Syncope in K’ichee’

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1 Introduction

This paper presents original data on syncope and related processes in K’ichee’, a Mayan language, and develops an optimality-theoretic analysis of the data. The analysis of a brand-new set of data generally raises conflicting desires: on the one hand, it’s interesting to find a new and mysterious phenomenon that requires a revision of the current theory, but on the other hand, a theory that must be radically changed every week is not a viable one, and so it’s reassuring to find that new data can be captured with existing tools. Ideally, of course, a new set of data leads to an analysis that is reassuring in some respects but also shows something new.

In the end, the analysis presented here is a reassuring one: syncope is shown to be tightly interrelated with other phonological processes in a way that is captured very naturally in an OT framework. As the path to the final analysis is not always obvious, the development of the account has theoretical import beyond the observation that our tools still work. In particular, an opacity problem can be avoided by making the right assumptions about the representation of vowels, showing that even in OT, the input representation can play an active role in the analysis.

Syncope in K’ichee’ interacts in interesting ways with three aspects of the basic phonology of the language, and the analysis therefore alternates between treatments of the basic phonology and of the syncope facts.

First, I argue that the same constraints that govern foot shape and stress placement also give us a way to understand the functional motivation for syncope. Given current assumptions about theory and typology, the K’ichee’ prosodic system is best analyzed with right-to-left trochees; the stress placement can be captured with the help of a constraint requiring stressed syllables to be heavy. Since syncope results in the creation of heavy syllables, it makes sense to treat this as an extension to feet bearing

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secondary stress of the prosodic constraints requiring feet to be trochaic and stressed syllables to be heavy.

Second, I investigate the interaction of syncope with syllable structure and coda devoicing. Liquids and glides are devoiced in coda position; syncope is blocked following a liquid or glide, that is, in cases where syncope would either create a (marked) voiceless sonorant or result in a violation of the coda condition. In section 3 I develop an analysis of syllable structure and coda devoicing, and show how the analysis extends naturally to account for the syncope facts; the interaction cannot be captured in a serial model.

Finally, syncope interacts with the system of vowel weight. In section 4.1 I motivate a three-way distinction among long, short and glottalized vowels. Section 4.2 considers the interaction of syncope with this three-way distinction. The basic fact is that glottalized vowels are optionally reduced to short vowels in fast speech, but not syncopated. If the three-way vowel distinction is accepted, this interaction can be accounted for in a straightforward way. Otherwise, the interaction is a case of opacity requiring an unappealing application of output-output faithfulness.

The analysis presented in this paper is based on data collected in my own fieldwork. Given that it is based on the intuitions of a single speaker, with limited resources for phonetic study, the data is necessarily of a preliminary nature. Nevertheless, the data are clear enough to be of interest descriptively and theoretically. From a descriptive standpoint, a close investigation of syncope also helps illuminate the prosodic structure and vowel system of K'icheé'. From a theoretical standpoint, it is interesting to find that the analysis depends in part on the representation of vowels in the input. This paper thus represents a small piece of the growing recognition in the literature that even when no limits are set on input forms, the input representation can be made to do some interesting work. The more general theme of the analysis is the finding that the new data presented here can be captured in a satisfying way with the theoretical tools currently available to us.

The remainder of this section gives some background on K'icheé' and its phonemic inventory.

1.1 Background on K’icheé’

K’icheé’ (or K’iche’, formerly Quiché) is a Mayan language spoken by over 600,000 people, mostly in Guatemala (Grimes 2000). It is a member of the Quichean branch of Eastern Mayan, and is most closely related to Tzutujil, Cakchiquel, Sacapultec and Sipacapeño (England (1983:7); DuBois (1981) notes that the latter two languages were once considered to be dialects of K’icheé’). The dialect described here is spoken in Nahualá, Guatemala.
Examples will be given in the K’ichee’ orthography. The consonants of the language are shown in (1) below. IPA equivalents for the consonants are given in parentheses where the standard orthography differs from the IPA.

(1) K’ichee’ Consonant Inventory

<table>
<thead>
<tr>
<th></th>
<th>bilabial</th>
<th>alveolar</th>
<th>alveopalatal</th>
<th>palatal</th>
<th>velar</th>
<th>uvular</th>
<th>glottal</th>
</tr>
</thead>
<tbody>
<tr>
<td>stops</td>
<td>p</td>
<td>t</td>
<td></td>
<td>k</td>
<td>q</td>
<td>’(ʔ)</td>
<td></td>
</tr>
<tr>
<td>glottalized stops</td>
<td>b’</td>
<td>t’</td>
<td></td>
<td>k’</td>
<td>q’</td>
<td></td>
<td></td>
</tr>
<tr>
<td>affricates</td>
<td>tz(ʔs)</td>
<td>ch(ʔʃ)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>glottalized affricates</td>
<td>tz’(ʔs’)</td>
<td>ch’(ʔʃ’)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>fricatives</td>
<td>s</td>
<td>x(ʃ)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>j(χ)</td>
</tr>
<tr>
<td>nasals</td>
<td>m</td>
<td>n</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>lateral</td>
<td>r(r)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>tap</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>glides</td>
<td>w</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>y</td>
</tr>
</tbody>
</table>

The table does not include the voiced stops d and g, which occur only in loan words.

The “glottalized stops” pattern together for the purposes of the phonological processes described below, so for the purposes of this paper I’ll assume that they share a “glottalization” feature. But for the sake of completeness, a word on their phonetic implementation is in order here.

The glottalized stops t’ and k’ and the glottalized affricates are uncontroversially realized as (voiceless) ejectives. The status of b’ and q’, on the other hand, is less clear. López Ixcoy (1997) treats the uvular glottalized stop as an ejective; Ixchajchal Batz et al. (1996) claim that it is realized as a voiceless implosive word-initially before o or u; and according to Campbell (1973, 1977) and Pinkerton (1986), it is realized as a voiceless implosive in all environments. There is even less agreement about the realization of the bilabial glottalized stop. López Ixcoy (1997) transcribes the phoneme as [ɓ], and according to Ixchajchal Batz et al. (1996) the phoneme has two allophones, [ɓ] and [p’], that is, a voiceless implosive and a voiceless ejective, though the conditioning environment is unclear. On the other hand, the general pattern in the Quichean languages is to produce this stop as a voiced implosive (Grimes 1972), and Pinkerton (1986) reports on a phonetics experiment in which /b’/ is shown to be produced as a voiced implosive in K’ichee’ and several related languages, and as a voiceless implosive in two dialects of Pocomchi. To summarize, q’ is either an ejective or a voiceless implosive, and b’ is an ejective, a voiceless implosive or a voiced implosive.

In fact, any of these possible realizations of q’ and b’ are consistent with what is known about the typology of ejectives and implosives, and they are mostly consistent with what is known about the phonetics of these phonation types as well. Perhaps the range of transcriptions represents dialectal variation.

One typological observation is that implosives are more likely to be front consonants and ejectives are more likely to be back consonants. This was observed most famously in Greenberg (1970); Javkin
(1984) summarizes the observation in the following two implicational universals:

(2) If a language has velar implosives, then it will also have alveolar and labial implosives; if it has alveolar implosives, then it will have labial implosives.

(3) If a language has labial ejectives, then it will have alveolar and velar ejectives; if it has alveolar ejectives, then it will have velar ejectives.

Note that the implications don’t mention uvulars (Javkin (1984) suggests that relevant generalizations cannot be made about uvulars and palatals because stops are dispreferred in general at these places), so either phonation type for q’ is consistent with (2-3). Furthermore, since K’ichee’ has alveolar and velar ejectives, the language is consistent with (3) whether b’ is an ejective or an implosive.

Another typological observation is Greenberg, Gamkrelidze and Sherman’s claim (cited in Pinkerton 1986) that front stops tend to be voiced and back stops tend to be voiceless. Since K’ichee’ has at most one voiced stop, and that is the bilabial b’, the claimed realizations of the glottalized stops are consistent with this observation as well.

Javkin (1984) points out that, contrary to certain remarks in the literature, the phonetic basis for Greenberg’s implicational universals cannot simply have to do with the relative ease or difficulty of changing the air pressure of different volumes of air. Whether the air pressure is increased in the oral cavity (for an ejective) or lowered (for an implosive) the change will be easier to make for a smaller volume of air. An account based on this fact would predict that both ejectives and implosives should be more common for back consonants than front consonants. Javkin offers two speculative accounts of the phonetic basis of Greenberg’s universals; only one of these accounts is fully consistent with the range of pronunciations cited for K’ichee’ q’.

The first account is that raising or lowering the larynx also moves the tongue root. If the tongue root is lowered along with the larynx in making an implosive, it should be difficult to make a velar closure at the same time; thus, back implosives are dispreferred. On this account, we would not expect the uvular q’ to be realized as an implosive.

The second account is that the lowering of oral air pressure for an implosive is potentially achieved by movements in addition to the lowering of the larynx. These additional movements are possible with bilabial implosives but not with velars or uvulars. If we factor in the effect of these movements, bilabial implosives can maintain a lower air pressure in the mouth even when air is leaked in with voicing, but velars and uvulars cannot do so. In other words, any implosive except a voiced velar/uvular should be possible, and this exactly describes the range of sounds cited for b’ and q’ in K’ichee’.

Although the contrast between ejectives and implosives is not relevant to the analysis, the voicing of b’ is potentially relevant to the discussion of coda devoicing in section (3.3) below. If b’ is underlingly voiced, we might expect it to show special behavior — after all, it would be the only voiced obstruent
in the language. However, \( b' \) does not display any particularly unusual behavior with respect to the processes described below. The analysis developed in this paper predicts that, if \( b' \) is voiced, it should be subject to coda devoicing, but unlike the sonorants, \( b' \) is not predicted to block syncope in a following vowel.

K'ichee' has a five-vowel system with a phonemic length contrast, as shown in (4) below. The length contrast for vowels has changed in some dialects of K'ichee' to a tense/lax contrast. While the contrast is still primarily based on length in the Nahuala dialect, the short vowels also tend to be somewhat laxer than the long vowels. The vowel system shown in (4) is the traditional conception; in section 4.1 I'll argue that there is also a set of glottalized vowels.

(4) K'ichee' Vowel Inventory

<table>
<thead>
<tr>
<th>short vowels</th>
<th>long vowels</th>
</tr>
</thead>
<tbody>
<tr>
<td>front</td>
<td>central</td>
</tr>
<tr>
<td>high</td>
<td>i</td>
</tr>
<tr>
<td>mid</td>
<td>e</td>
</tr>
<tr>
<td>low</td>
<td>a</td>
</tr>
</tbody>
</table>

2 Syncope as a Prosodic Process

This section introduces some basic facts about syncope in K'ichee' and discusses possible motivations for the process. I'll argue that syncope is motivated by constraints on prosodic structure. In order to see how syncope can be viewed as a prosodic effect, it is necessary to know something about the prosodic structure of the language, and this section therefore begins with a discussion of stress placement in K'ichee'.

2.1 Prosodic Structure

Main stress in K'ichee' falls on the final syllable, which is nearly always heavy. Secondary stress is not reported in the grammars, and I do not have access to reliable evidence for the placement of secondary stress. Given these facts, it is conceivable that footing could be either iterative or non-iterative. However, I argue below that syncope interacts with prosodic structure, and this implies that footing is iterative, from right to left. Kager (2001) notes that right-to-left iambic systems without degenerate feet are crosslinguistically unattested, and I do not have evidence for the existence of degenerate feet in K'ichee'; the conservative position, then, is to assume that K'ichee' is a trochaic system.

