THE PHONOLOGY OF GLOTTALIZATION IN MIXTEC[1]

MONICA MACAULAY AND JOSEPH C. SALMONS

PURDUE UNIVERSITY

1. Introduction. The phonological status of glottal stop and glottalization is problematic across many languages of the world, particularly in languages of the Americas. Even in those languages where there clearly exists a phoneme /ʔ/, it very often shows a restricted distribution, especially a lack of contrast in word-initial position (as is, for example, generally the case in Tzutujil, cf. Dayley 1985:17–18). In some languages, one finds that glottal stop has a timing slot but ambiguity with regard to whether it behaves consonantally or vocalically (e.g., Mam, cf. England 1983:34–36). In numerous other languages, the phonemic status of what is phonetically a glottal stop is at best marginal, and its behavior appears to be linked as closely to prosodic phenomena as to segmental phenomena (e.g., Koasati, cf. Kimball 1991:24–25; and Ponca, cf. Rankin 1988). In still other languages, some analyses have proposed that glottalization serves primarily prosodic functions and can characterize entire roots or words (e.g., Quechua, cf. Carenko 1975; also see Salmons 1991 for a more general discussion).

The substantial body of literature on Mixtec phonology provides a microcosm of this broader discussion.[2] Work on Mixtec, both synchronic and diachronic, has proposed two quite different approaches to what is usually treated phonetically as a glottal stop. The more descriptively oriented analyses simply posit a phoneme /ʔ/ in the consonant inventory. Under this view, for example, a Chalcatongo Mixtec word like *bàʔà* 'good' would be assigned a structure of CVCV, as shown in (1*a*). Another, more recent view is known among Mixtecanists as the "prosodic approach." There are several variants of this view, the most common of which posits "checked" or "glottalized"

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[2] Mixtec is an Otomanguean language spoken by well over 300,000 people throughout much of the state of Oaxaca, Mexico, as well as in parts of the neighboring states of Puebla and Guerrero. Although the different varieties of Mixtec are not all mutually intelligible, they are traditionally referred to as "dialects," and that terminology is retained here.

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vowels,[3] assigning a structure of CVV (with the first V glottalized) to words like *bàʔà*, as shown in (1*b*):

(1) CV Structure of *bàʔà* 'good'

(1*a*) Consonantal approach:

b	*a*	*ʔ*	*a*
|	|	|	|
C	V	C	V

(1*b*) Prosodic/vocalic approach:

b	*aʔ*	*a*
|	|	|
C	V	V

In this paper, we show that both approaches are flawed as synchronic solutions to the problem, basing our arguments on a variety of phonological and other evidence. To overcome the difficulties inherent in each approach, we posit for the majority of Mixtec dialects a floating glottalic feature as a (facultative) characteristic of the root or "couplet" in traditional Mixtecanist terms. This allows us to build on the basic insight of the prosodic approach while avoiding its shortcomings. We present the analysis of present-day Mixtec using data from our fieldwork on Chalcatongo Mixtec (a Western Alta dialect) and closely related neighboring dialects, as well as using examples drawn from the literature on other dialects. We further explore the diachronic dimension of the problem and suggest that a version of the approach which posits checked vowels is perhaps tenable as representing an earlier stage in the development of glottalization in Mixtec, as well as the current state of a very small number of conservative dialects. We close with a sketch of diachronic parallels between the Mixtec developments and similar instances from other languages, an evolutionary path still reflected to some extent across the modern Mixtec dialects.

2. The data and previous analyses. Roots in Mixtec are minimally disyllabic;[4] this structure is referred to by Mixtecanists as the "couplet"

[3] In this paper, we alternate between calling such vowels "laryngealized" (following Maddieson 1984) and using the more traditional terms "checked" or "glottalized."

[4] We leave aside those recent analyses (e.g., Gittlen and Marlett 1989) which treat examples such as (2*a*) and (2*c*), and sometimes (2*b*) and (2*d*), as ultimately monosyllabic but bimoraic. For our purposes, what matters is that the Mixtec root has two timing units, and whether we call them syllables or morae is not important here. For a detailed discussion of this matter, see Salmons (n.d.).

(or "tonemic couplet," cf. Pike 1948). Chalcatongo Mixtec, a fairly typical system, has the following set of possibilities for couplet structure:[5]

(2) Chalcatongo Mixtec[6]

(2*a*) VV: *uù* 'two', *uà* 'bitter'

(2*b*) V?V: *ú?u* 'hurt', *í?a* 'saint, god'

(2*c*) CVV: *čàà* 'man', *saù* 'rain'

(2*d*) CV?V: *bà?à* 'good', *bá?ù* 'coyote'

(2*e*) CVCV: *kɨtɨ* 'animal', *katu* 'make tortillas'

(2*f*) CV?CV: *kó?lo* 'turkey', *bí?ža* 'nopal'

(2*g*) VCV: *inì* 'inside', *úna* 'eight'

Glottalization in Chalcatongo Mixtec couplets of the form (2*b*), (2*d*), and (2*f*) is most commonly realized phonetically as a glottal stop, as it is in neighboring highlands dialects as well. On some occasions, however, laryngealization of surrounding vowels is audible as well. As we discuss at some length below, glottalization before a consonant (as in roots of type 2*f*) usually results in a short echo vowel after the glottal stop, so that 'turkey', for example, often but not always appears phonetically as [kó?ºlo].

The couplet is subject to further affixation (which in practice is limited to prefixation) and/or cliticization, resulting in words of more than two syllables. However, virtually all longer forms can be analyzed as polymorphemic; if not synchronically, then certainly diachronically. We restrict our attention to the disyllabic couplet in what follows.

As mentioned above, traditional analyses treat [?] as a consonant phoneme.[7] A variant of this view of Mixtec glottal stop has made its way into the recent theoretical literature, in Piggott (1992). Piggott regards phonetic glottal stop in Mixtec as "just a default segment that fills a position which

[5] There is also a very limited set of possible syllable-initial consonant clusters. These are omitted from discussion here for purposes of clarity. Their existence does not affect our analysis in any way.

Note also that we ignore throughout the discussion the insertion of glottal stop in vowel-initial words. In those dialects which have it, this process is postlexical, i.e., purely phonetic at the end of the derivation. As we noted in the first paragraph above, this is common across numerous languages of the world.

[6] We mark the three tones of Chalcatongo Mixtec as follows: acute accent (´) indicates High tone, grave (`) indicates Low, and unmarked syllables are Mid.

