seen on the map, some of which, namely, Huautla (160), Chiquihuitlan (165) and Jalapa de Diaz (168), have been studied in depth.

The sociolinguistic situation among speakers of Soyaltepec Mazatec is complicated by the fact that a majority of the speakers were displaced because of the building of the Miguel Aleman dam in the 1950's and subsequent flooding. They now live in communities where several varieties of Mazatec are spoken in addition to Spanish. There is intermarriage both between speakers of different Mazatec dialects and with non-Mazatec speakers. There is also outside pressure on speakers through media such as television, internet and instant messaging which are not available in any form of Mazatec, and so encourage Spanish use. While Soyaltepec Mazatec is a language which is potentially in danger because of its complex sociolinguistic situation, it is not an endangered language. There is evidence that the language is still strong and viable. Despite societal pressures, Mazatec continues to be widely used in homes and between friends. As a general rule, children speak their mother's language as well as the dominant community language and, as they attend school, Spanish. The local government encourages indigenous language use and provides bilingual elementary education in the indigenous language spoken by the majority of constituents of each school zone. Often, students entering the school system do not speak adequate Spanish[4] to begin their education without transitional help in their primary language.

No one can predict with certainty the future of a language. It is important to document the language now while there are still many speakers and multiple generations available. Also, documentation along with a usable orthography (which will be enhanced by a better understanding of the tone system as provided by this dissertation) may help preserve this language.

1.3 Motivation

There is a need for further study and documentation of Mexican tone languages such as Soyaltepec Mazatec. As noted by Yip, "Many of these languages have been very well described," but she adds, "There is relatively little recent theoretical work on their tonal systems" (2002:212-213).

Pike (1956) noted Soyaltepec's complex system of tone sandhi and gave numerous examples of processes demonstrating its complexity as well as rules to predict surface tone from the underlying tones. Her analysis is meticulous; however, there are some remaining questions. For example, she describes a rising tone which begins at the second highest level and rises to the highest level (˦˥).[5] In context, this tonal contour often splits apart and the final tone links itself to the following syllable where sometimes, (1a), it surfaces as a High tone (˥) as would be expected, and sometimes, (1b), it unexpectedly appears as a Mid-high tone (˦).

[4] My information on the state of students in the school system is not scientific; it is based on personal communication with and the opinion of bilingual teachers.
[5] The tonal notations are discussed and explained in §1.5.1.

(1) Examples of Mid-high to High contour tone simplification

Rising contour				Resulting tones
a. ma˧t͡ʃa˥ 'It grows'	+	t͡se˧ 'guava'	→	ma˧t͡ʃa˧ t͡se˥ 'guavas grow'
b. t͡si˥ 'he makes'	+	se˧ 'thick'	→	t͡si˧se˥ 'he thickens'

Furthermore, in Pike's data, every time this contour simplification occurs, the level tone that remains on the original syllable is a Mid tone (˧). If the underlying tones are truly Mid-high and High, it is difficult to understand why after the contour simplification a completely different tone (Mid) surfaces on the original syllable. Also, clarification is needed to determine when the resulting tone on the following syllable bears a High tone and when it bears a Mid-high tone. In the fifty-plus years since her work was published, there have been several analyses of Pike's data in efforts to understand this complex system and glean linguistic insights (c.f., Biber 1981, Goldsmith 1990, and Pizer 1994), but none have taken into account all of the data contained in Pike's article. There has not been any further exploration of the tone system based on fresh data which either confirms or contradicts this unlikely behavior.

One of the complications of any analysis of tone is discerning which differences in tone are due to phonological processes and which are phonetic. In a system such as Soyaltepec Mazatec that employs so many levels and contours, this can be especially challenging and the conclusions made are often debatable. Determining phonetic variations is not straightforward because the results at first can seem capricious, but once understood, are very regular, even predictable. These results can include the raising or lowering of the original tone which can be motivated by either assimilation or dissimilation, as well as the formation of contour tones which are usually the phonetic transition between the original tone and the triggering tone and therefore can be rising or falling. Also, like phonological changes, phonetic changes are predictable. One difference between phonetic variation and phonological change is based in the need and ability to represent the change in terms of the abstract structure of the toneme. Phonetic changes result from the mechanics of transition and the psychology of differentiation while phonological changes result from environmentally motivated structural manipulations. Neither Pike nor any of the subsequent analyses of

Soyaltepec Mazatec make any differentiation between phonological tone processes and phonetic implementations. I will indicate tonal changes described by Pike which appear to be phonetic implementations and give reasons for this assessment; however, the majority of the dissertation will focus on phonological changes which can be structurally described. This dissertation documents the tonal system using original data and provides a phonological account which is internally consistent and explanatory of the surface forms present. I demonstrate tone sandhi that occurs and discuss register effects that are present.

An investigation of the literature surrounding phonological approaches to tonal languages with four level tones revealed little agreement among phonologists as to how tones should be represented. The acceptance of Autosegmental Phonology means that phonologists agree that tones exist in a separate tier from the articulatory segments; however, what that tier looks like or if it has any imbedded structure has been unresolved. A number of phonologists have explored the issue but, "In practice, most work on tonal phonology skirts the issue of the features and represents tones as H, M, L or with digits. . ." (Yip 2002: 234). In fact, Hyman concludes that there is little advantage to treating tones more deeply than referring to their, "relative and scalar phonetic properties," and suggests that linguists, "adopt the integer system even for two-height systems: /H, L/ = /2, 1/, /H, M, L/ = /3, 2, 1/, and so forth." (Hyman 2009:19). The problem with ignoring the structure of tone in a complex system such as Soyaltepec Mazatec is there is no way to make generalizations beyond descriptions, as will be evidenced below in §2.2 when Pike's article is discussed. When each toneme is a separate and distinct primitive, there is no way to describe natural classes or predict expected behaviors. If each primitive is one dimensional, there is no way to explain why a tone articulated at the second to highest level of pitch in a language might cause syllables following it to be lowered as will be described in Chapter 5.

A detailed description and thorough investigation of the interesting and complex tonal system of Soyaltepec Mazatec will both augment the available literature regarding the tonal systems of the Americas and provide an ideal venue for the exploring of tonal features which is so commonly skirted. Because Soyaltepec Mazatec has four level tones, multiple contours and rich sandhi, it is ideally suited to explore the necessity of correctly specifying tone features. I will demonstrate how the tone features and geometry described by Snider (1999) account for the phenomena present in Soyaltepec Mazatec.

1.4 Methodology

In order to collect data for this project I traveled to the state of Oaxaca, Mexico where I personally collected data between 2005 and 2009 during eight visits varying in length from one week to three months to the San Miguel Soyaltepec Municipality. I digitally recorded data from six speakers using a Sony MD Walkman MZ-R70. The data was transferred to .wav files on a PC where they were analyzed using Speech Analyzer (version 3.0.1 © 1996-2007 SIL International) and PRAAT (©1992-2009 by Paul Boersma and David Weenink). The speakers include four women and two men between the ages of 20 and 65.

The data was collected in word lists, specific frames, simple sentences and texts. Since tone is relative, the relationship between the pitch values for given utterances has more bearing on the phonology of the language than the exact values. The shape of each utterance was therefore documented in isolation as well as how it appears in various contexts. Target utterances were placed in frames before a High tone, a Mid tone and a Low tone, as well as after a High tone and a Mid tone. Every effort was made to collect a wide sampling of data in a variety of semantic domains; however, there is always the possibility of artificial gaps which might be filled with future research. I am confident that phonemes or tonemes which do not appear in my database are at least rare in the language, if not nonexistent.

1.5 Tone Theory

In Soyaltepec Mazatec, the tone on each syllable is important for the lexical and grammatical understanding of every utterance. As a tonal language, it is expected that examples in which tone differentiates between minimal lexical pairs will be found. Tone in many languages, including Soyaltepec, can also be used to indicate the end of a phrase, the aspect of a verb and differentiate between the subject and object of a sentence. In other words, if a person only has access to the non-tonal segments of an utterance, they may misunderstand not only the semantic reference of the utterance, but the tense, aspect and agent of the utterance as well.

While according to Yip up to 60-70 per cent of languages are estimated to be tonal,[6] tone is sometimes seen as an afterthought to linguistic analysis and is therefore not the focus of most educational

[6] This figure is surprisingly high and most likely includes languages often considered to be accentual.

programs; “even among linguists tone is sometimes seen as a specialized topic that the general linguist can largely ignore.” (Yip 2002:1). Because tone is understudied, the theories surrounding tone are, perhaps, not as widely distributed, accepted or as well developed as other facets of linguistic theory. In an effort to make the content of this dissertation available to a wider audience, the background necessary to understand basic tone notations and theory that is used herein is elucidated in this section. I begin with a description of the notations that are used to represent tone, and then discuss the tone theories that are the foundation of the analysis in this dissertation, specifically the theory of Autosegmental Phonology, the concept of tonal hierarchy, and finally Register Tier Theory.

1.5.1 Tone Notations

There are four level tones in Soyaltepec Mazatec and thus a potential of six rising tones and six falling tones. Although all of these contour tones are not lexical, I include them here for reference as all can occur as surface tones given the correct environment. There are five level tone letters available in standard IPA. Since only four levels of tone appear in Soyaltepec Mazatec, four tone letters must be chosen. As will be discussed in Chapter 3, the difference in the pitch levels between the High and Mid-High tones and the Mid-high and Mid tones in Soyaltepec Mazatec is smaller than the difference between the Mid and Low tones. Rather than choosing four contiguous tone levels, the traditional ‘low’ tone letter (˨) has been omitted in favor of the ‘extra low’ tone letter (˩); therefore, the four level tone keys that have been chosen, ˥, ˦, ˧ and ˩, more closely approximate the pitch levels that actually occur than four equally spaced tone letters.

In order to indicate rising and falling tonal contours, the names of the tones are adjoined using ‘to’, i.e., ‘Mid-high to High’ indicates a rising pitch from the Mid-high level to the High level. The tone letters are combined to form a slanted bar which begins at the level of the first tone and ends at the level of the second tone to show the amount of the rise or fall, i.e., the Mid-high (˦) to High (˥) rise is indicated as

(˦˥). When the tones are abbreviated, rising and falling tones are indicated by the abbreviation for the starting and ending points separated by a dash (-), i.e., M_1-H.

Table 1-1 summarizes the IPA tone letters used in this dissertation. The level tones are listed first, followed by rising and falling tones and an example of a convex tone. The tone name is listed first followed by the tonal abbreviation and the IPA Tone letter. The final column lists the traditional Mesoamerican tone numbers used by Pike (1956) for reference. The tones which occur lexically in Soyaltepec Mazatec are shaded.

Table 1-1 Tone notations

	Tone Name	Abbreviation	IPA Tone Letter	Mesoamerican Number
Level Tones	High	H	˥	1
	Mid-high	M_1	˦	2
	Mid	M_2	˧	3
	Low	L	˩	4
Rising Contours	Mid-high to High Rising	M_1-H	˦˥	2-1
	Mid to High rising	M_2-H	˧˥	3-1
	Mid to Mid-high Rising	M_2-M_1	˧˦	3-2
	Low to High Rising	L-H	˩˥	4-1
	Low to Mid-high Rising	L-M_1	˩˦	4-2
	Low to Mid Rising	L-M_2	˩˧	4-3
Falling Contours	High to Mid-high Falling	H-M_1	˥˦	1-2
	High to Mid Falling	H-M_2	˥˧	1-3
	High to Low Falling	H-L	˥˩	1-4
	Mid-high to Mid Falling	M_1-M_2	˦˧	2-3
	Mid-high to Low Falling	M_1-L	˦˩	2-4
	Mid to Low Falling	M_2-L	˧˩	3-4
Convex Contour	Rising-falling	L-M_2-L	˩˧˩	4-3-4

The tones are referred to using the tone name listed in the second column or the tonal abbreviation listed; the tone letters are usually used when data is listed or for clarification. The tone letter appears at the end of the syllable on which it is expressed. For example, in (2) the three Soyaltepec Mazatec words that are presented differ only in their tone.

(2) Minimal Tone Set (Mid, Low, rising Mid-high to High comparison)

Transcription	Tone	Gloss
a. ʃa˧	M_2	'wild cat'
b. ʃa˩	L	'fog'
c. ʃa˥	M_1-H	'work'[7]

The rise in tone represented in (2c) does not indicate any difference in the duration of the syllable. The duration of the syllable is not significantly different for any of the syllables represented in (2).

Two syllable words also have the tone marked at the end of each syllable as in (3). When the tone on two syllable words is abbreviated, the tone abbreviations are listed in order and separated by a space. If the tone abbreviations are connected by a dash as in (3a), this indicates a contour tone on a single syllable.

(3) Two syllable Minimal Tone Pair

Transcription	Tone	Gloss
a. t͡sɛ˧hɛ̃˧˦	M_2 M_2-M_1	'visible'
b. t͡sɛ˧hɛ̃˧	M_2 M_2	'he fell'

In (3), both words begin at a Mid tone; however, (3a) ends with a rising Mid to Mid-high tone while (3b) ends with a level Mid tone.

1.5.2 Autosegmental Phonology

The introduction of Autosegmental Phonology (Goldsmith 1976) increased our understanding of tone immensely and is now generally accepted among phonologists. To briefly summarize the theory as it pertains to tone, the features that define tone occupy a separate tier from the features that define the segments of a morpheme. The tone can therefore act independently from the segments. Tones exist on their own plane and are, for all practical purposes, adjacent to one another regardless of the number of segments

[7] The noun as in, "The work of teaching…"

which intervene on the feature skeleton. The general representation employed in order to show a one-to-one association between tone and syllables appears in (4) below.[8]

(4) General autosegmental representation

$$\begin{array}{cc} T_1 & T_2 \\ | & | \\ \text{CVCC} & \text{CV} \end{array}$$

The tones (T_1 and T_2) are linked to the tone bearing unit (TBU) of the syllable which is usually centered on the most sonorous part of the syllable (the nucleus); however, it has been argued that associations are actually made to prosodic entities rather than segments (Yip 2002:74), i.e., the syllable or mora. In Soyaltepec Mazatec, all syllables are open and no vowel length distinctions exist, as will be addressed in Chapter 3, therefore, tonal associations are directed to the syllable in general.

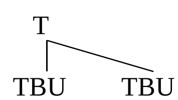
Tones are linked to the TBU via association lines. How the links between the tones and TBUs are formed has been a matter of debate. One of the original components of Autosegmental Phonology is the Universal Association Convention (UAC) which states that tones are linked to TBUs one-to-one in a left to right direction until all tones and TBUs are associated. When a disparity exists between the numbers of tones and TBUs, language specific techniques are employed to resolve the unmatched units. Some of these techniques include stray erasure or deletion of extra tones and the formation of tonal plateaus or contour tones. As the theory progressed, the left-to-right directionality of the association was questioned. In Hausa (Newman 1986), it was found that the direction of association needs to be right-to-left. Some have even adopted a bi-directional approach such as Archangeli and Pulleyblank's (1994) proposed Edge-In Association to account for the patterns in Mende. Zoll (2003) proposed Optimal Tone Mapping in which she questions the idea of directionality all together, though she maintains the need to associate tones via conventions, in this case constraints. Despite the literature and debate surrounding tonal mapping which calls into question the universality of the UAC, some languages appear to conform while others require that some or all tones need to be assigned in the lexicon. Soyaltepec Mazatec is one of the languages in which at

[8] The segments represented as C (consonant) and V (vowel) would also be hierarchically arranged bundles of features hanging off the skeleton from a place-holder X, sometimes referred to as the anchor for the features. The skeletal layer itself does not contain any information other than linear ordering of timing slots. However, since other segmental features are not in focus, this shorthand approach helps locate the tones.

least some tones need to be pre-linked; however, it is not necessary to associate all of the tones in the lexicon. Throughout the dissertation I will indicate tonal associations in Soyaltepec Mazatec which are in agreement with the UAC as well as tonal associations which either need to be pre-linked or in some way contradict the expectations of the UAC.

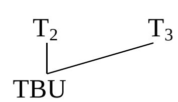
As stated above, no part of the theory requires that the number of tones and the number of TBUs must be the same. In fact, some key advantages of Autosegmental Phonology are observed when there is a disparity of tones and TBUs. First, there may be more TBUs than tones in which case a tonal plateau is formed, as in (5) where two TBUs are linked to the same tone and would therefore be articulated at the same level of pitch.

(5) Tonal plateau

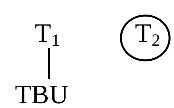


When, however, there are more tones than TBUs there are two possible outcomes. Either all of the tones will be associated and a contour tone will form, as in (6a) where T_1 and T_2 are linked to the same TBU, or one or more tones may be left floating meaning it has no association to a TBU, as in (6b), where the floating tone is represented by a circled tone, in this case T_2.

(6) a. Contour tone



b. Floating tone



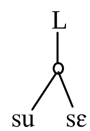
In order for a tone to be directly expressed it must be linked, or associated, with a TBU.[9]

Floating tones can originate as part of the lexical representation of a word or when the segmental information of a syllable is deleted leaving a tone stranded. The independent nature of tones which can lead to tonal stability despite the deletion of its initial segments is another of the theoretical advantages of an autosegmental analysis.

[9] Note, however, that a floating tone may still have an effect on the pronunciation of the surrounding tones, even if it is not expressed; this situation produces downstep in many languages such as Bimoba (Snider 1998) and Konni (Cahill 1999).

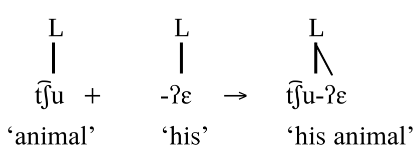
Another aspect of tonal behavior involves the Obligatory Contour Principle (OCP) which prohibits identical adjacent elements, in this case tonal features, from existing in the representation of a morpheme. One of the primary effects of the OCP is the prohibition of two identical tones being linked to the same or adjacent syllables. For example, a word with two syllables both of which are articulated at a low pitch will have only one Low tone which is shared by both syllables. An example from Soyaltepec Mazatec appears below (7).

(7) The representation of a disyllabic Low-toned word *su˩sɛ˩* 'green'



This principle is regularly extended to address elements brought into adjacency by the concatenation of morphemes and closely associated words as well. When two morphemes come together to form a lexeme, the OCP indicates that if their tones are identical, some form of repair must occur. This repair could be dissimilation (as in Meeusen't rule in Bantu) or tonal deletion with subsequent default tone insertion. A third possibility is tonal merger, as occurs in Soyaltepec Mazatec. Notice example (8) in which a low-toned possessive suffix is added to a low-toned noun, placing two Low tones on adjacent syllables within one grammatical word. Since these two syllables are articulated at the same pitch level, it is clear that no dissimilation has occurred. It is possible that one or the other L tones has been deleted with subsequent L tone spread to the adjacent or that merger has occurred (since no default L tone has been hypothesized in Soyaltepec Mazatec, this possibility will not be entertained here). If the OCP is strictly obeyed, the two Low tones should not remain independent on adjecnt syllables. A bimorphemic, disyllabic word with only one Low tone is indicated in (8).

(8) OCP merger produces the surface form of *t͡ʃu˩-ʔɛ˩* 'his animal'



The two morphemes each start out with their own Low tone, but, in the result, they share one Low tone. This is true only if the two syllables are articulated at the same pitch level. If two Ls remain overtly, RTT which will be discussed in §1.5.4 below will dictate that the second L must be articulated at a lower pitch. The level of adherence to the OCP is a language specific parameter; some languages strictly forbid feature adjacency while others completely allow it, and there are varying degrees of partial adherence.

Another aspect of tonal behavior which is easily represented using Autosegmental Phonology is tonal spreading. The process of spreading involves a tone extending an association line to an adjacent TBU. Example (9) comes from Chumburung as demonstrated by Snider (1999:11) and involves a High tone spreading to an adjacent syllable which is linked to a Low tone. The High tone spread is indicated by a dashed association line. In this case, the Low tone that was originally linked to that syllable is then delinked which is indicated by the two parallel bars across the association line.

(9) Chumburung HTS with Lo tone delink[10]

H L H L

ka + mbʊja → ka mbʊja

ká m̀bʊ̀jà ká ḿbʊ̀jà
'wife's blood'

When the nouns in (9) come together in the associative construction,[11] the tone from the first noun spreads to the first syllable of the second noun and displaces the original tone from that syllable. This accompanying delinking is separate from the tone spreading process; it does not happen in every instance of High Tone Spread (HTS) in every language, alternatively, a contour tone is sometimes formed.

The theory of Autosegmental Phonology explains how tones behave as if they are adjacent to one another even though there are segments, in the linear sense, which separate them. In the above discussion, we have seen that Autosegmental Phonology describes tones as existing on a separate tier from the segments of an utterance. This separation allows for the existence of both more TBUs than tones (i.e., tonal plateaus or a one-to-many relationship) and more tones than TBUs (i.e., contour tones and floating tones or

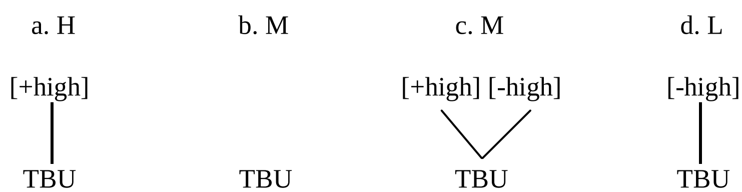
[10] In this example, the acute accent indicates a High tone while the grave accent a Low tone.
[11] The associative construction is a grammatical construction in which two nouns are placed together to indicate possession.

a many-to-one relationship). Occasionally a segment or TBU can be deleted without affecting the tone, in essence leaving the tone stranded (tonal stability). OCP violations can encourage adjacent tones to merge which also results in tonal plateaus. Finally, the process of tonal spreading demonstrates tonal mobility. Each of these tonal processes is explained simply and elegantly using Autosegmental Phonology.

1.5.3 Tonal Hierarchy

Much of the work in Autosegmental Phonology has represented tones with an H or L (adding an M when necessary) linked via an association line directly to the skeletal tier. In many languages, this seems to be enough. If there are only two or three tone levels, a system with High (10a) and Low (10d) can be devised based on a binary feature choice similar to [±high]. The Mid in this system can either be an unmarked tone (10b) or a syllable which is linked to both a [+high] and a [-high] (10c).[12] In this type of system, the features merge phonetically rather than forming a contour tone, and a pitch between Low and High results, i.e., a Mid tone. While this kind of linkage to clashing features may on the surface seem self contradictory and unlikely, systems involving this kind of linkage are occasionally proposed.[13]

(10) Simple feature geometry



One problem with representing tone in this way is that there is no way to discretely describe four levels of tone as the two Mids in this system are indistinct and would tend to merge phonetically. Some, such as Tsay (1994) and Hyman (2009), have suggested assigning an integer value to each tone to circumvent the feature debate. This numbered tone can then be linked to the segment as an autosegmental feature. However, assigning an integer value relationship as a primitive value does not allow natural classes or cross

[12] The Mid that results from the multiple linking of [+high] and [-high] features is often a surface tone which is created environmentally through the spreading of adjacent features and not considered to be a distinct underlying tone (see Hyman 1986, 1993).

[13] A similar Mid tone which is linked to both a H and a L is proposed by Pizer in her analysis of Soyaltepec Mazatec data as is discussed below in §2.5.4; however, her fourth is not unmarked as in (10b), instead it hosts two L tones.

linguistic tendencies to emerge based on phonological properties. Nor does it give any explanation of the numbers of tones found cross-linguistically. Specifically, there is no reason to limit the number of levels of tone that a language might have or give reasons why two and three level tone systems are very common, four level systems less common (but definitely attested), and five levels (the maximum that has been convincingly argued) very rare.[14] Essentially, while being descriptive, numbering the pitches to represent the primitives in a system is not phonologically revealing and allows an unlimited proliferation of tones. If just numbering the tone levels is unsatisfactory and using only one feature cannot describe four tones, then another feature must be necessary.

1.5.3.1 Features

In this section, several different approaches to tonal features that have been suggested for tone are summarized, problems that arise from fixed features are exemplified and potential responses to these problems are discussed. In order to describe four levels of tone which are phonetically distinct and phonologically informative, two separate feature specifications must be made.[15] While the possibility described above, where one morpheme is unmarked for tone (10b) and one is multiply marked (10c), is technically possible as a four-way distinction, it is unclear how the phonetic realization in this language would be consistently implemented with two distinct and recognizable mid tones. The hierarchical structure of tones and which features should be included is an area which has not been agreed upon. Yip in her 2002 textbook on tone does not illuminate us further, "I will often, in common with most phonologists, duck the issue of tonal features and couch my analysis in terms of atomic tones H, M, and L, but ultimately the reader should bear in mind that these are shorthand for some set of tonal features yet to be authoritatively determined" (Yip 2002:46-47).

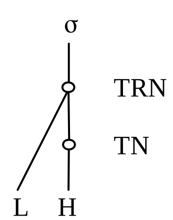
[14] Occasionally systems with five levels have been convincingly described (c.f. Flik's 1977 description of Dan (Côte d'Ivoire), Longacre's 1952 description of Trique (Mexico) and Edmondson and Gregerson's 1992 survey of various languages reported to have 5 level tones, especially Shidong Kam (China) which, "must be accounted the status of a bona fide five-level tone system" (Edmondson and Gregerson 1992: 572).

[15] Even breaking the tone height distinction into two binary features like [±high] and [±low] is unsatisfactory because while a tone that is [–high] and [-low] (i.e., neither high nor low) is possible, one that is [+high] and [+low] is a contradiction and three levels remains the maximum that you can distinctly define, a situation analogous to vowel height distinctions.

Many tonologists (Yip 2002, Bao 1990, Duanmu 1990) agree that two somewhat independent features need to be posited to deal with tone. The most commonly referred to features are those first argued by Yip (1980): [±upper] (often abbreviated as H L) and [±high] (abbreviated as h, l). These two features result in a system with four levels divided into two registers by [upper] with each of these levels divided into two tones by [high]. In this system, register is used to distinguish two halves of the pitch range.[16] These features nicely divide the speech range into four quadrants; however, because there are four distinct pitch levels each associated with a separate and specific spatial quadrant; they do not allow for a phonological description of the phenomena of upstep or downstep or even for the expression of a fifth level of tone which is necessary for some languages.

As a response to the need to account for more phonetic pitch heights, Hyman (1993) proposed using H and L as unary features to distinguish both the register and the tone. These features are defined as register or tone based on their location in the tonal geometry. Hyman's 1993 model places the register feature on the Tonal Root Node (TRN) and the tonal feature on the Tonal Node (TN) as in (11).

(11) Hyman 1993 – proposed tonal geometry



When a L is located on the TRN, as in (11), it serves to lower the register relative to the previous tone. Therefore, the structure in (11) is the depiction of a downstepped High. Each time a new TBU appears in an utterance with a L on the TRN, the register is lowered again. This recurrent lowering allows the stair-step downstep that occurs in some African languages. The register, in this case, is a more abstract level of pitch and not strictly speaking dividing the speaker's pitch range as it does in Yip's definition. The 'tones'

[16] Occasionally, [± raised] is used instead of [± high] to refer to the tone feature (Pulleyblank 1986). This is just a terminology distinction without redefinition. Bao (1990, 1999) and Duanmu (1990, 2000) propose attributing these features to laryngeal features using the features of [± stiff] and [±slack] from Halle and Stevens (1971). Duanmu also adds [±above], [±below] (1990) and [thick] versus [thin] (2000) to make the necessary distinctions.

denoted by the H and L attached to the TN are then high and low compared to the current register which I interpret to mean the reference point. Hyman (1986) defines the primitive features responsible for tone and register height as: H raises the pitch one unit above a neutral reference point and L lowers the pitch by the same amount. When both an H and L are attached at the TN, the effects cancel each other out, as in (10c) above, producing a mid tone at the neutral height. Hyman's approach resolves the problem of describing downstep; however, there is no way to distinctly distinguish four levels of tone.[17]

Although not widely adopted, Snider (1999) builds on the relative nature of tone expressed by Hyman and attempts to resolve the two problems mentioned above: the need to describe at least four discrete levels of tone and the need to have a system that allows downstep (and upstep). His features are abstract and unary like Hyman's, but, unlike Hyman, Snider maintains the separateness of register and tone. The register features are *h* and *l* which he defines as, "Effect a register shift *h* = higher, and *l* = lower relative to the preceding register setting." The tonal features are *H* and *L* which he defines as, "Realize this TBU at *H* = high pitch, and *L* = low pitch relative to the current register" (Snider 1999: 25). Because Snider's definitions do not refer to a specific part of the pitch range or to specific muscles and their level of tension, he is able to allow a high tone to be expressed at the same pitch level as a low tone at a different place in the utterance, yet still be phonologically distinct. Furthermore, like Yip, he is able to define four distinct levels of tone as: H (*H, h*), M_1 (*H, l*), M_2 (*L, h*) and L (*L, l*). Snider's features are the only ones described here that allow at least four distinct pitch levels with flexibility in the expressed pitch of a given phonological representation. [18]

1.5.3.2 Tonal Geometry

In this section, I discuss the concept that features have a specifically defined relationship with the skeletal structure of an utterance. Just having two features does not give the complete picture. The

[17]Pizer (1994) tries to solve this problem by allowing more than one H or L to exist on the TN in an additive fashion: i.e., if one L is one pitch unit below the neutral pitch level, then two Ls are two units below the neutral pitch level. See §2.4 for the way she suggests this would play out in Soyaltepec.

[18] The features defined in RTT allow up to six distinctly defined levels of tone. A super High tone is defined as a High tone which is preceded by a lexically prescribed floating low register while a super Low tone is a Low tone preceded by a floating high register in the lexicon. For further discussion the interested reader is referred to Snider 1999: 62-65.

relationship between features is often part of the definition and crucial to the understanding of the application of tonal features. Recall the discussion of the features proposed by Hyman (1993) which were defined partially based on their position in the tonal feature tree as was shown above in (11). In this section, I discuss some of the geometries proposed for tone and give arguments in support of adopting Snider's model. Since we have already addressed Hyman's (1993) geometry, I will not revisit it.

Yip's original proposal (1980) involved features directly linked to the skeletal tier (12). In this model, register and tone are completely independent.

(12) Yip's 1980 geometry diagramming a rise in the upper register (˦˥ or ˧˥)

```
 H
 |
 σ
/\
l h
```

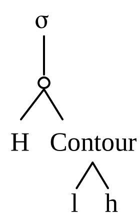
A rising tone from *l* to *h* in the upper register *H* is represented in (12). The problems with this representation are: first, as there is no relationship between the two features, it is difficult to spread a tone to another syllable as a unit, and second, it is impossible to distinguish between (˦˥) and (˧˥), thus limiting the number of contours that are possible. Yip (1989) revises this geometry to incorporate a relationship between the features as shown in (13).

(13) Yip's 1989 geometry diagramming a rise in the upper register (˦˥ or ˧˥)

```
 σ
 |
 H      (Register)
/\
l h      (Tone)
```

In (13), the same rising tone (from *l* to *h*) in the upper register (*H*) is demonstrated; however, this time the register serves as the Tonal Node to which the tonal primitives are subordinate. The structure allows spreading from the tonal node to the TBU, thereby spreading the entire tone easily. The tones are allowed to spread independently; however, if the register spreads, the tones must accompany it. The representation allows for the changing of register only through a deletion and insertion process. In other words, a neighboring register cannot alter the register in question (through a spreading process, for example) without also altering the tonal features. This geometry works well for the types of contours that Yip proposes for Asian tones where contours are confined to one or the other register. It cannot accommodate a rise or fall between the registers, however, as is necessary for languages like Soyaltepec Mazatec. And again, it does not allow for a distinction between (˦˥) and (˧˥). An alternative with more flexibility is offered by Bao (1990) as represented in (14).

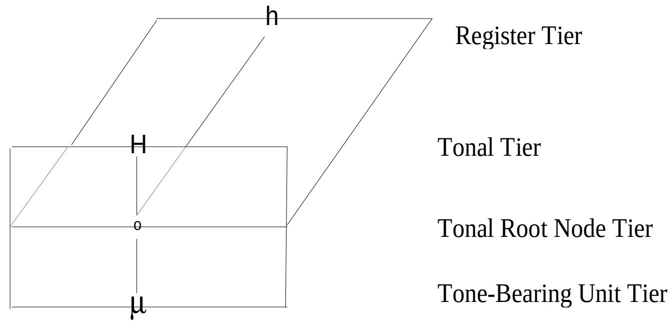
(14) Bao’s 1990 geometry diagramming a rise in the upper register (˦˥ or ˧˥)



In (14) the same rising tone on a high register is demonstrated. In this geometry, the register, H (or L), and the Contour feature are sisters under the Tonal Node. The tonal features of l and h are subordinate to the contour feature. The contour and register, as well as the tone primitives, can spread independently. It is more natural to replace the register in this representation than in a geometry such as (13) because a new association can be formed and the existing register delinked without disturbing the remainder of the geometry. Bao, however, still defines register in the same way as Yip, thereby confining the contours to only one register, and once again fails to distinguish between (˦˥) and (˧˥). Only one rise or fall is allowed per register.

Snider’s (1999) geometry appears similar to Bao (1990); however, there is no contour node. Instead, Snider proposes a tonal tier and a register tier that exist in separate planes, as in (15).

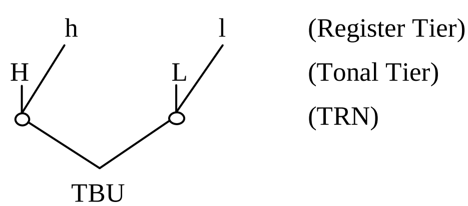
(15) Snider's 1999 geometry diagramming a high tone (˥)



In (15), a high tone on the high register is represented. Because the tone and register features exist in separate planes, they function completely independently of each other. Either feature can spread to a neighboring TBU without affecting the other. Also, the entire tone can spread from the Tonal Root Node (TRN) which serves as a point of coalescence for the features.

In terms of representing contours, this geometry allows three types of contour tones to exist: contours that are true sequences of separate tones called composite contours by Snider (16),[19] unitary contours in which there is a change in register while the tone remains constant (17a) and, finally, unitary contours in which there is a change in tonal melody while the register remains constant (17b). Note that the contour which changes in tonal melody is the only type of unitary contour capable of being represented by Yip and Bao above.

(16) Composite Contour (Snider 1999: 56) diagramming a fall from High to Low (˥˩)



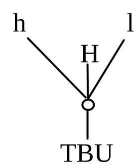
The structure in (16) represents a falling tone from a High to a Low tone. The H and L have come together each with its own TRN and are joined by association lines to one TBU. The separate planes of the tone and

[19] All of the geometries presented here, other than Yip 1980, allow two separate TRNs to associate to a TBU, thereby allowing sequential contours.

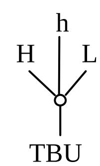
register are represented by lines which slant differently. Also, the register features are always represented by lower case letters with longer association lines while the tone features are represented by capital letters with shorter association lines.[20]

(17) Unitary Contours (Snider 1999: 56)

a. Change in register
Fall from High to Mid-High (˥˦)



b. Change in tone melody
Fall from High to Mid (˥˧)



In (17a), the unitary contour has a change in register from high to low while a high tonal melody is maintained. This represents a High to Mid-high falling tone. In this case there are two features on the register tier which are linearly ordered with respect to each other and therefore must be articulated in sequence. In (17b), the unitary contour has a change in tonal melody from high to low while the high register is held constant which represents a High to Mid falling tone. In this case, the two tone features are in the same plane and are linearly ordered.[21] Having a geometry which allows both composite contours and two types of unitary contours allows for a great deal of flexibility. First, any two tones can come together and, second, eight of the twelve contours which are possible given four levels of tone can be represented as either composite (two TRNs) or unitary (one TRN). The only exceptions are the contours between the extreme tones H and L, rising or falling (which was represented in (16)) and the rise or fall between the middle two tones. These two sets of tones do not have either register or tone features in common, so therefore must maintain separate TRNs and are therefore by nature composite contour tones.

I have described the evolution of tonal geometries starting from Yip's single level 1980 proposal to her incorporation of hierarchy in the 1989 geometry, the innovation of a sister node by Bao 1990, and a totally different approach offered by Hyman. Finally, I described the approach taken by Snider 1999 which is very similar in many ways to the previous suggestions; however, it incorporates sister planes instead of

[20] The length of the association lines is relevant only as a visual aid in interpreting the diagrams.
[21] Features which occur on the same plane must be articulated in sequential order from left to right.

sister nodes, allowing for greater autonomy between the features and a greater level of flexibility than the other models. It is this model that I will argue best describes the tone system of Soyaltepec Mazatec because it both discretely defines four levels of tone and allows a register feature to spread independently from the tonal features. No significantly different models for tonal geometry have been widely distributed in the past ten years.

1.5.3.3 Summary

In summary, in order to fully describe a system with four level tones such as Soyaltepec Mazatec, it is necessary to adopt more than one feature for tone. When there is more than one feature for tone, the question of how the two features are related to each other must also be addressed. Yip (1980) offers a solution in which the two features are completely independent from one another and attach directly to the skeletal tier. The problem with assuming this simplest of geometries is that it does not allow for generalizations and predictions based on the behavior of the features in question, and it does not allow the tone to spread from one TBU to another as a unit. Hyman and Snider each offer features that are defined relatively which allows for a phonological explanation of the phonetic realities of upstep and downstep. Yip, Bao and Snider each offer geometries that allow for the description of four level tones, and each allows concatenations of level tones to form contour tones. Furthermore, each allows a mechanism to describe unitary contour tones. Snider's geometry, however, allows a degree of flexibility beyond Yip and Bao in that some tones may be described as having both a unitary and sequential nature. Snider's geometry also allows the contours to occur between two registers, and it allows the register features to spread independently of the tone melody features. The flexible nature of Snider's geometry combined with the relative nature of the features he uses provides a system which will allow a discrete description of up to six levels of tone, as well as giving a phonological explanation for effects such as upstep and downstep. The description of the tone system of Soyaltepec Mazatec requires this kind of explanatory power and flexibility.

1.5.4 Register Tier Theory

In the above section, I explained the motivation for choosing features and geometry described by Snider (1999). These features and geometry work together in a system called Register Tier Theory (RTT). Proposing a more complicated hierarchical geometry of tone does not change the way the autosegmental approach to tone handles tone processes. There are still one-to-many and many-to-one relationships. Tones are stable, they remain despite changes in segmental values; but, they are also mobile, they can be expressed on a different segment without changes in the segments themselves. Tones can still be floating and TBUs unassigned. Linkages can be already formed in the lexicon or assigned through processes. The difference in RTT is that now there are two features which may be involved. In this section, I summarize the implications of utilizing these features and geometry to describe a tonal system. First, I discuss how the structures described account for four levels of tones and how these relate to pitch levels, next I describe how RTT structures are used to describe autosegmental phenomena followed by a section discussing tone spreading and finally I address OCP effects in RTT.

1.5.4.1 Four Tone Levels

In order to represent four discrete level tones using Snider's (1999) geometry, the two register features and two tonal features are combined into the four possible groupings (18).

(18) Features of the four tones

	H Tone	*L* Tone
h Register	H (*H h*)	M_2 (*L h*)
l Register	M_1 (*H l*)	L (*L l*)

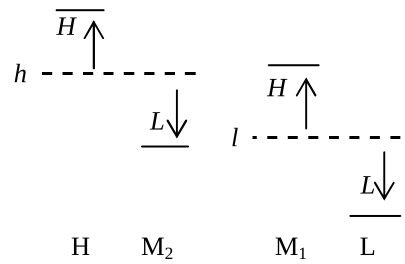
The geometry of the tones and features was discussed in §1.5.3.2 and was illustrated in (15). Based on the features, we expect to find natural classes in which tones which share a feature, pattern together. For example, the H and M_1 share a *H* Tone feature as demonstrated in (18) and therefore form a natural class. The only two groups which share no features are {H L} which is not surprising given that these are the extremes and {M_1 M_2} which is somewhat surprising since the two levels are adjacent in the pitch scale.

These definitions indicate that we do not expect to find overlap in the behaviors of the M_1 and M_2 tones, nor do we expect to find ease of transition between the two. In other words, the H and the M_1 share any behaviors that are based on the *H* tonal melody. And the M_1 and L share behaviors based on the *l* tonal register. For example, a process which spreads the *l*-register feature causing a lowered register on an adjacent TBU can be triggered by both the Low tone and the Mid-high tone. We do not expect the H and L to share behaviors nor do we expect the M_1 and M_2 to share behaviors. The theory predicts two phonological Mid tones (M_1 and M_2) which are separate and distinct.

The theory predicts that a H tone could be changed to a M_2 tone by changing its register feature from *h* to *l*, or to a M_1 by changing its tonal melody feature from *H* to *L*. A M_1 could be changed to a L by changing its tonal feature from *H* to *L* or to a High by changing its register feature from *l* to *h*. But, a H cannot be changed to a L without a complete change of all of its tonal features, nor can a M_1 be changed to a M_2 without a complete change of both features.

In order to determine the phonetic implications of these tonal specifications, the definitions of the features must be applied. First, the register is defined relative to the register of the previous TBU (or a neutral point if the tone is utterance initial). A high register, *h*, is defined as being higher than the previous register, while a low register, *l*, is defined as being lower than the previous register. In other words, there is no fixed point in the pitch space that corresponds to register. If separate *l*-registers are linked in sequence (although this potentially violates the OCP), the pitch will become successively lower with each new *l*-register. Second, the tonal melodies are relative to the register, so a high tonal melody, *H*, is defined as high with respect to its register and a low tonal melody, *L*, is defined as low with respect to its register. The phonetic height of these tones can therefore be represented as in (19). In this representation, the dashed lines represent the register features (labeled with their feature designation but which are known to be higher, *h*, or lower, *l*, only by reference to the other register present) while the solid lines represent the tonal features which are further described through the use of an up- or down-arrow and feature label (*H* or *L*). The level of the solid horizontal line symbolizes the phonetic pitch level.

(19) Phonetic height for four level tone phonemes (Snider 1999:24).



In (19), it is apparent that according to these feature specifications while M_2 occurs on the higher register, it can be phonetically lower than M_1. The exact pitch distance between the tone's melody features and the register features is language specific. By increasing the space between the registers and decreasing the distance between the tone and register, the two mid tones can be caused to align phonetically resulting in a system with three phonetic tone levels but four phonological descriptions, or the M_1 may be made lower than the M_2. The interested reader is referred to Snider (1999:59-62) for a demonstration.

Theoretically, every language should have access to these levels. Some languages never make use of them, in which case evoking the geometry unnecessarily complicates the phonology. In languages with downstep, the downstepped High is structurally the same as the Mid_1. These types of languages may or may not have a lexical Mid_1. A two tone language usually has a H on the higher register and a L on the lower register. A three tone language might have either of the two Mid tones described here. For example, in hypothetical Language A, a language with three levels of tone, both M and H tones are subject to downstep. When analyzed according to the features described here, this means that these two tones must share a *h* register, i.e., H is (*H h*) and M is (*L h*). When a *l* register spreads, the H is downstepped to (*H l*) or M_1 phonetically and the M is downstepped to (*L l*) or L phonetically. The Mid tone in Language A is therefore a M_2 as described above. Conversely, in Language B, another language with three levels of tone, the process of downstep behaves differently. The M is not subject to downstep but instead instigates downstep of the H. Therefore, the M of Language B must be represented as a M_1 (*H l*) which does not share a *h* with the H tone, and is therefore not subject to downstep because it already has a *l* register. In this language, the Mid tone is expected to form a natural class with the Low tone both of which will trigger downstep of the High tone.

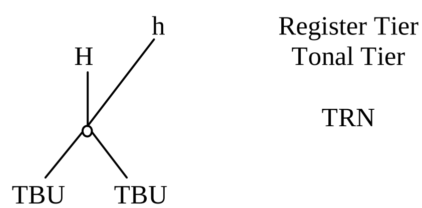
The four levels of tone as described in RTT have four distinct phonological representations. In some languages, like Soyaltepec Mazatec, all four levels occur lexically. In other languages only three lexical levels of tone occur, but the phonological definitions are still relevant and helpful in explaining the difference between the occurrence patterns of downstep between the two languages such as the hypothetical Language A and Language B described above. For the purposes of this dissertation, it is important to remember that each of the four levels of tone is specified for either *h* or *l* register and *H* or *L* tone, and these features are what define the phonological activity of the tones.

1.5.4.2 RTT Representations

In this section, I illustrate the autosegmental representations of tonal plateaus[22] and floating tones as represented in RTT. Contour tones were already addressed above in §1.5.3.2.

First, plateaus in RTT can be either complete or partial plateaus. (20) demonstrates a complete tonal plateau in which two TBUs are attached to the same TRN, and a level High tone is expressed on each.

(20) Tonal Plateau – the representation of a disyllabic H H word



In this example, both tonal features are shared by each TBU. Partial plateaus are also possible in which only one of the two tonal features is the same. In this case, the tone is not the same on the two syllables. A plateau can occur between adjacent register levels (21a) or adjacent tonal levels (21b).

[22] Recall that a plateau occurs when the same feature occurs on more than one syllable in succession.

(21) Partial Plateaus

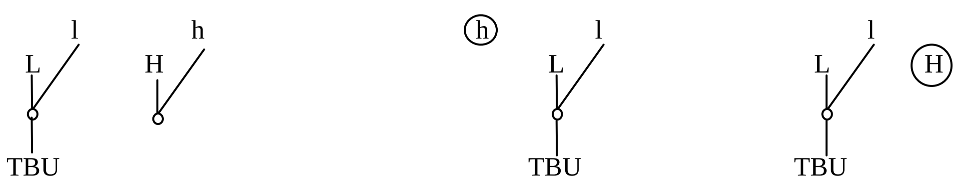
a. Register Plateau – H M_2 b. Tonal Melody Plateau – H M_1

The diagram in (21a) represents a High tone (*H h*) on the first TBU followed by a Mid tone (*L h*) on the second TBU. The register is the same, *h*, for each tone; however, the tonal melody changes from *H* to *L*. In (21b), the tonal melody on each syllable is the same, *H*; but, the register changes from *h* to *l*. This represents a High tone (*H h*) on the first TBU and a Mid-high tone (*H l*) on the second TBU.

Second, floating elements may be represented in RTT. The entire tone could float (22a), a register feature could float (22b), or a tonal feature could float (22c). There are two ways to indicate floating elements in RTT. First, when two tonal features are present but not associated to a TBU, the features are linked to a TRN as in (22a), but the TRN is not linked to the TBU. The absence of the association line indicates the floating nature of the tonal element. In (22b and c) floating elements are circled which is the more traditional representation of a floating element. This method is only possible when there is only one feature which is floating.

(22) Floating elements

a. Floating tone b. Floating register c. Floating tonal feature



In each of the diagrams in (22) there is a linked Low tone and a floating high element. The linked tones are placed purely for reference. I have altered the order of the floating elements in relation to the linked elements as a reminder that floating elements may occur to the right or the left of a given linked element, e.g.: a floating tone may occur as a prefix or a suffix, it may mark the beginning or the end of a phrase, or it may be the result of a deleted first syllable or a deleted final syllable. The situation in (22a) in which a

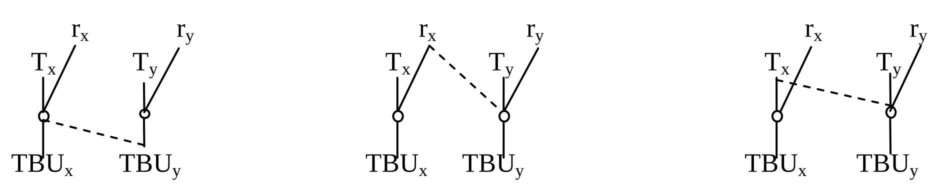
TRN is floating is often the result of segmental deletion. Because of the phenomenon of tonal stability, a fully specified tone which was previously linked to a segment may remain after the segment is deleted leaving the tone unattached to a TBU. In many languages, floating tones can also be part of an underlying lexical representation. In (22b), there is a floating high register and in (22c) there is a floating high tonal feature. A floating tone may attach to the surface element to its right or to its left, or it may remain floating and make its presence known by influencing the adjacent elements through downstep, upstep or through the prevention of expected OCP violations. The directionality of floating tone attachment is not only language specific, but in some cases is morpheme specific as we will see below in Chapter 5. A floating tone may be part of an underlying representation of a morpheme or it may be the entire underlying representation in the case of grammatical tones. For example, the case of a border tone representing the edge of a phrase is often a floating low register feature.

1.5.4.3 Spreading

Again, since RTT is an extension of Autosegmental Phonology, the tonal processes are similar. Any level of the tonal representation can spread to a neighboring entity by linking one level below itself. In other words, a TRN can spread to a TBU in which case both the associated register (r) and tonal melody (T) specifications would spread as well (23a). The register can spread and link to a neighboring TRN (23b) or a tonal melody feature can spread (23c), likewise to a TRN. Whether or not the target of spread needs to be an unassociated node is language specific as is whether or not delinking accompanies spreading.

(23) Possible spreading routes in RTT

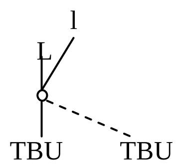
a. TRN spread | b. Register spread | c. Tone melody spread



In each of the structures in (23), the spreading feature is indicated with a dashed association line. Each of the TBUs present is fully specified as a reminder that the spread of tonal features is not necessarily dependent on whether or not the targeted anchor location is already specified for tone. No further processes such as delinking which often accompany spreading processes have been indicated. Below, some possible results are demonstrated.

First, complete tone spread is demonstrated in the Low Tone Spread (LTS) of (24). In this case, the TBU which is targeted by the spread is unspecified for tone.

(24) LTS to unassociated TBU

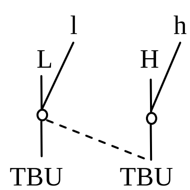


The result of the spread in (24) is a tonal plateau; the two TBUs are both linked to the same Low tone and pronounced at the same level of pitch.

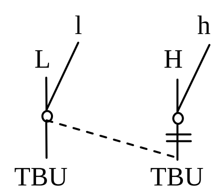
If the targeted TBU is already linked to a tone, a contour may appear on that TBU (25a) or the tone that is present may be delinked (25b).

(25) LTS to associated TBU

a. Contour tone formation



b. LTS with delinking

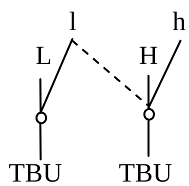


In (25a), the first TBU maintains a low tone while the second TBU which originally had a level High tone acquires a rising Low to High contour tone. In (25b), both TBUs surface with a level Low tone. The original High tone is delinked which is represented by the two parallel bars across the association line.

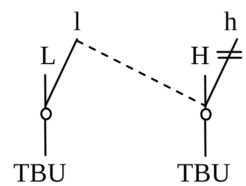
Similarly, when only the register feature spreads, the result is either the formation of a contour (26a) or delinking of the original feature (26b) which will create a level tone on that TBU as well, though the level tone may not be the same as the tone on the adjacent syllable.

(26) Register Spread

a. Contour formation



b. Delinking

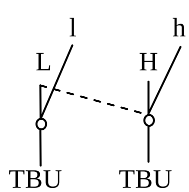


In (26a) the low register spreads from the first TBU to the second, forming a register contour on the second TBU. The first syllable surfaces with a level Low tone while the second syllable surfaces with a Mid-high to High rising contour tone. In (26b), the same register spreading process occurs; however, the register from the second TBU is delinked, again indicated by the two parallel bars across the original association line. In this case, the initial TBU surfaces with a Low tone and the second TBU surfaces with a level Mid-high tone. In many languages, this low-register spreading accounts for downstep. If the second TBU is not already specified for register, the spreading of the register can form a level tone on that syllable without the need for delinking.

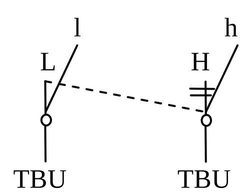
The final spreading process that can occur is the spreading of a tonal feature. Again, the spreading may result in the formation of a contour, as in (27a), or delinking may produce level tones on each syllable, as in (27b).

(27) Tonal Feature Spreading

a. Contour formation



b. Delinking



In (27a), the low tone feature spreads from the first TBU to the second and a contour is formed. In this case, the first TBU surfaces with a level Low tone and the second TBU surfaces with a Mid to High rising contour. In (27b), the tonal feature on the second TBU is delinked after the tone melody feature spreads so a level Low tone remains on the first TBU and a level Mid is formed on the second. In both cases, the registers of the TBUs are not affected at all. Again, if no tonal melody is originally specified, a level tone is formed on the targeted syllable without the need for delinking.

In the process of spreading as it occurs within RTT, the entire tone can spread with all of its features, a register feature may spread or a tonal feature may spread. In each case, a level tone may result on the targeted syllable (in the case of delinking or if that syllable was not previously associated with a tone specification) or a contour tone may result on the targeted syllable (if multiple features for a given register or tone remained linked to the TBU.) Whether level tones or contour tones result from spread is a language specific parameter. In all of the examples provided here, spreading has been represented as occurring in a rightward direction. While this is more common cross-linguistically (Cahill 2007), it is not required; leftward spread is possible as well.

1.5.4.4 OCP Effects

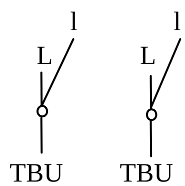
In this section, I discuss some potential effects of the OCP as represented within a RTT approach. As has been previously stated, if a language adheres strictly to the OCP, adjacent features are prohibited. Whether identical feature adjacency is forbidden only within a lexical representation or if this prohibition also extends to tones which are adjacent due to inflection, affixation, the addition of a clitic or due to phrasal formation is also a language specific parameter. For example, in Soyaltepec Mazatec, the phonological domain governed by the OCP extends beyond the grammatical word to include closely related modifiers. [23] Similar to the spreading processes, OCP effects may be applied to the entire tonal representation, to the register feature or to the tonal feature.

First, (28a) illustrates an unacceptable tonal representation if the OCP is active while (28b) representes an acceptable representation.

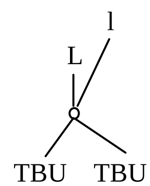
[23] The exact nature of the syntactic relations involved here needs further study. At this point in the analysis, the phonological domain in Soyaltepec Mazatec seems to encompass the entire noun phrase which includes quantifiers which precede the noun and modifiers which follow it. A phonological domain is also formed by a verb phrase and encompasses at least the verb and its direct object.

(28) Accpetable and Unacceptable representations

a. Adjacent L tones



b. Tonal plateau

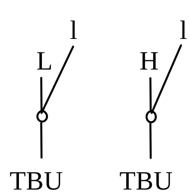


When two identical tones become adjacent, as in (28a), only one tonal specification is allowed. If the pitch of the two syllables is identical, then the two identical tones in (28a) could merge at the level of the TRN to produce the structure in (28b). Whether the first or second TBU loses its features (with accompanying stray erasure and potentially default insertion) or whether the two sets of features merge is a language specific matter for debate and beyond the scope of this dissertation. If the OCP is active in a language and two TBUs are adjacent within the domain specified, the structure given in (28a) is not allowed. The representation given in (28b) which contains one set of tonal features is more appropriate as the result of TRN merger or deletion (with accompanied spread) motivated by the OCP.

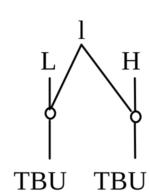
Second, the OCP may affect the register features when they become adjacent as in (29). Again, the effected register could be deleted, dissimilation could occur or merger may be used as the repair strategy for the OCP violation.

(29) Register Merger

a. Adjacent *l* registers



b. Register Plateau



The structure in (29b) demonstrates the merger of the two *l*-registers. The tones on the two TBUs remain distinct, the first being a level Low and the second being a level Mid-high. If the OCP is not active in a language or repair strategies are blocked for some reason (such as the presence of a floating *h*-register), thus leaving two *l*-registers on adjacent TBUs, then the second TBU will be lowered. The reason for this is that each overt *l*-register is defined as creating a register lower than the preceding register. Therefore, two Low toned TBUs that are adjacent and articulated at the same pitch must share the *l*-register specification. In the tonal situation specified in (29) where the second TBU has a different tonal melody, if two *l*-registers remain on the adjacent TBUs, then the second *l*-register would indicate a lowering of the Mid-high. The exact pitch of this lowered Mid-high, i.e., whether or not it would be pronounced below the Low tone preceding it would depend on the language specific pitch distance specified between the registers and tonal melodies of the given language.

Finally, the tonal feature may violate the OCP resulting in merger, deletion or dissimilation. When two tone features become adjacent and no other repair strategy is indicated, the two features will end up as a shared feature between TBUs, as is represented in (30b).

(30) Tonal Feature Merger

a. Adjacent L tone features b. OCP Result

Recall that the tonal features and register features exist in separate planes, so the association lines are not crossing, despite the 2-dimentional representation. The first TBU in both (30a and b) has a Low tone and the second TBU has a Mid tone.

The power and effects of the OCP are language specific as are the repair strategies, but it is important to note that the effects may be felt between any two adjacent elements. OCP motivated merger can join entire TRNs or just the feature on the register or tonal tier.

1.5.4.5 Summary

RTT is a theory that builds on Autosegmental Phonology in order to allow for the discrete representation of at least four level tones as well as both sequential and unitary contours. RTT allows all of the expected autosegmental phenomena, but with the potential to expand any process to any tonal tier. In other words, RTT allows for both total tonal plateaus as well as partial (either register or tone melody) plateaus. It also allows for contour tones to form in expanded ways. Either two TRNs can be connected to the same TBU or a register or tonal melody contour may occur between the two TRNs that are both linked to the same TBU. An entire tone may be unassociated and therefore floating or only the register feature or tonal feature may be floating. Finally, spreading may occur on any of these three levels as well. In addition, because of the relative definitions given to the register features, RTT allows for sequential upstep and downstep. Upstep and downstep are described in some African languages like Chumburung and Engenni (which both have downstep in a two level system, per Snider 1999). Upstep has also been described in a Mexican language with three level tones, Acatlán Mixtec (a Mexican language first described by Pike and Wistrand 1974, reanalyzed by Snider 1999). RTT allows the demonstration of register affects similar to upstep and downstep in languages with four levels of tone; however, languages rarely seem to offer this level of complexity. Soyaltepec Mazatec is one of the languages which require a theory of tone that allows for both four levels and the presence of register effects. It is my assertion that without the expanded apparatus provided by RTT, the complete description of the tonal phenomena that occur in Soyaltepec Mazatec would be difficult and even arbitrary, but through using RTT, the system is easily explained.

1.6 Tonal Typology

Tonal languages have been divided into two fundamental groups since at least the time of Pike's 1948 *Tone Languages*. The terms 'African tone language' and 'Register tone system' are often held in opposition to the terms 'Asian tone language' and 'Contour tone system.' Each group encompasses various language families and diverse types of tone languages. The opposition between these groups can be exemplified by looking at some basic tendencies of each. African tone languages tend to have small tonal inventories while Asian systems tend toward more complex inventories. African systems tend to have level tones[24] and if contour tones exist they can be shown to be sequences of the level tones which are expressed on a single TBU. The Asian systems often include contour tones which are primitive and unitary adding to multi-tiered minimal sets on single syllables. Because the Asian languages tend to have a simpler syllable structure and morphology, a heavy lexical weight is placed on the tones.

[24] Level tones are sometimes referred to as 'register tones.'

In addition to the differences in the composition of the tonal inventories, the behavior of the tones is also different. In Asian systems, tones tend to be sedentary as there is often a strong affinity of a tone to its lexical TBU. While sandhi is rare, when it exists it is usually between neighboring tones. Processes include spreading which is blocked by associated TBUs, assimilation, dissimilation and contour metathesis. Tonal changes can also be the result of a TBU's prosodic position in a grammatical word in which case complex chain-shifting has been described. On the other hand, in African systems sandhi is common and there is a high degree of tonal mobility. A tone may surface multiple TBUs away from its lexical source. Phenomena including spreading (both bounded and unbounded), downstep, polar tones and toneless TBUs are common as are OCP effects such as Meeussen's Rule. Additionally, general phonological constraints can be used to assign tones such as alignment with word edges, prominent syllables or phrasal boundaries. In addition, grammatical tones are common in African languages.

Traditional tonal typology describes specific types of tone languages which are more likely to be found in certain geographical areas; however, works such as *Kuki-Thaadow: An African tone system in Southeast Asia* (Hyman 2007), occasionally surface which disrupt the traditional, geographically established expectations. The geographic area of the Americas does not fit into either of these geographic designations, just as the tonal languages found in the Americas do not nicely fit into either typological group. Unfortunately, according to Yip 2002, the languages of the Americas have not been as widely studied, documented or analyzed as African and Asian languages, especially with respect to modern tonal theories. The question concerning if this group is completely distinct typologically and therefore warrants its own separate characterization has yet to be authoritatively addressed. Yip 2002 offers a separate chapter describing tonal languages of the Americas rather than assigning the languages to either aforementioned group. Yip describes American tone languages that have characteristics of Asian languages and others that have characteristics of African languages. The interested reader is referred to her work for further details.

This dissertation demonstrates that Soyaltepec Mazatec shares some characteristics with African tone languages and other characteristics with Asian tone languages. Considering the fact that occasionally languages surface which geographically fit into one group, but typologically the other and that languages of the Americas can be found which seem to have attributes of both types of languages, perhaps it is time to re-evaluate linguistic thinking of tonal typology and remove the artificial binary distinction.

1.7 Dissertation Overview

In Chapter 2, the literature that specifically refers to Soyaltepec Mazatec is reviewed. In Chapter 3, the general segmental phonology of Soyaltepec Mazatec is described. Chapter 4 addresses the surface tones that occur. Chapter 5 explores tonal processes of Soyaltepec Mazatec. Finally, Chapter 6 presents discussions, conclusions and recommendations for future research.

CHAPTER 2

LITERATURE REVIEW

2.1 Overview

In this chapter, I discuss the specific linguistic literature about Soyaltepec Mazatec with the intention that the reader will understand what literature is available that describes Soyaltepec Mazatec and the basic contribution that each item has made. In 1956, Eunice Pike published "Tonally differentiated allomorphs in Soyaltepec Mazatec" which is a description of Soyaltepec's tonal system in which she details complex phenomena that occur. It is the only article written specifically about Soyaltepec Mazatec tone using original data. This article has been referred to by two distinct groups of people. The first group involves those interested in comparative Oto-Manguean phonology. This group was interested in overall reconstruction, not the tone system specifically. They published several works which included extensive word cognate lists with data beyond Pike's, but they did not seek to further analyze the system. The data they offer is in the form of word lists, so it does not contribute to an understanding of the tonal interactions involved. The second group involves those interested in advancing phonological theory, specifically in the areas of tone studies and autosegmental analysis. This group relied on Pike's data but offered fresh analysis.

Gudschinsky (1959), Kirk (1966) and Rensch (1966), were interested in Proto-Oto-Manguean reconstruction. Gudschinsky collaborated with Pike to collect data throughout the Mazatec area, including Soyaltepec, which she used in her research on Proto-Mazatec, Proto-Popolocan and Proto-Popotecan[25] (which was published in different levels of detail in 1953, 1956 and 1959). Kirk made use of data sets from both Pike and Gudschinsky's published works, as well as their field notes, in his dissertation, Proto-

[25] Mazatec is part of the sub-family of languages known as Popolocan. Gudschinsky hypothesized another level of reconstruction which combined Popolocan languages with Mixtecan languages and named this subgroup Proto-Popotecan, a term that has not endured the test of time. For a listing of the currently accepted sub-classification of Oto-Manguean languages, refer to Appendix A.

Mazatec Phonology (1966). Rensch (1966) also investigated comparative Oto-Manguean phonology, making use primarily of data from Gudschinsky (1959). While each work on Proto-Mazatec gives a summary of the phonology of the individual languages like Soyaltepec, Pike's work is the only in-depth investigation of the tone system, and the other researchers each defer to it. Because there is no new tonal information other than increased numbers of examples of individual lexical items, I will not discuss the reconstructionist's work further at this time.

In addition to the American linguistic interest in Soyaltepec Mazatec, a comparative dialect dictionary entitled *Alfabeto Mazateco* was published in 1993 by Juan Gregorio Regino, a Mazatec linguist. This work includes word lists with glosses from four lowland Mazatec dialects (Soyaltepec, San Jose Independencia, Jalapa, and Ixcatlan), with some explanatory notes about the sound systems of each. This work is descriptive and informative, but not analytical. It demonstrates the orthography that is currently in use in the area, but it does not address issues relating to tone or tone sandhi. Furthermore, it only identifies three levels of tone and fails to describe most of the rising and falling tones that exist. Because I am interested in tonal analysis, the Regino work is not detailed enough to be incorporated here.

Pike's Soyaltepec Mazatec data has also been used by theoretical linguists (e.g., Biber (1981), Goldsmith (1990) and Pizer (1994)) to illustrate how specific theories handle a complex tonal language. Biber used Soyaltepec Mazatec data in his investigation of the proper representation of contour tones. Although the exact type of distinctive feature charts used by Biber are no longer in common usage, his conclusion that Soyaltepec Mazatec "demonstrates the necessity of the level-sequence analysis [of tone contours] for certain languages," (Biber 1981:273) is still relevant today. Goldsmith also demonstrates theoretical arguments[26] based on Soyaltepec Mazatec contour tone phenomena as described by Pike. He illustrates that contour tones can best be understood as concatenations of level tones on a separate tier from the segmental information of the syllables. Building on Goldsmith's analysis, Pizer reanalyzed Pike's data. She noted that the contour tones in Mazatec "behave like units with respect to some processes and like series of level tones with respect to others," (Pizer 1994: 97). In her article, she proposes that linguists may

[26] Soyaltepec Mazatec data appears only in Goldsmith's 1990 work, not in his earlier 1976 description of Autosegmental Phonology. The data he uses illustrate the theory but are not foundational to it.

need to rethink tonal geometry and typology by adding a class of languages of the Mazatec (or possibly Mesoamerican) type. Because the theory that Biber uses in his article is antiquated, I will not go into depth about it here. In the sections that follow, first I will detail the information provided in Pike's article. Then I will discuss Goldsmith 1990 and Pizer 1994.

2.2 Pike (1956)

In this section I discuss the initial paper written about Soyaltepec Mazatec tone. In my discussion, I include Pike's analysis, not my own; however, I use more current terminology as well as IPA symbols where appropriate. In the early 1950's Eunice Pike lent her expertise to the Instituto Nacíonal Indigenista (a government agency dedicated to the indigenous of Mexico) of Mexico for a brief time to study the Soyaltepec Mazatec language. As a result of her endeavors, a working orthography was produced and several primers were created for the school system. In addition, the IJAL paper was published. She starts her paper by saying, "Soyaltepec Mazatec has an extraordinarily complex system of tone sandhi," and goes on to describe a system that includes progressive perturbation, regressive perturbation, grammatical tone and "zero syllables with positive tone."(1956: 57) First, I will summarize the basic tone system that she describes, and then I will discuss the sandhi processes that she illustrates.

The tone system described by Pike includes four level tones that are numbered 1 to 4 with 1 being the highest. For the purposes of this paper, I will use standard IPA tone letter notations which were summarized in Table 1-1 above. To review, Pike's highest level tone, 1, will be indicated by the tone letter ˥, her 2 is Mid-high ˦, 3 is Mid ˧, and 4 is the lowest tone, indicated here by ˩. Rising and falling tones occur when two or more tones appear on a single syllable, Pike calls these tone clusters. This situation can be the result of morphophonemic processes, tone sandhi or the cluster may be lexical. She includes five rising tones[27] that are lexical: 2-1(˦˥), 3-2(˧˦), 4-3(˩˧), 3-1(˧˥), and 4-2(˩˦). She also briefly refers to one falling tone, 2-4 (˦˩). In most cases, she says this is a derived tone. She does give two examples that appear to be basic (these are listed in Table 2-1); however, they both occur in borrowed words. It is unclear if this falling

[27] Following Pike, multiple tones that appear on a single syllable will be written separated by a dash (-). If two tones appear separated by a space, this indicates tones on adjacent syllables.

tone should be viewed as a basic tone in the indigenous system and Pike never makes an explicit argument one way or the other. All other tones that appear in the paper, including most falling tones, are derived through the tone sandhi rules she explains.