It might be initially surprising to think that a system which places main stress on the final syllable is a trochaic system. However, if we take into account the fact that the overwhelming majority of K'ichee' words end in a closed syllable, this idea begins to make more sense. Words that end in a heavy syllable
satisfy three conditions at once: the foot bearing main stress can be analyzed as a trochee, the syllable bearing main stress is heavy, and stress falls on the rightmost syllable. A treatment of the K’iche’ prosodic system should provide a way to think about these three related conditions.

First, though, we need to make sure that the minority of words with final light syllables is not large enough to challenge the generalizations that stress falls on the final syllable and final syllables are heavy. Let’s take a closer look at words ending in a light syllables.

First, there are a few particles and prepositions that either consist of a light syllable or alternate between CVC/CVV and CV forms. Representative examples are shown below.

(5) k’a ‘still, yet, until’
(6) pa ‘on, in, at’
(7) taj/ta negative particle
(8) lee/le ‘the’

However, these forms do not receive stress, and thus will not be subject to the prosodic constraints.

Second, the attributive adjective ending is -a. Interestingly, this suffix never receives stress. Attributive adjectives thus appear to end in a (L.L) trochee:

(9) a. t´ew ‘cold’
   b. t´ewa ‘cold-attributive’

The next cases of words ending in a light syllable are intransitive verbs bearing the terminal suffix -a. According to Kaufman (1977:13), this suffix is used on some intransitive verbs with “dependent” status, a category that includes the imperative and hortative forms as well as verbs with incorporated verbs of motion.1 Unfortunately, he does not provide the stress facts, so it is not clear whether it is stressed or not. If it is not stressed, it can be given the same treatment as the attributive marker. If, on the other hand, it does bear stress, then we have a situation in which one suffix -a bears stress and another suffix -a does not. Clearly, in this case one or the other must have its stress, or lack thereof, marked in the input.2

A number of words in K’iche’ historically ended in -Vh. Currently, the phoneme /h/ is being lost from some dialects. In these dialects, words that historically ended in -Vh now end in a light syllable, and these dialects might require a different analysis of prosodic structure. Of course, dialects that have not lost /h/ pose no problem for the assumptions about prosodic structure under consideration. The Nahualá dialect retains final -h, as shown by the attested forms below3.

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1 Sometimes the terminal affix for this class of verbs is -oj; it is not clear what conditions this alternation.
2 This affix may not be a problem at all for the Nahualá dialect. The affix with this function that appears in my field notes is -a’, with a final glottal stop.
3 The terminal marker for plain root transitives, listed as -oh in Ajpacaja Tum (1996), is sometimes pronounced as -ó by my consultant, suggesting that the Nahualá dialect has begun to lose final -h. Since this variation is attested in just one form, I disregard it here.
The last set of words with final light syllables raises questions beyond the scope of this paper. At least a few verbs end in a light syllable when they occur without the terminal marker, such as xelb'i ‘he/she left.’ The terminal marker is used when the verb occurs at the end of a certain domain, and omitted otherwise. Unfortunately, the nature of this “domain” is very poorly understood. Perhaps it is a prosodic phrase, or perhaps syntactic structure also plays a role.

In one sense, verbs like xelb'i present a simple problem: they are forms that end in a stressed light syllable, and we need a way to account for this fact. On the other hand, the special morphosyntactic status of these forms suggests that the larger prosodic picture needs to be taken into account. In particular, we might ask how the prosodic structure at the phrase level affects the word stress, if at all. A related question is whether a verb that occurs nonfinally in some “domain” might have a special prosodic status. Finally, even if the larger prosodic structure does not affect word stress, the account of these forms will depend on how common it is for a verb without a terminal suffix to end in a short vowel. I suspect that this is not very common, but have no way to count these forms. In any case, if these forms are rare, then they can be accommodated in the collection of words with lexically specified stress, while if they are relatively common they suggest the need for a reanalysis of the stress system.

Unless verbs without terminal suffixes turn out to frequently end in a light syllable, it seems that the forms ending in light syllables are limited to those involving a few suffixes. At least one of these suffixes is never stressed; others may or may not be stressed. The analysis of the K’iche’ prosodic system will therefore be based on the assumption that final syllables are always stressed and heavy; I’ll assume that exceptions are handled with lexically specified stress (or stresslessness) as necessary.

Turning to the basic prosodic system, the ban on degenerate feet can be captured with the standard ranking FootBin >> Rightmost; the undominated constraint Trochee will require that feet be trochaic. The placement of main stress on a right-aligned foot can be captured with the alignment constraint that Kager (1999:167) names Rightmost. I follow Kager (2001) in using *Lapse, a constraint against adjacent unstressed syllables, to motivate iterative footing.

(15) Rightmost = Align-R(HdFt,PrWd): Every foot that bears main stress must be right-aligned to a prosodic word.
(16) *Lapse: *00
The one place where there is an interesting decision to be made is the question of how to think about the two generalizations about final syllables, namely that final syllables are stressed and heavy. These generalizations are closely related. Given the requirement that feet be strictly binary trochees, if we also require that the final syllable of a word be stressed, then the optimal final foot will consist of a single heavy syllable. On the other hand, if we require that stressed syllables be heavy, then the optimal foot in general will be one consisting of a single heavy syllable, and stress will fall on the final syllable. In other words, if we manage to capture one of these generalizations, then the other will follow for free.

One approach, then, is to replace Rightmost with an alignment constraint requiring the stressed syllable to be aligned with the right edge of the prosodic word, that is, Align-R(σ, PrWd). Given this constraint and Trochee, a final foot consisting of a heavy syllable fulfills the prosodic constraints better than any other configuration:

(17)

\[
\begin{array}{ccc}
\ldots (H) & \text{Align-R(σ, PrWd)} & \text{Trochee} \\
\ldots (L,L) & \ast & \\
\ldots (L,L) & \ast & \\
\end{array}
\]

The other approach is to retain Rightmost and add the constraint Stress-to-Weight (Kager 1999:268), which requires that a stressed syllable be heavy. This constraint, combined with Trochee and Rightmost, also results in a preference for a final foot consisting of a single heavy syllable.

(18)

\[
\begin{array}{ccc}
\ldots (H) & \text{Rightmost} & \text{Trochee} & \text{Stress-to-Weight} \\
\ldots (L,L) & & \ast & \\
\ldots (L,L) & \ast & & \\
\ldots (L,L) & \ast & & \\
\ldots (H,L) & \ast & & \\
\end{array}
\]

In order for either approach to have the desired effect, the prosodic constraints must of course dominate all relevant faithfulness constraints.\(^4\)

These two approaches express the same preference for shape of the head foot; the main difference between the two approaches is that Stress-to-Weight leads to the preference for all feet to consist of heavy syllables, not just the foot bearing main stress. This constraint clearly cannot be undominated — K’iche’ contains some light syllables. However, I’ll argue below that syncope is motivated by Stress-to-Weight, which suggests that this constraint should be used to understand the generalizations about final syllables as well.

The next section lays out some basic facts about syncope in K’iche’ and discusses how they are related to the prosodic facts that were discussed here.

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\(^4\)It might also be necessary to use output-output faithfulness or some other constraint on paradigm uniformity to rule out the emergence of morpheme-final light syllables when additional affixes are added.
2.2 Syncope: The Basic Pattern

Syncope in the Nahualá dialect of K’ichee’ is an optional process that deletes high vowels in open syllables. Syncope is characteristic of fast, casual speech, and is resisted in slow, careful speech. Typical examples are listed in (19-42) below. The forms on the left are the unsyncopated forms found in careful speech, and the syncopated forms are on the right.

(19) kab’nik → kab’nik ‘he/she goes’
(20) kub’sooj → kub’sooj ‘he/she pities him/her’
(21) kub’t’iij → kub’t’iij ‘he/she breaks it’
(22) kujusiij → kuiusiij ‘he/she peels it’
(23) kukutiiij → kukiitiiij ‘he/she shortens it’
(24) kunuk’uh → kunk’uh ‘he/she creates it’
(25) kunutuh → kuntuh ‘he/she puts it in order’
(26) kusipaaj → kuspaaj ‘he/she gives it’
(27) kutjoh → kutjoh ‘he/she eats it’
(28) kutukiij → kutkiiij ‘he/she waters it’
(29) lenutaat → lentaat ‘my father’
(30) ’achjajb’ → ’achjaj ‘men’
(31) katzukuun → katzkuun ‘he/she is looking for him/her (agent focus)’
(32) ketzukuun → ketzkuun ‘they are looking for him/her (agent focus)’
(33) xutzuukuuj → xutzuukuuj ‘he/she looked for him/her’
(34) katzukuuj → katzkuuj ‘they’re looking for you’
(35) kab’ixanik → kab’ixanik ‘he/she sings’
(36) kajiowik → kajiowik ‘he/she moans’
(37) kamuxanik → kamxanik ‘he/she swims’
(38) kanimajik → kammajik ‘he/she flees’
(39) katkarik → katkarik ‘he/she disturbs’
(40) katnik → katnik ‘he/she swims’
(41) kunik’ooj → kunk’ooj ‘he/she examines it carefully’
(42) kujunamaaj → kujunamaaj ‘he/she resembles him/her’

The optionality of syncope can be captured in the standard way, by assuming the constraint or constraints driving syncope and those protecting high vowels are crucially unranked (see Anttila 1997, 2000). On each evaluation a ranking for these constraints is chosen; when the constraint driving syncope is

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5Anecdotal evidence suggests that some dialects of K’ichee’ allow syncopation of non-high vowels. In addition, two forms in my data show syncope of non-high vowels:

i kujunamaaj → kujunamaaj ‘he/she resembles him/her’
ii kajob’okotik → kajob’okotik ‘it has ruffled feathers (of a bird)’

I assume that these are lexical exceptions. The unexpected form kujunamaaj might be influenced by jun ‘one.’ Kajob’okotik is more mysterious.
high-ranked, syncope will occur, and when the constraint protecting high vowels is high-ranked, syncope will not occur.

What motivates syncope in K’ichee’? Crosslinguistically, medial vowel deletion occurs for a variety of reasons, and so a number of options are available to us here.

The easiest approach, perhaps, is to motivate syncope by brute force, with an economy constraint that militates against some level of structure: for example, *STRUC, *σ, or *FOOT. If an economy constraint is ranked above MAX-V[+hi] and below other faithfulness constraints, all and only high vowels will be deleted:

(43)

<table>
<thead>
<tr>
<th>/...CiCaC.../</th>
<th>MAX-V[-hi]</th>
<th>*STRUC</th>
<th>MAX-V[+hi]</th>
</tr>
</thead>
<tbody>
<tr>
<td>a. ...CiCaC...</td>
<td></td>
<td>*!</td>
<td></td>
</tr>
<tr>
<td>b. →...CCaC...</td>
<td></td>
<td></td>
<td>*</td>
</tr>
<tr>
<td>c. ...CiCC...</td>
<td></td>
<td>*!</td>
<td></td>
</tr>
</tbody>
</table>

This is a theoretically uninteresting move, though; it does not really help us understand why deletion takes place. In general, it’s always more interesting to try to derive the effect of minimizing structure from independently motivated constraints, rather than directly from economy constraints. (See Grimshaw (2001) for a similar argument within OT syntax.) Let us set aside economy constraints as a last resort, and see whether syncope in K’ichee’ can be motivated in a more interesting way.