[7] For example: Alexander (1980; Atatláhuca), Daly (1973; Peñoles), Hunter and Pike (1969; Molinos), Macaulay (1987*a*; Chalcatongo), Mak (1958; Ocotepec), North and Shields (1977; Silacayoapan), Overholt (1961; Guerrero), Pankratz and Pike (1967; Ayutla), Pensinger (1974; Jamiltepec), Pike (1944; San Miguel el Grande), Pike and Ibach (1978; Mixtepec), Pike and Oram (1976; Diuxi), Pike and Wistrand (1974; Acatlán), and Zylstra (1980; Alacatlazala).

otherwise lacks phonetic content" (1992:39) and assigns it to an X slot.[8] He focuses in one section of his paper on the nature of Mixtec nasal harmony and cites several different patterns, including progressive and regressive nasal harmony. Parallel to the analysis of glottalization presented here, one form of such harmony involves a floating nasal feature, rather than spreading. Our analysis of glottalization will be shown in **4** below to simplify Piggott's account of nasal harmony in the environment of a glottal stop.

As an example of a traditional analysis of glottal stop, we can consider North and Shields's (1977:21–22) description of Silacayoapan Mixtec phonology. They list the consonant inventory as follows:[9] voiceless stops /p, t, č, k, k^w, ʔ/, prenasalized stops /mb, nd, nǰ, ng/, fricatives /v, s, š, ž, h/, nasals /m, n, ñ/, liquids /l, r/, and semiconsonant /y/. Syllable and couplet structures are similar to those presented for Chalcatongo Mixtec in (2), with the addition of the following patterns:

(3) Silacayoapan Mixtec

(3*a*) VʔCV: *ĩʔñ́* 'hot'

(3*b*) C*y*VCV: *vyahá* 'wet'

(3*c*) C*y*VʔCV: *kyàʔva* 'brother'

Under this traditional approach, syllables in Silacayoapan Mixtec may be described as open—that is, as (C)V[10]—with one exception: they may be (C)VC if the final C is /ʔ/, and if and only if the closed syllable is in initial position in the couplet. This is laid out in (4):

(4) Syllable canon for Silacayoapan Mixtec
(C)V(C)

Conditions:

(4*a*) Only /ʔ/ may close a syllable, and

(4*b*) Closed syllables may only occur couplet-initially

It has long been recognized that a sonority hierarchy plays a role in syllable structure. More specifically, restrictions on what segments may close a syllable (e.g., conditions like our 4*a*) are not unusual in and of themselves; many languages have similar restrictions. For example, Mandarin Chinese allows only nasals in coda position, and Modern Greek normally has only [s] or [n]. In one modern framework, autosegmental licensing is

[8] This approach is in some ways not unlike the generally prosodic approach to Mixtec diachronic and synchronic phonology which is taken in Salmons (n.d.), following in the footsteps of Rice (1990).

[9] We use their transcription here.

[10] We ignore the glide here simply for ease of presentation. In fact, it is possible that the consonants which are followed by [y] may be reanalyzable as palatalized unit phonemes, parallel to the /k^w/ found in so many Mixtec dialects (including this one).

understood as favoring the occurrence in coda position of segments of relatively high sonority, or of segments not contrastively defined by point of articulation (Goldsmith 1990:123–27, 130–31). Given that /ʔ/ is very often regarded phonologically as a glide and thus as a highly sonorous consonant, it could plausibly be licensed to occur in codas where other consonants are prohibited, fulfilling the first preference. Moreover, since it lacks all supralaryngeal specification, it ideally fulfills the second.

However, the distributional restriction on such syllables to initial position in the root (condition 4*b*) is unusual, and this has led us, like many other Mixtecanists, to search for alternative ways to look at the problem. Bradley (1970; 1977) was apparently the first to propose the "prosodic" solution, according to which glottalization is considered a feature of vowels, rather than constituting a consonant phoneme. Under this approach, vowels can be plain oral, checked oral, plain nasal, or checked nasal.[11] Numerous arguments can be made in support of this analysis. First, it relieves us of the necessity of including closed syllables in the syllable canon of the language: in the Silacayoapan example given above, the syllable canon can simply be stated as (C)V, with vowels either plain or checked. Silacayoapan, like Jicaltepec (the dialect studied by Bradley), has stress on the penultimate syllable of the couplet, and glottalized vowels can then be restricted to the stressed syllable, accounting for the distribution of "checked" vowels. This analysis directly connects the distribution of a segmental feature, glottalization of vowels, with particularly prominent prosodic positions. We explore this issue further below.

Hills (1990), Hinton et al. (1992), Josserand (1983), and others have all followed Bradley in their analysis of glottal stop.[12] In addition to the distribution argument, Hinton et al. bring to bear a strong second argument for the prosodic approach: they point out that this analysis makes the statement of certain tone sandhi rules more coherent. Such rules apply in a different manner to structures of the form CVV than they do to structures of the form CVCV. Crucially, CVʔV forms pattern like CVV forms. If the glottal stop is analyzed as a feature of the vowel, this follows automatically, whereas if it is analyzed as a consonant phoneme, exceptions to both rules must be stated.[13]

[11] Actually, in Bradley (1970), only the first three possibilities are listed; however, examples of checked nasal vowels are given. Josserand (1983), in describing Bradley's analysis, says that there are four series of vowels, as listed in the text. We assume that the statement that appears in Bradley (1970) is merely an oversight.

[12] Hills (1990) describes Ayutla Mixtec this way; Hinton et al. (1992) describe Chalcatongo Mixtec this way; and Josserand (1983) reconstructs Proto-Mixtec this way (with the exception that she posits glottalization of final syllables as well as of initial syllables). Josserand's work is discussed further below.

[13] A third argument offered by Hinton et al. is that, while we do find CVʔCV sequences, we do not find *CVCʔV sequences, which might be expected if [ʔ] were a consonant. This argument, however, rests on positing either CVC-initial syllables with unacceptable codas or

Another argument based on segmental diachronic evidence comes from Salmons (n.d.). In comparing the neighboring dialects of Chalcatongo and San Miguel el Grande (see 5 below), we find numerous phonological innovations in Chalcatongo Mixtec not shared by San Miguel Mixtec. One of these is a change in roots of the type C*ɨvɨ* in San Miguel to C*ɨu* in Chalcatongo, so that, for example, San Miguel *ndɨvɨ̀* 'egg' and *kɨvɨ̀* 'day' become *ndɨù* and *kɨù* in Chalcatongo. This very narrowly proscribed sound change involves only the precise environment given here, i.e., a root-medial labial obstruent between two central unrounded vowels. This sound change still applies, however, when glottalization is present, e.g., San Miguel *lɨ?vɨ́* 'slick' corresponds to Chalcatongo *lɨ?ú*. If glottal stop were linked to a C slot, statement of the context of this sound change would be more complex.

