Transactions of the Philological Society

PhilSoc The Philological Society

Transactions of the Philological Society Volume 00 (2021) 1–59 doi: 10.1111/1467-968X.12212

THE HISTORICAL RECONSTRUCTION OF GREATER TZELTALAN (MAYAN) VOWEL ASSIMILATION AND VOWEL RAISING PATTERNS

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(Submitted: 8 September, 2018; Accepted: 9 March, 2021)

Abstract

This paper examines the phenomenon of vowel assimilation at a distance in di- and trisyllabic roots and stems in the Greater Tzeltalan languages of the Mayan language family. The study focuses on changes undergone in disyllabic and trisyllabic roots and stems, characterized by either anticipatory or perseverative vowel assimilation, and discusses the historical scenarios relevant to their reconstruction to the various relevant stages (Proto-Greater Tzeltalan, Proto-Ch'olan, Proto-Tzeltalan), as well as likely cases of diffusion between Ch'olan into Tzeltalan. In addition, the paper also considers the question of vowel raising in Ch'olan, i.e. the so-called *oo > u and *ee > i shifts, identified by Kaufman and Norman and reexamined by Brown and Wichmann. We posit a series of phonetic blocking conditions, and we argue that most cases can be accounted for as examples of suffix-controlled vowel assimilation. It is also shown that the presence of certain typical suffixes with low or mid vowels can account for the etyma that did not experience the shifts.

1. Introduction

A variety of works have been published that propose systematic reconstructions of lexical roots and stems for the two branches of the Greater Tzeltalan subgroup of the Mayan language family.[1] This subgroup can be divided into two branches: the Ch'olan branch and the Tzeltalan branch, each described in more detail in section 2.1. The first of the aforementioned works dealing with the reconstruction of the Greater Tzeltalan languages is Kaufman's (1972), which consists of a Proto-Tzeltalan vocabulary and grammatical morphemes. The second is Kaufman and Norman's (1984), including Kaufman's reconstructions of Proto-Ch'olan vocabulary (along with relevant Tzeltalan and Proto-Mayan reconstructions), and Norman's reconstructions of Proto-Ch'olan verbal morphology. More recently, Kaufman with Justeson's (2003) *A preliminary Mayan etymological dictionary* provides not only reconstructions for the earliest stages of the Mayan family (Proto-Mayan, Late Proto-Mayan, Central Mayan), but also the cognates from each major subgroup supporting each reconstruction, and including updated reconstructions

[1] The original version of this paper was presented at the American Anthropological Association conference (Mora-Marín 2008). We are indebted to the Editorial Staff at TPHS and the reviewers of the manuscript for their careful, detailed, and constructive assessment of a previous version of this manuscript, which gave us the chance to produce a much clearer and focused treatment of the topic. Our especial thanks go to John Justeson, for his detailed commentary and insights on a number of specific instances of analysis.

for Proto-Tzeltalan and Proto-Ch'olan, as well as relevant Epigraphic Mayan attestations.[2]

These sources propose reconstructions of trisyllabic and disyllabic etyma that exhibit more vowel uniformity than the Proto-Mayan forms they descended from. Despite these widespread differences between the Proto-Mayan reconstructions, on the one hand, and their Proto-Ch'olan and Proto-Tzeltalan reflexes, on the other, to date there is no detailed, systematic discussion of the processes that conditioned vowel changes in tri- and disyllabic forms. We identify these vowel changes as the result of vowel assimilation at a distance, both anticipatory, as in the case of Proto-Mayan *7atyooty (or *7atyuuty) > Proto-Ch'olan *7otot 'home', and perseverative, as in the case of Proto-Mayan *winaq > Proto-Ch'olan *winik 'man, person/people', and we discuss the conditioning and blocking factors relevant to such processes.

This paper constitutes an attempt to evaluate this phenomenon for systematic patterns and factors, given that many trisyllabic and disyllabic stems did not experience such changes, for example, Proto-Mayan *7ikaaq' 'cousin' > Proto-Ch'olan *7ichak' 'nephew; cousin'. The paper also considers the possible connection of vowel assimilation to other vocalic changes, such as the exclusive Ch'olan vowel raising of *oo > *u and *ee > *i), as well as patterns of typical suffixation, and cases of diffusion between Ch'olan and Tzeltalan in the context of the Greater Lowland Mayan and Lowland Mayan diffusion areas (Justeson et al. 1985).