Another possibility is to motivate syncope with a constraint against light syllables. This constraint will produce the basic pattern much like the economy constraints, as shown below. Incidentally, this approach also predicts that syncope will not create complex clusters, which is probably correct; see section 3.2.

(44)

<table>
<thead>
<tr>
<th>/...CiCaC.../</th>
<th>MAX-V[-hi]</th>
<th>*σ</th>
<th>MAX-V[+hi]</th>
</tr>
</thead>
<tbody>
<tr>
<td>a. ...CiCaC...</td>
<td></td>
<td>*!</td>
<td></td>
</tr>
<tr>
<td>b. →...CCaC...</td>
<td></td>
<td></td>
<td>*</td>
</tr>
<tr>
<td>c. ...CiCC...</td>
<td></td>
<td>*!</td>
<td></td>
</tr>
</tbody>
</table>

While the constraint *σ is reminiscent of the brute-force economy constraints that we just set aside, it’s somewhat more interesting, in that there are some plausible reasons that light syllables might be dispreferred in K’ichee’. Heavy syllables are overwhelmingly more common than light syllables in certain contexts in K’ichee’, namely the final, main-stressed syllable of a word and as the canonical root shape. Given the preference for heavy syllables in these (presumably salient) cases, it’s possible that the preference for heavy syllables has been generalized to the language as a whole.

However, the existence of a constraint like *σ suggests that light syllables are crosslinguistically marked, and in fact the opposite appears to be the case. Also, it’s unsatisfying to take the preference for heavy syllables in the main-stressed position merely as evidence for a general preference for heavy
syllables. The reference to prosodic structure in this observation suggests that the real generalization might be related to constraints on prosodic structure, a possibility that we’ll return to below.

A third possibility for motivating syncope is a constraint against high vowels. This would directly capture the restriction of syncope to high vowels, as shown below:

(45)
\[
\begin{array}{ccc}
\ldots \text{CiCaC} \ldots / & *V[+hi] & \text{MAX} & *V[-hi] \\
\text{a.}\ldots \text{CiCaC} \ldots / & *! & * \\
\text{b.}\rightarrow \ldots \text{CCaC} \ldots / & * & * \\
\text{c.}\ldots \text{CiCC} \ldots / & *! & * \\
\end{array}
\]

This approach captures the basic facts, and there is a story that can be told about why we need constraints like *V[+hi]. The story is that low vowels are more sonorous than high vowels, and highly sonorous nuclei are preferred; thus non-high vowels are in one sense less marked than high vowels. The rankings *V[+hi] >> *V[-hi] and MAX-V[-hi] >> MAX-V[+hi] should perhaps be taken as two implementations of the idea that highly sonorous nuclei are preferred. Although constraints similar to these were once popular for deriving phonemic inventories, recent work in Dispersion Theory has shown that this is problematic (see Flemming 1996 in particular for discussion of vowel inventories).

In section 3.4, I will reject an approach based in *V[+hi]. It turns out to be necessary to include the constraint MAX-C, and it is undesirable to relativize both markedness and faithfulness constraints to classes of segments.

The final possibility is to motivate syncope with prosodic constraints. More specifically, the constraints *LAPSE and STRESS-TO-WEIGHT, which are independently necessary to account for the prosodic structure of the language, allow us to derive a preference for heavy syllables. If the prosodic constraints are ranked above MAX-V[+hi] and below MAX-V[-hi], high vowels will be deleted in order to ensure that as many stressed syllables as possible are heavy.

(46)
\[
\begin{array}{ccc}
/\text{ka-b’in-ik}/ & *\text{LAPSE} & \text{STRESS-TO-WEIGHT} & \text{MAX-V[+hi]} \\
\text{a.}\rightarrow(\text{k’a}’b’)(\text{nik}) & & * \\
\text{b.}\ (\text{ka}’b’i)(\text{nik}) & *! & \\
\text{c.}\ ka.b’i(\text{nik}) & *! & \\
\end{array}
\]

(47)
\[
\begin{array}{ccc}
/\text{ka-tikar-ik}/ & *\text{LAPSE} & \text{STRESS-TO-WEIGHT} & \text{MAX-V[+hi]} \\
\text{a.}\rightarrow(\text{k’a}t)(\text{ka})(\text{rik}) & & * \\
\text{b.}\ ka(\text{ti}ka)(\text{rik}) & *! & \\
\text{c.}\ ka.ti.ka(\text{rik}) & *!* & \\
\end{array}
\]

With this approach, it is immediately clear that the relevant constraints are motivated by factors other than syncope, and the approach gives us a way to think about the functional motivation of syncope. Since this approach does not use general markedness constraints that are relativized to classes of phonemes, it

\[6\text{See de Lacy 2002, chapters 4-5, for a more detailed implementation of this observation and applications to sonority-driven stress and vowel choice in epenthesis.}\]
does not face the conceptual problem of the approach based on *V[+hi]. Ultimately, this is the approach to syncope that I will adopt.\footnote{The ranking \textsc{Max-V[-hi]} >> *Lapse, \textsc{Stress-to-Weight} >> \textsc{Max-V[+hi]} does not predict exactly which vowel will delete when there are two medial high vowels, as in the hypothetical example in \textit{(7)}. As we’ll see in section 3.4, the interaction of syncope with liquids in my data set makes it impossible to be certain which form in \textit{(7)} should be the actual winner. Future work on this question should reveal something about foot alignment.}

In this section the K’ichee’ prosodic system was analyzed with iterative right-to-left trochees, and we saw that the constraints \textsc{Trochee}, \textsc{Rightmost} and \textsc{Stress-to-Weight} work together to produce a final heavy stressed syllable. We then saw the the same constraints can be used to drive syncope in a way that sheds some light on the motivation for the process. Now that the basic pattern of syncope has been laid out, we can look at the interaction of this process with other aspects of the grammar.

3 Syncope and Syllable Structure

This section explores the relation of syncope to conditions on syllable structure in K’ichee’. In general, syncope does not result in a violation of the normal constraints on syllable structure. This section begins with an overview of K’ichee’ syllable structure and a brief discussion of how the analysis of syllable structure applies to syncope. The most interesting interaction is the relation of coda devoicing to syncope, discussed in the second half of the section. Syncope is blocked in contexts where it would create an environment for coda devoicing; this type of interaction is easily handled in OT but cannot be captured in a serial model.

3.1 Syllable Shape

Let’s begin with two preliminary points. First, geminates appear to be entirely prohibited in K’ichee’, and I will assume that the constraint \textsc{*Geminate} is undominated. Second, every syllable in the language has an onset; words that appear to be vowel-initial in the orthography actually begin with a glottal stop (Ixchajch’al Batz et al. 1996; Lópex Ixcoy 1997). To avoid confusion, I give the initial glottal stop in the examples. I make the standard assumption that initial glottal stops are epenthesized, due to the ranking \textsc{Onset} >> \textsc{Dep}.

The distribution of complex clusters is less trivial. Within a single morpheme, a K’ichee’ syllable
never contains a complex onset or coda. However, morpheme concatenation sometimes creates word-initial clusters, such as xk in (48) below. Medial and final complex onsets or codas are unattested, even in cases of morpheme concatenation. That is, the only affixes that consist of a single C happen to be initial prefixes; non-initial affixes contain a vowel or alternate in shape to avoid creating complex onsets or codas.

(48) CP- A3pl- scatter- term
   x- ki- ti- k
   xkitik
   ‘they scattered it’

To rule out all complex codas, we simply need to assume that the constraint *Complex/Coda is undominated; the distribution of complex onsets poses more of a challenge. General (that is, non-positional) constraints clearly cannot account for the distribution of complex onsets. If we wanted to use general constraints to force an initial cluster from morpheme concatenation to surface, we would need to assume that the faithfulness constraints Max and Dep dominate *Complex/Onset — but of course this ranking predicts that complex onsets will be possible in all contexts.

The fact that complex clusters are derived just in cases involving an affix that consists of a single consonant suggests that the relevant constraint is RealizeMorpheme. That is, the complex onset surfaces because the affix consisting of a single C must be realized. However, this approach does not prevent the deletion of first consonant of the morpheme following x-, as shown below.9

(49) /x-ki-ti-k/ RealizeMorpheme *Complex/Onset Max
   a. !! xkitik *!
   b. kitik *!
   c. → xitik *

Furthermore, even if we save the above analysis by finding some way to protect the first segment of ki-, the high ranking of RealizeMorpheme predicts that medial complex onsets will be possible when a C-only affix occurs non-initially. In fact, the only affixes in the language that consist of a single C necessarily occur word-initially. In the analysis developed below, I suggest that this gap is not accidental.

An account of the distribution of onset clusters based on positional markedness does not work either. In order to make such an account, we need to formulate two positional markedness constraints, one limiting complex onsets to word-initial position, and the other limiting complex onsets to environments of morpheme concatenation. The restriction of complex onsets to initial position can be formulated as a positional markedness constraint in the spirit of Kager’s (2001) positional licensing constraints and Zoll’s (1996) Coincide constraints:

8Glosses contain the following abbreviations: CP = completive, A = Set A, B = Set B, 1 = 1st person, 2 = 2nd person, 3 = third person, sg = singular, pl = plural, term = terminal marker.
9Double exclamation points indicate a candidate that did not win but should have.
(50) **INITIAL-CLUSTER**: Every onset cluster must be word-initial.

However, if we try in the same way to formulate the restriction of complex onsets to contexts of morpheme concatenation, as below, some reference to correspondence — that is, faithfulness — creeps into what is intuitively a markedness constraint:

(51) **DERIVED-CLUSTER**: For every onset cluster $C_1C_2$, $C_1$ and $C_2$ must correspond to different morphemes.

Since reference to the input is inevitable here, it seems that we cannot account for the distribution of complex onsets in terms of positional markedness. Let us turn instead to an account based on positional faithfulness (Beckman 1997, 1999; Casali 1997), which I will argue is the best approach to the problem.

The account depends on Casali’s (1997) **MAX-MORPHEME-INITIAL**, one of a set of positional faithfulness constraints initially proposed to capture certain crosslinguistic tendencies in vowel hiatus resolution.

(52) **MAX-MORPHEME-INITIAL**: Every morpheme-initial segment in the input must have a corresponding segment in the output (Casali 1997:508).

The attested onset clusters in K’ichee’ are composed of two morpheme-initial consonants, and if **MAX-MORPHEME-INITIAL** is ranked above *COMPLEX it will protect both of them, as shown in (53). Tautomorphic consonant clusters are not protected by **MAX-MORPHEME-INITIAL**, as shown in (54).

(53) Initial clusters from morpheme concatenation are preserved

<table>
<thead>
<tr>
<th>/x-tak/</th>
<th>Max-MI</th>
<th>*COMPLEX/Onset</th>
<th>Max</th>
</tr>
</thead>
<tbody>
<tr>
<td>a. →x tak</td>
<td>*</td>
<td></td>
<td></td>
</tr>
<tr>
<td>b. tak</td>
<td>*!</td>
<td></td>
<td></td>
</tr>
<tr>
<td>c. x ak</td>
<td>*!</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

(54) Initial clusters within a morpheme are not preserved

<table>
<thead>
<tr>
<th>/xtak/</th>
<th>Max-MI</th>
<th>*COMPLEX/Onset</th>
<th>Max</th>
</tr>
</thead>
<tbody>
<tr>
<td>a. xtak</td>
<td>*!</td>
<td></td>
<td></td>
</tr>
<tr>
<td>b. tak</td>
<td>*!</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
| c. →x ak | | | *

Furthermore, this ranking rules out complex onsets word-internally, as long as they can be repaired by deleting a non-morpheme-initial consonant, as shown below.

