PHONETIC INTERPRETATION OF TONE FEATURES IN PEÑOLES MIXTEC

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ABSTRACT

Surface representations of tone in Peñoles Mixtec are derived from underlying representations which are determined largely by considerations of simplicity in the account of tone sandhi. There is tension between underlying tonal representations which simplify a description of tone sandhi and surface representations which lend themselves to straightforward phonetic interpretation. These demands are met within a theory of tone in which primary and register features are on separate planes and in which register has a cumulative effect.

1. Introduction

A coherent tone system of Peñoles Mixtec (PM)[1] emerges with the postulation of two primary features High (H) and Low (L) and two register features high (h) and low (l). These features make possible an insightful account of tone sandhi that is compatible with a relatively simple, although unexpected, account of the phonetic manifestation of tone.

The framework for this description of tone is Snider (1990), where the tone features are on two tiers (and planes) meeting at a Tone Node (TN). Every tone is specified for a primary feature (Snider's 'modal feature') and a register feature. Register features are cumulative in their effect, seen in tones in successive l registers being on successively lower levels.

In my adaptation of the model, tones in underlying structure are underspecified. Only the primary feature H and the register feature h appear, and subsequently the primary feature L is introduced by default. The introduction of default L is delayed until after all the rules have applied which do not require the presence of this feature, and which if it were present, would unnecessarily complicate the rules.

In underlying structure a register h feature is associated or unassociated. If it is unassociated, it is subject to association to a following vowel by rule. A register h feature is introduced in H tone assimilation following the last assimilated H tone, and this feature is also subject to association by rule. An associated register h feature, either underlying or derived, will have a primary L feature associated to its TN by default. The combination of the register h feature and the primary L feature, I call a h register L tone, symbolized as L^h.

The register feature l is not present in underlying structure but is introduced by default after all the rules accounting for tone sandhi have applied. Introducing this feature facilitates the specification of the phonetic value of H tone. H tones receive different values depending on whether they are in h or l register. Furthermore, l register accounts for the successive lowering of tones pertaining to a series of l registers by register features being defined as having a cumulative effect.

2. Tone Sandhi

The benefit of the tone features in tone sandhi is most clearly seen in tone alternation in the eight basic tone patterns on disyllabic morphemes. An informal representation of these patterns is: H H, H L, L H, L L, L^hH H, L^hH L, L^h H and L^h L. In one environment (following a subclass of L L morphemes) each of the first four tone patterns becomes one of the second four. In a different environment (following the pattern L^h L) each of the second four tone patterns becomes one of the first four. The same tone patterns are paired in whichever direction the change occurs. The two kinds of change are accounted for by the association or delinking of a register feature h.

The tone changes are summarized in (1). Following the subclass of L L morphemes which condition a change (morphemes with a floating register h feature), the

[1] Peñoles Mixtec is spoken in the village of Santa María Peñoles, located in the mountains to the west of Oaxaca City in the state of Oaxaca, Mexico. PM, along with a number of mutually intelligible varieties of Mixtec spoken in other villages of the same area, group together into what I have called Eastern Mixtec. Eastern Mixtec is sufficiently different from other dialects of Mixtec to be viewed as a distinct language. It is one of 30 or more Mixtec languages spoken in the states of Oaxaca, Puebla, and Guerrero, that are differentiated by mutual unintelligibility.

patterns on the left become the patterns on the right. Following the pattern L^h L, the patterns on the right become the patterns on the left.

(1)

H H	<--->	L^hH H
H L	<--->	L^hH L
L H	<--->	L^h H
L L	<--->	L^h L

The phonetic evidence that the tones of the L^hH glide are the appropriate ones is that these tones on one vowel have the same phonetic value as when they occur on two vowels. L^hH H, where the first two tones are on a single vowel, have the same phonetic values as L^h H H, where the first two tones are on separate vowels. The essential difference in two tones on a single vowel is the glide from one level to the next.[2]

An example of the tones L^h H on a single vowel is in (2a) and on two vowels in (2b). H tone is represented by (´), L tone by (¯) and L^h tone by (`). The combination of the tones L^h and H on a single vowel is represented by (˘).