With these goals in mind, the paper is organized as follows. Section 2 reviews several theoretical prerequisites for the undertaking of this paper: vowel assimilation at a distance; Mayan linguistic classification; and basic vowel correspondences across Mayan languages and subgroups, with a focus on Greater Tzeltalan vowel correspondences. Section 3 introduces the basic sources for compiling the datasets analysed in this paper, and then systematically surveys the vowel assimilation patterns evident in the Greater Tzeltalan languages, distinguishing between anticipatory and perseverative types, total and partial assimilation types, as well as specific phonetic features implicated. Section 4 discusses related matters, including Ch'olan vowel raising and the possible influence of suffixal vowels in promoting or inhibiting such change, cases of vowel assimilation that postdate the internal differentiation of both Proto-Ch'olan and Proto-Tzeltalan, respectively, and the epigraphic evidence from Epigraphic Mayan mostly from the Classic period (ca. 200–900 CE). Finally, section 5 posits several conclusions and goals for future research, including the need for a systematic consideration of diffusion involving other Mayan subgroups, especially Yucatecan, as well as stress patterns in di- and trisyllabic forms in Greater Tzeltalan, which has yet to be reconstructed.

Our analysis suggests that vowel assimilation was an active phonological process within the Ch'olan and Tzeltalan branches, accounting for the prevalence of vowel uniformity within disyllabic and trisyllabic lexemes, with 53.5 per cent of such forms exhibiting identical vowels in Ch'olan (38.9% inherited that way, 14.6% due to total vowel assimilation in PCh'), and 54 per cent in Tzeltalan (33.9% inherited that way, 16.9% due to total vowel assimilation in PTz). Several cases of vowel assimilation are shared by Ch'olan and Tzeltalan, and could be traced back to their immediate ancestor, Proto-Greater Tzeltalan, or subsequent diffusion between already differentiated Ch'olan and Tzeltalan subgroups or languages. In Ch'olan, the most common type of vowel assimilation is anticipatory, resulting in the vowels of roots changing to take on features of the vowels in following syllables (mostly suffixal vowels). In fact, we present evidence

[2] The term 'Epigraphic Mayan' was coined by Kaufman (cf. Kaufman with Justeson 2003). It now serves as the basis for the ISO code: Epigraphic Mayan (ISO 639-3 emy).

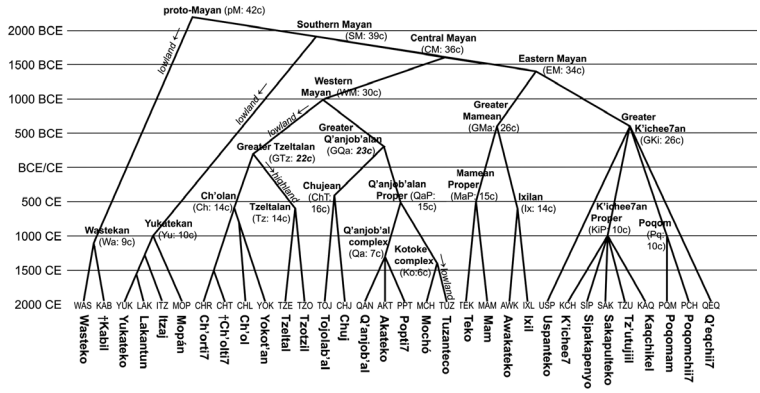

Figure 1. Model for the phylogenetic classification of the Mayan languages by Kaufman (2017:Figs. 4.2A-B).

that indicates that the *oo > u and *ee > i shifts that affected monosyllabic morphemes in Ch'olan were largely the result of suffix-controlled anticipatory vowel assimilation involving vowel-initial suffixes, as well as evidence showing that items that did not experience the 'shifts' exhibit blocking conditions, involving consonantal segments, as well as non-high vowels in following suffixes.

2. Preliminaries

2.1. Linguistic classification

This paper adopts the linguistic classification of Mayan languages by Kaufman (1990, 2015b, 2017), seen in Figure 1.[3] Kaufman's model proposes a series of binary splits: Huastecan from Proto-Mayan (PM), leaving Late Proto-Mayan (LPM, aka Southern Mayan or Core Mayan) in the homeland; Yucatecan from LPM, leaving Central Mayan (CM) in the homeland; CM into Eastern Mayan (EM) and Western Mayan (WM) branches; followed by the further differentiation of EM into Greater Mamean (GM) and Greater K'ichee'an (GK') subgroups, and of WM into Greater Q'anjob'alan (GQ') and Greater Tzeltalan (GTz) subgroups. These last four subgroups have in turned differentiated further. The focus of this paper is the GTz subgroup, also known in the literature by the terms Ch'olan-Tzeltalan and Ch'olan-Tzotzilan.