(55) Non-initial complex onsets are not preserved

<table>
<thead>
<tr>
<th>/tak-x-tok/</th>
<th>Max-MI</th>
<th>*COMPLEX/Onset</th>
<th>Max</th>
</tr>
</thead>
<tbody>
<tr>
<td>a. tak.xtok</td>
<td>*!</td>
<td></td>
<td></td>
</tr>
<tr>
<td>b. tak.tok</td>
<td>*!</td>
<td></td>
<td></td>
</tr>
<tr>
<td>c. tak.xok</td>
<td>*!</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
| d. →tax.tok | | | *

The analysis developed so far predicts that in K’ichee’, unlicensed complex onsets will be repaired by deleting a non-initial consonant. The obvious place to test this prediction is with loan words. Unfortunately, K’ichee’ loan words preserve all consonant clusters, so it is impossible to test the prediction
(see Isaacs 2003). Still, merely by adopting the constraint MAX-MORPHEME-INITIAL we predict that deletion of a non-initial consonant is in general a possible repair strategy for illicit clusters in loan words. This strategy will not be used in all languages, of course: in particular, if CONTIGUITY outranks MAX-MORPHEME-INITIAL, then clusters will be repaired by deleting an initial consonant, which is attested in, for example, Chol (Mayan) and Finnish (Campbell 1998:66).

The ranking MAX-MORPHEME-INITIAL >> *COMPLEX/ONSET >> Max predicts that morphemes that are underlyingly /CCV.../ will alternate between CCV... and CV..., as shown below. This alternation is unattested in the language.

(56) /C₁C₂VC/ surfaces as C₁VC in isolation

<table>
<thead>
<tr>
<th>/C₁C₂VC/</th>
<th>Max-MI</th>
<th>*COMPLEX/Ons</th>
<th>Max</th>
</tr>
</thead>
<tbody>
<tr>
<td>a. C₁C₂VC</td>
<td>*!</td>
<td></td>
<td></td>
</tr>
<tr>
<td>b. →C₁VC</td>
<td></td>
<td>*</td>
<td></td>
</tr>
<tr>
<td>c. C₂VC</td>
<td>*!</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

(57) /CCVC/ surfaces as CCVC after a vowel

<table>
<thead>
<tr>
<th>/CV-C₁C₂VC/</th>
<th>Max-MI</th>
<th>*COMPLEX/Ons</th>
<th>Max</th>
</tr>
</thead>
<tbody>
<tr>
<td>a. →CV-C₁C₂VC</td>
<td></td>
<td>*!</td>
<td></td>
</tr>
<tr>
<td>b. CV.C₁VC</td>
<td></td>
<td>*</td>
<td></td>
</tr>
<tr>
<td>c. CV.C₂VC</td>
<td>*!</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

(58) /C₁C₂VC/ surfaces as C₁VC or CCVC after a consonant

<table>
<thead>
<tr>
<th>/CVCA₀C₁C₂VC/</th>
<th>Max-MI</th>
<th>*COMPLEX/Ons</th>
<th>Max</th>
</tr>
</thead>
<tbody>
<tr>
<td>a. CVCA₀C₁C₂VC</td>
<td>*!</td>
<td></td>
<td></td>
</tr>
<tr>
<td>b. →CVCA₀C₁C₂VC</td>
<td></td>
<td>*</td>
<td></td>
</tr>
<tr>
<td>c. CVCA₀C₂VC</td>
<td>*!</td>
<td></td>
<td></td>
</tr>
<tr>
<td>d. →CVCA₀C₁C₂VC</td>
<td></td>
<td>*</td>
<td></td>
</tr>
</tbody>
</table>

The troubling candidates are (57a) and (58b), in which the relevant morpheme surfaces faithfully because the potential cluster can be distributed across two syllables. If we require that the first segment of every morpheme be aligned to the left edge of a syllable, we'll rule out these candidates and prevent the unwanted alternation:

(59) /CV-C₁C₂VC/ “Align L” * Max-MI *COMPLEX/Ons Max

<table>
<thead>
<tr>
<th>/CV-C₁C₂VC/</th>
<th>“Align L”</th>
<th>*Max-MI</th>
<th>*COMPLEX/Ons</th>
<th>Max</th>
</tr>
</thead>
<tbody>
<tr>
<td>a. CV₁C₂VC</td>
<td>*!</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>b. →CV₁C₂VC</td>
<td></td>
<td></td>
<td>*!</td>
<td></td>
</tr>
<tr>
<td>c. CV₂VC</td>
<td>*!</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

(60) /CVCA₀C₁C₂VC/ “Align L” * Max-MI *COMPLEX/Ons Max

<table>
<thead>
<tr>
<th>/CVCA₀C₁C₂VC/</th>
<th>“Align L”</th>
<th>*Max-MI</th>
<th>*COMPLEX/Ons</th>
<th>Max</th>
</tr>
</thead>
<tbody>
<tr>
<td>a. CVCA₀C₁C₂VC</td>
<td>*!</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>b. CVCA₀C₂VC</td>
<td>*!</td>
<td></td>
<td>*</td>
<td></td>
</tr>
<tr>
<td>c. CVCA₀C₁C₂VC</td>
<td>*!</td>
<td></td>
<td>*</td>
<td></td>
</tr>
<tr>
<td>d. →CVCA₀C₁C₂VC</td>
<td></td>
<td></td>
<td>*</td>
<td></td>
</tr>
</tbody>
</table>

There are two ways to implement the constraint called “Align L” above, namely with an ALIGN constraint (McCarthy and Prince 1993) or with an ANCHOR constraint (McCarthy and Prince 1999).
Informal definitions of the two constraints are given below.

(61)  **ALIGN-L***(morpheme, σ): If a segment s is on the left edge of a morpheme, then s is also on the left edge of a syllable.

(62)  **ANCHOR-L***(morpheme, σ): If a segment s is on the left edge of a morpheme in the input, then there is an s′ such that sℜs′ and s′ is on the left edge of a syllable.

These two constraints are not quite identical. One difference between the two constraints is that they make different assumptions about the structure of the input and output forms. The **ALIGN** constraint is a markedness constraint, in that it evaluates only the surface representation. It therefore requires the assumption that morpheme boundaries can be identified in the output structure. The **ANCHOR** constraint is a faithfulness constraint, in that it evaluates the relation of the input form to the output form; it requires the assumption that morpheme boundaries can be identified in the input. Of course, in this simple case of affixation it seems reasonable to assume that the morpheme boundaries can be identified in either the input or the output, so this difference doesn’t help us choose one constraint over the other.

More importantly, the two constraints assign different violation marks in some cases. Both constraints assign a violation mark when the first segment of a morpheme is realized as a coda. However, if the first segment of a morpheme is deleted and the second segment is aligned to the left edge of a syllable, then the candidate will violate **ANCHOR-L** but not **ALIGN-L**; this difference is summarized in (63) below.

More generally, the **ANCHOR** constraint is a constraint against deletion as well as (surface) alignment.

(63)  **ANCHOR vs. ALIGN**

<table>
<thead>
<tr>
<th>/CV-C₁C₂VC/</th>
<th><strong>ANCHOR-L</strong>*(morpheme, σ)</th>
<th><strong>ALIGN-L</strong>*(morpheme, σ)</th>
</tr>
</thead>
<tbody>
<tr>
<td>a. CVC₁, C₂VC</td>
<td>*</td>
<td>*</td>
</tr>
<tr>
<td>b. CV, C₂VC</td>
<td>*</td>
<td></td>
</tr>
</tbody>
</table>

Candidate (a) in (63) is the type of candidate that motivated the introduction of the **ANCHOR/ALIGN** constraint into the analysis in the first place. Since this candidate violates both constraints, it is not crucial which one is used. Candidate (b) is independently ruled out by **MAX-MORPHEME-INITIAL**.

The fact that **ANCHOR-L**, like **MAX-MORPHEME-INITIAL**, rules out a candidate in which an underlying morpheme-initial segment is deleted suggests that **MAX-MI** is superfluous here and can be entirely replaced by **ANCHOR**. After all, the definition of the **ANCHOR** constraint looks like a combination of **MAX-MI** with an alignment constraint, and those are the two pieces that we need.\(^{10}\)

\(^{10}\)This is not a case of local conjunction. The **ANCHOR** constraint requires, in effect, that both **MAX-MI** and **ALIGN-L**(morpheme, σ) be satisfied, while local conjunction of these latter constraints would only rule out the violation of both constraints in the same domain:

(i)  

<table>
<thead>
<tr>
<th>/CV-C₁C₂VC/</th>
<th><strong>MAX-MI</strong></th>
<th><strong>ALIGN-L</strong>(morph, σ)</th>
<th><strong>ANCHOR-L</strong>(morph, σ)</th>
<th><strong>MAX-MI&amp;ALIGN-L</strong>(morph, σ)</th>
</tr>
</thead>
<tbody>
<tr>
<td>CVC₁, C₂VC</td>
<td>*</td>
<td>*</td>
<td>*</td>
<td>*</td>
</tr>
<tr>
<td>CVC₁C₂VC</td>
<td>*</td>
<td>*</td>
<td></td>
<td></td>
</tr>
<tr>
<td>CVC₂C₂VC</td>
<td>*</td>
<td>*</td>
<td>*</td>
<td></td>
</tr>
</tbody>
</table>

16
However, Anchor alone cannot account for the distribution of complex onsets. This is because the attested complex onsets (those derived from morpheme concatenation) violate Anchor. If we replace Max-MI with Anchor nothing will protect the attested onsets from deletion, as shown below:

(64)

<table>
<thead>
<tr>
<th>/x-tak/</th>
<th>Anchor-L(morph,σ)</th>
<th>*Complex/Onset</th>
<th>Max</th>
</tr>
</thead>
<tbody>
<tr>
<td>a. !! xtak *</td>
<td></td>
<td>*!</td>
<td></td>
</tr>
<tr>
<td>b. →xak *</td>
<td></td>
<td>*</td>
<td></td>
</tr>
<tr>
<td>c. →tak *</td>
<td></td>
<td>*</td>
<td></td>
</tr>
</tbody>
</table>

Even though Anchor-L overlaps Max-MI in effect, it is thus unavoidable that we use the Max-MI constraint in addition to either Anchor-L or Align-L. If we use Align-L the ranking Max-MI >> Align-L is crucial, as shown below; there is no ranking argument for Max-MI and Anchor-R.

(65)

<table>
<thead>
<tr>
<th>/x-tak/</th>
<th>Max-MI</th>
<th>Align-L(morph,σ)</th>
<th>Align-L(morph,σ)</th>
</tr>
</thead>
<tbody>
<tr>
<td>a. →xtak</td>
<td>*</td>
<td>*</td>
<td>*</td>
</tr>
<tr>
<td>b. tak *</td>
<td>*!</td>
<td>*</td>
<td>*</td>
</tr>
</tbody>
</table>

To summarize, the ranking that produces the correct distribution of complex onsets is Max-MI >> Align-L(morph,σ), *Complex/Onset >> Max. The alignment constraint can be replaced by an anchoring constraint without changing the analysis.