In order to summarize the tonal contrasts, Pike gives eighteen minimal tone sets which are reproduced for the interested reader in Appendix B. Most of these involve near minimal segmental pairs because exact segmental matches were not always possible. Examples of each of Pike's basic tones appear below in Table 2-1. Unfortunately, there is no one minimal set which demonstrates all nine basic tones. In order to demonstrate all nine tones, two of Pike's minimal tone sets[28] are included along with other examples of the low rising tones as Pike does not provide minimal sets that include these tones. Also included are the two examples given of the falling tone which both happen to be in two syllable words. Examples here and throughout the chapter will be given with the notations adapted to standard IPA symbols.[29] The tone is listed down the left column; I give the abbreviation used throughout this dissertation as well as Pike's tone number for reference.

[28] For the sake of simplicity I have chosen minimal sets that involve monosyllabic words.

[29] The consonant clusters that occur will be discussed in Chapter 3, here and throughout this chapter, I will reproduce Pike's phonemes. For the interested reader, Pike indicates clusters which include aspiration and glottalization that occur after obstruents (e.g., th, tʔ, t͡sh, t͡sʔ etc.), but before sonorants (e.g., hn and ʔn). She also indicates pre-nasalized obstruents (e.g., nt, nt͡ʃ).

Table 2-1 Pike's Basic Tones of SM

	Tone	Minimal Set 1	Minimal Set 2	Other Examples
a.(level)	H (1)	swe˥ 'hot'	nta˥ 'smooth'	
b.	M_1 (2)	sjã˦ 'there [sitting]'		
c.	M_2 (3)	ʃa˧ 'tiger'		
d.	L (4)	ʃa˩ 'dew'	nta˩ 'voice'	
e.(rising)	M_1-H (2-1)	ʃa˦˥ 'work'		
f.	M_2-H (3-1)		nta˧˥ 'good'	
g.	M_2-M_1 (3-2)		nta˧˦ 'a song'	
h.	L-M_1 (4-2)			t͡ʃ̜ũ˩˦ 'woman'
i.	L-M_2 (4-3)			na˩˧ 'mother'
j.(falling)	M_1-L (2-4)			t͡ʃi˧tu˦˩ 'cat'
k.				ra˧ʃa˦˩ 'orange'

The examples above in rows (a-i) demonstrate the nine basic tones described by Pike using near minimal pairs and monosyllabic examples. Examples of four level tones are included as well as five of the six hypothetically possible rising tones that can exist in a system with four level tones. Only the rise from Low to High (4-1 ˩˥) is missing. Rows (j and k) show two examples of the falling tone. It is interesting that there are not any examples in Pike's article of falling contour tones that are basic tones on non-borrowed words.

According to Pike, most words exhibit their base tone in isolation as well as in environments that do not produce sandhi but can also be expressed with three or four derived tones, depending on their environment. In the sections that follow I discuss the tone sandhi that Pike discusses in order to show the relative complexity of the system she describes. Pike divides the sandhi into four basic types: 1. change caused by single tones, 2. change caused by contour tones, 3. change caused by grammatical position and 4. change caused by 'zero syllables with positive tone.' I follow Pike's general organization and summarize her main points.

2.2.1 Change Caused by Single Tones

Pike discusses two main effects of level tones: regressive perturbation (changes caused on the first morpheme when two morphemes are combined to form a new grammatical word)[30] and progressive perturbation (changes caused on the second word by a word final High tone of the first word). The processes are similar only in that they both involve level tones. I discuss each in turn.

2.2.1.1 Regressive Perturbation

In this section I explain the effects that adding a morpheme can have on the previous syllable's tone. These regressive changes occur as a consequence of suffixation[31] or of compounding. According to Pike, the effects are noticed on the final syllable of the first morpheme (the target), and the changes in question are caused by a level tone that occurs on the first syllable of the second linear morpheme (the trigger). The trigger syllable causes a change on the syllable to its left. This is what she refers to as 'regressive perturbation.'

Three of the four level tones (H, M_2, and L) trigger changes in the preceding syllable when morphemes are adjoined. For example, suffixes with Low tones (the trigger) cause the tone of the syllable to which they attach (the target) to change from a Mid to a Mid-high tone (the result) as in (1). The

[30] A grammatical word is defined by Pike as the stem of a word and its affixes, not including any enclitics. The unit which includes the enclitics is referred to by Pike as the phonological word.

[31] Although Soyaltepec makes use of several prefixes, Pike does not indicate whether or not prefixes participate in this process – none of her examples involve the prefixed forms.

syllables that contain the specific target, trigger and resultant tones are underlined for clarity. The tone is overtly listed for the syllable in question on the line above the data.

(1) Raising of a M_2 tone (Pike 1956:59)

Target		Trigger		Result
M_2		L		M_1
ʃa˧	+	-ʔɛ˩	→	ʃa˦ʔɛ˩
'wild cat'		'his'		'his wild cat'

In this process, the trigger tone (L) remains unchanged.

The alterations that occur are summarized in Table 2-2. The tones on the syllable that are the targets for change are listed in the left column. The trigger tones are listed in the central column. The tone that results from the transformation is listed in the final column.

Table 2-2 Regressive Perturbation

	Targeted tone / contour	Trigger tone	Resultant tone / contour
a.	M_1-H	H	H
b.	M_2-M_1	H	H
c.	M_1	H	H
d.	L-M_1	H	L-H
e.	H	M_2	M_1
f.	H	L	M_1[32]
g.	M_2	L	M_1
h.	M_1-L	L	M_1

The changes that Pike describes are difficult to generalize. The High tone apparently spreads left and overwrites the M_1 and two of the contours, as seen in (a-c) above. It also overwrites the M_1 that is the final member of a L-M_1 contour as can be seen in (d); however, in this case the initial member of the contour remains resulting in a L-H contour. In (e) we see that the Mid tone lowers a High tone to a Mid-high, possibly this could be viewed as a partial assimilation instead of the complete overwriting that we saw performed by the High tone in (a-d). A Low tone has an effect on three types of tones (f-h), always changing the previous tone to a Mid-high tone. If the previous tone is: a High (f) it lowers it, a Mid (g) it

[32] In the case of a H H sequence, the second H is changed to a M_2 instead of a M_1, i.e., H $H]_\mu$ + L → H M_2 L.

raises it or a Mid-high to Low contour (h) it simplifies it. The contour that is affected in (h), i.e., M_1-L, could be seen as splitting with the second member of the contour, the Low, spreading to the following syllable and merging with the low that is the trigger, leaving the first member of the contour unaffected. Recall that the Trigger tone is not changed in any of these processes.

While Pike claims that these changes are very regular in that they always occur given the correct environment; they are not easily described in terms of logical mechanisms or expected tone rules. The raising and lowering that are provoked by the low tone are especially challenging.[33] It is probable that these effects are actually phonetic realizations and not truly phonological changes. Since I am focusing on phonological tone behavior, I will not revisit these types of alternations.

I have listed the effects produced within grammatical words caused by level tones that are described in Pike's article. These are all regressive perturbations, i.e., the tone on a suffix changes the tone on the stem. The effects produced by level tones in separate words are always progressive as will be seen in the next section.

2.2.1.2 Progressive Perturbation

Pike uses the term progressive perturbation to refer to an effect produced by the tone in one word or morpheme on the following word or morpheme. In this case, progressive perturbation is always caused by a word final High tone, whether level or the final member of a contour. She describes two separate changes caused by a word final H: the first change is on the final syllable of the following word if that syllable has a High tone; the second change is on a Mid-high tone on the first syllable of the following word.

The first change caused by a word final High tone which is addressed by Pike involves a change in the final syllable of the following word, regardless of the number of syllables in that word. After a word with a final High, an underlying High tone at the end of the following word becomes a falling High to Mid-high contour. Consider the examples in (2). In (2a) two high-toned monosyllabic words come together to

[33] One potential explanation using the features described below by Snider is a spreading of the low register (l) from the low tone (L l) for both the change in H (H h) and M_2 (L h) which produces the desired change in H (to H l); however, the M_2 would then become identical to L (L l) thus necessitating subsequent dissimilation of the tonal melody of the original M_2 to maintain tonal distinction (producing (H l)).

form a phrase. In context, the High tone on the second word changes to a High to Mid-high falling contour. In (2b), the same effect is realized even though the target morpheme is disyllabic and therefore not adjacent to the trigger. The syllable in focus is underlined (i.e., the trigger syllable, the targeted syllable, and the resultant syllable) and the tones on those syllables are listed above the data.

(2) Creation of a H-M_1 (˥˦) falling tone (Pike 1956:60)

	Trigger[34]		Target		Result
	<u>H</u>		<u>H</u>		<u>H-M_1</u>
a.	<u>ho˥</u>	+	<u>t͡ʃʔa˥</u>	→	ho˥ <u>t͡ʃʔa˥˦</u>
	'two'		'father-in-law'		'two father-in-laws'
b.	<u>ho˥</u>	+	thi˥<u>t͡su˥</u>	→	ho˥ thi˥<u>t͡su˥˦</u>
	'two'		'is saying'		'is saying two'

The example in (2a) is the simplest scenario in which this perturbation occurs. As is demonstrated in (2b), the influence of the word final High tone on the final syllable of the following word is not affected by the presence of intervening syllables. The High tone which causes the change does not need to be level; it can also be the final member of a rising contour. Consider the example in (3) in which the trigger syllable has a word final rising contour from Mid-high to High. According to Pike, the presence of this High tone, even though it is part of a contour tone provokes the change in the following word. In this case, the following word again is multisyllabic, but ends in a High tone.

(3) Creation of a H-M_1 (˥˦) falling tone (Pike 1956:60)

Trigger		Target		Result
M_1-<u>H</u>		<u>H</u>		<u>H-M_1</u>
khi˦<u>nti˦˥</u>	+	ki˦<u>te˥</u>	→	khi˦nti˦˥ ki˦<u>te˥˦</u>
'baby'		'danced'		'(the) baby danced'

[34] As opposed to (1) above which exemplified regressive perturbation, the trigger in (2) comes first and targets the following morpheme, hence exemplifying progressive perturbation.

The targeted word may be monosyllabic or multisyllabic; the only requirement is that the final syllable is high-toned. Because both the trigger and target must be specified as High tones for this fall to occur, it is unlikely that the motivation for this newly formed falling tone is a phrasal effect which would occur at the end of a phrase regardless of the tones that are already present. Pike does not offer any motivation or any mechanism for the described change; she simply states that it occurs regularly. The only exception, according to Pike, involves two syllable words that begin with a low tone and end in a high tone. Words with this tone pattern, she says, are never perturbed.

In the second instance of progressive perturbation caused by a word final High tone, the initial syllable of the disyllabic word following the High tone is targeted. In this case, a Mid-high tone is lowered to a Mid tone when the second syllable of the targeted word is Low as in (4) (i.e., it only targets the word pattern M_1 L). Again, the syllable with the tone in focus is underlined, and the tones on those syllables are listed overtly above the data.

(4) Mid-high tone lowering (Pike 1956:60)

Trigger		Target		Result
H		M_1		M_2
hwa˧<u>hwe</u>˥	+	<u>Re</u>˦su˩	→	hwa˧hwe˥ <u>Re</u>˧su˩
'sleep'		'Lorenzo'		'Lorenzo sleeps'

The data in (4) shows the change from a M_1 on the targeted morpheme to M_2 on the resultant word which is provoked by the H of the trigger word. The example in (4) involves a trigger word with a level High tone. The change is also motivated by words which end in rising contour tones as long as the final member of the contour is a High tone. Additionally, the targeted word may have a derived tone. Notice that the targeted environment (M_1 L) can occur as a result of the regressive perturbation caused by a Low tone as described above in §2.2.1.1. The example in (5) contains both of these complications: a rising trigger syllable and a derived target syllable. The formation of the target word is illustrated in (5b).

(5) Lowering of a derived Mid-high tone by a contour tone

a. Mid-high tone lowering (Pike 1956:60)

Trigger		Target		Result
M_2-H		M_1		M_2
nta˧˥	+	t͡ʃʔa˦ʔna˩	→	nta˧˥ t͡ʃʔa˧ʔna˩
‘good’		‘my father-in-law’		‘my father-in-law is good’

b. The formation of t͡ʃʔa˦ʔna˩ ‘my father-in-law’

Target		Trigger		Result
H		L		M_1
t͡ʃʔa˥	+	-ʔna˩	→	t͡ʃʔa˦ʔna˩
‘father-in-law’		‘my’		‘my father-in-law’

From (5b) we see that ‘father-in-law’ started as a high-toned single syllable word which, when modified by the low toned ‘my,’ became a two syllable word with the word tone pattern M_1 L. When this new word is placed in the context of ‘good’ (a word with a rising tone which ends in a High tone), as demonstrated in (5a), the targeted syllable which began lexically with a High tone (i.e., the target in (5b)) is expressed with a Mid tone (i.e., the result in (5a)). Again, Pike does not hint at the motivation for the lowering of the Mid-high to Mid. It is possible that it is a dissimilation process; however, it is more likely that this effect is purely phonetic since it can be explained through a phonetic transition between the High and Low tones and there is no straightforward structural explanation for the process that would make it a phonological change.

While the changes Pike describes in this section that involve progressive perturbation can involve either level High or rising tones, it is clear that the effect is caused by the word final presence of the High tone. These types of perturbations have given linguists such as Biber (1981) and Goldsmith (1990) fodder for their arguments concerning the sequential nature of tones, i.e., the High tone behaves as a High tone whether it is the constituent of a contour or an individual level tone; therefore, they claim, the contours must be the concatenation of level tones which maintain their identity and influences even when within a contour.[35] The contour tones themselves are also involved in progressive perturbation which will be discussed in the next section.

2.2.2 Change Caused by Contour Tones

In this section, I discuss the second section of Pike's paper which details the sandhi caused by contour tones. She includes sandhi caused by three different rising tones: the Mid-high to High rise (˦˥), the Mid to Mid-high rise (˧˦), and the Low to Mid-high rise (˩˦). She indicates that the Mid to High rising tone (˧˥) does not participate in contour type sandhi, and she does not address the Low to Mid rise (˩˧) at all. In order to make generalizations, I do not maintain Pike's order or her groupings. Instead, I first demonstrate the most straightforward cases of contour tone splitting with endpoint shift in §2.2.2.1, followed by a discussion of the unusual behavior of the Mid-high to High rise in §2.2.2.2.

2.2.2.1 Contour Tone Split with Endpoint Shift

The sandhi caused by the rising tones ending in a Mid-high tone (i.e., Mid to Mid-high rising tone and the Low to Mid-high rising tone (˧˦ and ˩˦)) are both cases of contour simplification in which the contour splits and the endpoint shifts. In this section, I describe and give examples of this type of sandhi. Although Pike separates the processes that she discusses into two different groups depending on if the sandhi occurs within a grammatical word or across a word boundary, the result is tonally identical, so I discuss them together.

Pike describes the sandhi as progressive perturbation with a reciprocal effect. In other words, change can be seen on two syllables, both the trigger syllable and the following target syllable. The process can be described as a separation of the contour tone with the initial tone remaining attached to the original syllable and the second tone attaching to the syllable directly to the right of its origin. The examples below demonstrate the tone split and shift involving these contour tones: M_2-M_1 in (6) and L-M_1 in (7). To the left

[35] These linguists were not the first modern linguists to propose that contour tones are actually sequences of level tones (that was done by Woo (1969)); however, the formation of contour tones from level tones is demonstrated by these linguists, with Soyaltepec Mazatec as a primary example.

of the arrow appear the words as they occur in isolation. The first word is the trigger of change. The second word is the target. To the right of the arrow, the result demonstrates the words after tone sandhi has occurred. Notice that in the result, the morpheme that was the trigger word and had a contour now has a level tone and the tone of the targeted word now begins with a M_1 which is either level or the first member of a falling contour. In (6a-c) and (7a-b), the target syllable has a Mid tone and the result after the sandhi is a Mid-high tone. In (6d-e) and (7d-e) the target has a Low tone and the result of the sandhi is a Mid-high to Low falling tone. Examples (6a, b and d) and (7a-c) show contour split and endpoint shift across a word boundary while (6c and e) and (7d) show the process within a grammatical word.

(6) Examples of split and shift involving M_2-M_1 (˧˦) contour tone (1956:61-62)

Trigger		Target		Result
a. nku˧˦ 'one'	+	t͡sha˧ 'hand'	→	nku˧ t͡sha˦ 'one hand'
b. hĩ˧˦ 'eight'	+	ni˧sĩ˧ 'rats'	→	hĩ˧ ni˦sĩ˧ 'eight rats'
c. tu˧˦ 'fruit'	+	ʔa˧ʃi˧˦ 'sweet'	→	tu˧ʔa˦ʃi˧˦ 'candy'
d. te˧nku˧˦ 'eleven'	+	ti˩ 'fish'	→	te˧nku˧ ti˦˩ 'eleven fish'
e. tki˧˦ 'medicine'	+	-hni˩ 'our exc.'	→	tki˧hni˦˩ 'our exc. medicine'

(7) Examples of split and shift involving L-M_1 (˩˦) contour tone (1956:62)

Trigger		Target		Result
a. t͡ʃʔei˩˦ 'take!'	+	t͡se˧ 'guavas'	→	t͡ʃei˩ t͡se˦ 'buy guavas!'
b. nt͡ʃe˩˦ 'cooked corn'	+	t͡sʔa˧t͡se˧ 'she bought'	→	nt͡ʃe˩ t͡ʃe˦t͡se˧ 'she bought cooked corn'

c. t͡ʃʔei˧˦	+	t͡shu˩	→	t͡ʃʔei˩ t͡shu˩˦
‘take!’		‘onions’		‘buy onions!’
d. t͡ʃhũ˧˦	+	-hni˩	→	t͡ʃhũ˩hni˩˦
‘woman’		‘our exc.’		‘our exc. women’

In (6) the trigger syllable is a Mid to Mid-high rising tone, while in (7) the trigger is a Low to Mid-high rising tone. In (6a-c) and (7a-b), the Mid-high that shifts from the trigger syllable completely replaces the tone that was previously on the target syllable. In (6d-e) and (7d-e) the tone that shifts joins the already existing tone on the syllable, creating a contour tone. In each case, the original trigger syllable takes on the level tone that was the initial member of the contour: in (6) a level Mid and in (7) a level Low. It is not significant whether or not the trigger and target syllables become part of the same grammatical word (6c, e and 7d) or not (6a, b, d and 7a-c). The perturbation caused by the shift only affects the syllable that is directly adjacent to the trigger syllable; if the target syllable is part of a longer word the remainder of the word is unaffected.

I have summarized the basic contour tone split and endpoint shift process that involves contour tones ending in a Mid-high tone. Following Pike, I have not attempted to write rules, but merely given examples as they occur.

2.2.2.2 Sandhi Surrounding the Mid-high to High Contour

Unlike the contours described above, the Mid-high to High contour tone does not split and shift in the expected manner. It is similar to the process just described in that the trigger syllable which had the contour always ends up as a level tone and the following syllable is always raised; however, the exact tones that result are not the tones predicted from the members of the contour. Sometimes the following syllable becomes a High tone; other times it becomes a Mid-high tone. The tone on the trigger syllable itself is replaced by a Mid tone which is not a member of the original contour.

The case that is most similar to the simple splitting and shifting already described involves perturbation across a word boundary. In this case, the Mid-high to High contour causes the first syllable of the following word to be replaced by a High tone. It is not like simple splitting and shifting because the trigger syllable is changed to a Mid tone rather than the original Mid-high tone of the contour. Examples appear in (8). The words which occur to the left of the arrow appear as they occur in isolation, to the right of the arrow the tones appear as they occur in combination, after sandhi has occurred. The syllables in focus are underlined.

(8) M_1-H contour split and shift across a word boundary (Pike 1965:61-63)

Trigger		Target		Result
a. ma˧t͡ʃa˦˥	+	t͡se˧	→	ma˧t͡ʃa˧ t͡se˥
‘it grows’		‘guava’		‘guavas grow’
b. thĩ˦˥	+	ni˧ʔja˧	→	thĩ˧ ni˥ʔja˧
‘is present’		‘house’		‘there is a house’
c. ma˧t͡ʃa˦˥	+	ʃu˩ti˩	→	ma˧t͡ʃa˧ ʃu˥ti˩
‘it grows’		‘tomatoes’		‘tomatoes grow’
d. ti˩hi˦˥	+	tha˩t͡se˩	→	ti˩hi˩ tha˥t͡se˩
‘bowl’		‘new’		‘a new bowl’

The examples in (8a-b) involve targets with a Mid tone while (8c-d) involve targets with a Low tone. In each example, the first syllable of the target is replaced with a level High tone as expected. However, in (8a-c), the trigger tone is replaced by a Mid tone rather the predicted Mid-high tone. There is no explanation for this unexpected difference. In (8d), the tone on the trigger syllable is replaced by a Low tone, rather than a Mid-high tone because it assimilates to the Low of its first syllable. For this process to occur with the resultant morpheme containing the expected High tone, as the examples above have shown, the target may not be a monosyllabic word with a Low tone. In this case, it will surface with a falling tone which begins at the Mid-high level instead of the High level (9).

(9) M_1-H tone sandhi across a word boundary with a monosyllabic L target (Pike 1956:62)

Trigger		Target		Result
t͡ʃhẽ˦˥	+	t͡ʃu˩	→	t͡ʃhẽ˧ t͡ʃu˦˩
‘it is needed’		‘animals’		‘animals are needed’

The target syllable retains its tone (similar to (6d-e) and (7c-d) above) and incorporates the shifting tone from the trigger syllable creating a falling contour tone, M_1-L. This situation (of a monosyllabic target containing a L) is the only case of M_1-H perturbation across a word boundary that results in a M_1 on the resultant syllable instead of H. However, when the sandhi occurs within a newly created grammatical word, it always results in M_1 rather than a H, as the examples in (10) demonstrate.

(10) M_1-H sandhi within grammatical word (Pike 1956:61-62)

Trigger		Target		Result
a. t͡si˦˥	+	se˧	→	t͡si˧se˦
‘he makes’		‘thick’		‘he thickens’
b. nta˦˥	+	ʃkũ˩	→	nta˧ʃkũ˦˩
‘liquid’		‘eyes’		‘tears’
c. t͡sa˦˥	+	ki˩ʃũ˩	→	t͡sa˧ki˦ʃu˩
‘caterpillar’		‘charcoal’		‘a black caterpillar’

Each result in (10) consists of a single grammatical word. By combining morphemes, a verb is formed in (10a) while in (10b-c) nouns are formed. The target in (10a) contains a monosyllabic morpheme with a Mid tone which is changed to a Mid-high tone in the result. The target in (10b) is also monosyllabic, but in this case it contains a Low tone which is retained and incorporates the Mid-high tone that shifted and lowered from the trigger contour in the result. The product is a falling contour, M_1-L, similar to the case of the monosyllabic low toned target syllable discussed in (9) above. (10c) demonstrates a disyllabic Low toned target which allows complete replacement of the tone on the first syllable and retains the Low tone on the second syllable. In each case, the original trigger syllable’s contour tone is replaced by a level Mid.

Pike notes that the perturbation caused by the M_1-H contour tone is not altered by sandhi which has already occurred on the target syllable. Unlike the sandhi which was described in §2.2.1, the surface tone of individual constituents in isolation is irrelevant to the outcome, only the underlying tones are taken into account.[36] If the target syllable has an underlying Mid tone, the result will be a High tone on that syllable. In the case of (11), the target syllable contains a derived Mid-high tone which was originally a Mid tone. This syllable is still changed to a High tone when it is in the environment of the contour trigger in question. (11a) demonstrates the contour triggered sandhi while (11b) shows the formation of the target.[37]

(11) M_1-H perturbation of a derived form with underlying M_2 (Pike 1956:62-63)

a.

Trigger		Target		Result
nti˦˥	+	thya˦ʔna˩	→	nti˧ thya˥ʔna˩
'dirty'		'my arm'		'my arm is dirty'

b.

Target		Trigger		Result
thya˧	+	-ʔna˩	→	thya˦ʔna˩
'arm'		'my'		'my arm'

The sandhi demonstrated in (11) is analogous to the sandhi that was seen in (8a and b) in which a M_1-H contour perturbs the first syllable in the following word which had a Mid tone,[38] creating a High tone on that syllable and a Mid tone on the original syllable. The sandhi shown in (11b) is an example of the regressive perturbation discussed in §2.2.1.1.

The example in (12a), below, demonstrates again that the underlying tones are the agents of this sandhi, not the surface tones in isolation. It contains the same surface tones on the trigger and target morphemes as occurred in (11a), but the resultant tones are not the same. The targeted word in this case has surface tone which has already been altered by the regressive perturbation of a Low toned suffix that changes a High tone to a Mid-high tone as was described in §2.2.1.1 and demonstrated in (5b) above and is

[36] The relevance of the underlying tones as opposed to the surface tones also may add credence to the idea that the current sandhi is phonological whereas the previously described sandhi was a reflex of the phonetic manifestation of the words as opposed to a true phonological process.

[37] Notice that this process of forming the target before the process in (11a) takes place is artificial, the sandhi undoubtedly takes place as these three morphemes are brought from the lexicon together, rather than in two separate stages: i.e., *thya˦ʔna˩* 'my arm' is not a fixed form in the lexicon, but is created when needed, *ʔna˩* 'my' should be viewed as modifying the entire utterance rather than just the noun.

[38] Pike does not give any examples of sandhi produced when the target syllable has an underlying M_1.

repeated as (12b) to show the formation of target word. In this case, the target word has an underlying High tone which blocks the expected sandhi of the contour tone, forcing the contour to remain unchanged. The surface Mid-high tone is now subject to the progressive perturbation that was described in §2.2.1.2 in which a High tone at the end of the trigger morpheme causes a Mid-high tone to surface as a Mid tone. (12a) shows the perturbation that occurs while (12b) demonstrates the formation of the target and its underlying form.

(12) M_1-H Perturbation of derived form with underlying H (Pike 1956:60)

a.

Trigger		Target		Result
t͡ʃẽ˥	+	t͡ʃʔa˦ʔna˩	→	t͡ʃẽ˥ t͡ʃʔa˧ʔna˩
‘is needed’		‘my father-in-law’		‘my father-in-law is needed’

b.

Target		Trigger		Result
t͡ʃʔa˥	+	-ʔna˩	→	t͡ʃʔa˦ʔna˩
‘father-in-law’		‘my’		‘my father-in-law’

The underlying form of the target in (12a) has a High tone (as is demonstrated in (12b)) which blocks the shifting from the contour tone trigger. The result in (12a) shows that the contour does not change and the target syllable lowers to a Mid tone as was described above in §2.2.1.2.

Another example in which the contour does not produce the expected sandhi occurs when the contour is placed adjacent to a word which begins with a Mid tone, but which had an underlying M_1-H contour. Unlike the cases above in which a targeted Mid tone becomes a High tone in the resultant word, in this case no sandhi occurs, as is demonstrated in (13a). (13b) shows the formation of (13a)’s target word.

(13) Blocked M_1-H sandhi (Pike 1956:64)

	Trigger		Target		Result
a.	wa˧ku˥	+	ʔẽ˧ɲu˦ma˩	→	wa˧ku˥ ʔẽ˧ɲu˦ma˩
	‘he teaches’		‘an Indian language’		‘he teaches an Indian language’
b.	ʔẽ˥	+	ɲu˩ma˩	→	ʔẽ˧ɲu˦ma˩
	‘word’		‘poor’		‘an Indian language’

In (13a), even though the environment for sandhi seems to be met, there is no change in the trigger or the target. (13b) shows the formation of the compound noun which contains the targeted syllable for (13a). In a similar process as was described in (11) above, the M_1-H contour shown in the trigger of (13b) splits. The result is a M_2 appears on the original trigger morpheme and a M_1 occurs on the first syllable of the targeted morpheme as demonstrated in the result of (13b). This derived Mid tone is not perturbable as is demonstrated in (13a).

In summary, like the M_2-M_1 and L-M_1 contour tones, the sandhi of the M_1-H tone usually has an effect on both trigger and target syllables, but in this case, the results are unexpected. The trigger syllable acquires a Mid tone rather than retaining its original Mid-high tone except in the case of Low tone assimilation shown in (8d). The target receives the expected High tone only if it is across a word boundary (8) and not a monosyllabic low-toned morpheme (9). When it is within a grammatical word, the target receives a Mid-high tone instead (10). The perturbation produced by the M_1-H contour affects the underlying tone, not the surface tone (11 and 12) and is blocked by an underlying H or M_1-H on the target syllable (12 and 13).

It is this unusual combination of effects from the same contour tone which motivates Pizer's (1994) analysis. Two environments have been demonstrated, other than isolation, in which contour remains intact: when the underlying tone of the target is H or M_1-H. In the example given in (12), the target still undergoes the sandhi brought about by the final high tone, even though neither the effect of the contour nor the reciprocal effect is seen. In (13a) there was no apparent perturbation. There are other exceptions to the sandhi rules; Pike mentions several other environments which appear to be nonperturbable which will be discussed below.

2.2.2.3 Nonperturbable Sequences

Pike claims that the tone sandhi of Soyaltepec is very regular. The only time that morphemes fail to cause the expected perturbation is when the target syllable is nonperturbable. We have already seen that certain tones block the split and shift of the contours that was described above, namely an underlying H or M_1-H. In this section, I discuss those word tone patterns that are nonperturbable sequences.

The regressive and progressive perturbation discussed in §2.2.1 above are very regular processes and occur whenever the proper environment is met. The only exception offered by Pike is in the case of the progressive perturbation caused by a final High tone when it is influencing the final High tone of the following morpheme. Every High tone in this environment experiences the progressive perturbation described in §2.2.1.2 and surfaces as a High to Mid-high falling contour tone (˥˦) except when it is part of a disyllabic word with a L H word tone pattern. This type of word is never changed by its environment.

The first syllable of the L H disyllabic word is also not altered by the sandhi described in §2.2.2, but in this case it is not alone, there are four other word tonal patterns that resist change to the first syllable. Typically, when a morpheme has an initial syllable with a Mid or Low tone, it will experience the perturbation described above in §2.2.2.1 and §2.2.2.2, resulting in a High, Mid-high or Mid-high to Low falling tone on that syllable. The exceptions include the disyllabic words with the tone sequences listed in (14) below.

(14) Nonperturbable initial syllables of disyllabic words

M_2 H	L H
M_2 M_1-L	L M_1-L
M_2 M_1	

When the five tonal patterns listed in (14) are examined, we find that the second syllable of each of these exceptions to the sandhi pattern contains either a H or a M_1. The hypothesis, however, that the presence of these tones in some way hinders sandhi is overridden by Pike since she gives one example of a word with a M_2 M_1-H pattern which participates in the sandhi described in §2.2.2.1, reproduced here as (15).

(15) M_2 M_1-H participates in sandhi (Pike 1956:62)

Trigger		Target	Result
t͡shʔei˦˩	+	t͡sha˧kĩ˥ →	t͡shʔei˩ t͡sha˦kĩ˥
‘take!’		‘firewood’	‘buy firewood!’

It is evident from (15) that the presence of H and M_1 on the second syllable of the target word does not prevent sandhi from occurring. There is also a group of trisyllabic word tone patterns that resist sandhi on their first syllable. All of these patterns begin with the M_2 M_1 pattern on the first two syllables. The word patterns are listed in (16).

(16) Trisyllabic word patterns resistant to tone sandhi on the first syllable

M_2 M_1 M_2	M_2 M_1 M_2-M_1
M_2 M_1 M_1-H	(M_1 M_2 L)

The final trisyllabic word pattern that resists perturbation is placed in parentheses because it is only resistant to sandhi under certain conditions such as if it is a loan word from Spanish, or if the underlying representation contains a rising contour on the first syllable which has already been altered by sandhi. The interested reader is referred to the original article for more details.

It is suspicious that the second syllable once again contains the M_1 tone in most cases that are resistant to sandhi; however, an all-encompassing generalization is not forthcoming. Pike is very thorough in her description of what is possible in the tone system of Soyaltepec; however, the system she describes requires lists or classes of words which are difficult to generalize.

2.2.2.4 Sandhi and Enclitics

In general, the sandhi which takes place within other grammatical words that has been discussed above applies in the same way to enclitics including the Mid-high to High contour sandhi which splits and replaces the tone on a mid-toned enclitic. There are, however, two notable patterns that are unique. First, the tone on monosyllabic targets with Low tones can be replaced by a level Mid-high tone instead of forming the falling contour that was demonstrated in §2.2.2.1 and §2.2.2.2. Second, the tone on an enclitic with an underlying Mid to Mid-high contour tone can be raised to a Mid-high to High contour. I discuss each in turn.

The Low tone of a monosyllabic target, whether a member of the grammatical word or in a following word, is usually replaced by a falling Mid-high to Low contour tone when perturbed by a rising contour (i.e., M_2-M_1, L-M_1 or M_1-H). This is also true of enclitics except when the enclitic consists only of a vowel or an /h/ plus vowel. The tone on the enclitic is replaced by a level Mid-high tone (17).

(17) Enclitic perturbation resulting in a level mid-high tone (Pike 1956:64)

Trigger		Target		Result
a. sa˦˥	+	-a˩	→	sa˧-a˦
'moon'		'this'		'this moon'
b. ku˧ni˧˦	+	-i˩	→	ku˧ni˧-i˦
'monkey'		'this'		'this monkey'
c. wa˧ku˦˥	+	-hi˩	→	wa˧ku˧-hi˦
'to teach'		'you sg.'		'you, emphasis, teach'

The examples in (17a and c) involve perturbation caused by Mid-high to High (˦˥) contour while the example in (17b) involves the Mid to Mid-high (˧˦) contour. The results for all three examples are tonally equal: the trigger syllable acquires a Mid tone, the target syllable acquires a Mid-high tone and the original Low tone on the target syllable is delinked and presumably deleted. Interestingly, this is the only instance in which the type of onset (or lack thereof) is relevant in Pike's analysis. Pike does not offer any examples of the perturbation produced by the L-M_1 contour in combination with a monosyllabic low-toned enclitic; however, she states that it behaves as has been described here.

The second difference in the sandhi of enclitics involves an underlying Mid to Mid-high (˧˦) contour. When added to a morpheme ending in a High tone (whether level High or part of the Mid-high to High contour), the contour tone on the enclitic is raised as a unit to a Mid-high to High rise(˦˥) (18).

(18) M_2-M_1 contour raised to M_1-H contour (Pike 1956: 65)

Trigger		Target		Result
a. ni˥khyẽ˥	+	-ni˧˦	→	ni˥khyẽ˥-ni˦˥
'to feed'		'you for me'		'you feed me'
b. t͡shwa˦˥	+	-ɲa˧˦	→	t͡shwa˧-ɲa˦˥
'he gives'		'it to us'		'he gives us'

(18a) is an example of a High tone trigger while (18b) is an example of a rising Mid-high to High trigger. The important attribute of the trigger is that the final tone on the syllable is a High tone. In the case of (18a), the High tone is unaffected by the sandhi it causes, remaining High. This is the only case of progressive perturbation within a phonological word caused by the High tone. In the result of (18b), the rising contour trigger is replaced by a Mid tone, so the Mid-high tone is completely removed, similar to the split and shift above in §2.2.2.2. The process is noteworthy because it calls into question the behavior of rising contour tones in Soyaltepec Mazatec, and the overall typology of tone languages. Previously, the behavior of the Soyaltepec rising tones that has been described made them appear to behave as two tones attached to one syllable; however, this newly mentioned behavior makes them look more like units because the entire contour has shifted up by one pitch level as if it were a unit. Theoretically, the process would change only the first tone of a concatenation of tones, not both tones. According to the typology originally described by K. Pike (1948), tone languages either have unitary contours or contours made up of tautosyllabic juxtapositions of level tones. This process calls into question the concept that contour tones are either units or concatenations of level tones. The ability to rise as a unit should not co-exist with the ability to divide the contour into two tones which end up on different syllables. This behavior was also reanalyzed in Pizer's (1994) work.

2.2.3 Change Caused for Grammatical Reasons

Pike indicates two different kinds of changes that are related to grammar rather than environment. The first of these involves a semantic change in tense or person. The second is a change produced by the phrasal position of the lexeme in question.

2.2.3.1 Semantic Change Indicated by Tone

Pike does not give many examples of the type of grammatical tone which indicates semantic differences solely through changes in tone. The two categories that she mentions that can be modified by a change in tone are person and tense.

Both the subject and object can be indicated on a verb in Soyaltepec Mazatec, as the example in (19) demonstrates. By changing the tones on the verb and its enclitics, both the subject and object are altered.

(19) Person indicated through tone (Pike 1956:58)

a. t͡shwa˧-na˥
'He gives me'

b. t͡shwa˧˩-na˧˦
'I give him'

The non-tonal segments in (19a-b) are exactly the same. (19a) has a level Mid tone on the root of the verb followed by a High tone on the enclitic. This is contrasted in (19b) with a Mid to Low (˧˩) falling tone on the root of the verb followed by a Mid to Mid-high (˧˦) rising tone on the enclitic. Both words indicate a transaction between first and third person, but the choice of tone indicates the directionality of the transaction.

The other example that Pike gives in which tone is used to indicate a grammatical distinction is evident in the difference between the present and the future tense (20).

(20) Tense change indicated by tone (Pike 1956:58)

Present	Future
a. t͡ʃi˧ni˧˩ 'you eat'	t͡ʃi˩ni˩ 'you will eat'
b. t͡ʃʔa˦na˩t͡ʃei˩ 'you deceive'	t͡ʃʔa˩na˩t͡ʃei˩ 'you will deceive'

In (20a and b) the present tense of each verb contains tones that are lexically determined, in other words, no specific tonal pattern appears on the verb to indicate present tense. The first example, (20a), has a Mid tone on the first syllable followed by a falling tone on the second while the second example, (20b), has a Mid-high tone on the first syllable followed by two syllables with Low tones. In the future tense of each verb, all of the tones are Low. In this case, the Low tones on the first syllable of the verbs indicate that the tense of the verb is future.

These grammatical usages of tone are not pursued in depth by Pike. The limited number of examples clearly indicates that this is not the focus of her paper. She discusses tone changes produced by the phrasal position of the lexeme only slightly more than these semantically rich instances of grammatical tone.

2.2.3.2 Change Caused by Phrasal Position

In this section, I discuss the effects that Pike states are a result of the position of a word in its phrase. Simply stated, if a Mid-high tone occurs phrase medially it is expressed as a High tone. This process occurs whether the Mid-high tone is a level tone (i.e., M_1) or the final member of a rising tone (i.e., M_2-M_1 and L-M_1), and does not affect the meaning of the word. In addition, word order in Soyaltepec is variable; therefore, a change in the word order usually does not change the meaning of the sentence.[39]

Example (21) demonstrates two phrases that involve a word with a Mid-high underlying tone. Each phrase is acceptable in either order. In the left column, the underlying Mid-high tone is phrase final and it surfaces as a Mid-high tone. In the right column, the underlying Mid-high tone is phrase medial and it surfaces as a High tone. The syllable which contains the underlying Mid-high tone is underlined for clarity.

(21) Mid-high tone phrase medial raising (Pike 1956:65).

Phrase final	Phrase medial
a. fue˥ t͡si˧ni˧ʔna˦	t͡si˧ni˧ʔna˥ fue˥
‘goes, my uncle’	‘my uncle goes’
b. t͡sʔa˧t͡se˧ si˧nga˦	si˧nga˥ t͡sʔa˧t͡se˧
‘he bought a shirt’	‘a shirt, he bought’

[39] The emphasis or focus of the sentence may change based on word order; however, sometimes the word order can be a personal choice. Further discourse analysis is needed to give credence to theories relating to word order.

In (21a) the subject and verb are alternating while in (21b) the verb is alternating with the object (there is a null subject). The tone levels of the other words in the phrase are irrelevant to the raising of the Mid-high tone. In (21a) the verb is expressed with a High tone whether it is first or last in the phrase and in (21b) the verb has a Mid tone in both locations. In both cases, it is a noun that experiences the tonal change. Pike does not give any other examples to indicate if the part of speech is relevant or not, she also does not give any examples in which the rising of the Mid-high tone in the medial position occurs before a low-toned syllable.

Normally when the Mid to Mid-high contour occurs phrase medially, the split and shift contour sandhi, previously described in §2.2.2.1, occurs leaving a Mid tone on the syllable in question and transferring the Mid-high tone to the following syllable. However, there are some phrase medial environments which block this sandhi from occurring so that the contour is forced to remain intact. In this context, the Mid-high endpoint of the contour is raised to a High, just as if it were a level tone. The examples Pike gives of the M_2-M_1 (˧˦) contour tone being raised to the M_2-H (˧˥) contour tone appear in (22). Two of these examples, (22b-c), involve numbers which have a fixed word order within the noun phrase, so altering the word order of these phrases is not grammatically possible. The tones as they appear in isolation are indicated in the left column and the phrase medial sandhi is indicated in the right column. The syllables of interest are underlined for clarity.

(22) M_1 raising when final member of contour phrase medially (Pike 1956:66)

Tones in isolation	Expressed phrase medially
a. kã˧˦	kã˧˥ t͡su˥
'twenty'	'twenty, he says'
b. hõ˧˦	hõ˧˥ nte˥
'six'	'six shoes'
c. hĩ˧˦	hĩ˧˥ ɲu˧me˥
'eight'	'eight bumblebees'

In each of these examples, the vowel is nasalized; however, this is coincidental and irrelevant to the tone. The example in (22a) demonstrates the aforementioned raising process when the M_2-M_1 contour precedes a H tone which blocks the sandhi from occurring. In (22b) it precedes a M_1-H rising tone which is another sandhi blocking environment. Lastly, in (22c) it precedes a word with the nonperturbable word tone sequence M H. None of these environments allow the contour sandhi to occur. In each case, the M_1 of the contour is raised to a H and a M_2-H contour surfaces. Pike does not provide any examples of other nonperturbable environments which presumably would also prevent the splitting of the contour and cause a Mid to High or Low to High contour to occur phrase medially. Pike does provide one example of a number with a M_2-M_1 (˧˦) contour tone that occurs phrase finally which is reproduced here as (23).

(23) M_2-M_1 contour surfacing phrase finally (Pike 1956: 66)

<u>Tone in isolation</u>	<u>Expressed phrase finally</u>
<u>hõ˧˦</u>	t͡sa˧khyẽ˥ <u>hõ˧˦</u>
‘six’	‘he ate six’

In this example, the Mid to Mid-high tone remains intact phrase finally, demonstrating that it can surface in a phrase with its underlying tone. Pike also states that the Mid-high tone in the Low to Mid-high (˩˦) contour tone is raised to High producing a Low to High (˩˥) contour tone when in the same environment. She does not give any examples of this transformation.

The Mid-high tone can only appear word finally when it is also phrase final, otherwise it is raised to a High tone or altered by one of the sandhi processes that have been described.

2.2.4 Change Caused by Zero Syllable with Positive Tone

Pike identified two enclitics that begin with a syllable which has “no segmental phonemes, but tone only.” (Pike 1956:66) In modern terminology, these morphemes can be viewed as sponsoring a floating Low tone which attaches to the preceding syllable rather than its sponsoring syllable. In this section, I give examples of these morphemes.

The floating Low tone is expressed on the final syllable of the stem to which the enclitic attaches.[40] Two examples of each of the morphemes with a floating Low tone appear in (24). These floating tones are represented in the underlying forms as a Low tone letter placed to the left of the segmental information.

(24) Left floating low tones

Underlying form				Surface form	Notes
a. t͡sa˧	+	-˩ri˧	→	t͡sa˧˩-ri˧	M_2 becomes M_2-L
'pocket'		'your'		'your pocket	
b. tõ˩˧	+	-˩ri˧	→	tõ˩˧˩-ri˧	L-M_2 becomes L-M_2-L
'money'		'your'		'your money'	
c. ti˧	+	-˩t͡ʃi˥	→	ti˧˩-t͡ʃi˥	M_2 becomes M_2-L
'boy'		'little'		'little boy'	
d. ti˩	+	-˩t͡ʃi˥	→	ti˩-t͡ʃi˥	L remains L
'fish'		'little'		'little fish'	

In examples (24a and c), the noun being modified has an underlying Mid tone but surfaces with a falling tone when the enclitic is added. In (24b), the noun has an underlying rising tone and when modified becomes a rising then falling convex contour. (24d) is an example with a low-toned noun; no effect is audible by the addition of the Low tone from the enclitic.

Because this floating tone acts on the preceding syllable and the perturbation discussed in §2.2.2 involving contour tones acts on the following syllable, there is a potential for conflict between the sandhi processes. Pike includes one example of this conflict. She indicates that the tone on the expressed syllable of the enclitic experiences perturbation from the contour and surfaces with a falling tone. She hypothesizes that the zero syllable of the enclitic is also perturbed in some way but does not offer details as to what that might mean or look like. She indicates that the phonetics of this process needs to be investigated further. The example is given in (25).

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[40] If the syllable already ends in a Low tone, no effect is noticeable due to OCP motivated merger of the floating Low tone with the Low tone of the stem (24d).

(25) Conflict between progressive and regressive perturbation

Progressively perturbing σ		Regressively perturbing σ		Result
ʃka˧˥	+	-˩ri˧	→	ʃka˧-ri˧˨
‘trousers’		‘your’		‘your trousers’

In (25), the noun being modified by the enclitic has a M_1-H rising tone which normally perturbs the following M_2 tone, changing it to a M_1 tone, and becoming a M_2 tone itself. In this case, the progressive sandhi instigated by the contour occurs as expected; except, the M_2 tone on the target syllable is not completely overwritten by the M_1 tone, instead the M_1 combines with the M_2 to form a M_1-M_2 falling contour. The regressive sandhi instigated by the enclitic normally causes a L tone to be expressed on the previous noun (usually forming a falling tone) while the expressed syllable remains M_2. In this case, it retains its M_2 tone as the end-point of a falling tone and there is no apparent effect from the floating Low.[41] More examples of this type in which the progressively perturbing contour is juxtaposed with the regressively perturbing enclitic would be helpful; however, they are not provided.

The case of enclitics with floating Low tones provides an interesting area for further research. They behave in a very regular fashion except when there are conflicting environmental pressures, then it is not clear exactly what tones will surface or why. Pike concludes her remarks on tone sandhi with this section.

2.2.5 Summary

After explaining the different processes that occur in Soyaltepec, Pike summarizes the surface tones that can emerge from each underlying tone. In this section, I summarize the possibilities given by Pike.[42]

The following tables demonstrate which tones may surface from a given underlying tone. Table 2-3 demonstrates the possibilities for surface tones derived from level tones and falling contour tones while Table 2-4 demonstrates the possible surface forms originating from underlying rising tones. The underlying

[41] The presence of the floating Low tone may in fact be the factor that prevents the complete overwriting of the tone on the enclitic. More research is needed.

[42] I have expanded Pike’s summary so that my tables include all of the tones that she mentions in the paper.

tones are listed down the left column and the surface tones are listed across the top row. A checkmark (✓) indicates the occurrence of a surface tone derived from the underlying tone in question. The shaded columns indicate tones which do not occur in underlying forms. The final column indicates the total number of derived tones which can result from the underlying tone. The final row indicates the subtotal of the number of underlying tones from which a surface tone may have resulted. The subtotal for the level tones must be added to the subtotal from Table 2-4 to determine the total number of possible source tones for a given surface tone. Since the falling contour tones only originate from level tones the subtotal given in this table reflects the total number of sources for that surface realization.

Table 2-3 Possible surface tones derived from level and falling tones

Underlying Tones		Surface Tones								Total allologs
		Level				Falling				
		H	M_1	M_2	L	M_1-L	H-M_1	M_2-L	M_1-M_2	
Level	H	✓	✓	✓			✓			4
	M_1	✓	✓	✓						3
	M_2	✓	✓	✓				✓	✓	5
	L	✓	✓		✓	✓				4
Falling	M_1-L		✓			✓				2
subtotal of possible source tones[43]		(4)	(5)	(3)	(1)	2	1	1	1	

The table may be read in two ways. First, the table may be read across. For example, if a given syllable has a High tone in its underlying representation, then it may surface with one three level tones: High, Mid-high or Mid or it may surface with a falling contour, High to Mid-high falling. In the final column, the number of alternate allologs or surface realizations of an underlying High tone is indicated as 4 (reflecting the sum of 3 level possibilities and 1 falling possibility for the surface realization of an underlying High tone). Alternatively, the table may be read down. For example, if a syllable surfaces with a High tone, it may have been derived from one of the four tones which have been checked in the column beneath the H: High, Mid-high, Mid or Low. Again, a numerical summary is provided at the bottom of the column. For the level tones, this is not the complete picture. They may also be derived from an underlying rising tone, the allologs of which are listed below in Table 2-4. The totals for the level tones are in parenthesis because the

[43] The total for the level tones must be combined with the totals listed in Table 2-4 in order to determine the total possible source tones for level surface tones.

subtotal from Table 2-3 must be added to the subtotal from Table 2-4 to determine the total possible underlying sources from which a level surface tone may have originated. The surface falling tones which appear in the shaded columns without exception are each derived from just one underlying tone. In other words, if the surface form is H-M_1 the analyst knows that syllable must have a H as its underlying representation, etc. The falling tone that is underlying either surfaces unchanged or as a level tone equivalent to the first member of the contour.

If a syllable has a level tone in its underlying representation, it will surface with either a level tone or a falling contour tone. The only falling contour tone that, according to Pike, can be an underlying tone either surfaces unchanged or as the level tone equivalent to the initial tone of its cluster. There are several interesting gaps that can be seen in Table 2-3. First, an inspection of the column under Surface Tones, Level, L, it can be seen that the only underlying level tone which can surface with a L is a L, no other underlying level tone ever surfaces with the L. However, the three non-low underlying level tones can surface with any level tone other than L. Also, inspecting the row under Underlying Tones, Level, L, it can be seen that the underlying L can surface with any other level tone except the M_2.

If a syllable has an underlying rising contour tone, it usually surfaces with either a level tone or with its underlying tone. There are, however, some exceptions that can be seen in Table 2-4. An underlying rising tone never surfaces with a falling tone, except in the case of the derived convex tone which is rising then falling. Table 2-4 is set up in the same way as Table 2-3, but it includes the underlying representations of the rising tones instead of the level tones and falling contour listed down the left column. The surface tones which are derived from the underlying rising contour tones are listed across the top of the chart. Again, columns that are shaded indicate contours that are never underlying. The final row indicates the combined total of possible underlying tones for each level tone.

Table 2-4 Possible surface tones derived from rising tones

Underlying Tones		Surface Tones											Total allologs
		Level				Rising						Convex	
		H	M_1	M_2	L	M_1-H	M_2-H	M_2-M_1	L-M_1	L-M_2	L-H	L-M_2-L	
Rising	M_1-H	✓		✓	✓	✓							4
	M_2-H						✓						1
	M_2-M_1	✓	✓	✓		✓	✓	✓					6
	L-M_1				✓				✓		✓		3
	L-M_2									✓		✓	2
Subtotal possible source tones		2	1	2	2	2	2	1	1	1	1	1	
Combined Total		6	6	5	3								

The Mid to High rising tone is the only tone that has no alternate surface forms which raises the question if there is something inherently different about this tone or if it is just so rare that alternate allologs have yet to be found.[44] Based on the sandhi that Pike described which I have entitled "split and shift," it is not surprising to find that the two contours which participate in this type of sandhi can also be realized with a level tone equivalent to the first member of the contour tone: i.e., M_2-M_1 can surface with a level M_2 and L-M_1 can surface with a level L.

An inspection of both of these tables leads to some observations:

- There are fifteen surface tones described by Pike.
- A surface rising tone may result from tone sandhi only if the underlying tone is already rising; rising tones are never created from level or falling tones.
- An underlying tone may have from 1 (only the M_2-H) to 6 possible surface tones.
- There are eight surface tones (e.g. H-M_1, L-M_2, etc.) which arise from only one underlying source, so if they appear, the underlying tone on the syllable in question is immediately obvious.

[44] My research suggests that both of these are true, it is rare and there is something different about it, unlike several of the other tones, it does not host a floating tone. This will be addressed in Chapter 5.

- The remaining seven possible surface tones, including all four level tones, have multiple options (up to 6) for an underlying tone. For example, if a M_2 tone appears on the surface, it may have one of five underlying tones: H, M_1, M_2, M_1-H or M_2-M_1.

To try to alleviate some of the confusion that arises from the multiple possibilities presented in her article, Pike also offers a summary of the contexts which produce alternate tones and methods for identifying the underlying tones. According to Pike, the easiest environments for identifying underlying tones because they never produce sandhi are: single morphemes in isolation[45] and phrase finally after a M_2 or L tone. She also suggests that a comparison of the surface tones of a given morpheme in several different environments will help in determining the underlying tone with greater certainty. Another option is familiarity with the rules that she has described which will help the analyst know whether or not a given environment normally produces sandhi. Applying these rules backwards should reveal the underlying form. Of course, this latter method presupposes that the analyst knows the underlying forms of most of the morphemes in a given phrase so they can figure out which changes may have occurred. In all, Pike lists 20 rubrics with environmental criterion to guide the analyst in determining the underlying tone from a given surface representation. The interested reader is referred to the original work for further exposition.

2.2.6 Discussion

It is evident from Pike's article that the system of tone in Soyaltepec Mazatec is very complex. She describes a regular system; however, the number of changes that can occur and surface forms that result seem a bit arbitrary at times, especially the case of the sandhi surrounding the M_1-H rising tone. It is not immediately apparent why the reciprocal effect on this tone would yield a M_2 level tone instead of a M_1. Recall that when the other two rising tones produce sandhi, what Pike calls the reciprocal perturbation yields the tone that is equivalent to the left edge of the contour on the original syllable (a M_2-M_1 leaves a M_2 and a L-M_1 leaves a L). Also, the effect of the M_1-H rise on the following syllable sometimes produces

[45] While isolation, in fact, does not produce any sandhi on a word, the absolute level of a tone in isolation is impossible to determine without some reference point. If a level toned word which is a member of a minimal set is recorded and played for a native speaker, they will not be able to determine the exact word. For example, if ʃa˧ 'wild cat' is recorded, a native speaker hearing this recording is equally likely to interpret it as 'wild cat' or 'fog' (which would be ʃa˩).

the expected H, but other times results in a M_2. My own research revealed an inconsistency in the morphemes that were reported to have this tone in their underlying representation which when corrected yields regular and expected sandhi processes. For instance, I found that some of the words reported by Pike to have a M_1-H contour actually have a M_2-M_1 contour which would explain why these tones appear in contexts where sandhi has occurred.

Most of Pike's article points to contour behavior which indicates tonal sequences such as the ability of the contours to 1) separate, leaving the left endpoint of the contour on the original syllable, and 2) shift, moving the right endpoint to the following syllable. An example can be seen in (26) which was given by Pike to demonstrate the regressive perturbation caused by a Low tone (as was discussed in §2.2.1.1), but which can be interpreted as contour simplification with OCP merger.

(26) Separation of M_1-L falling tone (Pike 1956:59)

Underlying forms				In context
M_1-L		L		M_1 L
t͡ʃi˧tu˧˩	+	-ʔna˩	→	t͡ʃi˧tu˧ʔna˩
'cat'		'my'		'my cat'

As the morphemes come in contact through juxtaposition, the L of the contour attaches to the syllable to the right of its original syllable and merges with the L which is already associated to that syllable as is motivated by the OCP. This demonstrates that the two tones, M_1 and L, from the contour are acting independently. In isolation, when forced to associate to the same syllable, the two tones form a contour but when a syllable is added to the original morpheme, the two level tones can appear on separate syllables. In this case, the syllable which was added happened to have a L tone, so tonal merger rectified the tonal crowding, and no contour was necessary in the surface form.

However, contour tones acting as sequences should not be able to be raised as a unit, which was seen in §2.2.2.4. Example (18a) is repeated below as (27) for reference.

(27) Unit-like contour raising, ˦˥ to ˥ (Pike 1956:65)

Trigger		Target		Result
ni˦khyẽ˦	+	-ni˦˥	→	ni˦khyẽ˦-ni˥
‘to feed’		‘you for me’		‘you feed me’

The peculiar behavior of this contour as described by Pike inspired Pizer (1994) to conclude that the tones in Soyaltepec Mazatec behave both as concatenations of level tones and as units. Perhaps the tone system of Soyaltepec provides an argument against the traditional typology of tone languages; however, before that claim can be made, much more data is needed. To date, the data which I have collected argues in favor of sequential sequences of tones as will be demonstrated in Chapter 5.

Pike’s article describes a tone system with four levels of tone and multiple contour tones. The system has a complex system of tone sandhi which can condition an underlying tone to be expressed on the surface in as many as six different ways. Several linguists have analyzed data from Pike’s article (e.g. Biber (1981), Goldsmith (1990) and Pizer (1994)) in an effort to understand and explain contour tones from a theoretical perspective. My research helps to shed light on the inconsistent tonal behavior described by Pike and affirm the conclusions that Soyaltepec Mazatec is an excellent example of a language in which tonal contours behave as concatenations of level tones.

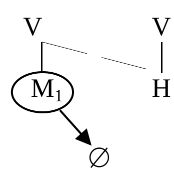
2.3 Goldsmith (1990)

The basic tenets of autosegmental phonology have already been reviewed in the previous chapter. In this section, I address the specific contribution that the tone system of Soyaltepec Mazatec makes toward the explanation of that theory as explained in Goldsmith’s *Autosegmental and Metrical Phonology* (1990). Similar to Biber, Goldsmith focuses on the contour tones of Soyaltepec. He explains the contour tones using autosegmental phonology’s possibility of many-to-one association. The basic assumption is that any two (or more) level tones which exist in a language can associate simultaneously to the same tone bearing unit. To create a contour, the tones are articulated in sequence. He states, “What we would like to convince ourselves of, however, is that these combinations of tones do indeed act phonologically as if they were concatenations of level tones, and even more, that they do so in ways consistent with an autosegmental analysis."(Goldsmith 1990:40) He makes three arguments from the data in Pike (1956) to demonstrate his points. First, he examines Mid-high tones which are the right endpoint of a rising tone to see if they behave in a similar manner to level Mid-high tones. Second, he looks at High tones that are the right endpoint of a rising tone to see if they behave in a similar way as level High tones. These two arguments both examine if the endpoint of the contour can behave independently. His final argument involves the ability of some contour tones to split apart and be expressed on two different syllables across a word boundary.

2.3.1 Contour Final M_1 Tones

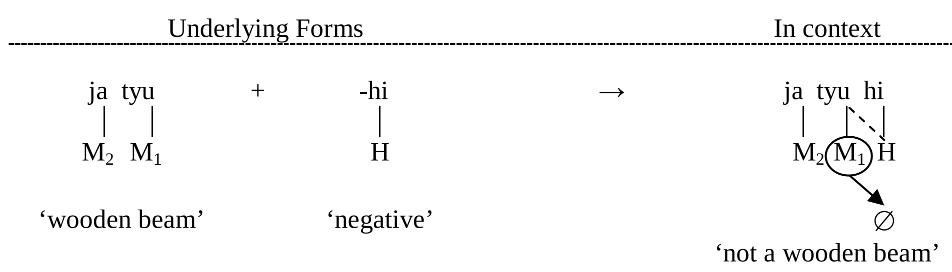
The first characteristic of Soyaltepec Mazatec's tone system that Goldsmith investigates involves the behavior of the Mid-high tone as it relates to the regressive perturbation caused by a High tone which was discussed in §2.2.1.1 above. Simply stated, when followed by a High tone in the same grammatical word, the Mid-high tone is deleted and the High tone spreads left. He gives the rule in autosegmental terms as in (28).

(28) Leftward High Spread (Goldsmith 1990:41)[46]



He gives the following example with a level Mid-high to demonstrate the normal behavior (29).

(29) Level M_1 undergoing regressive perturbation by H (Goldsmith 1990:41)



[46] I have changed the numerals that Goldsmith, following Pike, uses in his representations for letter abbreviations (1=H, 2=M_1, 3=M_2 4=L) and converted the segmental representations to IPA, for the sake of internal consistency.

The lexeme in (29) begins with a Mid tone on its first syllable and a Mid-high tone on its second syllable, but when combined with the negative marker the High from the negative marker spreads leftward to the second syllable which also becomes High and the Mid-high tone is deleted. He then gives two examples showing identical behavior of the Mid-high tone when it is the endpoint of a rising contour tone. Example (30a) shows the behavior of the Mid to Mid-high rise, while (30b) shows the Low to Mid-high rise.

(30) Leftward High Spread

a. applied to M_2-M_1 words[47] (Goldsmith 1990:41)

Underlying Forms In context

b. applied to L-M_1 words (Goldsmith 1990:41)

Underlying forms In context

The M_1 tones in (30a, b) behave exactly like the M_1 tone in (29). In each example, the M_1 tone is deleted and the following H tone spreads left to take its place. The fact that the rule applies to the M_1 tone regardless of whether or not it is a member of a contour tone supports the theory that the rising tones are really two separate tones which happen to be linked to the same syllable. Unfortunately, the example used in (30a) to demonstrate the change from a M_1 to a H when the M_1 is a member of a M_2-M_1 rising contour, is

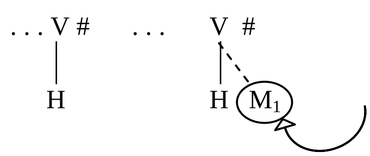
[47] Goldsmith's examples omit the dotted line linking the H to the previous syllable. I am assuming that this is a typo because the examples are given to show the application of the Leftward High Spread rule which includes the line and his prose implies the existence of the association line.

inconsistent with the data from Pike (1956). The way Goldsmith has represented the data seems to indicate that a M_2-H rising tone is formed when, in fact, the syllable in question emerges with a level H tone according to Pike. Recall from §2.2.1.1 that a High tone completely overwrites the tone that it perturbs, except in the case of the L-M_1 rising tone, as in (30b). Goldsmith does not address this discrepancy, but his work was not intended to be a complete analysis of Pike. His examples do show the indicated behavior, even if some questions are left unanswered.

2.3.2 Contour Final H Tones

Goldsmith's second argument is similar to his first in that it shows the endpoint of a contour tone behaving in the same manner as a level tone; however, instead of being the target of change, the tone in question is the trigger of change. This argument highlights the progressive perturbation caused by the High tone or rising tones ending in a High tone that was discussed above in §2.2.1.2. The rule that Goldsmith (1990:42) writes to explain this behavior is repeated here as (31).

(31) Creation of a H-M_1 falling tone (Goldsmith 1990:42)



The key environment for this rule is two adjacent words which each contain a final High tone. When this environment is met, the second final High tone is changed to a H-M_1 falling tone. For the application of this rule, the number of syllables in the words is irrelevant. He gives the following example to show the application of the rule when the trigger syllable is a level high tone.

(32) Example of H-M_1 tone creation (Goldsmith 1990:42)

He gives examples of two rising tones that end in High, M_1-H (33a) and M_2-H (33b), to demonstrate that they also trigger the same response in the following word.

(33) A contour tone triggers H-M_1 tone creation (Goldsmith 1990:42)

a. M_1-H as trigger

Underlying forms				In context
khi nti	+	ki <u>te</u>	→	khinte ki <u>te</u>
H M_1 H		H H		H M_1 H H H M_1
'baby'		'he danced'		'the baby danced'

b. M_2-H as trigger

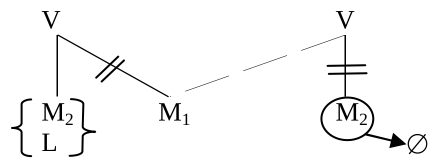
Underlying forms				In context
nta	+	thi<u>khye</u>	→	nta thi<u>khye</u>
M_2 H		H H		M_1 H H H M_1
'well'		'he is eating'		'he is eating well'

In the underlying forms found in (33), each phrase ends with a level High tone. In context, however, each phrase ends with the falling tone, H-M_1. Again, the High tone that appears at the end of the rising tone in each of these examples is behaving the same way a High tone in isolation behaves, indicating that they are inherently the same.

2.3.3 X-M_1 Contour Tones

The final process from Soyaltepec that Goldsmith uses to demonstrate the autosegmental nature of tone involves the splitting and shifting of contour tones that was discussed above in §2.2.2.1. In this process, the contour tones involved, M_2-M_1 and L-M_1, separated and the endpoints ended up linked to two different syllables. Goldsmith's (1990:43) formalization of the process appears in (34). The brackets in the representation indicate that either M_2 or L may be the first member of the contour. The second member is always M_1.

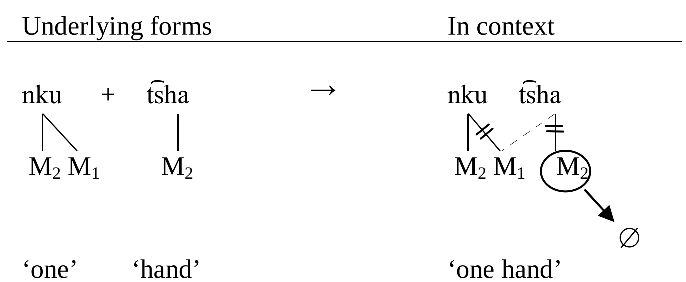
(34) Contour tone separation (Goldsmith 1990:43)



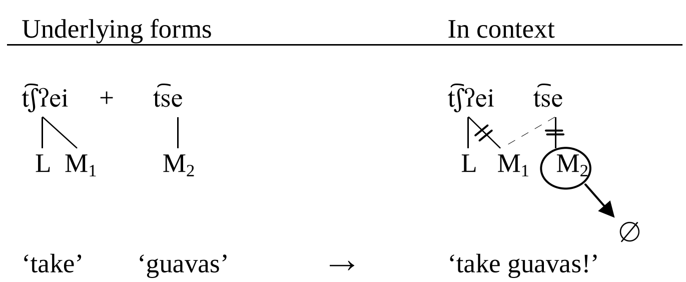
The M_1 begins with an association line linking it to the initial V; however, the bars across the association line indicate that this linkage is broken. The dotted line that connects M_1 to the second vowel indicates a new linkage. Finally the M_2 which originates on the second vowel is also delinked, as is indicated by the bars across its association line and is subsequently deleted. He gives the following two examples.

(35) Examples of contour tone separation (Goldsmith 1990:43)

a. M_2-M_1 followed by a M_2



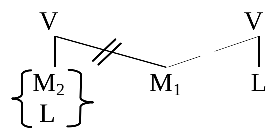
b. L-M_1 followed by a M_2



In each of the examples in (35), two tones are linked to the first word in the underlying forms. When the words are put into the context of preceding a word with a M_2, the initial word's contour is split. The leftmost tone remains on the initial word while the right tone links itself to the following word whose original tone is then delinked. The result is that the two tones from the original contour are now on separate syllables and each surfaces as a level tone.

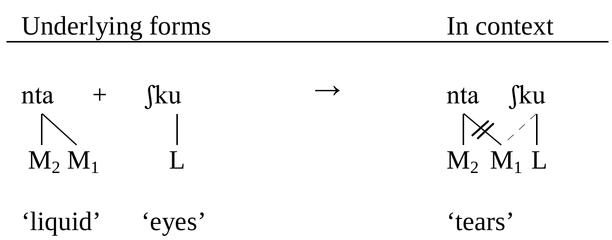
When the context is changed so that the contours precede a L instead of the M_2, the process is similar; however, the L is not delinked. Instead, a new contour is formed on the second word. The formalism (36) is very similar to (34) above, the only differences are the bars across the association line that indicate the delinking of the final tone are removed and the final tone is changed to a L. Again, the brackets indicate a choice for the initial member of the contour, either M_2 or L.

(36) Separation of a contour without subsequent delinking (Goldsmith 1990: 44)



The bars across the association line between the M_1 and the first V indicate delinking and the dotted line connecting the M_1 to the second V indicates a new association. In this case, there are no bars across the association line between the L and the second vowel, so the L remains and a M_1-L contour surfaces. Goldsmith only gives one example of this process and it appears in (37) below.

(37) M_2-M_1 tone followed by a L (Goldsmith 1990:43)



In this example, the original contour (M_2-M_1) has split itself over the two syllables. The first syllable now contains the level M_2 and a new contour has formed on the second syllable which begins with the former contour's endpoint, M_1. This new contour (M_1-L) is another confirmation that contours are formed when more than one level tone is attached to the same syllable.

Goldsmith's main point is that the contour tones found in Soyaltepec are best understood as concatenations of level tones. The endpoints of the contours have the same characteristics as the level tones in the system. They can be acted upon by rules that target a level tone and they themselves can have the same influence on another tone as a level tone would. Finally, there are demonstrable cases in which the tones involved in a contour can separate and be expressed on different syllables. Goldsmith provides a convincing argument for the sequential nature of contour tones; however, Pizer also analyzes Pike's data and has some different insights.

