Asymmetric Pitch Raising under Focus in San Martín Peras Mixtec*

Andrew A. Hedding
UC Santa Cruz

Abstract: In this paper, I describe a novel prominence pattern displayed in answers to wh-questions in San Martín Peras Mixtec. In this language, high tones that surface at the right edge of correlates of wh-words are raised in pitch. Additionally, I show that fronted foci are not moved to an intonational phrase boundary by using a novel tone sandhi process to diagnose phrase edges. This suggests that prominence in the language is not triggered by alignment to a prosodic boundary.

Keywords: Mixtec, focus, prominence, alignment, tone

1 Introduction

There is a well established generalization about sentential prominence in English: correlates of wh-words — that is, words in the answer to a wh-question that directly answer and correspond to the wh-word — are realized with prosodic prominence, even if they occur in a position that wouldn’t normally receive default phrasal prominence (Selkirk 1995; Jackendoff 1972; Rochemont 1986; a.m.o.). In broad focus or neutral contexts, phrasal stress falls on the head of the rightmost constituent (1). However, in narrow focus contexts like (2), a pitch accent, realized as higher pitch on the stressed syllable, is placed on the word that corresponds to the wh-word, instead of its default sentence-final position. Throughout this paper, I represent prosodic prominence with small caps.

(1) Q: What’s been happening? A: Mary bought a book about bats.


[Selkirk 1995:554]

In this paper, I will explore the prominence associated with correlates of wh-words in San Martín Peras Mixtec (henceforth SMPM), a tonal language. I will argue that wh-correlates display prominence that is asymmetric. This asymmetry is expressed in three ways: (1) prominence is only realized on the final syllable of the wh-correlate; (2) only high tones are affected; (3) this prominence is realized only as pitch raising — there are no other apparent correlates of phonetic prominence. While this prominence is superficially similar to one way in which prominence is realized in English (a high pitch accent on a stressed syllable), it is quite different from patterns found in other tonal languages, which often display f0 expansion on the entire wh-correlate (Hartmann 2008).

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Contact info: ahedding@ucsc.edu

The prominence pattern of SMPM can be seen in (3a). Here, because the correlate of the wh-word has a final high tone, that tone is raised in pitch, compared to the production of the same word in a neutral context.\(^1\) In (3b), however, because there is no high tone on the final syllable of the word corresponding to the wh-word, there is no detectable prominence.

(3) ‘What did Mariana give Bernardo?’

a. Chichí \(\uparrow\) tâshi=ñá ntâ’â=râ
   avocado give\.COMP=3SG\.F hand=3SG\.M
   ‘She gave him an AVOCADO.’

b. Ita tâshi=ñá ntâ’â=râ
   flower give\.COMP=3SG\.F hand=3SG\.M
   ‘She gave him a FLOWER.’

The generalization that correlates of wh-words are prosodically prominent has been shown to hold in many languages besides English (see Büring 2009), but key questions remain up for debate. For instance, there is debate about how foci trigger prominence, with two alternatives commonly suggested in the literature. On the one hand, there are researchers that view prominence on foci as a “default” prominence, which surfaces at a specific prosodic boundary to which correlates of wh-words are aligned, either by movement of prominence or prosodic rebracketing (Büring 2013; Féry 2013; Truckenbrodt 1999). That is, foci become prominent by being aligned to prosodic boundaries.\(^2\) Here, I refer to this as the FOCUS AS ALIGNMENT HYPOTHESIS. Crucially, this hypothesis marks correlates of wh-words as foci, but prominence is actually a default prominence that is sensitive to edges of prosodic boundaries.

On the other hand, there are those that view prominence on correlates of wh-words not as a default phrasal prominence at all, but as a special prominence that is directly associated with their status as foci. This association is either made via phonological constraints (Samek-Lodovici 2005), or by requiring a certain pitch accent to fall on a constituent that is in focus (Gusenhoven 1984; Selkirk 1995). Here, I refer to this as the DIRECT FOCUS HYPOTHESIS.

In this paper, in addition to outlining the empirical phenomenon of asymmetric prominence in SMPM, I will use one language-internal diagnostics — tone sandhi — to argue that fronted foci are not moved to a large prosodic boundary.