(5)

San Miguel	Chalcatongo	Gloss
C*ɨvɨ* → C*ɨu*		
ndɨvɨ̀	*ndɨù*	'egg'
kɨvɨ̀	*kɨù*	'day'
C*ɨ?vɨ* → C*ɨ?u*		
sɨ́?vɨ́	*sɨ́?u*	'name'
lɨ?vɨ́	*lɨ?ú*	'slick'

Finally, there is also some phonetic evidence for this view. Hinton et al. (1992) report that in Chalcatongo Mixtec, [?] correlates with phonetic shortening of the preceding vowel, while no other consonant does. They cite Meacham (1992), who shows that the sequence CV? is about as long as the sequence CV in initial syllables, leading them to conclude that [?] is associated with the vowel, rather than with a C slot.

Pike and Small (1974) also make use of a prosodic analysis of glottal stop in their description of downstep in Coatzospan Mixtec. Interestingly, their analysis is in some ways quite close to the one which we are proposing; however, they do not explain, argue for, or pursue the implications of the analysis. They simply describe "word-phrases" as being glottalized or nonglottalized. A word-phrase can be a single morpheme (i.e., a couplet) or it can be a longer string of morphemes, apparently corresponding to the NP. In either case, glottalization is realized only once, on the vowel of the syllable with the strongest stress. In order to understand this claim, however, we have to separate phonemic from phonetic analysis. A glottalized phrase, according to Pike and Small, may consist of more than one glottalized couplet. In rapid speech, a nonhead glottalized couplet loses its glottalization, while

CCV-final syllables with unacceptable consonant clusters in the onset, both of which contradict the syllable canon of the language. Thus we do not consider this argument further.

the "nucleus" of the phrase (i.e., the head) retains its glottalization. Thus the phonetic fact that there may be only a single instance of glottalization at the level of the phrase is merely a result of rapid speech rules deleting glottalization in nonhead constituents but retaining it in the prosodically most prominent element, viz. the head. We are interested, however, in phonemic glottalization, and this is what they describe when they talk about glottalization of word-phrases consisting of only a single couplet. We limit our attention, then, to this level of their analysis.

Pike and Small's description of the phonetics of (couplet-level) glottalization suggests an implicit argument for their analysis of it as a prosodic phenomenon. First, when there is no medial consonant, the initial syllable may simply end in [ʔ] (as in 6*a*) or the glottal stop may be followed by an echo vowel (as in 6*b*). Second, when there is a medial consonant, an echo vowel always follows the glottal stop (as in 7).

(6) /teʔú/ 'rotten'

(6*a*) [tɛ̀ʔ.ú]

(6*b*) [tɛ̀ʔ^{ɛ}.ú]

(7) /ràʔvà/ 'pot-bellied': [ràʔ^{a}.và]

This description implies that they see glottalization as an interruption of the first vowel, rather than as an element which counts as a consonant in its own right. However, they do not make this explicit, and so we are unable to evaluate their analysis further. We return to the problem of echo vowels as well as to the ultimately related matter of the timing of V*ʔ* sequences in **4** below.

3. Critique of previous analyses. We have presented a number of arguments against the consonantal approach. The strongest of these are summarized in (*a*)–(*c*) below. Under the consonantal view:

(*a*) We would have to say that syllable structure is (C)V(C), but we would then have to stipulate that only [ʔ] can close syllables and, further, that closed syllables may only occur initially in the root. This is avoided with the prosodic approach, although we show below that some problems remain with the distributional restrictions on glottalized syllables.

(*b*) We would have to stipulate that CVʔV behaves like CVV for the purposes of tone sandhi, rather than behaving like CVCV. This is an unnatural stipulation if [ʔ] is considered a member of the consonant inventory, but it follows automatically under the prosodic approach.

(*c*) Glottal stop would be peculiar among the consonants in its shortening of the preceding vowel. If it is a feature of the vowel, the timing would be explained.

TABLE 1
CM VOWEL INVENTORY

Oral	Nasal
i ɨ u	*ĩ ɨ̃ ũ*
e o	
a	*ã*

TABLE 2
CM VOWEL INVENTORY WITH GLOTTALIZATION

Oral	Nasal	Checked	Checked Nasal
i ɨ u	*ĩ ɨ̃ ũ*	*iʔ ɨʔ uʔ*	*ĩʔ ɨ̃ʔ ũʔ*
e o		*eʔ oʔ*	
a	*ã*	*aʔ*	*ãʔ*

Finally, there is one further argument against the consonantal approach which has not been made by previous authors and which can be added to these:

(*d*) Glottal stop does not occur in affixes or clitics, but only occurs in roots. (Recall from **2** above that roots in Mixtec are minimally disyllabic; affixes and clitics are all monosyllabic.) This would be an arbitrary distributional fact about the language if [ʔ] were considered a consonant. Since most of the prosodic analyses tie glottalization to stress, and since affixes and clitics are not stressed in Mixtec, this fact would follow naturally under the prosodic approach (as it will also under the approach taken in this paper).

Let us turn now to difficulties with the prosodic or glottalized vowel account, taking Chalcatongo Mixtec as a test case and beginning with a typological question. This dialect, under the traditional analysis, has ten vowel phonemes, as shown in table 1.[14]

However, the adoption of the analysis of glottalization as a characteristic of the vowel, as developed by Bradley (and advocated by a number of Mixtecanists since), would double the inventory for Chalcatongo Mixtec to twenty, by adding a glottalized counterpart to each of the ten vowels listed above, as shown in table 2. In certain other dialects (e.g., San Miguel

[14] This table does not include the extremely marginal /ẽ/ and /õ/, which appear in only two or three words each (cf. Macaulay, forthcoming). Their addition would only make the argument which follows stronger. Note also that in light of Gittlen and Marlett (1989) and Piggott (1992), it may be possible to analyze nasalization not as a feature of vowels, but as a floating root-level feature. If that reanalysis could be shown to work for Chalcatongo Mixtec, it, together with the one proposed in this paper, would result in a simple six-vowel inventory for this dialect.

el Grande), one would have to posit systems of twenty-two vowels, and in yet others (e.g., Diuxi), systems of twenty-four.