(2) a. úú tătá
two father
'two fathers'

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[—      /‾ ]
```

b. úú čìbá -dé
two goat -his
'two of his goats'

```
[—    _ ‾   ‾ ]
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Additional evidence for positing the sequence L^hH on a single vowel is that following tones have the same values as when the tones L^h H occur on two vowels. In (2) the second H tone, for example, is one step up from the preceding H whether the preceding H is on the same vowel as the L^h or on a separate vowel.

3. Tones in h and l Registers

Given the above assignment of tone that facilitates a description of tone sandhi, it remains to be seen whether this analysis is compatible with a reasonable account of the phonetic manifestation of tone. A way must be found to relate the underlying representations to surface representations which receive a straightforward phonetic interpretation.

The phonetic data to be accounted for can be divided into tone sequences which are preceded by a L^h tone and those which are not. The tone sequences preceded by L^h in my analysis are of h register and other sequences are of l register. Consider first the data in (3).[3]

(3) a. čìūⁿ[4]
work

```
[ – \ ]
```

b. čìūⁿ -dé
work -his

```
[ _‾   ‾ ]
```

c. kʷàžú
horse

```
[ _ ‾ ]
```

d. sàkú -dé
CON.laugh -he
'he is laughing'

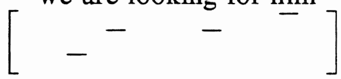
```
[ _ ‾     ‾ ]
```

[2] In Daly (1977) I postulated four tones: modified H, modified L, unmodifed H and unmodified L, differentiated by the features High and Modify, adapted to the phonetic requirements of PM (cf. Woo 1969). A modified H tone is equivalent to what I now analyze as a sequence of the two tones L^h and H, which more directly represent the phonetic facts; and a modified L tone is equivalent to the L^h tone.

[3] The data are based on my auditory impressions, supplemented by tracings of F0 in the CECIL system.

[4] Nasalization is represented by (ⁿ) following the last vowel of a morpheme. It spreads left to the adjacent vowel. It also spreads to a second vowel to the left if the two vowels are adjacent to each other or are separated only by a glottal stop.

e. ndùkū -ndɨ́-dé
CON.look.for -we.ex -him
'we are looking for him'

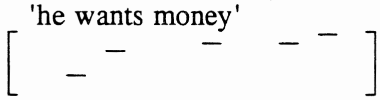


The following observations of the data in (3) must be taken into account: Immediately following a L^h tone, a L tone begins a step up and ends at extra low pitch before pause (3a). If a H tone follows the L tone, the L tone and the H tone are both level tones one step up from the L^h tone (3b). Immediately following a L^h tone, a H tone is one step up (3c). If there is a second H tone, it is one additional step up (3d). Two H tones are also a step apart, if a L tone intervenes between the L^h and the two H tones (3e).

Comparing (3b) and (3c) shows that one H tone following L^h has the same value whether there is an intervening L tone or not, and comparing (3d) and (3e) shows that two H tones have the same values whether there is an intervening L tone or not.

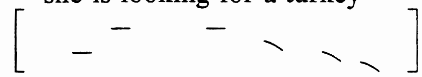
These sequences of tones can be expanded by adding any number of H tones (within the limits of a phonological phrase). H tones intermediate between the first and last H tone may be on the same level as the last H tone, but more often are on successively higher levels between the level of the first H tone and the last H tone. An approximation of the typical manifestation of the intermediate H tones is given in the graph in (4) where these tones are shown to be at the same level, halfway between the level of the first H tone and the last H tone.

(4) k^{w}ìní -dé díʔú^n
CON.want -he money
'he wants money'

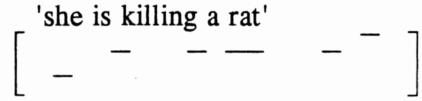


A sequence of any number of L tones following a L^h tone begins and ends at the same phonetic levels as a single L tone: If it is phrase final, the sequence begins a step up from the L^h tone and ends at extra low pitch (5a). If it is followed by one or more H tones, the L tones are level tones a step up from the L^h tone (5b).

(5) a. ndùkū -šī ɨ̄ɨ̄^{n} kōlō
CON.look.for -she one turkey'
'she is looking for a turkey'



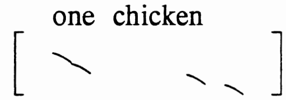
b. sàʔnī -šī ɨ̄ɨ̄^{n} čótó
CON.kill -she one rat
'she is killing a rat'



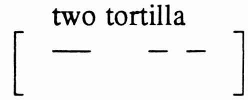
These data demonstrate the possible combination of tones and the typical manifestation of tones in h register. Zero or more L tones followed by zero or more H tones pertain to the same h register and have the phonetic values described above.