This paper is organized as follows: in Section 2, I provide some relevant background on the phonology and syntax of SMPM. In Section 3, I detail the empirical generalization and provide phonetic evidence to support the claim that correlates of wh-words are prominent in SMPM, and that this prominence is realized asymmetrically. In Section 4, I introduce a diagnostic for prosodic

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\(^1\) Here and throughout, a grave accent (\(\acute{V}\)) marks low tones, an acute accent (\(\acute{V}\)) marks high tones, a caron (\(\hat{V}\)) marks rising tones, a circumflex (\(\check{V}\)) marks falling tones, and mid tones are unmarked. Pitch raising is represented with an arrow (\(\uparrow\)). The following abbreviations are used in the glosses: COMP = Completive, CONJ = Conjunction, CONT = Continuative, COP = Copula, F = Feminine, INCL = Inclusive, M = Masculine, PL = Plural, POT = Potential, SG = Singular.

\(^2\) The details of this approach differ slightly by author in terms of the underlying motivation for alignment. Büring (2013) and Truckenbrodt (1999) argue that foci are aligned to prosodic boundaries in order to become prominent. Féry (2013), on the other hand, argues that prominence is a possible (though not necessary) consequence of a universal pressure to align foci.

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phrasing in SMPM, and use it to show that correlates of wh-words are not aligned to a prosodic boundary. Section 5 concludes.

2 Language background

San Martín Peras Mixtec is an Oto-Manguean language (ISO 639-3: JMX), spoken principally in and around the municipality of San Martín Peras in Oaxaca, Mexico, near the border with the state of Guerrero. The 2010 Mexican Census documents 10,386 residents of the municipality that report speaking an indigenous language. A little less than half also speak Spanish, and less than 200 report not speaking any indigenous language (Instituto Nacional de Estadística y Geografía 2010).

All uncited data in this paper come from two years of elicitation conducted with one female, middle-aged speaker who lives in Watsonville, California. The speaker grew up in a Mixtec-only household, in the town of Ahuejutla, which is roughly 10 miles away from San Martín Peras. In addition to elicitation sessions and personal use with family, the speaker also uses the language daily for work. All elicitation was conducted in Spanish.

SMPM is a verb initial language, like all other Mixtec languages (Macaulay 2005; Ostrove 2018). The default word order in out-of-the-blue contexts is VSO, as in (4).

(4) Kotô Pedro chichí like.CONT Pedro avocado
    ‘Pedro likes avocados.’

This default order is often disrupted, however, by movements to a pre-verbal position. This is the case with correlates of wh-words, for instance, which front to a pre-verbal position, as in (5b).

(5) a. Ná tàshĩ Ana ntà’ã Juan
    what give.COMP Ana hand Juan
    ‘What did Ana give Juan?’

b. Shi’ĩ tàshĩ=ñá ntà’ã=rà mushroom give.COMP=her hand=him
    ‘She gave him a mushroom.’

Fronting is not restricted to direct answers to questions, however. In SMPM, constituents can also front in response to a broad focus question, which elicits all new information. In response to a broad focus question, for instance, it is possible for the direct object to front.

(6) a. Ná kù biti what COP.COMP today
    ‘What happened today?’

b. Shi’ĩ tàshĩ Ana ntà’ã Juan mushroom give.COMP Ana hand Juan
    ‘Ana gave a mushroom to Juan.’

A similar phenomenon is also found in Chalcatongo Mixtec (Macaulay 2005). In that language, like SMPM, subjects, objects, and prepositional phrases can appear before the verb, even when they are not directly questioned by a wh-word. This fact allows for a direct comparison of the prosody of fronted constituents in two different contexts — as correlates of wh-words and as parts of answers.
to broad focus questions — without influence from other factors such as declination. A comparison of the prosody of fronted constituents in these two contexts will be the main empirical focus of this paper.

SMPM is a tonal language, like all other Oto-Manguean languages (DiCanio & Bennett 2020). It has five phonemic tones: three level tones (high, mid, low) and two contour tones (rising, falling) (Peters 2017). There are two distributional restrictions on tones in the language that will be relevant to the discussion here. First, falling tones occur much less frequently in the language, and for that reason they are not investigated in this paper — I will not compare how they are pronounced across the two contexts. Second, the use of the rising contour is almost completely restricted to the final syllable of a word. For this reason, all the rising tones that I consider in this paper appear in word-final position.