At this point, a question of typological plausibility arises. Is such a system plausible, both in terms of number and type of vowels? Taking these in order, we first note that a 24-vowel system would match the largest vowel inventory given in Maddieson (1984).[15] Adoption of Bradley's prosodic approach would thus result in reanalysis of all of the Mixtec languages[16] as having an extremely (and suspiciously) high number of vowels in their vocalic inventories. Clearly, this is a result that we would not want to argue for without careful consideration.

With respect to the second question (that is, concerning the plausibility of the type of system shown in table 2), we note that a system with the four-way contrast proposed by Bradley appears not to be completely unprecedented. Maddieson's (1984) survey includes only two languages with laryngealized vowels (the equivalent of "glottalized" in the Mixtecanist tradition),[17] but one of these has precisely the contrast we are considering. This is Southern Nambiquara, a language of Brazil, which is reported by Price (1976) to show the contrasting series oral, nasal, laryngealized, and laryngealized-nasal. Price does not actually posit a phonemic system in the usual way but includes "glottal closure" in his orthography. In fact, laryngealization is not just restricted to vowels; Maddieson's interpretation of Southern Nambiquara segments posits laryngealized (or glottalized) counterparts of EVERY segment except the glides /j/ and /w/ and the aspirate stops (although there are also two implosive stops). The lack of a clearly presented consonant inventory casts doubt on this parallel to the Mixtec case. Furthermore, more recent work by Price (1985:318) simply posits glottal stop and "laryngealization" in the phonological inventory, and it is not clear that he would still argue for the four-way contrast in the vowel inventory which is reported by Maddieson. The apparent precedent for a system with this four-way contrast is therefore very uncertain.

Thus, in light of both the unusual size and potentially unique complexity of this vowel system, as well as the probable absence of typological parallels, we conclude that it is worth looking for a more economical solution to

[15] We hasten to point out that this is not the largest number of vowels attested in the languages of the world, citing it only as an example of an extremely large system.

[16] Due to the situation of dialect continua which obtains in the Mixtec-speaking area, it is virtually impossible to say how many distinct languages the entity called "Mixtec" encompasses. As an indication of the large size of the eventual total, however, we may note that Josserand (1983) bases her survey on data from 130 varieties.

[17] Almost half of the languages he surveyed, however, have glottal stop as a consonant phoneme: 146 of 317 languages. Eleven of the languages with glottal stops showed aberrant distributions, such as extremely low frequency or occurrence only in loanwords.

the problem of glottalization in Mixtec. Note, however, that we are NOT arguing against the existence of such systems purely on typological grounds; rather we are noting that this kind of system is, other things being equal, less desirable. Our solution will be considerably simpler than the approach just discussed, and it is primarily on that basis that our case rests, along with the fact that glottalization is consistently restricted to a single occurrence per root in modern dialects. The typological concerns simply serve to underscore the need for a simpler analysis.

Two recent works already begin to move beyond the traditional approaches. First, Gittlen and Marlett (1989) sketch a new version of the prosodic approach in their analysis of Ñumí Mixtec phonology, in which glottalization is treated as a feature of syllables rather than of vowels. Stress appears on the penultimate syllable of Ñumí roots,[18] and glottalization occurs only on stressed syllables. This, of course, resolves the problem of restricting glottalization to initial syllables and can account for the distributional restrictions in many dialects of Mixtec. However, the analysis cannot be generalized to all Mixtec dialects, since there are some in which stress is not restricted to initial syllables, and others which have glottalization in unstressed syllables (these are described further in **4**). Our analysis, to be presented below, is able to avoid this lack of generalizability. Nonetheless, we wish to point out that their work anticipates key parts of our treatment.[19]

Second, one other recent hypothesis should be noted here about the status of glottalization in Mixtec. Hinton et al. (1992) consider arguments for and against treating glottalization as part of the tonal tier, as opposed to treating it as a feature of the vowel. Although they leave the question ultimately unresolved, they tend toward the latter (that is, toward the vocalic analysis). This is largely because they posit a set of items with underlying glottalization on both syllables (or morae) but with differing tones on the two syllables. They argue that if glottalization were on the tonal tier, it would spread or not spread with tone, which is not the case in this set of roots. Therefore, they favor the vocalic analysis. However, as we discuss

[18] Since they analyze CVV and CVʔV roots as underlyingly monosyllabic, stress of course appears on the ONLY syllable in this type of couplet. We do not consider here their claims about underlying syllable structure in Mixtec.

[19] However, their formulation appears to lead to a serious derivational problem. Note first that while all of the Mixtec dialects show many pairs where glottalization is distinctive (e.g., Chalcatongo *čaa* 'write' and *čaʔa* 'gourd'), stress is never distinctive. Glottalization, under Gittlen and Marlett's analysis, would have to be assigned after stress is assigned. This would violate structure preservation, at least as they presently have their hypothesis worded. One alternative would be to posit glottalization on both syllables and to allow it to surface only on stressed syllables. This, however, is essentially equivalent to making glottalization a feature of roots, not syllables.

further below, it is not clear that underlying glottalization of final syllables needs to be posited SYNCHRONICALLY for Chalcatongo Mixtec, although we agree that it must have been present at some earlier point. Thus, if final glottalization is not synchronically present in the grammar, their argument ceases to bear on our analysis.

We should point out here that the tendency in Mixtec toward identity of vowels across glottal stop does not necessarily support the view that glottalization is a feature of vowels.[20] Vowel harmony rules (full or partial) across a consonantal /ʔ/ are actually well attested, e.g., in Acoma (Sagey 1986), Tunica (Odden 1991), and Chemehuevi (Steriade 1987).[21] The reason for this is that glottal stop has no supralaryngeal specifications at all, and so, it is argued, it can easily be transparent to other features in adjacent segments; that is, such features can spread across it. Thus glottalization does not have to be tied to spreading vowel features in order to account for the tendency toward harmony across glottal stop which is observed in Mixtec. In fact, reconstructions of earlier stages of the language include a consonant phoneme /ʔ/ (see **6**) and appear to reflect exactly such a harmony rule, which we still see mirrored in the modern dialects.

In the next section we propose a modification of Bradley's analysis which overcomes the difficulties of the prosodic approach which have been discussed in this section, while maintaining its basic insight.