In Kaufman's (2017) model, the differentiation of GTz into separate Ch'olan (Ch') and Tzeltalan (Tz) branches was followed, on the one hand, by the differentiation of Tz into Tzeltal and Tzotzil, each with multiple dialects, and the differentiation of Ch' into an Eastern Ch'olan (ECh') branch, comprised of Ch'olti' and Ch'orti', and a Western Ch'olan (WCh') branch, comprised of Ch'ol and Acalan/Yokot'an (Chontal) (Kaufman & Norman 1984). Mora-Marín (2009a, 2009b) has discussed the differentiation of Ch'olan and provided

[3] There exist two additional models. One is a more conservative model that recognizes the following groupings (Campbell and Kaufman 1985; Justeson et al. 1985) as coordinate: Huastecan, Yucatecan, Eastern Mayan (consisting of Greater Mamean and Greater K'ichee'an), Greater Q'anjob'alan, and Greater Tzeltalan (Ch'olan-Tzeltalan). The other is a less conservative model by Robertson (1998), revised mostly in its terminology for use in Houston et al. (2000), with the following terminology and groupings: Common Wasteko-Ch'olan (Huastecan, Common Ch'olan, Tzeltalan), Common Mamean-K'ichee'an (Eastern Mayan), Common Q'anjob'alan (Q'anjob'alan, Motosintleko), Yukatekan. Neither Brown & Wichmann (2004) nor Campbell (2017) supports unifying Huastecan with Greater Tzeltalan (Ch'olan-Tzeltalan); more to the point, Kaufman & Justeson (2007, 2008) have presented evidence against such grouping.

additional support for the model: he identified the innovation of the definite article *hini*/*ni* by WCh' and *ne*/*e* by ECh' as yet another example of a morphological trait that supports such binary split (Mora-Marín 2009a: 99, Mora-Marín 2009b: 128, Table 5), along with the five others proposed by Kaufman & Norman (1984: 81–2, Table 2). Robertson (1998) supports an alternative model, recently rearticulated in Houston et al. (2000), in which Ch'olan differentiated into Ch'ol, Yokot'an/Chontal, and a Ch'olti'an language equivalent to Kaufman % Norman's (1984) ECh', but one in which Ch'olti' evolved into Ch'orti', instead of being its sibling. Wichmann (2002), however, has offered evidence against such model, noting differences between Ch'olti' and Ch'orti' that cannot be reconciled in a Ch'olti'-to-Ch'orti' model.

This paper also considers language contact between Mayan languages and subgroups. Justeson et al. (1985) have defined two language contact areas of relevance: the *Greater Lowland Mayan* (GLM, aka GLL) contact area, involving a core consisting of the Ch'olan, Tzeltalan, and Yucatecan languages; and the *Lowland Mayan* (LM, aka LL) contact area, involving the Ch'olan and Yucatecan languages. Several peripheral languages from the Greater Q'anjob'alan, Greater Mamean, and Greater K'ichee'an subgroups, were influenced by GLM and LM innovations. For the present purposes, these are the primary contexts of diffusion of relevance. Kaufman & Norman (1984) and Kaufman (2015b) further note that following the differentiation of Ch' into ECh' and WCh', the latter branch engaged in close contact with the Tz languages; Mora-Marín (2009a; 2009b) has presented additional data in support of such contact. Similarly, it would appear that Ch'orti', in particular, has undergone close contact with Yucatecan languages, especially Mopan, as suggested by Hofling (2007); this would have taken place following the split of ECh' into Ch'olti' and Ch'orti', in Kaufman & Norman's (1984) differentiation model. Kaufman (2015b) defines two additional spheres of interaction: the *Chiapas sphere* (Tojolab'al, Tzotzil, Ch'ol) and the *Huehuetenango sphere* (Greater Q'anjob'alan, minus Tojolob'al, and Greater Mamean). Justeson et al. (1985:9) also noted that in addition to Ch'olan and Yucatecan, another language, Q'eqchi', participated in the LM contact area, primarily as recipient of important cultural vocabulary; recently Wichmann & Hull (2009) have revisited this topic and have suggested that Q'eqchi' borrowed approximately 3.6 per cent of its vocabulary from Ch'olan and Yucatecan.