Figures 1a and 1b show time-normalized plots of the target tones across a wide variety of sentence contexts. Figure 1a shows the pitch of the three level tones across the vowel of word-initial vowels. Figure 1b shows the three level tones, plus the rising contour, across word-final vowels. Each vowel was isolated in Praat, and ten pitch measurements were taken at equal points across the vowel in Equivalent Rectangular Bandwidth (ERB), a psychoacoustic measurement scale that linearly plots the way pitch is perceived (Moore & Glasberg 1983). Colored lines represent the mean pitch of the tone across the entire vowel. Gray bars represent a 95% confidence interval around the mean. I have excluded the final measurement from the plots throughout this paper. Including this measurement resulted in sharp contour slopes at the end of the vowel, converging at roughly 5.4 ERB, the initial level of a low tone. I hypothesize that this effect is due to the fact that all target words were immediately followed by a verb beginning with a low tone — that is, it is the result of tonal co-articulation. Additionally, the fact that this effect is only realized within the final tenth of the vowel further suggests that it is the result of tonal co-articulation.

3 There are two important exceptions that I am aware of to this generalization. First, they can arise as the result of a regular tone sandhi process (see Section 4). Additionally, initial rising tones are used to signal some grammatical distinctions, especially negation (Eischens 2019).
3 Correlates of wh-words are prosodically prominent

3.1 Methodology

In order to compare the prosodic realization of correlates of wh-words and broad focus answers in a systematic way, I chose 36 target words with various tone melodies and elicited them using the question in (6a), as well as questions with the same shape as (5a) with the appropriate target word. All target words were bisyllabic. Target words were elicited as the direct object in a ditransitive construction. For each word, I would orally ask the appropriate question in SMPM, and would then show a picture representing a giving event between two individuals, with a picture of the target word in the middle (see Figure 2). The consultant would then respond with the appropriate answer. Sentences were held constant except for the target words and the proper names of the two individuals.

![Sample picture](image)

**Figure 2:** Sample picture

Each word was elicited eight times in response to a wh-question and eight times in response to a broad focus question, for a total of 576 target observations. This systematic elicitation was carried out during ten distinct elicitation sessions, over approximately three months. Elicitation was broken into blocks of broad focus questions and wh-questions. The condition that was presented first was counterbalanced to avoid any effects of repetition always occurring on one answer type. Elicitation of other unrelated material was often (though not always) interspersed between the two blocks of questions.

3.2 Results

The data elicited point to a clear asymmetry across tone type and position. Word-final high tones are significantly raised in pitch when they are in the correlate of a wh-word compared to when they are the part of the answer to a broad focus question (Figure 3b). This raising crucially depends on the position of the high tone, however — there is no raising in word-initial high tones (Figure 3a).

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4 Roots in Mixtec languages are minimally bisyllabic or bimoraic. This is often referred to as the couplet in the Mixtecanist literature (Pike 1948; Macaulay & Salmons 1995; a.m.o.).

5 P-values are the results of T-tests where the alternative hypothesis is that the difference in average pitch across the vowels is greater than 0.02 ERB, the Just Noticeable Difference threshold (Pulkki & Karjalainen 2015). This is a more conservative approach and requires a greater difference in means to achieve significance. This was done to ensure that any observed differences were perceptible. N-values represent the total number of syllables in each context. Differences are averages of pitch values across the syllable.
Figure 3a: Initial high tones
n=41, n.s.
Difference=0.02 ERB

Figure 3b: Final high tones
n=124, p<0.05
Difference=0.19 ERB

This difference can be contextualized by comparing it to the differences between each of the level tones in final position (Figure 1b). On average, high and mid tones are distinguished by 0.37 ERB, and mid and low tones are distinguished by 0.34 ERB. Thus, the raising effect seen in Figure 3b is slightly more than half the difference between each of the level tones, and is well above the Just Noticeable Difference threshold.