2.4 Pizer (1994)

Pizer (1994) examines the traditional typology of contour tones that pits "Asianists" with their unitary contour tones against "Africanists" with their concatenations of level tones. She discusses the basic characteristics of each type of tonal language and gives examples of each. After introducing and exemplifying the typology, she offers Soyaltepec Mazatec as a counterexample. She states, "I will show that contour tones in Mazatec behave like units with respect to some processes and like series of level tones with respect to others. The hybrid nature of Mazatec disrupts the neat two-class typology opposing African- and Asian-type tone languages."(Pizer 1994: 97) In this section, I summarize Pizer's arguments which are an interesting alternative analysis of Pike's data; however, the data which I collected do not necessitate this type of approach.

In looking at the contour tones as concatenations of level tones, Pizer does not disagree with Goldsmith's arguments which were summarized above. In fact, she agrees that in many environments, the contour tones of Soyaltepec behave as two separate tones; however, she examines other data from Pike's article and demonstrates instances where a unitary analysis is superior. I will not restate any of Goldsmith's arguments in detail.

2.4.1 Contour Split and Shift Reanalyzed

In this section, I discuss Pizer's reanalysis of contour sandhi involving the Mid-high tone. Pizer's first argument agrees with Goldsmith's analysis of contour split and shift that was discussed in §2.3.3, but stresses that only contour tones that end with a Mid-high tone behave this way. Pizer emphasizes that not all contour tones in Pike's data follow the same pattern. The contour tones that end in a Mid-high tone separate and shift the second tone of the contour to the final syllable when an affix is added, as in (38). However, the Mid to High contour tone does not separate and shift under similar circumstances, as in (39).

(38) Standard contour tone realignment (Pizer 1994:109)[48]

Underlying forms				In context
tki˧˦	+	-hni˩	→	tki˧-hni˦˩
'medicine'		'our'		'our medicine'

(39) Contour without realignment (Pizer 1994:109)

Underlying forms				In context
nta˧˥	+	-ra˩	→	nta˧˥-ra˩
'good'		'probably'		'it is probably good'

The first word in (38) has a Mid to Mid-high contour in its underlying form, but a level Mid tone in context while the first word in (39) maintains its underlying Mid to High contour in context. Furthermore, the final syllables in both examples are Low in their underlying forms, but in context the final syllable in (38) is a falling Mid-high to Low contour while the final syllable in (39) is a level Low. The behavior of the Mid to Mid-high (˧˦) contour is different from the behavior of the Mid to High (˧˥) contour. The contour in (39) is not redistributing itself over the available syllables in a one to one match up from left to right.[49] Pizer's initial hypothesis is that the shifting that occurs in (38) is provoked by the Mid-high tone, not by the contour itself. However, she also points out that not all Mid-high tones delink from their source and shift (or spread) to the right, only those Mid-high tones involved in contours shift. Level Mid-high tones do not perturb the following syllable, as is demonstrated in (40).

[48] Again, I have altered the representation of the data in Pizer's examples so that they are consistent with the IPA in both choice of segmental characters and tone keys in order to be internally consistent to the representations used in this dissertation.

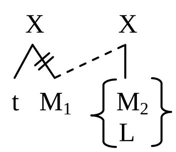
[49] The Universal Association Convention (UAC) described by Goldsmith (1976) and Pulleyblank (1986) states: "Match the tones and tone-bearing units (TBUs) one to one, left to right." (Kenstowicz 1994:317) Contours are traditionally formed when there are more tones than syllables because the leftover tones attach to the final syllable.

(40) Examples of M_1 not influencing the following syllable (Pizer 1994:110)

Attested form	Hypothesized by Pizer
a. na˧mi˦-sa˧	(*na˧mi˧-sa˦)[50]
‘yeast’	
b. t͡ʃʔa˦-ʔe˩	*t͡ʃʔa˦-ʔe˧˩
‘his father-in-law’	

Pizer indicates that if all Mid-high tones acted in the same way, then (40a and b) should not exist with the attested tones, but with her hypothesized tones.[51] She concludes that the Mid-high tone instigates the split and shift process, but only when it is part of a contour. The resulting process is similar to that which was described above in §2.3.3 (from Goldsmith) and §2.2.2.1 (from Pike). Pizer's rule is summarized as M_1-Shift[52] in (41). The brackets indicate that the final X may be linked to either a M_2 or a L.

(41) M_1-Shift (Pizer 1994:110)



Crucial to her rule is that the M_1 is part of a contour tone; but, the beginning point of the contour is not important, hence it is indicated with a t. The M_1 is originally linked to the initial X as is indicated by the solid association line; however, as part of the process, this linkage is broken which is indicated by the parallel bars across the association line. The M_1 forms a new association line with the second X which is indicated by the dashed association line.

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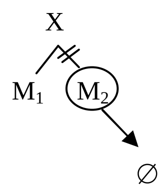
[50] Pizer does not actually spell out this form; I have deduced it from her statements and included it for clarity. She indicated that the M_1 should shift in this situation in the same way that other M_1's in contours shift, if in fact all level tones were behaving the same way whether or not they were in contours.

[51] It is an interesting argument, however, she does not take into account the fact that the forms in (40) each contain a derived Mid-high tone and the spreading indicated is usually provoked by an underlying Mid-high rather than the surface tone.

[52] In Pizer's terminology she refers to this as 2-Shift, I have changed the terminology in order to reflect my choice of tonal abbreviations, i.e., H for 1, M_1 for 2, M_2 for 3 and L for 4.

She also includes a rule for M_2 deletion which prevents a M_2 from following a M_1 when linked to the same syllable. This accounts for the absence of a falling contour if the targeted syllable contains a M_2, but not if it contains a L. This rule is provided in (42).

(42) M_2 deletion (Pizer 1994:111)



When the M_1 and M_2 are linked successively to the same X, the M_2 delinks which is indicated by the bars across the association line and the M_2 then deletes.

Pizer's argument demonstrates two points. First, not all contours behave the same way. Second, sometimes tonal primitives behave differently depending on whether or not they are in a contour which if true would be a significant finding. This indicates that something more complicated than a simple realignment of tones is occurring when contours split and shift.

2.4.2 H-Spread

The next argument that Pizer addresses involves the regressive perturbation of the High tone described by Pike that I have discussed in §2.2.1.1. Pizer names this process H-Spread.[53] The H-Spread targets a M_1 tone whether or not it is a member of a contour. This mirrors Goldsmith's first argument demonstrating the sequential nature of contour tones (see §2.3.1).

Pizer claims that this type of leftward High spread only targets the Mid-high tone which is subsequently deleted. Examples appear in (43): (43a-b) are positive examples and (43c-d) are negative examples. The leftward High spread is demonstrated in (43a and b), which are the same examples used by Goldsmith appearing above as (29) and (30b) respectively. Leftward High spread does not occur in (43c) which is a disyllabic lexeme with a Low tone followed by a High tone or in (43d) which is a multi-

[53] Again, in Pizer's terminology she refers to this as 1-Shift.

morphemic word which contains a similar environment, i.e., the High tone follows another tone and no spreading occurs.

(43) Leftward High spread (Pizer 1994:111)

Forms in isolation				In context	transformation
a. ja˧tyu˥ +	hi˥	→		ja˧tyu˥-hi˥	M_1 to H
'wooden beam'	'NEG'			'not a wooden beam'	
b. nt͡ʃe˨˦ +	hi˥	→		nt͡ʃe˨˦-hi˥	L-M_1 to L-H
'cooked corn'	'NEG'			'not cooked corn'	
c. t͡ʃa˩ʔa˥				t͡ʃa˩ʔa˥	(no change)
'armadillo'				'armadillo'	
d. kwi˧ +	t͡se˥	→		kwi˧-t͡se˥	(no change)
'this'	'emphatic particle'			'just this'	

(43a, b and d) provide examples of the combination of morphemes to produce the adjacency in question, while (43c) is an example of a disyllabic lexical form which surfaces with a final High tone, irrespective of context. In (43a and b) the juxtaposition of a High tone with the Mid-high tone results in the replacement of the Mid-high by the High tone. When the High tone is adjacent to the Low tone in (43c) and the Mid tone in (43d) there is no apparent effect. Pizer notes that it is not just any Mid-high followed by a High tone that is affected. She argues that if every Mid-high which was followed by a High was overwritten by leftward H-Spread, the Mid-high to High contour that is demonstrated in (44a) could not exist. Compare (44a) with (44b). The addition of the high-toned negative particle results in the leftward H-spread which overwrites the entire Mid-high to High contour.

(44) M_1-H, OK in isolation, but not when followed by H (Pizer 1994:112)

Form	gloss
a. the˦˥	'rubbish'
b. the˥-hi˥	'not rubbish'

Pizer never explicitly explains why the Mid-high is not overwritten in the Mid-high to High contour tone. She simply mentions that the H-Spread rule must have "some mention of linkages . . ." (Pizer 1994:112) in order to prevent a H tone from overwriting a M_1 tone when both are linked to the same syllable. In order to allow (44b) to occur without expanding her rule beyond the Mid-high tone, she explains that the first High, i.e., the final member of the contour tone, is deleted because it is a violation of the obligatory contour principle.[54] When the first High is deleted, the remaining situation fits the environment for her leftward High spread. Again, Pizer has demonstrated that the Mid-high tone is perturbed in the same manner when it is the final member of a contour as when it is a level tone, and she has indicated that sometimes the type, or perhaps number, of linkages (i.e., whether a tone is level or a member of a contour) needs to be considered when formulating rules.

Pizer acknowledges that there is something different about the situation of the Mid to Mid-high rising tone that is also replaced by a High tone when it is followed by a High tone. The rules she has established thus far would predict the formation of a Mid to High contour instead of a level High in this situation. She, in fact, does not include this type of transformation under simple H-Spread, but addresses it as part of the following argument that she calls neutralization.

2.4.3 Neutralization

Pizer introduces neutralization to explain the apparent anomaly in the behavior of the M_1-H rising tone. Recall from Pike's tonal changes described in §2.2.2.2 that when a Mid-high to High rising tone perturbs the following Mid or Low tone, the result is often a Mid-high tone on the target syllable (which can either be the first member of a falling contour or a level tone) and a Mid on the trigger syllable. The examples that Pizer cites appear in (45).

[54] The obligatory contour principle actually prohibits the adjacency of identical tones in the lexical representation of a morpheme, but it is commonly extended to any adjacent elements. Leben (1973), Kenstowicz (1994) and Yip (2002)

(45) M_1-H sandhi (Pizer 1994:113)

Trigger	Target		Result
a. t͡ʃẽ˦˥ +	t͡ʃu˩	→	t͡ʃẽ˧ t͡ʃu˦˨
‘is needed’	‘animals’		‘animals are needed’
b. t͡si˦˥ +	se˧	→	t͡si˧se˦˥
‘he makes’	‘thick’		‘he thickens’

If this contour followed a rule similar to the M_2-Shift rule proposed in §2.4.1 then the expected behavior would result in a M_1 tone remaining on the original trigger syllable and a H tone being attached to the target syllable, either resulting in a level H or a falling H-L tone. In this case, the tone that remains is not the original beginning point of the contour and the tone that ends up on the syllable to the right is not the original endpoint. In order to explain this odd behavior, Pizer proposes that the Mid-high to High (˦˥) contour is lowered when it precedes a Mid or Low tone, becoming a Mid to Mid-high (˧˦) contour. She calls this a register[55] lowering. Once the contour has been lowered, the Mid-high spread that was introduced earlier in (41), can take effect. The example from (45a) is shown in (46) with the inclusion of this intermediate stage which is then subject to the M_1-Shift. Since she does not offer a mechanism at this point, I will not assume one to show.

(46) M_1-H sandhi with register lowering (Pizer 1994:113)

a. Register lowering

Target	Trigger		Intermediate Result	
M_1-H	L		M_2-M_1	L
a. t͡ʃẽ˦˥ +	t͡ʃu˩	→	t͡ʃẽ˧˦	t͡ʃu˩
‘is needed’	‘animals’			

[55] Pizer’s use of the term register is not in line with the register discussed by other tonologists (cf. Bao 1990, Snider 1999, Yip 2002). She uses register in a more general way to represent a lowering or raising effect. Register in this sense is not a separate feature of tone.

b. M_1-Shift (the result from above is the new input)

Trigger	Target		Result
M_2-M_1	L	→	M_2 M_1-L
t͡ʃẽ˧˦	t͡ʃu˩		t͡ʃẽ˧ t͡ʃu˦˩
			'animals are needed'

First in (46a) the register of the second word has its lowering effect on the contour of the first word, then (46b) the effect of the contour is felt by the second word. It would be hard to explain this process without rule ordering. The effect of the lowering (46a) is that each member of the Mid-high to High contour tone is lowered by one tonal step producing the Mid to Mid-high contour. The endpoints of the newly produced contour, Mid and Mid-high, are those that appear in the result of (46b) on adjacent syllables. As far as this goes, it is an interesting and innovative solution. In order to lower the entire contour, it must be able to be viewed as a unit at some level in the phonology.

Additional support for the idea of register change comes in the form of a register raising process provoked when a Mid to Mid-high (˧˦) tone precedes a High tone (47). In this case, instead of being combined with the progressive M_1-Shift rule, the regressive H-Spread rule is applicable. The data that needs to be explained is presented in (47a) followed by the proposed explanation in (47b). The consequence of H-Spread without Register raising is demonstrated in (47c).

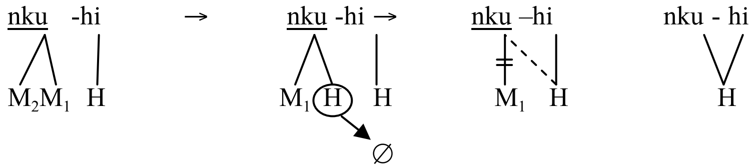
(47) H spread to M_2-M_1 produces level H, not M_2-H (Pizer 1994:114))

a. Data to be explained

Isolation		Result
nku˧˦ + -hi˥	→	nku˥-hi˥
'one' 'NEG'		'not one'

b. Register raising followed by OCP deletion then H-Spread

Register raising OCP deletion H-Spread Result



c. H-Spread without Register raising

H-Spread Incorrect Result

The process in (47b) which results in the correct tonal pattern involves Register raising of the M_2-M_1 (˧˦) contour because it is followed by a H tone. The contour rises to a M_1-H (˦˥) contour, then the H of the contour experiences an OCP violation and is deleted. Finally the environment is correct for the remaining H to spread left, producing a level H on each syllable. The process in (47c) demonstrates that the application of H-Spread without Register raising results in an incorrect M_2-H contour rather than a level H.

To further support her claim that there are register effects going on in Soyaltepec, she cites other examples of regressive perturbation across morpheme boundaries, this time involving level tones. These appear here as (48). I have indicated the participating tones above the data to highlight the change that occurs.

(48) Pike's Regressive Perturbation actually Register Lowering? (Pizer 1994:115)

Underlying form			Surface form
H	L		M_1 L
a. ɲu˧<u>me˥</u> +	-ʔna˩	→	ɲu˧<u>me˦</u>-ʔna˩
'bumblebee'	'my'		'my bumblebee'
H	M_2		M_1 M_2
b. <u>t͡su˥</u> +	ja˧	→	<u>t͡su˦</u>ja˧
'he says'	'inside'		'he explains'

(48a) shows a High tone being lowered to a Mid-high tone when it is followed by a Low tone and (48b) shows the same result when the high-toned syllable is followed by a Mid tone. The phenomenon of register change offers a phonological explanation for what may appear to be a phonetic effect. These two examples of register lowering thus far have no other phonological explanation. The representations employed to this point offer no motivation for the register effects. The mechanism and structures involved will be discussed in §2.4.5. It is possible that the H-Spread rule discussed above in §2.4.2 in which a Mid-high tone followed by a High tone across a morpheme boundary is raised to a High tone would also be an example of register raising.

The changes involved in neutralization appear to indicate that Soyaltepec contours are acting as units, so, according to the traditional typology they should be analyzed as Asian type tones; however, how then should the process of M_1-Shift be handled? There is an apparent discrepancy in the behavior of Soyaltepec tones.

2.4.4 Dual Nature of Soyaltepec Mazatec Tones

Pizer demonstrated a tone process in Soyaltepec, M_2-Shift, which requires that the members of a contour tone exist and behave independently, but she also demonstrated the process of neutralization which seems to require that the members of a contour act as a unit. First, I summarize the effects that Pizer refers to as register effects, and then I discuss how these effects relate to the traditional Asian contour tones.

The processes that Pizer describes as register effects (or potential register effects) can be summarized as followes: first, a High tone raises the entire M_2-M_1 contour to M_1-H (47); second, both Mid and Low tones lower the entire M_1-H contour to M_2-M_1 (46); third, both Mid and Low tones lower a H to M_1 (48); fourth, a High tone may raise M_1 to H which is a potential alternate explanation for the process in §2.4.2. In order to process these facts, it is necessary to place them within the context of the greater picture of the Soyaltepec Mazatec tonal system. First, notice that there is a lower contour in Soyaltepec Mazatec, the Low to Mid (*λ*), which is not involved in the alternations that occur, so it is clear the 'register lowering' does not lower the contour in question all the way to the lowest contour possible. Second, M_2 and L are not raised; only the M_1 is raised (if H-Spread is understood as a raising process). Furthermore, when the H is lowered, it is only lowered by one tonal level to the M_1. Finally, there appear to be three classes of tones: (L and M_2) which cause lowering, (H) which causes raising and (M_1) which apparently does not have either a raising or lowering effect, making it a neutral tone. The traditional Asian type register lowering or raising involves two tones with the same shape that can either be expressed in the higher register or the lower register, depending on the context. The gradient process that Pizer is discussing is something else entirely.

There is further support for the notion that the contours of Soyaltepec are different than those in Asian languages. Pizer points out that the five-way contrast of rising tones in Soyaltepec, (49), is impossible to represent in terms of two registers.

(49) The five rising tones of Soyaltepec (Pizer 1994:116)

a. M_1-H	b. M_2-M_1	c.L-M_2	d. M_2-H	e. L-M_1
the˦˥	the˧˦	tõ˩˧	nta˧˥	nt͡ʃe˩˦
'rubbish'	'itch'	'money'	'good'	'cooked corn'

Most linguists studying Asian tone specify two registers [±upper] and divide each into two tone levels [±raised]. Furthermore, they restrict contours to occurring within a given register.[56] In other words, a rising contour would move from [-raised] to [+raised] on either the [+upper] or [-upper] register. Thus defining two rising contours. Any attempt to define these five rising tones within the two traditional registers fails. Only (49a and c) align well with traditional Asian tone theories as can be seen below in (50a and b). Pizer offers the following structures for consideration.

(50) Rising tones diagramed per Yip/Bao (Pizer 1994:116)

a. M_1-H	b. L-M_2	c. M_2-H	d. M_2-M_1
X | H /\\ l h	X | L /\\ l h	X | ? /\\ l h	X | M /\\ l h

[56] See Yip (1989) and Bao (1990) for discussions of Asian contours.

First, it is impossible to define M_2-H (49d) and L-M_2 (49e) within one register as they each span three of the four tone levels. Pizer never tries to explain the structure she gives for M_2-H in (50c), she simply notes that there is no way to limit the M_2-H to one of the registers, thus she places a question mark in the register position. Second, it is unclear how to handle the M_2-M_1 (49b) which would rise from the upper level of the lower register to the lower level of the upper register, something impossible to represent if both tones of a contour need to have the same register. Pizer suggests the possibility of adding a third distinction to the register mix, namely an M as in (50d) but notes that there is still no way to make a distinction between rising tones that begin at the same point but rise different amounts such as the L-M_2 versus the L-M_1.

Since the traditional Asiatic approach fails, perhaps the Africanist approach which considers these tones as concatenations, i.e., completely separate but linked to the same TBU, would be more appropriate. However, Pizer's analysis indicates that there are examples where a unitary approach, impossible to express with concatenations, would resolve behavioral oddities that otherwise appear arbitrary. Alternatively, it may be suggested that some of Soyaltepec's contour tones are actually unitary tones, while others are concatenations. One problem with this approach that is pointed out by Pizer[57] is that the same contour appears to behave sometimes as a unit and other times as a sequence. For example, the Mid to Mid-high contour tone is the trigger in M_1-shift, a process which separates the contour over two syllables (i.e., tones in sequence), and the target of neutralization, a process which requires the contour to operate as a unit. Besides, traditional tonal typology calls for an either/or approach: contour tones either operate as units (Asian) or they behave as sequences (African).

2.4.5 Pizer's Resolution

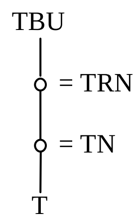
According to Pizer, "A more reasonable and useful goal is to try to discover a representation which will allow contour tones to be simultaneously unitary and non-unitary." (1994:118) In order to reconcile the facts of gradient raising and lowering in combination with the dual behavior of the contour

[57] This dilemma pointed out by Pizer is solved in my dissertation with fresh data which behaves differently, thus making the resolution of the dilemma a mute point.

tones (as units and as sequences), Pizer proposes that the representational schema developed by Hyman in 1986 (and summarized above with references to Hyman 1993) may be appropriate.

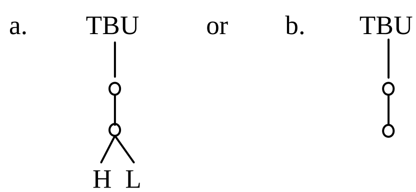
Recall from Chapter 1 that Hyman's representational schema is an expansion of the tiers used by traditional autosegmental phonology. Each tone bearing unit (TBU) has both a tonal root node (TRN) and a tonal node (TN). The primitive features (T) attach to the tonal node as in (51).

(51) Hyman's representational schema (Pizer 1994: 120)



Furthermore, Hyman (1986) defines the primitive features as relative to a neutral pitch height. Notice that while these primitives are relative, they are not relative to each other but to a third, neutral tone. Another important attribute of these primitives stressed by Pizer is that they are additive. Therefore a Mid tone can be represented as having one H and one L, or potentially, nothing as in (52) below.

(52) Representation of the mid tone (M_1) (adapted from Pizer 1994: 120)

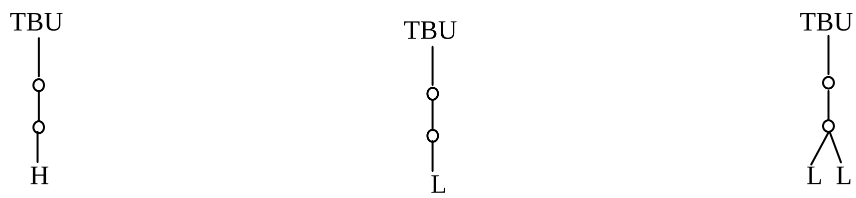


In (52a) the H and L are not linearly ordered, they could just as easily be L H, and because they are additive, they cancel each other out. Pizer exploits the additive nature of primitives in order to define the four tones necessary for Soyaltepec.[58] A High tone would have one H (53a), a Mid-high, nothing (or an equal number of H's and L's) as was seen in (52), a Mid, a single L (53b) and a low, two L's (53c).

[58] Pizer admits that this is, "not entirely in the spirit of Hyman, and owes more to particle phonology (cf. Schane 1984)" (Pizer 1994: 121).

(53) Representations of H, M_2 and L

a. High tone b. Mid (M_2) tone c. Low tone



As we have seen, Hyman represents a Mid tone via a branching TN. There is also the option of branching at the TBU, as in (54a) which would produce a tone cluster (i.e., a concatenation or sequence). The representation can also branch from the TRN as in (54b) which would produce a contour tone.

(54) Tone Cluster vs. Contour Tone (adapted from Pizer 1994: 121)

a. Tone Cluster b. Contour Tone

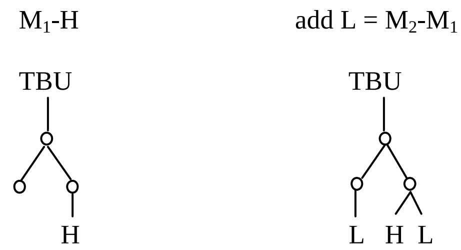
Branching at the TRN level as in (54b) allows a certain level of independence for each primitive, T, as they do not directly share a node, but it also allows a level at which the contour tone can act as a unit, which is precisely the geometry that Pizer has been looking for.

In order to accomplish the raising and lowering of a contour that Pizer has called neutralization, a primitive is added to each half of the contour, as is shown below in (55) and (56). Recall that when L and H share the TN, they merge to the neutral tone which has now been defined as the Mid-high tone.

(55) Raising M_2-M_1 (Pizer 1994:122)

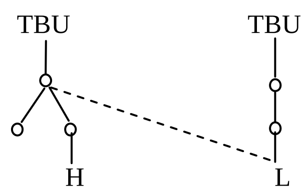
M_2-M_1 add H = M_1-H

(56) Lowering M_1-H (Pizer 1994:122)



Pizer admits that the mechanism by which this H or L is added is a little elusive. It must come from the following morpheme and it must attach at the level of TRN so that it can influence both members of the contour. This structure is represented in (57). Once the Low tone spreads left, it is unclear if it actually percolates through the structure to attach to the lower nodes or if it just has an affect from afar.

(57) Mechanism for Lowering? (Pizer 1994:122)



The linkage of a L to the TRN as occurs in (57) is the mechanism that Hyman proposed for downstep, so it is possible that what Pizer has referred to as a raised and lowered register are actually an upstepped or downstepped contour. One problem with this representation is that once the M_1-H has been lowered to M_2-M_1, M_1-Spread needs to be free to occur which means the right most TN of the contour must spread to the TRN of the following TBU, with all of its feature specifications. This cannot happen without crossing association lines unless a percolation process relocates the L tone from the TRN to the TN.

2.4.6 Discussion

Pizer's discussion of Soyaltepec tones is very innovative. She challenges the traditionally accepted tonal typology, giving informed arguments with data to support her claims. However, she never returns to demonstrate how the different processes that she proposed along the way would work out given her proposed geometry and; thus, never addresses the issues that arise such as crossing association lines. She also overlooks the issue of how having two Ls on the TN to create a low tone can occur without violating the OCP which she already invoked to remove unwanted H tones on neighboring syllables. Pizer also does not address the cases in which the rising Mid-high to High tone produces a High tone on the following syllable. Examples from Pike were given in (8) above, repeated here as (58).

(58) M_1-H producing H on target σ, leaving M_2 on Trigger (Pike 1956:61-63)

Trigger		Target		Result
a. ma˧<u>t͡ʃa˦˥</u> 'It grows'	+	<u>t͡se˧</u> 'guava'	→	ma˧<u>t͡ʃa˧</u> <u>t͡se˥</u> 'guavas grow'
b. <u>thĩ˦˥</u> 'is present'	+	<u>ni˧</u>ʔja˧ 'house'	→	<u>thĩ˧</u> <u>ni˥</u>ʔja˧ 'there is a house'
c. ma˧<u>t͡ʃa˦˥</u> 'It grows'	+	<u>ʃu˩</u>ti˩ 'tomatoes'	→	ma˧<u>t͡ʃa˧</u> <u>ʃu˥</u>ti˩ 'tomatoes grow'
d. ti˩<u>hi˦˥</u> 'bowl'	+	<u>tha˩</u>t͡se˩ 'new'	→	ti˩<u>hi˩</u> <u>tha˥</u>t͡se˩ 'a new bowl'

Her explanation of lowering the entire contour produces the correct results in the examples she chooses which all involve sandhi within grammatical words or on a following grammatical word that is a monosyllabic low-toned morpheme; however, it does not resolve the problem demonstrated in (58) involving sandhi between two grammatical words in which the endpoint shifts as is without the lowering that Pizer indicated, yet, the beginning point which is left on the original syllable is changed as it would have been through Pizer's lowering.

While Pizer's resolution does not completely resolve the issues of Soyaltepec tone, it is the most complete analysis of the system based on Pike's data that is available. It would be worth further investigation and fleshing out with fresh data if data were available that required this type of tonal alternations. However, in the data that I collected, I did not find any examples which fall into this category. It is possible that future research could reveal idiolects that still behave in this way in which case Pizer's analysis would need to be revisited.

2.5 Summary and Discussion

The theoretical and descriptive literature available specifically focusing on Soyaltepec Mazatec surrounds its complex tone system. The system originally described by Pike (1956) was referenced by Biber (1981) and Goldsmith (1990) in order to illustrate their theories, but the most complete analysis in terms of modern theory available appears in Pizer (1994). The tone system of Soyaltepec Mazatec provides a wealth of information about contour tones. Because there are five different rising contours in the tone system, most of which both instigate changes in other syllables and undergo changes themselves, linguists are able to explore the limits of available tone theory. Goldsmith used Pike's data to give evidence for the sequential nature of contour tones. Pizer used the same data to give evidence that contour tones are not just simple sequences. Neither Goldsmith nor Pizer took into account all of the data that Pike provided. What is most evident from the analysis provided by Pike, Goldsmith and Pizer is that the tone system of Soyaltepec Mazatec is very complex and has the potential for competing analyses. It is also evident that a simple autosegmental approach is not adequate to account for all of the tonal behavior in Soyaltepec Mazatec.

Although Pizer's evaluation of the tone system is relatively thorough, there are still gaps and inconsistencies in the analysis. To date, there is no satisfactory analysis of the data provided by Pike. Furthermore, no new data has become available on this system in the past 50 years which could be used to corroborate the phenomena documented by Pike. The goal of this dissertation is to address these two issues by offering both original data and a fresh analysis.

CHAPTER 3

SOYALTEPEC MAZATEC SEGMENTS

3.1 Overview

In this chapter, I give an overview of the segmental phonology of Soyaltepec Mazatec based on my own data. Tone will be indicated on every syllable, but because I will be focusing on tone in the remainder of the dissertation I will not spend time discussing it in this chapter. My intension is to provide a foundation that gives an understanding of the basic segments that occur, not to answer all questions concerning segmental phonology which is outside the scope of this dissertation. I do, however, provide a preliminary account. An organized and detailed presentation of the segmental information of Soyaltepec Mazatec is a novel contribution of this dissertation.

Although the consonants of Soyaltepec Mazatec have never been specifically studied, related Mazatec languages have been studied. Pike and Pike (1947) published a thorough analysis of Huautla Mazatec segments which also included information about other highland[59] Mazatec dialects. They focused specifically on Mazatec onsets and nuclei, proposing an analysis which included a hierarchical structure for each. Their data has been used as the basis for at least two other significant analyses (Steriade (1994) and Golston and Kehrein (1998)). While these discussions do not include a significant amount of data from lowland Mazatec dialects, they do involve information from the language family which may be insightful in the discussion of any dialect of Mazatec. The onsets of Huautla Mazatec in particular are considerably more complex than those of Soyaltepec Mazatec as they include onsets in which a glottal element[60] can

[59] As the name suggests, highland dialects of Mazatec exist in the mountainous area of Northern Oaxaca State, usually at least 1000 feet above sea level in an area commonly referred to as the Sierra Mazateca. There are four dialects often included in the lowland dialects which exist in the same region, but on the coastal plane, usually at altitudes below 1000 feet. They are Soyaltepec, Ixcatlan, San Jose Independencia and Jalapa Mazatec.

[60] Part of the debate in the varying analyses of this data is whether or not these features should be considered separate onset phonemes or modifications to the primary element and if they should be

either precede or follow most consonant phonemes, i.e., /ht/, /th/, /ʔt/ and /tʔ/ are all contrastive. Similar onset combinatorial sets exist for both obstruent and sonorant phonemes. Pike and Pike (1947) describe these onsets as complex units with ordered constituents in which one constituent serves as the principal member or head of the onset structure which can contain up to two subordinates. For example, the /nth/ onset has /t/ as the primary phoneme with /h/ as the first subordinate and /n/ as the second subordinate. Steriade (1994) reanalyzed the data in terms of aperture theory. In this theory segments are understood to host anchors for distinctive features. Plosives are defined as hosting two anchors, one for the closure and one for the release of a given element. Fricatives host just one anchor for the release. The least marked onsets are those which contain a single segment; however, given Steriade's definitions, a single segment can host a number of separate features. Therefore, /nth/ is a single segment with a nasal closure and aspirated release. She goes on to analyze most of the complex clusters of Highland Mazatec as complex single segments. Golston and Kehrein (1998) reject both Pike and Pike's analysis and Steriade's analysis and claim that Mazatec has neither complex onsets nor complex segments but instead has simple onsets and nuclei that can themselves host features, i.e., aspiration (or breathy vowels), nasalization (or nasalized vowels) and glottalization (or creaky vowels). In their view, if a feature perceptually occurs at the beginning of the onset, it is hosted by the onset, and if it appears to occur at the end of the onset, it is actually hosted by the nucleus. Sometimes this leads to a feature such as nasalization being spread over the entire nucleus while other features such as aspiration are heavier at the beginning of the nucleus and then fade. In this view, /nth/ becomes a simple /t/ onset which is nasalized followed by a nucleus which is breathy. The onsets which occur in Soyaltepec Mazatec are not as complex as those in highland Mazatec dialects, but a similar set of characteristics, i.e., aspiration, glottalization and nasalization, occur and the debate concerning how these features should be interpreted is just as relevant.

Aside from the theoretical discussions regarding the nature of phonemes, Pike and Pike (1947) also describe a series of restrictions for which types of onsets and nuclei can occur in the same syllable. Golston and Kehrein (1998) analyze the tendencies described and create a list of feature co-occurrence

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considered to be part of the onset or the nucleus – regardless of the interpretation, some kind of feature can be posited which I am calling an ‘element’ for now.

restrictions based on the OCP. Since most of these restrictions hold true for Soyaltepec Mazatec as well as offering insight as to the types of patterns that occur, I reproduce their restrictions in (1) with a few slight modifications to make them more specific to the data in this dissertation.

(1) Suggested feature co-occurrence restrictions within the syllable (adapted from Golston and Kehrein 1998:320):

*[labial labial]$_\sigma$	[o] and [u] are never preceded by [w] or [f]
	[o] and [u] are very rarely preceded by [m]
*[front front]$_\sigma$	[ɛ] is never preceded by [ʃ] or [ɲ]
	[ɛ] is very rarely preceded by [t͡ʃ] or [j]
	[i] is never preceded by [ɲ] or its clusters
	[i] is very rarely preceded by [j]
*[sv[61] sv]$_\sigma$	[ṽ] (nasalized vowels) are never preceded by [w, j, 1, r] or their clusters or [m, n, ɲ]

These restrictions are based on restricting identical features between adjacent segments per the OCP and therefore assumes certain features for vowels and consonants. There are some limitations to these restrictions. For example, they do not offer an explanation as to why these features could not be shared between two segments which is perfectly acceptable for tones as we will see in Chapter 5. There are also no guidelines to determine when a co-occurrence will be completely illicit versus when it will be rare. They also do not address certain anomalies such as why [ɛ] should be restricted from co-occurring with [ʃ], but [i] is not restricted, yet both are front vowels. The *[front front]$_\sigma$ formulation of this particular restriction is too restrictive for Soyaltepec Mazatec. Perhaps this restriction should be based more in articulatory facts, potentially accompanied by spreading features, than in OCP violations. For example, since the tongue is already in the [+high] position for [ʃ], perhaps it is easier to maintain this position for the vowel as well rather than dropping to [-high] for the [ɛ] (see Burquest 1998:62 for a similar argument). "Phonologically,

[61] The source of this abbreviation is explained as a shared feature between nasalized vowels and sonorant consonants, which is assumed to be [sonorant voice].

of course, there is a strong connection between front vowels (especially [i]) and alveopalatal consonants…" (Kenstowicz 1994:464) Alternatively, if the vowel is seen as the stronger element, it is possible that the [-high] from the vowel could spread to the /ʃ/ causing a [s] on the surface. I will leave the reformulation to future research and use the restriction as stated in Golston and Kehrein (1998); despite its inadequacy, it is still descriptive and a good starting point.

Although the restrictions offered by Golston and Kehrein are not without issues, they do at least superficially appear to hold for Soyaltepec Mazatec and they provide a source for comparison, as such I will tentatively adopt them. A full investigation of the features and restrictions is beyond the scope of this dissertation; the area deserves further research. As potential gaps in the co-occurrence data become evident, I will discuss how these gaps relate to the restrictions.

First, I provide a summary of pertinent segmental information to orient the reader to the phonemes and the combinatorial possibilities that occur in Soyaltepec Mazatec. In the sections that follow, I provide details, examples and discussion. The vowels are summarized in Table 3-1. The five basic vowel distinctions occur both orally and nasally.

Table 3-1 Soyaltepec Mazatec Vowel Inventory

	front	back
high	i, ĩ	u, ũ
mid	ɛ, ɛ̃	o, õ
low	a, ã	

The simple consonant phonemes are summarized in Table 3-2.

Table 3-2 Soyaltepec Mazatec Consonant Phonemes

	Labial		Coronal			Dorsal	Guttural
	bilabial	labio-dental	alveolar	postalveolar	palatal	velar	glottal
stops	p[62]		t[63]			k	ʔ
fricatives		f	s	ʃ			h
affricates			t͡s	t͡ʃ			
nasals	m		n		ɲ		
laterals			l				
flap			ɾ				
glide	w				j		

In addition to the simple vowels and consonants, clusters occur so that the maximal syllable is CCVV. Although two vowels may exist in the nucleus, long vowels never occur and vowel length is never contrastive. As implied by the syllable representation, all syllables in Soyaltepec Mazatec are open. The consonant combinations which occur fall into five basic categories:

- Sibilant–stop (/st/, /sk/, /ʃt/ and /ʃk/)
- Stop-Stop (/tk/)
- Obstruent–glottal[64] (/th/, /tʔ/, /kh/, /kʔ/, /sʔ/, /ʃʔ/, /t͡sh/ /t͡sʔ/ /t͡ʃh/ and /t͡ʃʔ/)
- Nasal-obstruent[65] (/nt/, /nk/, /nt͡s/ and /nt͡ʃ/)
- Glottal–sonorant (/hm/, /ʔm/, /hn/, /ʔn/, /hɲ/, /ʔɲ/, /ʔw/ and /ʔj/)

[62] Similar to other Oto-Manguean languages, /p/ occurs only in borrowed words (see Rensch 1966 for comparative Oto-Manguean studies).
[63] The /t/ is articulated in the denti-alveolar region.
[64] The consonant cluster involving a plosive followed by a glottal fricative is different from an aspirated plosive: the first is a combination of two separate phonemes involving all of their features and the latter is a modified consonant with the obstruent as the primary consonant and the aspiration is a turbulent release. Phonetically, the two are hard to distinguish, but phonologically they behave differently as will be shown regarding the co-occurrence restrictions that occur, see §3.4.3.
[65] Phonetically, the voicing from the nasal spreads to the obstruent and the place of articulation of the nasal assimilates to the following stop producing [nd], [ŋg], [nd͡z] and [nd͡ʒ]. Throughout, the nasal distinction will be ignored and depicted with a simple /n/ but the voicing distinction will be represented since voicing has the potential to play a role in tonal processes.

The vowels are discussed in §3.2 and the consonants in §3.3. The presentation of the consonants includes co-occurrence patterns between the vowels and consonants. Basic syllables and the clusters which occur are discussed in §3.4. In §3.5, the combination of syllables into larger prosodic units is presented. Stress and where it falls in Soyaltepec is examined in §3.6. Finally, the segmental inventory of Soyaltepec is summarized in §3.7.

3.2 Simple Vowels

In this section, I give examples of minimal pairs of oral vowels to establish the vowel qualities, and then of oral versus nasal vowels to establish contrast. Subsequently, I give an example of each vowel phoneme with /h/. Then, I discuss the pronunciation of the vocalic phonemes and the variation which occurs. Finally, I discuss the restriction of nasal vowels to stressed syllables.

3.2.1 Vowel Phonemes

Soyaltepec Mazatec makes use of five vowel specifications, each of which may be oral or nasal. The complete inventory was given above in Table 3-1. Minimal and near minimal sets demonstrating the distinctions between oral vowels appear in (2): (2a) contains examples with a Mid to Mid-high contour tone with a minimal pair between /a/ and /ɛ/, an /u/ which differs only in part of speech and /i/ which differs in onset; (2b) demonstrates words containing High tones with a minimal pair between /i/ and /ɛ/ and a near minimal pair for /u/ which differs in onset; (2c) contains Mid tone examples of a minimal pair /a/ vs. /i/, an /o/ which differs in part of speech, an /u/ which differs in onset and a second minimal pair /ɛ/ vs. /o/ which are also near minimal to the remaining examples; finally, (2d) contains High tones with a minimal pair between /o/ and /u/ which differ in part of speech.

(2) Minimal pairs for oral vowels

a. Minimal /a/ vs. /ɛ/ - near minimal /u/ and /i/

Transcription	Gloss
ta˧˥	‘toasted’
tɛ˧˥	‘squished’
tu˧˥	‘fruit’
t͡si˧˥	‘yours’

b. Minimal /i/ vs. /ɛ/ near minimal /u/

Transcription	Gloss
ti˥	‘burns’
tɛ˥	‘dances’
t͡su˥	‘says’

c. Minimal /a/ vs. /i/, near minimal /o/, /u/, minimal /ɛ/ vs. /o/

Transcription	Gloss
ʃʔa˧	‘open’
ʃʔi˧	‘grind’
ʃʔo˧	‘skirt’
ʃ̥u˧	‘boils’
sʔɛ˧	‘lay down’
sʔo˧	‘he breaks’

d. Minimal /o/, /u/

Transcription	Gloss
ko˥	'how many?'
ku˥	'and'

The examples in (2) show five vowel qualities which contrast on monosyllabic words of the same tone. There are minimal pairs for /a/ vs. /ɛ/, /i/ vs. /ɛ/, /a/ vs. /i/ and /ɛ/ vs. /o/ as well as multiple near minimal sets including (2c) which includes comparisons for all five of the oral vowels with similar onsets and the same tone.

Minimal pairs also occur which show a distinction between the oral and nasal vowels. Near minimal pairs for /ɛ/ vs. /ɛ̃/ are shown in (3) and for /a/ vs. /ã/ in (4). Unfortunately, while the segments are the same except for the nasality and the tones are the same, only (4b) contains a pair which has the same part of speech and is therefore truly minimal.

(3) Minimal Pairs for /ɛ/ vs. /ɛ̃/

	Transcription	Gloss
a.	sɛ˧	'thick'
	sɛ̃˧	'wager'
b.	tʔɛ˥	'hear'
	tʔɛ̃˥	'conjunctivitis'
c.	βa˧sɛ˧	'look'
	βa˧sɛ̃˧	'half'

(4) Minimal pairs for /a/ vs. /ã/

	Transcription	Gloss
a.	<u>ʔa˧</u>	'YNQ'
	<u>ʔã˧</u>	'I'
b.	<u>kʔa˧</u>	'tall'
	<u>kʔã˧</u>	'single'

There are no exact minimal pairs for /i/ vs. /ĩ/, /u/ vs. /ũ/ or /o/ vs. /õ/; however, each occurs in a wide variety of environments and near minimal pairs, none of which are in complementary distribution. I posit that each of these vowels follows the pattern of /a/ vs. /ã/ and /ɛ/ vs. /ɛ̃/ and are therefore distinct phonemes.

In order to demonstrate the phonemes that exist, Table 3-3 below supplies examples of the vowels with the glottal fricative and various tones. The table demonstrates that all ten vowel phonemes occur with the glottal fricative with various tones. While pairing the vowels with the glottal fricative provides numerous examples and near minimal pairs, there are no exact minimal pairs for oral versus nasal vowels which appear in this environment. The glottal fricative was chosen for demonstrative purposes because there are multiple examples available for each vowel and the consonant itself has little influence on the shape of the vowel. Whenever possible, a monosyllabic morpheme was chosen. The far left column lists the vowels being compared, the middle column gives examples with oral vowels and the rightmost column lists examples with nasal vowels. Here and throughout this chapter, the syllable with primary stress is underlined.

Table 3-3 Vowel Examples in Soyaltepec Mazatec

	Vowel	Oral Vowel	Nasal Vowel
a.	a/ã	ha˩ 'eagle' ha˧ʔa˧ 'happened'	hã˥ 'three' hã˦ 'there'
b.	ɛ/ɛ̃	hɛ˧ 'fat' hɛ˩ʔɛ˩ 'young ear of corn'	hɛ̃˨ 'smells' t͡sɛ˧hɛ̃˦ 'visible' t͡sɛ˧hɛ̃˧ 'fell'
c.	i/ĩ	-hi˥ 'negative suffix' hi˧ 'you (singular)'	hĩ˥ 'name' hĩ˥ 'blood' hĩ˦ 'eight' hĩ˨ 'we, exclusive'
d.	o/õ	ho˥ 'two' ja˧ho˥ 'sharp ja˧ho˧ 'meat'	hõ˦ 'six' hõ˧ 'soldier'
e.	u/ũ	ndu˧hu˥ 'long' ndu˩hu˩ 'soap'	hũ˧ 'yes' hũ˥ 'you (plural)'

The corresponding nasal vowel for each of the five oral vowels is contrastive; oral and nasal vowels are distinct phonemes. The further examples with various consonants given in §3.3 will reinforce this fact.

3.2.2 Pronunciation and Variation

In this section, I discuss the variation that occurs in Soyaltepec vowel pronunciation. For the most part, the pronunciation of the vowels is consistent. The vowels /a/, /i/, /o/ and /u/ are realized as [a], [i], [o] and [u] respectively in every environment with little variation. In the case of the nasalized phonemes, the vowel quality of /ã/, /ɛ̃/, /ĩ/ and /ũ/ is maintained by all speakers. The only vowels which undergo variation by some speakers are the oral vowel /ɛ/ and the nasal vowel /õ/.

The only oral vowel to exhibit variation is /ɛ/ which sometimes appears as [e]. While [ɛ] is more common, [e] often appears in Spanish loan words and occasionally in indigenous words. In (5), (5a) is borrowed from Spanish and (5b) is an indigenous word.

(5) Examples of [e]

Transcription	Gloss
a. pe˧ʃu˥˩	'peso' (the Mexican monetary unit)
b. te˧ja˦	'deaf'

It is possible that the presence of the palatal consonant following the /ɛ/ as occurs in (5b) conditions the pronunciation for some speakers. Occasionally, the same word will be articulated with the pronunciation of the [e/ɛ] varying from utterance to utterance or person to person. An initial hypothesis is that the [e] pronunciation is more prevalent in speakers who have a greater exposure to Spanish; however, the issue will be left to further research. Since there is no consistent environment across all speakers, the [e/ɛ] variation will be considered a case of free variation.

The only nasal vowel to exhibit variation is /õ/. Some speakers always pronounce the /õ/ as [õ], some pronounce it as [ũ] (thus merging these two phonemes) and others exhibit some free variation. Because of this variation, the alternate pronunciations in (6) occur; (6a) demonstrates the underlying phonemes maintained by some speakers while (6b) demonstrates the alternate articulation of [õ] as [ũ].

(6) Possible [õ] to [ũ] pronunciation alternation

Transcription	Gloss	Notes
a. Hũ˧, hõ˧ hõ˥˩	'Yes, six soldiers.'	underlying phonemes
b. Hũ˧, hũ˧ hũ˥˩	'Yes, six soldiers.'	alternate pronunciation

When speakers hear someone with the alternate pronunciation from their own, they attribute the variance to exposure to the San Jose Independencia dialect of Mazatec. These differences in pronunciation do not affect the tone system. I will always indicate the underlying /õ/.

Although there is not free variation between the oral vowels /o/ and /u/, it would appear that there may be vowel quality neutralization. It will be demonstrated in §3.3 that [o] has a very limited distribution, only occurring with velar and glottal consonants in indigenous words. It is unclear if /o/ occurs in other environments but surfaces as [u] under certain conditions, or if there are no underlying lexemes with /o/ in other environments. Borrowed words that contain an [o] in Spanish occasionally occur with [o] (7a), but more frequently they surface with an [u] (7b-c).

(7) Encoding of borrowed words

	Transcription	Spanish source	Gloss
a.	to˧ro˩	toro	'bull'
b.	ndu˧mi˥ngu˩	domingo	'Sunday'
c.	bu˧ru˩	burro	'donkey'

Further research is needed to determine if the [o] pronunciation is favored by speakers who are more familiar with Spanish[66] and monolingual speakers would never use the [o] even in borrowings. Perhaps examples such as (7a) are more recent borrowings which are in the process of shifting to a more natural Soyaltepec Mazatec pronunciation. Another possibility is that increasing exposure to Spanish is making the [o] more acceptable and more recent borrowings will never shift to [u].

The pronunciation of vowels in Soyaltepec is relatively stable, with the exception of some variation in the expression of /ɛ/ and /õ/. The differences are speaker specific and do not influence the greater phonological analysis of the language. There is also the possibility of vowel quality neutralization between /o/ and /u/ (and theoretically the nasal counterparts as well) in non-glottal, non-velar environments. These differences do not influence the tone of the language.

3.2.3 Nasal Occurrence Restrictions

The distribution of vowels within words, specifically restrictions on nasal vowels, is addressed below. The question of co-occurrence restrictions of vowels with various consonants will be addressed when the consonants are discussed in §3.3. Oral vowels occur without restriction or reduction in both

[66] All of my language collaborators demonstrate at least minimal proficiency in Spanish – I have not had the opportunity to interview any monolingual speakers to witness truly indigenous pronunciation.

stressed and unstressed syllables. Nasal vowels, however, do not occur in non-stressed syllables[67] of unbound, monomorphemic content words. In multisyllabic, monomorphemic words, there is at most one nasal syllable and it always occurs in the stressed syllable. In (8) there are two examples each of one, two and three syllable monomorphemic words with nasalized vowels appearing in the stressed (ultimate) syllable. The stressed syllable is underlined.

(8) Nasal vowels only appear in the stressed syllable of monomorphemic words

	Transcription	Gloss
1σ	a. ʃkũ˩	‘eyes’
	b. sɛ̃˧	‘a bet’
2σ	c. ʔa˧sɛ̃˥	‘an image’
	d. βa˧khã˥	‘a crack’
3σ	e. βi˧ʃtu˧t͡sĩ˥˩	‘a squirrel’
	f. nda˧t͡ʃa˥kũ˧˩	‘a sea’

There are three exceptions to this restriction of nasalized vowels to the stressed syllable. The exceptions all occur in multimorphemic words, for monomorphemic words, the rule stands. First, certain enclitics are always nasalized such as the first person marker demonstrated in (9).

(9) Occurrence of a nasalized enclitic

Transcription	Gloss
a. (ʔã˧) khɛ̃˧˩ʔã˩	‘I eat’
b. (ʔã˧) khue˧ʔã˩	‘I go’

The pronoun can optionally occur before a verb for the purpose of emphasis as is indicated through the use of parenthesis. The tone on the morpheme changes depending on whether or not it appears as an affix, but the nasalization remains in each form.

[67] Stress occurs on the final syllable of the stem and is indicated through intensity and a slight lengthening of the vowel. It will be discussed in more detail in §3.6 below.

The second exception to the restriction of nasal vowels to stressed syllables is that some enclitics, such as the negative marker (10), acquire nasality from the stem.[68]

(10) A clitic can take on the nasality of the stem

Soyaltepec	Gloss	Underlying forms	
a. hũ˧hĩ˥	‘no’	hũ˧ ‘yes’	-hi˥ ‘neg’
b. sɛ˧hi˥	‘not thick’	sɛ˧ ‘thick’	-hi˥ ‘neg’

The first example, (10a), demonstrates the negative particle attaching to a stem in which the final vowel is nasal and the suffix appears nasalized as well. The second example, (10b), demonstrates the case of an oral vowel occurring in the final syllable; in this case the suffix also appears with an oral vowel.

The final case in which a nasal vowel may occur outside of the primary stress syllable occurs in compound words. In compound words, nasality that initiates in the uncompounded morpheme is maintained in the compound whether or not it ends up in the primary stress position. Notice the form in (11a) which compounds two words, ‘skin’ (11b) and ‘mouth’ (11c), to form ‘lips.’

(11) Creation of a compound word with a nasalized vowel in the non-stressed syllable

Soyaltepec	Gloss
a. tjiu˩ʃĩ˧t͡sʔua˥-ɲa˦	‘lips’ (b + c)
b. tjiu˩ʃĩ˧	‘skin’
c. t͡sʔua˥-ɲa˦	‘our mouth’

The word for ‘skin’ in (11b) originates as a two syllable word with the final syllable nasalized. In the compounded word in (11a), the stem contains three syllables with primary stress on the final syllable of the stem which is the third syllable of the word; however, the nasal remains intact on the second syllable.

[68] This admittedly begs the question of whether nasality is able to spread in general; however, as the nasal vowel always appears in the final syllable of the stem, there is not much corroborating evidence. In compound words which contain a nasal, no spreading occurs as (11) confirms. It is possible that nasality only spreads across certain types of morphemes or phonemes (like the glottal fricative); however, more research is needed to make a statement one way or the other.

3.3 Simple Consonants and Distributional Issues

In this section, I discuss the simple, unmodified consonants followed by the allophonic variations that occur and then I show the co-occurrence patterns with oral and nasal vowels.

3.3.1 Consonant Phonemes

The consonant inventory was given in Table 3-2 above but will be repeated here as Table 3-4 for ease of reference.

Table 3-4 Soyaltepec Mazatec Consonant Phonemes

	Labial		Coronal			Dorsal	Guttural
	bilabial	labio-dental	alveolar	postalveolar	palatal	velar	glottal
stops	p		t[69]			k	ʔ
fricatives		f	s	ʃ			h
affricates			t͡s	t͡ʃ			
nasals	m		n		ɲ		
laterals			l				
flap			ɾ				
glide	w				j		

Soyaltepec Mazatec makes use of 17 consonant phonemes in seven places of articulation. Alveolar consonants are by far the most common. No consonants in Soyaltepec are contrastive for voicing. All of the voicing specifications are unmarked: obsturents are voiceless and sonorants are voiced. There are four stops, /p/, /t/, /k/ and /ʔ/; however, only three of these, /t/, /k/ and /ʔ/ occur in non-borrowed words. There are four fricatives: /f/, /s/, /ʃ/ and /h/. The fricatives do not follow the places of articulation of the stops. There is a labio-dental fricative /f/, but no labial-dental stop. Similarly, there is a postalveolar fricative /ʃ/, but no postalveolar stop. There is no velar fricative, but there is a velar stop /k/. The alveolar and glottal positions each contain both stops and fricatives. Affricates appear in alveolar /t͡s/ and postalveolar /t͡ʃ/ positions. These affricates behave like simple phonemes in terms of the modifications or clusters that can be formed For example they can occur in an onset with either glottal or nasal features like the other

[69] Remember that this /t/ is actually denti-alveolar.

obstruents and, therefore, will be considered to be single phonemes. Nasals appear in indigenous words in bilabial, alveolar and palatal positions. The only lateral that occurs, /l/, is in the alveolar position and all of its examples are in borrowed words. The only flap /ɾ/ is also alveolar. These are limited in distribution as will be seen below (Table 3-5); however, they occur in several pervasive indigenous function words. The final phonemes are the bilabial /w/ and palatal /j/ glides. The pronunciation of the /w/ tends to be unrounded especially among those speakers more fluent in Spanish whose pronunciation phonetically is closer to a /β/ which has become an accepted allophonic variation in the syllable initial position. Steriade (1994) in her analysis of highland Mazatec dialects centering on the Huautla dialect considers the corresponding phoneme to be the lacking bilabial stop; however, I consider it as a glide because: 1) it is voiced while all other indigenous stops are voiceless, 2) it lacks the expected consonant combinations that occur with other stops (/Ch/, /Cʔ/ and /nC/) as will be discussed below in §3.4.3 and 3) like the /j/ the only consonant combination it occurs with is being preceded by the glottal /ʔw/. Considering the underlying phoneme to be a bilabial glide produces a symmetrical system with no unexpected voicing or consonant combinations and it is faithful to an acceptable phonetic pronunciation.

3.3.2 Allophones

Most of the phonemes in Soyaltepec Mazatec are consistent, occurring word initially and intervocalically without restriction. The only exception is the case stated above regarding the /w/ in word initial positions which surfaces as a /β/. Consider the data in (12). The first column shows word initial examples while the second shows word medial examples.

(12) /β/ vs. /w/

Transcription	Gloss	Transcription	Gloss
βa˧sɛ˧	'half'	ti˧wa˩	'plate'
βɛ˧	'know'	kha˧wɛ˥	'grabs'
βi˧ʃu˥	'they fell'	nd͡ʒu˧wi˧	'worm'

The process in (12) can be expressed as the rule in (13a) which can be further generalized to (13b) since the /w/ is the only consonant phoneme which is rounded.[70]

(13) Loss of /w/ rounding

a. w → β / #__

b. [+round] →[-round] /#___

While there are no other positional allophones, there are allophones which occur when more than one phoneme occurs in the onset of a syllable. First, when a nasal precedes an obstruent, two changes occur: the first in the place of articulation of the nasal, the second in the voicing of the obstruent (14).

(14) Nasal assimilation data

Underlying Representation	Surface Structure	Gloss
a. /Nku˦/	[ŋgu˦]	‘one’
b. /Nta˥/	[nda˥]	‘good’
c. /Nt͡ʃa˩/	[nd͡ʒa˩]	‘watery/thin’

The nasal assumes the place of articulation of the obstruent and the obstruent assumes the voicing of the nasal. In each of these examples, the nasal is indicated as N – it is unclear if the nasal should have any specification for place in the underlying representation. In the surface form, the nasal assimilates to the place of articulation of the following obstruent. The position after the nasal is the only place where an obstruent in Soyaltepec Mazatec experiences voicing.

(15) Allophones resulting from nasal, voicing assimilation

Underlying form	Surface form
a. /N/	[n] or [ŋ]
b. /t/	[t] or [d]

[70] The features could also be represented in a tree structure and the tendency to flatten could be stated in a constraint; I am more interested in the processes which occur than in a theoretic orientation.

c. /k/	[k] or [g]
d. /t͡s/	[t͡s] or [d͡z]
e. /t͡ʃ/	[t͡ʃ] or [d͡ʒ]

A second set of allophones involving consonant clusters in the onsets are those which contain a glottal fricative and a nasal element. These morphemes are articulated with a voiceless nasal; however, there is no need to hypothesize the existence of the voiceless nasals as phonemes because this is the only environment in which they surface and the assimilation is not uncommon cross linguistically (16).

(16) Voiceless nasals

Underlying form	Surface form	Gloss
a. /hma˥/	[m̥ma˥]	'black'
b. /hnu˩/	[n̥nu˩]	'cornfield'
c. /hɲu˥/	[ɲ̥ɲu˥]	'night'

In each case, the glottal fricative assumes the place of articulation of the following nasal, but retains its voiceless distinction. Again, there is no need to posit three voiceless nasal phonemes which would unnecessarily expand the number of phonemes as this is the only place that the allophones occur.

(17) Glottal fricative allophones

Underlying representation	Surface form
/h/	[h], [m̥], [n̥] or [ɲ̥]

A final case of assimilation involves the postalveolar phonemes (/ʃ/ and /t͡ʃ/) which are optionally retroflexed when preceding a back vowel (18).[71]

[71] Although /ʂ/ is more universally used to indicate this phoneme, I have chosen to indicate the retroflexed phoneme with the symbol /ʃ̢/ because it is an allophonic free variation of the /ʃ/ and not a separate phoneme.

(18) Postalveolar sibilant pronunciation

Before back vowels		Elsewhere	
Transcription	Gloss	Transcription	Gloss
a. βi˧<u>ʃ̢u˥</u>	‘they fell’	g. ki˧<u>ʃi˥</u>	‘dry’
b. ʃ̢u˩<u>hũ˩</u>	‘paper’	h. na˩<u>ʃi˩</u>	‘hill’
c. ʃ̢u˧	‘boils’	i. βi˧ʃtu˧<u>sĩ˥˩</u>	‘squirrel’
d. t͡ʃ̢u˩	‘animal’	j. ʃkũ˩	‘eye’
e. t͡ʃ̢ho˩˥	‘egg’	k. t͡ʃi˧<u>ndɛ˧</u>	‘tender’
f. t͡ʃ̢hũ˩˥	‘woman’	l. t͡ʃhɛ˩	‘alms’

The retroflection occurs in both the simple phoneme (18a-c) as well we in the affricate (18d-f) and is not influenced by the presence of the glottal fricative as is evident in (18e, f and l). Likewise, the elsewhere condition holds for both the simple phoneme and the affricate for the environment directly preceding a front vowel (18g, h and k) which is also not hindered by the presence of the glottal fricative (18l). Also, the cluster before a stop retains the non-retroflexed version of the phoneme (18i, j) despite the back vowel in the nucleus. Finally, syllable structure, and by extension the stress on the syllable, does not play a role in this alternation (18a, b, g, h, i and k).

(19) Postalveolar allophones

Underlying representation	Surface form
/ʃ/	[ʃ] or [ʃ̢]
/t͡ʃ/	[t͡ʃ] or [t͡ʃ̢]

Each of these place and voice assimilations are common allophonic relationships cross-linguistically and none play a role in the tonal system.

3.3.3 Simple Consonants with Oral Vowels

As mentioned above, there are certain combinations of consonants with vowels which either do not occur at all or are very rare. Table 3-5 below gives examples of all of the simple, oral consonants with each oral vowel that occur in my database. Because the chart is grouped according to vowel type, minimal or near minimal pairs are provided for all of the phonemes and oral vowels. I include /p/ and /l/ here to give examples even though all the instances in which they occur are borrowed words. The fact that the sounds are borrowed does not make them any less a part of the phonological consciousness or awareness of the speakers, especially since the usage of these phonemes is widespread and frequent. Whenever available, monosyllabic words are given to illustrate the consonants. Nasal consonants have been omitted from this chart: they will be addressed in §3.3.5. In Table 3-5 below, the place of articulation (POA) appears in the far left column, followed by the specific consonant (C) in question. Across the top row each oral vowel is listed individually. Examples of the co-occurrence of the vowel with the consonant appear in the appropriate cell. An English gloss is provided in single quotes. If there are no examples of a co-occurrence in my database the cell is empty. When the only example of a phoneme occurs in a borrowed word, I have included the example, but I have shaded the box in order to clarify that they are not indigenous occurrences. In multisyllabic words, the stressed syllable is underlined.

Table 3-5 Examples of simple consonants with oral vowels

	POA	C	i	ɛ	a	o	u
a.	labial	p	pi˧su˩ 'floor'	pe˧ʃu˥˩ 'peso'	pa˧ju˥˩ 'handkerchief'	po˧me˧˥la˩ 'grapefruit'	pul˥mõ˥˩ña˩˥ 'lung'
b.		w	wi˧t͡ʃa˥ 'to cut'	we˥ 'to plant'	wa˧ho˥ 'spicy'	wo˩ra˩ 'corral'	t͡ʃi˧wu˩ 'goat'
c.		f	fi˥ 'slowly'	fɛ˧ 'finished'	fa˧fɛ˩ 'sleep'		fuei˥ 'goes'
d.	alveolar	t	ti˧ 'boy'	tɛ˧ 'ten'	ta˧˥ 'toasted'	to˧ɾo˩ 'bull'	tu˧˥ 'fruit'
e.		s	si˥hɛ̃˩ 'scented'	sɛ˧ 'thick'	sa˧˥ 'moon'	wa˩so˩ 'glass'	su˧wa˩ 'alone'
f.		t͡s	t͡si˥ 'rain'	t͡sɛ˧ 'guava'	t͡sa˧ 'bag'		t͡su˥ 'says'

Table 3-5 continued

	POA	C	i	ɛ	a	o	u
g.		l	li˧bru˩ 'book'	ja˦ʃi˧le˧˩ 'seat'	po˧me˦la˩ 'grapefruit'	pe˧lo˦ta˩ 'ball'	lu˧mɛ˦ta˧˩ 'bottle'
h.		ɾ	-˩ɾi˥[72] 'your'	-ɾɛ˩ 'to him'	-ɾa˧˩ 'probably'	to˧ɾo˩ 'bull'	bu˧ɾu˩ 'burro'
i.	post-alveolar	ʃ	ʃi˧ 'which'		ʃa˧ 'wildcat'		ʃu̥˧ 'boils'
j.		t͡ʃ	t͡ʃi˦sɛ̃˦ 'housefly'	t͡ʃɛ˧ʔɛ˥ 'costs'	t͡ʃa˦ 'mestiso'[73]		t͡ʃu̥˩ 'animal'
k.		j	ji˧ʔi˦ 'big'	jɛ˩ 'snake'	ja˧˥ 'tree'	tu˧wi˦jo˩ 'ankle'	ju˧fi˧˩ 'cloud'
l.	velar	k	ki˧˥ 'went'	ʃkɛ˧ 'swollen'	ka˧sĩ˦ 'neck'	ko˥ 'how much'	ku˥ 'and'
m.	glottal	ʔ	ʔi˩t͡ʃi˥ 'small'	-ʔɛ˩ 'his'	ʔa˧ 'YNQ'	ʔo˧ 'grinds'	ʔu˧t͡ʃ̥ã˧ 'hundred'
n.		h	hi˦ 'you'	hɛ˧ 'fat'	ha˩ 'eagle'	ho˥ 'two'	ndu˩hu˩ 'soap'

Of the 70 possible combinations expressed in this chart, 65 occur; however, 16 of these occur only in borrowed words. Of the co-occurrences, only 35 have monosyllabic examples available (leaving 30 multisyllabic examples, including all 16 of the borrowed words). All but one of the gaps in co-occurrences involves the /o/ which is the rarest vowel. Table 3-6 below provides a schematized summary of the simple, indigenous consonants which occur with oral vowels to demonstrate what occurs. The table is set up exactly as Table 3-5; however, the /p/ and /l/ have been omitted. The POA is in the far left followed by the exact consonant and each of the oral vowels. Co-occurrences which occur only in borrowed words have been removed. Those with available examples have been shaded. If no indigenous example exists, the cell is left blank. There are six instances of rare co-occurrence, meaning there are only a few examples available. These cells are marked with a diagonal line.

[72] The positioning of a tone key before a syllable indicates a floating tone which attaches to the left.
[73] A person of mixed indigenous and European heritage.

Table 3-6 Co-occurrence of simple consonants with oral vowels

	POA	C	i	ɛ	a	o	u
a.	labial	w					
b.		f					
c.	alveolar	t					
d.		s					
e.		t͡s					
f.		ɾ					
g.	postalveolar	ʃ					
h.		t͡ʃ					
i.	palatal	j					
j.	velar	k					
k.	glottal	ʔ					
l.		h					

The table clearly demonstrates the limited distribution of /o/ which only occurs in indigenous words following velar (/k/) and glottal (/ʔ/ and /h/) consonants. There is also a rare occurrence of /o/ with /w/ while /wu/ is lacking except in borrowed words. This is probably a case of phonetic dissimilation, perhaps giving evidence to a ban on homorganic syllables in Mazatec, specifically *[labial labial]$_\sigma$, as is proposed by Golston and Kehrein (1998). This confirms the restricted distribution and possible neutralization (i.e., /o/ →[u]/{non-glottal or velar}___) of /o/ that was introduced in §3.2.2.

Other gaps displayed in Table 3-6 involve postalveolar consonants (/ʃ/ and /t͡ʃ/) which rarely occur with /ɛ/. There are no examples of /ʃɛ/ and only a handful of /t͡ʃɛ/ (hence the /t͡ʃɛ/ cell contains a diagonal mark) in my database. This gap reflects the *[front front]$_\sigma$ restriction[74] of Golston and Kehrein (1998) which states that the postalveolar is never preceded by /ɛ/ and the affricate only rarely. Two methods to avoid this sound combination would be, 1. to posit that /t͡ʃɛ/ and /ʃɛ/ always surfaces as /t͡ʃi/ and /ʃi/ because the high sibilant could pull the mid vowel to a high; or 2. they always surface as /t͡sɛ/ and /sɛ/ because the

[74] Recall that this restriction needs refinement (which is left to future research) because it is too restrictive for Soyaltepec Mazatec.

mid vowel could force a lowering of the sibilant. Currently, there is no data which forces one repair strategy over the other, it is a matter for further research. It is also noteworthy that the indigenous usage of /ɾ/ is limited to /i/, /ɛ/ and /a/, and all of the occurrences appear in clitics.[75] It sometimes occurs with all of the vowels, but only in borrowed words. In other words, there are no examples of indigenous, monomorphemic, unbound morphemes which contain /ɾ/. The only restriction listed in Golston and Kehrein for the flap is the prohibition of occurring with nasalized vowels. Because of its limited distribution, I have placed a diagonal line through the cells indicating /ɾi/, /ɾɛ/ and /ɾa/.