All tones which do not pertain to h register pertain to l register. Examples of tones pertaining to l register are given in (6).

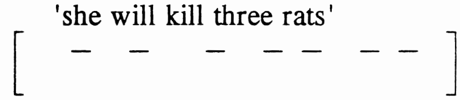
(6) a. ɨ̄ɨ̄^{n} nǰūšī
one chicken



b. úú dítá
two tortilla



c. kāʔnī -šī úní čótó
POT.kill -she three rat
'she will kill three rats'



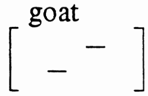
l register consists entirely of L tones (6a), entirely of H tones (6b), or of L tones followed by H tones (6c). L tones followed by H tones are level tones.[5]

The L^h tone, which contributes a register h feature to following tones, is itself of l register. It may be the

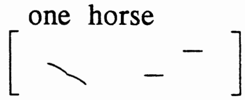
[5] The phonemic distinction between L and H is retained because of the potential contrast between them in most contexts--the contrast arising from the variants of L not being the same as the variants of H.

only L tone at l register (7a), or it may be the last of two or more L tones at l register (7b).

(7) a. čìbá
goat



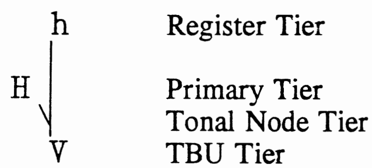
b. ɨ̄ɨ̄^{n} k^{w}àžú
one horse



4. Tone Representation in Surface Structure

In surface structure, every Tone Node (TN) has associated to it a primary feature and a register feature. A TN is associated to a vowel, the Tone Bearing Unit (TBU). The geometry of tone is illustrated in the diagram in (8) where a H tone is at h register.

(8)



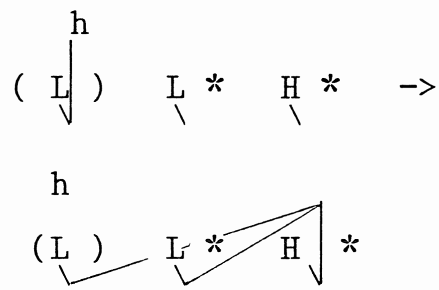
The same primary features in the same combinations pertain to a single register, whether h or l. The tones of a single register conform to the template in (9) of zero or more L tones followed by zero or more H tones. Thus, a register may consist of L tones followed by H tones, of only L tones or of only H tones.

(9) L* H*

In order to make this generalization, I create a node for each sequence of tones which is to become h or l register. A register h feature is disassociated from a L^{h} tone and is placed at a following register node.[6] Register nodes which do not become h register become l register by default.

The rule to create a register node is:

(10) Register Node Formation



The rule applies twice. The first time, it applies to the more restricted environment--to each sequence of zero or more L tones plus zero or more H tones which is preceded by a L^{h} tone. The rule creates a register node which is associated to the L and H tones, and delinks the register h feature. The second time the rule applies, it applies to each remaining sequence of zero or more L tones and zero or more H tones, creating a node which is associated to each sequence of L and H tones.

An example of two applications of the rule of Register Node Formation is given in (11). In (11a) no rules of tone sandhi have applied, so the underlying representation is the same as the intermediate representation to which further rules apply. (The diacritics on the vowels in each of the following diagrams represent the tones of the intermediate representation.)

On the first application of the rule to (11a), two L tones followed by two H tones are associated to a register node, and a register h feature is delinked, shown in (11b). On the second application of the rule, the L tone which had a register h node before it was delinked and the preceding L tones are associated to a register node, shown in (11c).