Table 1: Pitch differences between tones

<table>
<thead>
<tr>
<th>Tone</th>
<th>High↑</th>
<th>High</th>
<th>Mid</th>
<th>Low</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mean Pitch (in ERB)</td>
<td>6.13</td>
<td>5.94</td>
<td>5.57</td>
<td>5.23</td>
</tr>
<tr>
<td>Difference</td>
<td>0.19</td>
<td>0.37</td>
<td>0.34</td>
<td></td>
</tr>
</tbody>
</table>

This effect is restricted to high tones. There is no comparable raising effect in low tones (Figures 4a and 4b) or mid tones (Figures 5a and 5b), nor in the rising tones (Figure 6). Additionally, there is no lowering of low tones, as is found in Mandarin Chinese (Xu 1999), nor a global register shift as in Akan (Kügler & Genzel 2011). There is simply no difference between the two question conditions, except in word-final high tones. This is one respect in which prosodic prominence is asymmetric in SMPM.

This asymmetry, while distinct from other prominence patterns of tonal languages in the literature, is perhaps not completely unexpected. Ladd (2008:203) notes that pitch range expansion tends to be asymmetric, with more expansion happening at the upper bound of the pitch range than at the lower bound. This pattern may be especially unsurprising in SMPM for two reasons. First, high tones can freely raise without risking any neutralization with other tones. This is not the case, for
Ex: yù kù (‘leaf’)  

Figure 4a: Initial low tones  
   n=253, n.s.  
   Difference=0.01 ERB

Ex: sì bà (‘seed’)  

Figure 4b: Final low tones  
   n=52, n.s.  
   Difference=0.02 ERB

Ex: ndu shi (‘honey’)  

Figure 5a: Initial mid tones  
   n=237, n.s.  
   Difference=0.02 ERB

Ex: le so (‘rabbit’)  

Figure 5b: Final mid tones  
   n=162, n.s.  
   Difference=0.02 ERB
instance, with mid tones, which, if raised, would quickly encroach on the pitch range of high tones. Additionally, it is the case that there is only so low that a speaker can go without introducing glottalization into the voice quality. As SMPM uses several different glottal phonation types contrastively, including “checked” and “rearticulated” vowels (Angeles 2018; Ostrove 2018), lowering low tones may also introduce the chance of neutralization.

In addition to pitch, vowel duration is often a phonetic correlate of prominence (Gussenhoven 2004; Jun 2005; Ladd 2008). In SMPM however, there are no significant differences in duration between the questions conditions, for any of the tone types. This can be seen in Figure 7. Here, I compare the duration of vowels of each of the tone types across the two question contexts. The distribution of durations is represented as a violin plot — a box plot with a mirrored density plot on each side. The median is represented with a horizontal line, and each quartile of data is represented with a box or vertical line. Outliers are represented with dots. The mass between the curved lines and the midline of each plot represents the density of data at that point — the further the curved line from the mid-point, the more observations.

This pattern further indicates the asymmetry of prominence in SMPM. In addition to the fact that prominence is restricted to word-final high tones, only one correlate of prominence — pitch — can be detected.

### 3.3 Multiword correlates in SMPM

As demonstrated in the previous section, the phonetic reflex of prominence in SMPM is asymmetric: it is restricted to high tones in the final syllable. In fact, evidence from multiword wh-correlates suggests that the raising effect is limited to the absolute final syllable in the fronted focus phrase.

I elicited one- and two-word correlates of wh-words with final high tones, to determine patterns
of prominence in larger constituents. I compared the production of tones in three positions: word-final high tones on adjectives, word-final high tones on single nouns, and word-final high tones on nouns followed by an adjective. As expected, final high tones in one word answers are raised (7a). However, in two-word answers, only the absolute final high tone on the adjective undergoes raising. There is no raising on the noun, even if it ends in a high tone (7b).

(7) ‘What fell onto the ground?’

a. Tsyâkâ nàkábà nùhù nũ’ũ
   fish fall.COMP face ground
   ‘The FISH fell onto the ground.’

b. Tsyâkâ ndu’ũ nàkábà nùhù nũ’ũ
   fish fat fall.COMP face ground
   ‘The FAT FISH fell onto the ground.’