4. Glottalization as a feature of the root. We propose that glottalization in Chalcatongo Mixtec (as in most of the other dialects) is not a feature of vowels, nor of syllables, but rather that it is a feature of roots, i.e., of the couplet. (We discuss the analysis of those few dialects which show different patterns of glottalization below.) Specifically, certain lexical entries in Chalcatongo Mixtec will be marked for laryngealization, as illustrated in (8) for our earlier example *bàʔà*.[22]

(8) /baa/ 'good'
[+constricted glottis]

Under this approach, Chalcatongo Mixtec disyllabic roots (couplets) are optionally marked in the lexicon for a floating glottal feature,[23] which

[20] After we had written this section, an article by Meechan (1990) came to our attention. Meechan makes essentially the same argument concerning glottal stop as a nonbarrier to vowel harmony for the Villa Alta dialect of Zapotec.

[21] See also the more general discussion in Davis (forthcoming).

[22] This approach has a number of precedents in the literature (e.g., Goldsmith 1990:25 and Hollenbach 1984).

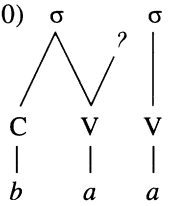
[23] Roots which are not glottalized simply have no marking for the feature [constricted glottis]. That is, just as Hoberman (1988:4) suggests that items which are not pharyngealized

then attaches to the leftmost vowel by a rule which can be stated as in (9):[24]

(9) Associate the feature [+constricted glottis] to the timing slot corresponding to the leftmost vowel of the couplet.

Rule (9) accounts for the phonetic [ʔ] found in CVʔV roots, as well as for the glottal stop and echo vowel found syllable-finally before a consonant in roots of the shape CVʔCV. We return to the latter set of roots below, turning first to the unmarked case, CVʔV. We conceive of the result of application of rule (9) to a root like that shown in (8) as follows, keeping in mind the mandatory disyllabic nature of the Mixtec root:

(10)



This representation is based on Goldsmith's discussion of Chimalapa Zoque (1990:161–62), to which we return below. A similar proposal is found in Levin (1985:313–16). Crucially, it accounts for the fact mentioned in **2** that CVʔ has about the same timing as the initial CV of a CVCV root. Piggott's (1992) suggestion (mentioned in **2** above) that glottal stop serves as a "default segment" fits well too with our understanding of how glottalization surfaces between vowels in disyllabic roots such as the one given in (10). Such phonetic realization is in line with universal preferences for CV syllables, creating an onset for the second syllable, so that an underlying CVV structure can then surface phonetically as [CVCV]. This would parallel the late word-initial insertion of glottal stop attested in many languages of the world, and underscores the evidence brought above that glottal stop is not phonemically present as an X slot in the root.

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have no need for a specification [– CP] (constricted pharynx) in Azerbaijani Jewish Aramaic, we suggest that there is no need in the grammar of most Mixtec dialects for a [–constricted glottis] specification. Note, however, that there are significant differences between Hoberman's Aramaic data and our Mixtec data, for example, the fact that in Aramaic entire words are affected, rather than just vowels. Also, note that while we draw parallels between laryngeal and pharyngeal phenomena, the two have significantly different phonetic properties.

[24] This can be accomplished by assuming association in Mixtec is from the left, as proposed by Piggott (1992) for nasality in Barasano and Guarani. Our analysis is consistent with either view.

We should also note at this point that we are not positing morphemic status for the glottal feature in Mixtec but are simply treating its phonological status as floating. Piggot makes use of both morphemic and phonemic floating features in his analysis of Mixtec nasal harmony.

Let us turn now to an issue of feature geometry. We have placed glottalization on a tier of its own in (10) but have not been specific about what tier that is. An obvious possibility (briefly discussed above) is the tonal tier. Laryngeal features have long been known to interact crucially with tone in some languages. For example, Clements (1985:241) writes: "I assume that tone features are distinct from other laryngeal features, though we find a limited degree of interdependence in some languages" (such as Thai and Zulu). Tone and glottalization of the sort we are dealing with here share important similarities, one being that they do not have unique X-slots but instead associate ultimately with V-slots. That is, the tone-bearing units are also the units which bear glottalization.

This parallelism is also reflected in the historical development of the phonology of Mixtec. In diachronic analyses, tonogenesis and tonal changes have long been widely associated with laryngeal features (see, for instance, Mazaudon 1977). Josserand (1983:243) and Dürr (1987) (among others) have argued that such interaction is evident in Mixtec tone sandhi, in which the loss of final glottal stop correlates with the development of tone sandhi effects on following morphemes.

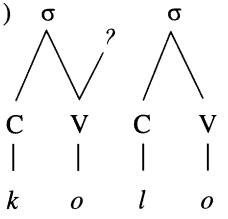
Hinton (1992) argues for a different kind of tone–glottal interaction in Chalcatongo Mixtec, in which the relatively rare LH tone melody in monomorphemic couplets is claimed to reflect the loss of a final glottal stop (where under her analysis an open final syllable would have been expected to yield LL). While Hinton posits this as a synchronic rule, we would argue instead that this is internal reconstruction, and that the process is in fact a diachronic one. If the process were active synchronically, one would expect some overt evidence of its presence. For example, it might at least occasionally surface as laryngealization on the final vowel, given the phonetics of glottalization in Mixtec. This is, for example, what happens in the related language Popoloca (cf. Veerman-Leichsenring 1984:54).

In a language closely related to Mixtec, Copala Trique, Hollenbach (1984) uses a broad range of such interactions between tone and laryngeals to place postvocalic laryngeals on the tonal tier. (Prevocalic laryngeals are treated quite differently.) In that work, she calls for comparative evidence, especially from other Otomanguean languages, to clarify universal versus language-particular aspects of the tonal tier, noting that "the composition of the laryngeal tier can change over time" (1984:385). As we have already noted above, we see such interaction in Mixtec largely in patterns no longer productive in the phonology.

Thus, we do not see synchronic justification for locating glottalization on the tonal tier in Mixtec at this point, although we again stress that an earlier stage of the language would presumably have required such an analysis. Instead, we adopt an approach parallel to Goldsmith's reanalysis

of data from Chimalapa Zoque (1990:161–62), which also enhances two points made in **2** above: the first concerning echo vowels, and the second concerning Piggott's (1992) analysis of nasal harmony. Zoque has echo vowels in a situation similar to but more complex than that described above for Mixtec, namely, in conjunction with vowel lengthening when a phonetic glottal stop appears to close a stressed syllable followed by a filled onset, i.e., a consonant.[25] Goldsmith posits glottalization on a separate tier (but see below), so that glottal stop and the lengthening vowel doubly associate with a single X slot. Because, he argues, the glottal stop is shorter in duration than the vowel, the effect of an interrupted or echo vowel is created. The Mixtec situation is quite similar, although there is no lengthening of the vowel (nor, necessarily, stress on the relevant syllable). Following Goldsmith, then, we can formalize this as in (11), using as our example the word *kó?lo* 'turkey'.