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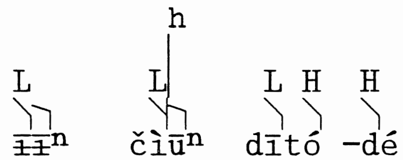
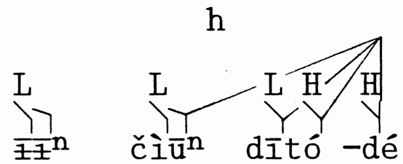
[6] The association of the register h feature with a primary L feature (L^{h}) and the subsequent delinking of the register h is an artifact of the underspecification of tone. The register h could be floating and not require delinking if instead of being associated to a primary L , a register l were associated to the L, the surface representation of this tone. The floating register h (on the same tier as the l) would follow the associated l, thereby assuring the proper ordering of the floating h with respect to following L and H tones to which the h comes to be associated. This possible simplification, however, is more than offset by the advantages of underspecification.

(11) a.

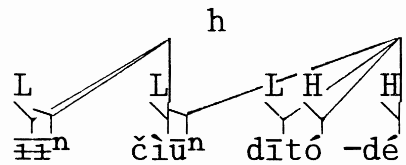


one work uncle -his
'his uncle's one job'

b.

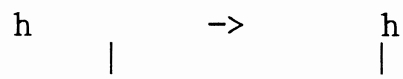


c.



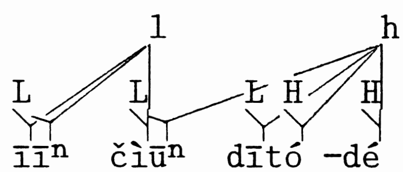
The rule which places the now floating register h feature at a following node is:

(12) Register h Labeling



This rule applies to the representation in (11c), and default l register is introduced to give (13). The second register node is labeled with the register h feature, and the first register node is labeled with the default l.

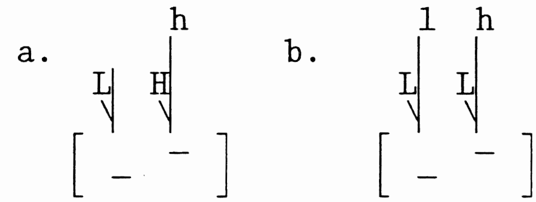
(13)



5. Phonetic Value of Features

The combination of a primary tone feature and a register feature determines the height of a tone. A register feature shifts a tone to a higher or lower phonetic level by the same degree that two primary tone features differ in height. A register h feature specifies the level of a tone as one step higher than the same tone in a preceding register, and a l register feature specifies the phonetic level of a tone as one step lower than the same tone in a preceding register. The relationship in the theory between primary tone features and register features is illustrated in (14). In (14a) a L tone and a H tone, which are in the same h register, are shown to be on two phonetic levels; the H tone is one step up from the L tone. In (14b) there are two L tones at two different pitch heights, the second on a separate h register. The second L tone is one step higher than the preceding L tone to the same degree that the L and H tones in (14a) are a step apart.

(14)



The phonetic value of tone features illustrated in (14) conform to Inkelas (1987) and Snider (1988, 1990). In PM an innovation in the model is needed for a H tone to be either at the highest level of its register or at its lowest level. The first H tone following a L tone does not have the value shown in (14a)--only subsequent H tones do. The first H tone in h register is lowered to the lower end of the register and is at the same level as the preceding L tone, although it may vary to a somewhat higher pitch level.

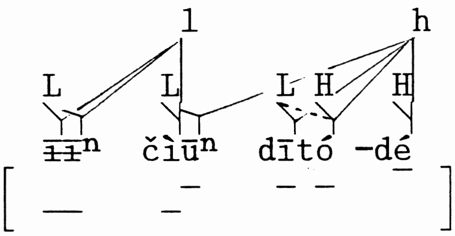
The lowered H tone, as will be seen, cannot simply be H or L, but must be both H and L. To obtain this combination of features, a primary L feature is spread to the tone node of a following primary H feature to form a merged L:H. By spreading L, (15) is derived from (13) above.

In (15) the primary L feature of the first vowel of dītó spreads to the tone node of the primary H feature of the second vowel of this morpheme to lower the H tone to the same level as the preceding L tone. The H tone of -dé is not lowered; it is at the highest level of h register.