The only significant gaps in the distribution of simple consonants with oral vowels involve /o/, /ɾ/ and postalveolar consonants with front mid vowels (/ʃɛ/ and /t͡ʃɛ/).

3.3.4 Simple Consonants with Nasal Vowels

The distribution of simple consonants with nasal vowels is more restricted than with oral vowels. Table 3-7 demonstrates the available co-occurrence examples for all simple oral consonants with the nasal vowels. Again, the POA is indicated in the far left column followed by the exact consonant (C) and then each nasal vowel. If the pattern occurs only in borrowed words, an example is listed but the cell is shaded. Stressed syllables are underlined in multisyllabic examples.

Table 3-7 Examples of simple consonants with nasal vowels

	POA	C	ĩ	ɛ̃	ã	õ	ũ
a.	labial	p			ni˩<u>pã˥˩</u> ‘bread’		
b.		w					
c.		f					
d.	alveolar	t	nd͡ʒu˩<u>tĩ˩</u> ‘corncob’			tõ˩˧ ‘money’	nga˧<u>tũ˧</u> ‘back’

[75] Although the existence of the /ri/, /rɛ/ and /ra/ is limited to clitics, several are very common and pervasive. This phoneme has a limited distribution in all of the Mazatec dialects; although it varies with the lateral /l/ in other dialects, the phoneme is mostly limited to this small set of common clitics.

Table 3-7 - continued

	POA	C	ĩ	ɛ̃	ã	õ	ũ
e.		s	ta˧sĩ˧˥ ‘tick’	sɛ̃˧ ‘wager’	sã˧ ‘sour’	kji˥sõ˥ ‘swims’	sũ˥ ‘straight’
f.		t͡s	t͡ʃu˩t͡sĩ˧˥ ‘glass’				
g.		l					
h.		ɾ					
i.	post-alveolar	ʃ	thiu˩ʃĩ˧˥ ‘skin’		ʃã˧ ‘liquor’		ʃũ˦˧ ‘diet’
j.		tʃ		t͡ʃɛ̃˥˨ ‘trap’	t͡ʃã˥ ‘brown’	t͡ʃõ˥ ‘a bird’	
k.	palatal	j					
l.	velar	k	t͡ʃa˧kĩ˧˥ ‘firewood’		kã˨˦ ‘twenty’		kũ˧ ‘are’
m.	glottal	ʔ	ʃi˩ʔĩ˧ ‘man’	ʔɛ̃˧˥ ‘word’	ʔã˧ ‘I’	ʔõ˥ ‘five’	t͡ʃʔũĩ˥ ‘chayote’
n.		h	hĩ˨˦ ‘eight’	hɛ̃˥˨ ‘smells	hã˥ ‘three’	hõ˨˦ ‘six’	hũ˥ ‘you (pl.)’

In general, nasalized vowels are much less widespread than oral vowels as can be seen by the multiple gaps in the table above which can be seen more clearly in the schematized table below. Of the 70 possible consonant-vowel co-occurrence possibilities only 28 occur, 8 of which are in multisyllabic examples and 2 are only in borrowed words. It is not surprising that borrowed words are usually encoded without nasalization since there is no contrastive nasalization in Spanish. In other words, pĩ, pɛ̃, lã, lĩ etc. do not occur in Spanish. The only time when nasalization occurs in a borrowed word is when a nasal occurs in the word final position of the original Spanish word. Since Soyaltepec does not allow closed syllables, these instances are interpreted as nasalized vowels, as in the example in row (a) of the Table 3-7 above. Table 3-8 below provides a schematized summary of the co-occurrence of the consonants with the nasal vowels in indigenous words. The table is a repeat of Table 3-7 with the data removed. I have also omitted /p/ and /l/ since they only occur in borrowed words. The shaded blocks indicate the presence of the given combination except when the only example appears in a borrowed word in which case the cell is left blank.

There was only one example of /t͡ʃɛ̃/ in my database, so I marked the representative cell with diagonal line to indicate rarity.

Table 3-8 Co-occurrence of simple consonants with nasal vowels

	POA	C	ĩ	ɛ̃	ã	õ	ũ
a.	labial	w					
b.		f					
c.	alveolar	t					
d.		s					
e.		t͡s					
f.		ɾ					
g.	postalveolar	ʃ					
h.		t͡ʃ					
i.		j					
j.	velar	k					
k.	glottal	ʔ					
l.		h					

The only consonants which demonstrate complete distribution with nasal vowels are /s/ and the glottals, /ʔ/ and /h/. Interestingly, the /s/ and /t͡ʃ/ appear with the nasal /õ/ but not with the oral /o/ (c.f. Tables 3-5 and 3-6). Conversely, /t/ only occurs with /ĩ/ and /ũ/ and /t͡s/ only occurs with /ĩ/, but they both have wide distribution among oral vowels.

The only co-occurrence restriction which specifically targets the modality of the vowel prohibits the co-occurrence of sonorants with nasal vowels. This accounts for the lack of [ɾ], [j] and [w]. The only other indigenously occurring phoneme that is completely absent is the /f/. According to Gudschinsky (1959), the /f/ finds its origins in the Proto-Mazatec /*hw/. If that is the case, it makes sense that /f/ would follow the same vocalic restrictions as /w/. The possibility of complementary distribution between all of these phonemes with nasal consonants is explored below in §3.3.5.

If we momentarily ignore the six consonants which never occur with nasal vowels and focus on the consonants which sometimes occur with nasal vowels, we can make some observations about the occurrence of nasal vowels. In Table 3-9 below, I have repeated the data from Table 3-8; however, I have removed the consonants which never occur with nasal vowels (i.e., /p/, /w/, /f/, /l/, /ɾ/ and /j/) and eliminated co-occurrences which only occurred in borrowed words. Shading signifies the attestation of the co-occurrence (and the diagonal bar, extreme rarity).

Table 3-9 Consonants occurring with Nasal Vowels

	POA	C	ĩ	ɛ̃	ã	õ	ũ
a.	alveolar	t					
b.		s					
c.		t͡s					
d.	postalveolar	ʃ					
e.		t͡ʃ					
f.	velar	k					
g.	glottal	ʔ					
h.		h					

First, we see that the mid vowels /ɛ̃/ and /õ/ are equally underrepresented which is not unexpected cross-linguistically.[76] The high and low vowels, /ĩ/, /ã/ and /ũ/, are the most common of the nasal vowels, occurring with all but one or two consonants each; however, the consonants omitted are not the same. In the case of /ĩ/, /t͡ʃĩ/ does not occur. The /ã/ does not occur with /t/ or /t͡s/. Finally, /ũ/ does not occur with /t͡s/ or /t͡ʃ/. Second, the nasalized mid vowels, /ɛ̃/ and /õ/, in general do not occur with coronal consonants with the exception of /s/ which occurs with all nasal vowels and /tʃ/ which occurs with the non-high nasal vowels.

When nasal vowels occur, it is always with voiceless onsets and they are most common when there is no oral obstruction to the airflow (i.e., glottal consonants, thus supporting the notion of rhinoglottophilia). The pervasive presence of /s/ with nasal vowels is interesting and perhaps indicates that Steriade's (1994) suggestion that /s/ is always phonetically aspirated in Huautla Mazatec should be revisited in search of phonological realities and features which would support a natural class between /s/ and /h/, or more research into Soyaltepec Mazatec may reveal a set of /sh/ clusters which are difficult to

[76]The absence of nasalized mid vowels was discussed in Hyman (1972).

distinguish phonetically, but are apparent because of the co-occurrence with the nasal vowels (see the discussion of consonant clusters in §3.4.3 for clarification of this argument).

3.3.5 Simple Nasal Consonants

The discussion of the co-occurrence of vowels with nasal consonants cannot be separated into two distinct groups of oral versus nasal vowels because the nasality of vowels after nasal consonants is indistinct. While some degree of phonetic nasalization occurs on vowels which occur after nasals, there are no contrasting examples of oral versus nasal vowels in this position.[77] Phonetically, the vowel following a nasal does not sound nasalized. Residual nasality on the nucleus which results from the consonant phoneme's nasality decreases over the course of the syllable. Golston and Kehrein (1998) would argue that the same feature can never occur on both the onset and nucleus in Mazatec syllables (*[sv sv]$_\sigma$) and therefore since the vowels in question occur after a nasal consonant, they must be underlyingly oral.

The distribution of the nasals with different vowels appears in Table 3-10. The nasal consonant is listed down the left column and the vowels are listed across the top row of the table. There is one instance (/mu/) in which the co-occurrence is only present in borrowed words, the cell is shaded to indicate this distinction. Finally, the occurrence of /ɲɛ/ is limited to a morphophonemicly derived environment, no underlying examples exist. The stressed syllables are underlined in multisyllabic words.

[77] An alternative analysis of nasals in languages which contain contrasts between oral and nasal vowels posits a relationship of allophony between nasal consonants and nasalized, voiced obstruents via the process of denasalization (Burquest 1998:127). The idea behind the process being that when the vowel which occurs after a nasal is specified as oral, an oral consonant is inserted to ensure the lowering of the velum. Soyaltepec Mazatec does have a series of prenasalized, voiced stops: [nd], [ŋg], [nd͡z] and [nd͡ʒ]. Unfortunately, the series does not line up with the nasal vowels. If the process of denasalization was occurring, we would expect [mb], [nd] and [ɲɟ]. We would also expect alignment in the types of vowels which occur with each POA which is also contrary to the language facts. Therefore, the process of denasalization cannot account for either the existence of the prenasalized obstruents or for the neutralization of nasalization after nasal vowels.

Table 3-10 Nasal Consonants

	POA	C	i	ɛ	a	o	u
a.	labial	m	mi˧ɲa˥ ‘threshes’	mɛ˧hɛ˥na˩ ‘I want’	ma˧ ‘he can’	mo˧ʔõ˦[78] ‘hit with stick’	mu˧la˧˩ ‘mule’
b.	alveolar	n	ni˩hĩ˩ ‘dried corn cob’	si˧nɛ˥ ‘yellow’	na˩˦ ‘mother’		nu˦˥ ‘year’
c.	palatal	ɲ			ɲa˥ ‘we inclusive’		ɲũ˧hũ˥ ‘four’

The nasals /m/ and /n/ appear mostly with front vowels. There are a few examples of /nu/, but /mu/ only occurs in borrowed words. The only instance of /mo/ occurs as a phonetic variant of /ma/ and /no/ does not occur. All three nasal consonants occur abundantly with the /a/. The palatal nasal is plentiful with low and back vowels (excluding /o/), but does not occur with the other front vowels which aligns with the co-occurrence restriction *[front front]$_\sigma$ as it was described by Golston and Kehrein (1998). Given the limited distribution of /ɲ/ it is reasonable to look for complementary distribution or some other means of explaining its occurrence.

First, it is possible that /m/, /n/ and /ɲ/ all vary with the sonorant consonants that occur at the same points of articulation but never occur with nasal vowels, namely /w/, /ɾ/ and /j/. The bilabial /m/ and /w/ share widespread distribution among front vowels and an avoidance of back vowels (which aligns with the co-occurrence restriction *[labial labial]$_\sigma$). The coronal /n/ and /ɾ/ likewise share a distribution pattern that avoids back vowels; however, recall that the flap is limited to a closed set of clitics. The nasal on the other hand is very common in both unbound and bound morphemes. Since nasal vowels are in general less common than oral vowels, it seems unlikely that the nasal version of this one phoneme would be so much more plentiful than the oral version. Finally, the palatal /j/ and /ɲ/ do not share a distribution pattern like the other two nasals did with the non-nasal sonorant corresponding to their place of articulation. Both palatal

[78] This word has a variant pronunciation, ma˧ʔõ˦. It is the only example of /mo/.

sonorants are relatively uncommon phonemes, but, while the /ɲ/ only occurs with /a/ and /u/ the /j/ can also occur with /ɛ/ in indigenous words. Positing that the /ɲ/ emerges when the vowel is nasalized, or even when the consonant is nasalized, fails to explain the lacking vowel co-occurrences, although, the restriction labeled *[front front]$_{\sigma}$ leads us to expect that neither /j/ nor /ɲ/ should occur very frequently with [i] or [ɛ].

Even though the nasal and non-nasal sonorants somewhat align in their distribution, the process of alternating a sonorant phoneme with the nasal which occurs at the same place of articulation in a process similar to denasalization would be unusual (i.e., the assumption would be that when a nasal feature is present, the nasal phoneme emerges but when no nasal feature is present, the non-nasal sonorant phoneme emerges). The language facts do not make a case for it. Positing that the nasal phonemes are underlying seems the most natural alternative.

Since there is not a strong argument in favor of complementary distribution between the sonorant consonants and the nasals at the same point of articulation, there is the possibility that just the /ɲ/ is derived since it occurs with a very restricted distribution. It is not uncommon for a high front vowel to form diphthongs[79] with the central /ia/ and back /iu/ vowels. It is also not uncommon cross-linguistically for a high front vowel to palatalize a nasal. In my data, there are no examples of these diphthongs occurring with any nasals, therefore, it is possible that when the underlying diphthongs occur with nasals the palatal nasal surfaces rather than the diphthong. While it is a possibility, more research is needed to document this as a real process in Soyaltepec Mazatec. The only argument against this possibility is that the occurrence of /ɲa/ and /ɲu/ is much more common than all of the instances of the occurrence of the respective diphthongs with other consonants combined.

The most straightforward interpretation of the data at hand supports the existence of all three of the nasal consonants as independent phonemes.

[79] Diphthongs will be discussed in §3.4.2.

3.3.6 Summary

Some general observations regarding the vowels and their distribution patterns with the consonants of Soyaltepec include the following. First, nasal vowels are less common than oral vowels which is not uncommon in world languages. Table 3-8 clearly shows that there are gaps in the distribution of the nasal vowels, while Table 3-4 shows nearly complete distribution of the oral vowels. Second, concerning in the distribution of the specific vowels, /i/, /a/ and /u/ are well attested with all consonants, while /ɛ/ is common except for its limited distribution with postalveolar consonants. Co-occurrence of /o/[80] is only attested in indigenous morphemes with /k/, /h/ and /ʔ/. Although this is a limited distribution, there are no conditioning environments capable of explaining its existence; it is more likely that the phoneme is underlying but phonetically merged with /u/ when following labial or coronal consonants. Third, the labial and sonorant consonants, (i.e., /p/, /w/, /f/, /l/, /r/ and /j/) never occur with nasal vowels. Finally, the occurrences of the high and low vowels, /ĩ/, /ã/ and /ũ/ are equally common while the mid /ɛ̃/ is slightly more restricted (similar to its oral counterpart, it is limited with postalveolar consonants, but the nasal is also limited with /t/, /t͡s/ and /k/ as well). The mid /õ/ is still the least common vowel. There are a few rare occurrences of /õ/ with /m/, /t/, /s/ and /t͡ʃ/ which do not occur with /o/; however, the nasal vowel does not occur with /k/ which did occur with the oral version.

The co-occurrence restrictions based on OCP violations specified by Golston and Kehrein (1998) in their reinterpretation of Pike and Pike's data for Huautla Mazatec (1947) hold for Soyaltepec Mazatec as well, especially if the restrictions are understood in terms of violable constraints. There is a question of the over-restrictiveness of the *[front front]$_\sigma$ restriction which needs further refinement to be truly applicable in

[80] The rarity of the /o/ can be traced to its development. Historically, the /u/ and /o/ are related. Proto-Otomanguean is reconstructed by Rensch (1976) as having only four vowels (/a/, /e/, /i/ and /u/) which is consistent with the description of Proto-Popolocan (by Gudschinsky 1956 and 1959) and Proto-Mazatec (by Kirk 1966). It isn't until the development of individual dialects of Mazatec that the /o/ emerges. In Soyaltepec the /o/ is derived from certain environments of the previous /*au/ sequence. Specifically, "In Maz-S when *au is interrupted by *h, it yields au where nasalized and ao where oral; when no longer interrupted by *h, it yields o." (Rensch 1976:115) Since /o/ developed later in the history of the dialect, and from only one specific environment of *u, it is not surprising that it is much more limited than the other, non-derived vowels.

Soyaltepec Mazatec. The restrictions, in general, dictate that a well-formed syllable should not have common features between the onset and nucleus as this would violate the OCP;[81] therefore, nasal consonants should not be followed by nasal vowels and labial consonants should not be followed by rounded vowels, etc. This is an area worthy of further investigation; however, it is beyond the scope of this dissertation and will not be addressed further at this time. Aside from the instances of allophonic alteration which were discussed, all of the stated phonemes will be considered to be independent and underlying, even though the palatal nasal is especially suspicious.

3.4 Syllable Structure

In this section I discuss the types of syllables that occur in Soyaltepec Mazatec. I address the possible combinations of vowels that occur in the nucleus and consonants that occur in the onsets and give examples of each. I also give several arguments in favor of the interpretation of all consonant phoneme combinations as clusters rather than modified phonemes.

3.4.1 Maximal and Minimal Syllable

All syllables in Soyaltepec Mazatec are open: codas never occur. Onsets are mandatory. All 17 consonant phonemes of Soyaltepec can occur alone in the onset of syllables. CV is the minimal and most common syllable type. Up to two consonants and vowels are allowed in monomorphemic words; therefore, there are four possible syllable types: CV, CCV, CVV and CCVV. All of these occur as can be seen in (20) through (23) which list examples of each type. At this point in the discussion, onsets that are more universally understood as clusters (i.e., /st/, /sk/, /ʃt/, /ʃk/ and /tk/) are used whenever possible. In three instances this type of cluster was not available so examples with onsets which could potentially be interpreted as aspirated (21b and f) or glottalized (23a) were included. The exact possibilities for complex syllable nuclei and onsets are discussed at length in §3.4.2 and §3.4.3 respectively. Each example set below includes examples of the designated syllable type with the four level tones arranged from highest to lowest

[81] Again, this restriction does not allow the merger of adjacent elements which will be shown to be a common strategy for rectifying OCP violations among the tonal elements.

(in a-d) and one example of a rising tone (e) and a falling tone (f).[82] For example, (20a) is an example of a CV syllable with a High tone, (20b) of a CV syllable with a Mid-high, and so forth.

(20) CV Syllables

	Transcription	Gloss
a.	fi˥	‘slowly’
b.	hi˦	‘you’
c.	t͡sɛ˧	‘guava’
d.	t͡ʃu˩	‘animal’
e.	hĩ˦˥	‘blood’
f.	ta˧˩	‘unripe’

(21) CCV Syllables

	Transcription	Gloss
a.	ʃki˥	‘whirlpool’
b.	thi˦	‘round’
c.	tka˧	‘bald’
d.	ski˩	‘cicada’
e.	tki˧˦	‘medicine’
f.	thɛ˥˧	‘breed

Soyaltepec allows either one (20) or two (21) consonants to occur in the onset of the syllable with each type of tone. Soyaltepec also allows clusters of two vowels to occur in the nucleus of a syllable with either one or two consonants. Examples of CVV syllables appear in (22) and examples of CCVV appear in (23). Each of these syllable patterns also occurs with the six tonal classes indicated. In two cases, (22d) and (22f), monosyllabic words were not available; these examples are enclosed in parentheses to indicate their divergence from the desired monosyllabic pattern and the syllable that contains the syllable example which is in focus is underlined.

[82] The rising and falling tones are not as common, so I have not endeavored to include examples of all rises and falls exhaustively for each syllable, but just representative examples to show that this type of tone is possible.

(22) CVV Syllables

	Transcription	Gloss
a.	suɛ˥	'hot'
b.	sĩã˦	'standing'
c.	kui˧	'he'
d.	(<u>kua</u>˩t͡su˥	'they say')
e.	ʔai˧˥	'heavy'
f.	(ja˧<u>tiu</u>˧˩	'wooden beam')

(23) CCVV Syllables

	Transcription	Gloss
a.	t͡ʃʔũĩ˥	'chayote'
b.	ʃtiu˦	'underdeveloped'
c.	tkue˧	'raspy'
d.	ʃkũã˩	'dust'
e.	ʃkue˧˥	'lettuce'
f.	ʃkiɛ˧˩	'frog'

In summary, there are multiple examples of each syllable type. Each occurs with the four level tones (H, M_1, M_2 and L) as well as rising and falling tones. Currently there are no monosyllabic examples of CVV with L or falling tones. A multisyllabic example was provided to show that there is not a restriction against these tones appearing on a CVV syllable. CVV is the least common syllable type so the omissions can be attributed to its rarity rather than a restriction.

3.4.2 Vowel Clusters

In mono-morphemic words up to two vowels can occur in a single syllable.[83] Vowel clusters can be composed of either oral or nasal vowels, but they are always completely oral or completely nasal. These diphthongs have no significant length difference compared to single vowel syllables. Vowel length is never contrastive lexically, so there is never an occurrence of /ii/ or /aa/, etc. There are seven diphthongs which can occur either orally or nasally and three more that are very rare or only occur in multimorphemic situations. At this point there are no nasal examples of these three rare diphthongs. These are listed in Table 3-11, the first vowel of the diphthong is listed down the left column and the second across the top row.

[83] There is one example of three vowels occurring on one syllable in the verb, fuei˥ 'he goes'. Because this is clearly exceptional, it will not be addressed at this time.

Table 3-11 Diphthongs

v1↓ v2→	i/ĩ	ɛ/ɛ̃	a/ã	o/õ	u/ũ
i/ĩ		/iɛ/ /ĩɛ̃/	/ia/ /ĩã/	/io/	/iu/ /ĩũ/
ɛ/ɛ̃	/ɛi/				
a/ã	/ai/ /ãĩ/			/ao/	
o/õ					
u/ũ	/ui/ /ũĩ/	/uɛ/ /ũɛ̃/	/ua/ /ũã/		

The first member of a diphthong is usually a high or low vowel. Mid vowels do not usually begin diphthongs, the rare cases of /ɛi/ being the only exceptions. The /ɛi/ only occurs in multimorphemic situations. There are only four examples in my database of diphthongs ending in /o/. Diphthongs never occur with nasal consonants. First, I discuss oral vowel combinations, then nasal vowel combinations.

3.4.2.1 Oral Diphthongs

Table 3-12 provides examples of the oral diphthongs that occur. All seven common diphthongs are listed across the top row of the table. The oral consonants are listed down the left column to show the startlingly limited distribution of diphthongs; most consonants do not occur with dipthongs. When an example is available, it is provided with its gloss, otherwise the cell is left blank. Consonant clusters are included with the example in the row which corresponds to the consonant which is immediately adjacent to the nucleus. In other words, /th/ is listed in the /h/ row. Most of the glottal examples come from these clusters. Multimorphemic examples are purposefully excluded in order to focus on lexical possibilities.

Table 3-12 Examples of Oral Diphthongs

	C	iɛ	ia	iu	ai	ui	uɛ	ua
a.	p							
b.	w							
c.	f					fui˧t͡ʃu˥ ‘arrives’	fuɛ˥ ‘goes’	ndi˥fua˧ ‘water’
d.	t		tia˧wa˧ ‘white’	tiu˧wa˩ ‘plate’				
e.	s						suɛ˥ ‘hot’	
f.	t͡s							
g.	l							
h.	ɾ							
i.	ʃ							
j.	t͡ʃ							
k.	j							
l.	k	ʃkiɛ˥˩ ‘frog’				kui˧ ‘here’	kuɛ˧ho˩ ‘takes away’	kua˩t͡su˥ ‘they say’
m.	ʔ		kʔia˩ ‘there’	kʔiu˥ ‘cacao’	ʔai˥ ‘heavy’	kʔui˧ ‘here’	kʔue˥t͡ʃhi˩ri˧ ‘thank you’	t͡sʔua˧ ‘mouth’
n.	h		khia˥ ‘when’	thiu˩ʃĩ˥ ‘skin’	nda˩hai˧ ‘reed’		˩khuɛ˥ ‘will go’	t͡shua˥ ‘gives’

The four level tones as well as rising and falling tones also occur on diphthongs; however, because of the more limited availability of examples, there are not examples of each tone with each diphthong. Row n contains examples of the four level tones as well as a rising tone. Row l contains a falling tone. From the varied occurrence of the tones it can be deduced that there are no restrictions on which tones co-occur with diphthongs.

The /iɛ/ only occurs after a velar stop. The remaining diphthongs which begin with the high front vowel, /i/, occur after the alveolar stop or glottal consonants. The /ai/ only occurs after glottal consonants. The diphthongs which begin with the high back vowel, /u/, in general occur after labial fricatives, velar stops and glottal consonants. For the /ui/, the glottal fricative is missing and the /uɛ/ adds /s/ to its list of co-occurrences. This suggests a generalization that when diphthongs occur, they begin with a high front vowel and follow the oral stop which reflects the [front] or [back] characteristic of the vowel or a glottal consonant which lacks an oral place of articulation.

Most of the diphthongs, other than the /ai/, occur with consonant clusters[84] which end with a glottal consonant, but they do not occur with simple glottal consonants or the first member of the consonant cluster (unless the first member is a /t/ in the case of the /iV/ or a /k/ in the case of the /uV/). The motivation for this is curious, but beyond the scope of this dissertation.

The co-occurrence of the /i-/ initial diphthongs with /t/ suggests the potential for these particular examples to be phonetic transitional off-glides; however, the /t/ also occurs without these vocalic transitions as is demonstrated in (24), so this element must be considered to be a phonemic reality.[85]

(24) /t/ occurs with and without apparent /i/ off-glide

	a. tia/ta comparison		b. tiu/tu comparison	
	Example	Gloss	Example	Gloss
diphthong	tia˧wa˧	'white'	tiu˧wa˩	'plate'
simple V	ta˦ha˥	'hard'	tu˧wa˥	'short'

The /u-/ initial diphthongs appear with two phonemes, /f/[86] and /k/. Once again examples can be found both with and without the suspected off-glide. The off glide comparisons appear in (25) for /f/ and (26) for /k/.

[84] Alternatively, these might be considered to be modified consonants, either glottalized or aspirated as will be discussed in §3.4.3.

[85] It is also possible that the consonantal inventory could be expanded to include palatal consonants (/t^y/) or that the list of consonantal modifications could be expanded to include palatalization; however, both of these possibilities unnecessarily complicate the inventories and upset the symmetry of the system. An interpretation as a diphthong is the most straightforward, least systemically complicating option. This argument can likewise be made for the /u/ initial diphthongs which could represent either underlying labialized consonants or consonant modifications.

[86] The co-occurrence of /u/ with /f/ might reflect the origins of /f/ in /w/.

(25) /f/ occurs with and without apparent /u/ off-glide

	a. fui/fi comparison		b. fuɛ/fɛ comparison		c. fua/fa comparison	
	Example	Gloss	Example	Gloss	Example	Gloss
diphthong	fui˧t͡ʃu˥	'arrives'	fuɛ˥	'goes'	ndi˥fua˧	'water'
simple V	fi˥	'slowly'	fɛ˧	'finished'	fa˧ʔa˧	'pass'

(26) /k/ occurs with and without apparent /u/ off-glide

	a. kui/ki comparison		b. kuɛ/kɛ comparison		c. kua/ka comparison	
	Example	Gloss	Example	Gloss	Example	Gloss
diphthong	kui˧	'here'	kuɛ˧ho˩	'takes away'	kua˩t͡su˥	'they say'
simple V	ki˦	'went'	ʃkɛ˧	'swollen	ka˥tɛ˧	'thirty'
min. pair- ʃk			ʃkuɛ˥	'lettuce'		

The possibility of a transitional phonetic off-glide whose presence is conditioned by the consonant would also not explain the occurrence of both types of diphthongs with the glottal consonants. The presence of the high, vocalic phoneme must be lexical, but perhaps they are licensed by similar features on the consonant.[87] The glottal consonants appear to be the least restrictive onset environment in Soyaltepec Mazatec and could possibly be interpreted as neutral phonemes.

3.4.2.2 Nasal Diphthongs

Like nasal vowels in general, nasal diphthongs are less common than their oral counterparts. The nasal diphthongs follow a similar pattern to the oral diphthongs; however, there are no co-occurrences with /t/ or /f/. Recall that /f/ also never occurs with simple nasal vowels, so it is unsurprising that nasal diphthongs are likewise absent. Table 3-13 demonstrates the occurrence of the nasal diphthongs. It is set up

[87] This argument in some ways is contradictory to the co-occurrence restrictions based in the OCP that forbade similar features between the onset and nucleus and were argued for in §3.3.

analogously to Table 3-12 with the consonant phonemes listed down the left column and the nasal diphthongs listed across the top row.

Table 3-13 Examples of Nasal Diphthongs

	C	ĩɛ̃	ĩã	ĩũ	ãĩ	ũĩ	ũɛ̃	ũã
a.	p							
b.	w							
c.	f							
d.	t							
e.	s		sĩã˦ ‘upright’					
f.	t͡s							
g.	l							
h.	ɾ							
i.	ʃ							
j.	t͡ʃ							
k.	j							
l.	k						ʃkũɛ̃˥ ‘unripe’	kũã˥ ‘purple’
m.	ʔ	kʔĩɛ̃˧ ‘dead’			tʔãĩ˩ ‘go’	t͡ʃʔũĩ˥ ‘chayote’		
n.	h	khĩɛ̃˥ ‘eat’	thĩã˦ ‘seated’	t͡shĩũ˩ ‘tobacco’	thãĩ˧˩ ‘fungus’			nd͡ʒu˧khũã˦ ‘aunt’

The nasal diphthongs are in a very restricted distribution. They mostly occur with consonant clusters ending in glottal phonemes, perhaps reflecting the neutral nature of the glottal phoneme. It is curious that there are no examples of nasal diphthongs appearing after a simple /h/ phoneme. There is one example of a nasal diphthong (/ĩã/) occurring with /s/ which is perhaps more motivation to look for /sh/ clusters as this type of co-occurrence could indicate the presence of the /h/ phoneme. Also, similar to the oral diphthongs, /ũ-/ initial diphthongs can occur after /k/. A variety of tones occur on the nasal diphthongs (the four level tones occur in Row n along with a falling tone and a rising tone occurs in Row k); there are no restrictions on the tones that occur with nasal diphthongs.

The seven more common oral diphthongs each have a nasalized counterpart. Like the common oral diphthongs, the nasal diphthongs each contain a high vowel. All except /ãĩ/ begin with a high vowel. It is possible that nasalized examples of the three rare oral diphthongs (/ei/, /ao/ and /io/) will surface with further research. There are no diphthongs that appear nasally without an oral counterpart.

3.4.3 Consonant Clusters

Syllable onsets may consist of single consonant phonemes or a combination of the features of two phonemes. These complex onsets can be analyzed according to any of the three theories mentioned above (as hierarchical constituents, according to aperture theory or as modified onsets); however, as has already been noted, the onsets that occur in Soyaltepec Mazatec are much less complicated than those in the highland Mazatec varieties. While Huautla Mazatec is claimed to have a fairly symmetrical system in which aspiration and glottalization can occur either before or after a given obstruent or sonorant, this is not the case in Soyaltepec Mazatec. Glottal elements only occur after obstruents and before sonorants; the order is never reversed and a glottal element never occurs both before and after the same phoneme. In addition, all (and only) obstruents which contain an oral plosive (i.e., stops and affricates) can be preceded by a nasal.[88] Some analysts in general make arguments in favor of clusters thereby avoiding an increase to the segmental inventory of a language while others make arguments for aspiration (glottalization, etc.), thereby avoiding syllabic complexity. Kehrein and Golston question the necessity of differentiating between a cluster and an aspirated (or glottalized) phoneme positing instead that onsets can host at most

[88] All obstruents including fricatives can be onsets of syllables containing nasal vowels.

one unordered laryngeal feature. “Linguists may imagine a difference, deciding to treat glottalization as subsegmental [p’] in one language and as segmental [pʔ] in another. But if they contrast in no language, the distinction is probably specious.”(Kehrein and Golston 2004:347)

Syllable structure is best determined by combinations of phonemes which cannot be interpreted as modified phonemes. Unfortunately, Soyaltepec Mazatec onsets do not offer a very compelling and indisputable argument based on this type of cluster either. There are four combinations formed by sibilants preceding plosives. Sibilants are cross-linguistically notorious extrametrical elements, able to exist in a special slot before the normal consonant template begins, and therefore their combinations are not the best to use as the basis for the formation of a syllable template. The only other cluster which occurs that cannot be interpreted as a modified consonant contains two plosives, /tk/[89]. This is the only cluster which consists of two phonemes both of which are non-sibilant, non-glottal and non-nasal phonemes. The order is invariant (i.e., */kt/ never occurs). While it is inarguably a cluster, one example sounds more like an exception than the basis for a rule.

Some onset combinations such as /tk/ appear to incorporate two completely separate phonemes with separate places of articulation and separate releases, while others such as /th/ are much closer to one phoneme with added friction or energy in its release. Regardless of the exact nature of the combinations, it is clear that, at most, two phonemes or the features of two phonemes can appear in the onset. The /tk/ cluster never appears aspirated, glottalized or nasalized. Additionally, an aspirated phoneme is never also nasalized or glottalized, etc.. Therefore, features of at most two different phonemes are present in each of these complex onsets. I call these onsets complex onsets or clusters in order to distinguish them from simple onsets (which contain a single, unmodified phoneme) without the intention of aligning myself with Pike and Pike’s analysis. The onsets are summarized in (27).

[89] The /tk/ is pronounced as an alveolar stop which is lightly though audibly released, followed by a brief closure before the velar stop.

(27) Complex onsets of Soyaltepec Mazatec

Type	Obstruent Clusters	Sonorant Clusters
with /ʔ/	/tʔ/, /kʔ/, /t͡sʔ/, t͡ʃʔ/, /sʔ/, /ʃʔ/	/ʔm/, /ʔn/, /ʔɲ/, /ʔw/, /ʔj/
with /h/	/th/, /kh/, /t͡sh/, /t͡ʃh/	/hm/, /hn/, /hɲ/
with /n/[90]	/nt/, /nk/, /nt͡s/, /nt͡ʃ/	
s-stop	/st/, /sk/, /ʃt/, /ʃk/	
stop-stop	/tk/	

Clusters with /ʔ/ are the most pervasive; all of the indigenous phonemes participate in these clusters except for the /f/[91] and the /ɾ/ which never participate in clusters. I consider the member of the cluster which supplies the oral place of articulation to be the primary member of the cluster. The glottal consonants never appear as the primary member (i.e., they modify but are never 'modified'). The s-stop and stop-stop clusters do not have a primary member as neither member assumes features from the other. In other words, the /s/ retains its coronal features and sibilant energy even when paired with the dorsal /k/, etc.

Consonant clusters of Soyaltepec can be divided into two main groups. The first group consists of the five clusters which are combinations of two distinct phonemes which do not influence the characteristics of their neighbor, specifically, /st/, /sk/, /ʃt/, /ʃk/ and /tk/. Each phoneme has equal weight in the cluster. An analysis which proposed that /st/ was a /t/ with /s/ modification seems linguistically unusual. Similarly, considering the /s/ to be primary with some kind of /t/ modification in unacceptable. The second groups involves combinations such as /th/ which could be analyzed as a /t/ with the modification of /h/ features, i.e., aspiration. All members of this group involve combinations of phonemes in which one member of the clusters may be seen as more dominant and therefore may be argued to be modified

[90] The obstruent in these clusters assumes the voicing of the nasal; therefore, these will be transcribed as [nd], [ng], [nd͡z] and [nd͡ʒ]. The place of articulation of the obstruent is also assumed by the nasal; however, this will not be transcribed.
[91] The /f/ never occurs in clusters, possibly because it originated historically from the /*hw/ cluster and clusters of more than two consonants do not occur.

phonemes instead of true clusters. This group involves clusters with glottal consonants and nasals such as /tʔ/, /th/ and /nt/, which might be interpreted as glottalized, aspirated or pre-nasalized respectively. I begin the discussion by giving examples of s-stop and stop-stop clusters, and then present the combinations which could either be interpreted as clusters or as modified consonants.

3.4.3.1 S-Stop and Stop-Stop Clusters

As stated above, this group includes /st/, /sk/, /ʃt/, /ʃk/ and /tk/; clusters with two distinct phonemes, both obsturents, in which there is no subordinate member. The first four clusters involve a fricative followed by a stop and the final cluster combines two stops. General observations include that each cluster ends with a stop (either /t/ or /k/) and the places of articulation are either similar (i.e., both coronal) or begin forward in the mouth and move back (i.e., move from coronal to dorsal). The members of this group are all less common than the clusters which will be discussed in the three sections below. Phonetically, the two phonemes present are articulated separately in succession, in the order specified.

Examples of all five of the clusters co-occurring with oral vowels can be found in Table 3-14 which is similar to the tables found above that display the simple consonants in order to demonstrate the distribution of the clusters with oral vowels. The vowels are listed across the top row. When monosyllabic examples are unavailable, multisyllabic words are included in order to demonstrate the co-occurrence. As Soyaltepec Mazatec does not allow codas, these clusters do not separate even when intervocalic. Recall that the syllable break occurs after the tone letter and stressed syllables are underlined.

Table 3-14 Examples of indisputable clusters

cluster	i	ɛ	a	o	u
st	ni˩<u>sti˧</u> 'child'	stɛ˧<u>ɲa˦</u> 'he sells'			
ʃt	ʃtiu˧ 'underdeveloped'		ʃta˩ni˩<u>sti˧</u> 'adult son, unmarried'		βi˧ʃtu˧<u>t͡sĩ˧˩</u> 'squirrel'
sk	ski˩ 'cicada'		ska˧<u>ngi˩</u> 'collected'	ta˧ri˦<u>sko˩˥</u> 'vulture'	sku˧<u>nda˩</u> 'she took care of him'

Table 3-14 - continued

cluster	i	ɛ	a	o	u
ʃk	ʃki˩ ‘stories’	ʃkɛ˧ ‘swollen’	ʃka˥ ‘pants’		ʃkua˧ ‘ugly’
tk	tki˥ ‘medicine’		tka˧ ‘bald’		tku˩ ‘head’

Although the only examples of /ʃti/ and /ʃku/ occur with diphthongs, they nevertheless confirm the adjacency of the phonemes in question. An inspection of the data presented reveals all four level tones and rising tones. Falling tones are absent here but there is an example in Table 3-15 below which focuses on diphthongs. The gap is due to the rarity of both falling tones and this type of cluster rather than a prohibition.

All five clusters occur with /i/. All except /st/ occur with /a/ and /u/. The /ɛ/ only occurs with /st/ and /ʃk/ and /o/ only occurs with /sk/. Recall that examples of /t/ and /k/ co-occurring with /i/, /ɛ/, /a/ and /u/ where given in §3.3.3. There are no examples of indigenous words containing /to/; however, examples with /ko/ are available. While there are not examples of all of the vowels with each cluster, there are no examples in which a vowel occurred adjacent to a cluster ending in a given phoneme when the simple onset is not also represented in my database. Stated another way, [Cto][92] is not allowed since [to] does not occur while [Cko] is allowed because [ko] exists. The mid vowels are, in general, underrepresented.

There are only four examples of co-occurrence of the consonant clusters with nasal vowels; one cluster appears with /ã/ and three with /ũ/. Examples are listed in (28).

(28) Consonant clusters with nasal vowels

Cluster V	Example	Gloss
a. /skã/	ja˧<u>skã˥</u>	‘after’
b. /skũ/	nga˧<u>skũ˥</u>	‘left’

[92] C refers to a generic consonant.

c. /ʃkũ/ ʃkũ˩ 'eyes'

d. /tkũ/ ndʒa˧tkũ˩ 'be frightened'

Two of the examples with nasalized vowels (28a and b) occur with /sk/ which is also the only cluster which occurs with /o/. Although there are multiple examples of several of these combinations, they are not common. Recall from §3.3.4 that the simple onset /k/ also occurs with /ã/ and /ũ/.

The consonant clusters can also occur with vowel clusters. Table 3-15 is set up in the same way as Table 3-14, but only lists the four diphthongs that occur with the consonant clusters in my data, rather than all oral diphthongs. These are listed across the top row of the chart. The consonant clusters are listed down the far left column.

Table 3-15 Consonant Clusters with Oral Diphthongs

cluster	ua	uɛ	iu	iɛ
st				
ʃt			ʃtiu˥ 'underdeveloped'	
sk	skua˩ 'heron'			
ʃk	ʃkua˧ 'ugly'	ʃkuɛ˥ 'lettuce'		ʃkiɛ˧˩ 'frog
tk	tkua˧ 'snail'	tkuɛ˧ 'raspy'		

Three of the clusters, /sk, /ʃk/ and /tk/ occur with /ua/, and the latter two also occur with /uɛ/. The final two diphthongs which occur with clusters are /iu/ which occurs with /ʃt/ and /iɛ/ with /ʃk/. Again, while there are not examples of all possible combinations, the ones that occur also occur with the corresponding simple onset, i.e., /kua/, /kuɛ/, /kiɛ/ and /tiu/ (see §3.4.2.1 for examples).

There are only two nasalized diphthongs which occur with these consonant clusters, examples appear in (29).

(29) Nasal diphthongs with consonant clusters

Cluster	Example	Gloss
a. sk	skũã˩	'dust'
b. ʃk	ʃkũɛ̃˥	'unripe'

This is unsurprising given the co-occurrence pattern that was demonstrated in §3.4.2.2. Nasal diphthongs never occur with /t/ and the only two which occur with /k/ are the same two which occur here, /ũã/ and /ũɛ̃/. There are no examples of nasalized diphthongs occurring with a cluster if the corresponding oral diphthong does not also occur with that cluster.

There is some evidence that /tk/ emerged from the elision of /i/. For example, in (30a) the common form of the word for 'snail' appears. A disyllabic form containing and /i/ in the first syllable is shown in (30b). This form is recognized and used by some of the older speakers, but is no longer used commonly by younger speakers. If they recognize it at all, they note that it is the pronunciation used by their grandparent's generation.

(30) Emergence of /tk…/ from /tik.../

Soyaltepec	Gloss
a. tkua˥	'snail' (current pronunciation)
b. ti˧kua˥	'snail' (antiquated pronunciation)

While the /tk/ cluster might be attributed, with some validating examples of /i/ elision (which may explain its existence in the absence of other similar clusters), there is no such evidence for the remaining four members of this group. A comparison with other Mazatec dialects reveals that /st/, /sk/, /ʃt/ and /ʃk/ appear in varying degrees of commonness. There is a hypothesis (Gudschinsky (1959), that the sibilants formed from older forms that were pre-aspirated; however, some, including Steriade (1994), claim that the present pre-aspirated stops, /ht/, etc, in Highland Mazatec are derived from underlying /st/. There is also no explanation for the differentiation of /st/ from /ʃt/ if both derived from the pre-aspirated /ht/. I will leave further speculation to future research.

The two clusters which end in /t/ are the least common clusters; /st/ and /ʃt/ are involved in only a handful of examples each. There are no single syllable examples of /st/ and only one of /ʃt/ which occurs with a diphthong.[93] The clusters which end in /k/ are more plentiful; each is available both in single and multi-syllable words. The instances of nucleus co-occurrence with clusters always have corresponding examples in which the given nucleus appears adjacent to the simple onset that represents the second member of the cluster in question.

These five clusters provide evidence that the syllable template of Soyaltepec Mazatec needs to allow at least two consonants (CC). Furthermore, these forms never appear in combination with any other consonant phoneme; they are never aspirated, glottalized or nasalized. This is evidence that the maximal template contains at most two consonants. The consonant clusters also occur with several diphthongs, giving examples of CCVV as the maximum syllable of Soyaltepec Mazatec.

3.4.3.2 Clusters Containing Glottal Stops or Glottalized Consonants

These onsets occur in two groups: obstruents which are followed by a glottal (/tʔ/, /kʔ/, /t͡sʔ/, t͡ʃʔ/, /sʔ/ and /ʃʔ/) and sonorants which are preceded by a glottal (/ʔm/, /ʔn/, /ʔɲ/, /ʔw/ and /ʔj/). Both of these groups could be considered to be glottalized consonants, although Golston and Kehrein (1998) considered the first group to have simple consonants with glottalized nuclei while the second group would have a glottalized onset (not phoneme) in their view. Phonetically, the obstruent consonants in this group are articulated with a slight release followed by a glottal closure and release. The nucleus is often at least somewhat creaky. The sonorant consonants are articulated after a glottal closure giving them an abrupt beginning. There is no gap between the sonorant and the nucleus and there is not usually any creakiness in the nucleus. Because the vowel co-occurrence patterns are distinctive, I address the two groups separately.

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[93] Notice that although the /st/ and /ʃt/ usually occur in multisyllabic words, they are not limited to stressed syllables.

3.4.3.2.1 Obstruents with /ʔ/

Table 3-16 below lists the obstruents which co-occur with glottal stops. Across the top row of the table the vowels are listed. Each obstruent-/ʔ/ cluster is listed down the left column. The consonants are arranged from the front of the mouth to the back. Preference is given to monosyllabic examples with simple nuclei; however, when these are not available examples which demonstrate direct adjacency of the onset with the initial vowel of the nucleus are given. Stressed syllables are underlined.

Table 3-16 Obstruent - /ʔ/ clusters with oral vowels

	i	ɛ	a	o	u
tʔ	tʔi˥ ‘take’	tʔɛ˥ ‘hear’	tʔa˧ ‘distance indicator’		
sʔ		sʔɛ˩ ‘after a while’	sʔa˧<u>ngi˥</u> ‘surpass’	sʔo˧ ‘he breaks’	sʔui˥ ‘party’
t͡sʔ		t͡sʔɛ˩ ‘brother’	t͡sʔa˧<u>t͡sɛ</u>˥ ‘bought’	t͡sʔo˧ ‘it’s going to break’	t͡sʔu˧ ‘cultural dress’
ʃʔ	ʃʔi˧ ‘grind’		ʃʔa˧ ‘open’	ʃʔo˧ ‘skirt’	ʃʔui˥ ‘ember’
t͡ʃʔ	t͡ʃʔi˩ ‘drunk’	t͡ʃʔɛi˩˥ ‘take!’	t͡ʃʔa˥ ‘cargo’	t͡ʃʔo˧ ‘handful/bundle’	
kʔ	kʔia˥ ‘there’		kʔa˧ ‘tall’		kʔui˧ ‘here’

There are gaps in the table above. Four of the five vowels each have two blanks; however, there are no vowels which are strikingly underrepresented. In previous comparisons, there was usually a pattern in which the mid vowels were underrepresented, or, minimally, the /o/ had more gaps in its co-occurrence patterns than the other vowels. Recall from §3.3.3 that /o/ only occurred in indigenous morphemes with /k/, /h/ and /ʔ/ while the remaining oral vowels had very widespread occurrence. In the data in Table 3-16, the /o/ is absent from the stop-glottal clusters, but unlike the corresponding simple onsets, the /o/ occurs with both the fricative and affricate clusters. Gaps appear for /i/ in /t͡sʔ/ and /sʔ/. Likewise there are two gaps for /ɛ/, /kʔ/ and /ʃʔ/ and for /u/, /tʔ/ and /t͡ʃʔ/.

The /tʔ/ does not occur with any back vowels while the /kʔ/ does not occur with mid vowels. The /kʔ/ only occurs with a simple nucleus when the vowel is low /a/; when the vowels are front or back they appear in the form of diphthongs. Three of the four occurrences of back vowels with the glottal clusters appear as diphthongs, only /t͡sʔ/ appears with the simple /u/. Table 3-17 summarizes the differences in distribution between obstruent-ʔ clusters and simple obstruents. The shaded cells indicate the co-occurrence of an onset-vowel pair. Data for the simple obstruents is repeated from Table 3-6 above. The numbers (1-4) represent co-occurrences which never (or rarely in the case of 5) occur between oral vowels and simple obstruents, but do occur when the obstruent is part of a cluster which ends with the glottal stop.

Table 3-17 Distribution of Obstruent-ʔ Clusters vs. Simple Clusters and Oral Vowels

Obstruent-ʔ with oral vowels						Simple obstruent with oral vowels					
Cluster	i	ɛ	a	o	u	Consonant	i	ɛ	a	o	u
tʔ						t					
sʔ						s				1	
t͡sʔ						t͡s				2	
ʃʔ						ʃ				3	
t͡ʃʔ						t͡ʃ		5		4	
kʔ						k					

The presence of these five co-occurrences (/sʔo/, /t͡sʔo/, /ʃʔo/, /t͡ʃʔo/ and /t͡ʃʔɛ/) that were absent among simple obsturents suggests that the vowel is adjacent to the glottal features which allows them to co-occur, not the obstruent features which would block the co-occurrence. This is an argument in favor of considering the onsets to be clusters and not modified phonemes.

Next, the same clusters co-occurring with nasal vowels are investigated. The co-occurrence of obstruent-/ʔ/ clusters with nasal vowels is demonstrated in Table 3-18. Again, the consonants are listed in the same order from the front of the mouth to the back down the left column and the vowels are listed across the top row. Preference was given to monosyllabic morphemes with simple nuclei, but diphthongs and multisyllabic words were used when necessary. Stressed syllables are underlined

Table 3-18 Obstruent - /ʔ/ clusters with nasal vowels

Cluster	ĩ	ɛ̃	ã	õ	ũ
tʔ		tʔɛ̃˥ ‘conjunctivitis’			
sʔ		sʔɛ̃˧ ‘fits’			
t͡sʔ		t͡sʔɛ̃˧ ‘sprout’			
ʃʔ			ʃʔã˩ ‘orphan’		
t͡ʃʔ			t͡ʃʔã˧ ‘cold’		t͡ʃʔũĩ˥ ‘chayote’
kʔ	kʔĩɛ̃˧ ‘dead’	kʔɛ̃˧ ‘shade’	kʔã˧ ‘single’		t͡su˧kʔũ˩ ‘crab’

In this case, there are only ten co-occurrences between the glottal clusters and the nasal vowels. No examples are available with /õ/, only one with /ĩ/, which happens to be in a diphthong, and two with /ũ/: one is in a diphthong and one in a multisyllabic word. The alveolar consonant clusters only occur with the /ɛ̃/. This is the first data set in which combinations with /ɛ̃/ are the most common and the more peripheral vowels are more underrepresented. The postalveolar consonant clusters both occur with /ã/ and the affricate also occurs with /ũ/, but in a diphthong. Unlike the oral examples, the /kʔ/ occurs with four of the five nasal vowels. In the case of the simple consonants, the distribution with nasal vowels is a bit more complicated. Again, the schematized data from Table 3-9 above is repeated for obstruents which co-occur with nasal vowels in Table 3-19 for comparison with the obstruent-glottal co-occurrence patterns which are schematized from Table 3-18 and appear in the first half of Table 3-19. The shaded blocks represent available co-occurrence of the elements in question with the given nasal vowel. Only the simple consonants which also occur in clusters are included. The numbers (1, 2 and 3) indicate gaps in the co-occurrence of simple obstruents which do occur with the clustered obstruents.

Table 3-19 Comparison of ʔ-Cluster vs. Simple Obstruents with Nasal Vowels

Obstruent-ʔ with nasal vowels						Simple obstruent with nasal vowels					
Cluster	ĩ	ɛ̃	ã	õ	ũ	Consonant	ĩ	ɛ̃	ã	õ	ũ
tʔ						t		1			
sʔ						s					
t͡sʔ						t͡s		2			
ʃʔ						ʃ					
t͡ʃʔ						t͡ʃ					
kʔ						k		3			

It is clear that obstruent-glottal stop clusters do not follow the same distribution pattern for co-occurrence with nasal vowels as the simple obstruents. Perhaps this is due to the relative infrequency of the nasal vowels; however, there are three instances in which the nasalized vowel occurs after the glottal stop, but not after the simple obstruent. The /t/, /t͡s/ and /k/ do not occur with /ɛ̃/ while their clusters with /ʔ/ do. Also recall that /ʔ/ co-occurs with all of the nasal vowels.

The examination of the co-occurrence of the obstruent-glottal stop clusters with both the oral and nasal vowels reveals that the co-occurrence patterns of the clusters do not align well with the co-occurrence patterns of the simple consonant onsets. If there are co-occurrence restrictions, such as against /o/ occurring with coronal consonants, or if there is a rule which neutralizes the /o/ when it follows a coronal consonant, then the obstruent-glottal stop clusters violate these if they are interpreted as modified consonants. If, however, the glottal stop of these clusters is allowed to fill a consonant slot in the syllable template, then the /o/ is adjacent to the glottal and no violation occurs.

3.4.3.2.2 Sonorants with /ʔ/

All of the sonorants which appear in indigenous unbound morphemes also occur in complex onsets where they are preceded by a glottal stop. Examples appear in Table 3-20 where the clusters appear down the far left column and the vowels across the top row.

Table 3-20 /ʔ/-Sonorant Clusters

cluster	i	ɛ	a	o	u
/ʔm/	ʔmi˥ 'named'	ʔmɛ˧ 'die'	ʔma˧ 'hidden'		
/ʔn/	-ʔni˧ 'it is x'		ʔna˩ 'shiny'		
/ʔɲ/			ʔɲa˩ 'chills'		ʔɲu˧ 'twins'
/ʔw/	ʔwi˥ 'to drink'	ʔwɛ˩ 'to plant'	ʔwa˩ 'curves'		
/ʔj/			ʔja˧ 'mule driver'		ʔju˩ 'bud'

Once again the limited distribution of the /o/ is confirmed. There are gaps in co-occurrence of /i/ with /ʔɲ/ and /ʔj/ which is in alignment with the co-occurrence restriction *[front front]$_{\sigma}$ previously suggested. These two in addition to the /ʔn/ do not co-occur with /ɛ/. Finally /ʔm/, /ʔn/ and /ʔw/ do not occur with /u/. All of the /ʔ/-sonorant combinations occur with /a/. The two consonants /m/ and /w/ do not occur adjacent to rounded vowels. The two consonants which are palatal (/ɲ/ and /j/) do not co-occur with the front vowels (/i/ or /ɛ/). The distribution of the sonorant-glottal clusters in Table 3-20 closely approximates the distribution of the sonorants without the glottal (which were given in Table 3-5 and Table 3-10 above). The two sets are compared in Table 3-21. The cells which have attested examples are shaded, the co-occurrence which is very rare contains a diagonal bar.

Table 3-21 Comparison of ʔ-sonorant clusters and simple sonorants with oral vowels

ʔ-Sonorant with oral vowels						Simple Sonorant with oral vowels					
Cluster	i	ɛ	a	o	u	Consonant	i	ɛ	a	o	u
ʔm						m					
ʔn						n					
ʔɲ						ɲ					
ʔw						w					
ʔj						j					

Table 3-21 reveals that there are no additional possibilities for co-occurrence that are allowed because the onset is a cluster instead of a simple phoneme. The glottal of the glottal-sonorant consonant does not license the co-occurrence of any vowels which do not occur with the simple consonants. The onsets with simple /n/ and /j/ are more widespread than those in which the sonorant is preceded by the glottal stop. Otherwise, the distribution pattern is almost identical. Just as nasal vowels never occur with simple sonorant consonants, they are likewise absent here. If the co-occurrence were enabled by the presence of the glottal we would expect to find at least some co-occurrence with nasal vowels.

Unlike the obstruent-glottal stop clusters which were described above, it is clear that the presence of the glottal with the sonorant onset does not license the cluster to co-occur with vowels which did not occur with the simple onset. This difference in distributional patterns between the obstruent and sonorant glottal clusters indicates that the ordering of the phonemes in the onset is important. The glottal always precedes sonorant phonemes while it always follows obstruent phonemes. The restrictions on the vowels which can occur in the following nucleus reflect this ordering. When the glottal follows the phoneme, it is adjacent to the nucleus and additional vowel co-occurrences are licensed.

3.4.3.3 Clusters Containing Glottal Fricatives or Aspirated Consonants

Similar to the complex onsets which contain glottal stops, the onsets which contain features of two elements, one of which is a glottal fricative, can be divided into two groups: clusters with obstruent consonants and clusters with sonorant consonants, each of which reflect an ordering similar to the clusters with glottal stops demonstrated above. When combined with obstruents the glottal fricative appears after the obstruent but when combined with sonorant consonants the glottal fricative appears before the sonorant. These types of combinations in many languages are considered aspirated or pre-aspirated consonants respectively. The group of phonemes which participate in these combinations is somewhat more limited than the one which combined with the glottal stops. It does not include simple fricatives or approximants. Again, since the co-occurrence patterns are different for the obstruent clusters versus the sonorant clusters, I discuss the two groups separately.

3.4.3.3.1 Obstruents with /h/

Obstruent phonemes which are followed by /h/ are usually expressed phonetically as the release of the first member of the cluster followed by a segment of high velocity air. While there is often a very breathy release, it is sometimes a release which simply involves a delay in the voice onset time of the nucleus with little audible friction.[94] The following vowel is either completely modal or it begins somewhat breathy, gradually becoming more modal as the nucleus progresses. The clusters in this group include: /th/, /kh/, /t͡sh/ and /t͡ʃh/.

Table 3-22 below lists examples of the obstruents followed by glottal fricatives which co-occur with oral vowels. Across the top row of the table the vowels are listed. The obstruent-h cluster is listed down the left column. Preference is given to monosyllabic examples; however, when none is available, multisyllabic examples are employed if possible. Stressed syllables of multisyllabic words are underlined.

Table 3-22 Obstruent – /h/ clusters with oral vowels

Cluster	i	ɛ	a	o	u
th	thi˦ ‘round’	thɛ˧˩ ‘breed’	tha˩t͡sɛ˩ ‘new’	tho˩ ‘air’	thu˧t͡sɛ˦ ‘burns’
t͡sh	t͡shi˦ ‘thin’	t͡shɛ˩ ‘gourd’	t͡sha˥ ‘badger’		t͡shu˥ ‘toasted’
t͡ʃh	t͡ʃhi˩ ‘soursop’	t͡ʃhɛ˧˩ ‘charity’	t͡ʃa˧˩wa˩ ‘grasshopper’	t͡ʃho˩˧ ‘egg’	t͡ʃhu˦ja˧ ‘sew’
kh	khi˥ ‘he jumps’	khe˦ndu˥ ‘unties’	kha˧ ‘skunk’	kho˧˩ ‘with’	khu˧ndu˩ ‘gourd’

[94] In the simple phoneme, when /h/ (or /ʔ/) is not present, the nucleus begins immediately following the release of the phoneme with no voice onset delay.

There is almost complete data coverage in the table above. Each obstruent clustered with /h/ occurs with each vowel – including /o/, with the exception of /t͡sho/. Recall from §3.3.3 that none of these obstruents co-occur with /o/ when they are not in clusters; however, the simple /h/ does co-occur with /o/. Also, the /ɛ/ only rarely occurred with /t͡ʃ/, but there is no restriction when it is involved in the /t͡ʃh/ cluster. These co-occurrence patterns are displayed in the schematized table below. If the combination is attested, the cell is shaded. The only exception is the /t͡ʃɛ/ combination which is rare and is marked as such with a diagonal line. The numbers (1-4) indicate gaps in the occurrence of the simple obstruents which do not occur in the clustered data.

Table 3-23 Comparison of /h/-clusters vs. simple obstruents with oral vowels

/h/-Obstruent with oral vowels						Simple Obstruent with oral vowels					
Cluster	i	ɛ	a	o	u	Consonant	i	ɛ	a	o	u
th						t				1	
t͡sh						t͡s					
t͡ʃh						t͡ʃ		2		3	
kh						k				4	

Recall that /h/ co-occurs with all oral vowels. The co-occurrence patterns line up more closely with /h/ than with the 'dominant' member of the cluster. The presence of the /h/ adjacent to the nucleus licenses the /o/ to occur (as well as the /t͡ʃɛ/).

The clusters also appear with nasal vowels as is demonstrated in table 3-24 below. The clusters appear down the left column and the vowel is listed across the top. The stressed syllable of multisyllabic words is underlined.

Table 3-24 Obstruent–/h/ clusters with nasal vowels

Cluster	ĩ	ɛ̃	ã	õ	ũ
th	thĩ ˦˥ 'there are'	thɛ̃˥˦ 'forehead'	thãĩ˧ 'thick'		nde˩˧thũ˥˦ 'nose'
t͡sh	t͡shĩũ˩ 'tobacco'				t͡shũ˥ 'kicks'
t͡ʃh		ma˩t͡ʃɛ̃˧ 'occupy oneself with'	t͡ʃhã˧˩ 'yellow plum'		t͡ʃhũ˩˧ 'woman'
kh	khĩ˥ 'many'	khɛ̃˥ 'pulls'	khã˧ 'he fights'		t͡sa˧khũ˦˥ 'fears'

As expected because of the less common availability of the nasal vowels, there are more gaps in the available data. Although the co-occurrence of obstruent-/h/ clusters with nasal vowels is not as complete as it was for oral vowels, there are still more examples of nasal vowels with the clusters than there were with the simple obstruents. Table 3-25 provides a side by side schematized comparison of which co-occurrence patterns are attested. When an example is available, the cell is shaded. In Table 3-25, the numbers (1-5) indicate co-occurrences which do not occur with the simple obstruents, but do occur with the /h/-obstruent clusters.

Table 3-25 Comparison of /h/-clusters vs. simple obstruents with nasal vowels

Obstruent-h clusters with nasal vowels						Simple Obstruent with nasal vowels					
Cluster	ĩ	ɛ̃	ã	õ	ũ	Consonant	ĩ	ɛ̃	ã	õ	ũ
th						t		1	2		
t͡sh						t͡s					3
t͡ʃh						t͡ʃ					4
kh						k		5			

When the obstruents appear in the onset followed by /h/, there is a wider distribution with the nasal vowels than when the obstruents are not followed by /h/. There are five more combinations in the clustered environment: i.e., while examples of /thɛ̃/, /thã/, /t͡shũ/, /t͡ʃhũ/ and /khɛ̃/ are all available, /tɛ̃/, /tã/, /t͡sũ/, /t͡ʃũ/ and /kɛ̃/ never occur. If the /h/ is in fact filling the second consonant slot of the syllable template this is easily explained since the vowels are therefore co-occurring adjacent to the /h/ which is more promiscuous than other obstruents.

3.4.3.3.2 Sonorants with /h/

Among the sonorants, only the nasals occur in combination with /h/. Recall that in these clusters, /h/ precedes a nasal phoneme and assumes the place of articulation of the nasal, resulting in a voiceless nasal fricative: [m̥m], [n̥n] and [ɲ̥ɲ]. For the remainder of the dissertation, I report each example with the underlying glottal fricative /hm/, /hn/ and /hɲ/ instead of the voiceless nasal. This encoding is faithful to the phonemic inventory and does not have an effect on the tonal system. Again, examples are supplied in tabular form to demonstrate the patterns of co-occurrence between the clusters and the vowels. In Table 3-26, the clusters are listed down the far left column and the vowels across the top row and the underlined syllables represent stress.

Table 3-26 /h/-Nasal Clusters

cluster	ĩ	ɛ̃	ã	õ	ũ
/hm/ - [m̥m]	hmi˧ 'mestiso'	ma˧hmɛ˧ 'vomit'	hma˥ 'black'		
/hn/ - [n̥n]	-hni˩ 'we excl.'	hnɛ˥ 'tepejilote (palm) tree'	khi˥˧hna˧ 'light weight'		hnu˩ 'cornfield'
/hɲ/ - [ɲ̥ɲ]			hɲa˩ 'chili'		hɲu˩ 'dizziness'

There are no monosyllabic examples available for /hmɛ/ or /hna/ so multisyllabic words are provided to show that co-occurrence is possible. Table 3-27 reinforces that /o/ never co-occurs with nasals. Also, /hm/ does not occur with /u/ while /hɲ/ does not occur with /i/ or /ɛ/, these restrictions again align with the feature co-occurrence restrictions *[labial labial]$_\sigma$ and *[front front]$_\sigma$. All of these co-occurrence gaps are similar to those found in the non-clusters nasal consonants as Table 3-27 shows.

Table 3-27 Comparison of /h/-Sonorant vs. simple Sonorant with oral vowels

h-Sonorant with oral vowels						Simple Sonorant with oral vowels					
Cluster	i	ɛ	a	o	u	Consonant	i	ɛ	a	o	u
ʔm						m					
ʔn						n					
ʔɲ						ɲ					

Again, similar to the glottal stop-sonorant clusters, the co-occurrence patterns coincide with the nasal patterns rather than the glottal fricative patterns indicating ordering in the onset which aligns the sonorant with the nucleus rather than the glottal fricative. The glottal features do not appear to be a characteristic of the entire onset because, in this case, the presence of the glottal does not license any additional vowel co-occurrences versus the simple sonorant. Like the simple sonorant consonants, there are no examples of co-occurrence with nasal vowels, therefore aligning with *[sv sv]$_{\sigma}$. It should also be noted that while several examples of /h/-nasal clusters occur in common, frequently used words (like ‘black,’ ‘cornfield,’ ‘chili’ and ‘we’) in general examples of this type of cluster are not widespread.

3.4.3.4 Clusters Beginning with Nasals or Pre-nasalized Consonants

The clusters which begin with nasals, but whose primary member is the obstruent that occurs second, are often called pre-nasalized consonants cross-linguistically. Unlike the clusters involving glottal elements, this group only clusters with obstruents, the non-nasal sonorants do not participate.[95] In Soyaltepec Mazatec, the group of obstruents which can appear preceded by a nasal includes /t/, /k/, /ts/ and /tʃ/; this is the same group of obstruents that was able to combine with /h/ in §3.4.3.3.1 above. The articulation of these clusters involves a clear nasal which assumes the point of articulation of the following obstruent. The obstruent, in turn, acquires the voicing of the nasal as was discussed in §3.3.2. This is the only instance in which voicing plays a part of the Soyaltepec system. Because voicing can play a role in the

[95] While there is a temptation to claim that the /ɲ/ could be the result of a /nj/ cluster, the participation of the /ɲ/ in /hɲ/ clusters makes this hypothesis very unlikely as clusters of three phonemes never occur in Soyaltepec Mazatec. Also the /j/ enjoys a wider co-occurrence with vowels, namely /i/ and /ɛ/ than the /ɲ/.

pitch of the syllable, I will refer to these clusters using the voiced symbols; however, in so doing I do not mean to imply that these should be added to the consonantal inventory as their occurrence is completely predictable and environmentally determined.

Examples of /NC/ can be seen in Table 3-28. The nasal cluster occurs down the far left column and vowels across the top row. There are no instances of nasal vowels occurring with these clusters. When multisyllabic morphemes are used, the stressed syllable is indicated through underlining.

Table 3-28 /N/-Obstruent clusters

Cluster	i	ɛ	a	o	u
nt [nd]	ndi˧ ‘sterile’	ndɛ˦˥ ‘shoe’	nda˩ ‘voice’		ndu˩hu˩ ‘soap’
nt͡s [nd͡z]	nd͡zi˧hĩ˨˩ ‘equals’	nd͡zɛ˧ ‘fool’	nd͡za˩ ‘hand’		tɛ˧nd͡zu˥ ‘goat’˩
nt͡ʃ [nd͡ʒ]	nd͡ʒi˨˩ ‘wet’	nd͡ʒɛ˧˦ ‘hominy’	nd͡ʒa˩ ‘watery/thin’		nd͡ʒu˥ ‘narrow’
nk [ng]	ngi˥ ‘sad’		nga˧ ‘when’[96]		ngu˦˥ ‘one’

None of the pre-nasalized clusters co-occurs with /o/. The only other gap is /nkɛ/. There are several combinations which do not occur in monosyllabic words in my database (i.e., /ntu/, /nt͡si/ and /nt͡su/); multisyllabic words are provided to show that the combinations are possible. As opposed to the sonorant clusters discussed above in §3.4.3.2.2 and §3.4.3.3.2, these clusters follow the co-occurrence patterns of the obstruents rather than the sonorants. Again these co-occurrence patterns indicate a linear ordering within the onset; however, in this case it does not add evidence in favor of clusters as opposed to modified consonants as the pre-nasalized obstruent would logically share similar co-occurrence patterns as the unmodified obstruent.

The question of the exact nature of these combinations, whether they be clusters or modified phonemes, will be left to future research. The fact that this combination is in violation of the Sonority

[96] This is the subordinating conjunction, not the question word.