3.2 Syncope and Syllable Shape

Currently, there is insufficient evidence to determine conclusively whether or not syncope may create complex onsets or codas. In (66-67) below, syncope is blocked when it would otherwise create a complex coda or onset:

(66) xatirqo → *xatirqo ‘I found you’
(67) kuitjoh → *ktijoh ‘he/she eats it’

On the other hand, complex onsets occur in the syncopated forms in (68-71) below:

(68) xtijowik → xtjowik ‘He ate it (agent focus)’
(69) xinr̃qo → xir̃qo ‘I found it’
(70) kulutzukuuj → klutzkunuj ‘He comes to search for it’
(71) xinuluriqa’ → xmuluriqa’ ‘He came and found me’

Since the majority of syncopated forms in my data do not contain complex onsets or codas, I’ll adopt the working hypothesis that syncope does not create complex clusters.

Assuming that syncope does not create complex onsets or codas, the constraints *Complex/Onset and *Complex/Coda must dominate the constraints driving syncope, as shown below.

---

11This one may be formed by analogy with the many words containing onset clusters formed by concatenating the completive aspect marker x- with a C-initial stem.
Note that if the creation of complex onsets as in (68-71) turns out to be a regular phenomenon, then the constraint driving syncope must outrank MAX-MORPHEME-INITIAL in addition to *COMPLEX/ONSET, as shown in (74) below. This is because the forms in (70) and (71) involve the deletion of a morpheme-initial vowel.

3.3 Coda Devoicing

K’ichee’ codas never contain voiced consonants other than nasals. Liquids and glides are devoiced when they occur in coda position, as shown below.

(75) a. q’e’l ‘old’
   b. q’e’l-a ‘old-attributive’
(76) a. tew ‘cold’
   b. tew-a ‘cold-attributive’

While the data on final devoicing is quite clear, there are relatively few medial clusters in K’ichee’, so it’s harder to verify that the devoicing process applies to medial codas as well. Still, the evidence from Ajpacaja Tum (1996) is at least consistent with the view that devoicing applies to all codas. For example, the medial codas in the following words are given as voiceless, even though they precede voiced onsets:

(77) ’alner ‘strainer’
(78) mʉlmux ‘husk’
(79) karne’l ‘sheep’
(80) charnajeem ‘to drag one’s feet’

Some loan words in Ajpacaja Tum (1996) contain voiced sonorants in medial and final codas, suggesting that loan words may not be subject to the same devoicing process:

(81) muul ‘mule’ (Sp. mula)
(82) oor ‘hour; gold’ (Sp. hora; oro)
(83) rosaary ‘Rosario (name)’
Finally, a few native words in the dictionary have voiced sonorants in coda position, such as the following:

(87) jaarpaa ‘how much?’
(88) b’eyeylab’eem ‘to take a long time to do or say something’
(89) q’aysaxik ‘to rot things’
(90) q’oyolb’al ‘place to lie down; lodging’

The picture that emerges from the dictionary is that sonorant devoicing generally applies to all codas, with some loan words being exempt; a few native words are also exceptions to the devoicing process, perhaps as a result of the Spanish influence.

Unfortunately, the data from my field work is somewhat less clear on this point. James Isaacs (p.c.) observes that in the Nahualá dialect, codas in loan words appear to be subject to regressive voicing assimilation rather than devoicing, as shown below:

(91) puertah ‘door’ (Sp. puerta)
(92) karsoon ‘shoe’ (Sp. calzon)
(93) pernand ‘Fernanda’
(94) parmaas ‘pharmacy’ (Sp. farmacia)

It would be surprising to find a process of voicing assimilation in the loan word phonology that is not active in the main phonology, and in fact some native words in the Nahualá dialect contain voiced codas preceding voiced onsets, as in (95-96) below. Note that these forms are given with devoiced medial codas in Ajpacaja Tum (1996).

(95) ’alne’r ‘strainer’
(96) mulum’x ‘husk’

On the other hand, my field notes include the forms shown below, which contain devoiced medial codas that precede voiced onsets:

(97) karne’l ‘sheep’ (same as (79)
(98) xuñur[i]qa’ ‘he came and found me’

Clearly, more work is needed to determine whether medial codas are subject to voicing assimilation or devoicing in the Nahualá dialect. For the purposes of this paper I’ll assume that the dialect is consistent with the data in Ajpacaja Tum (1996), and that all codas are subject to devoicing; loan word phonology is beyond the scope of the paper, and I’ll assume that native words that do not undergo devoicing are lexical exceptions.
Although at first glance the K'ichee' coda devoicing process might appear to be due to a completely routine coda condition, similar to German or Dutch, that can be analyzed either with positional faithfulness or with positional markedness, in fact it is a case of allophonic distribution that requires an account based on positional markedness. The crucial fact is that voiceless sonorants do not appear in onset position. A standard positional faithfulness analysis, which protects the underlying voicing features of onset consonants, predicts that voiceless sonorants will surface in onset position, as shown below.

(99) 

<table>
<thead>
<tr>
<th></th>
<th>IDENT-VOI/ONSET</th>
<th>*[nas,+voi]</th>
<th>IDENT-VOI</th>
</tr>
</thead>
<tbody>
<tr>
<td>/q'el/</td>
<td>q'el</td>
<td>*</td>
<td></td>
</tr>
<tr>
<td>a.</td>
<td>q'el</td>
<td>!</td>
<td></td>
</tr>
<tr>
<td>b.</td>
<td>¬q'el</td>
<td>!</td>
<td>*</td>
</tr>
</tbody>
</table>

Further, if we rank a constraint prohibiting voiceless sonorants above the positional faithfulness constraint that protects onsets, we end up with a system in which sonorants are never devoiced.

On the other hand, it is not difficult to account for the devoicing pattern using positional markedness. Let’s assume that we have a constraint banning voicing in the coda.\(^{12}\)

(100) CODACond: *\([+\text{voi}]\)_\(_{\text{coda}}\): If a consonant is in coda position, then it is not voiced.\(^{13}\)

If the coda condition outranks IDENT(voice) it will produce coda devoicing, as shown below:

(101) 

<table>
<thead>
<tr>
<th></th>
<th>CODACond</th>
<th>IDENT(voice)</th>
</tr>
</thead>
<tbody>
<tr>
<td>/q'el-a/</td>
<td>q'el-a</td>
<td>*</td>
</tr>
<tr>
<td>a.</td>
<td>¬q'el-a</td>
<td>!</td>
</tr>
<tr>
<td>b.</td>
<td>q'el-a</td>
<td>!</td>
</tr>
</tbody>
</table>

Since nasals are not devoiced in coda position, I assume that the coda condition is outranked by a markedness constraint banning voiceless nasals.

(102) VoiNas: *\([+\text{nas},-\text{voi}]\): If nasal, then voiced.

\(^{12}\)Another possibility is that coda consonants must be obstruents, and devoicing is a side effect of obstruentization. Distinguishing between obstruentization and simple devoicing is (surprisingly) an empirical question. According to Maddieson and Emmorey (1984), there are phonetic differences between languages with voiceless lateral approximants and languages with voiceless lateral fricatives. In principle, a comparison of the K’ichee’ voiceless sonorants with voiceless approximants and fricatives in other languages should help determine the status of the K’ichee’ sounds. As this is beyond the scope of this paper I’ll continue to assume that the K’ichee’ coda condition is a requirement about voicing.

\(^{13}\)I assume that this constraint is still violated if a \([+\text{voi}]\) feature is doubly linked to a coda consonant and an onset consonant. This differs from the usual assumptions about coda conditions on place specifications (Itô 1986; Itô and Mester 1993; Kager 1999; Lombardi 2001), but there is no a priori reason to assume that the particular representational assumptions necessary to account for place assimilation or neutralization will also apply to voicing alternations — in fact, Lombardi (2001) argues for similar reasons that place and voice features require different representational assumptions.
Finally, voiceless sonorants can be ruled out in onset position by a markedness constraint against voiceless
sonorants, a more general version of the constraint against voiceless nasals. Clearly, this constraint must
be ranked below the coda condition in order for coda devoicing to occur at all.

(104)  VoISoN: *[+son, -voi]: If sonorant, then voiced.

(105)

<table>
<thead>
<tr>
<th>/q'ela/</th>
<th>CodaCond</th>
<th>VoISoN</th>
<th>IDENT(voice)</th>
</tr>
</thead>
<tbody>
<tr>
<td>a. q'ela</td>
<td>*</td>
<td></td>
<td>*</td>
</tr>
<tr>
<td>b. q'ela</td>
<td>*!</td>
<td></td>
<td>*!</td>
</tr>
</tbody>
</table>

To summarize, the K'ichee' coda devoicing can be captured with the ranking in (106):

(106)  VoINas >> CodaCond >> VoISoN >> IDENT(voice)

Let’s turn now to the interaction of coda devoicing with syncope.

3.4 Syncope and Coda Devoicing

In general, syncope is blocked when a high vowel follows a liquid, as shown in (107-117). It seems that
it is better to resist syncope than to be forced either to change the voicing specification of a consonant
or to violate the coda condition.

(107)  kaluxik → *kalxik ‘he/she gasps after eating hot chiles’
(108)  kulikoh → *kulkok ‘he/she takes/loads (a liquid)’
(109)  kurib’eej → *kurb’eej ‘he/she lugs’
(110)  kuripoh → *kurpoh ‘he/she extends it’
(111)  kuriit’iij → *kurt’iij ‘he/she breaks it’
(112)  kulik’eej → *kulk’eej ‘he/she wears a cape’
(113)  kajulwik → kajluwik (*kajulwik) ‘it burns’
(114)  kulutzukuuj → kulutzkuuj (*kultzuukuuj, but klutzkuuj) ‘he/she comes to search for him/her’
(115)  kuluk’isa’ → *kulk’isa’ (but kluk’isa’) ‘he/she comes to finish it’
(116)  kalib’ilotik → kalib’ilotik ‘it flickers out/burns low’
(117)  kaluq’ulub’ik → kaluq’ulub’ik ‘it melts/bends from heat’

In a few cases, shown in (118-119), a vowel appears to delete following a liquid, but the liquid does
not devoice.

(118)  kawu’nik → kawnik ‘it moos’
(119)  kuk’illipuj → kik’illipuj (*kuk’illipuj) ‘he/she spreads it out’

There are also a few cases in which a vowel following a liquid or glide is deleted and the liquid or
glide is devoiced, shown below. The only examples of this involve the derived noun k’aq[b’al and verbs
with the root riq.
(120) kurqo → kurqo ‘he/she finds him/her’
(121) k’ayib’al → k’ayb’al ‘market’
(122) xulqariqa’ → xulqarqa’ ‘we came and found him’

Even from the preliminary data presented here, it is quite clear that the general pattern is that syncope is blocked after a liquid. Words in which a vowel is syncopated after a liquid cannot be given the same status as words in which syncope is blocked, or we’ll never be able to predict what will happen after a liquid. So it is necessary to make some special assumptions about the forms in (118-122): here are some assumptions that are plausible and empirically testable.

The forms in (118-119) might be cases of “vowel reduction” rather than true syncope. That is, the vowels in question in these forms might be present in the phonology, but so short that they are not transcribed. I’ll assume that an output form like kawnik is actually ka.wV.nik, where V is a vowel that is phonetically short. Whether or not the extra-short length of the vowel is represented in the phonology is not central to the analysis, though “vowel reduction” is apparently so idiosyncratic that it might be necessary to use a diacritic in the input to represent the possibility of undergoing vowel reduction. The important part is that the w in kawnik is actually in onset position and thus not subject to coda devoicing. If this treatment is on the right track, careful phonetic investigation should find some evidence for the presence of a vowel (or at least the length consistent with the presence of another syllable) in words like kawnik but not in words like kurqo.