This effect can be seen in Figure 8. Here, we see that high tones on nouns that are modified are produced significantly lower than high tones on nouns that are unmodified. This difference can be seen by comparing the yellow and blue lines on the graph. Additionally, there is no significant difference between the pitch of high tones of unmodified nouns and adjectives. Furthermore, high tones on adjectives are raised in pitch when compared to the nouns that they modify. Importantly, this is the opposite of what we would expect based on declination, as adjectives follow nouns in SMPM.
Figure 8: High tones in fronted positions
Modified vs. unmodified nouns: n=242, \( p<0.05 \)
\textbf{Difference}=0.14 ERB
Unmodified nouns vs. adjectives: n=181, n.s.
Difference=0.07 ERB

4 Against focus as alignment

Féry (2013) argues that correlates of wh-words are universally aligned to a prosodic boundary, most often to an intonational phrase. Languages differ as to which edge of the prosodic domain is relevant for alignment purposes. Thus, a possible way to account for the prominence of correlates of wh-words would be to say that they are aligned to the edge of an intonational phrase (iP). Recall from Section 1 that I refer to this as the \textit{FOCUS AS ALIGNMENT HYPOTHESIS}.

This is the case, for instance, in Italian. Féry (2013), following Samek-Lodovici (2005) and Truckenbrodt (1995), argues that the subject in (9) is moved to the right edge of the intonational phrase, where it receives the final nuclear accent.

(8) What happened?
(Gianni ha \underline{RISO})
Gianni has laughed
‘Gianni has laughed.’

(9) Who has laughed?
(Ha riso \underline{GIANNI})
has laughed Gianni
‘GIANNI has laughed.’

Here, Féry argues that \textit{Gianni} is not prominent because it is a focus, \textit{per se}. Rather, its status as a focus forces it to be aligned to the right edge, where it happens to receive the nuclear accent.

I assume, given that constituents are fronted in both wh-answers and answers to broad focus questions, that the left edge cannot be the crucial edge to which the focus has to be aligned in SMPM.
(as it is in some other languages). If the left edge did trigger prominence, then we would expect the same prominence pattern on correlates of wh-words and fronted objects in broad focus answers, as they are both left-most in the sentence. Instead, one might posit an intonational phrase boundary between the fronted correlate of a wh-word and the verb, allowing the right edge of correlates of wh-words to be aligned to an $\ell$ phrase. Crucially, under this account, there would be no such boundary between broad focus fronted constituents and the verb.

(10) Phrasing to be rejected
   a. What did Mariana give Bernardo?
      
      (Chichí $\uparrow$) (táshí=ñá ná’tá=rá) $\downarrow$
      avocado give.COMP=3SG.F hand=3SG.M
      ‘She gave him a AVOCADO.’

   b. What happened today?
      
      (Chichí táshí Mariana ná’tá Bernardo) $\downarrow$
      avocado give.COMP Mariana hand Bernardo
      ‘Mariana gave Bernardo an avocado.’

   On this approach, the difference between broad focus constructions and correlates of wh-words would be a difference in prosodic phrasing — correlates of wh-words would be aligned to the right edge of an intonational phrase while broad focus answers would not. This prosodic boundary is likely not a $\phi$, as it is in some languages, due to the fact that we see no evidence of final high raising at other $\phi$ boundaries in the language. The difference in prominence across the conditions would have to be due to a larger boundary, such as an $\ell$ phrase. This phrasing could, in theory, be achieved via rebracketing, or as a faithful match from syntax to prosody if fronted correlates of wh-words were in a distinct, and higher, syntactic position than fronted constituents in broad focus answers. Under this view, the prominence realized on the correlates of wh-words is a default prominence that occurs on all intonational phrases.

In the following subsection, I will use tone sandhi as a diagnostic to determine intonational phrase boundaries in the language. I will argue that this diagnostic suggests that correlates of wh-words are not followed by an intonational phrase boundary in SMPM.

4.1 Tone sandhi

In SMPM, some adjectives that normally begin with a high tone will instead begin with a rising tone if preceded by a low tone. This can be seen, for example, with the adjective ká’no (‘big’), which undergoes this sandhi process after a noun that ends in a low tone (11), but not after a noun that begins in a mid tone (12).

(11) Shin=ì kíni ká’no
     see.COMP=I pig big
     ‘I saw the big pig.’