(11)



This formalization neatly accounts for the timing of V? sequences as well as for the echo vowel. The structures proposed in (10) and (11) find support in the Coatzospan CV?V echo vowels (recall 6*b* from **2**), since (10) predicts the possibility of echo vowels in this context, viz. before syllables without overt onsets.

Note that Goldsmith does not identify the tier on which Zoque glottalization appears. As we have already briefly argued, one location which is unlikely for Mixtec glottalization is the tonal tier.[26] One further piece of evidence indicates that it simply belongs on the laryngeal tier along with voicing, as in standard presentations of feature geometry such as Clements (1985) and Sagey (1986). Namely, Chalcatongo Mixtec glottalization can only surface in entirely voiced environments, after any vowel and before any vowel or voiced consonant, indicating close interaction between voicing and glottalization. We assume here that voicing is represented

[25] Coatzospan Mixtec shows a similar pattern of glottal stops with echo vowels in stressed syllables of loanwords before voiceless stops, while before sonorants the vowel is simply lengthened (Barbara Hollenbach, personal communication).

[26] On the other hand, Glyne Piggott points out (personal communication) that associating glottalization with the tonal node could potentially simplify our (8) and (9) above, exploiting his notion of "variable dependency." As with other theoretical issues in feature geometry, we leave this aside for the present.

phonologically as [−constricted glottis, −spread glottis, −slack vocal folds]; glottalization is typically characterized by [+constricted glottis].[27] Given the fact (noted in **2**) that Mixtec glottalization is realized as a superimposed glottal stop with (in some cases) laryngealization of surrounding vowels, the vocal folds can be either slack or stiff during glottalization. We assume therefore that glottalization is not specified for [±slack vocal folds, ±stiff vocal folds]. As a result, the only relevant difference on the laryngeal tier between a voiced segment and glottalization in Mixtec is [±constricted glottis]. We suggest then that the specification [+constricted glottis] can only occur in an environment of [−spread glottis] in Mixtec. This scenario works on the minimal and uncontroversial requirement that voicing—[±spread glottis]—and glottalization—[±constricted glottis]—are grouped together in the feature geometry.[28]

An examination of the Proto-Mixtec forms reconstructed in Josserand (1983) confirms that this is a longstanding tendency in the language. Aside from the many cases of word-final glottalization, she posits twenty instances of glottalization before glides (/w/ and /y/), nineteen in intervocalic position, and three each before nasals (always /n/) and prenasalized stops (always /nd/). This indicates a preference for high sonority environments for glottalization in the proto-language, but it also indicates a distribution closely connected to that in contemporary Chalcatongo Mixtec, where the possible contexts have broadened somewhat. The low overall frequency of liquids in Proto-Mixtec probably explains the absence of ʔL sequences in Josserand (1983), and both liquids and ʔL sequences remain relatively rare in contemporary Chalcatongo Mixtec: only *tíʔlu* 'small' and *kóʔlo* '(male) turkey' occur in Macaulay's dictionary (Macaulay, forthcoming). Occurrence of glottalization in Chalcatongo Mixtec before the obstruents /b/ and /ž/—cf. *káʔbá* 'dirty' and *tikáʔžá* 'corn fungus'—is historically explicable since these segments clearly derive from /w/ and /y/, respectively. In Chalcatongo Mixtec, glottalization also occurs before noncoronal nasals and prenasalized stops, e.g., *naʔmà* 'to confess', *skʷãʔñã́* 'to strangle', and *bíʔnža* 'nopal'.[29]

[27] In recent theoretical work, there has been some controversy about the appropriate feature representation of voicing. Our proposal does not depend particularly on the choice we make here; our analysis still holds under alternative conceptions.

[28] It appears that defining the role of a voiced environment for glottalization could also be accomplished using recent notions such as "spontaneous voicing," cf. Piggott (1992:48, 66, and elsewhere), who cites an unpublished paper by Avery and Rice on the same topic.

[29] The once exception to the restriction on glottalization occurring only in voiced environments in Chalcatongo Mixtec is the Spanish loanword *čúʔči* 'Jesus' (probably derived from *chucho*, a nickname for "Jesus"). The addition of glottalization to this word is unexplained.

Moving on to the other issue mentioned above, our analysis also solves a problem for Piggott's (1992) treatment of nasal harmony, in which glottal stop is transparent to regressive nasal harmony. Piggott assumes in his analysis that Mixtec glottal stop is assigned an X slot, but that it has no Root Node. This is done so that the harmony rule can spread the nasal feature across glottal stop. However, the assumption that Mixtec glottal stop has an X slot but no Root Node is not further motivated. Our treatment of Mixtec glottalization, however, posits no X slot at all, so that it falls out automatically that glottal stop has no Root Node. Therefore, nasal harmony across glottal stop is completely unproblematic.

5. Cross-linguistic parallels. Turning now to additional typological support for our analysis, we note that there are numerous languages in which glottalization of some sort is similarly restricted to a specific position in the root. Hollenbach (1984:152) provides a close parallel on this count, since Copala Trique allows only one nuclear laryngeal per word, which must occur as the last element on the laryngeal tier.

In other languages, such a feature surfaces in association with consonants rather than vowels. Quechua (following Hardman 1985), for example, has three obstruent series. Both marked series, i.e., the aspirates and the glottalics, occur only in roots, not in suffixes, and furthermore, they occur only as the first stop of a root. Carenko (1975) argues specifically that glottalization in Quechua should be understood as a characteristic of "whole words."