The introduction of a process like “vowel reduction” is dangerous, because we run the risk of not being able to distinguish between cases of vowel reduction and cases of true syncope. Still, something must be said about the unexpected voicing of the liquids and glides in (118-119), and this seems to be a coherent story. I’ll assume that (118-119) are the only cases of vowel reduction in my data, as the rest of the data can be given a unified account.

The forms in (120-122) must be cases of syncope, since the liquids in the syncopated forms are devoiced. Evidently, something special about these words allows a vowel to be deleted under circumstances when it would normally be preserved. There is not much to be said about the root riq — it is simply necessary to make some stipulation about this root. Either the vowel is marked for “deletability,” or the root is really rq and an exceptional process of epenthesis inserts a vowel into the root to break up complex clusters. The word k’ay[i]b’al is more interesting. Kaufman (1977) analyzes it as a deverbal noun:

(123) k’ay- i- b’al

sell ‘place for doing X’

According to Kaufman, the i marks the status of k’ay as a derived transitive verb. It’s interesting to note that b’al also appears as -ib’al on some classes of roots. There are a number of possibilities here. One
possibility is that the morpheme marking derived-transitive status is exceptionally subject to deletion like the vowel in riq. Another is that this morpheme is not actually required on deverbal nouns. A third possibility is that the existence of the strings -i-b’al and -ib’al, which are structurally different but consist of the same string of phonemes, leave room for reanalysis or instability. In any case, the best analysis of this word depends on the behavior of other deverbal nouns and on the behavior of derived transitive verb roots in other contexts.

Now let’s set aside the exceptions and return to the analysis of the interaction of syncope and coda devoicing. We can capture the fact that syncope is blocked after liquids by ranking the markedness constraints driving coda devoicing above Stress-to-Weight and/or *Lapse, as shown below. Due to the difficulty of identifying secondary stress, I have no principled way to distinguish between candidate (a), which is fully parsed and contains a stressed light syllable, and candidate (b), which contains two unparsed syllables. Which of these candidates wins depends on the relative ranking of *Lapse and Stress-to-Weight.

(124)

<table>
<thead>
<tr>
<th>/ka-lux-ık/</th>
<th>CODA-COND</th>
<th>VOiSON</th>
<th>*LAPSE</th>
<th>STRESS-TO-WEIGHT</th>
</tr>
</thead>
<tbody>
<tr>
<td>a. →(kå.lu)(xìk)</td>
<td></td>
<td></td>
<td>*</td>
<td></td>
</tr>
<tr>
<td>b. →kå.lu(xìk)</td>
<td></td>
<td></td>
<td>*</td>
<td></td>
</tr>
<tr>
<td>c. (kål)(xìk)</td>
<td></td>
<td>*!</td>
<td></td>
<td></td>
</tr>
<tr>
<td>d. (kål)(xìk)</td>
<td></td>
<td>*!</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

It is interesting to note that if medial codas are subject to voicing assimilation, rather than the devoicing process that I’ve been assuming here, there is no obvious explanation for why syncope is blocked following all liquids. If constraints forcing voicing assimilation outranked the constraints driving syncope, we might expect syncope to occur when a sonorant-sonorant cluster is produced, since the output of syncope in this case could satisfy the assimilation requirement without containing a (marked) voiceless sonorant. However, (113) shows that even when the following consonant is a sonorant, syncope is blocked following a liquid. The syncope facts could thus be taken as evidence that medial codas are indeed subject to devoicing.

In addition to the ranking in (124), a constraint protecting consonants must be high-ranking. Otherwise, the optimal candidate is potentially one that deletes a liquid along with the vowel:

(125)

<table>
<thead>
<tr>
<th>/ka-lux-ık/</th>
<th>MAX-C</th>
<th>CODA-COND</th>
<th>VOiSON</th>
<th>STRESS-TO-WEIGHT</th>
</tr>
</thead>
<tbody>
<tr>
<td>a. →(kå.lu)(xìk)</td>
<td></td>
<td></td>
<td>*</td>
<td></td>
</tr>
<tr>
<td>b. (kål)(xìk)</td>
<td></td>
<td></td>
<td>*!</td>
<td></td>
</tr>
<tr>
<td>c. (kål)(xìk)</td>
<td></td>
<td>*!</td>
<td></td>
<td></td>
</tr>
<tr>
<td>d. ka(xìk)</td>
<td></td>
<td>*!</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

The MAX constraint that specifically protects consonants is required even if we motivate syncope with *V [+hi], as shown below. But this means that the ranking used in (126) relativizes both MAX and
Markedness constraints to specific classes of segments. This is too powerful a theory: it will be able to single out any arbitrary group of segments for preservation or non-preservation. The analysis shown in (125) is preferable, because it only relativizes MAX constraints to classes of segments, and so requires less powerful machinery.

\[(126)\]

<table>
<thead>
<tr>
<th></th>
<th>MAX-C</th>
<th>CODA-COND</th>
<th>VOISON</th>
<th>*V[+hi]</th>
<th>MAX</th>
</tr>
</thead>
<tbody>
<tr>
<td>a.</td>
<td>−kaluxik</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>b.</td>
<td>kalxik</td>
<td>*!</td>
<td></td>
<td>*</td>
<td></td>
</tr>
<tr>
<td>c.</td>
<td>kalxik</td>
<td></td>
<td>*!</td>
<td></td>
<td></td>
</tr>
<tr>
<td>d.</td>
<td>kaxik</td>
<td>*!</td>
<td></td>
<td></td>
<td>**</td>
</tr>
</tbody>
</table>

Recall that syncope is possible after the glottalized bilabial stop. The ranking in (124) above accounts for this fact without requiring any particular assumption about the underlying voicing specification of \(b'\). If \(b'\) is underlyingly voiceless, then syncope will occur as with any other voiceless obstruent. If \(b'\) is voiced, then the optimal candidate is one in which syncope and coda devoicing both take place, since the devoicing of an obstruent does not give rise to a violation of VOISON:

\[(127)\]

<table>
<thead>
<tr>
<th></th>
<th>CODA-COND</th>
<th>VOISON</th>
<th>*LAPSE</th>
<th>STRESS-TO-WEIGHT</th>
</tr>
</thead>
<tbody>
<tr>
<td>a.</td>
<td></td>
<td></td>
<td>*!</td>
<td></td>
</tr>
<tr>
<td>b.</td>
<td></td>
<td></td>
<td>*!</td>
<td></td>
</tr>
<tr>
<td>c.</td>
<td></td>
<td></td>
<td>*!</td>
<td></td>
</tr>
<tr>
<td>d.</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

It is worth noting that the interaction of syncope with coda devoicing is straightforward to capture in a parallel model like Optimality Theory but gives rise to an ordering paradox in a derivational model. The problem arises if we assume that syncope and coda devoicing are driven by the two rules stated below.

\[(128)\]  
**Coda Devoicing:** Devoice a liquid or glide in coda position.

\[(129)\]  
**Syncope:** Delete a high vowel in the environment VC.CV.

Whichever order these rules are applied in, they produce the wrong output, as shown below.

\[(130)\]  
Devoicing − Syncope kal.xik  
Syncope *kal.xik Devoicing *kal.xik

This problem cannot be avoided by identifying the rules with lexical or postlexical strata. The only way to avoid the problem is to revise the Syncope rule as below.

\[(131)\]  
**Syncope (revised):** Delete a high vowel in the context VC\(_1\)C\(_2\)V, where C\(_1\) is not a liquid or a glide.

However, by building the blocking effect of liquids into the syncope rule, we lose the generalization that syncope is avoided in order to better satisfy the constraints on voicing and syllable structure.

This section considered K’ichee’ syllable structure and the interaction of syncope with constraints on syllable structure, and in particular the interaction of syncope and coda devoicing. The central
observation was that, in order for the interaction of these two processes to be captured, they must be evaluated in parallel. Given that an optimality-theoretic account is being developed here, this is a reassuring finding. The next section turns to a potentially less transparent interaction, namely the relation between syncope and glottalization.

4 Syncope and the Vowel System

In the previous sections, only short vowels were considered. This section investigates the interaction of syncope with long and postglottalized vowels. As before, some analysis of the basic phonology is necessary, and the section begins with a discussion of the K’ichee’ vowel system. Although the traditional conception of the vowel system has a two-way contrast between long and short vowels, I argue that it is actually necessary to make a three-way distinction among long, short and glottalized vowels. The second half of this section looks at the relation of syncope to the proposed category of glottalized vowels, and shows that what would otherwise be a case of opacity is in fact transparent if the three-way vowel distinction is made.

4.1 Long and Glottalized Vowels

Although vowel length is contrastive in K’ichee’, long vowels are preserved only in the final syllable. Examples (132-133) below show minimal pairs with contrasting vowel length. Examples (134-135) show alternations in vowel length: the long vowels of *siik’* and *kunaneel* surface only when they occur in the final syllable.

(132) a. k’ix ‘shame’
   b. k’iix ‘back’

(133) a. chaj ‘pine’
   b. chaaj ‘ash’ (Ixchajchal Batz et al. 1996:41)

(134) a. siik’ ‘cigarette’
   b. xusik’aaj ‘he/she smoked it’ (López Ixcoy 1997:38)

(135) a. kunaneel ‘doctor’
   b. kunanelaab’ ‘doctors’ (López Ixcoy 1997:54)

The distribution of long vowels can be captured with a constraint against long vowels dominated by a constraint preserving underlying vowel length in the main-stressed syllable, as shown below.

(136)  | /CV:CV:C/ | IDENT-LENGTH/σ | *V: | IDENT-LENGTH |
--- | --- | --- | --- | --- |
 a.  | CV:CV:C | **! | |
 b.  | →CVCV:C | * | * |
 c.  | CV:CVC | *! | * | *
 d.  | CVCVC | *! | ** |
Unlike long vowels, V? is treated as a sequence of two segments in traditional K’iche’e’ grammars. However, there are several reasons to adopt the view that V? is, in some circumstances, a special kind of bimoraic vowel — in other words, to assume that in some circumstances postvocalic glottalization does not constitute an independent segment.

The strongest evidence for this view comes from the range of syllable shapes available in the language. Syllable shapes include CVC, CV:C, and CV?C, but CV:?C is impossible, as is CVCC with a consonant cluster that does not begin with a glottal stop.

If we assume that postvocalic ? is always a consonant, then we’ll need a way to limit coda clusters to those beginning with a glottal stop, while leaving the heterosyllabic consonant clusters entirely unrestricted. The technology to accomplish this exists. We’ll need to use one of de Lacy’s (2002) “marked-cluster” constraints, namely *{KPT}{KPT?}, relativized to coda position.

(137) *{KPT}{KPT?): Every CC cluster must begin with ?.
(138) *{KPT}{KPT?}/CODA: Every coda cluster must begin with ?.

However, this is a surprising state of affairs to find in the first place: why should complex coda clusters be subject to this complicated constraint when simple codas and heterosyllabic clusters are completely unrestricted?