(12) Shin=i leso ká’no
     see.COMP=I rabbit big
     ‘I saw the big rabbit.’
This tone sandhi rule, which I call high tone contouring, can be formalized with the following rule:

\[(13) \text{HIGH TONE CONTOURING} \]

\[H \rightarrow R / L \omega \]

This process only applies across word boundaries, not within words — it doesn’t, for instance, trigger a rising tone on a word with a low-high tone pattern, such as yòsó (‘metate’).

Despite being a general process of the language, this tone sandhi rule is systematically blocked when the noun and adjective are separated by a clause boundary — it does not apply, for instance, between a matrix subject and an embedded adjectival predicate, even when the conditioning environment is seemingly satisfied.

\[(14) Kã’ã kînì [ká’nò itù] \]

\[\text{think} . \text{CONT} \quad \text{pig} \quad \text{big} \quad \text{tree} \]

‘The pig thinks that the tree is big.’

Assuming a faithful match from syntax to prosody (Hamlaoui & Szendröi 2017; Selkirk 2011), it is reasonable to conclude that a clause is mapped to an intonational phrase, which in turn blocks tone sandhi in the language. This fact is reminiscent of tone sandhi processes in other languages, which can also be blocked at prosodic boundaries. Campbell (2014), for instance, describes a process of high tone spreading onto toneless syllables, which additionally triggers downstep of mid and high tones, in Zenzontepec Chatino, another Oto-Manguean language. This rightward spreading is blocked, however, at an intonational phrase boundary, represented with the red arrow.\(^6\)

\[(15) \quad Jā kisō?ná= ná tā+kā+ (\text{maxi} k-\text{i}=\text{q} \quad \text{laa}= \quad \text{nyā?ā}) . \]

\[\text{CONJ} \quad \text{master}=1 \text{PL.INCL} \quad \text{exist} \quad \text{even.if} \quad \text{pot-feel}=1 \text{PL.INCL} \quad \text{like.so} \quad \text{sec.2SG} \]

‘We have our master, even if we think that way, you see.’ [Campbell 2014:138]

\(^6\) Here I adopt Campbell (2014)’s tonal orthography. Mid tones in this example are marked with a macron (\(\text{V} \)) and toneless syllables are unmarked.
Additional evidence that tone sandhi processes are sensitive to prosodic boundaries comes from Xiamen Chinese (Chen 1987). Assuming that tone sandhi in (14) is blocked by a prosodic boundary, we can leverage this fact to test the phrasing in (10a), which supposes that there is an intonational phrase boundary between the correlate of a wh-word and the following verb.

Contrary to the predictions of the alignment account, tone sandhi is not blocked between a fronted correlate of a wh-word and an adjectival predicate. This can be seen in Figure (10).

(16) What is big?

Kînî kā’no
pig big
'THE PIG is big.'

This lack of a blocking effect strongly suggests that there is no intonational phrase boundary in between the correlate of the wh-word and the following verb, casting doubt on an analysis that relies on alignment to a P boundary to account for the prosodic differences between answers to different questions in SMPM.

5 Conclusion

In this paper, I have described a novel empirical pattern from an understudied language: San Martín Peras Mixtec. I have shown that correlates of wh-words in the language are asymmetrically prominent — pitch raising targets the rightmost syllable if it is a high tone, but otherwise there is no difference between these answers and answers to broad focus questions. No other tone is raised or lowered, and there are no durational differences. In cases of multiword correlates of wh-words, only the absolute final syllable of the correlate is raised in pitch if it is a high tone.

Furthermore, I have provided one argument against the FOCUS AS ALIGNMENT HYPOTHESIS, which suggests that correlates of wh-words are aligned to a prosodic boundary, which is often a prosodically prominent position. I showed, based on tone sandhi, that no such boundary exists between correlates of wh-words and the verb in SMPM. This suggests that prominence of correlates of wh-words in SMPM is directly related to their status as foci. There is no evidence that foci surface in a position that has some associated default prominence.

I believe the pattern in SMPM suggests that the typology of focus prominence is not yet complete. More work, especially on understudied languages, is needed to understand the full range of
phonological expressions of focus. Until that work is done, I believe theories of focus prominence will be limited in scope, and we will not fully understand what is shared across the information structure systems of the world’s languages.

References