2.2. Vowel assimilation at a distance

There is a great deal of terminological variation regarding vowel assimilation at a distance, i.e. assimilation between vowels that serve as nuclei of adjacent syllables. These varied terms are often restricted to specific traditions of scholarship distinguished by study of a different branch of Indo-European: affection (Celtic), metaphony (Romance), umlaut (Germanic), and mutation (Germanic). The literature further distinguishes some of these terms on the basis of specific phonetic features targeted in the processes; *i-umlaut* is used to refer to cases where vowel raising or fronting takes place; *a-umlaut* for vowel lowering; and *u-umlaut* for vowel rounding. These terms – affection, metaphony, umlaut, mutation – are essentially synonyms, and are all accurately described as cases of vowel assimilation at a distance.

The term Vowel Harmony or VH is a bit more complicated, and potentially problematic. Crucially, as described by Hyman (2002:5), VH is typically 'unbounded,' applying to all the vowels within a certain domain (e.g. phonological or morphological word), while Vowel Assimilation (at a distance) or VA is typically 'bounded,' applying to a single vowel, and therefore not necessarily to all the vowels within a certain domain. In this paper the phenomenon of interest is bounded, applying rather narrowly to roots or stems.

VA can be *anticipatory*, whereby the vowel of a syllable assimilates to the vowel of the following syllable; or *perseverative*, whereby the vowel of a syllable assimilates to the vowel of

the preceding syllable. Additionally, we may speak of *root-triggered* (or *root-based*) or *suffix-triggered* (or *suffix-based*) VA, as well as *stress-triggered* VA. Hyman (2002: 5), in his discussion of the differences between tone assimilation and VH, argues that VH is often triggered by either the root vowel or the stressed vowel (prominent position), for one, and that the target of harmony or assimilation is either the affixal vowel or the unstressed vowel (non-prominent position). That said, Rose & Walker (2011: 254) note that some types of VH are characterized by stressed targets, such as *umlaut* in Germanic languages (a post-tonic vowel triggers fronting and/or raising of a stressed vowel) and metaphony in Romance languages ('a post-tonic high vowel causes raising of a stressed vowel'). For the present paper, stress will not be considered; its reconstruction to Proto-Mayan and each descendant subgroup, particularly Greater Tzeltalan and its descendant Ch'olan and Tzeltalan groupings, has yet to be thoroughly addressed and discussed in the literature, and is thus a matter better left for a future and much needed paper. For this paper, instead, the focus will lie on VA patterns within di- or tri-syllabic roots, as well as within stems involving derivational suffixes, in which case root- or suffix-controlled VA patterns may be at play.

2.3. *Mayan vocalic correspondences in monosyllabic and disyllabic roots and stems*[4]

Since the topic of this paper is VA, some background to the reconstruction of vowels in the Mayan family is necessary. Figure 2 provides the segmental inventory and canonical monosyllabic root shapes of PM by Kaufman (2017:76), which we assume in this paper.[5]

Regarding the relative stability of the segmental inventory, Kaufman (2017: 70) has recently remarked:

> Sounds that are completely stable in Mayan are *p, *b', *ty', *s, *x, *7, *m, *n, *l, *w, *y; short *i, *e, *o, *u. Sounds that undergo change in individual Mayan languages include *t, *t', *ty, *tz, *tz', *ch, *ch', *k, *k', *q, *q', *j, *h, *nh, *r, *a, and long vowels.

In monosyllabic roots, most short vowels are stable: some can be characterized as 'completely stable' (*i, *e, *o, *u). Long vowels and *a, in contrast, are less so. Table 1 provides general patterns of correspondence among Mayan subgroups based on canonical root shapes, including both the vowel, whether short (*V) or long (*VV), as well as cases were a short vowel was followed by a preconsonantal *h (i.e. *CVhC) or *7 (i.e. *CV7C); some scholars refer to simplex (*V) versus complex (*VV, *Vh, *V7) syllable nuclei when treating vowels (Brown & Wichmann 2004; Wichmann & Brown 2011).[6] The subgroup of focus here, GTz, preserved PM *V and *Vh rather faithfully, but experienced the merger of PM *V7,

[4] This paper utilizes a practical orthography for the Mayan languages of Mexico and Guatemala, the orthography employed by Kaufman with Justeson (2003): <7> for [ʔ], <b'> for [ɓ], <ch(')> for [tʃ(')], <nh> for [ŋ], <x> for [ʃ], <j> for [x], and <tz(')> for [ts(')]. We use Kaufman & Norman's (1984) <ä> for a non-low central vowel that may correspond phonetically to one of the following: [ə i]. We also use <+> for clitics and <-> for affixes; we will explicitly distinguish between inflectional and derivational affixes whenever necessary in the discussion of the data, but mark them both with <->. Also, henceforth, <P> will be used for 'Proto-' and it will be distinguished from 'Pre-' as follows: PCh' for 'Proto-Ch'olan' and Pre-Ch' for 'Pre-Ch'olan'.