Sequencing Principle encourages their interpretation as modified phonemes; however, we have seen from the examples of s-stop clusters above (/st/, /sk/, etc.) that strict adherence to the SSP is not required in Soyaltepec Mazatec.[97] None of these onsets can appear in combination with a glottal stop or fricative, lending credence to the theory that they are filling both C slots in the CC of the onset and no more consonants are possible.

3.4.3.5 Discussion

In the sections above, detailed co-occurrence patterns have been examined for each of the consonant clusters that occur in Soyaltepec Mazatec. In each case, the pattern of co-occurrence of the nuclei with an onset cluster follows the same pattern as the second member of the cluster, not the first member of that cluster. This is true both in terms of which vowels are licensed to occur as well as adherence to the feature co-occurrence restrictions outlined by Golston and Kehrein (1998). This gives credence to the theory that each phoneme in an onset cluster is acting independently to fill a slot in the syllable structure, and that adjacency matters both in the indisputable clusters as well as the clusters which might be interpreted as modified phonemes. In the case of obstruent-glottal clusters, the features of the glottal, which might be considered subordinate by some, are actually licensing the nucleus, not the dominate phoneme. The opposing interpretation of modified phonemes has some credence in that only three phonemes participate widely in the onset margins and cross-linguistically they are common onset modifications. It is noteworthy that in every instance only two phonemes combine which is in line with the maximal syllable template.[98] It could be argued that if aspiration and glottalization were in fact modifications to any phoneme in Soyaltepec, examples of the definite clusters with each attribute should occur (i.e., /sth/, /stʔ/, /ʃth/, /ʃtʔ/, /skh/, /skʔ/, /ʃkh/, /ʃkʔ/, /tkh/ and /tkʔ/). None of these combinations ever occur, adding credibility to the claim that the maximal syllable template only allows two phonemes.

To summarize the arguments in favor of viewing the complex onsets of Soyaltepec Mazatec as clusters:

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[97] It may be argued by some that a fricative followed by a stop is still a sonority plateau while a nasal followed by a stop is a more egregious violation of sonority.
[98] Alternately, it could be posited that only one modification can be made to each phoneme.

- First in §3.4.3.1 it was established that two consonants can occur in the onset of a syllable. Viewing the questionable combinations as clusters does not exceed this limit.
- Second, in the case of the combinations of obstruents followed by /ʔ/ and /h/, nuclei occur which never occur after the simple obstruent. This increased distribution or wider co-occurrence with vowels indicates that the vowels are behaving as if they were adjacent to the /ʔ/ or /h/ and not the obstruent. Therefore the combination is acting like a cluster.
- Third, as was introduced in §3.3.1, /h/, /ʔ/ and /n/ all occur as separate, independent phonemes.
- Fourth, the indisputable clusters introduced above never occur modified with aspiration, glottalization or pre-nasalization.
- Finally, the phonemes align themselves in the onset of the syllable according to the SSP so that the occurrence of the glottal consonants with the obstruents is always /obstruent-glottal/ but with the sonorants is always /glottal-sonorant/.[99]

In conclusion, there is evidence in favor of considering the phonemic combinations addressed above as clusters; however, alternate analyses are also available. Their exact interpretation does not have an influence on the tone system. For the purposes of this dissertation, it is sufficient to be aware that these combinations of features exist as possible syllable onsets. They appear to behave as consonant clusters; however, an alternate interpretation as a modified phoneme is possible and, if Kehrein and Golston (2004) are to be believed, it does not matter which interpretation is chosen other than for orthographic purposes. For the sake of the data presented in this dissertation, I list them as clusters and leave further investigation to future research.

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[99] Unfortunately, this argument using the SSP does not hold up in the case of the nasal-obstruent combinations. It is possible that this group would better be viewed as pre-nasalized phonemes; however, then an explanation needs to be offered for why they alone among the indigenous phonemes of Soyaltepec never participate in clusters.

3.4.4 Summary of Syllable Structure

Four types of syllables were shown to occur in Soyaltepec Mazatec: CV, CCV, CVV and CCVV. All four level tones were shown to occur on each syllable type, as well as rising and falling tones. It is irrelevant to the tone system how many consonants or vowels occur in a syllable. Similarly, nasal vowels were shown to occur in each syllable type, indiscriminately.

Two types of clusters have been demonstrated in Soyaltepec, vowel clusters and consonant clusters. Vowel clusters occur, but single vowels are much more common, making CVV and CCVV the least common syllable types. The consonant clusters also can be broken down into two groups. The first are clusters in which neither member of the cluster can be seen as dominant, but they are not very widespread in the language (§3.4.3.1). Their presence in combination with diphthongs establishes the maximal syllable structure of Soyaltepec to be CCVV. The second group of consonant clusters can be broken down into three groups; the first is very common and includes all obstruents, both stops and fricatives, grouping with glottal phonemes (discussed above in §3.4.3.2.1 and §3.4.3.3.1). The second and third groups are not very widespread, they include obstruents preceded by nasals (§3.4.3.4) and sonorants preceded by glottal phonemes (§3.4.3.2.2 and §3.4.3.3.2). The status of these latter groups of phoneme combinations as clusters is, perhaps arguable. I have offered evidence that they should be interpreted as clusters. It is beyond the scope of this dissertation to investigate the clusters further.

3.5 Larger Prosodic Units

Both monosyllabic and disyllabic words are common in Soyaltepec Mazatec. Trisyllabic words also occur although they are not as common among monomorphemic words. Longer words also occur, but they are usually the product of morphology as both affixation and compounding are common processes. There are currently no examples of monomorphemic words with more than three syllables.

3.5.1 Two Syllable Words

Any two syllable types can be combined to form disyllabic words. Since codas are never allowed, consonant clusters which appear remain clusters whether word initial or intervocalic. The same set of onset possibilities occurs for each syllable of multisyllabic words. The only restriction that occurs involves the nasal vowels which are limited to stressed syllables, otherwise, any onset and any nucleus can occur in any syllable of a monomorphemic word. Four basic syllable types occur in Soyaltepec as was discussed in §3.4. If these four syllable types combine indiscriminately, sixteen possible structures for two syllable words are produced. However, as has been demonstrated in §3.4, diphthongs are not as common as simple vowels; consequently, the distribution of two syllable words with diphthongs is somewhat limited. Words with diphthongs on both syllables are even more uncommon. There are no attestations in my database of CVV.CCV, CVV.CVV, CVV.CCVV or CCVV.CCVV, and there are no monomorphemic examples of CV.CVV.

The attested two syllable word types appear in Table 3-29. In general, as one descends the table, the number of occurrences diminishes. In the left part of the table, the syllable structure of each syllable of the disyllabic word is described while the right column gives examples. Stressed syllables are underlined.

Table 3-29 Disyllabic word patterns

	Word structure		Example
	1st σ	2nd σ	
a.	CV	CV	ʔi˩t͡ʃi˥ ‘small’ ʃu˩ti˩ ‘tomato’
b.		CCV	ni˧ʔju˧ ‘paca’ wa˧kjã˥ ‘crack’
c.		CVV[100]	(t͡ʃa˧sei˨˩ ‘look (2s)’) (ja˧tiu˥ ‘wooden beam’)
d.		CCVV	ʔo˩ʃkũã˦ ‘brilliance’ ʔi˩kʔui˩ ‘here’
e.	CCV	CV	khi˥sũ˥ ‘nothing’ ndi˧ha˩ ‘horn’
f.		CCV	t͡sʔɛ˧nda˥ ‘algae’ ʃʔo˥thi˥ ‘woman’s dress’
g.		CVV	nda˩jai˧ ‘reed’ ndi˥fua˦ ‘water’
h.		CCVV	nga˩khãĩ˦ ‘face’

[100] No monomorphemic examples are available, t͡ʃa˧sei˨˩ ‘look (2s)’ includes verbal morphology and ja˧tiu˥ ‘wooden beam’ is a compound word.

Table 3-29 - continued

	Word structure		Example
	1st σ	2nd σ	
i.	CVV	CV	tia˧wa˧ ‘white’ kua˧nɛ˧ ‘O-clock’
j.		CCV	-
k.		CVV	-
l.		CCVV	-
m.	CCVV	CV	thiu˩ʃĩ˥ ‘skin’ ndia˧jo˩ ‘stone’
n.		CCV	thiu˧ngu˩ ‘fist’
o.		CVV	ndiu˩fuɛ˧ ‘opossum’
p.		CCVV	-

Soyaltepec Mazatec favors simple CV syllables; however, up to two consonants and two vowels can occur in each syllable. If a diphthong exists in a two syllable word, it is more likely to be on the second syllable; however, there are examples of words with a diphthong on the first syllable, as the second half of Table 3-29 demonstrates, as well as words with a diphthong on both syllables, as row (o) demonstrates.

3.5.2 Three Syllable Words

Since there are four syllable types, there are 64 possible combinations of syllables in three syllable words. In my database, I only have examples of 17 patterns. The currently attested syllable types appear in (31). The CV structure is described on the left and examples are given in the right column.

(31) Trisyllabic words

	CV Structure			Example	
	1st σ	2nd σ	3rd σ	Transcription	Gloss
a.	CV	CV	CV	ʔa˧ni˥ma˩	‘heart’
b.	CV	CV	CCV	ta˧ri˥sko˩˥	‘vulture’
c.	CV	CV	CCVV	ra˧ʃa˥tʔai˩	‘grapefruit’

d.	CV	CV	CVV	tu˩ku˥kui˧	‘they’
e.	CV	CCV	CV	βi˧ʃtu˧t͡sĩ˧˩	‘squirrel’
f.	CV	CCV	CCV	ni˩ski˧ndi˥	‘children’
g.	CV	CCV	CVV	ta˩nga˩ʔai˥	‘ash’[101]
h.	CV	CCVV	CV	ti˩khai˦t͡sɛ̃˧	‘thinks’
i.	CVV	CV	CCVV	kui˧ʃi˧khũã˥	‘that’
j.	CCV	CV	CV	nda˧t͡ʃa˦kũ˧˩	‘sea’
k.	CCV	CV	CCV	nga˩su˩ndɛ˧	‘world’
l.	CCV	CVV	CV	ndi˥fua˥ti˥	‘petroleum’
m.	CCV	CCV	CV	khi˧˩ndɛ˩ti˧˥	‘comb’
n.	CCV	CCV	CCV	sʔɛ˧hɲa˧ʔɲu˧˥	‘tighten’
o.	CCV	CCV	CCVV	khi˧ndɛ˩thua˩	‘door’
p.	CCVV	CV	CV	thia˩wa˩ja˥	‘bark’
q.	CCVV	CV	CCV	thia˥˧ʔõ˥ngu˧˥	‘sixteen’

In three syllable words, all three syllables can be of the same type as in CV in (31a) or CCV in (31n). Usually, if there is a complex syllable it involves a consonant cluster rather than a diphthong; however, 10 of the 51 syllables in (31) contain diphthongs. In general, only one syllable with a diphthong appears per word; however, one example, (31i), contains two. Three examples, (31i, p, q), have the diphthong on the first syllable, two, (31h and l), on the second and five, (31c, d, g, i and o) on the final syllable. None of the patterns which appear have diphthongs on all three syllables. The three most common

[101] This word is usually used as part of the phrase, ndɛ˧su˥ ta˩nga˩ʔai˥ which is translated as a whole as ‘ash’.

patterns are trisyllabic words with CV on each syllable as in (31a), words with a CCV on the final syllable but CV on the first two syllables as in (31b) and words with the first and last syllables as CV with CCV on the middle syllable as in (31e). The most complex syllable of Soyaltepec Mazatec (i.e., CCVV) can occur in any syllable position: first, (31p and q), second (31h) or third (31c, i and o). These examples demonstrate that there are no restrictions as to placement of syllable types in Soyaltepec Mazatec.

3.6 Stress

Stress[102] or prominence occurs on the final syllable of the stem. It does not shift when a suffix or clitic is added to the stem. Stress has been indicated in this chapter through underlining to avoid the multiplication of diacritics. Stress is predominantly indicated through increased intensity occasionally accompanied by a slightly lengthened vowel.

In monomorphemic words, stress occurs on the final syllable as can be seen in (32).

(32) Stress on monomorphemic words

	Transcription	Gloss
1σ	a. t͡sha˧	'hand'
	b. sĩã˦	'standing'
2σ	c. ʃu˩ta˩	'person'
	d. ni˥khĩɛ̃˥	'to feed'
3σ	e. t͡si˧wa˦ʔa˩	'rain'
	f. ʔa˧ni˦ma˩	'heart'

(32a and b) show examples of single syllable words, (32c and d) are two syllable words and (32eand f) are three syllable words. In multimorphemic words, the stressed syllable is always the final syllable of the stem, even when an affix or clitic is added. Note the examples in (33) below. In (33a) a prefix is added to the stem and the stress remains on the final syllable of the word. In (33b-f), clitics are

[102] Since primary stress is constant and immovable in Soyaltepec Mazatec, it is possible that the phenomena should be described as a prominent syllable or with some other term. Secondary stress can also be found in some words, but further investigation is beyond the scope of this paper.

added to the end of the stem and the stress remains on the final syllable of the stem, it does not shift to the final syllable of the word. Note the stressed syllable that is underlined in each example.

(33) Stress on multi-morphemic words

Transcription	Stem	Gloss
a. thi˥-t͡si˥ʃa˥	t͡si˥ʃa˥	'he is working'
b. thi˥-t͡si˥ʃa˥-hi˥	t͡si˥ʃa˥	'he is not working'
c. t͡ʃu˩ndu˩-ra˨˩	t͡ʃu˩ndu˩	'probably a worm'
d. ni˩sĩ˩-na˩	ni˩sĩ˩	'my basket'
e. tku˩-ʔɛ˩	tku˩	'his head
f. tjiu˩ʃĩ˧t͡sʔua˥-ɲa˦	tjiu˩ʃĩ˧t͡sʔua˥	'our lips'

The actual placement of the stem in the surface grammatical word and the number of affixes is irrelevant. Stress placement is only dependent on the stem.

All syllable types can occur in stressed and unstressed syllables. There is no indication of vowel reduction or tone loss on unstressed syllables. The only phenomenon in Soyaltepec Mazatec that has been associated with stress, up to this point, is nasality. Nasalized vowels usually occur in stressed syllables; however, when a word with a nasal syllable becomes the first member of a compound, the nasality is not lost even though it no longer receives primary stress as is demonstrated above in (33f).

Although stress is active in the licensing of tone in many Oto-Manguean languages, there is no indication of this effect in Soyaltepec Mazatec. Because stress is very regular and does not enter into the tone system, it will not be marked in the remainder of the dissertation.

3.7 Summary

Soyaltepec Mazatec is a tonal language which contains 10 vocalic phonemes (5 oral and 5 nasal vowels), 17 consonant phonemes, 13 diphthongs (10 oral and 7 nasal) and 27 possible consonant clusters. Consonant clusters are as common as simple onsets, but simple vowels are preferred to diphthongs. The maximal syllable is CCVV, but CV syllables are preferred. Onsets are required and codas are prohibited. Monosyllabic words are common, but disyllabic words are slightly more common. Trisyllabic words, and even longer words, occur occasionally, but most frequently are the result of morphology. There are no restrictions on the placement of syllable types within multisyllabic words. Any type of syllable may occur word initially, medially or finally. Stress occurs in Soyaltepec Mazatec on the final syllable of the stem, but it is not a very active process. The only feature licensed by stress is vocalic nasalization.[103]

[103] While in general tone is independent of stress in Soyaltepec Mazatec, one tonal process described in §5.2.2 may be shown to involve the attraction of a floating tone to a stressesd syllable under certain conditions. More research is needed to confirm the association.

CHAPTER 4

SURFACE TONE

4.1 Overview

In this chapter, I outline the surface tones that occur in Soyaltepec Mazatec and suggest representations based on the geometry proposed by Snider. The richness of the tonal inventory is reminiscent of Asian tone systems. While the major tonal categories found agree with those described by Pike that were examined in Chapter 2, some of the specific words examined have different tones than she described. In addition, I have expanded the tonal inventory to include an additional falling tone, i.e., Mid to Low (˧˩), that Pike did not use. Also, I found that both falling tones can occur lexically. The major divergences from Pike's work involve not only the underlying representation of specific words but also the behavior of the Mid-high to High contour tone which was reported to be erratic in Pike's description. I was not able to confirm any cases of the contour tones which were problematic for Pike and inspirational for Pizer. Specifically, I did not find examples in which a Mid-High to High rising tone split into a Mid on the original host syllable and a Mid-high on the following syllable. This tonal behavior will be addressed in Chapter 5.

Another expansion I offer over Pike's work is commentary on the relative incidence of the tones. Pike's work did not indicate the overall commonness of any given tone other than to say that the Mid-high tone (M_1 or 2 in Pike's notation) was not very common on single syllable words. The data that I found is in agreement with this claim. I found the H, M_2 and L tones to be common in addition to two of the rising tones: M_1-H and M_2-M_1.

A characteristic of Soyaltepec Mazatec that makes the system challenging to analyze is the tendency of speakers to maximize the pitch separation within each utterance.[104] Furthermore, the exact

[104] I am not aware of any published works which address this topic cross-linguistically, so I am not able to say if this is a tendency of all tone languages, or a specific characteristic of Soyaltepec Mazatec.

pitch of a tone from a given speaker appears to be almost irrelevant. For example, unless a speaker is purposefully trying to enunciate, a word in isolation is often spoken near the middle of the speakers pitch range regardless of if it is High, Mid or Low. Furthermore, the difference in pitch between two words, the first with a High tone, the second with a Low tone, may be the same as the difference in pitch between two words in which the first has a High tone and the second a Mid tone. The difference between the two sets only becomes evident if a third word with a different pitch is added. Therefore, the analyst must be cognizant of the relationship of each syllable to its surrounding syllables and be careful to consider the morphemes not just in isolation or any given environment but also in several different environments.

As a preview of the tones that will be discussed, Table 4-1 gives examples[105] of the tones that can appear on monosyllabic morphemes in Soyaltepec Mazatec. The tones are listed down the left column followed by vertical lists of near minimal pairs; i.e., there is minimal difference in the segmental material. The letters heading each column are placed for ease of reference to the material.

In the sections that follow, I first present the tonal primitives of Soyaltepec Mazatec,and then I discuss how these primitives combine to form clusters. Throughout I suggest phonological representations. The underlying representations of the morphemes are assumed to contain no association lines between the tones and their anchors unless otherwise specified. The unassociated tones are linked via the Universal Association Convention (UAC). Recall that in addition to being specified for both melody and register, each phonological unit must conform to the Obligatory Contour Principle (OCP) which prohibits identical elements from occupying adjacent positions.

[105] In all of the data in the remainder of the dissertation, the segmental phonemes will be given, not allophones, except for the voiced obstruent allophones which occur after nasals.

Table 4-1 Minimal Tone Comparisons on Monosyllabic Morphemes

Tone	Near Minimal Sets								
	A	B	C	D	E	F	G	H	I
H	thɛ˥ ‘itch’	ti˥ ‘flame’	tɛ˥ ‘dance’	sũ˥ ‘flat’	khia˥ ‘when’	ku˥ ‘and’		nda˥ ‘works’	hĩ˥ ‘name’
M_1		thi˦ ‘round’			thĩã˦ ‘there seated’	kũ˦ ‘are’			hi˦ ‘you’
M_2		ti˧ ‘boy’	tɛ˧ ‘ten’		thia˧ ‘arm’	tkuɛ˧ ‘raspy’	thãĩ˧ ‘thick’	khan˧ ‘fights’	hɛ˧ ‘fat’
L	thɛ˩ ‘grass’	ti˩ ‘fish’	tɛ˩ ‘crushed’		kʔia˩ ‘there’	tku˩ ‘head’	thao˩ ‘wind’	nda˩ ‘voice’	hɛ˩ ‘young corn shoot’
M_1-H	thɛ˦˥ ‘trash’	thĩ˦˥ ‘there are’		sʔui˦˥ ‘party’		tkua˦˥ ‘snail’			hĩ˦˥ ‘blood’
M_2-H	thɛ˧˥ ‘bug bite’	ki˧˥ ‘went’	tɛ˧˥ ‘wide’					nda˧˥ ‘good’	
M_2-M_1	thɛ˧˦ ‘cough’				ta˧˦ ‘toasted’	tku˧˦ ‘elbow’		kha˧˦ ‘skunk’	hĩ˧˦ ‘eight’
M_1-L	thɛ˦˩ ‘type’			sũ˦˩ ‘song’			thãĩ˦˩ ‘fungus’		
M_2-L		nd͡ʒi˧˩ ‘wet’			ta˧˩ ‘unripe’		kho˧˩ ‘with’	kha˧˩ ‘delicate’	hĩ˧˩ ‘we’
L-M_2			nd͡ʒɛ˩˧ ‘hominy’	t͡ʃhũ˩˧ ‘woman’			t͡ʃho˩˧ ‘egg’		
L-M_1							hao˩˦ ‘OK’	na˩˦ ‘mother’	

4.2 Tonemes

In this section, I discuss the four level tones which are the primary tonemes that make up the tonal system of Soyaltepec. These level tones can combine to form contour tones or tonal clusters as well, but the tonal combinations are not considered to be basic tonemes.

As demonstrated in Table 4-1, near minimal sets exist which show the need to differentiate between four levels of tone. Unfortunately, there are not any minimal sets which include all four levels of tone over monosyllabic words. Furthermore, the Mid-high tone does not commonly occur as a level tone on monosyllabic morphemes. While it is slightly more common on multisyllabic morphemes, evidence for the existence of this primitive is reinforced from near minimal sets, phonetic distinctions which are demonstrated below in §4.2.2, and arguments from cluster tones which include both the beginning point (M_1-H) and the endpoint (M_2-M_1 and L-M_1) for several cluster tones as discussed in §4.3 as well as evidence from tone sandhi associated with these cluster tones which will be discussed in §5.3.

Near minimal sets for the tonal primitives that will be discussed in this section are listed in vertical groups in Table 4-2 with a reference letter across the top and the tone category listed down the left column.

Table 4-2 Near minimal sets for tonal primitives

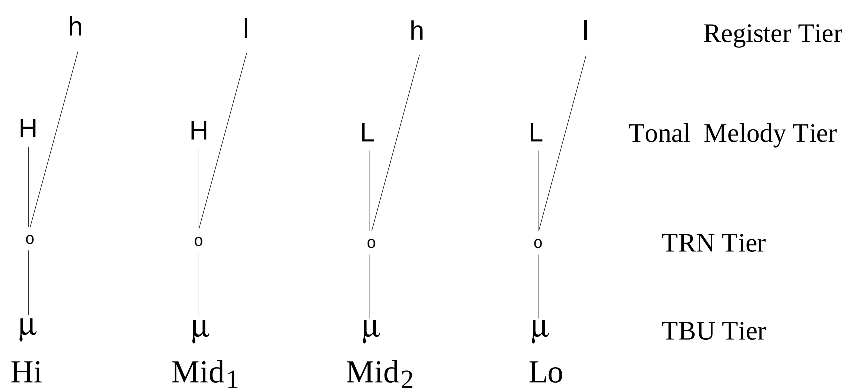
Tone	A.	B.	C.	D.	E.	F.	G.
H	ti˥ ‘flame’	tɛ˥ ‘dance’	khia˥ ‘when’	ku˥ ‘and’	t͡su˥ ‘says’	hĩ˥ ‘name’	t͡ʃʔũĩ˥ ‘chayote’
M_1	thi˦ ‘round		thĩã˦ ‘there seated’	kũ˦ ‘are’	sĩã˦ ‘there standing’	hi˦ ‘you’	ʃʔui˦ ‘ember’
M_2	ti˧ ‘boy’	tɛ˧ ‘ten’	thia˧ ‘arm’	kui˧ ‘he’	ʃa˧ ‘wildcat’	hɛ˧ ‘fat’	ʃʔi˧ ‘grind’
L	ti˩ ‘fish’	tɛ˩ ‘crushed’	kʔia˩ ‘there’	tku˩ ‘head’	ʃa˩ ‘fog	hɛ˩ ‘young corn shoot’	ʃkũ˩ ‘eye’

First, I illustrate and discuss the phonological representations adopted for the purposes of this dissertation, next I briefly touch on the phonetic realization of the four primitives and then I investigate each toneme individually.

4.2.1 Phonological Representations

The phonological representations described by Snider (1999) in accord with Register Tier Theory (RTT) are adopted for this dissertation. Recall from the discussion of Autosegmental Phonology in §1.5.2 and RTT in §1.5.4 that for each syllable to be articulated, it must be associated with a TRN which in turn must be specified for both tonal melody (H or L) and tonal register (*h* or *l*). In many languages at least some of these features can be filled in through environmental stipulations or default processes. In Soyaltepec Mazatec, however, each syllable is lexically specified. The geometry that Snider (1999:24) describes for four level tones was introduced in Chapter 1 (21). It is repeated here as (1). Recall that the Tonal Melody Tier and the Tonal Register Tier exist in separate planes and are therefore independent features.

(1) The phonological representation of 4 levels of tone (Snider (1999:24))



In this representation, the Hi tone is specified as a high tonal melody (*H*) and a high tonal register (*h*). These features can be written as (*H h*). The Mid_1 or Mid-High tone has a high melody and low register (*H l*). The Mid_2 or Mid has a low tonal melody and high register (*L h*). Finally, the Lo tone has a low melody and low register (*L l*). Examination of these feature designations reveals that two sets of natural classes are formed. The first group opposeses Hi and Mid_2 (which share the high register feature) to Mid_1 and Lo (which share the low register feature). The second pairing is the Hi and Mid_1 (which share the high melody feature) and oppose the Mid_2 and Lo (which share the low melody feature). In Chapter 5, we will see that the Hi and Mid_1 each occur as floating tones and that the Hi and Mid_2 can both be lowered when they occur after the floating Mid$_1$. Interestingly, the Mid$_1$ and Mid$_2$ do not share any features in common, so we do not expect them to act together. Not surprisingly, the High and Low tones also share no common features and therefore share no common behaviors.

4.2.2 Phonetic Realization of Tonemes

The phonetic realization of the tonemes is demonstrated in Figure 4-1 which shows a graphic representation of the level tones on a single syllable. The y-axis is measured in semitones and represents the fundamental frequency of the tone in question. The x-axis reflects the duration of the nucleus of the syllable and is measured in seconds.

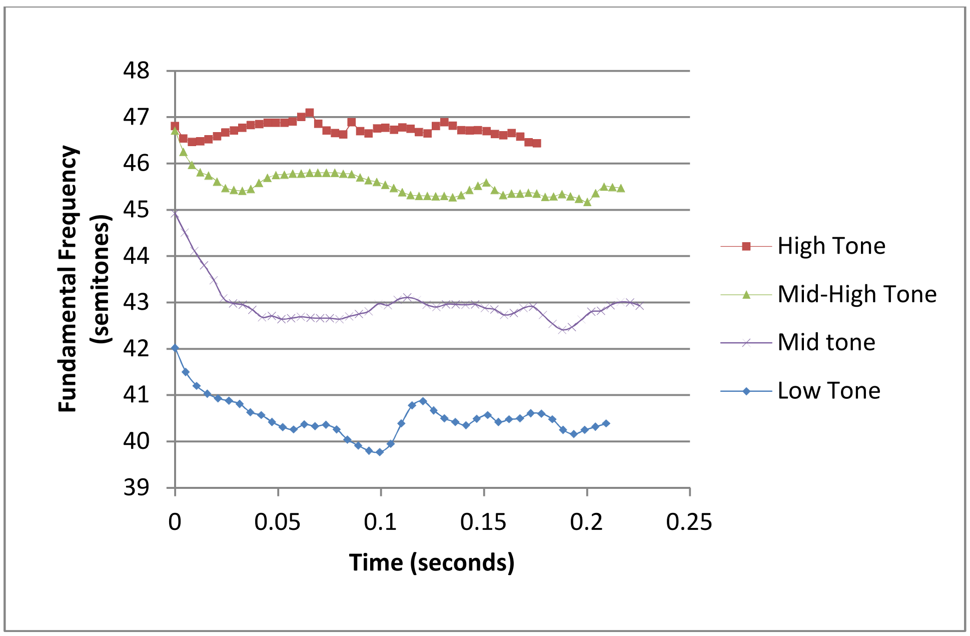


Figure 4-1 Soyaltepec Mazatec tonemes

The above chart demonstrates the relative level of each tone in the speech range of an individual as it occurs in isolation. The specific data used to create this chart is taken from a single speaker who is purposefully enunciating. It reflects the average of six to eight utterances for each tone which have been normalized for duration using a program called COMP developed by Courtney Gillett. The slight jump in the Low tone trace between 0.1 seconds and 0.15 seconds is an artifact resulting from the averaging of the tonal values some of which drop off at a faster rate than others. The pitch trace of a single Low tone would be a smoother line. Notice that the relative distance between the four tones is not uniform. The High tone and Mid-High tone are much closer together than any of the other tones.[106]

4.2.3 High tone – H (˥)

The level High tone is common; multiple examples are readily found on every type of word form in Soyaltepec Mazatec from monosyllabic, monomorphemic words to multisyllabic, multimorphemic words. It occurs at a fundamental frequency near the top of the speaker's normal range (Figure 4-1) and is either level or rises initially with a reduction in slope (leveling out) as the vowel progresses. The rate of reduction in slope depends on the sonority of the preceding consonant; with the least sonorant onsets producing the most rapid reduction in slope. Phonologically, the High tone consists of a high tonal melody (*H*) and a high tonal register (*h*). An example representation appears in (2).

(2) Phonological representation of ho˥ 'two'

h	Register
H	Melody
○	TRN
ho	TBU
'two'	gloss

Examples of monosyllabic morphemes with level High tones appear in (3) and (4). The data is organized by onset type in order to demonstrate that the onset does not in any way influence or restrict the tones that are possible on a syllable: (3) demonstrates simple onsets and (4) demonstrates complex onsets. In (3) the place of articulation is listed on the far left, followed by the manner.

[106] It is for this reason that I have chosen the four tone keys to represent these level tones as ˥, ˦, ˧ and ˩, rather than four evenly spaced tone keys.

(3) High toned words with simple onsets

	POA	Manner	Transcription	Gloss
a.	Labial	glide	ɦi˥	'slowly'
b.	Coronal	stop	tɛ˥	'dance'
c.	Coronal	stop	ti˥	'burn'
d.	Coronal	fricative	suɛ˥	'hot'
e.	Coronal	affricate	t͡su˥	'say'
f.	Coronal	nasal	ni˥khĩɛ̃	'to feed'
g.	Dorsal	stop	ko˥	'how many?'
h.	Dorsal	stop	ku˥	'and'
i.	Glottal	fricative	ho˥	'two'
j.	Glottal	fricative	hã˥	'three'
k.	Glottal	stop	ʔõ˥	'five'

In (4) complex onsets are organized according to the clusters present which are grouped according to the classifications that were described in §3.4.3 above. Recall that the complex onsets were divided into groups based on the phonemes involved. In (4) the 'Type' of onset refers to the following possibilities: S-stop/stop-stop, Contains /ʔ/, Contains /h/ or Begins with /N/. Next the 'Sub-type' of the onset further divides Contains /ʔ/ and Contains /h/ into categories based on whether or not the onset contains an obstruent or a sonorant.

(4) High toned words with complex onsets

	Type	Sub-type	Example	Gloss
a.	S-stop/stop-stop		ʃki˥	‘whirlpool’
b.	Contains /ʔ/	Obstruent	t͡ʃʔũĩ˥	‘chayote’[107]
c.	Contains /ʔ/	Sonorant	ʔmi˥	‘named’
d.	Contains /ʔ/	Sonorant	ʔja˥	‘who?’
e.	Contains /ʔ/	Sonorant	ʔwɛ˥	‘to plant’
f.	Contains /h/	Obstruent	t͡shu˥	‘toasted’
g.	Contains /h/	Obstruent	t͡shũ˥	‘kicks’
h.	Contains /h/	Obstruent	khĩ˥	‘many’
i.	Contains /h/	Obstruent	khɛ̃˥	‘pull’
j.	Contains /h/	Sonorant	hma˥	‘black’
k.	Begins with /N/		nda˥	‘works’

In (3) and (4) there are representative examples of each onset type that occurs in Soyaltepec Mazatec. The only gaps in the data are the absence of a monosyllabic morpheme which begins with a simple nasal and a stop-stop cluster. Neither of these gaps signifies a restriction. Notice that there are examples of complex onsets which contain nasals, i.e., nasals preceded by glottal consonants (4c, j) and nasals preceding stops (4k). There are also examples of multisyllabic words with syllables containing simple nasals that are articulated with a High tone (3f).

High tones are also independent of the type of nucleus of the syllable. Examining (3) and (4), examples can be found of words which contain each of the ten vowels:

- [i] - (3a, c, f), (4a, c)
- [ĩ] - (4h)

[107] A chayote is a type of vegetable sometimes called a ‘vegetable pear’.

- [ɛ] - (3b), (4e)
- [ɛ̃] - (4i)
- [a] - (4d, j, k)
- [ã] - (3j)
- [o] - (3g)
- [õ] - (3k)
- [u] - (3e, h), (4f)
- [ũ] - (4g)

There are also oral and nasal diphthongs which host High tones. Examples include:

- [uɛ] – (3d)
- [ũĩ] – (4b)

High tones exist on monosyllabic morphemes of all consonant and vowel types. High tones also occur across several grammatical categories. Examples include:

- Nouns - (4a, b)
- Verbs - (3b, c, e), (4c, e, g, i, k)
- Adverbs - (3a)
- Adjectives - (3d), (4f, j)
- Quantifiers - (3i, j, k), (4h)
- Question particles - (3g), (4d)
- Connective particles - (3h)

The examples in (3) and (4) show that High tones exist on monosyllabic morphemes independent of segmental and grammatical categories. The High tone also exists on any syllable of multisyllabic morphemes. Disyllabic words with High tone on the first syllable appear in (5).

(5) High tone on first syllable of disyllabic words

Soyaltepec Mazatec	Gloss	Tone Pattern
a. ʃʔo˥thi˥	'a dress'	H H
b. ngi˥ngu˧	'other'	H M_1
c. ngi˥sa˧	'more'	H M_2
d. si˥hɛ̃˩	'scented'	H L

The examples in (5) show that the High tone can appear on the first syllable of a disyllabic word followed by any of the other tonal primitives on the final syllable. The High tone can also exist on the final syllable of words which begin with any of the other level tones (6).

(6) The High tone on the final syllable of disyllabic words

Soyaltepec Mazatec	Gloss	Tone Pattern
a. ni˥khĩɛ̃˥	'to feed'	H H
b. thi˧kũ˥	'alive'	M_1 H
c. na˧hmi˥	'thing'	M_2 H
d. t͡ʃa˩ʔa˥	'armadillo'	L H

The examples in (6) show that the High tone can occur on a disyllabic word after any of the tonemes. The High tone can also occur in longer words. Recall that words beyond three syllables are very unusual when inflection and morphology are discounted, so I will limit the discussion here to trisyllabic words. The High tone can occur on all three syllables (7a), the first two (7b), just the first (7c), just the second (7d), the second and third (7e) or just the third syllable (7f).

(7) The High tone on trisyllabic words

Soyaltepec Mazatec	Gloss	Tone Pattern[108]
a. ndi˥fa˥ti˥	‘petroleum’	H H H
b. thi˥t͡si˥ʃa˥	‘working’	H H M_1-H
c. thi˥t͡su˦ja˧	‘explaining’	H M_1 M_2
d. ʔɛ˦ni˥ma˩	‘indigenous language’	M_1 H L
e. ʃi˧ne˥t͡shu˥	‘fried pork rinds’	M_2 H H
f. te˧ɲu˧hũ˥	‘fourteen’	M_2 M_2 H

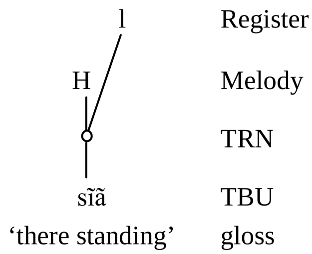
The High tone occurs on all of the syllables of monosyllabic words, disyllabic words and trisyllabic words without regard for the characteristics of the segments present or the grammatical category of the morphemes.

4.2.4 Mid-high tone – M_1 (˦)

The expression of the Mid-high tone as a level tone is not as pervasive as the other tonemes. While examples are available, they are hard to find. It occurs very rarely as a single tone on monosyllabic monomorphemic words, but it commonly occurs as the endpoint or origin of several rising and falling tones including: M_1-H, M_2-M_1, L-M_1 and M_1-L. It is somewhat more common as part of longer words. The Mid-high tone appears with a fundamental frequency slightly lower than the High tone (Figure 4-1) and tends to fall slightly over the syllable. Phonologically, the Mid-high tone consists of a high tonal melody (*H*) and a low tonal register (*l*). An example representation appears in (8).

[108] Recall that tonal abbreviations separated by a space represent level tones on separate syllables while those separated by a dash are tonal clusters which occur on the same syllable.

(8) Phonological representation of sĩã˦ ‘there standing’



Examples of words with a Mid-high tone appear below in (9) and (10). Unlike the High toned morphemes, there are very few examples of monosyllabic morphemes with Mid-high tones. In order to offer examples of various onsets, I have also included multisyllabic words whose first syllable contains the Mid-high tone. The examples are still somewhat limited and, for a few categories, there are gaps in my data, such as complex onsets which end in nasals. More research is needed to determine if any of these types of onsets exist with the Mid-High tone. Despite the more limited distribution of the Mid-high, it will be demonstrated that there is no reason to postulate a correlation between this toneme and any specific structure. The examples in (9) show syllables with Mid-high tones whose onset is simple. The place and manner of articulation are listed for the syllable with the Mid-high tone which in these examples is always the first syllable of the word listed.

(9) Mid-high toned syllables with simple onsets

	POA	Manner	Transcription	Gloss
a.	Labial	glide	wɛ˦tkũ˦˥	'respect'
b.	Coronal	stop	ta˦ha˧˥	'hard'
c.	Coronal	fricative	sĩã˦	‘there standing’
d.	Coronal	affricate	t͡su˦ʔwi˦˥	'sun'
e.	Coronal	nasal	mi˦nd͡ʒi˧	'to hoe'
f.	Dorsal	stop	kã˦ho˧˨	'twenty two'

g.	Dorsal	stop	kũ˦	‘are’
h.	Glottal	fricative	ji˦	‘you’
i.	Glottal	stop	ʔɛ̃˧ni˥ma˧	'indigenous language'

In (10) examples of Mid-high toned syllables with complex onsets are given. The onsets are again grouped according to the categories discussed in §3.4.3. ‘Type’ of onset refers to the following possibilities: S-stop/stop-stop, Contains /ʔ/, Contains /h/ or Begins with /N/. Next, the ‘Sub-type’ of the onset further divides Contains /ʔ/ and Contains /h/ into categories based on whether or not the onset also contains an obstruent or a sonorant. The syllable containing the Mid-high tone is the first syllable of the example.

(10) Mid-high tones syllables with complex onsets

	Type	Sub-type	Example	Gloss
a.	S-stop/stop-stop		ʃtiu˦	‘underdeveloped’
b.	Contains /ʔ/	Obstruent	ʃʔui˦	‘ember’
c.	Contains /ʔ/	Obstruent	t͡ʃʔo˦kũ˦	'bad'
d.	Contains /ʔ/	Sonorant	ʔwɛ˦ʔɲu˥	'he ties'
e.	Contains /h/	Obstruent	thi˦	‘round’
f.	Contains /h/	Obstruent	thĩã˦	‘there sitting’
g.	Contains /h/	Sonorant	none	
h.	Begins with /N/		ngu˧hɲa˩˨	‘yesterday’

In (9) and (10) there are examples representing each onset type that occurs in Soyaltepec Mazatec. There are many onset types which are not found in monosyllabic Mid-High toned words; however, multisyllabic words can be used to fill most of these gaps. The only gap in the data is the absence of an example which begins with a complex onset with a /h/-sonorant cluster. Considering that both the Mid-high tone and the /h/-sonorant cluster onsets are relatively rare, it is not surprising that there is a gap in their intersection. More research could fill this gap.

Tone does not depend on the vowel of the syllable. Examples can be found in (9) and (10) of syllables which contain the Mid-high tone with nine of the ten vowels:

- [i] - (9h), (10e)
- [ĩ] - (9e)
- [ɛ] - (9a), (10d)
- [ɛ̃] - (9i)
- [a] - (9b)
- [ã] - (9f)
- [o] - (10c)
- [õ] - none
- [u] - (9d), (10h)
- [ũ] - (9g)

There is no example of the [õ] which is the least common vowel, so again it is not surprising that no examples are available.

There are also several examples of diphthongs, both oral and nasal, which host the Mid-High tone. Examples include:

- [ui] - (10b)
- [ĩã] - (9c), (10f)
- [iu] - (10a)

The above examples demonstrate that the Mid-high tone occurs with almost all of the onset types and vowels. The only gaps that occur happen among the less common onsets and vowels. There are also examples of various grammatical categories. Examples include:

- Nouns - (9d, i), (10b)
- Verbs - (9a, c, e, g), (10d, f)
- Pronouns - (9h)
- Adjectives - (9b), (10a, c, e)
- Adverbs - (10h)
- Quantifiers - (9f)

The Mid-High tone level is independent of segmental characteristics and grammatical categories. Like the High tones, the Mid-high tone can be found as the first syllable of disyllabic words followed by any of the other tonal primitives (11).

(11) Mid-High tones on the first syllable of disyllabic words

Soyaltepec Mazatec	Gloss	Tone Pattern
a. thi˦kũ˥	'alive'	M_1 H
b. t͡ʃʔo˦kũ˦	'bad'	M_1 M_1
c. t͡ʃhu˦ja˧	'to sew'	M_1 M_2
d. wu˦ru˩	'donkey'	M_1 L

The Mid-High tone can also appear on the final syllable of disyllabic words preceded by any of the tonal primitives (12).

(12) Mid-High tones on the final syllable of disyllabic words

Soyaltepec Mazatec	Gloss	Tone Pattern
a. ngi˥ngu˦	'other'	H M_1
b. t͡ʃi˦sɛ̃˦	'housefly'	M_1 M_1

c. t͡sa˧wɛ˥ 'crazy' M_2 M_1

d. sa˩wa˥ 'shame' L M_1

In (11) and (12) it was shown that the Mid-high tone can combine with all the other tonemes on disyllabic words both the first and second syllable. Like the High tone, the Mid-high tone can also be found on larger words. Since words larger than two syllables are not numerous, it is not surprising that the examples are rare; however, trisyllabic words can be found with the Mid-high on the first (13a), second (13b) and third syllable (13c).

(13) Trisyllabic words with Mid-high tone on each syllable

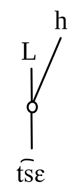
Soyaltepec Mazatec	Gloss	Tone Pattern
a. ʔɛ̃˧ni˥ma˩	'indigenous language'	M_1 H L
b. ʔa˧ni˧ma˩	'heart'	M M_1 L
c. nga˩su˩ndɛ˥	'world'	L L M_1

There are no examples in my database of trisyllabic words which have a Mid-high on both of the first two syllables of a word or the last two; this is a matter for further research. Although the Mid-high tone is not as common as the High tone or as the Mid and Low tones that we will discuss below, it is clear that it is a viable and important tone in the tone system of Soyaltepec Mazatec. I demonstrate below in §5.3 that the characteristics of the Mid-high tone are responsible for a large part of the tone sandhi that occurs in Soyaltepec Mazatec which gives the tone system its unique character. The placement of the Mid-high tone is independent of segmental characteristics, grammatical category and syllable position within a word.

4.2.5 Mid tone – M_2 (˧)

The Mid tone is very common; examples are readily available on every type of word form in Soyaltepec Mazatec. Phonetically, the tone tends to appear with a fundamental frequency in the middle of the speakers pitch range at the most relaxed or neutral setting. The pitch trace often appears with a slight fall (Figure 4-1). Phonologically, the Mid tone consists of a low tonal melody (*L*) and a high tonal register (*h*). An example of the representation appears in (14).

(14) Phonological representation of t͡sɛ˧ ‘guava’



‘guava’

Examples of monosyllabic words occurring with a Mid tone appear in (15) and (16). The data is arranged according to onset type in order to demonstrate that the onset does not influence the tone. In (15), the point of articulation and manner are listed for the simple onsets to demonstrate the occurrence with M_2.

(15) Mid-toned words with simple onsets

	POA	Manner	Transcription	Gloss
a.	Labial	fricative	fɛ˧	‘finished’
b.	Coronal	stop	ti˧	‘boy’
c.	Coronal	fricative	sã˧	‘sour’
d.	Coronal	fricative	ʃa˧	‘wild cat’
e.	Coronal	affricate	t͡sa˧	‘bag’
f.	Coronal	nasal	ma˧	‘he can’
g.	Dorsal	stop	kui˧	‘he’
h.	Glottal	fricative	hũ˧	‘yes’
i.	Glottal	fricative	hõ˧	‘soldier’
j.	Glottal	stop	ʔo˧	‘he grinds’

Examples of Mid toned words with complex onsets are given in (16). The onsets are again grouped according to the categories discussed in §3.4.3. 'Type' of onset refers to the following possibilities: S-stop/stop-stop, Contains /ʔ/, Contains /h/ or Begins with /N/. Next, the 'Sub-type' of the onset further divides Contains /ʔ/ and Contains /h/ into categories based on whether or not the onset contains an obstruent or a sonorant.

(16) Mid-toned words with complex onsets

	Type	Sub-type	Example	Gloss
a.	S-stop/stop-stop		tka˧	'bald'
b.	S-stop/stop-stop		tkuɛ˧	'raspy'
c.	Contains /ʔ/	Obstruent	kʔĩɛ̃˧	'dead'
d.	Contains /ʔ/	Sonorant	ʔnu˧	'twins'
e.	Contains /ʔ/	Sonorant	ʔja˧	'mule driver'
f.	Contains /h/	Obstruent	thãĩ˧	'thick'
g.	Contains /h/	Obstruent	khã˧	'he fights'
h.	Contains /h/	Sonorant	hmi˧	'mestizo'
i.	Begins with /N/		ndi˧	'sterile'
j.	Begins with /N/		ndia˧	'salty'
k.	Begins with /N/		nd͡zɛ̃˧	'fool'

In (15) and (16) there are examples of the Mid tone appearing with all of the major onset categories. Examples of nine of the ten vowels can also be found:

- [i] - (15b), (16h, i)

- [ĩ] - none
- [ɛ] - (15a)
- [ɛ̃] - (16k)
- [a] - (15d, e, f), (16e, a)
- [ã] - (15c), (16g)
- [o] - (15j)
- [õ] - (15i)
- [u] - (16d)
- [ũ] - (15h)

While there are no examples of [ĩ] occurring on monosyllabic Mid toned words, the combination does occur on the final syllable occasionally, for example:

(17) Mid-toned example containing [ĩ]

niꜜthĩ˧ 'day'

Various diphthongs, both oral and nasal also occur with the Mid tone. Examples include:

- [ui] - (15g)
- [uɛ] - (16b)
- [ia] - (16j)
- [ãĩ] - (16f)
- [ĩɛ̃] - (16c)

The above examples demonstrate that the Mid tone occurs on syllables in Soyaltepec Mazatec without regard for the segmental characteristics. The Mid tone also occurs on words of various grammatical categories including:

- Nouns - (15b, d, e, i), (16d, e, k)
- Pronouns - (15g)
- Verbs - (15f, j), (16g)
- Adjectives - (15c), (16a, b, c, f, h, i, j)
- Adverbs - (15a)

The Mid tone also occurs on both syllables of disyllabic words. It can occur on the first syllable preceding any of the other tonemes (18).

(18) Mid tone on the first syllable of disyllabic words

Soyaltepec Mazatec	Gloss	Tone Pattern
a. na˧hmi˥	‘thing’	M_2 H
b. t͡sa˧wɛ˦	‘crazy’	M_2 M_1
c. ni˧sɛ̃˧	‘rat’	M_2 M_2
d. ki˧t͡sa˩	‘fast’	M_2 L

The Mid tone also occurs on the final syllable of disyllabic words, following any of the other tonemes (19).

(19) Mid tone on final syllable of disyllabic words

Soyaltepec Mazatec	Gloss	Tone Pattern
a. ngi˥sa˧	‘more’	H M_2
b. t͡ʃhu˦ja˧	‘to sew’	M_1 M_2
c. ni˧sɛ̃˧	‘rat’	M_2 M_2
d. ni˩sɛ˧	‘bird’	L M_2

In (19) and (20) the Mid tone is demonstrated to combine with all of the other tonemes on disyllabic words on both the first and second syllables. The Mid tone can also appear on any syllable of a trisyllabic word (20).

(20) Mid tone on trisyllabic words

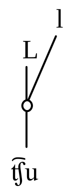
Soyaltepec Mazatec	Gloss	Tone Pattern
a. wa˧sɛ˧ja˧	'half'	M_2 M_2 M_2
b. na˧ndu˧ʔwa˩	'urine'	M_2 M_2 L
c. ʃi˥wa˧ngui˧	'surplus'	H M_2 M_2
d. t͡si˧wa˦ʔa˩	'rain'	M_2 M_1 L
e. t͡ʃu˩ʔa˧ni˥	'red animal	L M_2 H
f. ti˩khai˦sɛ̃˧	'he thinks'	L M_1 M_2

The Mid tone can occur on all three syllables of a trisyllabic word (20a), on the first two syllables (20b), on the last two syllables (20c), just the first syllable (20d), just the middle syllable (20e) or just the last syllable (20f). The Mid tone can occur on any syllable of a word in Soyaltepec Mazatec. Its presence is not dependent on segmental characteristics, grammatical category or the syllable's position in the word in question.

4.2.6 Low tone - L (˩)

Low tones are also common; their presence is pervasive on all word types of Soyaltepec Mazatec. The Low tone is produced with more force than the Mid tone and occurs near the bottom of the normal pitch space (Figure 4-1). The tone occurs with either a level pitch or a falling pitch which can level out over the course of the syllable or remain slightly falling over the entire course of the syllable. Phonologically, the Low tone consists of a low tonal melody (*L*) and a low tonal register (*l*). An example representation appears in (21).

(21) Phonological representation of t͡ʃu˩ ‘animal’



‘animal’

Examples of words with Low tones can be found in (22) and (23). Examples of words with Low tones and simple syllables are shown in (22). Monosyllabic examples are not always available so multisyllabic words with a Low tone on the first syllable are occasionally used. The place and manner of articulation are listed for the example syllable with the Low tone which is always the first syllable of the example given.

(22) Low-tone syllables with simple onsets

	POA	Manner	Transcription	Gloss
a.	Labial	glide	wa˩sʔɛ˩	‘enter’
b.	Coronal	stop	ti˩	‘fish’
c.	Coronal	fricative	ʃa˩	‘fog’
d.	Coronal	affricate	t͡ʃu˩	‘animal’
e.	Coronal	glide	jɛ˩	‘snake’
f.	Coronal	nasal	ni˩hĩ˩	‘dried corncob’
g.	Dorsal	stop	ki˩t͡ʃa˩	‘metal’
h.	Glottal	fricative	hɛ̃˩	‘he smells’
i.	Glottal	stop	ʔa˩sɛ̃˧	‘light’

Examples of low-toned words with complex onsets are given in (23). The onsets are again grouped according to the categories discussed in §3.4.3. 'Type' of onset refers to the following possibilities: S-stop/stop-stop, Contains /ʔ/, Contains /h/ or Begins with /N/. Next, the 'Sub-type' of the onset further divides Contains /ʔ/ and Contains /h/ into categories based on whether or not the onset contains an obstruent or a sonorant. Monosyllabic examples were available for all of the categories in (23).

(23) Low-toned syllables with complex onsets

	Type	Sub-type	Example	Gloss
a.	S-stop/stop-stop		skũã˩	'grit'
b.	S-stop/stop-stop		ʃkũ˩	'eyes'
c.	Contains /ʔ/	Obstruent	sʔɛ˩	'after a while'
d.	Contains /ʔ/	Obstruent	kʔia˩	'there'
e.	Contains /ʔ/	Sonorant	ʔwa˩	'crooked'
f.	Contains /h/	Obstruent	t͡shĩũ˩	'tobacco'
g.	Contains /h/	Obstruent	t͡shu˩	'onion'
h.	Contains /h/	Obstruent	t͡ʃha˩	'chat'
i.	Contains /h/	Obstruent	tho˩	'air'
j.	Contains /h/	Sonorant	hɲa˩	'chili'
k.	Contains /h/	Sonorant	hnɛ˩	'palm'
l.	Begins with /N/		nda˩	'voice'
m.	Begins with /N/		nd͡ʒi˩	'wet'

In (22) and (23), examples of low-toned syllables which begin with examples of each consonantal category are found. A cursory inspection of the data seems to indicate that Low tones are more common on words which contain complex onsets. For several categories, i.e., labial, dorsal, glottal stop and simple nasal, monosyllabic words were not available in my database. For these categories, disyllabic words which carry the Low tone on their first syllable were supplied. For three of the four, the Low tone is on both syllables. An examination of (22) and (23) shows that the Low tone also occurs on syllables with seven of the ten vowels of Soyaltepec Mazatec:

- [i] - (22b, f, g), (23d, m)
- [ĩ] - second syllable of (22f)
- [ɛ] - (22e), (23c, k)
- [ɛ̃] - (22h)
- [a] - (22a, c, i), (23e, h, j, l)
- [ã] - none
- [o] - (23i)
- [õ] - none
- [u] - (22d), (23g)
- [ũ] - (23b)

The vowel, [õ], which fails to co-occur with the Low tone, is the least common vowel. The [ĩ] and [ã] are also infrequent pairings with the Low tone. They do, however, occur occasionally in the final syllable of longer words such as those in (24).

(24) Low tone on final syllable to demonstrate [ĩ] and [ã]

a. [ĩ] - ni˩sĩ˩ 'basket'

b. [ã] - khɛ̃˩ʔã˩ ‘I eat’

The Low tone can also occur on both oral and nasal diphthongs. Examples from (23) include:

- [ia] - (23d)
- [ũã] - (23a)
- [ĩũ] - (23f)

The examples given in (22)-(24) demonstrate that segmental characteristics do not license the Low tone. The same can be said for grammatical categories. Although there seems to be a preference for nouns, examples can be found in various grammatical categories including:

- Nouns - (22b, c, d, e, g, i, f), (23a, b, f, g, i, j, k, l), (24a)
- Verbs - (22a, h), (23h), (24b)
- Adjectives - (23e, m)
- Adverbs - (23c, d)

Low tones can occur on any syllable in Soyaltepec Mazatec regardless of the segmental characteristics or the grammatical category of the morpheme in question. They can also occur on either syllable of a disyllabic word. Low tones can precede any other toneme (25).

(25) Low tones on the first syllable of disyllabic words

Soyaltepec Mazatec	Gloss	Tone Pattern
a. t͡ʃa˩ʔa˥	‘armadillo’	L H
b. sa˩wa˧	‘shame’	L M_1
c. ni˩sɛ˧	‘bird’	L M_2
d. ti˩ʃa˩	‘cave’	L L

Similarly, the Low tone can occur on the final syllable of disyllabic words, paired with any toneme on the first syllable (26).

(26) Low tone on second syllable of disyllabic words

Soyaltepec Mazatec	Gloss	Tonal Pattern
a. si˥hɛ̃˩	‘scented’	H L
b. wu˧ru˩	‘donkey’	M_1 L
c. ki˧t͡sa˩	‘fast’	M_2 L
d. ʃa˩nda˩	‘chicken’	L L

The Low tone can also occur on trisyllabic words (27). It can occur on all three syllables (27a), the first two syllables (27b), the last two syllables (27c), just the first syllable (27d), just the middle syllable (27e) or just the final syllable (27f).

(27) Low tone on trisyllabic words

Soyaltepec Mazatec	Gloss	Tone Pattern
a. ni˩ngu˩ʃi˩	'church'	L L L
b. ha˩ma˩ja˧	"tree root'	L L M_2
c. khi˧ndɛ˩thua˩	'door'	M_2 L L
d. na˩mi˧t͡ʃa˥	'father-in-law'	L M_1 H
e. kʔuɛ˥t͡ʃhi˩ri˧	'thank you'	H L M_2
f. ʔa˧ni˧ma˩	'heart'	M_2 M_1 L

The Low tone can occur on any syllable of Soyaltepec Mazatec, regardless of the segmental characteristics, the grammatical category or the placement of the syllable within a word.

4.2.7 Summary of Tonal Primitives

Several characteristics of the tonal system of Soyaltepec Mazatec are evident above. There are four level tones which can occur on any syllable in Soyaltepec Mazatec. Each level is important and distinct lexically, phonetically and phonologically. All four tones occur with most of the onset and vowel types that occur in Soyaltepec Mazatec. Each tone level also occurs on words of various grammatical categories. Finally, each of the tonemes can occur both before and after every other toneme and on each syllable in multisyllabic words. There are occasionally gaps in the data, but all are accidental. There are no consistent gaps which indicate potential phonological patterns. The four level tones are not in complementary distribution. The Mid-high tone is not as common as the other three tones, but there is nothing in the data to suggest that it is somehow environmentally derived. The discussion of the contour tones below in §4.3 and the tonal sandhi of Soyaltepec Mazatec in Chapter 5 will confirm the importance of a phonologically distinct Mid-high level toneme.

4.3 Tonal Contours

The phenomenon of concatenations of level tones on single syllables has been referred to by Pike using the term, 'tonal cluster.' This reflects the phonological state of multiple tonemes combining on a single syllable in a similar manner as a consonant cluster describes two or more consonants occurring together in a syllable onset or rhyme. Snider (1999) refers to the tonal phenomenon as a composite contour tone.[109]

The four level tones of Soyaltepec Mazatec could combine to form as many as six rising and six falling contours. In fact, five rising contours occur lexically (all except the rise from Low to High ˩˥) as well as three falling tones (Mid-high to Mid ˦˧, Mid-high to Low ˦˩ and Mid to Low ˧˩). However, only two of the contour tones, the rises from Mid to Mid-High (˧˦) and Mid-High to High (˦˥) are common. The Mid-high to Mid falling tone is exceedingly rare and will not be investigated at this time.

In languages in which the contour tones are composed of level tones which co-occur on a single TBU, the contour tones tend to occur on the final syllable of the word. This is the case with Soyaltepec Mazatec. Although contours can occur on any syllable of a word, especially when they appear for grammatical reasons, lexical contours in general are more common on the final syllable.

[109] There has been speculation (c.f. Pizer above in §2.4) concerning the composition of the contour tones in Soyaltepec Mazatec and whether or not they should be considered to be unitary; however, while Pizer's argument in favor of unitary tonal behavior is intriguing, the facts uncovered by the fresh data do not support this analysis.

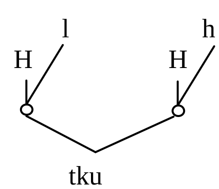
In the sections below, I document the contour tones: I briefly discuss their phonetic realization, illustrate the phonological representation and give examples of each which will demonstrate the distribution of each contour.

4.3.1 Mid-high to High Rising Tone Contour (˦˥)

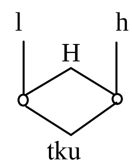
The Mid-High to High contour is relatively common. Examples are readily found on both monosyllabic and multi-syllabic words. It appears at the top of the speakers normal pitch range, beginning at the level of the Mid-high and rising dramatically usually with no leveling off of the slope. Phonologically, the Mid-high to High tonal contour results from a Mid-high tone (*H l*) and a High tone (*H h*) being expressed on the same syllable. As we will see in Chapter 5, these contours tend to only appear in isolation. Because there are two identical *H* tonal melodies attached to the same tone bearing unit (TBU), the OCP motivates the two to merge producing the representations in (28b and c). Although the two representations are phonologically distinct, they yield identical pronunciations and for the purposes of this dissertaion will be considered equivalent. Recall that the TRN is a structural node and in itself does not specify any feature value, it merely hosts the intersection of the tonal feature plane with the tonal register plane and tonal root node fissure or merger is easily accomplished. The difference between the two is theoretical and beyond the scope of this work. This process is demonstrated in (28).

(28) Phonological represesntation of tku˦˥ 'elbow'

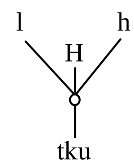
a. M_1 and H both associate to the same TBU



b. OCP Melody Merger with two TRNs



c. OCP Melody Merger with one TRN



The examples of the Mid-high to High contour tone in (29) and (30) are arranged according to onset type. All of the onset types are not available in monosyllabic words so examples from multisyllabic words are included as well. Because contour tones are universally more likely to occur on the final syllable of a word, the multisyllabic examples host the contour on their final syllable. For clarity, the syllable with the tone and onset in question is underlined. In (29) examples appear of the Mid-high to High contour with simple onsets.

(29) Examples of M_1-H contour tone with simple onsets

	POA	Manner	Transcription	Gloss
a.	Labial	glide	kha˧<u>wɛ˦˥</u>	‘grabs’
b.	Coronal	stop	tɛ˦˥	‘wide’
c.	Coronal	fricative	ʃã˦˥	‘liquor’
d.	Coronal	affricate	t͡si˦˥	‘rain’
e.	Coronal	glide	ndu˩<u>ja˦˥</u>	‘jail’
f.	Coronal	nasal	thiu˨<u>ma˦˥</u>	‘mucous’
g.	Dorsal	stop	kũã˦˥	‘purple
h.	Glottal	fricative	hɛ˦˥	‘sin’
i.	Glottal	stop	ʔɛ̃˦˥	‘language’

Examples of Mid-high to High toned words with complex onsets are given in (30). The onsets are again grouped according to the categories discussed in §3.4.3. 'Type' of onset refers to the following possibilities: S-stop/stop-stop, Contains /ʔ/, Contains /h/ or Begins with /N/. Next, the 'Sub-type' of the onset further divides Contains /ʔ/ and Contains /h/ into categories based on whether or not the onset contains an obstruent or a sonorant. Monosyllabic examples were not available for all of the categories in (30) so the syllable with the tone and onset in focus is underlined for clarity.

(30) Mid-high to High toned syllables with complex onsets

	Type	Sub-type	Transcription	Gloss
a.	S-stop/stop-stop		ʃka˥	'pants'
b.	S-stop/stop-stop		ʃkũɛ̃˥	'unripe'
c.	Contains /ʔ/	Obstruent	tʔɛ̃˥	'conjunctivitis'
d.	Contains /ʔ/	Obstruent	t͡ʃʔa˥	'cargo'
e.	Contains /ʔ/	Obstruent	kʔiu˥	'cacao'
f.	Contains /ʔ/	Sonorant	ʔɲu˥	'many'
g.	Contains /ʔ/	Sonorant	t͡su˥<u>ʔwi˥</u>	'sun'
h.	Contains /h/	Obstruent	t͡sa˧<u>khũ˥</u>	'he fears'
i.	Contains /h/	Obstruent	thĩ˥	'there are'
j.	Contains /h/	Obstruent	khĩ˥	'far away'
k.	Contains /h/	Sonorant	none	
l.	Begins with /N/		ngi˥	'sad'
m.	Begins with /N/		ni˩˥ndɛ˧<u>nd͡ʒa˥</u>	'abode'

In (29) and (30) there are examples of all of the onset types in Soyaltepec Mazatec except /h/-sonorant clusters which are not very common. There are examples of both glottal fricatives and simple nasals; the gap is accidental and not due to the nature of the segments or tones in question.

Examples of eight of the ten vowels can be found:

- [i] - (29d), (30g, l)
- [ĩ] - (30i, j)
- [ɛ]- (29a, b, h)
- [ɛ̃] - (29i), (30c)
- [a] - (29e, f), (30a, j, m)
- [ã] - (29c)
- [o] - none
- [õ] - none
- [u] - (30f)
- [ũ] - (30h)

There are no examples of either oral or nasal [o/õ]. These are two of the rarest vowels and it is possible that further research will reveal examples. There are no other tones or contours which appear exclusively on the [o], so any type of complementary distribution is unlikely. There are also examples of both oral and nasal diphthongs:

- [iu] - (30e)
- [ũã] - (29g)
- [ũɛ̃] - (30b)

While there are some gaps in the data, they appear to be arbitrary, resulting from the relative rareness of certain phonemes and not from the complementary distribution of these tones. There are also examples of various grammatical categories:

- Nouns - (29c, d, e, f, h), (30a, c, d, e, g, i, m)
- Verbs - (29a), (30h, i)
- Adjectives - (29b, g), (30b, l)
- Adverbs - (30j)
- Quantifiers - (30f)

The examples in (29) and (30) demonstrate that the Mid-high to High tone occurs on syllables in Soyaltepec Mazatec regardless of the onset or nucleus and without regard for grammatical category. The Mid-high to High contour tone may appear on the final syllable of a disyllabic word following any of the four tonemes (31a-d) as well as several other contour tones (31e-h).

(31) M_1-H on the final syllable of disyllabic words

Soyaltepec Mazatec	Gloss	Tonal Pattern
a. nda˥tɛ˦˥	‘saliva’	H M_1-H
b. t͡su˦ʔwi˦˥	‘sun’	M_1 M_1-H
c. wa˧khã˦˥	‘crack’	M_2 M_1-H
d. ni˩hma˦˥	‘bean’	L M_1-H
e. t͡sha˦˩ɲa˦˥	‘our hand’	M_1-L M_1-H
f. na˩˧ti˦˥	‘louse’	L-M_2 M_1-H
g. ni˧˦hɲa˦˥	‘bedroll’	M_2-M_1 M_1-H
h. t͡ʃu˧˩ʃĩ˦˥	‘skin’	M_2-L M_1-H

While the distribution of the Mid-high to High tone on the first syllable of disyllabic words is less common, it does occasionally occur (32).

(32) M_1-H on the first syllable of disyllabic words

Soyaltepec Mazatec	Gloss	Tonal Pattern
a. wɛ˦˥hĩ˥	‘doesn’t know’	M_1-H H
b. je˦˥t͡ʃã˦	‘forty’	M_1-H M_1
c. ndi˦˥fua˧˦	‘water’	M_1-H M_2-M_1

There are no current examples in my data base of disyllabic words which begin with the Mid-high to High rising tone and end with either a Mid or a Low tone. These types of words may be found in further research; however, it is possible that they do not exist because when such a structure exists in the underlying form the sandhi which will be described §5.3 overrides the lexical tones so that the combination is never allowed to surface. More research is needed to determine the reason for the gap, perhaps investigating the tones on compound words would give further insights. There are, however, a few examples of words in which the first syllable is M_1-H and the second syllable is H (32a) or M_1 (32b), and where both syllables are rising, the first hosting a Mid-high to High tone while the second syllable hosts a Mid to Mid-high tone (32c).

There are also examples of the Mid-high to High rising contour on trisyllabic words. The Mid-high to High contour can occur on the first (33a), second (33b) or third syllable (33c). The syllable in focus is underlined for clarity.

(33) M_1-H in trisyllabic words

Soyaltepec Mazatec	Gloss	Tonal Pattern
a. <u>tu˦˥</u>sʔu˦ɲa˧˦	‘our bellybutton’	<u>M_1-H</u> M_1 M_2-M_1
b. tu˩<u>ku˦˥</u>t͡shɛ̃˧˦	‘pineapple’	L <u>M_1-H</u> M_2-M_1
c. ni˩ski˧<u>ndi˦˥</u>	‘children’	L M_2 <u>M_1-H</u>

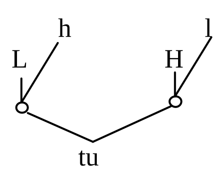
While the Mid-high to High contour can occur on any syllable of a trisyllabic word, there are no examples of the Mid-high to High tone occurring before a Mid or Low tone in trisyllabic words. There are also no examples in which it occurs on every syllable of a multi-syllabic word.

The Mid-high to High contour occurs on all syllable types of Soyaltepec Mazatec regardless of the segmental characteristics or grammatical category of the morphemes involved. It is possible that there is a restriction about the placement of the Mid-high to High contour before a Mid or Low tone in multisyllabic words or that tone sandhi actively obliterates the contour in this environment.