If we assume that postvocalic glottalization is always an independent consonant, we’ll also need a way to rule out CV:?C while admitting CV:C and CV?C. If we use the constraint in (138) to limit complex codas to clusters beginning with ?, then this second problem reduces to ruling out CV:CC but admitting CV:C and CVCC. This is clearly not a matter of ruling out trimoraic syllables by saying that a V: nucleus is incompatible with any coda. Instead, it seems that we have to conclude that trimoraic syllables are possible and 4-mora syllables are impossible. But this is the kind of counting that phonology is not supposed to do.

Both of these surprising states of affairs — the overly complicated coda condition and the need to count up to four moras — simply disappear if we assume that ? can occupy a nuclear position. The existence of the syllable shape CV?C is not surprising: this is a syllable with a glottalized vowel in the nucleus and a simple coda; no special coda condition is required. It’s equally unproblematic to rule out CV:?C — we need only make the standard assumption that trimoraic nuclei are not licensed.

It appears that ? can in fact be consonantal in some circumstances as well, because syllables of the form CV:? are permitted. (The name of the language includes one such syllable.) We need to assume that V:? is not a well-formed nucleus, so syllables of this shape can only be analyzed as containing a coda glottal stop.
Finally, the range of syllable shapes alone is not enough to determine the structure of a CV? syllable. We’ve just seen that the description of possible syllable shapes in K’ichee’ is straightforward if we assume that ? is licensed either in the nucleus or in the coda, but that leaves several options for analyzing CV?— perhaps it is a closed syllable, perhaps open, or perhaps the structure of this type of syllable is systematically ambiguous.

A second reason to conclude that the K’ichee’ vowel system makes a three-way distinction among V, V: and V? is that this view gives us a way to understand a process of hiatus resolution.

Some cases of vowel hiatus in K’ichee’ are repaired by deleting the first vowel and postglottalizing the second.14 This is a productive strategy for hiatus caused by morpheme concatenation in the verbal system, as demonstrated in (139-140) below, and occurs sporadically when the plural marker e’ is combined with V-initial nouns, as in (141-142).

(139) INCP B3PL arrive TERM
k- e- ul- ik
ku’lik
‘They arrive’
(140) CP B3PL A3SG look.for TERM
x- e- u- tzu- uu
xu’tzukuuj
‘He/she looked for them’
(141) PL skirt
e inup
i’nup
(142) PL bee
e aqaj
a’qaj

In these cases of hiatus resolution, why should glottalization be added — why not resolve the hiatus by simple deletion? On the view of the vowel system that we’re exploring, the obvious explanation is that the glottalization adds weight. Although the process might appear superficially to be an example of consonant epenthesis, this is actually a case of vowel coalescence. Ordinarily, coalescence would result in a long vowel, but recall that long vowels are licensed only in the main-stressed syllable. The appearance of the glottalized vowel is thus a compromise between the need to preserve the length of the input vowels and the ban on V: outside the main-stressed syllable.

On the other hand, if postvocalic glottalization is a consonant, this strategy of hiatus resolution appears to be a process that deletes the first of a sequence of two vowels and inserts a consonant after the second vowel. Now, this process might appear to have the same weight-preserving effect as the process of vowel coalescence proposed above. That is, a vowel is deleted but leaves its mora behind, and

14The exception is the sequence /e-i-in/, which surfaces as e’n, deleting the second vowel instead of the first.
a coda consonant is inserted to bear the mora because the remaining vowel is not allowed to lengthen. However, on this view there is no need for -epenthesis if there happens to be a coda consonant already available to bear the mora. In other words, /... V-VC₁C₂.../ should be realized as [...VC₁C₂...]. But when this kind of hiatus resolution occurs before a consonant cluster, glottalization still occurs:

(143) ICP B3PL leave TERM
  k- e- elb’i- k
  ke’lb’ik

(144) ICP B3PL come.in TERM
  k- e- okb’i- k
  ko’kb’ik

(145) ICP B3PL count TERM
  k- e- ajlan- ik
  ka’jlaniik

(146) ICP B3PL repeat.three.times TERM
  k- e- oxmulin- ik
  ko’xmulinik

(147) ICP B3PL rest TERM
  k- e- uxlan- ik
  ku’xlanik

This process of hiatus resolution is mysterious if treated as a case of vowel deletion followed by consonant epenthesis, but unproblematic if treated as a case of vowel coalescence.

So far, we’ve seen two reasons internal to K’ichee’ to treat at least some occurrences of V? as bimoraic, glottalized vowels. This approach is also supported by descriptions of the prosodic systems of other Mayan languages, several of which suggest that weight-sensitive processes distinguish V? from long and short vowels.

First, in Tzutujil, a Quichean language very closely related to K’ichee’, underlying long and glottalized vowels both surface as V in nonfinal syllables, but resist syncope (Dayley 1985). This suggests that underlying V? and V: are both treated as bimoraic vowels.

The prosodic systems of the Mamean languages have been described more extensively than other Mayan languages, and these languages are particularly interesting because stress is weight-sensitive; stress placement is then a probe into the relative weights of V:, V? and V. In Mam, main stress is assigned to the rightmost long vowel. If there is no long vowel, stress is assigned to the rightmost glottalized vowel. If there is no glottalized vowel either, stress is assigned to the rightmost closed syllable, and if the word consists entirely of light open syllables, stress is penultimate (England 1983). This indicates a weight hierarchy that distinguishes among V:, V? and V, with long vowels being the heaviest and short vowels being the lightest. On the other hand, according to Kaufman (1968), in Teco V? is actually lighter than V in terms of stress attraction, while in Aguaterc V? is even heavier than V:. These three languages
all distinguish V? from both short and long vowels, but it seems that V? does not have any particular inherent weight relative to the other categories.

A final example of a Mayan language that gives a special prosodic status to V? is the Chajul dialect of Ixil. In this dialect, syllables containing long vowels obligatorily attract stress, and syllables containing V? optionally attract stress, while other syllables, open or closed, do not attract stress (Ayres 1991).15

Moving linguistically farther afield, we find that the K’ichee’ glottalized vowels are similar to Danish glottal accent, or stød (see, e.g., Liberman 1982 for an overview of the Danish facts). In both languages, glottalization in the syllable rhyme is partly morphologically conditioned and partly unpredictable.16 In Danish, it’s more obvious that this glottalization is not an independent segment, since it appears on the coda when the coda consonant is highly sonorous, and otherwise appears on the vowel.

Furthermore, the Danish stød-no stød contrast and the K’ichee’ V?-V contrast both correspond to tonal contrasts in related languages. The stød-no stød contrast is realized as a difference in lexical tone in Swedish/Norwegian. Likewise, K’ichee’ V? corresponds to a low tone in the Quichean language Uspantec(Campbell 1977:38-39).17 These two correspondences differ in their historical development: Danish stød is thought to have developed out of the Scandinavian tonal system, while Campbell (1977) argues that Uspantec tone is an innovation. Nevertheless, the result is a strikingly similar pair of correspondences.

In this section I’ve motivated the idea that the K’ichee’ vowel system makes a three-way contrast among V, V? and V:, unlike the two-way length contrast that is traditionally assumed. Support for the three-way contrast comes from the range of syllable shapes and a process of hiatus resolution, as well as comparisons to other Mayan languages and to the Danish glottal accent, or stød. In the next section, we’ll see how this three-way contrast interacts with syncope. I’ll argue that it allows us to avoid what would otherwise be an opacity problem.

15The Nebaj dialect of Ixil, on the other hand, apparently treats all syllables other than CV as equally “heavy,” so glottalized vowels do not have a special status in all Mayan languages.

16In addition to postglottalization as a side effect of hiatus resolution, K’ichee’ uses the contrast between V: and V? to distinguish between male and female names borrowed from Spanish:

<table>
<thead>
<tr>
<th></th>
<th>a  xwaan Juan</th>
</tr>
</thead>
<tbody>
<tr>
<td>a</td>
<td>xwa’n Juana</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th></th>
<th>a  toon Antonio</th>
</tr>
</thead>
<tbody>
<tr>
<td>a</td>
<td>to’n Antonia</td>
</tr>
</tbody>
</table>

The language also contains a few minimal pairs of unrelated words contrasting in V: versus V’. For example, mees ‘table’ contrasts with me’s ‘cat.’

17More precisely, the Uspantec low tone corresponds to Proto-Quichean V?, VhC where the final C is a stop or affricate, and Vx.
4.2 Syncope and Glottalized Vowels

Since postglottalized vowels are relatively rare in K’ichee’, data on the interaction of syncope with glottalization is currently highly preliminary. The few pieces of data available to me suggest that postglottalized vowels resist syncope. In (148-150) below syncope is blocked outright, and (151) is an apparent case of vowel reduction rather than syncope, as discussed in section 3.4 above.

(148) kaluk’u’pik → kalukupik ‘it is fragile’
(149) kalu’nik → kalunik ‘it digs (of an animal)’
(150) kaki’kotik → kakikotik ‘he/she is happy’
(151) kawu’nik → kawnik ‘it moos’

Notice, however, that postglottalized vowels do not surface faithfully in the fast-speech forms. Instead, they are realized as plain short vowels — though my impression is that they retain the secondary stress even when reduced. My consultant reports that postglottalized vowels are optionally reduced to plain short vowels in fast speech. This intuition is consistent with a phonetics experiment conducted by Duong et al. (2002). In the experiment, which looked for phonetic correlates of vowel quantity and postglottalization, long vowels were successfully distinguished from short and postglottalized vowels, but the experiment failed to find a phonetic distinction between short and postglottalized vowels. Since speech rate was not controlled in the experiment, the negative result is not surprising: some of the supposed tokens of postglottalized vowels may have actually been plain short vowels. Further phonetic investigation is clearly needed, but for the purposes of this paper I will assume that my consultant’s intuition about the reduction of postglottalized vowels is accurate. I will also assume that the data in (148-151) is on the right track and postglottalized vowels do indeed resist syncope. Finally, I’ll assume that reduced postglottalized vowels retain secondary stress. The last assumption is the shakiest; I entertain it because forcing the retention of secondary stress is an interesting analytic challenge, and furthermore it seems far simpler to remove from an analysis the requirement that secondary stress be retained than to add such a requirement.

Given these assumptions, the interaction of syncope with postglottalization lends support to the treatment of postvocalic glottal stop as a vocalic feature. As before, if we treat postvocalic glottal stop as a coda consonant we’ll be driven to an unnecessarily complicated analysis. Let’s begin by considering what this analysis would look like.

First, if postvocalic ? is a coda consonant, then the reduction of V? to V must be treated as a case of consonant deletion — specifically, a coda simplification process that targets only glottal stop. This is possible to implement using de Lacy’s (2002) “marked-faithfulness” constraints: a constraint protecting
all places of articulation except glottal ranked over a markedness constraint promoting consonant deletion will result in the deletion of all and only glottal stops, as shown below:

(152)

<table>
<thead>
<tr>
<th></th>
<th>IDENT{KPT}</th>
<th>*{KPT}?</th>
<th>IDENT{KPT}?</th>
</tr>
</thead>
<tbody>
<tr>
<td>a. ku?p</td>
<td>***!</td>
<td></td>
<td></td>
</tr>
<tr>
<td>b. → kup</td>
<td>**</td>
<td>*</td>
<td></td>
</tr>
<tr>
<td>c. ku?</td>
<td>*!</td>
<td>**</td>
<td>*</td>
</tr>
</tbody>
</table>

Glottal stops in onset position can be protected by IDENT/ONSET.