Tepehua (as described in Watters 1987) maps glottalization only to stops and affricates. In Tepehua, glottalization has both a lexical and a morphological function, the latter marking second-person subject on verbs. Watters proposes the following informal but succinct rule for such marking: "Glottalize the verb" (1987:392). The further details of the occurrence of glottalization are then determined by phonological restrictions on where it can surface. Watters notes parallels to the related language Totonac, where glottalization is also morphological but where it surfaces on vowels rather than consonants. He further points out that a glottal-stop phoneme also exists in the language and that in fast speech glottals tend to be lost unless they are close to a primary stress.[30]

The Hokan languages provide yet another parallel. Langdon (1979:613–14) shows that laryngeals have been attracted in Hokan onto the stressed monosyllabic root via various processes such as metathesis. They have also been inserted into positions in which they cannot etymologically have

[30] As Barbara Hollenbach has pointed out to us, this is also the case in Popoloca (Veerman-Leichsenring 1984:54–55).

been present originally, viz. Spanish loans. These glottalics surface invariably on the first consonant of the root, in some cases preceding it and in some cases following it. The crucial point for our purposes is that these laryngeals are restricted to initial position in the root.

A final example from an Austronesian language, Uma, brings us back closer to the problem we began with and raises a diachronic aspect. Martens and Martens (1988:279) are hesitant to posit glottal stop as a consonant in Uma because it would be the only possible coda in a language with otherwise open syllables, and also because glottal stop occurs only at the ends of roots. They propose instead that glottalization characterizes roots, much as we have for Mixtec. More importantly, they note that younger speakers have begun to spread glottalization leftward, so that entire words become phonetically "tense," to use their term. Uma thus appears to have a floating glottal, given its consistent occurrence in root-final position, which is now being generalized by younger speakers to glottalization of the entire word.[31]

To summarize, then, we find that glottalization is often restricted to a specific position in the root in the languages of the world. Furthermore, it is not unusual for this position to be root-initial. An explanation for this involving prosodic prominence is offered in the next section.

6. Diachronic aspects of Mixtec glottalization. In order to examine the diachronic aspect of our claim, we need first to look at the purported dependence of glottalization on stress. One significant difference between our analysis and most of the other prosodic analyses (e.g., Gittlen and Marlett 1989) is that glottalization is not inherently tied to stress under our approach. It is merely a feature of the couplet, and individual dialects may realize that feature differently. In the majority of the dialects, it surfaces as glottalization of the leftmost vowel of the root, as described above for Chalcatongo Mixtec. Since most dialects have penultimate stress, the correlation between glottalization and stress has appeared to be a natural one. However, for an analysis to be applicable to glottalization in the Mixtec languages in general, it must also be able to account for those languages which either do not have consistently penultimate stress, or which have glottalization in unstressed syllables.

With respect to the former case, Zylstra (1980:37, n. 3), for example, writes about Alacatlazala Mixtec that "Couplets of the CV?V pattern appear to have extra force on the syllable beginning with glottal stop. Couplets of other CV patterns appear to have equal stress on each syllable."

[31] This also happens with pharyngeal constriction for "emphasis" in most Aramaic words, as described by Hoberman (1988).

Let us take each statement in turn: first, if CV?V couplets have final stress and we want to retain our analysis of glottalization in such couplets as glottalization of the first vowel, clearly stress and glottalization do not correlate. The stress-based approach could be salvaged by claiming that it is instead the second vowel which is glottalized in this dialect, and that glottalization is manifested as [?V] rather than [V?]. However, when we consider the second statement, we see that the stress-based approach cannot be maintained. It is not clear whether Zylstra includes CVV couplets in the second statement; however, even restricting ourselves just to CVCV couplets, we can see that the stress-based approach would allow glottalization in both syllables, since both are equally stressed. Yet Alacatlazala Mixtec does not allow couplets with final glottal stop, i.e., of the form CV(?)CV?. Thus we cannot correlate glottalization with stress in Alacatlazala Mixtec. The rules given above for Chalcatongo Mixtec, however, do correctly predict the placement of glottalization in Alacatlazala Mixtec, since they are not dependent on stress.

The other side of the coin is represented by those few dialects which do, according to Josserand (1983:181–82), have couplet-final glottalization: Ayutla and Zacatepec Mixtec. Taking as our example the case of Ayutla Mixtec (as described in Pankratz and Pike 1967), we find couplets with the forms shown in (12). In these examples, tone is marked as follows: 1–high, 2–mid, 3–low. Stress is marked by acute accent.

(12) Ayutla Mixtec

(12*a*) CV?CV: *yá^{3}?vi^{3}* 'market'

(12*b*) CVCV?: *ná^{2}ma^{3}?* 'soap'

(12*c*) CV?CV?: *ka^{3}?ví^{1}?* 'younger brother'

It is the second example (*ná^{2}ma^{3}?* 'soap') which shows that glottalization does not correlate with stress in Ayutla Mixtec, since the second syllable is glottalized but not stressed.[32] An analysis which accounts for the distributional patterns of glottalization by restricting it to stressed syllables will not be able to account for glottalization in Ayutla Mixtec.

However, we hasten to point out that our sample lexical entry (8) and rule (9) (devised for Chalcatongo Mixtec) will not account for the Ayutla data either. From the examples just given, it is clear that glottalization in Ayutla Mixtec does not associate only to the leftmost vowel. In order to arrive at an adequate account of the Ayutla facts, we advance the following hypothesis. First, we note that in Proto-Mixtecan (the ancestor language of

[32] In fact, stress in this dialect correlates with tone. See Pankratz and Pike (1967:293) for details.

Mixtec, Trique, and Cuicatec), glottal stop is reconstructed as a consonant by both Longacre (1957:75–92) and Rensch (1976:43–51). Longacre and Rensch differ on a number of points, but both understand glottal stop as having a somewhat restricted distribution, including the absence of contrast in initial position. This, as we noted at the outset, characterizes glottal stop in many languages of the world. Our starting point, then, is a glottal-stop consonant. Josserand (1983) reconstructs Proto-Mixtec (the ancestor of the present-day Mixtec dialects) with no glottal-stop consonant, but with glottalization as a feature of vowels, i.e., as no longer being associated with a unique C-slot. She reconstructs both root-medial and root-final glottal stops, e.g., **keyi?* 'to go out' and **ka?yu* 'to paint'. We differ from Josserand, however, in viewing glottalization at this point as characterizing syllables, rather than vowels, due to the aberrant vowel system which would result from the narrow vocalic proposal (as detailed in **3**). Ayutla Mixtec, then, can be seen as a conservative dialect which reflects this earlier state of affairs, since it still shows glottalization as a possible feature of either or both syllables of the couplet. The syllable-based analysis of glottalization given by Gittlen and Marlett (1989) would be appropriate for this dialect.[33] The next step in this evolution is the disassociation of glottalization from syllables, resulting in a floating glottal feature as part of the lexical entry for glottalized couplets (as found in Chalcatongo Mixtec and the majority of the other present-day dialects).[34] We discuss below the fact that this is in line with the cross-linguistic tendency for laryngeal features to play prosodic roles. The development we posit, then, is schematized in (13):

(13)

Proto-Mixtecan	>	Proto-Mixtec (preserved in Ayutla, Zacatepec)	>	Mixtec (most dialects)
glottal-stop consonant		glottalization of syllables		glottalization of couplets

In fact, it appears that there is a cross-linguistic diachronic tendency for glottalization (or other laryngeal node features) to start out associated to a C-slot and to evolve eventually into a floating feature.[35] This kind of change is reflected in Hayward's claim that aspiration and breathy voice

[33] It is quite possible that in such dialects (or at this point in the diachronic evolution), glottalization is still located on the tonal tier, as in Hollenbach's analysis of Copala Trique. This is a topic which deserves further research.