4.3.2 Mid to Mid-high Rising Tone Contour (˧˦)

The Mid to Mid-High tone contour is less common than the Mid-high to High rising tone discussed in §4.3.1, but still fairly common. Examples are readily found on all word types in Soyaltepec Mazatec. Phonetically, the pitch begins at a Mid level and rises with no leveling in the slope. The endpoint of the rise is somewhat indeterminate in isolation. Some speakers allow the rise to continue seemingly unchecked, a phenomenon more common among female speakers, while others allow only a slight rise.[110] Phonologically the Mid to Mid-High tonal contour occurs when a Mid tone (*L h*) and a Mid-High tone (*H l*) are linked to the same syllable. Similar to the Mid-high to High contour discussed above, this contour occurs predominantly in isolation. Unlike the Mid-high to High contour, there are not identical tonal melodies or registers attached to the same tone bearing unit (TBU), so no OCP motivated merger is possible (or necessary). An example of the phonological representation appears in (34).

(34) Phonological representation of tu˧˦ ‘fruit or seed’



Examples appear in (35) and (36) arranged according to onset type. Examples of syllables with simple onsets and a Mid to Mid-high contour tone appear in (35). The place of articulation and manner are noted. There are several onset types that do not occur with monosyllabic words, but they do occur with multisyllabic words. When the multisyllabic examples are necessary, sometimes the contour occurs on the

[110] This phenomena may account for the confusion of this tone contour with the Mid-high to High contour as was reflected in the data from Pike (1956).

first syllable (35a) and sometimes on the last (35b, c). For clarity the syllable in focus is underlined. The onset type refers to the syllable which contains the Mid to Mid-High contour.

(35) Examples of the M_2-M_1 contour tone (˧˦) with simple onset

	POA	Manner	Transcription	Gloss
a.	Labial	glide	<u>wɛ˧˦</u>ndu˧	‘they are going to stay’
b.	Labial	fricative	ndi˥<u>fua˧˦</u>	‘water’
c.	Labial	fricative	ndiu˩<u>fuɛ˧˦</u>	‘opossum’
d.	Coronal	stop	tu˧˦	‘fruit or seed’
e.	Coronal	fricative	sa˧˦	‘moon’
f.	Coronal	affricate	t͡si˧˦	‘your’
g.	Coronal	glide	ja˧˦	‘wood, tree’
h.	Coronal	nasal	ɲã˧˦	‘we (inclusive)’
i.	Dorsal	stop	kã˧˦	‘twenty’
j.	Glottal	fricative	hĩ˧˦	‘eight’
k.	Glottal	fricative	hõ˧˦	‘six’
l.	Glottal	stop	ʔai˧˦	‘heavy’
m	Glottal	stop	ʔɛ̃˧˦	‘bunch’

Examples of Mid to Mid-high words with complex onsets are given in (36). The onsets are again grouped according to the categories discussed in §3.4.3. ‘Type’ of onset refers to the following possibilities: S-stop/stop-stop, Contains /ʔ/, Contains /h/ or Begins with /N/. Next, the ‘Sub-type’ of the onset further divides Contains /ʔ/ and Contains /h/ into categories based on whether or not the onset contains an obstruent or a sonorant. Monosyllabic examples were not available for all of the categories in (36) so the syllable with the tone and onset in focus is underlined for clarity.

(36) Examples of M_2-M_1 contour tone with complex onsets

	Type	Sub-type	Transcription	Gloss
a.	S-stop/stop-stop		tki˦˧	'medicine'
b.	S-stop/stop-stop		wɛ˧ <u>tkũ˦˧</u>	'respect'
c.	Contains /ʔ/	Obstruent	t͡ʃʔã˦˧	'ice'
d.	Contains /ʔ/	Obstruent	ki˧<u>t͡sʔo˦˧</u>	'breaks'
e.	Contains /ʔ/	Sonorant	tõ˧<u>ʔwɛ˦˧</u>	'hates'
f.	Contains /h/	Obstruent	t͡sha˦˧	'bitter'
g.	Contains /h/	Sonorant	ja˧tu˧<u>hmã˦˧</u>	'amaranth plant'
h.	Begins with /N/		ngu˦˧	'one'

In (35) and (36) there are examples of words containing all of the major onset types co-occurring with the Mid to Mid-high tone. There are no gaps; however, occasionally multisyllabic words are necessary to find a given onset type. Syllables with all ten vowels can be found:

- [i] - (35f), (36a)
- [ĩ] - (35j)
- [ɛ] - (35a), (36e)
- [ɛ̃] - (35m)
- [a] - (35e, g), (36f)
- [ã] - (35h, i), (36c, g)

- [o] - (36d)
- [õ] - (35k)
- [u] - (35d), (36h)
- [ũ] - (36b)

Examples of diphthongs also occur, but there are no examples of nasalized diphthongs:

- [ua] - (35b)
- [uɛ] - (35c)
- [ai] - (35l)

It is interesting that there are no nasal diphthongs, but this does not constitute a significant gap considering the fact that diphthongs are comparatively rare and nasalized diphthongs are rarer still. There are many examples of nasalized vowels, so, nasalization in itself is not contraindicated. More research will probably reveal examples of the Mid to Mid-high contour with nasal diphthongs. The contour occurs without regard to the segmental characteristics of the onset or nucleus of the syllable in question. Various grammatical categories are also found including:

- Nouns - (35b, c, d, e, g), (36a, c, f, g)
- Verbs - (35a), (36b, d, e)
- Quantifiers - (35i, j, k, m), (36h)
- Adjectives - (35l), (36f)
- Pronouns - (35f, h)

The words that contain the Mid to Mid-high rising tone occur in several different grammatical categories. Even though the final syllable of a word is the most common place for a contour to occur, the Mid to Mid-high contour can also occur at different positions within a word. For instance, it can occur in disyllabic words after any of the tonemes (37a-d) or the Mid-high to High contour (37e).

(37) M_2-M_1 on the second syllable of disyllabic words

Soyaltepec Mazatec	Gloss	Tone Pattern
a. tu˥hma˧˦	‘amaranth seed’	H M_2-M_1
b. wɛ˦tkũ˧˦	‘respect’	M_1 M_2-M_1
c. t͡ʃha˧ngi˧˦	‘plum’	M_2 M_2-M_1
d. ndi˩ja˧˦	‘trail’	L M_2-M_1
e. ja˦˥t͡ʃhĩ˧˦	‘women’	M_1-H M_2-M_1

While contours are more common on the final syllable, they do occasionally occur on the first syllable of disyllabic words (38).

(38) M_2-M_1 on first syllable of disyllabic words

Soyaltepec Mazatec	Gloss	Tone Pattern
a. t͡shua˧˦hi˥	‘doesn’t give’	M_2-M_1 H
b. wɛ˧˦ndu˧	‘they are going to stay’	M_2-M_1 M_2
c. ni˧˦hɲa˦˥	‘bedroll’	M_2-M_1 M_1-H

The M_2-H occurs on the first syllable before a H (38a), a M_2 (38b) and a rising M_1-H (38c). Similar to the Mid-high to High contour, there are no examples of the Mid to Mid-high contour preceding either Mid or Low tones. Again, this could be an indication of tone sandhi or it could just be an absence of data. This is an area for future research.[111] The Mid to Mid-high contour also occurs on trisyllabic words, either on the first syllable (39a) or more commonly the last (39b).

(39) M_2-M_1 on trisyllabic words.

Soyaltepec Mazatec	Gloss	Tone Pattern
a. ngui˧˦hɛ˧ɲa˧˦	‘all of us’	M_2-M_1 M_2 M_2-M_1

[111] Perhaps a study which investigates the tones on compound words would give insight into the behavior of contour tones occurring before M_2 and L tones within a word.

b. ni˩sĩ˩ja˧˦ ‘large covered basket’ L L M₂-M₁

There are no examples that have the Mid to Mid-high contour on the middle syllable of trisyllabic words. The example in (39a) is the only example in which the Mid to Mid-high contour occurs before a Mid tone, it is possibly allowed because the final syllable also hosts a contour, or it could just be an exception. There is not enough data to make predictions.

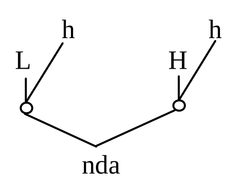
The Mid to Mid-high contour occurs on monosyllabic, disyllabic and trisyllabic words, regardless of the segmental characteristics. It does not usually precede a Mid or Low tone, but otherwise can occur on the first or last syllable of a word.

4.3.3 Mid to High Rising Tone Contour (˧˥)

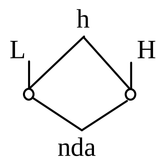
The Mid to High rising tone contour is relatively rare. Examples are limited on all word types. Phonetically, the rise begins at the midpoint of the speaker’s pitch range and rises to the highest level of the normal pitch range. Phonologically, the Mid to High tonal contour results from a Mid tone (*L h*) and a High tone (*H h*) being expressed on the same syllable. Unlike the contours described above in §4.3.1 and 4.3.2, this contour tone is not limited to an isolated environment, the rising shape of the contour is maintained even when in various contexts. It does, however, experience an OCP register merger due to the fact that two identical *h* registers are associated to the same TBU. The phonological shape of the contour is demonstrated in (40) with the OCP merger demonstrated by the alternative forms in (40b and c).

(40) Phonological representation of nda˧˥ ‘good’

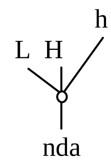
a. Preliminary Phonological Representation



b. OCP Register Merger
with two TRNs



c. OCP Register Merger
with one TRN



The representation in (40b) includes two TRNs stemming from the two separate tones which unite on this TBU while the representation in (40c) includes only one TRN. Recall that the melody and register features exist in separate planes, so there is linear ordering between the two tonal melodies represented, but no ordering between the melody features and the register feature. Both representations are possible for this contour and each indicates the same phonetic expression. For the purposes of this dissertation, they will be considered equivalent. While the two contours already discussed can be considered to have lexical representations in which the tones are unlinked in their underlying representations except when they occur word medially, the High tone of this contour must always be linked in its underlying representation. The motivation for this linkage will be demonstrated in §5.2.1 below. To summarize, in this contour even though there are more tones than TBUs, both tones always associate to the specified syllable; the second tone never shifts to a following syllable as would be expected if the UAC were used to form its linkages. It is possible that the Mid tone is associated by the UAC or that it is linked as a unit with the High.

Examples of the Mid to High rise appear in (41) and (42) arranged according to onset type. The example syllables that begin with a simple onset appear in (41). The place of articulation and manner are indicated. Multiple gaps reinforce the relative rarity of this rising tone. All significant onset types are indicated even when they do not occur in order to demonstrate the gaps. Multisyllabic words are included to fill the gaps where available. All the multisyllabic words used have the contour on the final syllable which is underlined for clarity. The onset type is of the syllable which contains the contour tone.

(41) Examples of the M_2-H contour tone (˧˥) with simple onsets

	POA	Manner	Transcription	Gloss
a.	Labial	fricative	tu˧<u>wa˧˥</u>	'short'
b.	Coronal	stop	none	
c.	Coronal	fricative	ʔa˧<u>su˧˥</u>	'tepid'
d.	Coronal	affricate	none	
e.	Coronal	glide	none	
f.	Coronal	nasal	nũ˧˥	'year'
g.	Coronal	nasal	t͡su˧<u>mĩ˧˥</u>	'sand'
h.	Dorsal	stop	ki˧˥	'he went'
i.	Glottal	fricative	hã˧˥	'there'
j.	Glottal	stop	none	

Examples of Mid to High words with complex onsets are given in (42). The onsets are again grouped according to the categories discussed in §3.4.3. 'Type' of onset refers to the following possibilities: S-stop/stop-stop, Contains /ʔ/, Contains /h/ or Begins with /N/. Next, the 'Sub-type' of the onset further divides Contains /ʔ/ and Contains /h/ into categories based on whether or not the onset contains an obstruent or a sonorant. Monosyllabic examples were not available for all of the categories in (42) so the syllable with the tone and onset in focus is underlined for clarity.

(42) Examples of the M_2-H contour with complex onsets

	Type	Sub-type	Transcription	Gloss
a.	S-stop/stop-stop		none	
b.	Contains /ʔ/	Obstruent	t͡ʃʔa˧˥	'in-law'

c.	Contains /ʔ/	Sonorant	nĩ˩ɲũ˧<u>ʔɲã˧˥</u>	‘paca’
d.	Contains /h/	Obstruent	thɛ˧˥	‘bug bite’
e.	Contains /h/	Sonorant	ngui˧<u>hɲã˧˥</u>	‘grass’
f.	Begins with /N/		nda˧˥	‘good’

In (41) and (42) the absence of the Mid to High contour on coronal stops (41b) and affricates (41d) as well as glottal stops (41i) can be seen. The contour is somewhat more pervasive with complex onsets, but still does not occur on syllables with an S-stop or stop-stop onset (42a). Coronal stops and affricates and glottal stops are all found as parts of the complex onsets which co-occur with the contour, e.g., (42b, d). The contour occurs on syllables with onsets that are sonorant and voiced (41a, f, g) as well as those that are not sonorant or voiced (41c, h, i).

Examples can be found of the contour occurring with seven of the ten vowels:

- [i] - (41h)
- [ĩ] - (41g)
- [ɛ] - (42d)
- [ɛ̃] - none
- [a] - (41a), (42b, d)
- [ã] - (41i), (42c, e)
- [o] - none
- [õ] - none
- [u] - (41c)
- [ũ] - (41e)

There are no examples of the Mid to High contour occurring with [ɛ̃], [o] or [õ]. The most common vowels occurring with the Mid to High contour are [a] and [ã]. There are no examples of diphthongs occurring with this contour.

Various grammatical categories are represented including:

- Nouns - (41e, f, g), (42b, c, d, e)
- Verbs - (41h)
- Adjectives - (41a, c)
- Adverbs - (41i)

Despite its relative rarity, there are examples of the Mid to High contour occurring in disyllabic words after all four tonemes (43).

(43) M_2-H occurring on second syllable of disyllabic word

Soyaltepec Mazatec	Gloss	Tonal Pattern
a. tku˥ɲa˧˥	'our head'	H M_2-H
b. ta˧ha˧˥	'hard'	M_1 M_2-H
c. t͡su˧mĩ˧˥	'sand'	M_2 M_2-H
d. ʃa˩nga˧˥	'river'	L M_2-H

There are no examples of the Mid to High contour occurring on the first syllable of multi-syllabic words. It does occasionally occur on the final syllable of trisyllabic words (44).

(44) M_2-H on the final syllable of trisyllabic words

Soyaltepec Mazatec	Gloss	Tonal Pattern
a. ni˩ɲu˧<u>ʔɲa˧˥</u>	'paca'	L M_2 <u>M_2-H</u>
b. sʔɛ˧hɲa˧<u>ʔɲu˧˥</u>	'tighten'	M_2 M_2 <u>M_2-H</u>

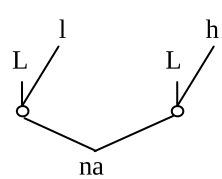
The Mid to High contour is not common and there are no examples in my database of it occurring with all of the onset and vowel types; however, the absences do not fall into a regular pattern. The most startling absence is the absence of the co-occurrence with simple coronal and glottal stops which are otherwise very pervasive in the language. In §4.3.8 I provide a comparison of the contour tones to rule out any suspicion of complementary distribution.

4.3.4 Low to Mid Rising Tone Contour (λ)

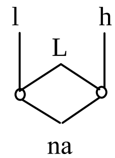
The Low to Mid rising contour is rare. The examples available are extremely limited. Phonetically, the rise begins at the lowest pitch of the speaker’s normal pitch range and rises to the midpoint. Phonologically, the Low to Mid tonal contour results from a Low tone (*L l*) and a Mid (*L h*) tone being expressed on the same syllable (45a). Like the Mid to High tone discussed above, the Low to Mid contour maintains its rising nature in various environments, never separating and spreading its final tone to the following syllable. Because the second tone associated to this syllable fails to re-associate, it must be pre-linked in the lexicon rather than being linked according to the UAC. There is no data available at this time to confirm whether or not the initial Low tone is also linked in the Underlying Representation or if it receives its association line at a later point. Again, when both tones are linked, an OCP violation occurs, in this case it is of the low tonal melody (45b, c), due to the fact that two identical melodies are associated to the same TBU. Tonal melody merger is motivated. The two representations in (45b) and (45c) are equally valid alternative representations.

(45) Phonological representation of naλ ‘mother’

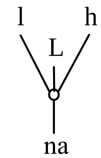
a. Two tones associate to one TBU



b. OCP Melody Merger with two TRNs



c. OCP Melody Merger with one TRN



The difference between (45b) and (45c) is theoretical and beyond the scope of this work. The two registers exist in the same plane and are therefore linearly ordered, meaning they must be articulated in succession, while the melody is in its own separate plane and not ordered with respect to the registers.

Examples of the Low to Mid contour tone are listed in (46) and (47). The examples are arranged according to onset type as has been demonstrated for each tonal category. Since only four unique types of onsets co-occur with the contour, listing all of the normally included categories highlights what does not occur.

(46) Examples of the L-M_2 rising contour with simple onsets

	POA	Manner	Transcription	Gloss
a.	Labial		none	
b.	Coronal	stop	tõ˩˧	‘money’
c.	Coronal	fricative	none	
d.	Coronal	affricate	none	
e.	Coronal	glide	none	
f.	Coronal	nasal	na˩˧	‘mother’
g.	Coronal	nasal	ni˩˧ndɛ˧nd͡ʒa˥	‘abode’
h.	Dorsal		none	
i.	Glottal	fricative	hao˩˧	‘OK’

There are no examples of simple labial (46a) or dorsal (46h) onsets with a Low to Mid contour tone. The example in (47a) is the only example of the Low to Mid rising tone that occurs with a complex onset. The remaining categories of complex onsets are included to remind the reader which possibilities are unattested.

(47) Examples of L-M_2 rising contour with complex onsets

	Type	Sub-type	Transcription	Gloss
a.	S-stop/stop-stop		ta˧ri˥<u>sko˩˧</u>	‘vulture’
b.	Contains /ʔ/	Obstruent	none	
c.	Contains /ʔ/	Sonorant	none	
d.	Contains /h/	Obstruent	none	
e.	Contains /h/	Sonorant	none	
f.	Begins with /N/		none	

In (46) and (47) the complete absence of labial fricatives and glides as well as coronal fricatives, affricates and glides and dorsal and glottal stops is demonstrated. There are also almost no complex onsets, only the complex onset which ends in a dorsal stop is represented which is interesting since there were no simple dorsal onsets. Two simple nasals are included for two reasons: first, they have different vowels and second, the majority of syllables that host this contour have a nasal onset. There are examples of just four vowels and one diphthong:

- [i] - (46g)
- [a] - (46f)
- [o] - (47a)
- [õ] - (46b)
- [ao] - (46i)

The two least common vowels ([o] and [õ]) and the least common diphthong ([ao]) each co-occur with this rare contour. All of the words that contain the contour are nouns.

In multisyllabic words, the contour can occur either on the first syllable of di– and trisyllabic words (48a, b) or last syllable of trisyllabic words (48c).

(48) L-M_2 on multisyllabic words

Soyaltepec Mazatec	Gloss	Tonal Pattern
a. na˩˧ti˧˥	'louse'	L-M_2 M_1-H
b. na˩˧ʃu˧hnu˧˩	'spike'	L-M_2 M_2 M_1-L
c. ta˧ri˥sko˩˧	'vulture'	M_2 H L-M_2

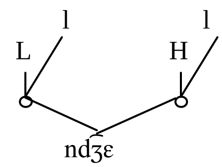
While the contour is rare, several of the words that contain it are common, such as 'mother,' 'money' and 'OK.' It occurs with a limited set of onsets and vowels (several of which are also rare), only on nouns, and with a more limited syllable distribution within words than most tones; however, it is not in complementary distribution with any other tone or contour, as will be seen in §4.3.8 below. It seems likely that it is an archaic form that was fossilized on certain common morphemes.

4.3.5 Low to Mid-high Rising Tone Contour (˩˦)

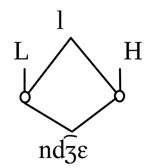
The final rising contour to be discussed, the Low to Mid-high contour, is also rare. Available examples are limited. Phonetically, it begins at the low point of the speaker's pitch range and rises above the midpoint of that range. Phonologically, the Low to Mid-high tonal contour results from a Low tone (*L l*) and a Mid-high tone (*H l*) being expressed on the same syllable. This contour is similar to the M_1-H and M_2-M_1 contours in that it usually only surfaces in isolation and tends to separate in context, giving evidence that its tones do not need to be linked in its underlying representation but can be linked using the UAC. Because there are two identical *l* registers attached to the same tone bearing unit (49a), the two are motivated by the OCP to merge producing the representations in (49b-c).

(49) Phonological representation of ndʒ͡ɛ˩˦ ‘hominy’

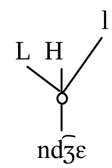
a Two tones attached to one TBU



b. OCP Register Merger
with two TRNs



c. OCP Register Merger
with one TRN



The difference between (49b) and (49c) is a theoretical distinction and beyond the scope of this paper. Either representation can be used to indicate a rise from a Low tone to a Mid-high tone and therefore yield identical phonetic realizations. For the purposes of this dissertation, either representation is acceptable. The tonal melodies are linearly ordered and therefore must be articulated in succession, but they are not ordered with respect to the register.

Examples appear in (50) arranged according to onset type. All of the onsets that co-occur are complex. There are no examples of simple labial, coronal, dorsal or glottal onsets that occur with the Low to Mid-high contour; therefore, a completely blank example set will not be inserted here. The standard groupings for complex onsets appear in (50) including S-stop/stop-stop, Contains /ʔ/ (obstruent and sonorant), Contains /h/ (obstruent and sonorant) and Begins with /N/. In multisyllabic words, the contour in question occurs on the final syllable which is underlined for clarity.

(50) Examples of the L-M_1 rising contour with complex onsets

	Type	Sub-type	Transcription	Gloss
a.	S-stop/stop-stop		none	
b.	Contains /ʔ/	Obstruent	t͡ʃʔei˩˧	‘take!’
c.	Contains /ʔ/	Sonorant	none	
d.	Contains /h/	Obstruent	t͡ʃho˩˧	‘egg’
e.	Contains /h/	Obstruent	t͡ʃhũ˩˧	‘woman’
f.	Contains /h/	Sonorant	none	
g.	Begins with /N/		na˩˧nda˩˧	‘godmother’
h.	Begins with /N/		t͡ʃu˩ndu˩˧	‘worm’
i.	Begins with /N/		nd͡ʒɛ˩˧	‘hominy’

Again, there are no simple onsets which co-occur with the Low to Mid-high contour. Among the complex onsets, there are none represented that end in a sonorant consonant (50c, f). There are, however, both voiced (50g, h, i) and voiceless (50b, d, e) onsets represented. Four of the six examples contain affricates and all contain coronal segments (the most common phonemes).

Five of the ten vowels are represented along with one diphthong:

- [ɛ] - (50i)
- [a] - (50g)
- [o] - (50d)
- [u] - (50h)
- [ũ] - (50e)
- [iɛ] - (50b)

Of the five simple vowels, one is nasal and the remaining four are oral. The high front vowel is only present in the diphthong. Only two grammatical categories occur:

- Nouns - (50d, e, g, h, i)
- Verbs - (50b)

The Low to Mid-high contour only occurs on the two disyllabic words already listed above (50g, h) and each time it is on the final syllable. In the first example (50g), the contour in question follows a Low to Mid rising contour and the second (50g) it follows a level Low tone.

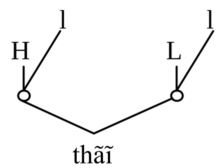
Similar to the Low to Mid rising contour, the Low to Mid-high contour is rare and occurs with limited types of onsets which for the most part do not overlap with each other. Most of the words that appear with this contour are very common in Mazatec culture, e.g. ‘woman,’ ‘hominy,’ ‘egg.’ Again, it seems to be an archaic form that has become fixed on these common words and not a contour which is in complementary distribution with another contour as will be seen in §4.3.8.

4.3.6 Mid-High to Low Falling Tone Contour (˦˩)

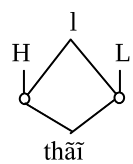
The Mid-high to Low falling contour tone is not common on single syllable words; it is, however, slightly more common on multisyllabic words. It is the usual tone used on borrowed words. Phonetically, the syllable sounds somewhat clipped and rapid. More research is needed to discover if the duration of the syllable which contains this type of tone is statistically shorter than it is with other tones. The pitch begins at a Mid-high level and drops uniformly to a Low level. Occasionally the syllable surfaces with a level Mid-high tone. Phonologically, the Mid-high to Low tonal contour results from a Mid-high tone (*H l*) and a Low tone (*L l*) being expressed on the same syllable (51a). Because there are two identical *l* tonal registers attached to the same tone bearing unit, the two merge producing the representations in (51b-c). These two representations are alternative phonological ways to represent the same phonetic reality and are being considered equivalent for the sake of this dissertation.

(51) Phonological representation of thãĩ˧˩ ‘fungus’

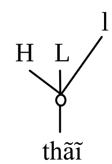
a. Two tones attached to one TBU



b. OCP Register Merger
with two TRNs



c. OCP Register Merger
with one TRN



Comparing (51) with (49) above, the representations are exactly the same except for the linear ordering of the two tonal melodies.

Examples appear arranged according to onset type in (52) and (53). In (52), simple onsets are listed with the point of articulation listed in the first column while manner is in the second. The majority of the examples occur in multisyllabic words. The syllable in focus is underlined for clarity.

(52) Examples of the M_1-L falling contour with simple onsets

	POA	Manner	Transcription	Gloss
a.	Labial	fricative	none	
b.	Coronal	stop	t͡ʃi˧<u>tu˧˩</u>	‘cat’
c.	Coronal	stop	ya˧<u>tiu˧˩</u>	‘wooden beam’
d.	Coronal	fricative	sũ˧˩	‘song’
e.	Coronal	affricate	t͡ʃɛ̃˧˩	‘trap’
f.	Coronal	lateral	mu˧<u>la˧˩</u>	‘mule’

g.	Coronal	flap	ʔma˥rɛ˦˩	‘know’
h.	Coronal	nasal	none	
i.	Dorsal	stop	t͡ʃa˧ki˦˩ɲa˧˦	‘our breast’
j.	Glottal	fricative	nd͡zi˧hĩ˦˩	‘equals’
k.	Glottal	fricative	ɲa˧hõ˦˩	‘ear’
l.	Glottal	stop	none	

Examples of Mid-high to Low toned words with complex onsets are given in (53). The onsets are again grouped according to the categories discussed in §3.4.3. ‘Type’ of onset refers to the following possibilities: S-stop/stop-stop, Contains /ʔ/, Contains /h/ or Begins with /N/. Next, the ‘Sub-type’ of the onset further divides Contains /ʔ/ and Contains /h/ into categories based on whether or not the onset contains an obstruent or a sonorant. Monosyllabic examples were not available for all of the categories in (53) so the syllable with the tone and onset, always the final syllable in this case, is underlined for clarity.

(53) Examples of Mid-high to Low contour with complex onsets

	Type	Sub-type	Transcription	Gloss
a.	S-stop/stop-stop		ʃkiɛ˦˩	‘frog’
b.	S-stop/stop-stop		t͡si˧skũã˦˩	‘pulverizes’
c.	Contains /ʔ/	Obstruent	t͡su˧kʔũ˦˩	‘crab’
d.	Contains /ʔ/	Sonorant	ja˧ʔwa˦˩	‘wooden meat hook’
e.	Contains /h/	Obstruent	thãĩ˦˩	‘fungus’
f.	Contains /h/	Obstruent	thɛ˦˩	‘race/breed’
g.	Contains /h/	Sonorant	ngu˥hɲa˦˩	‘yesterday’

h. Begins with /N/ fi˧<u>ndu˩˥</u> ‘rots’

i. Begins with /N/ na˧<u>ngui˩˥</u> ‘land’

j. Begins with /N/ tɛ˧<u>nd͡zu˩˥</u> ‘goat’

There are no examples of the Mid-High to Low falling contour occurring with labials (52a), glottal stops (52l) or simple nasals (52h), there are, however, examples of each of these consonantal types as members of complex onsets (e.g., (53d, c, g) respectively).

Examples of eight out of the ten vowels are available:

- [i] - (52i)
- [ĩ] - (52j)
- [ɛ] - (52g), (53f)
- [ɛ̃] - (52e)
- [a] - (52f), (53d, g)
- [ã] - none
- [o] - none
- [õ] - (52k)
- [u] - (52b), (53h, j)
- [ũ] - (52d), (53v)

Only the [o], a rare vowel, and the [ã] fail to co-occur. There are also five diphthongs, three oral and two nasal:

- [iɛ] - (53a)
- [iu] - (52c)

- [ui] - (53i)
- [ãĩ] - (53e)
- [ũã] - (53b)

There are also examples of various grammatical categories including:

- Nouns - (52b, c, d, e, f, i, k), (53a, c, d, e, f, i, j)
- Verbs - (52g, j) (53b, h)
- Adverbs - (53g)

While the Mid-high to Low falling contour is found occasionally on monosyllabic words (54a), it mostly occurs on the final syllable of disyllabic words (54b). There is one example of a disyllabic word with the fall on the first syllable (54c). It also occurs on the final syllable of trisyllabic words (54d). The final position that occasionally surfaces with the falling contour is the penultimate syllable when it constitutes a morpheme boundary (54e). The syllable in focus is underlined.

(54) Word placement of M_1-L falling contour

Position	Soyaltepec Mazatec	Gloss	Tone pattern
a. mono-σ	<u>ʃkiɛ˦˩</u>	'frog'	M_1-L
b. final σ	ʔma˥<u>rɛ</u>˦˩	'know'	H M_1-L
c. 1st σ	<u>t͡ʃha</u>˦˩wa˩	'grasshopper'	M_1-L L
d. final σ	khua˩ki˧<u>ʃi</u>˦˩	'law'	L M_2 M_1-L
e. penalt. σ	wi˧si˦<u>thɛ̃</u>˦˩ʔã˩	'I get up'	M_2 M_1 M_1-L L

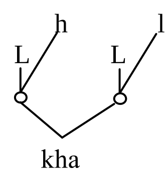
The Mid-high to Low falling contour is not pervasive, but it co-occurs with most of the onset types as well as the vowels and various grammatical categories. Within the word it is mostly limited to the stem final position (54a, b, d, e).

4.3.7 Mid to Low Falling Tone Contour (˧˩)

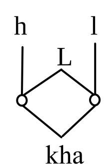
The final falling contour to be discussed is the fall from Mid to Low. This is not a very common contour tone. It occurs slightly more frequently on multisyllabic words than on monosyllabic ones. Phonetically, the contour begins at the middle of the speaker's pitch range and falls to Low without leveling out. Phonologically, the Mid to Low tonal contour results from a Mid tone (*L h*) and Low tone (*L l*) being expressed on the same syllable (55). Because there are identical tonal melodies attached to the same TBU, OCP merger occurs (55b, c).

(55) Phonological representation of kha˧˩ 'delicate'

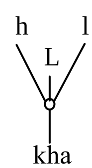
a. Two tones attched to one TBU



b. OCP Melody Merger with two TRNs



c. OCP Melody Merger with one TRN



The two representations in (55b-c) are alternate phonological representations, equally valid for the sake of this dissertation and producing phonetically indistinguishable contours.

Examples of the M-L falling contour arranged according to onset type occur in (56) and (57). The examples of syllables which occur with simple onsets are listed in (56) with their place and manner of articulation indicated. Because multisyllabic words were necessary to find examples of certain onsets, the syllable in focus is underlined.

(56) Examples of M_2-L falling contour with simple onsets

	POA	Manner	Transcription	Gloss
a.	Labial	fricative	ju˧fi˩˥	`cloud’
b.	Coronal	stop	ta˩˥	‘unripe’
c.	Coronal	fricative	t͡ʃa˧sɛi˩˥	‘you are looking’
d.	Coronal	affricate	t͡ʃu˩˥ʃĩ˥	‘skin’
e.	Coronal	flap	wɛ˧ɛ˧rɛ˩˥	‘hit with fist’
f.	Coronal	nasal	t͡ʃi˧ni˩˥	‘you eat’
g.	Dorsal	stop	nda˧t͡ʃa˥kũ˩˥	‘sea’
h.	Glottal	fricative	hĩ˩˥	‘we (excl.)
i.	Glottal	fricative	t͡su˥tõ˩hõ˩˥	‘play with’
j.	Glottal	stop	none	

Examples of syllables with complex onsets appear in (57), arranged according to onset type which are categorized according to the divisions established in §3.4.3 and include: S-stop/stop-stop, Contains /ʔ/ (obstruents and sonorant), Contains /h/ (obstruent or sonorant) and Begins with /N/. When multisyllabic words were necessary the contour sometimes occurs on the first syllable and sometimes on the final syllable. The syllable in focus is underlined for clarity.

(57) Examples of Mid to Low contour with complex onsets

	Type	Sub-type	Transcription	Gloss
a.	S-stop/stop-stop		none	
b.	Contains /ʔ/	Obstruent	none	

c.	Contains /ʔ/	Sonorant	ni˧ʔwai˧˩	‘you bending’
d.	Contains /ʔ/	Sonorant	nu˧ʔjɛ˧˩	‘you hear’
e.	Contains /h/	Obstruent	kha˧˩	‘delicate’
f.	Contains /h/	Obstruent	kho˧˩	‘with’
g.	Contains /h/	Obstruent	khɛ̃˧˩ʔã˩	‘I eat’
h.	Contains /h/	Obstruent	thia˧˩wa˩ndɛ˥	‘sandals’
i.	Contains /h/	Obstruent	thiu˧˩ma˥	‘mucous’
j.	Contains /h/	Sonorant	none	
k.	Begins with /N/		nd͡ʒi˧˩	‘wet’

In (56) there are examples of the Mid to Low falling tone co-occurring with all major simple onset types except glottal stops. The contour occurs on all but three of the complex onsets: i.e., except S-stop/stop-stop, Obstruent-/ʔ/ and /h/-sonorants.

There are examples of nine of the ten vowels:

- [i] - (56a, f), (57k)
- [ĩ] - (56h)
- [ɛ] - (56e), (57d)
- [ɛ̃] - (57g)
- [a] - (56b), (57e)
- [ã] - none
- [o] - (57f)
- [õ] - (56i)

- [u] - (56d)
- [ũ] - (56g)

The Mid to Low falling contour occurs on syllables which contain all of the simple vowels except the [ã]. There are also examples of various oral diphthongs including:

- [iu] - (57i)
- [ia] - (57h)
- [ɛi] - (56c)
- [ai] - (57c)

There are no examples of nasal diphthongs; however, this is not a significant gap considering the relative rarity of each.

There are examples of various grammatical categories including:

- Nouns - (56a, d, g), (57h, i)
- Pronouns - (56h)
- Verbs - (56c, e, f, i), (57c, d, g)
- Adjectives - (56b), (57e, k)
- Connective particles - (57f)

The word position of the Mid to Low falling tone is also variable. It occurs on monosyllabic morphemes (58a), on the first (58b) or last (58c) syllable of disyllabic words and on any syllable of a trisyllabic word (58d, e, f). The syllable with the contour in focus is underlined for clarity.

(58) Word placement of M_2-L contour

Position	Transcription	Gloss	Tone pattern
a. mono-σ	ta˨˩	‘unripe’	M_2-L
b. 1st σ	<u>tʃu˨˩</u>ʃĩ˦	‘skin’	<u>M_2-L</u> M_1-H

c. final σ	ngui˥rɛ˩	'day after tomorrow'	H $\underline{M_2\text{-}L}$
d. first σ	ti˩khɛ̃˧jɛi˧	'lend!'	$\underline{M_2\text{-}L}$ M_2 M_2
e. penalt. σ	cha˧sɛi˩-hi˩	'YOU[112] are looking'	M_2 $\underline{M_2\text{-}L}$ L
f. final σ	lu˧mɛ˦ta˩	'bottle'	M_2 M_1 $\underline{M_1\text{-}L}$

The Mid to Low falling tone is not limited to a specific position in a word. It is not very common but it does occur across a wide range of onset and vowel types and grammatical categories. There are no current examples on syllables in which glottal stops are directly adjacent to the nucleus. There are, however, examples with both coronal (56b) and dorsal stops (56g) which eliminates the suspicion that the fall results from the effects of a sonorant onset. More research is needed on this contour tone.[113]

4.3.8 Summary of Contour Tones

Soyaltepec Mazatec has been shown to make use of seven of the twelve possible contour tones that emerge from the concatenation of four level tones, and since there is still ongoing research concerning grammatical tones and sandhi in verb phrases, it is very possible that more contours will emerge; however, the above examples include all of the common (and some rare) tones and contours that occur on lexical items. The seven tonal contours discussed above include five rising tones (M_1-H, M_2-H, M_2-M_1, L-M_2 and L-M_1) and two falling tones (M_1-L and M_2-L). The unattested contours include the rise from Low to High (L-H) as well as the three falls that start on High (H-M_1, H-M_2 and H-L). Contours spanning the entire pitch range (Low to High or High to Low) are avoided.[114] Rising contours are more common lexically than falling contours, a characteristic that is unusual cross-linguistically. It may be hypothesized that falling contours play a more significant role in another part of the phonology such as relating grammatical

[112] The YOU is being emphasized in this form through the addition of the –hi.
[113] The contour tends to separate when preceding a Low toned syllable leaving a level Mid on the sponsor syllable which makes the contour more difficult to recognize since it essentially disappears in one of the primary contexts I used for comparisons.
[114] The absence of contours spanning the entire pitch range could also be attributed to a phonetic effect which causes the H-L to be expressed as M_1-L and the L-H as L-M_1. This possibility will not be pursued at this time – the H-L contour does occasionally occur as a result of sandhi, so is not completely excluded phonetically.

information rather than lexical information. Chapter 5 will give some examples which support this possibility.

For each of the contour tones, the co-occurrence with the different onsets used in Soyaltepec Mazatec was examined. The majority of the contours occur over most of the onsets with only accidental gaps; however, two of the contours, the L-M_2 and the L-M_1 have a more limited distribution. It remains to be proven that they are not in complementary distribution either with each other or any other tones. Table 4-3 summarizes the distribution of the contour tones with the different onset types that occur. The different contours are listed across the rows and the potential onsets are listed down the columns. If an example exists, a ‘Y’ is placed in the appropriate box, if not, a ‘–’ shows that no examples are available at this time.

Table 4-3 Distribution of Contour Tones with Onset Type

	Onset Type	Manner	Contour Tone						
			M_1-H	M_2-M_1	M_2-H	L-M_2	L-M_1	M_1-L	M_2-L
1)	Labial		-	Y	Y	-	-	-	Y
2)	Coronal	stop	Y	Y	-	Y	-	Y	Y
3)		fricative	Y	Y	Y	-	-	Y	Y
4)		affricate	Y	Y	-	-	-	Y	Y
5)		glide	Y	Y	-	-	-	-	-
6)		lateral	-	-	-	-	-	Y	-
7)		flap	-	-	-	-	-	Y	Y
8)		nasal	Y	Y	Y	Y	-	-	Y
9)	Dorsal	stop	Y	Y	Y	-	-	Y	Y
10)	Glottal	fricative	Y	Y	Y	Y	-	Y	Y
11)		stop	Y	Y	-	-	-	-	-
	Complex								
12)	S-stop/Stop-Stop		Y	Y	-	Y	-	Y	-
13)	Obstruent -/ʔ/		Y	Y	Y	-	Y	Y	-
14)	/ʔ/-Sonorant		Y	Y	-	-	-	Y	Y
15)	Obstruent -/h/		Y	Y	Y	-	Y	Y	Y
16)	/h/-Sonorant		Y	Y	Y	-	-	Y	-
17)	Begins with /N/		Y	Y	Y	-	Y	Y	Y

Through examining Table 4-3, it is evident that there are only two contour tones with limited distribution among onset types. The L-M_2 only occurs with four types of onsets and the L-M_1 only with three; and the two sets of onsets do not overlap at all. It appears that these two Low rising tones could be in complementary distribution; however, the groups into which they fall are not easily defined. L-M_1 only appears with complex onsets, but one (Begins with /N/) is voiced and more sonorant and the other two are not sonorant (Obstruent-/ʔ/ and Obstruent-/h/). The L-M_2 also appears with one complex obstruent onset and its simple onset co-occurrence includes the nasal which is sonorant. It is true that the L-M_1 is more likely to occur with a glottal element, but the L-M_2 can occur with the glottal fricative. It is not clear what could motivate or condition a tonal difference between the two sets of onsets which occur with these two contour tones. The fact remains that the two are among the rarest lexical tonal distinctions and the disparity in their distribution is most likely due to this rarity and not phonologically motivated based on their onsets.

An examination of the vowel and diphthong distribution yields little evidence of complementary distribution. Table 4-4 summarizes the distribution of the contour tones with the different nucleus types that occur. The different contours are listed across the rows and the potential nuclei are listed down the columns. If an example exists, a 'Y' is placed in the appropriate box, if not, a '–' shows that no examples are available at this time.

Table 4-4 Distribution of contour tones with syllable nucleus

	Nucleus	Contour Tone						
		M_1-H	M_2-M_1	M_2-H	L-M_2	L-M_1	M_1-L	M_2-L
a.	[i]	Y	Y	Y	Y	-	Y	Y
b.	[ĩ]	Y	Y	Y	-	-	Y	Y
c.	[ɛ]	Y	Y	Y	-	Y	Y	Y
d.	[ɛ̃]	Y	Y	-	-	-	Y	Y
e.	[a]	Y	Y	Y	Y	Y	Y	Y
f.	[ã]	Y	Y	Y	-	-	Y	-
g.	[o]	-	Y	-	Y	Y	-	Y
h.	[õ]	-	Y	-	Y	-	Y	Y
i.	[u]	Y	Y	Y	-	Y	Y	Y
j.	[ũ]	Y	Y	Y	-	Y	Y	Y
k.	[iu]	Y	-	-	-	-	Y	Y
l.	[iɛ]	-	-	-	-	Y	Y	-
m.	[ia]	-	-	-	-	-	-	Y
n.	[ɛi]	-	-	-	-	-	-	Y
o.	[ai]	-	Y	-	-	-	-	Y
p.	[ãĩ]	-	-	-	-	-	Y	-
q.	[ao]	-	-	-	Y	-	-	-
r.	[ui]	-	-	-	-	-	Y	-
s.	[uɛ]	-	Y	-	-	-	-	-
t.	[ũɛ̃]	Y	-	-	-	-	-	-
u.	[ua]	-	Y	-	-	-	-	-
v.	[ũã]	Y	-	-	-	-	Y	-

Unlike the distribution of the onsets with the contour tones, examining the nuclei reveals there are no contour tones in complementary distribution based nucleus type. There is overlap between the nuclei sets which occur with each of the uncommon contours in question: L-M_1 and L-M_2, both with each other and the other contours. Each of these contours contains high vowels and low vowels as well as front and back vowels. It is not possible to formulate an environment which would predicate one or the other contour based on nucleus type.

There is not enough evidence from the syllable's segmental characteristics to predict the occurrence of any of the tonal contours. Table 4-5 compares the grammatical categories. The contour tones are listed across the rows and the categories down the columns.

Table 4-5 Distribution of Contour Tones over Grammatical Categories

	Gram. Category	Contour Tone						
		M_1-H	M_2-M_1	M_2-H	L-M_2	L-M_1	M_1-L	M_2-L
a.	Noun	Y	Y	Y	Y	Y	Y	Y
b.	Pronoun	-	Y	-	-	-	-	Y
c.	Verb	Y	Y	Y	-	Y	Y	Y
d.	Adjective	Y	Y	Y	-	-	-	Y
e.	Adverb	Y	-	Y	-	-	Y	-
f.	Quantifier	Y	Y	-	-	-	-	-
g.	Connective Particle	-	-	-	-	-	-	Y

All of the contour tones occur on nouns and most occur with verbs. There is no one-to-one relationship between any grammatical category and any tonal category. In other words, the tone on a word or syllable cannot be determined from the grammatical category, nor can the grammatical category be determined from the tone. The only contour which only occurs with one grammatical category is the L-M_2, and since this is a rare contour, it is not surprising that all of its members to date fall into the grammatical category (nouns) which contains the most examples in my data base.

The final area addressed above is the position within the word that the contour appears. Table 4-6 summarizes the findings. The contour tones are listed across the top row and the word type/position is listed down the fist column.

Table 4-6 Distribution of Contour tones within words

	Word type/position	Contour Tone						
		M_1-H	M_2-M_1	M_2-H	L-M_2	L-M_1	M_1-L	M_2-L
a.	monosyllabic	Y	Y	Y	Y	Y	Y	Y
b.	disyllabic/ first σ	Y	Y	-	Y	-	Y	Y
c.	disyllabic/ final σ	Y	Y	Y	-	Y	Y	Y
d.	trisyllabic/ first σ	Y	Y	-	Y	-	-	Y
e.	trisyllabic/ second σ	Y	-	-	-	-	Y	Y
f.	trisyllabic/ final σ	Y	Y	Y	Y	-	Y	Y

All of the contour tones appear on monosyllabic words and most appear on the final syllable of multi-syllabic words. The least common position for a contour tone is the middle syllable of a trisyllabic word. While the contours can occur at various positions within a word, it is good to remember that the most common place for them to occur is on the final syllable of a word. Also, that the least common place for a contour to occur is the middle of a word reinforces the idea that concatenations of tones tend to occur at word edges because they are often the result of the loss of a syllable.

Seven contour tones occur lexically in Soyaltepec Mazatec. These contours are not dependent on the segmental characteristics of the syllables on which they appear or on grammatical categories or word position. They each play an important role in the semantic interpretation of Soyaltepec Mazatec.

4.4 Summary

In the above sections, four tonemes were demonstrated. Each can appear singly on a syllable. They also can form combinations of two tones on a single syllable to form seven contour tones. Minimal and near minimal sets were given in Table 4-1 to show contrasts between the eleven different tonal expressions that can appear on single syllables in Soyaltepec Mazatec. Unfortunately, there is no one minimal set which demonstrates all of the contrasts. There are, however, enough minimal contrasts to demonstrate the existence of the four level tones as well as the seven contour tones listed. In two of the contour tones (i.e., M_2-H and L-M_2), at least some of the tonal features must be pre-linked in each instantiation of the contour, regardless of its placement in a word. Otherwise, except in the case where contours surface word internally, most, but not all, tonal linkages can be assumed to be made according to the UAC. When a contour surfaces word internally, the tonemes of the contour must be pre-linked, otherwise the 'extra' tone would shift to the right edge of the word, forming a contour only when necessary. The distribution of the contour tones was examined in relation to onset type, nucleus, grammatical category and word placement and no complementary distribution was found. Each of the seven contour tones examined is lexically specified, none are allophonic.

CHAPTER 5

TONAL PROCESSES

5.1 Overview

In Chapter 4, the tonemes and lexical contours of Soyaltepec Mazatec were introduced with underlying structures as they occur in isolation. When the morphemes of Soyaltepec are placed into various contexts, the surface tones that result are often different than the lexical tones. The explanation for some of these differences is the focus of this chapter.

In this chapter, I demonstrate that Soyaltepec Mazatec behaves in a manner consistent with traditional Autosegmental phonology. The highlighted processes demonstrate autosegmental behavior as applied to a language with four levels of tone. In order to specify four distinct levels of tone, the RTT geometry employed by Snider 1999 is adopted. One of the arguments in support of this apparatus in general is that it allows the representation of downstep as traditionally seen in African languages in a manner that both explains the phonological process and predicts the phonetic expression of the effected TBU. The behavior of the low register feature which accounts for this downstepping in African languages is similarly active in Soyaltepec Mazatec. The richness of the geometry employed allows more complex behavior than a flat geometry would as was discussed in §1.5.4.2. Specifically, because each tone is represented with a tier for the tonal melody and a tier for tonal register, we expect to find instances in which these tiers behave independently. I demonstrate that at times the entire tonal root has an effect on a neighboring syllable while other times only the tonal register has an effect. I show how the Obligatory Contour Principle (OCP) is upheld at the word level in Soyaltepec Mazatec. In addition, I show that the phonological domain in Soyaltepec Mazatec encompasses lexical items with their affixes as well as closely associated words. For example, a noun and its modifiers work together as a phonological unit and tonal features can spread across the word boundaries to the end of the domain. Some processes in Soyaltepec Mazatec seem to uphold the

UAC while others do not. In the applicable tonal processes discussed below, I indicate agreement with or violation of the UAC when appropriate.

In §5.2 I give examples of the tonal behavior of Soyaltepec Mazatec focusing on five tonal behaviors highlighted by Yip 2002 which she claims that any phonological model must be able to explain. I demonstrate how these behaviors are elucidated using autosegmental phonology and RTT. In §5.3 contour tones which tonally influence a following syllable are explored in more depth. Finally, in §5.4, I summarize the arguments given. Throughout the chapter it will become evident that the representational conventions adopted here allow an analysis of the tone in Soyaltepec Mazatec consistent with the principles of autosegmental phonology.

5.2 Soyaltepec Mazatec in Autosegmental Phonology

In this section, specific examples of the tonal behavior of Soyaltepec Mazatec are shown and the advantages of employing an autosegmental approach using Register Tier Theory (RTT) (per Snider 1999) is demonstrated. In Yip's 2002 work, *Tone*, she identifies five specific behaviors of tone which any phonological model must address: mobility, stability, one-to-many, many-to-one and toneless segments. In Chapter 1, these phenomena were discussed in autosegmental phonology in general. In the sections that follow, these behaviors, as found in Soyaltepec Mazatec, are demonstrated with the exception of toneless segments. It is possible that further research will reveal clear examples of toneless segments which are absent in my research to date. There are some examples which suggest the possibility of toneless segments which are filled via a default tone; however, my investigation has not revealed any morphemes that consistently behave in this manner. Nor have any morphemes been found that behave as if they are completely unassigned for tone and therefore receive their tone via phonetic interpolation. In my research to date, a morpheme which appears to acquire its tone solely from its environment or through a default rule from one speaker always has an acceptable variant which displays a clearly specified tone from a different speaker. This is an area for future research and may indicate an area in which there is some language shift occurring. Instead of addressing toneless segments, the mirror image of the idea, morphemes which occur as a tone with no segmental specifications, i.e., tonal morphemes, is addressed.

5.2.1 Mobility

Mobility is defined by Yip (2002:65) as tonal movement away from its point of origin. Yip goes on to say that autosegmental phonology characterizes mobility “as a change in association” (2002:74) of a feature. This behavior is demonstrated in Soyaltepec Mazatec through an examination of tonal clusters as they appear in context. In chapter 4, five rising contour tones were demonstrated to appear in isolation, i.e., M_1-H, M_2-M_1, M_2-H, L-M_1 and L-M_2. Three of these rising contours, M_1-H, M_2-M_1 and L-M_2, appear to split when placed in context. These will be addressed in further depth in §5.3. Below, I give an example of how each of these clusters demonstrates tonal mobility.

The original host TBU surfaces with a level tone equivalent to the first tone of the contour while the second tone of the contour shifts its association to the following syllable. The diagram in (1) offers a mechanism for this ‘contour simplification’ using the Mid-high to High contour as an example. (1a) shows the data that needs to be explained. (1b) demonstrates an underlying representation for each morpheme that assumes all tones are unlinked in the lexicon and subsequently linked by the UAC, i.e., in a one to one fashion from right to left until all tones are assigned. In isolation, the first morpheme surfaces with a rising contour while the second as a disyllabic low-toned word. When the two morphemes are placed into the context of adjacency within the same phonological domain, a noun phrase, the tones link to the available TBUs as expected based on the UAC[115] (1c). The newly formed linkages are represented by dashed association lines. The High tone which is lexically sponsored as part of the first morpheme surfaces on the second morpheme.

(1) Tonal Mobility of the H from M_1-H

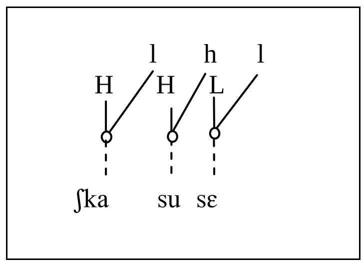
a. Data to be explained

ʃka˥ + su˩sɛ˩ → ʃka˧ su˥sɛ˩
‘pants’ ‘green’ ‘green pants’

[115] Notice that these words must form a phonological unit to allow the UAC to apply across the morpheme boundaries. This application of the UAC is slightly expanded from its traditional lexical application.

b. Underlying Representations

c. Surface linkages in context



In the underlying representation of these two morphemes there are a total of three tones and a total of three TBUs. The tones are able to distribute themselves evenly with one tone linked to each syllable and a level tone is articulated on each syllable. The first morpheme has one TBU and two tones in its underlying representation (1b). In isolation the two tones associate to the only available TBU producing a rising contour;[116] however, as was demonstrated in (1c), the two tones are not tied to their lexical sponsor as a unit but can surface separately as two level tones on separate syllables. Each syllable, and therefore each TBU of the utterance, is associated with one TRN and each is expressed with a level tone. This redistribution of tone from its lexical sponsor demonstrates the mobility of the High tone which is sponsored by the initial morpheme, but surfaces on the second.

This same mobility is seen in the Mid to Mid-high tonal cluster which was introduced in §4.3.2. For the sake of comparison, a disyllabic low-toned word is used for the target of the new association. The process (2) is identical except that different tones are lexically sponsored by the first morpheme. When placed in context (2c) the same one-to-one association occurs (demonstrated by the dashed association

[116] Refer to §4.3.1 to see how the Mid-high to High contour associates in isolation.

lines); however, in this case when the M_1 links to the following TBU, two low registers become linked to the same morpheme and OCP merger is motivated (2d).

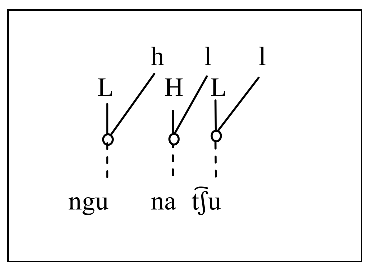
(2) Tonal mobility of the M_1 from M_2-M_1

a. Data to be explained

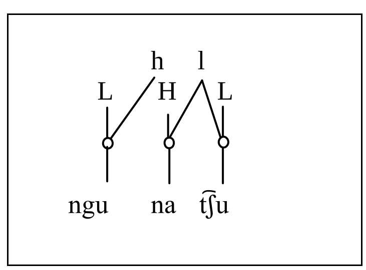
ngu˧˦ + na˩t͡ʃu˩ → ngu˧ na˦t͡ʃu˩
'one' 'squash' 'one squash'

b. Underlying Representations

c. Surface linkages in context



d. OCP motivated *l*-register merger



When the word with the M_2-M_1 contour is placed in context (2c), the M_1 preferentially links to the TBU to the right, leaving its sponsor syllable with a level M_2 tone. If the specified OCP merger did not occur in (2c), the final syllable would be articulated at an even lower pitch than the L specified in response to a second overt *l*-register.

The final cluster that was introduced in Chapter 4 which participates in this type of mobility is the Low to Mid-high (§4.3.4). Again, two tones are sponsored by a monosyllabic morpheme (3b) and the tones associate in a one-to-one, left-to-right manner across the phonological domain (3c). Once again, the linkages place two *l*-registers into adjacency on the same morpheme and OCP motivated merger occurs.

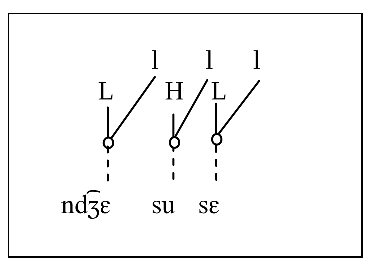
(3) Tonal mobility of the M_1 from L-M_1

a. Data to be explained

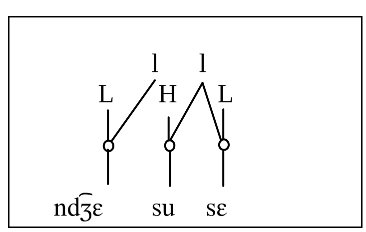
nd͡ʒɛ˩˦	+	su˩sɛ˩	→	nd͡ʒɛ˩ su˦sɛ˩
'hominy'		'green'		'green hominy'

b. Underlying Representations

c. Surface linkages in context



d. OCP motivated *l*-register merger



The only difference in the tones between (2) and (3) is that the first tone is a Low. The process demonstrated above in (1) – (3) shows the tonal behavior of monosyllabic morphemes which sponsor two tones but have only one TBU. In isolation, these morphemes surface with contour tones: M_1-H, M_2-M_1 and L-M_1 respectively. When the morpheme which has more tones than TBUs is placed into a context in which there is an extra TBU, as is the case when a disyllabic word is articulated with both syllables at the same pitch and therefore has two TBUs but only one tone, the extra tone from the first morpheme is able to associate to the extra TBU of the second morpheme and all three morphemes surface with level tones. This redistribution of tones is not limited to the environment of a tonal cluster preceding a disyllabic Low toned word; the environment was kept constant for demonstrative purposes. The resolution of the conflicts that arise when these morphemes are placed into various contexts is addressed in §5.3.

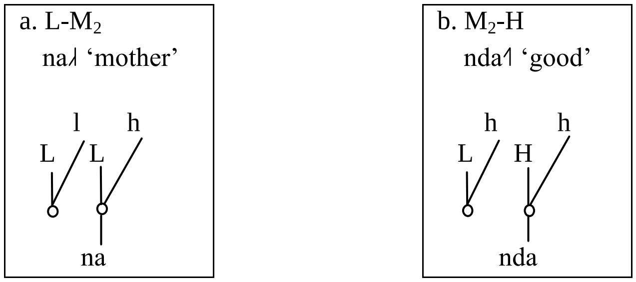
While the M_1-H, M_2-M_1 and L-M_1 contours of Soyaltepec Mazatec demonstrate tonal mobility, there are two rising contours that behave differently. Consider the data in (4). The utterance in (4a) begins with a morpheme which sponsors a Low tone followed by a Mid tone. When placed into the identical environment that was demonstrated above, preceding a disyllabic low-toned word, nothing happens. There is no redistribution of tones. Similarly, (4b) demonstrates a Mid to High contour which maintains its contour in the same environment.

(4) Cluster tones that do not demonstrate tonal mobility

Isolation forms			Surface Forms	Expected Forms
a. na˩˧ +	su˩sɛ˩	→	na˩˧ su˩sɛ˩	*na˩ su˧sɛ˩
'mother'	'green'		'green mother'	
b. nda˧˥ +	na˩t͡ʃu˩	→	nda˧˥ na˩t͡ʃu˩	*nda˧ na˥t͡ʃu˩
'good'	'squash'		'good squash'	

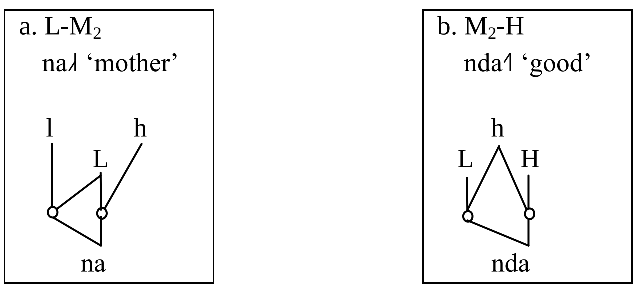
If all tones were underlyingly unlinked in the lexicon, we would expect these cluster tones to behave as was demonstrated in (1) – (3) above. However, these clusters always surface as contour tones and therefore must have a different underlying representation than the other contour tones which demonstrate tonal mobility. Hypothesizing that these two contours contain at least one tone that is linked in the underlying representation rectifies this problem (5).

(5) Underlying Representation for clusters with one lexically linked tone



Using the underlying representation from (5), when the UAC applies, the left most tone sponsored by the morpheme will attach to the morpheme which sponsors it even though it already contains a tone, thus creating the contour tone. This will motivate OCP merger of the *L*-melody feature in (5a) and the *h*-register feature of (5b). Alternatively, both tones could be lexically linked as in (6) which shows the forms in which the merger has already occurred.[117]

(6) Underlying Representation for clusters with two lexically linked tones



The structures in (6) show two TRNs multiply linked to the TBU, recall that a structure with one TBU which has multiply linked registers in (6a) or multiply linked tonal melodies in (6b) is equally valid. There is no data at this point which clearly indicates whether one or two tones are lexically linked in these clusters. It is a matter for future research. One association line between the right most tone and the TBU is enough to block the mobility as can be seen in (7). When the UAC applies in (7b), a contour is formed on

[117] The two contours which never split and re-associate may in fact be unitary contours (the M_2-H having a rise in tonal melody on the high register and the L-M_2 having a change in tonal register while maintaining a Low melody), which would argue for the representation with one TBU. The remaining three contours may be seen as composite contours, necessitating the full specification of each associated tone and therefore more easily disassociated than the unitary contours.

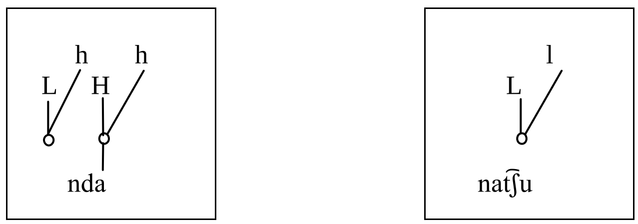
the first morpheme. The tone which was linked in the underlying representation is not changed by the UAC which only applies to unassociated tones.

(7) Tonal immobility of the H from M_2-H

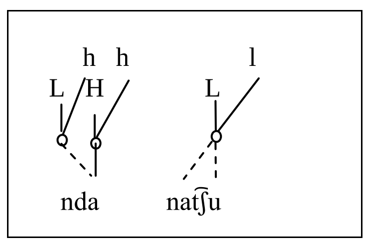
a. Data to be explained

nda˦˥ + na˩t͡ʃu˩ → nda˦˥ na˩t͡ʃu˩
‘good’ ‘squash’ ‘good squash’

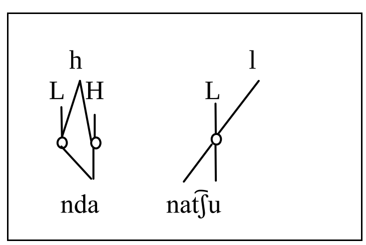
b. Underlying Representations



c. Surface linkages in context



d. OCP motivated *h*-register merger



No tonal mobility occurs in (7), both morphemes surface with only their own lexically specified tones. The reason for the difference in behavior between the various contour tones originates in their lexically designated structure, i.e., whether or not tones are specifically linked in the underlying representation, and not just in the fact that they are contour tones.

The processes described above demonstrate both tonal mobility which is a characteristic of African tone systems and the greater affinity of some tones to specific TBUs which is more similar to Asian tone systems. The tonal behavior was demonstrated using RTT structures; however, no specific advantages to using these structures emerged. Tonal mobility could just as easily be demonstrated without the expanded geometry of RTT. The only distinction that occurres using the RTT geometry is that OCP motivated merger is demonstrated on the tonal melody tier in (6a) and on the tonal register tier in (2d), (3d), (6b) and (7d).

5.2.2 Stability

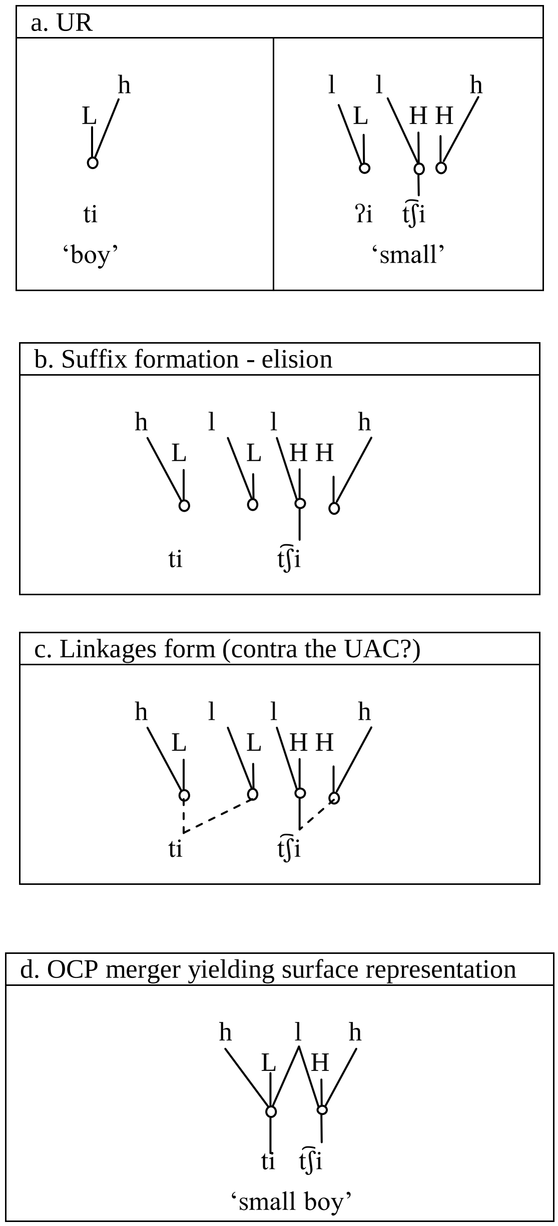
Yip (2002: 65) defines stability as the survival of a tone after the loss of the original host segment. Arguments for stability are either diachronic or synchronic. For the purposes of this study I address an example of synchronic stability, the case of the diminutive morpheme *ʔi˩t͡ʃi˥˧* ‘small.’

When the morpheme in question is said in isolation, it is a two syllable word which begins with a low-toned syllable followed by a syllable with a Mid-high to High rising contour. The most common usage of the morpheme; however, is as a suffix to the noun which it describes. In this case, it consists of a single syllable with segments and tone equivalent to the second syllable of the stand alone morpheme: *-t͡ʃi* with a Mid-high to High rising tone. The first syllable of the morpheme is subject to elision.[118] However, when the morpheme is affixed as in (8), a Low tone is added to the final syllable of the stem of the noun (8c). This demonstrates that even though the segments of the first syllable have been deleted, the tone remains. In (8) the stages of the derivation of *ti√t͡ʃi˥˧* ‘small boy’ are explained beginning in (8a) with the underlying representation of the individual morphemes, a noun with a level Mid tone and the disyllabic diminutive in question. This is followed by the elision required for suffix formation in (8b). The Low tone which remains

[118] A counter argument could be made in favor of the insertion of an epenthetic syllable necessary to support the tone in isolation rather than elision. There is not enough evidence at this time for a definitive argument.

after the segments are deleted then docks to the left (8c) in violation of the UAC. Finally in (8d) the OCP is satisfied by the merger of adjacent features and the surface form emerges.

(8) Tonal stability of the L in *ʔi˩t͡ʃi˥* despite segmental elision



In (8a) the underlying representations, the noun has one TBU and one TRN (a level Mid tone) while the diminutive has two TBUs and three TRNs (a Low, a Mid-high and a High). When the suffix is formed, the segmental material of the first syllable is deleted (8b); however, the tones remains unchanged leaving three TRNs and one TBU. In both (8a) and (8b) an association line is indicated between the Mid-high tone and the final syllable of *ʔi˩˧t͡ʃi˥˧*. It might be argued that the process of elision creates the link or it could be present in the UR. This link must be in place before the linkages are formed in order to force the Low tone to associate to the left of the suffix in the newly formed word (8c). In (8c) the combination of the two morphemes shows that the L tone TRN which was sponsored by the first syllable of the diminutive morpheme docks to the stem of the noun which is indicated by the dashed association line from the TRN to the TBU. This association is not expected based on the standard application of the UAC.[119] Even the existence of a pre-linked TBU does not block application of the UAC which would link the Low tone to the right. In this case, the tone docks preferentially to the stem in a leftward direction; therefore, the UAC must not be strictly followed in Soyaltepec Mazatec. The final syllable of the stem is the stressed syllable. It is my hypothesis that when surrounded by two linked tones word medially, a floating tone attaches preferentially to the stressed syllable rather than to the suffix which is not stressed.[120] This pressure to link to the stressed syllable unexpectedly forms a contour on the first syllable of the newly formed word. Finally, the OCP is violated two times by the linkages in (8c): there are adjacent *L* melodies on the first syllable and there are adjacent *H* melodies on the second syllable. The merger of these tonal melodies is demonstrated in (8e). The final result is a two syllable word with a falling M_2-L contour on the first syllable and a rising M_1-H contour on the final syllable.