The second challenge faced by this approach is more serious: the interaction of Vʔ reduction with syncope appears to be opaque. The analysis of syncope developed so far predicts that postglottalized vowels can be targets of syncope, as shown below.

(153)

<table>
<thead>
<tr>
<th>/ka-lukuʾp-ik/</th>
<th>STRESS-TO-WEIGHT</th>
<th>MAX-V[+hi]</th>
</tr>
</thead>
<tbody>
<tr>
<td>a. !! (k<code>ä.lu)(k</code>uʾ)(p ´ ık) *!</td>
<td></td>
<td></td>
</tr>
<tr>
<td>b. →ka(l`uk)(p ´ ık) *</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Given the assumption that ? is always a normal consonant, a postglottalized vowel is just like any other vowel in the input; IO-Faithfulness constraints will not protect postglottalized vowels from syncope. It appears that Output-Output Faithfulness is required.

It does not seem unreasonable to assume that a correspondence relation holds between fast-speech and slow-speech forms of the same word: the two forms cannot be arbitrarily different, after all. What we need, then, is a constraint on this OO-correspondence relation that protects a vowel in the syncopated form if it is followed by a glottal stop in the slow-speech form, but that does not protect the glottal stop from deletion.

A plausible constraint is one that requires the stress placement to match in the two forms. The relevant Vʔ sequence in the slow-speech form will of course occur in a closed syllable, and thus attract secondary stress. OO-Faith constraints relativized to stressed syllables in the base (slow-speech) forms can then preserve the vowel and stress placement of a Vʔ sequence without preserving the glottal stop itself.

In fact, two OO-Faith constraints are required. OO-MAX(stress) protects vowels in stressed syllables from deletion, while OO-IDENT(stress) requires that stress placement be the same in the two forms. If OO-IDENT(stress) is ranked above the constraints governing foot size, the stress placement will match even at the cost of creating a degenerate foot in the fast-speech form. The effect of the two OO-Faith constraints is demonstrated below.

(154) OO-MAX-V/ʔ: If V occurs in a stressed syllable, then there is a V′ such that VŘV′.
(155) OO-IDENT(stress): If V occurs in a stressed syllable and VŘV′, then V′ also occurs in a stressed syllable.

---

18Intervocalic ? exists in K’iche’e’, but is extremely rare, and I disregard it here.
The constraint \( \text{OO-Max-V/\text{\textbar{\sigma}}} \) is still not quite right. As it stands, the analysis predicts that stressed vowels will never be syncopated. But given right-to-left moraic trochees, there are many counterexamples to this claim. A few are repeated below.

\begin{align*}
\text{(157)} & \quad \text{ka(m\text{\textbar{\textbar{.}}}.xa)(n\text{\textbar{\textbar{.}}}.nk)} \rightarrow \text{ka(m\text{\textbar{\textbar{.}}}.m)xa(n\text{\textbar{\textbar{.}}}.nk)} \\
\text{(158)} & \quad \text{ka(t\text{\textbar{.}}.ka)(r\text{\textbar{.}}.nk)} \rightarrow \text{ka(t\text{\textbar{.}}.ka)(r\text{\textbar{.}}.nk)} \\
\text{(159)} & \quad \text{(k\text{\textbar{.}}.li)(b\text{\textbar{.}}.lo)(t\text{\textbar{.}}.nk)} \rightarrow \text{ka(l\text{\textbar{.}}.m)lo(t\text{\textbar{.}}.nk)}
\end{align*}

The ranking established in (156) prevents syncope in these forms, as shown below.

\begin{align*}
\text{(160)} & \quad \text{/ka-tikar-ik/} \quad \text{OO-Max-V/\text{\textbar{\sigma}}} \quad \text{STRESS-TO-WEIGHT} \quad \text{MAX} \\
\text{a.} & \quad \rightarrow\text{ka(t\text{\textbar{.}}.ka)(r\text{\textbar{.}}.nk)} \quad \text{**} \\
\text{b.} & \quad \text{(k\text{\textbar{.}}.t)(ka)(r\text{\textbar{.}}.nk)} \quad *! \quad * \quad *
\end{align*}

The analysis can be saved if the OO-Max constraint is relativized to heavy syllables instead of stressed syllables.

\begin{align*}
\text{(161)} & \quad \text{OO-Max-V/\text{\textbar{\sigma}}: If V occurs in a heavy syllable, then there is a V’ such that V\text{\textbar{\textbar{.}}}.V’.}
\end{align*}

The relativized constraint no longer prevents secondary stress from shifting off of a light syllable, as in (157-159). It does not affect long vowels, because they surface only in the final syllable, which is never a target for syncope. The relativized constraint prevents syncope in closed syllables, duplicating the effect of \(*\text{Complex}\) for syllables closed with consonants other than glottal stop. Thus, the only effect unique to this constraint is to prevent the syncope of postglottalized vowels even when the glottal stop is deleted.

The constraint \( \text{OO-Ident(stress)} \) is necessary in any analysis, if it’s correct that stress is preserved even when \( V? \) is reduced to \( V \). The constraint \( \text{OO-Max-V/\text{\textbar{\sigma}}} \) is more troubling. This contraint allows us to account for the \( V? \)-reduction even on the assumption that this process involves the deletion of a consonant. However, the constraint really amounts to a stipulation that syncope does not target closed syllables — a result that is partially captured already by the analysis of syllable structure. The assumption that \( V? \)-reduction is consonant deletion also requires a special process that deletes glottal stops, but no other consonants, from coda position. All of this complicated machinery is not very appealing.

If we instead make the assumption that \( V? \) is a kind of vowel, the analysis of \( V? \)-reduction is much simpler. In particular, the resistance of glottalized vowels to syncope is no longer a case of opacity. We
can block the syncope of postglottalized vowels in essentially the same way that we block the syncope of non-high vowels:

(162) \text{MAX-V[+glottalized]: If a V has the feature [+glottalized] in the input, then it is has a correspondent in the output.}

(163)

<table>
<thead>
<tr>
<th>/kalukupik/</th>
<th>MAX-V[+glot]</th>
<th>*V?</th>
<th>STRESS-TO-WEIGHT</th>
</tr>
</thead>
<tbody>
<tr>
<td>a. (kà.lu)(kù')(pìk)</td>
<td>*!</td>
<td>*</td>
<td></td>
</tr>
<tr>
<td>b. →(kà.lu)(kù')(pìk)</td>
<td>**</td>
<td></td>
<td></td>
</tr>
<tr>
<td>c. kalukpik</td>
<td>*!</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Note that the MAX constraint is not a MAX-Feature constraint, since the [+glottalized] feature is in fact deleted in the optimal candidate. The preservation of stress on the reduced V? is still opaque, of course, and OO-IDENT(stress) can be applied to capture this effect.

It is also interesting to note that this strategy is not fully compatible with an approach to syncope based on specialized markedness constraints like *V[+hi]. In order to produce syncope on this approach, we need the ranking V[+hi] \text{>> MAX}. One might assume that V?-reduction without syncope can then be produced with the ranking MAX, *V? \text{>> IDENT[+glot]}, as below:

(164)

<table>
<thead>
<tr>
<th>/kalukupik/</th>
<th>MAX</th>
<th>*V?</th>
<th>IDENT[+glot]</th>
</tr>
</thead>
<tbody>
<tr>
<td>a. kalukupik</td>
<td>*!</td>
<td></td>
<td></td>
</tr>
<tr>
<td>b. →kalukupik</td>
<td>*</td>
<td></td>
<td></td>
</tr>
<tr>
<td>c. kalukpik</td>
<td>*!</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

However, high-ranking *V[+hi] will force syncope of high glottalized vowels as well:

(165)

<table>
<thead>
<tr>
<th>/kalukupik/</th>
<th>*V[hi]</th>
<th>MAX</th>
<th>*V?</th>
<th>IDENT[+glot]</th>
</tr>
</thead>
<tbody>
<tr>
<td>a. kalukupik</td>
<td>*!</td>
<td>*</td>
<td>*</td>
<td></td>
</tr>
<tr>
<td>b. !! kalukupik</td>
<td>*!</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>c. →kalukpik</td>
<td>*</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

This approach, then, requires the constraint *V[+hi,-glot] as opposed to *V[hi], raising the question of just how specific constraints can or should be.

Of course, if postvocalic glottal stop is a vocalic feature, we need not postulate any coda deletion processes. Thus, the approach allows us to dispense with the complicated “marked-faithfulness” constraints used in (152).

In the first part of this section we saw several reasons to believe that K’ichee’ makes a three-way distinction among long, short and glottalized vowels. The preliminary evidence from syncope provides additional support for this position. If we take V? to be a vowel, then the treatment of V?-reduction is straightforward and the fact that glottalized vowels are reduced but not deleted is not a case of opacity.
5 Conclusion

This paper developed an analysis of syncope and related phenomena in K’iche’che’. It was shown that the process of syncope is closely related to the general phonology in several ways. First, the motivation for syncope is best understood as an application of the constraints on prosody. The constraints *LAPSE, STRESS-TO-WEIGHT, and TROCHEE, which are independently required for the prosodic system of the language, motivate syncope when ranked above MAX-V[+hi] and below MAX-V[-hi]. That is, as many high vowels as possible are deleted to produce a prosodic structure in which the stressed syllables of iterative trochees are heavy.

Second, syncope respects the constraints on syllable structure. The clearest interaction in this regard is the relation of syncope with coda devoicing, which is captured very naturally in a parallel framework but cannot be captured at all in a serial framework. The ranking VOINAS >> CODACond >> VOISOn >> IDENT(voice) was proposed to account for the coda devoicing of liquids and glides. If the two markedness constraints driving the voicing alternation, namely CODACond (“Codas are voiceless”) and VOISOn (“Sonorants are voiced”) outrank the contraints driving syncope, then syncope is correctly predicted to be blocked after liquids and glides. The intuition is that it’s better to have a suboptimal prosodic structure than either to violate the coda condition or to produce a voiceless sonorant.

Finally, the connection between syncope and postvocalic glottalization was investigated. The analysis of this relation turns out to be quite simple, but only if the vowel system is taken to make a three-way distinction among long, short and glottalized vowels. Independent evidence for this three-way distinction comes from the inventory of syllable shapes and from a process of hiatus resolution in K’iche’. Similar distinctions are found in several Mamean (Mayan) languages with weight-sensitive stress placement and in Danish stød. The resistance of glottalized vowels to syncope is treated very simply: MAX-V[+glot] protects glottalized vowels from syncope, just as MAX-V[-hi] protects non-high vowels.

The Hasse diagram below summarizes the main constraint rankings proposed for K’iche’che’ in this paper.

\[ \text{STRESS-TO-WEIGHT, } *\text{LAPSE} \quad \rightarrow \quad \text{MAX-V}[+hi] \]

\[ \begin{array}{c}
\text{TROCHEE, RIGHTMOST} \\
\text{MAX-V}[+hi] \\
\text{MAX-V[+glot]} \\
\text{VOINAS} & \text{CODACond} & \text{VOISOn} \\
\text{IDENT(voice)}
\end{array} \]
Taken together, these interactions show that syncope must be evaluated in parallel with other phonological processes, and they demonstrate one way in which an assumption about the input structure contributes to the analysis.

References


Duong, Khue, Vera Lee-Schoenfeld, Nathan Sanders, and Lynsey Wolter (2002). “The Realization of the B3PL and the Nominal Plural Markers in K’ichee’.” Ms, UCSC.