[34] Of course, we have access in such dialects to earlier final glottals via internal reconstruction, as discussed above.

[35] Typologically, there is also an intermediate step between linked instances of [+constricted glottis] and a root-level floating glottal feature of the type that we propose. Blevins (1993), for example, posits a linked as well as a floating glottal feature for Klamath. Both are realized either

"both . . . seem prone to become detached from associated segments and achieve suprasegmental status" (1989:45). This kind of development can be motivated in a variety of ways phonetically and phonologically. With respect to the latter, feature geometry may give us some insight into why glottal features tend to become floating: as mentioned above, a consonant slot which contains only laryngeal specifications is transparent to neighboring segments in some languages—as data from Tunica, Chemehuevi, etc., show. This minimal specification apparently also leads to a tendency to disassociate from the C-slot and to become floating (cf. Hoberman 1988:23). Such features then spread and associate with other segments in the root, in any of various ways: vocalic as in Mixtec and Totonac, consonantal as in Quechua and Tepehua, or producing both vocalic and consonantal modifications as in Aramaic. Word- or root-initial position is inherently prosodically prominent, and this provides a motivation for these floating segments to appear so often in that position. Also, the tendency might be motivated by appeal to the effects of the Obligatory Contour Principle, forbidding underlying sequences of the same prosodic feature.[36] Phonetically, glottal feature floating could be the result of mistiming of closure, which could lead to reanalysis of the domain of a laryngeal feature.[37] Another extremely plausible phonetic motivation comes from Henton, Ladefoged, and Maddieson (1992:77), who note that complete glottal occlusion characterizes not only glottal-stop consonants but also phonation. In languages like Mazatec (cf. Pike and Pike 1947:79) and some varieties of Mixtec (see above), glottal closure alternates with laryngealization of the neighboring vowels, and thus constitutes a phonation type rather than a consonantal segment. This possible phonetic realization of glottal stop, which is actively exploited in Mixtec, disconnects it from its C-slot and thus allows it to float. These kinds of phonetic motivation could be enough to trigger phonological reinterpretation among acquirers of a language.

7. Conclusion. We conclude that in most Mixtec dialects glottalization has the status of a characteristic of roots or couplets and is represented as a floating feature in the lexicon. This solves several significant shortcomings of the older analyses of glottalization as either a consonantal segment (/ʔ/) or as a property of vowels.

To summarize briefly, the analysis of glottalization as a consonant suffered due to its inability to explain the distributional restrictions on this

as glottalization of a preceding consonant or as a glottal stop. Thus, under this analysis, Klamath has a floating glottal feature, but it does not take a domain larger than the segment.

[36] Stuart Davis pointed out this connection to us.

[37] This was suggested to us by an anonymous reviewer.

phoneme (i.e., that in most dialects it can only appear in the initial syllable of the couplet, and that it does not appear in affixes or clitics). Also damaging is the fact that, in some dialects and in some environments, CV?V roots show the same behavior as CVV roots under tone sandhi, rather than identifying with CVCV roots as would be expected under the consonantal analysis. Similarly, the presence of glottalization does not hinder an otherwise narrowly defined sound change in Chalcatongo. These facts do not follow naturally from any other aspect of Mixtec phonology.

The analysis of glottalization as a feature of vowels overcomes some of these problems but is subject to drawbacks of its own for those dialects which restrict glottalization to a single instance per root (i.e., the vast majority of dialects). To explain the distributional restrictions, most analyses have restricted glottalization to stressed syllables. However, some dialects have glottalization on unstressed syllables. Furthermore, the assumption behind this restriction to stressed syllables is that stress is initial, hence it should follow naturally that glottalization is also initial. Once again, however, the assumption does not hold for all dialects; some dialects have stress on final syllables, yet do not allow glottalization of final syllables.

Our analysis is able to overcome all of the problems cited above. Glottalization is seen as a feature of the couplet, and the rule for phonetic realization of the feature [+constricted glottis] accounts for its placement within the couplet. Roots which are phonetically CV?V have an underlying structure of CVV, and so the tone sandhi patterns are explained. Likewise, the presence of glottalization should not enter into segmental changes like the development of C*i̱u* roots. Finally, the lack of correlation between glottalization and stress is not a factor in this analysis.

Another advantage of our approach is that it frees us of the unwanted conclusion of the vocalic analysis that Chalcatongo Mixtec has a twenty-vowel system resting on a four-way contrast. If glottalization is treated as a feature of roots, the vowel inventory remains at ten with a two-way contrast (oral vs. nasal), or may even be reducible to only five, if nasalization is analyzed as a root-level feature.

In addition, this proposal accounts for the fact that glottal stop appears only in roots in Mixtec but does not appear in affixes or clitics. Affixes and clitics will simply not be of the morphological type which has glottalization as a feature, and thus glottal stop will not occur in these bound morphemes.[38]

[38] Note that this lends further support to Macaulay's (1987*a*; 1987*b*) arguments that monosyllabic bound forms should not be synchronically derived from underlying disyllabic forms, contra Pike (1944).

Our approach is rendered typologically plausible by analyses of other languages with similar root-based glottalization features, e.g., Quechua, Tepehua, and Uma. Such root structure features are well attested throughout the languages of the world, and this fact lends support to our analysis. This approach has implications not only for the phonology of the Mixtec languages, but it also may be suggestive of possible reanalysis for some non-Otomanguean languages where the role of glottalization has proven problematic.

Finally, we have also argued that the development of the present-day situation involved a stage in which glottalization was a feature of syllables, and that this is still reflected in a small number of conservative dialects, such as Ayutla Mixtec. This diachronic path is consistent with evidence from languages from other parts of the world, especially Aramaic and Uma.

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