The presence of a low tone preceding the suffix demonstrates tonal stability in the presence of segmental deletion. It also gives an additional argument for the necessity of linking at least some tones in the underlying representation. Specifically, the M_1 must be linked to the suffix. If the M_1 is not linked in the UR and if there was a strict adherence to the left to right directionality of the UAC, then we would expect

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[119] It might be hypothesized based just on this example that two tones per TBU is superior to three as would happen if the tones associated according to the UAC leaving any unassociated tones to form a contour on the final syllable, therefore forcing the association of two tones on each syllable. The problem with this supposition is that the realities of the language do not require or encourage such a restriction, the L will dock to the left even if a rising tone already exists on the initial morpheme as will be shown in §5.2.4 and §5.3.2.

[120] Alternatively, the leftward linkage could be lexically specified; however, this is intellectually unsatisfying because it seems arbitrary.

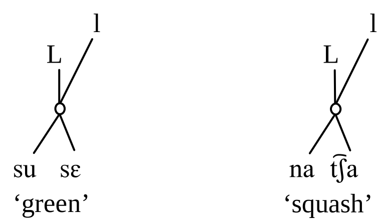
that the Low tone would dock to the suffix rather than docking to the preceding syllable of the stem. Therefore, linkages exist in the UR and the UAC is not strictly obeyed.

5.2.3 One-to-Many

Yip (2002: 65) defines the one-to-many relationship as a single tonal feature being shared by two or more TBUs. This phenomenon, also called a tonal plateau has been demonstrated in several of the examples above. When two sequential syllables are articulated at the same pitch, they share features thus producing feature plateaus. Plateaus can occur at the level of either the tone melody feature or the tone register feature, as well as over the entire TRNs.

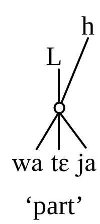
When two syllable words are expressed with the same tone on each syllable, a plateau occurs at the TRN level (9).

(9) Two syllable words in which the two syllables share a L tone



In (9), both examples contain Low tones and both the tonal melody and tonal register are shared.[121] This type of plateau can occur at any tone level (H, M_1, M_2 or L). Three (or more) syllables may share one tone as in (10) in which all three syllables of the word occur with a Mid tone.

(10) Three syllables attached to one M_2

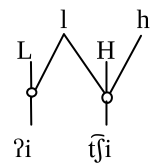


[121] The argument concerning the exact nature of the tonal root node and whether these cases truly contain one TRN which is shared by two syllables, or two TRNs which overlap, or possibly which do not overlap; however, are each linked to the same tonal register and melody is grounded in the definition of the syllable structure, i.e., if the TRN is part of the skeletal structure or just a feature which is attached to the structure. The exploration of this issue is beyond the scope of this dissertation.

(10) demonstrates three syllables all linked to the same tonal features. It is not relevant to this analysis if the TRN is centered above a given syllable. Each syllable is linked with a solid association line indicating equal association of each syllable to the TRN.

While the plateaus demonstrated in (9) and (10) involve both the tonal melody and register and therefore the TRN, a plateau can occur on any feature tier. The one-to-many relationship in (11) involves only the tonal register, even though the two syllables are articulated at different pitch levels: L followed by M_1-H rising.

(11) Tonal register plateau

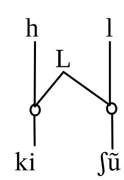


'small'

In (11), each syllable shares the low register feature but has a separate designation for tonal melody. Notice also that there is a contour on the final syllable indicated by the presence of another associated register feature.

These plateaus can also occur on the tonal melody feature. Consider the two syllable word in (12) with the first syllable expressed on Mid tone and the final syllable on a Low tone.

(12) Tonal melody plateau



'charcoal'

The two syllables of the word in (12) share the low tonal melody while maintaining separate tonal registers.

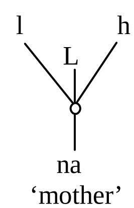
In Soyaltepec Mazatec, the one-to-many relationship of tonal features which produces feature plateaus can occur at the tonal root node level, producing words which share both tonal melody and tonal register, or at the tonal feature level, producing words which share either the tonal register or the tonal melody. Using the geometry of RTT allows three types of plateaus to exist on tonal features as opposed to using traditional Autosegmental Phonology which allows only one type of plateau for tonal features, i.e., a complete tonal plateau.

5.2.4 Many-to-One

Many-to-one mapping is defined by Yip (2002: 65) as multiple tonal features being hosted by a single anchor. This tonal characteristic is exemplified through tonal contours. Any time more than one tone is expressed on a single syllable many-to-one mapping occurs. Contours that occur word medially are stable in that they are expressed whether the word they occur in is in isolation or various contexts. As was introduced in §5.2.1, there are also examples of contours consisting of two tonal values that are stable in mono-morphemic situations even when they occur word finally. All of these contours are examples of many-to-one mapping.[122]

The Low to Mid contour is an example of many-to-one mapping. The morpheme in (13) shows a single TBU which has been linked to two tonal registers and one tonal melody.

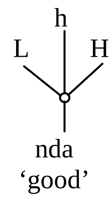
(13) One TBU linked to two tonal registers: the L-M_2 contour



This example demonstrates a contour which moves between the two tonal registers while maintaining a *L* tonal melody. There are also examples of TBUs which are linked to multiple tonal melodies while maintaining one tonal register. The Mid to High contour is such an example (14).

[122] Recall from §5.2.1 that the M_2-H and L-M_2 tones may have only one link in the UR, more data is needed to confirm this; however, considering these contour tones as pre-linked units in the UR is also a valid interpretation.

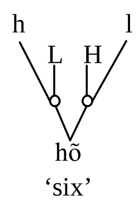
(14) One TBU with two tonal melodies the M_2-H contour



The morpheme in (14) is always expressed as a rising tone; there are two tonal melodies, *L* and *H*, expressed on one TBU with a single *h*-register feature.

The above examples involve either multiple registers over one melody (13) or multiple tonal melodies over one register (14). There are also examples which involve a change in both the tonal melody and the tonal register which therefore require two completely separate tonal root nodes such as the Mid to Mid-High contour (M_2-M_1). This contour has been shown in §5.2.1 to demonstrate tonal mobility in context; however, in isolation it surfaces as a contour. An example is given in (15).

(15) One TBU with two TRNs, the M_2-M_1 contour

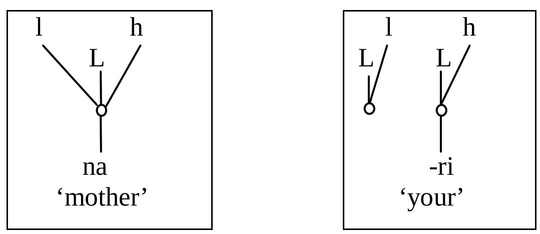


The contour in (15) requires two tonal root nodes because there is no shared information on either the tonal melody plane or the tonal register plane to warrant a shared node.

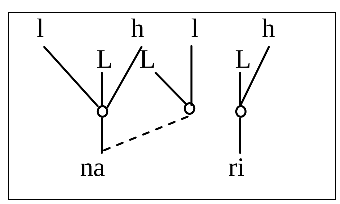
Contour tones involving two different tones are common in Soyaltepec Mazatec. More rarely the situation arises in which morphemes abut and three tones become associated to one syllable at the surface level. This is the most complex example of a many-to-one relationship that I have encountered in Soyaltepec Mazatec. One scenario which produces this situation occurs at the morpheme boundary when a morpheme with an immobile rising contour tone is combined with a morpheme which contains a Low tone that preferentially attaches to the stem as was demonstrated in §5.2.2 above. This type of example also demonstrates that there is no restriction requiring two tones per TBU in Soyaltepec Mazatec.[123] The example in (16) shows the this type of combination. In (16a) the underlying structure of each morpheme is shown. Recall that the M_2-H tones must have at least one if not both tones linked in the UR. In order for the second morpheme to host a Low tone that will preferentially link to the stem, it must have a tone which is linked in the UR as well. (16b) shows that the Low tone must link to the stressed syllable to its left because the TBU to its right is already associated to a TRN. After the initial association occurs, the OCP demands merger of the three *L* tonal melodies that are now associated to adjacent syllables of the same grammatical word which produces the surface structure (16c).

(16) Three tonal registers associated to the same syllable: na˩˧˩-ri˧ ‘your mother’

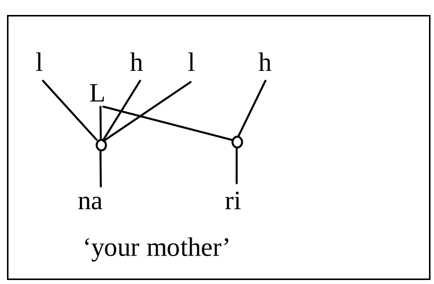
a. Underlying Representations



b. Tonal association



c. OCP merger: surface form



[123] Although it may reinforce the idea that three tones are limited to stressed syllables which is a separate matter.

The unbound morpheme in (16a) is a single syllable that hosts two register designations which in itself is already an example of a many-to-one relationship. The bound possessive morpheme is a suffix which contains a Low tone that links to the stem to which the morpheme attaches. This is considered to be a left-floating Low tone. When the structures unite in (16b), the TRN from the Low tone forms an association with the TBU of the unbound morpheme which is indicated through the dashed line. When this association occurs, features with identical values become adjacent within a grammatical word which suggests that feature merger must occur to satisfy the OCP. In (16c) the fully fused grammatical word is represented. The first syllable hosts three tonal register features which are expressed in linear order each combining with the designated *L* tonal melody to form an expressible tone, i.e., Low, Mid, Low (˩˧˩) on this one syllable.[124] This type of bidirectional contour is rare in Soyaltepec Mazatec, only occurring at morpheme boundaries. In the final surface form, the first syllable clearly exhibits a many-to-one relationship with respect to register. The two syllables share the low tonal melody, exhibiting the one-to-many relationship discussed in §5.2.3. This disyllabic word contains a rising then falling, bidirectional contour on the first syllable and a level tone on the second which is an apparent violation of a left to right UAC.

The many-to-one relationship occurs in Soyaltepec Mazatec on the level of the tonal register (13, 16), the tonal melody (14) and the tonal root node (15). The employment of Snider's geometry allows this complexity.

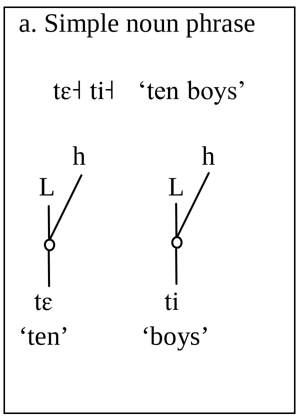
5.2.5 Tonal Morphemes

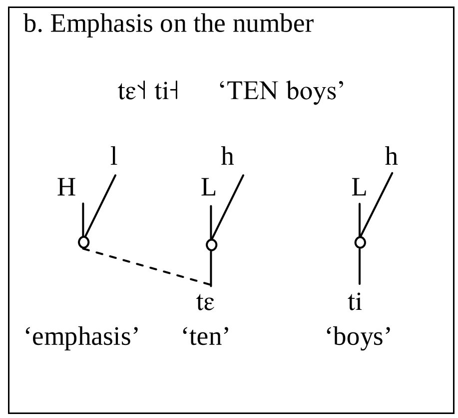
In this section, I discuss segmentless tones instead of toneless segments which were defined by Yip (2002:65) as TBUs which lack phonological tone. Segmentless tones involve a TRN which lacks a TBU. Below, I introduce two tonal morphemes. The first is used to indicate emphasis and the second is used to mark the subject of a sentence. They are both segmentless in that their lexical specification includes only tonal information.

[124] Recall that the register tier exists in a separate plane from the melody tier, therefore the association lines do not cross in three dimensional space, even though the two dimensional image would seem to indicate otherwise.

Emphasis is indicated in Soyaltepec Mazatec through the insertion of a Mid-high tone at the beginning of the item in focus. The tone is simply added to the beginning of the tone that is already present, usually forming a contour. For example (17a) is a simple noun phrase uttered without emphasis while (17b) is emphasizing that the number of boys is ten (as opposed to two for example). Note that the examples in (17) are indicating the surface tones. In the UR, none of the association lines would be present for these lexemes.

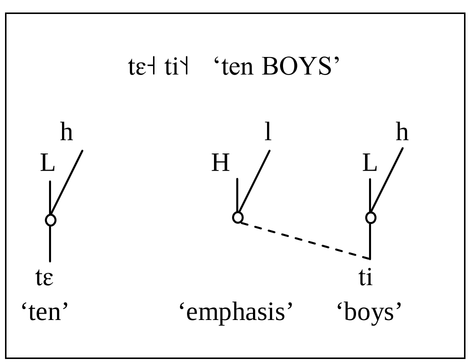
(17) A noun phrase with and without emphasis





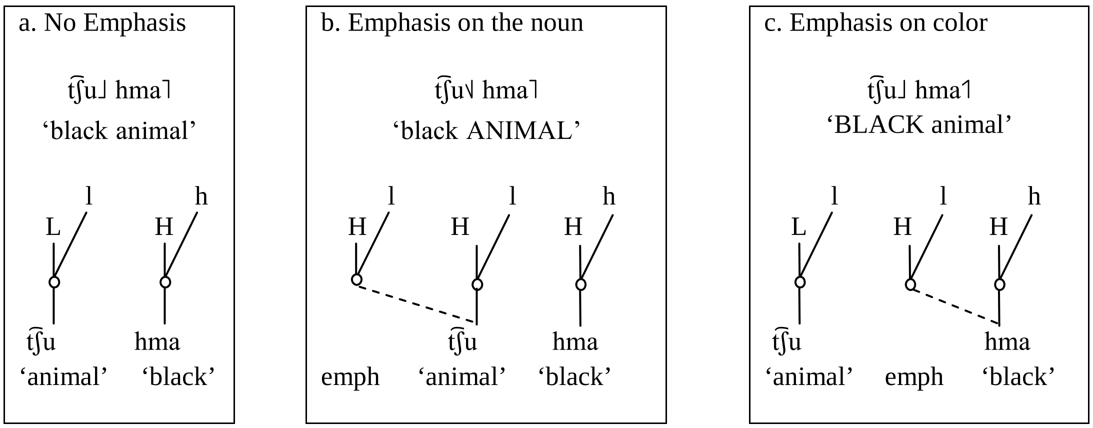
The dashed line in (17b) indicates the linkage of the Mid-high tone to the morpheme in addition to the tones which were already present lexically. The new tone adds a falling contour to the pronunciation of the existing tones. The emphasis can be added to any morpheme. For example, the above utterance can also be articulated with emphasis on boys instead of ten (18).

18) Emphasis on the noun in a modified noun phrase



Emphasis can be added to any part of speech and to any existing tone (19b). If the lexical tone happens to be High, a rising tone is formed (19c).

19) Emphasis on a High toned morpheme

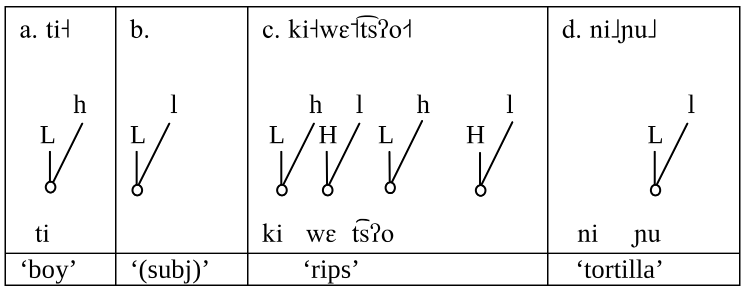


The second tonal morpheme introduced here is used to mark the end of a noun phrase which is employed syntactically as a subject: a Low toned clitic. It is not unusual cross-linguistically to encounter a Low tone at the end of a phrase which is commonly called a boundary tone. The appearance of this Low tone is different from a declination effect for several reasons. First, the drop to Low is sudden and always over the course of a single syllable as opposed to a gradual lowering effect which happens over the entire prosodic unit. Also, the drop occurs at the end of the phrase, regardless of where the phrase occurs in the larger utterance.

Soyaltepec Mazatec allows a null subject; this is the norm. When the subject is stated overtly, a Low tone appears at the end of the noun phrase. This is a helpful marker since the word order is not rigid. In the two phrases below, the same noun that occurs in (17a) with a level Mid tone, *ti˧* 'the boy,' is the subject of each; however, it appears first in the sentence in (20) and (21) and last in (22) and (23). In (24) I will give an example of a longer NP which appears as the subject to illustrate the Low tone in this case appears at the end of the noun phrase and not on the noun itself.

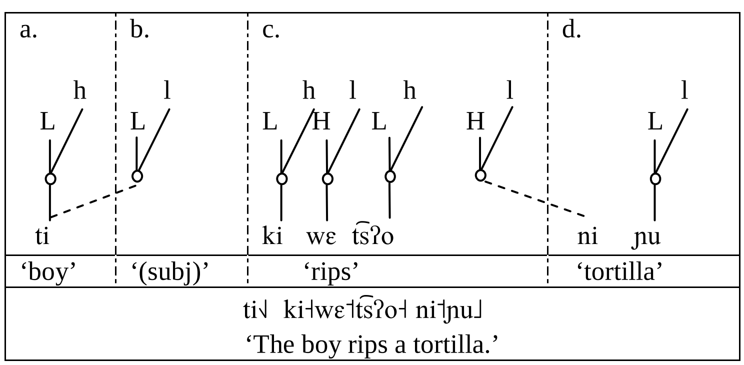
For the sake of clarity, each segment of (20) is outlined individually and its underlying structure is indicated without sandhi, as it is supplied from the lexicon. The surface structure that results from the sandhi is indicated in (21). (20a) is the subject of the sentence. It appears with a Mid tone to which (20b), the subject marking clitic will be added. At this stage, the Low tone is floating as is indicated by the absence of an association line to the TRN. (20c) is the verb of the sentence. It appears with a Mid-high cluster that contains a floating tone at its right edge which appears from the lexicon without an association line. (20d) contains the direct object of the sentence.

(20) L marks the subject: subject appears first in sentence. UR.



After the individual elements of the sentence are brought from the lexicon, they are placed into the context of a phrase and relationships form. The subject marking morpheme indicated in (20b) above must associate with the subject and all tones must either link or delete (or stray erase). The changes which occur as the lexical items in (20) form a phrase are shown in (21). In this representation, dashed lines are used to demonstrate a linkage between a tone which is sponsored by one morpheme, but surfaces on a different morpheme.

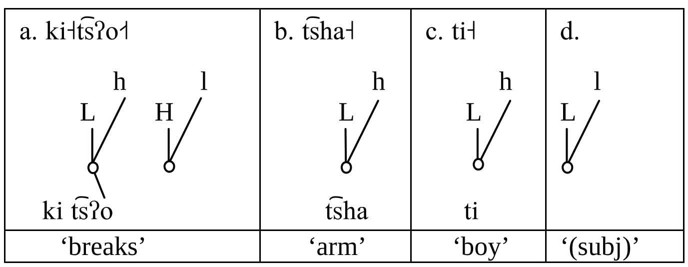
(21) L marks the subject: subject appears first in sentence. Sandhi indicated.



The new linkage between morphemes indicated by the dashed association line between the TBU in (21a) and the TRN in (21b) forms a Mid-Low falling contour on the subject. The next bit of cross-morphemic tonal association which occurs in this sentence is the docking of the Mid-high floating tone that was sponsored by the verb in (20c). The floating tone links to the first TBU of the following noun, again indicated by the dashed association line between the final TRN in (21c) and the first TBU in (21d). The OCP merger of the *L* melodies in (21a, b) and the *l* registers in (21d) which occur before the surface structure is finalized have been omitted.

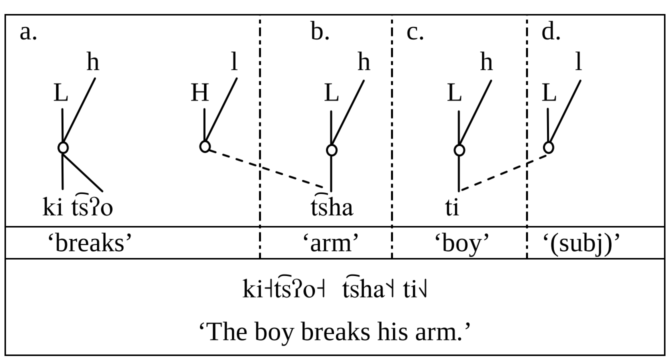
A similar process can be observed when the subject appears at the end of the sentence as will be demonstrated in (22) and (23). In (22) the underlying structures for each of the lexical and grammatical items is provided without indicating any sandhi. In this sentence, the verb appears first (22a), followed by the direct object (22b) and finally the subject (22c).

(22) L marks the subject: subject appears last in the sentence. UR.



The verb in (22a) has an underlying linkage of the Mid tone to its final syllable which forces the Mid-high which is also associated to the morpheme to float and link preferentially to the following syllable if possible. There are two tones in this sentence that surface attached to segmental information that was not part of its lexical specification, the subject marker in (22d) and the final tone of the verb in (22a). Each must be associated in the context of an overt phrase such as (23).

(23) L marks the subject: subject appears last in the sentence. Sandhi indicated.



The first element in the sentence is a verb that sponsors a floating Mid-high tone[125] on its right edge which in context links to the direct object (23b). This is the first example of a floating tone attachment to something other than a disyllabic low-toned word; however, the process is analogous to that which we have already seen. The difference is that in this case the floating tone attaches to the following morpheme which is expressed with this tone in addition to its lexical tone.[126] The direct object therefore surfaces in this sentence with a falling Mid-high to Mid contour. The subject of the sentence appears last (23c). Again the subject marking clitic (23d) links to the subject giving the subject a falling Mid-Low contour in context. To obtain the final surface form which is not indicated by this structure, the two L melodies in (23c-d) merge to satisfy the OCP.

Each of the examples above involves a simple, one word subject. That the subject marking Low tone is a clitic which marks the noun phrase is demonstrated in (24) and (25). The lexical tones are again provided first in (24), followed by the contextually indicated surface forms in (25). In (24) the subject NP occurs first in the sentence in (24a-c): (24a) is the subject, (24b) is an adjectival modifier and (24c) is the subject marking clitic. Next in the sentence is an NP which is the direct object: (24d) is the noun and (24e) is an adjectival modifier of the direct object. The sentence ends with a verb (24f).

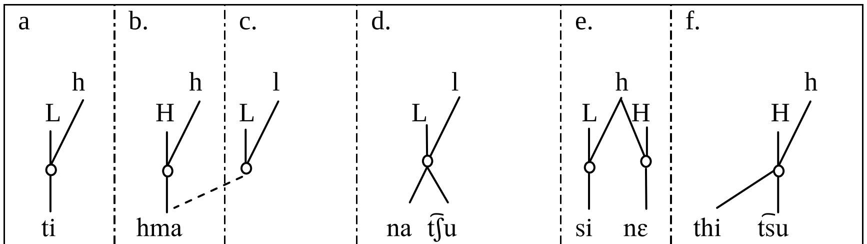
(24) L marks subject: subject is a phrase. UR

a. ti˧ h L ti	b. hma˥ h H hma	c. l L	d. na˩t͡ʃu˩ l L na t͡ʃu	e. si˧nɛ˥ h h L H	f. thi˥t͡su˥ h H thi t͡su
'boy'	'black'	'(subj)'	'squash'	'yellow	'is saying'

[125] It is common for verbs to contain floating tones and a coincidence that the two sentences in (20) and (22) have the same floating tone.
[126] I am omitting the process of *l*-register spread which will be introduced in §5.3.2 for the sake of simplicity.

This sentence only contains one floating tone, the subject marker (24c). Most of the lexemes contain the same number of TBUs and TRNs. (24d) and (24f) contain two TBUs but only one TRN each, so tonal plateaus will be formed.

(25) L marks subject: subject is a phrase. Sandhi indicated



‘boy’	‘black’	‘(subj)’	‘squash’	‘yellow	‘is saying’

ti˧ hma˥˩ na˩t͡ʃu˩ si˧nɛ˥ thi˥t͡su˥

‘The black boy is saying yellow squash.’

The only tone which is expressed on segments that were not in its lexical specification is the floating L subject marking clitic (25c). This new association is indicated by the dashed line between the TBU in (25b) and the TRN in (25c).

Both the subject marking clitic and the emphatic morpheme attach to the tones which appear lexically usually forming a contour tone at the right or left edge respectively. The direction of their association is part of their lexical specification. They do not overwrite the lexical tones nor do they displace the lexical tones as might be expected if the UAC were strictly followed.

5.2.6 Summary

The geometry proposed by Snider provides a tool which can be used to explain five distinct tonal behaviors in Soyaltepec Mazatec predicted by autosegmental theory which Yip claims a successful theory must address. These are:

- Mobility - floating tones
- Stability – a segment is lost, but the tone remains
- One-to-Many – tonal plateaus

- Many-to-One – contour tones
- Tonal Morphemes – tones surface without segmental values

While the essential nature of the tonal behavior is autosegmental, one tier of binary features is not enough to successfully enumerate the four levels of tone which occur in Soyaltepec Mazatec, nor the overall complexity which exists. However, when Snider's geometry is used as a platform, the behaviors exhibited are easily explained.

5.3 Right Floating Tones

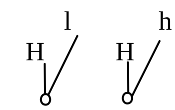
As was described in §5.2.1 above, there are some tones in Soyaltepec Mazatec that are sponsored by one syllable and surface preferentially on the following syllable. The effects of this sandhi process are both widespread and complex in Soyaltepec Mazatec and therefore warrant a more in-depth discussion. First, I describe some common characteristics of right floating tones and then, in the sections that follow, I give detailed examples and demonstrate differences in the behavior of H and M_1.

Certain H and M_1tones in Soyaltepec Mazatec dock preferentially to the syllable which follows their lexical sponsor when they are the second member of specific cluster tones: M_1-H, M_2-M_1 and L-M_1. These types of tones are often considered to be floating tones. They represent an extra tone after the initial one-to-one association has occurred and they seem to have a weaker allegiance to their lexical sponsor than most tones. If there is no available TBU after their lexical segments, they can form a contour on the final lexical syllable of the sponsor syllable. This contour is usually present when the word is said in isolation. The rising pronunciation in isolation is accepted by all speakers; however, for some the rise is produced in free variation with a level tone, i.e., the initial tone of the cluster. For these speakers, the rise is only produced in hyper-enunciated speech. For all speakers whether they always pronounce the rise in isolation or not, in certain contexts (which will be discussed below) the morpheme which hosts the cluster will instigate a tonal change on the following syllable. If a change is instigated on the following syllable, the host syllable will be articulated as the level tone equivalent to its left endpoint. In §5.3.1 I address the behavior of the floating H and in §5.3.2 I address the behavior of the floating M_1.

5.3.1 Floating H

The Mid-high to High contour is the only tonal cluster which hosts a floating High tone. Recall that the M_1-H was introduced in §4.4.1. The underlying representation reveals that the TBU sponsors two TRNs, M_1 (*H l*) and H (*H h*), neither of which usually need to be associated in the lexicon (26) (repeated from (1) in §5.2.1 above).

(26) UR of M_1-H



ʃka
‘pants’

In isolation both sponsored tones can link to the only available TBU producing a rising contour on that TBU as was discussed in §4.4.1; however, this linkage is not in the lexicon. The lack of lexical linkage is the explanation for the mobile behavior of the H that will be exemplified in the coming sections.

In the sections below, I discuss five of the different tonal environments that can follow the M_1-H: a disyllabic L toned word (L L), a disyllabic M toned word (M_2 M_2), a disyllabic word which has a M_2 on the first syllable and a H on the second syllable (M_2 H), a monosyllabic H toned word (H) and a monosyllabic L toned morpheme (L). The behavior of the contour in each environment will be explained. Finally, I summarize the M_1-H discussion.

5.3.1.1 Juxtaposition of the M_1-H with a Disyllabic L Toned Word

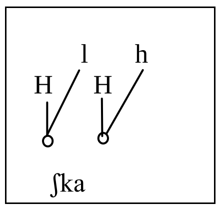
The behavior of the M_1-H contour followed by a disyllabic L toned word was described above in §5.2.1. The derivation illustrated in (1) above is repeated here as (27) for clarity and comparison to other environments in which the mobile H tone has an effect, and to contrast with the mobile M_1. In this environment, the floating H was shown to link preferentially to the first syllable of the following word (27c). The docking of the floating tone causes a redistribution of the tones present so that one of the tones sponsored by the first morpheme surfaces on the second morpheme. All three tones which were lexically specified surface linked to separate TBUs and each syllable is expressed with a level tone.

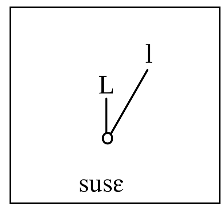
(27) M_1-H when juxtaposed against disyllabic L toned word

a. Data to be explained

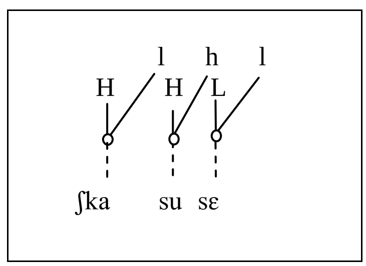
ʃka˥ + su˩sɛ˩ → ʃka˦ su˥sɛ˩
‘pants’ ‘green’ ‘green pants’

b. Underlying Representations





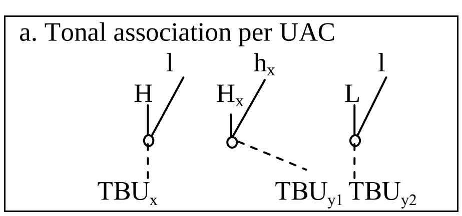
c. Surface linkages in context

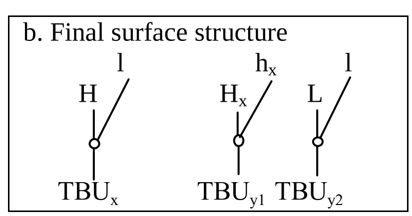


In the case of the disyllabic L toned word, there is only one TRN lexically specified for the two TBUs present; therefore, there is room to accommodate the docking of a second complete TRN without the formation of a contour or the loss of any underlying tonal information.

The process of the floating tone association can be schematized as follows:

(28) Schematization of M_1-H followed by L L





The result of the juxtaposition of the cluster which hosts a floating H tone with a disyllabic low toned word is that the H links to the first syllable of the following word leaving the original Low tone linked to the final syllable of the lexeme. In the next two sections, I examine the juxtaposition of other disyllabic words with different tones to see if this pattern of docking the H as a level tone on the first syllable of the following word is pervasive or limited.

5.3.1.2 Juxtaposition of the M_1-H with a Disyllabic M_2 Toned Word

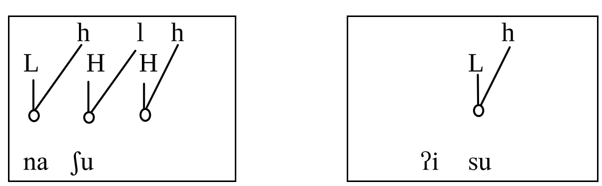
A similar pattern of floating tone attachment as seen in the disyllabic L toned word can be seen when the word following the Mid-high to High contour is a two syllable Mid toned word as in (29). The key similarity to the disyllabic L toned environment already discussed is that the juxtaposed word comes from the lexicon with two syllables but only one TRN. The example in (29) shows the interaction of a sponsor of the M_1-H that is a two syllable word which hosts a M_2 on the first syllable and the M_1-H on its final syllable followed by a disyllabic word with M_2 on each syllable.

(29) M_1-H juxtaposed with disyllabic M_2

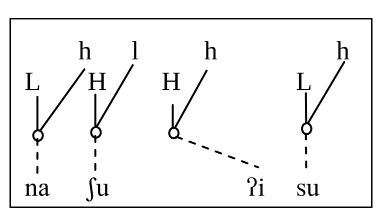
a. Data to be explained

na˧ʃu˥ + ʔi˧su˧ → na˧ʃu˥ ʔi˥su˧
'flower' 'blue' 'blue flower'

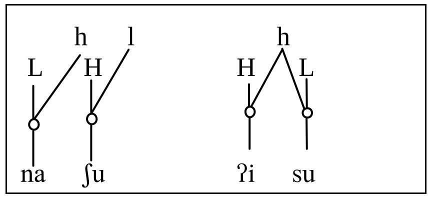
b. UR



c. UAC in context



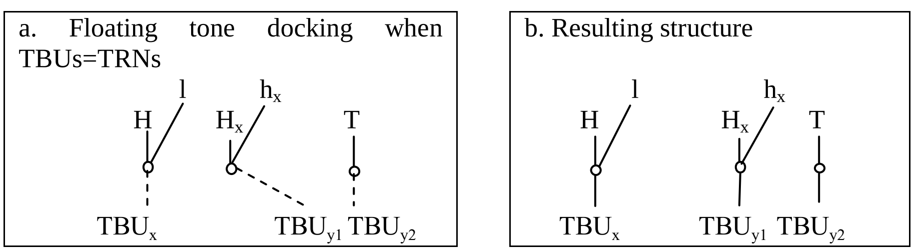
d. OCP merger yields surface structure



In (29b) the first lexeme has more tones than TBUs while the second lexeme has more TBUs than tones. When juxtaposed, the UAC causes the tones to align one-to-one from the left to the right so that each TBU receives one tone (29c). Similar to the disyllabic L toned word, the disyllabic M_2 toned word has room to accommodate the complete TRN of the floating tone without the formation of a new contour or the loss of lexical tonal information. In (29c) two *h* registers are linked to adjacent syllables in violation of the OCP. (29d) shows the surface representation after OCP has instigated merger of the adjacent *h* register features.

The re-association of the floating H in this situation is analogous to the floating H behavior when juxtaposed with the dissyllabic L toned environment; therefore, a similar generalization can be made. The schematized diagram that was presented in (28) above will be repeated here as (30) with a further generalization of the tones on the word following the floating tone.

(30) Schematization of M_1-H cluster followed by disyllabic T toned word



The schematization indicates that if the number of tones and TBUs are the same, the tones will associate one-to-one, left-to-right. The lexical origin of the tones is irrelevant as is the tone on the second lexeme (T). The schematization does not reflect any resulting OCP motivated mergers which may need to happen before the surface structure is finalized. In context, each syllable surfaces with a level tone. Each of these juxtaposed environments has involved a disyllabic word with one associated TRN. In the following section, I present the results of the juxtaposition of a disyllabic word with two TRNs associated lexically.

5.3.1.3 Juxtaposition of the M_1-H with a Disyllabic M_2 H Toned Word

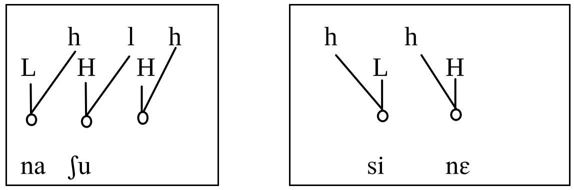
When the M_1-H contour is followed by a disyllabic word which comes from the lexicon with the first syllable designated as a Mid tone and the second syllable designated as a High tone, there is no longer an extra TBU to accommodate the extra tone supplied by the M_1-H. The key difference of this environment is that there are two syllables and two TRNs associated with the word following cluster tone whereas in the above examples, (27) and (29), there were two syllables with only one TRN which allowed the H to attach resulting in an overall equal number of tones and syllables in the resulting utterance. This distribution of the cluster tone over two syllables occurs without the loss of any underlying tonal information and without the formation of any new contours. The additional lexical TRN on the word following the M_1-H introduces a conflict. There is not room for each TRN present in the utterance to occupy a separate syllable after the floating tone docks. If the floating tone behaves in a similar pattern as was described above, then we would expect the H to dock to the first syllable of the juxtaposed word, but since there is not room to accommodate the new TRN we expect some change on the targeted lexeme. Rigid application of the UAC would result in the lexical tones on the targeted lexeme being shifted to the right, forming a contour on the final syllable of that word which potentially could become a floating tone in the proper environment. However, this is not the case. When a morpheme with a M_1-H cluster is juxtaposed to a disyllabic morpheme which hosts two separate TRNs rather than one TRN, the expected floating tone attachment we have seen above does not occur. Consider (31). (31a) shows the data that needs to be explained. (31b) shows the underlying representations of the two morphemes which will be juxtaposed and (31c) shows the apparent surface representation of the words in combination.

(31) M_1-H juxtaposed with M_2 H

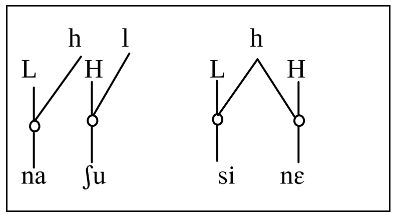
a. Data to be explained

na˧ʃu˥ + si˧nɛ˥ → na˧ʃu˥ si˧nɛ˥
‘flower’ ‘yellow’ ‘yellow flower’

b. UR

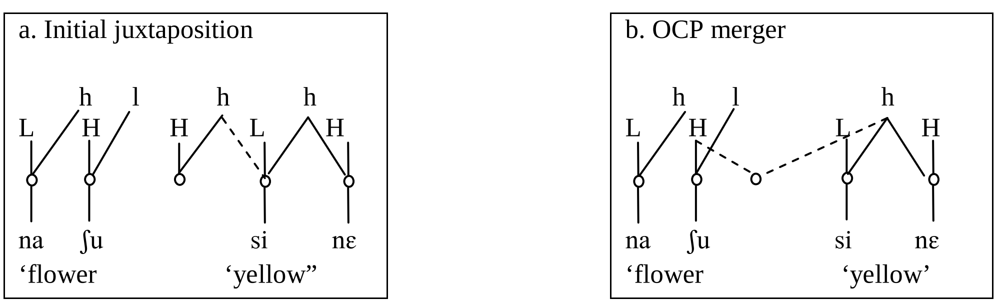


c. Surface tones in context



The extra tone sponsored by the first word in (31b) appears to disappear, having no effect on the surface structure. The pronunciation of the word which follows the floating tone is not changed and the original host surfaces without a rising tone which might have been expected from the behavior of this cluster of tones in isolation. The question of exactly what happens to the superfluous High tone is impossible to answer from this data alone. It is possible that the tone is subject to deletion, or that the *H* melody merges with the *H* melody of the sponsor syllable while the *h* register merges with the register of the target. The behavior of the M_2-M_1 contour that will be discussed in §5.3.2 will give evidence to support the claim that the tonal register attaches to the target syllable (32a) (as is shown by the dashed association line from the *h* register to the TRN) and then merges with the *h* register that is already present (32b), and that the *H* tonal melody either deletes or is merged with its initial host syllable which also has a *H* tonal melody.

(32) Hypothesized floating tone attachment



The structure in (32b) is unusual and perhaps deletion to remove the TRN in the center of the structure is indicated; however, the linkage here depicts the close relationship between the morphemes and mirrors the process which will be demonstrated when a *l*-register is present. There is insufficient evidence to assert a conclusive mechanism without comparison with the effects of the M_1 floating tone that will be discussed below.

In summary, when there is an available syllable with an opened TBU, both the register and melody of the floating H from the M_1-H dock to that TBU as is the case in (27) and (29) above. However, when the adjacent syllable is specified for tonal melody but shares a register feature as in (31), the register feature is able to attach while the *H* tonal melody appears to disappear. The behavior of and effects from the floating tone will become clearer when the M_2-M_1 cluster is examined. Since the behavior is only hypothesized at this point, I will leave schematization until there is more evidence. It is clear that a rigid application of the UAC does not occur. In order to explain the above behavior while still incorporating the UAC, either the tones of the second morpheme must be pre-linked in the lexicon, or the lexical tones for each individual morpheme must be allowed to preferentially attach before floating tones. It is not surprising that the UAC would act first over lexical items; however, it has been shown in §5.3.1.1 and §5.3.1.2 that it can apply across the entire phonological domain rather than preferentially at the lexical level when the numbers of TBUs equals the number of TRNs in that domain.

5.3.1.4 Juxtaposition of the M_1-H with a Monosyllabic H Toned Word

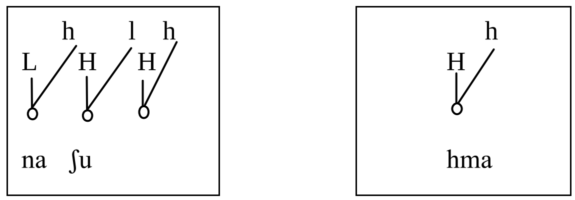
Up to this point, all of the environments demonstrated have been disyllabic. Below, an example of floating H behavior when followed by a monosyllabic word is discussed. It is common for a single syllable High toned word to follow the M_1-H contour. In this situation, the behavior is parallel to that described above in §5.3.1.3. The syllable that hosted the contour will be left with a level Mid-high tone while the juxtaposed High toned word will be left unchanged. Just as example (31) above, in (33) the floating tone and the following syllable share the same register and the tonal melodies are fully specified. In this case, the tonal melody is identical as well. There is no apparent effect on the following syllable.

(33) M$_1$-H juxtaposed with monosyllabic H

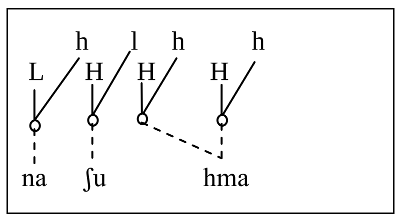
a. Data to be explained

na˧ʃu˥ + hma˥ → na˧ʃu˧ hma˥
‘flower’ ‘black’ ‘black flower’

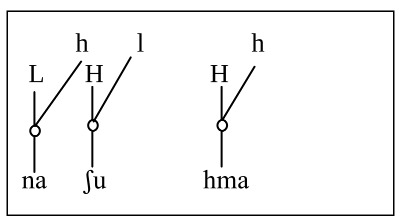
b. UR



c. When juxtaposed, UAC



d. Surface structure after OCP merger or deletion



In this case when the floating tone links to the following syllable, the tonal features are completely identical (33c) so a complete TRN merger can occur (33d); alternatively, the duplicated High tone may simply delete. In this environment, there is never a rising contour on the original host syllable so the situation is not analogous to isolation.

5.3.1.5 Juxtaposition of the M$_1$-H with a Monosyllabic L Toned Morpheme

Placing a monosyllabic L toned word after the M$_1$-H provides an analogous structural environment to that which was discussed in §5.3.1.3 and §5.3.1.4 in terms of the number of available TBUs on the juxtaposed morpheme. If the behavior of the mobile tone is dependent on the structure, we can extrapolate the behavior from that already witnessed and expect to see similar results, i.e., no visible consequence on the following morpheme. Unlike the situation above in which the targeted syllable contains the same features (*H, h*) as the floating tone, when the M_1-H is followed by a monosyllabic L toned word both the tonal register and the tonal melody of the following syllable are different (*L l*). Because of the differences, no merger is possible; therefore, we are able to determine if the tonal features are being blocked due to the presence of a TRN on the adjacent TBU or if they are merging with identical features.

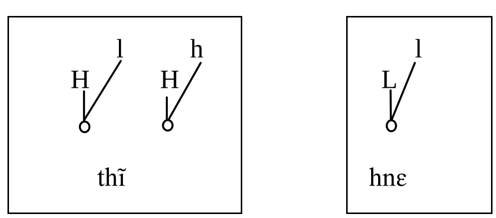
Because neither monosyllabic Low toned words nor M_1-H clusters appear as common modifiers, examples in which Low toned words are preceded by M_1-H cluster are rare within noun phrases; however, examples can be found when verb phrases are included. When a verb is closely associated with the following noun, sandhi is possible (34). In (34b) the behavior of the floating tone is identical to the floating tone attachment that we saw above in the cases of disyllabic Low toned words and disyllabic Mid toned words. The difference that appears is that there is not an extra TBU. In this case, a contour falling from a High tone to a Low tone is formed as is demonstrated by the two TRNs which are associated to one TBU (34c).

(34) M_1-H juxtaposed with monosyllabic L

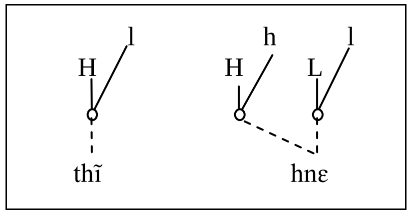
a. Data to be explained

thĩ˥	+ hnɛ˩	→	thĩ˧ hnɛ˥˩
‘there are’	‘palms’		‘there are palms’

b. UR



c. UAC



The monosyllabic environment does not allow the displacement of the tonal information to a following syllable. Rather than overwriting the lexical tones on the targeted morpheme which has the potential to result in ambiguity, both tones are maintained on the same TBU. All of the lexically supplied tonal features from both morphemes are expressed.

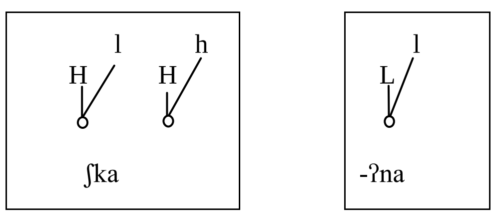
An analogous example is found when a Low toned suffix is added to a noun with a M_1-H cluster (35). Once again the floating tone preferentially attaches to the right (35b).

(35) M_1-H juxtaposed with monosyllabic L toned affix

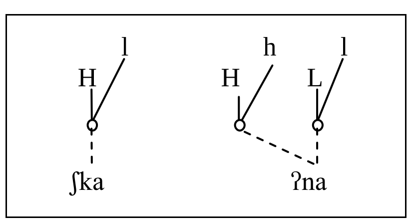
a. Data to be explained

ʃka˥	+	-ʔna˩	→	ʃka˧ʔna˥˩
‘pants’		‘my’		‘my pants’

b. UR



c. UAC



A cross morphemic linkage is formed between the H TRN and the TBU of the suffix. Once again, the falling contour that is formed is maintained in the surface pronunciation. The surface structure would appear after OCP merger of the two H tonal melodies.

These two examples demonstrate that the mobile H from the M_1-H is preferentially expressed on the following morpheme even when there is not an available TBU which is in agreement with the universally expected rightward movement of tones (Cahill 2007).

5.3.1.6 Summary

The floating High tone originates on specific lexical items which in isolation surface with a rising Mid-high to High contour tone; however, in the underlying structure the tones are not linked. Because there are two tones associated with one TBU but they are both linked to that TBU forming a contour only when the morpheme appears in isolation, the term cluster rather than contour may be a more adequate description. The usual behavior of this High tone in context is attachment to the syllable immediately following its sponsor syllable. The sponsor syllable then surfaces with a level Mid-high tone. The tone which surfaces on the syllable to which the High tone prefers to dock is dependent both on the structure of the morpheme and on the tone that already exists on that morpheme. Table 5-1 summarizes the outcomes discussed in this section. The first column indicates the type of morpheme which follows the mobile H tone. The second column describes the tonal substructure of the targeted syllable and, if relevant, indicates whether any of the tonal features are the same as the floating tone's features. The central column indicates the tone which remains on the sponsor syllable. The column second from the end indicates the resulting tone on the targeted syllable and the resulting surface tone of the entire morpheme. The final column indicates the section above in which the behavior is described.

Table 5-1 Summary of Sandhi caused by the M_1-H

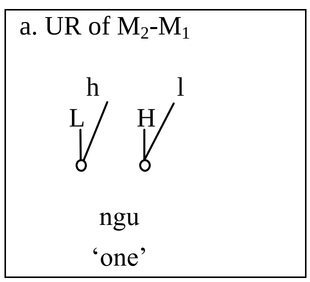
	Specific type targeted word	Tonal shape of target σ -	Resulting tone on sponsor σ	Resulting tone on target σ -word	§ #
A.	L toned disyllabic word	TBU which shares TRN	M_1	changed to H - remaining word unchanged become (H L) and (H M_2) respectively	5.3.1.1
	M_2 toned disyllabic word				5.3.1.2
B.	M_2 H disyllabic word	TBU with own TRN - word with shared register identical to floating tone register	M_1	no change, remains M_2 H	5.3.1.3
C.	H toned monosyllabic word	TBU with own TRN - identical to floating tone	M_1	no change remains H	5.3.1.4
D.	L toned monosyllabic word	TBU with own TRN – different from floating tone	M_1	H linked – becomes falling H-L	5.3.1.5

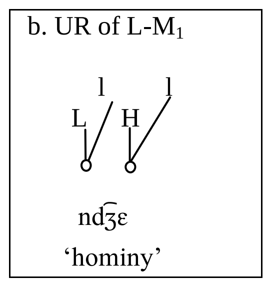
If there is room to displace the lexical tone in order to accommodate the floating tone while maintaining the lexical tone information of the targeted morpheme, as described in Row A of the table, the targeted syllable will appear with a level High tone and the second syllable of the targeted word will retain its original lexical tone. If any tonal features are identical between the floating tone and the targeted syllable, as described in Row B and C, OCP merger is motivated. In Row B, only the register is shared and the tonal melody has no affect on the targeted word. In Row C, both the register and melody features are shared and there is no apparent influence on the targeted word; complete OCP merger occurs. However, if there is not room for tonal displacement and no OCP merger is possible, a contour tone is formed as described in Row D. All of the tonal features that were present in the lexical tonal information appear at the surface level. In each case, when the floating tone is placed into context, its sponsor syllable surfaces with a level tone, a M_1. Finally, the mobility of the H is specific to the M_1-H tonal cluster. Although the M_2-H also has the H as the second member of a rising contour, the H of this contour is not mobile.

5.3.2 Floating M_1

The mobile behavior of the M_1 tone is present in both the M_2-M_1 and the L-M_1. The M_2-M_1 and L-M_1 contours were introduced in §4.3.2 and §4.3.5 respectively and were reinvestigated in §5.2.1 as examples of tonal mobility because of the extra unlinked or floating tones they contain. Because a contour tone is only formed when the sponsor syllable occurs in isolation, phrase finally or word medially, these two lexical tone groups will also be called tonal clusters. The sandhi they produce on the following syllable is identical because the effects are caused by the final tone of the cluster, i.e., the M_1 tone. The difference in the surface tones results because the initial tone in the cluster is different: the M_2-M_1 cluster sponsor will have a level M_2 in context while the L-M_1 will be left with a level L. The behavior of the M_1 floating tone is independent of the initial member of the cluster. The underlying representations which were proposed in (2) and (3) in §5.2.1 will be repeated here as (36).

(36) UR of clusters with M_1 floating tones





Each cluster is composed of two tonal primitives that are associated but not linked to the TBU in the UR. Because there are two TRNs and only one TBU, one of the tones is extra. The M_2-M_1 cluster (36a) consists of a M_2 (*L h*) and a M_1 (*H l*) while the L-M_1 cluster (36b) consists of a L (*L l*) and a M_1 (*H l*).

The behavior of the floating M_1 is similar in many ways to the behavior of the floating H, an unsurprising characteristic considering they each contain a *H* tonal melody. There are, however, some notable differences which will be explained below. The behavior is similar in that the floating tone mechanism is the same. If the following targeted morpheme contains:

i. An available TBU, the second member of the cluster will dock to that syllable (Similar to Table 5-1 A, see examples containing disyllabic L and M_2 toned words in §5.3.2.1 and§5.3.2.2)

ii. Completely specified tonal melodies, the tonal melody will be blocked from having an effect, but the register will remain active and dock to the following syllable (Similar to Table 5-1 B and C, see examples containing disyllabic M_2 H words in §5.3.2.3 and monosyllabic H in §5.3.2.4)

iii. A monosyllabic morpheme, a falling contour will usually be formed (Similar to Table 5-1 D, see examples containing monosyllabic morphemes in §5.3.2.5 and §5.3.2.6)

While the evidence for the activity of the tonal register was inconclusive in §5.3.1.3, clear evidence for this activity, despite blockage of the tonal melody, will be seen below in §5.3.2.3. The difference in noticeable effect is due to the difference in register of the mobile tone: the H has a *h* register while the M_1 has a *l* register.

In the sections that follow, the same environments that were discussed with the M_1-H cluster above will be illustrated for the mobile M_1: disyllabic L toned morphemes, disyllabic M_2 toned morphemes, disyllabic morphemes with M_2 on the first syllable and H on the second, monosyllabic H toned morphemes and monosyllabic L toned morphemes. In addition, an example of a monosyllabic M_2 toned morpheme will be discussed. For each environment, the similarities and differences between the effects of floating a H tone versus a floating M_1 tone will be discussed.

5.3.2.1 Juxtaposition of the Floating M_1 with a Disyllabic L Toned Word

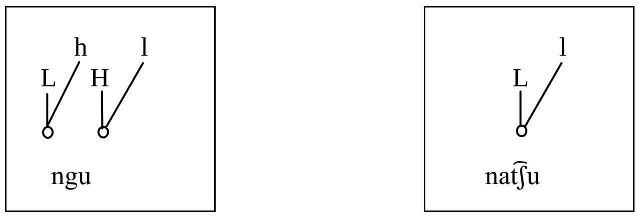
The first environment to be discussed is the juxtaposition of a disyllabic word with two level low tones. This behavior was exemplified above in the discussion concerning mobility and is parallel to the behavior of the M_1-H cluster. Recall that in the case of the disyllabic Low toned word, there is only one tonal melody and one tonal register associated with the two syllables; therefore, there is room to accommodate a second complete TRN without the formation of a contour. The case of the M_2-M_1 cluster was demonstrated in example (2) and will be repeated here as (37). The M_2 links to the cluster's original host syllable and the M_1 docks to the first syllable of the following word (37c) which surfaces with the M_1 on its first syllable and the L from its lexical specification on its second syllable.

(37) M_2-M_1 juxtaposed with disyllabic L

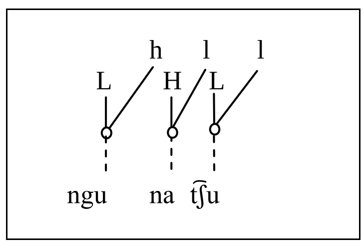
a. Data to be explained

ngu˧˥ + na˩t͡ʃu˩ → ngu˧ na˦t͡ʃu˩
‘one’ ‘squash’ ‘one squash’

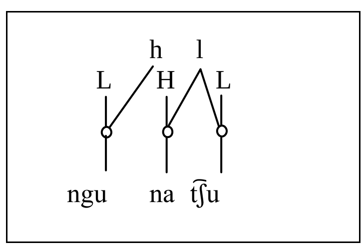
b. Underlying Representations



c. Surface linkages in context



d. OCP motivated *l*-register merger



The first TBU on the targeted morpheme is considered available because it is part of a disyllabic morpheme which hosts only one TRN; the morpheme has two TBUs but only one TRN. In (37c), two *l*-registers are linked adjacently to the same morpheme, so merger is motivated by the OCP (37d). Each syllable in the final representation hosts one tone and all three tones which were lexically supplied are expressed as level tones.

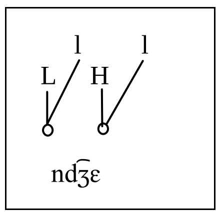
The L-M_1 mimics the behavior of the M_2-M_1 when juxtaposed with a disyllabic Low toned word. The first syllable of the juxtaposed word will surface with a Mid-High tone while the original sponsor syllable of the cluster surfaces with a level Low tone. The example from (3) above is repeated here as (38). As has already been demonstrated, when the two morphemes are in context, the UAC links one tone to each TBU irrespective of the tone's lexical origin (38c) which each surfaces with a level tone.

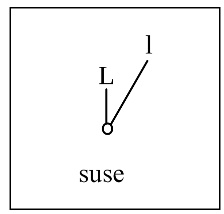
(38) L-M_1 juxtaposed with disyllabic L

a. Data to be explained

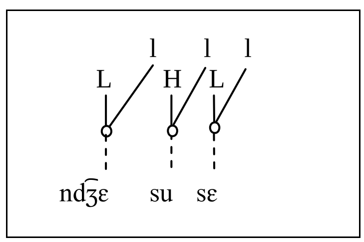
nd͡ʒɛ˩˧	+	su˩sɛ˩	→	nd͡ʒɛ˩ su˧sɛ˩
'hominy		'green'		'green hominy'

b. Underlying Representations

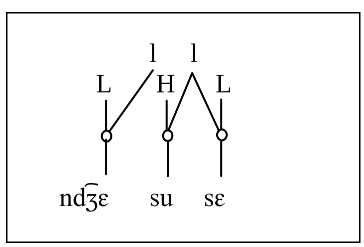




c. Surface linkages in context



d. OCP motivated *l*-register merger

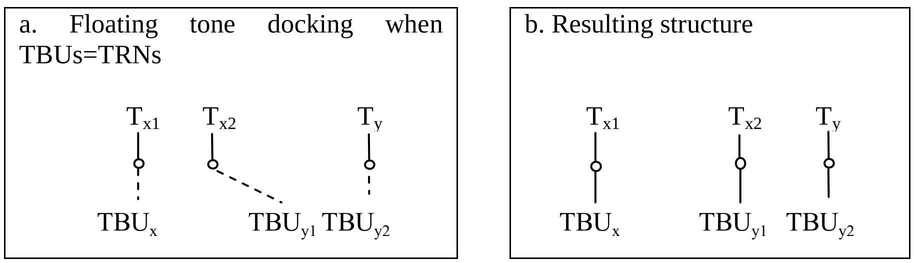


In (38c) two *l* registers are brought into close association by the new linkage and merger as is motivated by the OCP gives the surface structure (38d).[127]

[127] Actually, the *l*-register of the initial morpheme will also participate in this OCP merger as will be demonstrated below in §5.3.2.6.

In the case of juxtaposition of the M_2-M_1 and L-M_1 clusters with disyllabic Low toned words, the docking of the M_1 floating tone is analogous to the behavior of the floating H of the M_1-H contour in a similar environment as was described in §5.3.1.1. The schematization that was offered there can be expanded to include the floating M_1. The only differences in the schematization are the generalizations of the tonal feature specifications to a completely generic (T). The subscript *x* and *y* are used to indicate the tonal origin.

(39) Schematization of Floating T_x docking to disyllabic T_y toned word



The behavior of the floating tones in these examples is in agreement with what would be expected to be motivated by the UAC with a left to right directionality. At this level of representation, it is identical to standard Autosegmental Phonology.

5.3.2.2 Juxtaposition of the Floating M_1 with a Disyllabic M_2 Toned Word

The juxtaposition of the floating M_1 with a disyllabic M_2 toned word is the first case in which the importance of specifying the features of the M_1 as (*H l*) is apparent. Not only do these features precisely distinguish four levels of tone from one another, they also explain the odd influence that the M_1 has on a following morpheme. Initially, the rightward docking of the floating M_1 onto a disyllabic M_2 toned word is comparable to that of the floating H discussed above in §5.3.1.2. In each case, the floating tone docks on the first syllable of the juxtaposed word which is considered available because the disyllabic morpheme lexically contains only one tonal specification and therefore one TRN. The second syllable of this juxtaposed word, however, demonstrates a departure from the pattern discussed above. In this case there is a lowering effect which stems from the spreading of the *l* register of the M_1. At this point, a level of complexity beyond standard Autosegmental Phonology becomes necessary in order to both describe and explain the behavior that occurs.

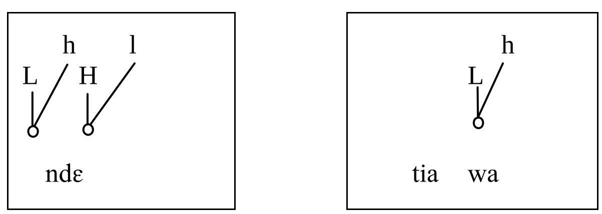
In (40) a monosyllabic noun which has the M_2-M_1 cluster is juxtaposed with a disyllabic M_2 toned modifier. The result is that the monosyllabic noun is left with a level M_2 while the first syllable of the following word is changed to a M_1 as might be expected based on a standard floating tone mechanism; however, instead of leaving the lexical tone on the second syllable as we would have expected, the second syllable surfaces with a Low tone (40a). The explanation for this change is found in the *l*-register feature of the M_1 which spreads in this context (40d) causing the delinking of the original *h*-register.

(40) M_2-M_1 juxtaposed with disyllabic M_2

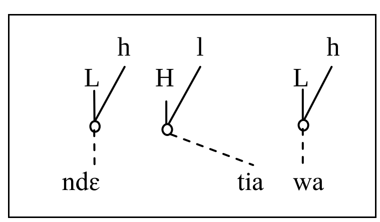
a. Data to be explained

ndɛ˧˦	+	tia˧wa˧	→	ndɛ˧ tia˦wa˩
'shoe'		'white'		'white shoe'

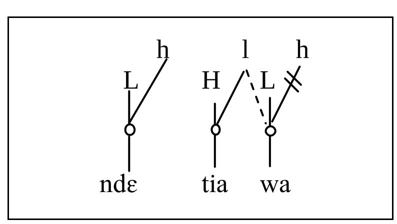
b. UR



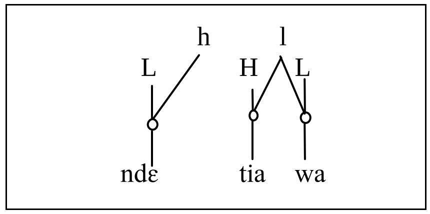
c. UAC in context



d. *l*-register spread, *h*-register delink



e. Surface representation (after stray erasure)



In (40c) we see the initial association of the floating M_1 as predicted by the UAC and in the same manner that we have seen in most of the above examples. In the other examples that we have seen, the utterance would surface with the structure depicted in (40c); however, this structure does not reflect the surface reality in this case. What is unexpected is that the second syllable becomes Low instead of remaining Mid. The *l*-register spreads as is shown by the dashed line in (40d). When the *l*-register spreads, the underlying *h*-register delinks, shown by the bars across the association line in (40d). The *h*-register which is delinked does not remain floating, but stray erases. It does not re-link to its sponsor syllable to cause a contour there, nor does it cause sandhi in a following word. This second syllable of the targeted word contains a lowered Mid tone which is represented by $^{\downarrow}M_2$. This tone has the same features as a Low tone (*L l*). The register spreads without affecting the tonal melody in a manner reminiscent of downstep in African tone languages. The low register causes the syllable to be articulated at a lower pitch, even though the tonal melody feature has not changed. The *l*-register spread is licensed by the derived environment. The *l*-register spread does not occur just because a M_1 precedes a M_2, it is specific to the environment created by the mobile M_1. Recall from §4.5.1 that there are lexical examples of words with a M_1 on the first syllable and M_2 on the second, so the word pattern is not disallowed or automatically overwritten by the automatic spreading of the *l*-register. Some examples appear in (41).

(41) Examples of words with M_1 M_2 word pattern

	Soyaltepec	Gloss
a.	mi˦nd͡ʒi˧	‘to hoe’
b.	t͡ʃhu˦ja˧	‘to sew’

c. ʔo˥kha˧ ‘he breaks’

d. ka˥tɛ˧ ‘thirty’

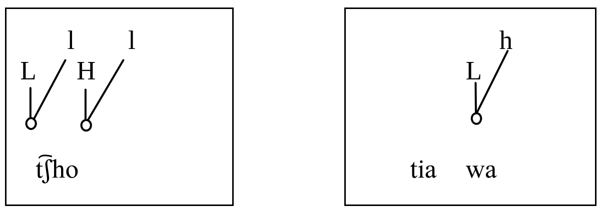
The L-M_1 cluster produces an analogous result in a similar environment (42).

(42) L-M_1 juxtaposed with disyllabic M_2

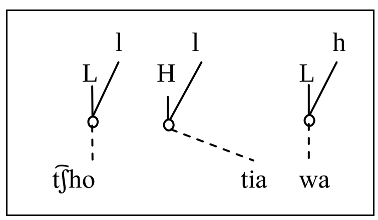
a. Data to be explained

t͡ʃho˩˧	+	tia˧wa˧	→	t͡ʃho˩ tia˥wa˩
‘egg’		‘white’		‘white egg’

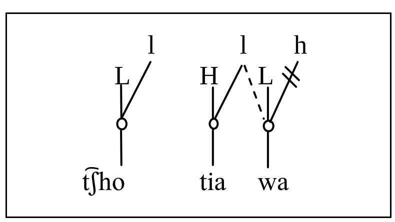
b. UR



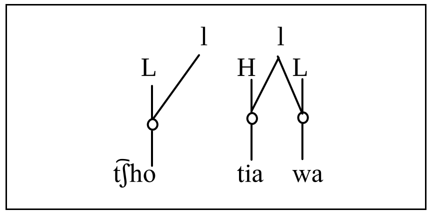
c. UAC in context



d. *l*-register spread, *h*-register delink



e. Surface representation (after stray erasure)



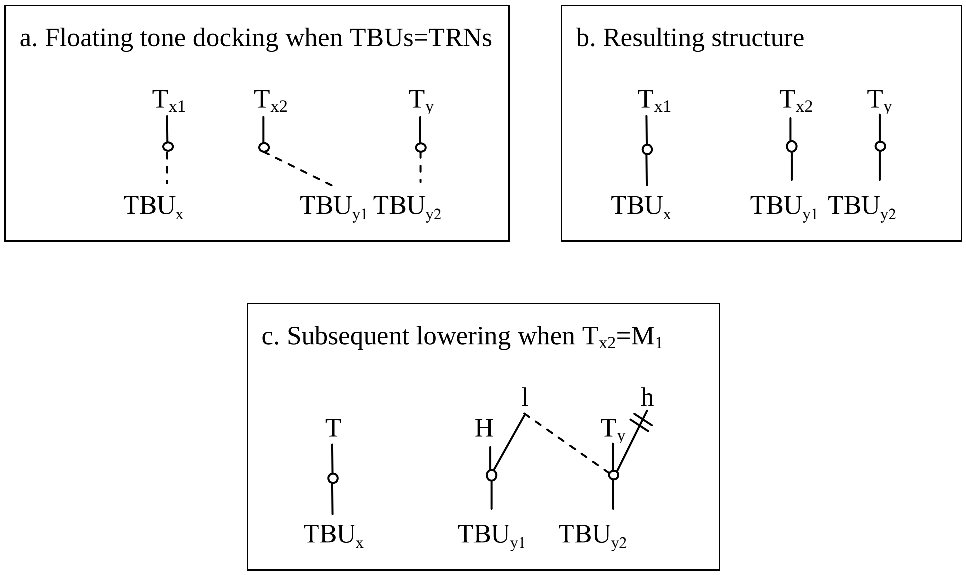
Again, the floating M_1 docks to the TBU to the right of its sponsor TBU (42c) producing a level M_1. Similarly to the situation discussed for the M_2-M_1 cluster; this process does not produce the final surface form. The surface form is produced when the *l*-register spreads to the second syllable of the disyllabic word, thus lowering that syllable to a $^{\downarrow}M_2$ (*L l*) (42d). Once again the previously linked *h*-register is delinked (42d) and stray erases, yielding the surface form (42e).

The behavior of the floating M_1, is the same regardless of which cluster sponsors it. When a cluster which contains a floating M_1, is juxtaposed with the disyllabic M_2 word, the floating tone mechanism is similar to that for the floating H that was discussed above; however, the *l*-register spread is novel. The floating tone attaches to the first syllable of the disyllabic word producing an intermediate word form with a M_1 M_2 pattern; however, that is not the complete picture. In this case the *l*-register from the M_1 also has an effect on the remainder of the targeted word. This lowered M_2 on the second syllable is easily explained through the spreading of the *l* register. If we had chosen to represent the levels of tone in one dimensional manner such as through simply representing them with an integer value (or T_x as in (39) above), it would be difficult to explain why this second to highest level of tone should ever have a lowering effect on the following syllable.[128] Employing Snider's geometry provides a simple and elegant explanation for the observed phenomena. The multi-tiered geometry allows the spreading of the *l*-register separately from the tonal melody and explains how a Mid-high tone can have both a raising and a lowering effect on the following word.

[128] A possible phonetic explanation could be hypothesized in the form of dissimilation, but then the existence of the M_1 M_2 lexical word pattern would need to be explained.

The floating tone docking schema that we proposed above needs another adjustment to account for the behavior of the register. Because only the *l*-register spreads and the effect is only noticeable when a *h*-register is displaced, the schema will still work for the majority of cases. A second step is necessary when the environment aligns as described.

(43) Floating tone docking rule with specification for subsequent lowering



When the register feature on the floating tone is *h*, the environment is not met and the *l* spread of (43c) is not enacted. When the register feature on the final syllable is already *l*, the effects of the *l* spread are invisible. (43c) will serve to lower both a High tone and a Mid tone.