As the diagram indicates, the phonetic difference between the two H tones in h register is as great as the phonetic difference between the two L tones of čìūⁿ, which are of two registers. The difference between the two H tones is also as great as the difference between the first L tone of čìūⁿ and the H tone of dītó. Put another way, the allophonic distinction between the

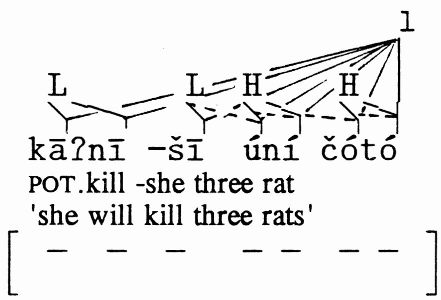
H tone of dītó and the H tone of -dé is as great as the phonemic distinction between the first L tone of čìū^n and the H tone of dītó.

(15)



It is only the first of two H tones that is lowered to low pitch level in h register. Contrast this with the level of H tones in l register. Not just the first, but every contiguous H tone following a L tone is at a lower level, so a primary L feature is spread to the tone node of each following H tone. In (16) the H tones of úní and of čótó are lowered and are each specified by the features L:H.[7]

(16)

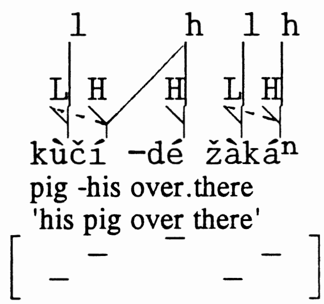


An alternative to the merged L:H might seem to be to spread a L tone and to delink a H tone, with the delinked H accounting for the derived L not gliding lower. This alternative is not feasible because a L tone maintains its identity into the phonetic component even when followed by an anchored H tone of the same register. While in one context the L tone is always a level tone, indistinguishable in pitch from a following H tone, in other contexts it fluctuates between being a level tone and being a drifting tone. In some contexts it is more likely to be a level tone, and in other contexts it is more likely to be a drifting tone. This kind of fluctuation is more appropriately handled in the phonetic component rather than by a change from one contrastive tone to another.[8]

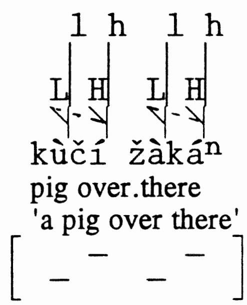
A second alternative to the merged L:H is to place the two H tones which are phonetically a step apart on separate h registers. However, in PM this is not an option. If two H tones are of two h registers, following tones should be shifted to a higher level from what they are when there is only one H tone because of the cumulative effect of register, but tones following two H tones and tones following a single H tone are at the same level. The two H tones must therefore pertain to one h register, as does a single H tone.

Examples showing following tones being unaffected by the number of preceding H tones at h register are in (17). In (17a) there are two H tones in the initial h register, and in (17b) there is one H tone in the initial h register. This difference does not affect the level of the following L^h H pattern.

(17) a.



b.

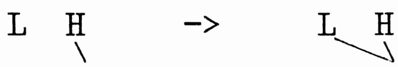


[7] Spreading L to more than one following H violates the no-crossing constraint. A possible remedy is to place L on a separate plane from H in the same way that register features are on a separate plane (cf. Coleman and Local 1991).

[8] A single L tone may drift lower, and a series of L tones may drift to successively lower pitch levels. Relevant to the likelihood of L tone drift is the presence or absence of a following H tone of the same register and the presence or absence of a preceding H tone. A following H tone of the same register diminishes the likelihood of L tone drift, and a preceding H tone increases the likelihood of L tone drift.

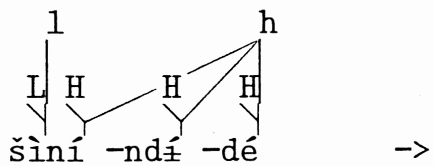
The association of a L feature to the first following H tone in h register, or to every following H tone in l register, is done by the same rule. In the case of h register the rule applies once, and in the case of l register it applies iteratively. The rule is:

(18) Primary L Spread

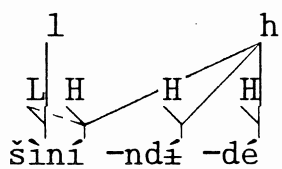


The Primary L Spread rule is applied to the first H tone of h register in (19). The primary L feature of šìní is spread to the primary H features of this same morpheme.