[5] We follow Kaufman's reconstruction of phonemic *7 in all positions of the word, including initially, an argument recently strengthened by Kaufman (2015a) and Hopkins (2018), contra Campbell (2017). Kaufman (2017: 77) also reconstructs a phoneme *H which "is /h/ word-initially, but deleted after ERG proclitics, as is *7." He also adds that "It is found in under ten roots, for example *Ha7 'water', *Ho7 'five', *Haty 'eye', *Hal 'to say it', *Huul 'to arrive', *Ha7b' 'year'." We systematically insert *7 in reconstructions where it has been omitted root-initially in the work of Kaufman & Norman (1984) and Justeson et al. (1985), for example, but represented explicitly in Kaufman with Justeson (2003).

[6] Brown & Wichmann (2004) and Wichmann & Brown (2011) propose a rather different scenario for the reconstruction of Proto-Mayan 'syllable nuclei' from Kaufman's (1976). We follow most authors in utilizing Kaufman's model, but as we explain, the vowel assimilation patterns we identify appear to be impervious to the presence or absence of preconsonantal *h or *7 (or *j) after the vowel.

Consonants

p	t	ty	tz	ch	k	q	7
b’	t’	ty’	tz’	ch’	k’	q’	
			s	x		j	h
m	n				nh		
	l						
	r						
w				y			

Vowels

i		u
e		o
	a	

vowel length /:/ represented VV

Syllable Canons

CVC, CVVC, CV7C, CVhC, CVSC (S = s, x, j)

Figure 2. Segmental inventory and canonical shapes of PM (Kaufman 2017:76).

Table 1. General syllable nuclei correspondences across Mayan subgroups.

PM	Hu	Yu	GQ’	GTz	GM	GK’
*V >	*V, *VV	*V	*V	*V	*V	*V
*VV >	*VV, *V	*VV	*VV	*VV > *V	*VV	*VV
*Vh >	*V	*Vh	*V	*Vh	*VV	*Vh
*V7 >	*V	*V7	*V7	*V7 > *VV > *V	*V7	*V7

*VV > *VV, and subsequently, after differentiation, each of the separate branches, Ch’ and Tz, underwent a change of *VV > *V independently, as explained in brief.

Ch’olan experienced an exclusive process of vowel raising of the two mid vowels characterized as ‘neither regular nor pervasive’ by Kaufman & Norman (1984:87): (PM *oo, *o7 >) PGTz *oo > Pre-Ch’ *uu > PCh’ *u, and (PM *ee, *e7 >) PGTz *ee > Pre-Ch’ *ii > PCh’ *i. Brown & Wichmann (2004:146, 152) have argued that the shift of Proto-Mayan **ee*/***e?* (in Kaufman’s model) or **e*/**E*/**eh* (in Brown and Wichmann’s model) to Proto-Ch’olan **i* was conditioned by the presence of ‘a stem-final fricative,’ and that the shift of Proto-Mayan **oo*/***o?* (in Kaufman’s model) or **ooh* (in Brown and Wichmann’s model) to Proto-Ch’olan **u* was unconditioned. They thus treat each mid-vowel raising as a separate process from that of the other. We return to the problem of Ch’olan vowel-raising in section 4.1.

In connection with these parallel vowel-raising changes, there is evidence from loanwords that *VV was preserved in Pre-Ch’, before merging with *V in PCh’. Justeson et al. (1985: 14, 18, 42, 78) first presented the case of Yucatec *tùun* ‘stone’: given that Yucatecan preserved vowel-length contrasts in lexical roots and stems, and that it did not undergo the vowel-