5.3.2.3 Juxtaposition of the Floating M_1 with a Disyllabic M_2 H Toned Word

The third environment that will be addressed is the juxtaposition with a disyllabic M_2 H toned word, a word which has a separate tone specified for each syllable. In §5.3.1.3 on floating H tones in this environment, it was hypothesized that the register feature attached to the targeted syllable and the melody feature was stray erased; however, there was little evidence to confirm this assertion. In this section, the behavior of the floating M_1 will confirm the behavior that was postulated. Because the M_1 has a *l*-register rather than a *h*-register, the behavior of the register is evident.

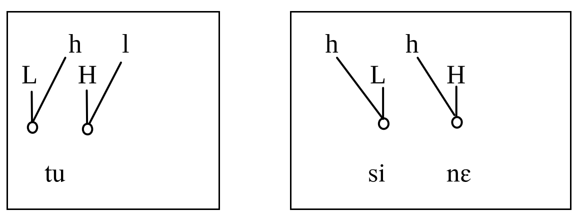
The sandhi which occurs when a M_2-M_1 cluster is juxtaposed with a disyllabic M_2 H word is shown in (44). The underlying representations are shown in (44b). The targeted morpheme has two separate tonal melodies but only one tonal register is specified, so OCP merger can combine the *h*-registers. Similar to the example in §5.3.1.3, the TRN of the M_1 is blocked from associating as is demonstrated by the bar blocking the dashed association line (44c). Even though the TRN is blocked, the *l*-register still spreads, delinking the *h*-register (44d) which is an iterative process (44e). The *l*-register spread causes the complete delinking of the *h*-register from both TBUs (44e) which results in the downstep of the entire morpheme. (44f) shows a potential surface structure; however, this structure leaves two unresolved issues. The first is the floating H melody which still has its TRN. The second is the floating h register. These two unassociated tonal features probably stray erase; however, more research is needed to confirm this.

(44) M_2-M_1 followed by a M H

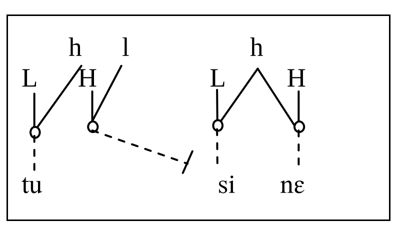
a. Data to be explained

tu˦ + si˧nɛ˥ → tu˧ si˩nɛ˦
'fruit' 'yellow' 'yellow fruit'

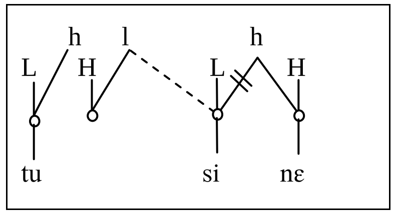
b. UR



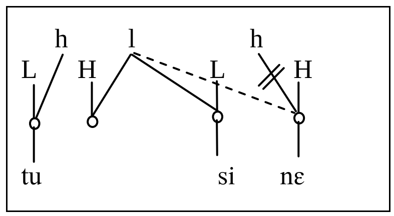
c. UAC (and OCP merger of *h*-register), M_1 TRN blocked



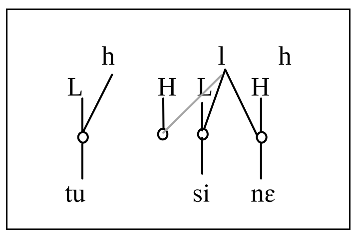
d. *l*-register spread with *h*-register delink



e. *l*-register spread with *h*-register delink (an iterative process)



f. Surface structure



The floating Mid-high tone has an effect on the register of the following syllable; however, the tonal melody is not affected. There is at this point insufficient evidence to conclusively postulate the fate of the *H* tonal melody or the *h* tonal register which are left unassociated. The overall effect of the floating Mid-high tone in this environment is a lowering of the following word. The lowered ꜜM_2 (*L l*) is phonetically and phonologically equivalent to a L (*L l*) while the lowered ꜜH (*H l*) is phonetically and phonologically equivalent to a M_1 (*H l*). The word therefore maintains its overall tonal shape (i.e., the second syllable is higher than the first by two levels of tone) while being lowered as a unit (from M_2 H to L M_1).

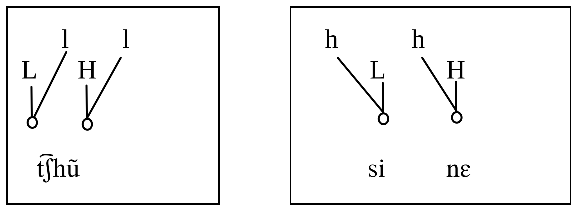
The L-M_1 cluster produces analogous results. Consider the example in (45).

(45) L-M_1 juxtaposed with disyllabic M_2 H

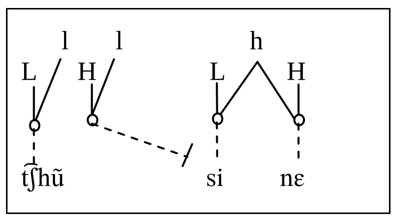
a. Data to be explained

t͡ʃhũ˩˧ + si˧nɛ˥ → t͡ʃu˩ si˩nɛ˧
‘woman’ ‘yellow’ ‘yellow woman’

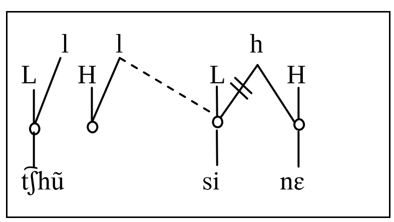
b. UR



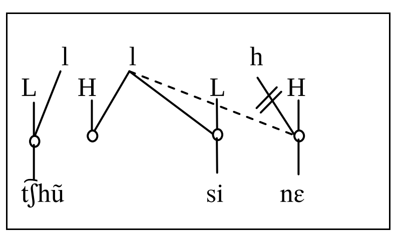
c. UAC (and OCP merger of *h*-register)



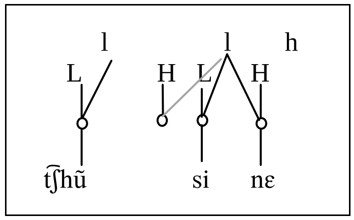
d. *l*-register spread with *h*-register delink



e. *l*-register spread with *h*-register delink (an iterative process)



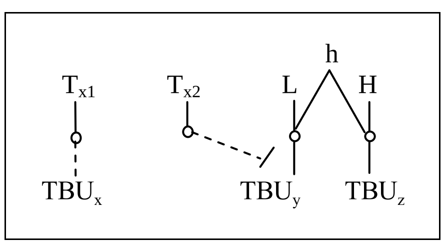
f. Surface structure



The syllable which hosted the Low to Mid-high cluster tone surfaces with a level Low tone as expected and the modifier that follows this word surfaces with a lowered tone on both syllables ↓(M_2 H). The word which normally appears as a Mid (*L h*) followed by a High tone (*H h*), now begins at the phonetic Low level (*L l*) and is followed by a phonetic Mid-High level tone (*H l*) because the *h*-register on both syllables was replaced by a *l*-register through low register spreading. As in example (44), the tonal melody does not appear to have any effect on the surface realization of the utterance.

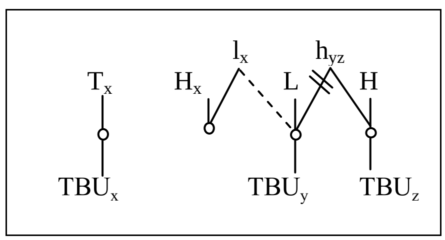
As was introduced in §5.3.1.3, the rigid application of the UAC does not produce the correct results. In both (44) and (45), it is evident that the lexical tones for each morpheme are given precedence over the cross morphemic linkage. Because there is a TRN already associated with each TBU of the juxtaposed word, the linkage of the floating tone at the level of the TRN to the TBU is blocked. (46) is a schematized illustration of the environment. The dashed association line with bar across it depicts the blocked association of the floating tone. At this point, the only verified blockage of this sort occurs when the second morpheme has a M_2 H tonal melody, so the tonal features are specified exactly

(46) TRN docking blocked



While each TRN in (46) has a specified tonal melody, TBU_y and TBU_z share one tonal register feature. Because these TBUs are not fully, uniquely specified, there is room of the accommodation of the tonal register from the floating tone as was demonstrated in (44d) and (45d) without conflict or contour formation; however, it is unclear if this is a linkage similar to a floating tone linkage or if it is simple *l*-register spreading. The result is the same. Recall that while most of the floating tone linkages in Soyaltepec Mazatec occur between the level of the TRN and TBU, linkages between feature nodes, either the tonal melody feature or the tonal register feature, and the TRN are also acceptable. In this case, the *l*-register spreads to the neighboring TRN causing it to delink from its original register, a process which is only visible if the neighboring register is different, i.e., *h*. The depiction in (47) could be generalized because theoretically the process can happen regardless of the register specification present; however, in practice in Soyaltepec Mazatec, the *l*-register is the only one that spreads, and the spread is only visible when the neighbor is a *h*.

(47) Register docking with delink



The environment of (47) is now appropriate for the normal *l*-register spreading that was specified in (43c) to occur. Employing RTT's multi-tiered geometry allows the spreading of the *l*-register separately from the tonal melody, and explains how a Mid-high tone can have a lowering effect on the following word, even when the raising effect of the *H*-tonal melody is blocked.

5.3.2.4 Juxtaposition of the Floating M_1 with a Monosyllabic H Toned Word

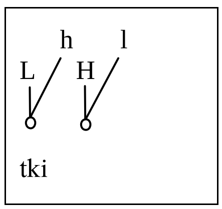
The effect of juxtaposing a monosyllabic H toned morpheme after a floating M_1 is similar to the effect described above in §5.3.2.3. Structurally, the targeted morpheme has an equal number of TRNs and TBUs, so we do not expect the floating tone to be able to attach; however, as was demonstrated in §5.3.1.6, when monosyllabic morphemes follow a floating tone, a contour can be formed. Furthermore, in this scenario, the floating tone and the following morpheme have identical melody features which we expect to merge based on the OCP. When the floating tone was a H (§5.3.1.5), there was no apparent change in the following morpheme since both the melody and register features were identical. The M_1, however, provides a *l*-register instead of the *h*-register of the H tone. Based on the behavior of the M_1 with the disyllabic M_2 H toned word, we expect the floating M_1 to have a downstepping effect on the following H. Example (48) demonstrates the downstepping of the H when it follows the M_2-M_1 cluster.

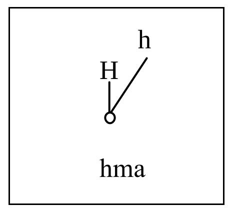
(48) Floating M_1 juxtaposed with a monosyllabic H

a. Data to be explained

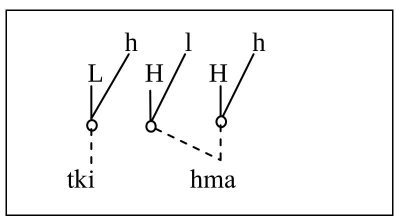
tki˧˦	+	hma˥	→	tki˧ hma˦
'medicine'		'black'		'black medicine'

b. UR

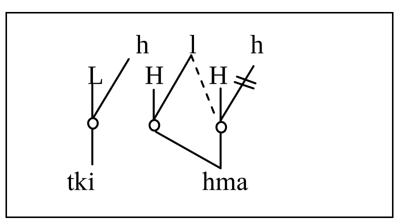




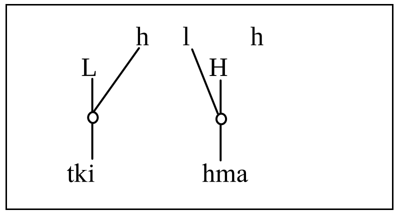
c. When juxtaposed, UAC



d. *l*-register spread, *h*-register delink



e. OCP merger produces the surface form



In (48b) the TRN of the floating M_1 links to the following TBU. When this happens, two *H* melodies are linked to the same TBU and an OCP motivated merger is required before the surface structure can be produced. There are also two tonal registers which can either remain associated with the same TBU thus forming a rising contour (M_1-H) or the second tonal register can be delinked which produces a level M_1. Both of these options occur in Soyaltepec Mazatec, but the more normal pronunciation is a level M_1. The targeted syllable's surface tone can be interpreted as being a downstepped High tone, i.e., $^{\downarrow}$H (*H l*) which is phonetically and phonologically the same as the M_1.

5.3.2.5 Juxtaposition of the Floating M_1 with a Monosyllabic L Toned Word

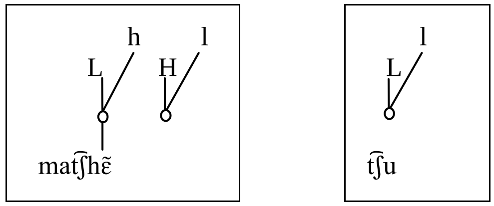
The behavior of the floating M_1 when it precedes a monosyllabic L toned word is similar to the behavior of the floating H in a similar environment occurs, i.e., the formation of a falling contour. The only difference is the presence of the *l*-register from the M_1 which merges with the l-register of the L toned target word. Consider the example in (49) in which a verb with a floating tone precedes its Low toned subject. In this case, the verb is disyllabic and has one pre-linked M_2 on its final syllable (49b). When the UAC applies (49c) the first syllable receives its tone through linking to the same M_2 which is already linked to the final syllable. It links because the UAC aligns the initial syllable of the word with the initial tone of the word, even if this tone is pre-linked.

(49) M_2-M_1 juxtaposed with L

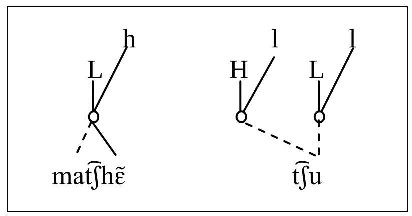
a. Data to be explained

ma˧t͡ʃhɛ̃˦	+	t͡ʃu˩	→	ma˧t͡ʃɛ̃˧ t͡ʃu˦˩
'needed'		'animals'		'animals are needed'

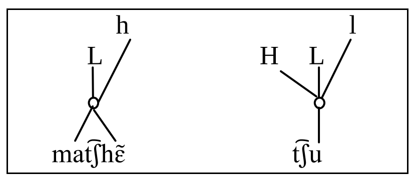
b. UR



c. UAC



d. OCP – surface structure



In this case, both the floating tone has a *l*-register and the attacked syllable has a *l*-register so merger occurs rather than register spreading (49c-d). The alternate pronunciation of a level M_1 on the juxtaposed syllable which was preferred for in (48) is rare in this case. Two factors motivate the difference in pronunciation between the level M_1 and a contour. First, the L tone in Soyaltepec Mazatec is usually expressed somewhere on the morpheme if it is present lexically. In the monosyllabic case, a contour is formed because there is no second syllable on which to displace the *L* melody. Second, *l*-register spread is expected in the environment following a floating tone, so in this case, the *l*-register from the floating tone can spread and merge with the *l*-register of the targeted syllable without affecting the tonal melody tier which is forming the contour. In the example in (48) where the targeted syllable hosts a H tone, the only available contour is on the register tier and *l*-register spread displaces the h-register.

5.3.2.6 Juxtaposition of the Floating M_1 with a Monosyllabic M_2 Toned Word

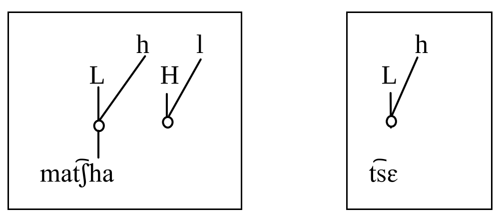
The behavior of the M_1 floating tone when followed by a M_2 toned monosyllabic word provides another opportunity to observe the expected contour formation on a monosyllabic morpheme accompanied by *l*-register spread. In this case, the targeted syllable has a *L*-tonal melody and a *h*-register. Based on the previous two examples, we expect the formation of a falling contour because both the *H*-melody from the floating tone and the *L*-melody from the targeted tone should be expressed. We also expect the *h*-register to be overwritten by the *l*-register from the floating tone. Consider (50) in which the targeted syllable is a monosyllabic Mid toned noun following a verb which ends with a M_2-M_1 cluster. Once again, the sponsor of the floating tone is a disyllabic verb which has a M_2 pre-linked to its final syllable in the UR.

(50) Floating M_1 juxtaposed with monosyllabic M_2

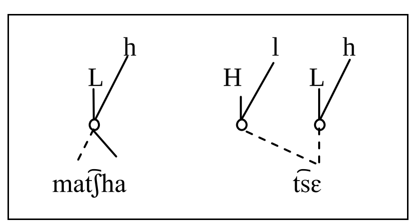
a. Data to be explained

ma˧t͡ʃha˦ + t͡sɛ˧ → ma˧t͡ʃa˧ t͡sɛ˦˩
'grow' 'guavas' 'guavas grow'

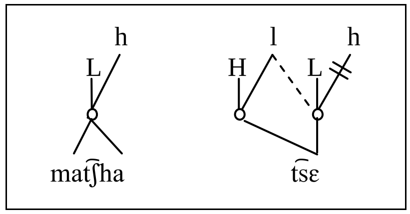
b. UR



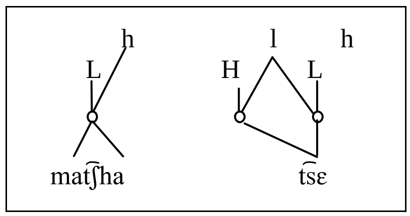
c. UAC



d. *l*-register spread with h-register delink



e. Surface Structure



The process in (50) is very similar to the process that we saw in (49), the difference being the underlying presence of a *h*-register on the targeted syllable. Therefore, instead of *l*-register merger, we see *l*-register spread with the accompanying delink of the original *h*-register. The result is a falling M_1-$^{\downarrow}M_2$ contour which is phonetically equivalent to a M_1-L.

A key difference between the tonal behavior illustrated here and that which was seen in the disyllabic M_2 H examples in §5.3.2.3 is that the targeted morpheme is monosyllabic. Even though the tone on the targeted syllable is fully specified and in this case exactly the same as in those examples, the floating tonal melody is not blocked as it was there. This is a special circumstance for monosyllabic morphemes.

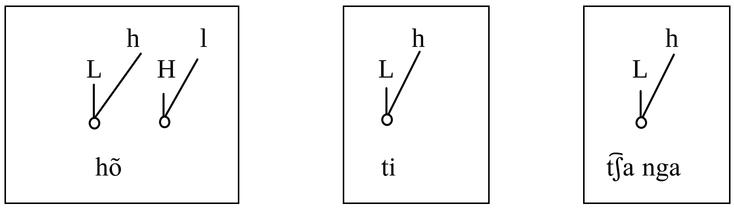
I will give one final example to demonstrate the spreading of the *l*-register to the end of the phonological word which in a Soyaltepec Mazatec noun phrase can include modifiers with the noun. In (51) the example contains a floating M_1 that occurs on a quantifier which is the initial member of the noun phrase. This floating M_1 is juxtaposed with a monosyllabic M_2 toned word in a manner that is parallel to (50) above. The difference here is that the monosyllabic M_2 toned word is followed by a modifier which is part of its phonological word, i.e., the domain of the register spread.

(51) M_1 juxtaposed with a mono-σ M_2 which is part of a larger phonological domain

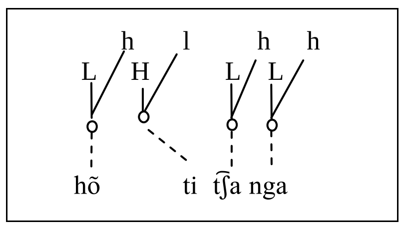
a. Data to be explained

hõ˧˦ + ti˧ + t͡ʃa˧nga˧ → ho˧ ti˥ t͡ʃa˩nga˩
‘six’ ‘boy’ ‘gray’ ‘six gray boys’

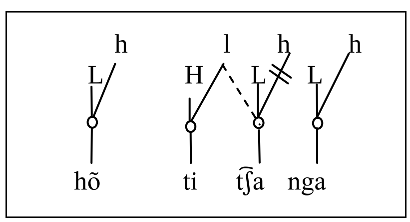
b. UR



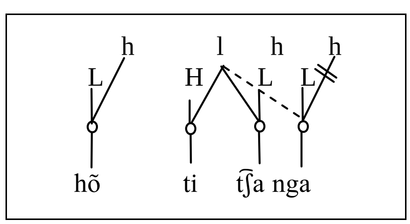
c. UAC



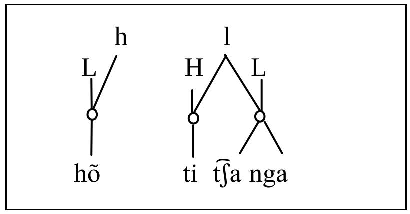
d. *l*-register spread with h-register delink



e. *l*-register spread with h-register delink (iterative)



f. Surface representation after OCP merger and deletion



Lexically, there are three separate words which are specified as a cluster M_2-M_1, a monosyllabic level M_2 word and a level, disyllabic M_2 toned word. When the words are juxtaposed, several processes take place. First, since the noun and modifiers are closely associated, a single phonological domain is formed. Second, when the UAC motivates tonal linkages (51c), four separate linkages occur, aligning the four available tones with the four available TBUs. Third, *l*-register spread happens twice, (51d, e). And finally, the OCP motivates identical, adjacent features to merge (51f) and deletion removes unassociated features. These three words are now articulated with the first syllable as a level Mid tone, followed by a level Mid-High toned syllable, followed by two syllables each articulated at a Low tone. The two fold effect of the Mid-High floating tone is that it is expressed as a level M_1 tone on the middle word and it lowers the final word to a Low; an effect that is only possible with the expanded geometry offered by RTT.

The two examples in this section demonstrate that the monosyllabic situation is special. When a monosyllabic morpheme is the target of a floating tone, a contour tone is able to form. However, when the target's domain is expanded to be trisyllabic but with only one specified tone, the floating tone causes the tones to redistribute so that a contour does not form. I do not have an example of a larger domain that does not contain a tonal plateau. In this environment, I hypothesize that the contour would still form, but further research is needed for confirmation.

5.3.2.7 Summary

The floating M_1 tone occurs as part of two clusters, the M_2-M_1 and the L-M_1. Regardless of which cluster sponsors the floating tone, its behavior is the same. The floating M_1 possesses a similar floating tone mechanism to the floating H; however, the results of its linkage are slightly different. While the floating H, when active, raises all or part of the following syllable and has no influence on the rest of the morpheme, the floating M_1 both can raise all or part of the following syllable and can lower the following syllable as well as the rest of the morpheme. The investigation of the floating M_1 demonstrates the need for a lowering element in the Mid-high tone since words (or parts of words) following the floating tone surfaced lower than their lexically specified tones as was demonstrated in §5.3.2.2, §5.3.2.3, §5.3.2.4 and §5.3.2.6. The presence of the low register feature on the M_1 provides an explanation for the lowering effect of the tone, specifically, the spreading of the *l*-register. Adopting the geometry of RTT allows first, the presence of the l-register as part of the Mid-high tone and second it allows the spreading of this feature independently, as a discrete entity separate from the tonal melody.

Table 5-2 summarizes the activity of the floating M_1. As has been repeatedly demonstrated, the initial tone of the cluster is unaffected by the activity of the floating tone, so it will not be addressed in the table. The first column indicates the type of word which follows the floating tone. The second column describes the substructure of the tonal specification of the word and specifies its tonal register. The third column describes the changes that take place in the targeted morpheme. Within each block in this column, first the effect on the immediately adjacent syllable is listed, then the effect on the remainder of the word is summarized and finally the resulting surface tone of the entire word is indicated after the word 'becomes.' The final column references the dissertation section in which the behavior is described.

Table 5-2 Summary of Sandhi caused by the floating M_1

	Specific type of targeted word	Tonal shape of target σ – register present	Resulting tone on target σ – change on word, surface tone	§ #
A.	L toned disyllabic word	TBU which shares TRN *l* register	changed to M_1 – remaining word unchanged, becomes (M_1 L)	5.3.2.1
B.	M_2 toned disyllabic word	TBU which shares TRN *h* register	changed to M_1 – remaining word lowered, becomes (M_1 ${}^{\downarrow}M_2$)	5.3.2.2
C.	M_2 H toned disyllabic word	TBU with own TRN no shared tonal melody - but shared *h* register	no tonal melody change- entire word lowered, becomes ${}^{\downarrow}$(M_2 H)	5.3.2.3

Table 5-2 - continued

D.	H toned monosyllabic word	TBU with own TRN tonal melody same as floating tone *h* register	no tonal melody change (OCP merger)- H lowered, becomes ($^{\downarrow}$H)	5.3.2.4
E.	L toned monosyllabic word	TBU with own TRN tonal melody different *l* register	M_1 added- L unchanged, becomes falling M_1-L	5.3.2.5
F.	M_2 toned monosyllabic word	TBU with own TRN tonal melody different *h* register	M_1 added- M_2 lowered, becomes falling M_1-$^{\downarrow}M_2$	5.3.2.6

As can be seen in the table above, even when the tonal melody from the floating M_1 has no influence on the following syllable (as in Row C and D), the register still has influence. In rows A and B the syllable following the floating tone's sponsor becomes a level M_1. The targeted morphemes in these two sections include disyllabic words with more syllables than TRNs. There is therefore room to accommodate the entire floating tone without forming a contour or losing any lexical information. The difference between the examples represented by row A and row B is that examples in row A already host a *l*-register, so their registers are not changed by the spread of the *l*-register from the floating tone.[129] The examples in row B, on the other hand, host a *h*-register, and are therefore lowered by the *l*-register spread from the floating tone. Row C summarizes the consequences of the juxtaposition of the floating M_1 and a disyllabic M_2 H toned word. In this case, the tonal melody is blocked since the targeted syllable has its own TRN, but the register is still active. The entire word which began with a shared *h*-register is lowered to the *l*-register. Rows D through F describe the consequences of the juxtaposition of monosyllabic words with the M_1. The examples in D share a tonal melody with the floating tone and therefore OCP merger occurs. The examples in E and F have a different tonal melody than the floating tone and therefore contours are formed. The examples in D and F begin with a *h*-register and are therefore subject to lowering.

[129] Note that the specified *l*-registers must either merge or experience a similar overwriting since two consecutive *l*-regsiters would be visible by a sequential downstepping of the pitch

5.3.3 Summary of right floating tones

The above discussion and examples have demonstrated the behavior of two floating tones in six types of environments. Several unifying characteristics are evident. First, concerning the floating tones themselves, they:

- are members of underlying clusters which usually are unlinked in the UR
- preferentially attach to the right
- have a *H* tonal melody feature
- in isolation form a rising contour on the sponsor syllable

Second, concerning the results of the floating tones linkages on the following syllable, the linkages result in:

- a level tone equivalent to the floating tone (when the lexical tones can be shifted to accommodate the added tone)
- a level tone equivalent to the floating tone (when the floating tone can merge with the tone on the target syllable)
- a level tone lower than both the floating tone and the level tone originally on the targeted morpheme (when the melody merges and the register spreads)
- a falling contour tone (when the following morpheme is monosyllabic and has a *L* tonal melody)

Finally, the influence of the floating tone's melody feature is limited to the following syllable, but the influence of the floating tone's register feature is dependent on the quality of the feature: the *h*-register feature can influence only the following syllable, the *l*-register feature can extend influence to the end of the phonological domain.

5.4 Discussion

Tones in Soyaltepec Mazatec are best understood to behave in an autosegmental fashion but with the expanded geometry of RTT described in Snider 1999. Using this geometry the fundamental areas of tonal behavior are easily described using autosegmental techniques. First, mobility, the tones in Soyaltepec Mazatec are not always expressed on the morpheme which sponsors them lexically. Second, it was shown that the tones of Soyaltepec Mazatec can remain even after the segmental information has been deleted from a morpheme. The tones can be expressed either on other syllables of the same morpheme or they can attach to a neighboring morpheme. Third, examples of several different types of tonal plateaus were shown, including the sharing of tonal root nodes, the sharing of tonal melody features and the sharing of tonal register features. Fourth, TBUs of Soyaltepec Mazatec were shown to be able to host up to three separate tones. Finally, several morphemes were discussed that contain no segmental information in the lexicon. These tones function like clitics and can attach either to the right or left edge of a morpheme or the domain that they modify. The direction of their attachment is part of their lexical specification as it does not adhere to the UAC.

The floating tones discussed in §5.3 were members of tonal clusters with *H* tonal melodies. The tonal processes described relied heavily on the UAC; however, several processes that were more briefly described show that the UAC is not strictly adhered to in Soyaltepec Mazatec. For example, the floating tones with a *L* tonal melody that occur at the left edge of bound morphemes which were described in §5.2.2 and §5.2.4 defied both the typical left-to-right directionality of the UAC in Soyaltepec Mazatec and the expected one-to-one nature of attachments as contour tones formed within the word rather than at the edge. This unusual behavior is completely different from the right floating tones described above in §5.3. To begin with the left floating tone never links to its host morpheme to form a contour tone. Second, the floating tone always attaches to the syllable to its left forming a falling contour which ends at a Low level on that syllable. There were also several exceptions to the UAC in which tones were shown to be pre-linked in the lexicon. Morphemes demonstrated an affinity for their own lexically prescribed tones over tones supplied by the environment which was especially true of the tonal melody feature. Despite the several examples which contradict the expected direction of the UAC, necessitate pre-linking in the lexicon or disallow the expected tone shifting of the UAC, the tonal system of Soyaltepec Mazatec in general follows the UAC. Tones can be considered to be unmarked in the lexicon and then linked to the available TBUs in a one-to-one, left-to-right manner.

Morphemes from Soyaltepec Mazatec were shown to surface with tones that differed from those specified in the lexicon. Aside from the expected shifting of tones to the next TBU in line when there are more tones than TBUs, some morphemes in Soyaltepec Mazatec were demonstrated to cause a raising of the next syllable while at the same time lowering the entire phonological domain that followed the disruptive morpheme. Employing the multi-tiered geometry of RTT allows a straight forward explanation of this lowering which is caused by the Mid-High tone in certain environments. The independent spreading of the *l*-register from the M_1 tone to a H tone creates a representation which is phonologically equivalent to a M_1. Similarly, spreading the *l*-register to a M_2 creates a representation which is phonologically equivalent to a L. No other geometry explains this type of lowering in which a tone is lowered by one phonetic step, and the lowering is reflected exactly as such in the phonological representation.

CHAPTER 6

CONCLUSION

6.1 Overview

In this chapter, I conclude the work of this dissertation which has documented the sound system of Soyaltepec Mazatec. The complexity of the tone system of Soyaltepec Mazatec has provided ample opportunity to explore the geometry and features of tone suggested by RTT. After summarizing the main points discussed above, I discuss the advantages of adopting Register Tier Theory to describe the tone in Soyaltepec Mazatec. I also point out that while the processes discussed above generally support the adoption of the UAC in Soyaltepec Mazatec, there are some issues which preclude its strict application. Next, I comment on the placement of Soyaltepec Mazatec in traditional tonal typology. Finally, I propose topics for future research.

6.2 Summary

This dissertation set out to describe the basic phonology of Soyaltepec Mazatec by investigating the segmental and tonal elements. In Chapter 2, I detailed the primary literature available and phonological analyses that utilize Soyaltepec Mazatec data. Pike (1956) initially described Soyaltepec Mazatec tone, but did so without differentiating between phonological and phonetic processes. Her article demonstrates the incredible number of surface variations that one underlying tone can produce. Several of the tonal changes that Pike portrays appear to describe differences in the phonetic realization of tones rather than phonological processes. I include all of the alterations caused by single tones which were discussed in §2.2.1 in this category, as well as the sandhi that was initiated by changes in phrasal position which was discussed in §2.2.3.2. Pike also described behavior which is more likely phonological in nature, in particular the behavior surrounding the contour tones. The behavior she described mostly hinted at processes typical of contours composed of individual segments; however, some of the behavior of the Mid-high to High contour as described by Pike is potentially explained if the contour tones are unitary. The composite behavior was explored in analysis by Biber (1981) and Goldsmith (1990). Pike's data helped ferment and exemplify phonological thinking regarding the nature of contour tones. Building on these analyses, Pizer (1994) proposed an expanded tonal geometry to allow for a structure that was able to both reflect this sequential nature of tone, while also allowing unitary behavior. Pizer's analysis is interesting and accounts for more of the processes described by Pike than her predecessors, but it does not solve all of the problems introduced by Pike's data, specifically, concerning the behavior of the Mid-high to High contour.

In order to understand this complex system, I collected fresh data. The basic non-tonal segments were introduced and used in Gudschinsky (1959), Pike (1956) and Kirk (1966). While the segments were previously introduced, they were never exemplified in a systematic manner. In Chapter 3, examples were given to demonstrate the co-occurrence of each possible onset with each nucleus. In so doing, an argument in favor of considering the complex onsets of Soyaltepec Mazatec to be consonant clusters rather than modified phonemes immerged; however, the argument is not definitive and the result does not fundamentally influence the tone of the syllable. This is an area for continuing research.

Concerning the tones of Soyaltepec Mazatec, my data confirms that the tonal system is indeed complex, but I found differences from what Pike described. In Chapter 4 the four levels of tone of Soyaltepec Mazatec were described along with five rising contours and two falling contours that can occur on monomorphemic, monosyllabic words. I was not able to replicate all of Pike's data or the processes she described but I discovered the tonal process of register lowering heretofore never described for a Mazatec language. This process is best described using Register Tier Theory. Soyaltepec Mazatec contour tones behave in a manner consistent with sequential tones, and processes that need to be explained using unitary tones do not occur. Specifically, no instances of Mid-high to High rising tones which reduced to Mid tones were found. The system does not require the geometry described by Pizer; however, the typical single tiered geometry employed by Autosegmental Geometry which offers only one level of tone specifications is inadequate to explain the behavior exhibited.

Register Tier Theory was demonstrated to both fully specify four levels of tone and allow enough flexibility to fully describe and explain the tonal phenomena present in an insightful manner. Specifically, the explanation of the lowering behavior of the floating Mid-high tone hinges on RTT features and the geometry which allows two tonal features to be specified separately and function either as a unit or separately. Examples such as those in (1) in which a floating M_1 causes the following syllable to assume its value (through spreading both the tonal melody and the tonal register) are not surprising; however, the resulting Low tone on the final syllable is surprising unless the M_1 is specified to contain a *l*-register which can spread independently.

(1) The M_1 raises the adjacent syllable and lowers the following syllable

ndɛ˦	+	tia˧wa˧	→	ndɛ˧ tia˥wa˩
'shoe'		'white'		'white shoe'

When the M_1 tone is specified to contain a *l*-register as prescribed by RTT, simple register spreading (without tonal melody spread) accounts for the surface tone. The example in (2) reconfirms that the *l*-register from the M_1 can spread completely independently of its tonal melody.

(2) The lowering behavior of the M_1

tu˦	+	si˧nɛ˥	→	tu˧ si˩nɛ˦
'fruit'		'yellow'		'yellow fruit'

The features and geometry of RTT simply and elegantly explain this otherwise mysterious behavior.

6.3 Tonal Processes of Soyaltepec Mazatec and the UAC

When the structure of the tonal primitives is defined according to the geometry of RTT as I have suggested in this dissertation, the tonal processes of Soyaltepec Mazatec are readily understandable and explainable. Most of the tonal behavior exhibited can be explained without unusual or complicated rules. The tonal redistribution that occurs is simply the alignment and linkage of tones according to the UAC applied over the phonological domain, i.e., in a one tone to one TBU ratio from left to right with several stipulations that will be highlighted below.

When the number of tones sponsored by a single morpheme exceeds the number of TBUs, the morpheme will have an optional contour tone on its final syllable when articulated in isolation (depending on the idiolect of the speaker); however, when the phonological domain is expanded to multiple morphemes the extra tone can be expressed on the following morpheme. This process is illustrated in (3).

(3) Illustration of UAC

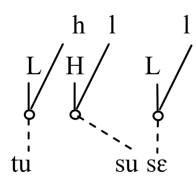
a. Soyaltepec Data

tu˧˥ + su˩sɛ˩ → tu˧ su˥sɛ˩
‘fruit’ ‘green’ ‘green fruit’

b. Simple obedience to UAC:

Underlying tones:

Application of UAC:



Results in correct surface tones:

M_2 M_1 L
tu˧ su˥sɛ˩

In (3) the total number of lexical tones exactly matches the number of available TBUs and a one to one match up is uncomplicated.

The straightforward application of the UAC over a phonological domain is not without its problems, however. For example, when the total number of tones specified for an utterance exceeds the number of TBUs available, preference within each morpheme is given to the tones which originate lexically on that morpheme. In (4) a simple redistribution of tones within the phonological domain according to the UAC would cause the incorrect alignment represented in (4b). However, when preference is given to the lexical tones of each morpheme as demonstrated in (4c), the correct surface form emerges.

(4) Illustration of UAC with preference for lexical tones

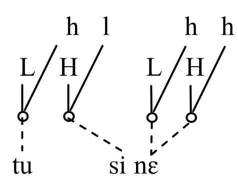
a. Soyaltepec Data

tu˧˥ + si˧nɛ˥ → tu˧ si˩nɛ˦
‘fruit’ ‘yellow’ ‘yellow fruit’

b. Simple obedience to UAC without regard for morpheme boundaries:

Underlying tones:

Application of UAC:[130]



Resulting in incorrect surface tones:

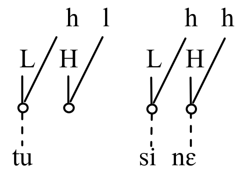
$^*M_2$ M_1 M_2-H
*tu˧ si˦ nɛ˧˥

c. Obedience to UAC allowing linkage of morpheme specific tones before sandhi:

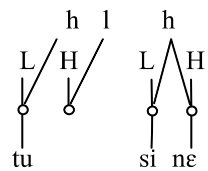
Underlying tones:

[130] I have allowed the extra tone at the end to link forming a contour tone as is usually the case in Soyaltepec Mazatec; this tone may also be left floating as occurs in some idiolects.

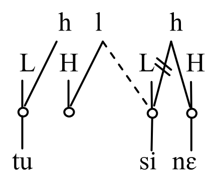
Application of UAC at morpheme level:[131]



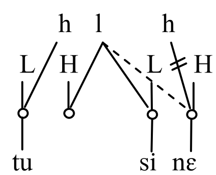
OCP merger of *h*-register:



l-register spread with *h*-register delink:



l-register spread with *h*-register delink (an iterative process):



Resulting in correct surface tones:

M_2 L M_1
tu˧ si˩nɛ˦

Notice that when preference is given to lexically specified tones before floating tones are allowed to associate, a complication arises in disyllabic words which sponsor one TRN. Instead of simple association to available TBUs, a process of delinking will have to occur and the availability of the syllable will need to

[131] Multiple linkages occur only as a last resort at the end of the derivation when a completely unassociated TRN exists word finally.

be specified using reference to multiple linkages. This does not change the overall process, but if preference is given in one instance, it must be given to both and an additional delinking step must be added for the sake of consistency.

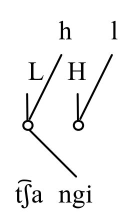
An alternate explanation for the preference of morphemes for their lexically prescribed tones is to propose that the tones are pre-linked in the lexicon, making the application of the UAC unnecessary. There are morphemes in Soyaltepec Mazatec which must have at least some of the tones pre-linked. For example, there are two types of disyllabic words which host a M_2 and a M_1. The words in (5a) must contain a lexically linked tone while the words hosting the same tones in (5b) can have their tones linked through the application of the UAC. The fact that both tone patterns are attested confirms that at least some tones must be pre-linked in the lexicon of Soyaltepec Mazatec.

(5) Lexically prescribed tones in Soyaltepec Mazatec

a. M_2 pre-linked		b. M_2 linkage UAC assigned	
SM	Gloss	SM	Gloss
t͡ʃa˧ngi˦	‘plum’	t͡ʃa˧nga˥	‘old’
ku˧ni˦	‘monkey’	ka˧sĩ˥	‘neck’
na˧ɲa˦	‘dog’	na˧hɲa˥	‘dream’

The words in (5a) must minimally contain the linkage of the Mid tone to the second syllable as depicted in (6) while the words in (5b) may exist in the lexicon with no linkages depicted.

(6) Minimal underlying tonal association mandated by the forms in (5a)



‘plum’

Assuming a form such as that in (6) still allows the first syllable to be linked via the UAC which calls for the first tone of the morpheme to be linked to the first TBU whether it is already linked or not. Alternately, both syllables of the morpheme may be pre-linked to the M_2. The only other alternative would be that two M_2 tones exist in the lexical entry for this morpheme so that the tonal assignment would be (M_2 M_2 M_1) forcing an OCP merger after the UAC applies, but this seems the least likely option.

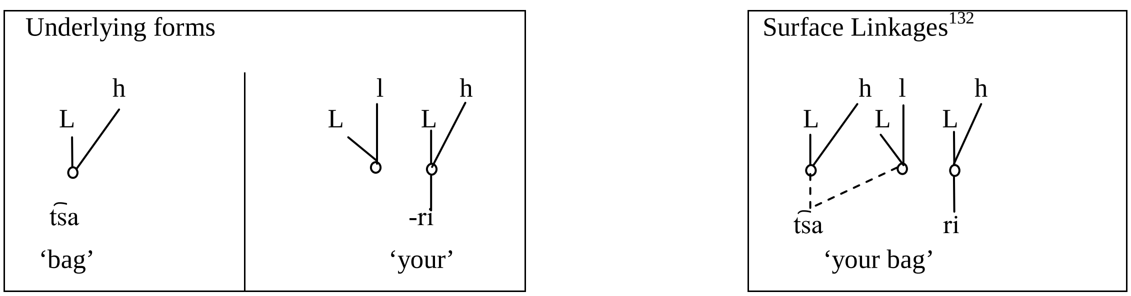
The tonal process described in §5.2.2 and §5.2.4 in which a suffixed morpheme causes the linkage of a Low tone to the final syllable of the stem also necessitates a lexically prescribed tone linkage. Consider the example in (7) in which the M_2 on the clitic must be lexically linked to force the L tone to link preferentially to the stressed syllable of the stem rather than to the clitic as left to right directionality would predict.

(7) L attaches to the left, not to the right

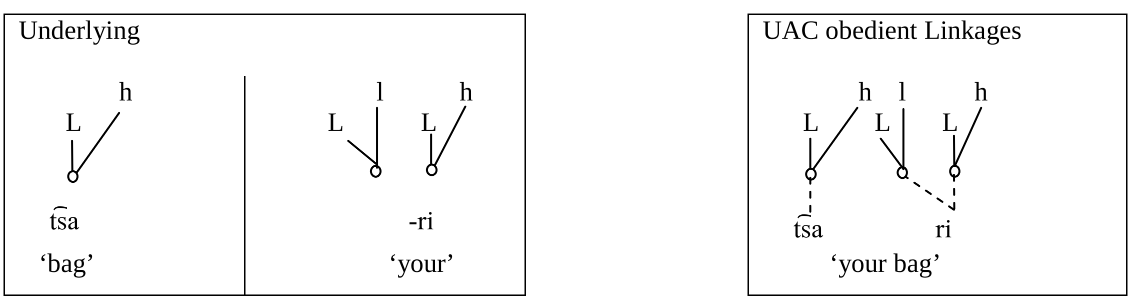
a. Data to be explained

t͡sa˧ + -˩ri˧ → t͡sa˧˩-ri˧ not *t͡sa˧-ri˧˥
‘bag’ ‘your’ ‘your bag’

b. Process reflecting lexically linked M_2 on the clitic correctly yielding t͡sa˧˩-ri˧



c. Process with no lexical linkages incorrectly yielding *t͡sa˧-ri˧˥



[132] The final structure will reflect OCP necessitated mergers which are left to the reader at this time.

The process actually calls into question the application of the UAC in Soyaltepec because the Low tone supplied by the clitic must attach to the left of its source, forming a contour word medially. There are also examples of morpheme medial contours which must employ lexically prescribed linkages such as the examples in (8).

(8) Morphemes with internal contour tones

SM	Gloss
ja˥t͡ʃĩ˧	‘women’
ku˥t͡ʃa˧	‘how’
tu˥ʃʔĩ˥	’bellybutton’

Despite the examples which necessitate lexically prescribed tone linkages, for the majority of the words and processes in Soyaltepec Mazatec, the application of the UAC is not contraindicated with the following stipulations:

1. The phonological domain encompasses the entire noun phrase or a verb and closely associated nouns (when the number of TBUs in the domain is equal to the number of TRNs and at least one morpheme has less TRNs than TBUs or if the following morpheme is monosyllabic).
2. Despite the ability to spread extra tones across morpheme boundaries, preference is still given to lexically prescribed tones.
3. There are some tones that must be linked in the lexicon (and, or the direction of alignment may need to be specified lexically for some morphemes).
4. An unassociated tone between two linked tones within a grammatical word will associate to a stressed syllable if available.

In general, having a few tones which need to be linked in the lexicon does not contraindicate the application of the UAC, and assuming its general precepts simplifies the explanation of the tonal processes that occur. However, it is clear that it cannot be seen as a strict, universal convention. Whether or not the analyst chooses to presuppose the UAC or to assume that most tones are linked in the lexicon, the depiction of the tones using RTT is useful to the understanding of the system.

6.4 Tonal Typology

Pizer (1994) suggested that Soyaltepec Mazatec did not fall neatly within either of the traditional typological categories used to describe tone and suggested that there should there be a third distinction which she entitled Mesoamerican. Yip (2002) also seems to offer a third distinction for tone languages which she calls tone systems of the Americas. The data from Soyaltepec Mazatec presented in this dissertation reveal that the system possesses some characteristics that are more African in nature and some that are more Asian; however, there are no processes that fall outside both groups.

The first characteristic that is usually considered when labeling a tone language is the type of tones that are present. Asian languages tend to have more contour tones than level tones while African languages tend to have mostly level tones. In this manner, Soyaltepec Mazatec appears more like an Asian language since it has four level tones and seven contour tones. The second distinction is that Asian languages usually have unitary contour tones while African languages tend to have level tones with contours which are made up of combinations of the level tones expressed on a single syllable. Based solely on this distinction, Soyaltepec Mazatec appears to fit in better with African tone languages. While there are at least two contour tones in Soyaltepec Mazatec which appear to be units (M_2-H and L-M_2), there are no processes which exploit their unitary nature. On the other hand, there are several instances in which the composite nature of the majority of the contour tones is exploited. Also, a register lowering process similar in nature to the downstep traditionally found in African tone languages was found. The tones in Soyaltepec Mazatec have a strong affinity for their TBU which is similar to Asian tone languages; however, it is common for the TBU to surface with its tone altered even though the lexical tonal information is maintained. Also, while the processes that occur in Soyatlepec Mazatec are very reminiscent of African tone systems, the highly mobile tones often exhibited in African systems do not occur.

In order to visualize and summarize these differences and the place of Soyaltepec Mazatec (SM) in the typology, I have placed the characteristics as described in Yip 2002 in Table 6-1. While the characteristics given are not exhaustive or strictly binary (i.e., agreement on one side of the chart does not automatically signify disagreement on the other side), they give a picture of the tendencies of the two groups. When Soyaltepec Mazatec exhibits the given characteristic, a checkmark is placed in the following column under SM. When the characteristic is present, but not definitive, an asterisk is placed. If the characteristic is not present, the SM cell is left blank.

Table 6-1 Asian versus African tonal systems and the place of Soyaltepec Mazatec

Asian Tonal Systems	SM	African Tonal Systems	SM
complex inventories	✓	small tonal inventories	
heavy lexical weight on tones	✓	grammatical tones	✓
unitary contours	*	sequential contours	✓
strong affinity of tone to TBU	✓	highly mobile tones	
spread blocked by assigned TBUs	✓	toneless TBUs common	
complex sandhi: local affect assimilation, dissimilation, contour metathesis, chain-shifting	✓	sandhi: spreading polar tones downstep OCP motivated changes	✓ ✓

From the list of characteristics given in Table 6-1, it is evident that Soyaltepec Mazatec has characteristics of both African and Asian tone systems; however, there is more agreement with the Asian tone characteristics. These characteristics place greater emphasis on tonal inventory and the nature of the tones themselves than on the tonal processes. For a different perspective, I present a comparison chart created by Hyman (2007:17) which highlights eleven typical characteristics of tone languages. The characteristics from the chart are reproduced here in Table 6-2. When the tone system of Soyaltepec Mazatec aligns with a given characteristic, a checkmark is placed in the box following that characteristic and an asterick indicates that the characteristic at least partially applies.

Table 6-2 Soyaltepec Mazatec in Tonal Typology

"Contour tone systems" (ASIAN)	**(SM)**	**"Register tone systems" (AFRICAN)**	**(SM)**
Fewer level tones than contours	✓	More level tones than contours	
Contour tones = units	*	Contour tones = sequences (clusters)	✓
Contour tones have free distribution within the utterance	✓	Contour tones (clusters) are often limited to the last syllable	*
Dissimilation of contour + contour[133]		Dissimilation of contour tones = rare	✓
Metathesis of features within a contour[134]		Metathesis of contour tones = rare	✓
No downstep		Downstep	✓
Floating tones = rare		Floating tones = frequent	✓
Tone spreading = rare		Tone spreading = frequent	✓
Function of tone = lexical		Function = lexical *and/or* grammatical	✓
Words are monosyllabic		Words come in various sizes	✓
Tones are restricted by syllable type		Tones may occur on any syllable type	✓

The reason an asterick is placed in the cell describing unitary contours in Soyaltepec Mazatec has already been discussed: there are two contours which appear to be unitary; however, there are three rising contours and a falling contour which are definitively concatenations. The second asteric in this chart appears because even though one of the Asian characteristics of allowing contour tones on any syllable is present in Soyaltepec Mazatec, it is also true that the contour tones are still more commonly found on the final syllable. Although the tonal inventory of Soyaltepec Mazatec is perhaps more complicated than some African Tone languages with four levels of tone and a proliferation of contours, according to the characteristics in Table 6-2 it overwhelmingly aligns with the register type languages traditionally found in Africa.

Given the two different sets of characteristics, one summarized from Yip (2002) in which Soyaltepec Mazatec aligns more with the Asian systems, and the other from Hyman (2007) in which

[133] As in the process in Tianjin 35-35 → 55-35.
[134] As in the process in Pingyao 53-53 → 35-53.

Soyaltepec Mazatec aligns with the African systems, it is apparent that the tonal system in question is not easily characterized into one group or the other. Soyatlepec Mazatec has an Asian tonal inventory whose tones participate in African type processes. Based on the tonal data from Soyaltepec Mazatec, there is no reason to advocate a third type of tone language specifically for the Americas. However, there is motivation to eliminate the either-or mindset and strict division set up by the binary typology.

6.5 Recommendations for Future Research

This dissertation has just begun to touch on the depths of the richness of Soyaltepec Mazatec. In this section I make recommendations for some of the areas which deserve further study.

First, it is suspicious that /s/ and /ʃ/ co-occur with a glottal stop but not a glottal fricative. It is possible that this combination should have been represented. The high energy friction produced in the formation of a sibilant may mask the presence of /h/. The examination of the segmental co-occurrence in Chapter 3 revealed that /s/ and /t͡ʃ/ are the only coronal phonemes to occur with the nasalized /õ/, while /h/ and clusters with /h/ do occur with /õ/. These facts suggest the possibility that the syllables listed as /sõ/ and /t͡ʃõ/ are actually /shõ/ and /t͡ʃhõ/ respectively. The sibilants deserve more attention, perhaps via an instrumental study comparing both the length of the onset as well as the frequency of the energy produced.

Second, I made a case for *l*-register spread which results in the lowering or downstep of some tones. At this point in the analysis, all of the documented instances occur as the result of word final floating M_1 tones. It is logical to expect the L tone to exert a similar influence since it also contains a *l*-register; however, there are no instances of word final floating Low tones. Future research should examine the Low tone as well as diverse environments surrounding the Mid-high tone to determine if register lowering occurs in other circumstances.

Third, evidence for upstep should be examined. Other Mesoamerican/Mexican languages such as Acatlán Mixtec as re-analyzed by Snider (1999) have been shown to have upstep, a phenomenon in which High tones which become progressively higher when articulated in succession. Occasionally when I recorded words in lists, I observed that the High tones seemed to get progressively higher when they occur in succession. To date I have not documented this pattern in natural, spontaneous utterances. In order to investigate the potential for upstep in Soyaltepec Mazatec, carefully designed word lists should be elicited from various speakers and the pitch height of each word measured and compared. Also, natural utterances in the form of short texts should be examined to determine if the pattern occurs outside of list intonation and if so the environment should be documented.

Fourth, the tonal patterns of women and men should be examined separately to determine if there are patterns that are gender specific. The patterns of upstep that I observed occurred in the recordings of women and it has not been observed in any of the male speakers; however, I do not have the identical lists recorded by a male speaker. Also, in my experience, it is much easier to discern rising tones among female speakers than male speaker while falling tones are more apparent among male speakers than female speakers. More data and speakers are needed to determine if these trends are speaker specific or statistically relevant. Another manner to address the issue of gender specific speech would be to interview native speakers to illicit their opinion on the subject.

Fifth, the verb system offers immense opportunity to witness tonal activity especially with regards to the inflections that occur, some of which include overt segmental material and some of which are purely tonal. This system deserves in-depth consideration. For the purposes of this dissertation, I focused primarily on non-verbal phrases in order to demonstrate the primitives of the tonal system without the confusion of possibility of the layering of grammatical morphemes which are often indicated completely through tones. Now that the basics of the tone system have been established further work on the verb system would demonstrate the interaction of tone in more diverse environments and has the potential to reveal processes as yet undiscovered.

Sixth, I would like to study the perception of tone by native speakers. The tone on native speaker utterances could be manipulated using the computer program PRAAT (©1992-2009 by Paul Boersma and David Weenink) in order test the tolerance for tonal variation by native speakers. Perception studies in which the tone on the given word is as it would be, but the tone on the following syllable is not affected properly, i.e., so the sandhi rules aren't followed, would be interesting. Perception tests could determine how much variance in tone or mistakes in tonal pronunciation influence the semantic perception.

Seventh, it has been demonstrated that mobile tones occur at the end of nouns, verbs and modifiers. Thus far, the interaction between the mobile tone and a following morpheme has been demonstrated only in utterances which contain one mobile tone. It is possible to conceive of an utterance in which several morphemes have mobile tones such as (9). Does the implementation of tonal shift proceed with a domino type effect (9b)?

(9) A potential utterance with 3 mobile tones[135]

a. Underlying forms

(ma˧t͡ʃɛ̃˦) (hõ˦) (t͡ʃho˩˥) (tia˧wa˧)
'are needed' 'six' 'eggs' 'white'

b. Potential surface form

(ma˧t͡ʃɛ̃˧ hõ˥˩ t͡ʃho˥˩ tia˥wa˩) 'Six white eggs are needed.'

I have observed that the tonal shift is sometimes blocked by the presence of a High tone or a cluster containing a High tone, but I have not witnessed the consequences when this blocking tone is itself shifted to a different morpheme. In this situation, will the blockage be lifted and the tone allowed to shift, or will the shift remain blocked? If the utterance in (9) ended with a color such as purple (*kũã˧˥*) which has a rising tone would all of the tone shifting be blocked or just the immediately preceding morpheme? Is there a limit to the number of tonal changes which can occur in a single utterance? Etc.

Also, the interaction of tone, intonation and discourse functions should be studied through the examination of natural speech and texts. Tone definitely serves to mark phrasal boundaries. The possibility of further discourse functions that may be important for the purposes of translation should not be overlooked.

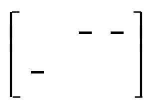
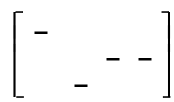
Finally, I would like to do further analysis of the system with instrumental documentation in order to explore my observation that some speakers of Soyaltepec Mazatec tend to maximize the tonal space within each utterance. Specifically, if a brief utterance consists of only two tones, they will tend to be near

[135] I suspect that in natural speech the verb in this utterance would be shifted to the end to alleviate some of the tonal complications, but I have never tried to illicit such a phrase.

the extremes of the tonal range for a speaker, leading the analyst to the conclusion that they represent examples of a High and a Low tone. However, when a third tone is added to the utterance, the tone space can be redistributed to reveal that the first two tones were actually not tonal extremes. For example, consider the data in (10) in which the lines within the bracket represent the relative pitch height of each syllable. All of the tones in this example are level tones.

(10) Difference in pitch space in an a two tone utterance verses a three tone utterance

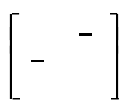
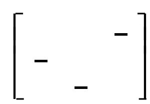
a. Utterance with two tones that are L and M_2 vs. three tones which are H L M_2

t͡ʃu tia wa vs. ho t͡ʃu tia wa

'white animal' 'two white animals'

b. Utterance with two tones that are L H vs. three tones which are M_2 L H

t͡ʃu hma vs. te t͡ʃu hma

'black animal' 'ten black animals'

The morphemes in the two toned utterances in (10a and b) appear to have similar tones until a third morpheme with a known tone is added. When a High tone is added as in the second utterance in (10a), the two original morphemes in the utterance prove to be closer in pitch than they were at first, revealing a Low followed by a Mid, not a High. The utterance in (10b), on the other hand is shown to be a Low followed by a High when a morpheme known to contain a Mid tone is added. Adding a known High tone would also confirm that the second syllable is indeed articulated at a similar height, but, for the sake of comparison, the demonstration was provided using three separate tones. To the best of my knowledge, this type of phenomena has never been documented in a systematic study.

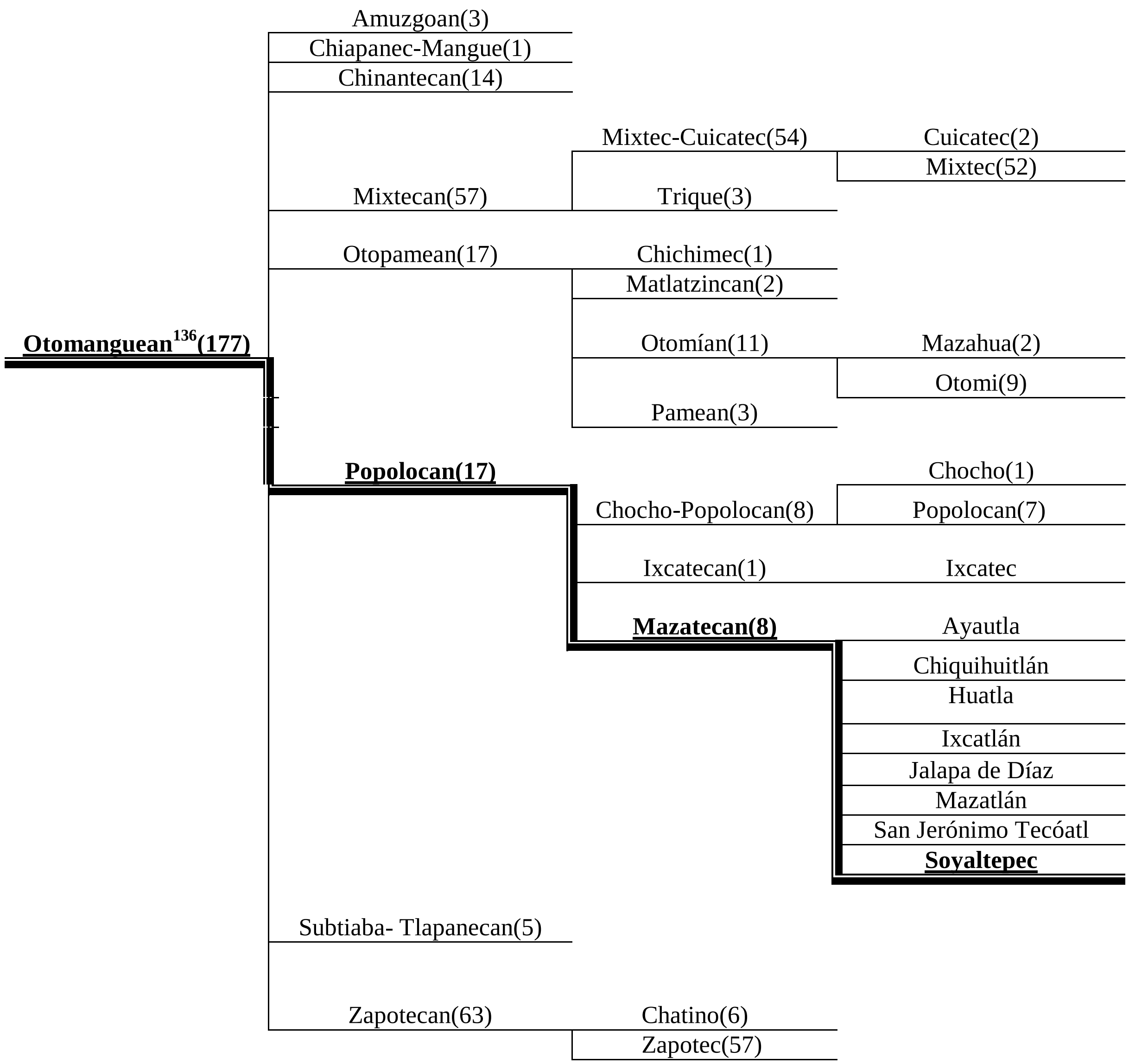
6.6 Final Remarks

This dissertation has provided a complete description of the phonemes and tonemes of Soyaltepec Mazatec. The foundation for understanding its complex tonal system has been established. Soyaltepec

Mazatec is a language which demonstrates that the traditional monovalent manner of examining tones is inadequate for complex systems. The geometry and features of tone as described by RTT are not only adequate but illuminating when applied to the tonal data of this rich and energetic tone system. The flexibility of RTT which allows independent spreading of the register tier is necessary to explain the lowering instigated by the Mid-high tone. When two features for tone are allowed, the tone system of Soyaltepec Mazatec exhibits typical Autosegmental phenomena. Similar to African tone languages, its contour tones are viewed as concatenations of level tones instead of as units. Soyaltepec Mazatec has more levels of tone than the average African language, but up to five levels of tone have been documented in African languages. However the complexity of the inventory is more in line with Asian tone systems, as is the affinity of the lexical tones to their specified TBU. The tone system also includes morphological tones and floating tones, both of which are common among African type tone languages. Soyaltepec Mazatec offers a more dynamic and extensive use of tone than some languages, combining African and Asian characteristics, but the essence of the behaviors which occur are not extraordinary or unique, just expanded.

APPENDIX A

THE OTO-MANGUEAN LANGUAGE FAMILY



[136] These language family associations are as found in Yasugi 1995:7-8. The format is my own design.

APPENDIX B

PIKE'S MINIMAL PAIRS

Minimal tone sets listed in Pike's article, section 7.1 page 69. I have listed the pairs here using IPA notations and separated into groups with headings (Pike's list was a running list separated by commas and semicolons.) Recall that tones on separate syllables are separated by a space while contour tones are indicated by a dash (-)

(1) Contrasting H and M_1 on second syllable.

a. L H	na˩t͡ʃʔa˥	'mother-in-law'
b. L M_1	nt͡ʃɛ˩ʔna˦	'my cooked corn'

(2) Contrasting L and M_2 (b, c) on first syllable and M_1-H, M_2 and L on second syllable.

a. L M_1-H	ni˩ʔju˦˥	'fierce'
b. M_2 M_2	ni˧ʔju˧	'gopher'
c. L M_2	ni˩ʔju˧	'ant'
d. L L	na˩ʔju˩	'corn dough'

(3) Contrasting M_2 M_1-H with L M_2.

a. M_2 M_1-H	na˧ʔja˦˥	'thorn'
b. L M_2	na˩ʔja˧	'a net'

(4) Contrasting M_2 H with L L

a. M_2 H	t͡se˧ʔe˥	'lazy'
b. L L	t͡se˩ʔe˩	'his'

(5) Contrasting M_1-H, M_2-M_1 and M_1 on the second syllable.

a. M_2 M_1-H	te˧ja˦˥	'wide'
b. M_2 M_2-M_1	te˧ja˧˦	'deaf'
c. M_2 M_1	wa˧ja˦	'she makes [tortillas]'

(6) Contrasting H, M_1, M_1-H, M_2 and L.

a. H	swe˥	'hot'
b. M_1	sjã˦	'there [sitting]'
c. M_1-H	ʃa˦˥	'work'
d. M_2	ʃa˧	'tiger'
e. L	ʃa˩	'dew'

(7) Contrasting H, M_1-H and M_2.

a. H	te˥	‘he dances’
b. M_1-H	te˦˥	‘wide’
c. M_2	te˧	‘ten’

(8) Contrasting M_2-H, M_1-M_2 M_2 and L

a. M_1-H	the˦˥	‘rubbish’
b. M_2-M_1	the˧˦	‘a cough’
c. M_1	thjã˦	‘there [standing]’
d. L	the˩	‘a plant’

(9) Contrasting H, M_1-H and L.

a. H	t͡shu˥	‘toasted’
b. M_1-H	t͡shu˦˥	‘grave’
c. L	t͡shu˩	‘onion’

(10) Contrasting M_2, M_2-M_1 and M_1 on the second syllable

a. M_2 M_2	t͡se˧hɛ̃˧	‘it fell’
b. M_2 M_2-M_1	t͡se˧hɛ̃˧˦	‘it is visible’
c. M_2 M_1	nta˧he˦	‘River Tilpan’

(11) Contrasting H, M_1-H, M_2-M_1 and L.

a. H	nta˥	‘smooth’
b. M_2-H	nta˧˥	‘good’
c. M_2-M_1	nta˧˦	‘a song’
d. L	nta˩	‘voice’

(12) Contrasting L with M_1-H on second syllable (a, b) L with M_2 on first syllable (d, c) and L-M_2 M_2-H (e) with both.

a. L L	na˩nta˩	‘cactus’
b. L M_1-H	na˩nta˦˥	‘spring’
c. M_2 M_1-H	na˧nta˦˥	‘river’
d. L-M_2 M_2-H	na˩˧nta˧˥	‘godmother’

(13) Contrasting M_2 with L on first syllable (a, e) and L, M_1-H, M_2-H and M_2-M_1 on second syllable (b-e).

a. M_2 M_2-M_1	ni˧nta˧˦	'bone'
b. L L	ni˩nta˩	'fox'
c. L M_1-H	ti˩ntai˦˥	'buy!'
d. L M_2-H	ti˩ntai˧˥	'make [it]!'
e. L M_2-M_1	t͡su˩ntu˧˦	'worm'

(14) Contrasting M_2 on first syllable with H and M_2-M_1 on second syllable and both contrast with L M_2.

a. M_2 H	ni˧ntu˥	'slippery'
b. M_2 M_2-M_1	ni˧ntu˧˦	'needle'
c. L M_2	ni˩ntu˧	'pimple'

(15) Contrasting M_2, M_1 and L on final syllable.

a. M_2 M_2	t͡sa˧nka˧	'he ran'
b. L L	t͡sa˩nka˩	'cotton'
c. M_2 M_1	t͡ʃa˧nka˦	'old'
d. L L	t͡ʃa˩nka˩	'liver'

(16) Contrasting M_2 H with L L.

a. M_2 H	ntu˧hu˥	'long'
b. L L	ntu˩hu˩	'soap'

(17) Contrasting M_1-H, M_2-M_1, M_1 and L on final syllable.

a. M_2 M_1-H	na˧ʃu˦˥	'flower'
b. L L	na˩ʃu˩	'throat'
c. L M_1-H	t͡sha˩ʃu˦˥	'fuzz'
d. M_2 M_1	t͡si˧ʃu˦	'he boils [something]'
e. M_2 M_2-M_1	ni˧su˧˦	'dipper'

(18) Contrasting 4 level tones on final syllable

a. L H	t͡ʃa˩ʔa˥	'armadillo'
b. L M_1	t͡ʃhũ˩ẽ˦	'his wife'
c. L M_2	ha˩ʔo˧	'all right'
d. L L	he˩ʔe˩	'new corn'

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BIOGRAPHICAL INFORMATION

Heather Beal began her academic career studying Chemistry at the University of Delaware where she earned a B.S. in 1991. After graduation, she worked in the pharmaceutical industry for several years before pursuing New Testament Studies at Biblical Theological Seminary in Hatfield, PA. After receiving her M.A. in 1995, she began studying linguistics through the Summer Institute of Linguistics (SIL) at the University of Oregon, and then through the University of Texas at Arlington where her studies turned into a doctoral program. For the past 10 years she and her family have been dividing their time between Temascal, Oaxaca, Mexico, and Dallas, Texas as they pursued the study of the Soyaltepec Mazatec language.