(19)

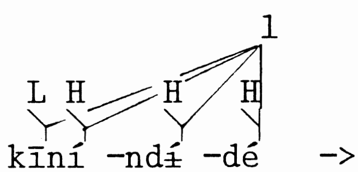


CON.know/see -we.EX -him
'we know/see him'

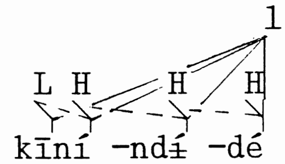


The rule is applied iteratively to each H tone of l register in (20). The primary L feature of kīní is spread to the primary H feature of this same morpheme and to the primary H features of -ndɨ́ and -dé.

(20)

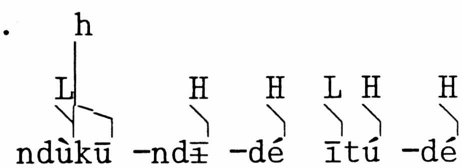


POT.see -we.EX -him
'we will see him'



The application of the Primary L Spread rule, as well as the Register Node Formation and Register h Labeling rules previously introduced, is illustrated in the following derivation. Beginning with an intermediate representation (21a), Register Node Formation applies once to delink a register h and to create a register node associated with following tones (21b), and applies a second time to create two additional register nodes (21c). Register h Labeling applies next (21d), and then register l is introduced by default (21e). Primary L Spread applies in h register (21f) and then in l register (21g).

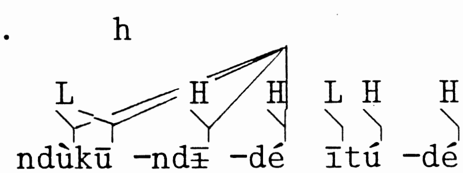
(21) a.



CON.look.for -we.EX -him corn.field -his
'we are looking for him in his corn field'

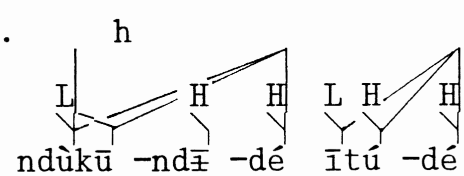
intermediate representation

b.



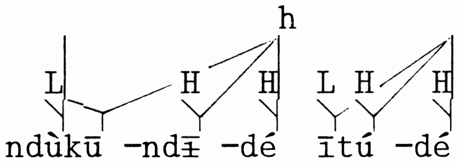
Register Node Formation
(first application)

c.



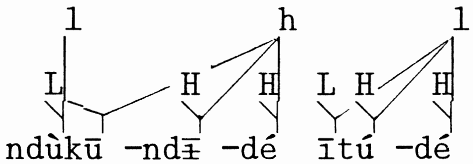
Register Node Formation
(second application)

d.



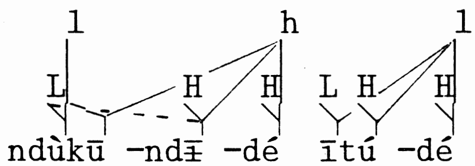
Register h Labeling

e.



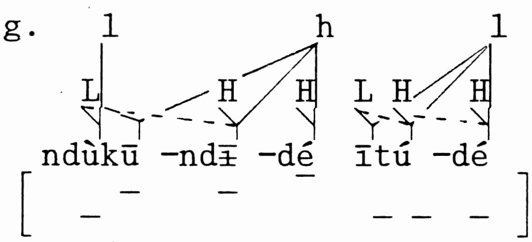
Default l Register

f.



Primary L Spread
(h register)

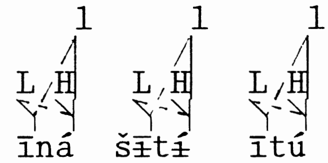
g.



Primary L Spread
(l register)

A series of l registers occurs when L and H tones alternate. Each sequence of one or more L tones plus one or more H tones pertains to a single l register that places them lower than the tones of the immediately preceding l register, as exemplified in (22).

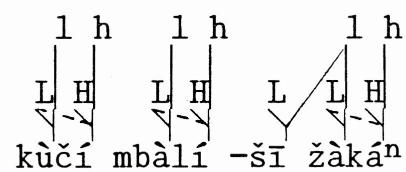
(22)



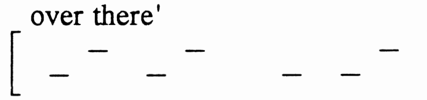
dog inside corn.field
'dog in a corn field'

There is no case of h register being cumulative, although this possibility is allowed for in the definition of register. Two h registers are always separated by a l register. Thus, the effect of h register on following tones is always offset by l register. In (23) three L^h H sequences are shown to be identical phonetically (apart from optional L tone drift).