raising change experienced by Ch'olan, it must have borrowed *tùun* 'stone' from a Pre-Ch' form *tuun rather than PCh' *tun, from PM *toonh. In fact, Mora-Marín (2010: 168) notes that Yucatecan has preserved a reflex of PM *toonh 'stone' as Yucatec *tòon* 'penis, testicles'. Mora-Marín (2010: 168) has added another possible case of a Ch' loan into Yucatecan supporting the supposition that Pre-Ch' had retained *VV, including *VV from an earlier *V7. It involves the GLM term *tzo7n (Kaufman with Justeson 2003: 292), reconstructed to PCh' as *tzun 'moss, pubic hair' and PTz *tzon 'body hair'. It is attested in Colonial Yucatec as <choon> 'body hair' (Kaufman with Justeson 2003: 292), and in Modern Yucatec as *chó7om* 'pubic hair' (Bricker et al. 1998: 73). But interestingly, Modern Yucatec also bears the term *tzùum* 'tuft of hair on chest of mature turkey' (Bricker et al. 1998: 45), likely a loan from Pre-Ch' *tzuun, following the GTz change of *o7 > *oo, as well as the Pre-Ch' raising of *oo > *uu, and serves as evidence that the merger of *V7 and *VV to *VV occurred prior to the vowel-raising.[7] Lastly, Kaufman & Justeson (2007:201) have identified another case of a Ch'olan loanword with a similar significance: PM *peeq 'pataxte (a type o cacao)', shifted in PCh' to *pik '8,000', but is attested in Yucatecan as *pìik* 'skirt', due 'the semantic association derives from the use of gunny sacks to store large numbers of cacao beans,' once again supporting the proposition that Pre-Ch' experienced the change of *VV, *V7 > *VV before the vowel-raising shift of *ee and *oo to *ii > i and *uu > u, respectively.

Regarding *a, more must be said before we review the regular correspondences for vowels. First, Kaufman & Norman (1984: 85) proposed that, during the merger of GTz *VV, *V > PCh' *V, the following process took place also: GTz *aa > PCh' *a and GTz *a > PCh' *ä, except under specific conditions in which *a < *aa merged with those 'instances of *a [which] did not undergo the shift' to *ä. Regarding such instances (exceptions), Kaufman & Norman (1984: 85) propose four blocking conditions for the *a > *ä shift, including two partially morphological ones, 'initially in all roots except verb roots' and 'in final position in nouns,' and two strictly phonetic ones, when adjacent to *h or *7. In addition, with regard to their proposed *a : *ä contrast, they note that 'since its formulation depends on the existence of a contrast between long *aa and short *a, a distinction that was present in Greater Tzeltalan but had been lost by the time Western Ch'olan split off from common Ch'olan', it *cannot* be argued that WCh' innovated the /a/ : /ä/ contrast, but must instead be ascribed to PCh'.[8] This is the reason why Kaufman & Norman (1984: 85–6) also explain that ECh' then merged *a < *aa and *ä < *a into ECh' *a: the source of ECh' *a is traceable to an earlier GTz *aa and *a, retained in WCh' as /a/ and /ä/, and therefore not a WCh' innovation, but a contrast that must have been present in a stage intermediate between GTz and WCh', and therefore, PCh'. This means that ECh' *a is the innovation (specifically a merger).

Campbell (2017: 50–1) has recently asked whether the contrast between short and long vowels was one of purely length or possibly also vowel-quality, noting that 'In a majority of the Mayan languages that maintain the contrast, the 'short' vowels are typically also more open or slightly lower than their 'long' counterparts, except that 'short' /a/ is phonetically [ä] or schwa-like'. Campbell adds that 'If PM had had solely a straightforward length contrast,

[7] Note that Yucatec /n/ is typically realized as [m] word-finally: compare *7òom* 'avocado' to *u 7òon-il* 'his avocado' and *x 7òon-il* 'grove of avocado trees' (Bricker et al. 1998: 18).

[8] The only alternative would be to propose that PCh' preserved the *VV : *V contrast, and that after its split into ECh' and WCh', the former underwent a change of *aa, *a > a, at the same time as *VV > V, while the latter underwent a change of *VV > V, with *a > ä under specific conditions. This would make for a much more complicated scenario, one that is presently unwarranted. Furthermore, since Justeson et al. (1985: 14, 18, 42, 78) observe that Pre-Ch' preserved a *VV : *V contrast, the innovation of the /a/ : /ä/ contrast from earlier /aa/ : /a/ took place during the Pre-Ch' to PCh' transition.

Table 2. Syllable nuclei correspondences for GTz.

PM	GTz	Tz	Ch'	WCh'	ECh'
*V >	*V >	*V	*V >	*V	*V
*VV >	*VV >	*VV > *V	*VV > *V >	*V	*V
*Vh >	*Vh >	*Vh	*Vh >	*Vh	*Vh
*V7 >	*V7 > *VV >	*V	*V >	*V	*V
*a >	*a >	*a, *ä	*ä > *a >	*ä, *a	*a
*aa >	*aa >	*a, *ä	*a >	*ä, *a	*a

there would be no strong phonetic motivation for why the contrast traditionally represented as /a:/ vs. /a/ should not have been lost along with the loss of the length contrast in the other vowels in those languages'. This suggests that GTz, Tz, and Ch' could very well have exhibited a contrast between *aa, on the one hand, and */a/ characterized by *[a] ~ *[ä], on the other. In such a scenario, PCh' may have undergone a merger of *aa with *[a], but not with *[ä], a situation that would have been preserved in WCh'; however, in ECh', under this scenario, *[ä] would have merged with *a from */a/ and */aa/ both, resulting in *[a].

Table 2 provides the correspondences for the GTz languages and subgroups. PM *V7 was retained in GTz but it subsequently merged with *VV, followed by a merger of *VV, *V > *V independently in both Tz and Ch', as already noted. PM *Vh was retained in GTz and in PTz and PCh', however, it experienced some changes in subsequent stages of both Tzeltalan (individual varieties of Tzeltal and Tzotzil) and Ch'olan, including PCh', such as deletion of preconsonantal *h before two consonants (e.g. *b'äk't-a 'to get scared' < *b'ahk'ut 'fright; fear') and before *s, *x, or *j in Late PCh' (e.g. *mis-u 'to sweep' < earlier *mihs-u, *7ax < earlier *7ahx 'breadnut'), in the latter case as indicated by evidence of Ch'olan loanwords into other languages that preserved *h before such consonants (Kaufman & Norman 1984: 86, footnote 6). The reflexes of PM *a and *aa in GTz and Ch' have been reviewed above; the corresponding reflexes in Tz are more complex than there is space to review here, and we will instead address specific etyma that appear relevant as the need arises.

For now, there is another component to the Ch'olan shift of GTz *a > PCh' *ä that requires consideration, as it affects three of the disyllabic roots discussed in this paper. Kaufman & Norman (1984: 86) observe that several instances of PM *aa and *ah, occurring 'in the root syllables of some derived stems,' became realized in PCh' as *ä: (1) *k'äk'=nahb' 'sea' (< PCh' *k'ahk < Pre-Ch' **k'ahk' 'fire'); (2) *b'äk't-a 'get scared; be afraid' and *b'äk't-esä 'to frighten' (< *b'ahk'ut 'fright; fear'); (3) *7äk'b'-äl 'night' and *7äk'b'-i 'yesterday' (< *7ahk'äb' 'night'); (4) *7äk'n-i 'to weed corn' (< *7ak'in 'weeding corn (corn-weeding)'); (5) *7äl(ä)s-i 'to play with' (< *7alas 'play, game; toy'); and (6) *chäb'-ij-i 'day before yesterday' (< *chab'-ij 'day after tomorrow'). Examples (1)–(3), those authors explain, are the result of the change of *h > Ø/__CC, a morphophonemic process that results from the addition of a derivational suffix or compounding term, and which results in cases of 'exposed' [a], unprotected, so to speak, by a following *h, that then undergo the shift to [ä]. Examples (4)–(6) do not exhibit those conditions, but are instead explained as the result of analogical change by those authors: 'the split of Greater Tzeltalan *a into Ch'olan *a and *ä gave rise to a synchronic morphophonemic alternation of *a* and *ä* (Examples (1)–(3)); this alternation has been extended to forms that originally did not alternate Examples (4)–(6))' (Kaufman & Norman 1984:86).

Next, we review the data for VA in GTz. A few examples could point to instances where the change of *a > *ä could have been motivated, or reinforced, by a vowel in an adjacent syllable.

3. Vowel assimilation in Greater Tzeltalan

3.1. Sources and methods

The datasets were compiled from several sources. To be able to determine the type of assimilation occurring in any given lexical item, it is necessary to have a point of reference. To this end, we have used Kaufman with Justeson's (2003) *A preliminary Mayan etymological dictionary*. Also, we have used Kaufman's (1971) Proto-Tzeltal-Tzotzil vocabulary, and Kaufman & Norman's (1984) Proto-Ch'olan vocabulary. Appendix 1 lists 142 examples of disyllabic or trisyllabic PCh' lexemes, thirty six of which may exhibit evidence of VA. Appendix 2 lists 119 disyllabic or trisyllabic proto-Tzeltalan lexemes, thirty three of which exhibit evidence of VA. In addition, we have paid close attention to the lexical items that exhibit evidence of the Ch'olan *oo/*o7 > *oo > *uu > *u and *ee/*7e > *ee > *ii > *i shifts; these are included in Appendix 3. Appendix 4, in contrast, lists the terms with **oo/**o7 and **ee/**e7 that did not experience the shift. In section 3.2 all tables presenting data are formatted in the same manner: the column labeled 'Item #' refers to the entry number from Appendix 1 (for Ch'olan) or Appendix 2 (for Tzeltalan); the column labelled 'Gloss' provides the meaning of the item in question; the column labelled 'Source' provides the forms prior to the VA change as reconstructed to PM or Pre-Ch' or PCh'; the column labelled 'Changed Form' provides the forms following the VA change; and the column labelled 'Class' refers to the grammatical class of the root or stem.