(23)

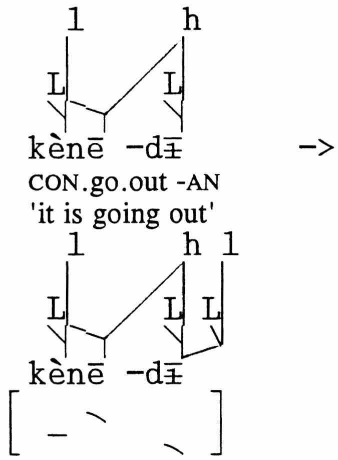


pig co-godparent -her over.there
'pig of her co-godparent
over there'



There is one important conditioned variant that has not been accounted for. A L tone always glides to extra low at the end of a phonological phrase. The model of tone followed here makes it possible to give a distinctive representation to a final L tone by adding a second L tone to the final vowel and assigning to this L tone a register l feature all its own. Thus, a final L tone ends at a register a step down from its beginning point. For example, the representation of a morpheme such as -dɨ̄ 'animal' in (24), which has a single L tone at h register, will come to have two L tones in surface structure, one at h register and the other at l register.

(24) a. b.



6. Conclusion

The choice of tone features and their assignment to strings of tones in PM are governed by considerations of simplicity and coherence in the description of tone sandhi and in the phonetic interpretation of tone. Simplification in the description of tone sandhi leads to a specification of the phonetic value of tone that is relatively straightforward.

The features which meet these requirements are the primary features High (H) and Low (L) and the register features high (h) and low (l). The primary features specify tones which are on two phonetic levels a step apart. The register features shift the primary features a step up or a step down. Tones at h register are a step higher than the tones of a preceding register, and tones at l register are a step lower than the tones of a preceding register.

The cumulative nature of tone register accounts for the lowering of a series of alternating L and H tones by a single register feature l being associated to each sequence of L plus H tones. The cumulative nature of register is not seen in h register although at first sight it may appear to be. Instead, every series of tones at h register is preceded by one or more tones at l register.

Underlying forms are underspecified for tone. They have only the primary feature H and register feature h, associated or floating, the latter associated by rule in the course of a derivation. The primary feature L and register feature l are filled in by default.. The register feature h is associated only to the first vowel of underlying disyllabic forms, and comes to be associated with the feature L by default.

The benefit of these tone features is seen in tone sandhi where a floating register h associates to a following vowel and where an associated h is delinked. A third major process of sandhi is the assimilation of L to H and the introduction of a floating register h following the last H tone.

After rules of tone sandhi have applied, the tone representations are prepared for phonetic interpretation. First, zero or more L tones followed by zero or more H tones are identified as pertaining to the same tone register. Second, a register h, disassociated from its primary L feature is associated to the following tones pertaining to the same register. Third, all remaining tone registers are specified as l by default.

Finally, a primary L feature is spread to every following H tone of l register and to the first H tone only of h register. The need for this additional rule is to differentiate two levels of H tones which are both of the same h register, the first lowered to the lower end of h register and the last at the upper end of h register. It is seen that the two levels of H cannot be accounted for by the first H tone being at one h register and the last H tone at a second h register because following either one or two H tones, tones of a following l register maintain their same phonetic pitch level and are not shifted upward as they would be following two h registers. Tones intermediate between the first and last H tone are typically on successively higher pitch levels, ending below the level of the last H tone.

One or more L tones of the same register may be level or may drift lower. One or more merged L:H tones may be at the same phonetic level as a preceding L tone of the same register or may vary to a higher pitch level. If a L does not drift lower or a L:H does not vary to a higher level, the contrast between L and H tones may be lost. Nevertheless, the distinction between L and H tones is maintained until they are interpreted phonetically because in most contexts the L tones may be manifested as either level or drifting tones. Furthermore, the manifestation of L tones is on a continuum between their being clearly level or clearly drifting that makes it impossible to determine in every case whether the L tones are the same or different phonetically than H tones.

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