3.2. Anticipatory vowel assimilation

3.2.1. Ch'olan

Table 3 shows examples of Ch'olan stems exhibiting total anticipatory raising and fronting. We discuss a few of the items in some detail below, but first a general remark: most cases appear to involve a suffixal vowel as the trigger for VA, and thus, we may be dealing with suffix-controlled VA.

The first example, item #49, is based on the PCh' root *b'äk' 'seed', from PM *b'aq'; Kaufman (1972:95) reconstructs it for PTz as *b'ak' and *b'ek', based on Tzeltal and Tzotzil, respectively, to which we return in section 3.2.2. A likely derivational suffix *-et of low productivity yields the PCh' form *b'äk'-et 'flesh; body', to which a suffix *-al was likely added to mark the unpossessed (absolute) form, as suggested by the Ch'ol unpossessed form *b'äk't-al* (Kaufman & Norman 1984:116), as well as the Tz data reviewed in section 3.2.2. Yokot'an/Chontal attests to the forms *b'ek't-a(l)* 'flesh' and *b'ek'et* 'cattle', as well as the form *b'ek'* 'seed' (Keller and Luciano 1997:43, 44). The form *b'ek'-et*, the base for *b'ek't-a(l)*, likely resulted from anticipatory VA; and the form *b'ek'* 'seed' was likely the result of analogy, reanalysed on the basis of the assimilated form.

Table 3. Total anticipatory (raising and fronting) VA in Ch'olan.

Item no.	Gloss	Source	Changed form	Class
49	body	PCh' *b'ak'-et	YOK b'ek'et	n
53	to do, make	PCh' *cha7-le	AC <chele>, YOK *che*, CHR *che*	v
22	messenger > work	PM *7aab'-(7)eety-eel	PCh' *7eb'et > *7eb't-el	n
22	messenger > work	PM *7aab'-(7)eety-eel	PCh' *7eb'et > *7eb't-el	n
103	griddle	*sa7m-et	PCh' *seme(h)t	n
134	ant	*sanik	PCh' *xinich	n
128	meat	*wa7-eel	PCh' *we7-el	n
129	hung(er/ry)	*wa7-inh-aal	PCh' *wi7n-al	n

The second example, item 53, is reconstructed to PCh' as *cha7-le 'to do, make', attested in Acalan as <chele>, and in Yokot'an and Ch'orti' as *che*; only Ch'ol preserves *cha7-le*. The Acalan form is crucial, and points to /che7-le/, resulting from anticipatory VA; the Yokot'an and Ch'orti' forms suggest a process of phonetic erosion, but we cannot at this time offer a singular series of steps. It is possible that the /che7-le/ form was innovated after the breakup of PCh' into WCh' and ECh', and furthermore, after the differentiation of WCh' into Ch'ol and Acalan/Yokot'an, after which it was diffused between Acalan/Yokot'an and Ch'orti' (or possibly between Acalan/Yokot'an and a largely undifferentiated ECh').

Next is item 22, PCh' *7eb't-el 'work', derived from PCh' *7eb'et 'messenger'. Kaufman & Norman (1984: 119) reconstruct *7eb'et 'messenger', from PM *7ab'-aaty, noting 'Vowel changes unexplained'. We propose the vowel changes followed the addition of the abstractivizing suffix *-eel > *-el, resulting in a form *7ab'-aaty-eel , and more likely a Pre-Ch' form *7ab'-aat-eel, that served as the basis for two successive steps of anticipatory VA: *7ab'-aat-eel > *7ab'-eet-eel > *7eb'-eet-eel > PCh' *7eb'-(e)t-el. The syncope of the vowel of the second syllable took place after the initial root *7ab'- had already undergone anticipatory VA to *7eb'-.

Item 103 is ultimately a loan from Mixe-Zoquean *sam 'to get heated' (iv) (Wichmann 1995: 449) attested in GQ' as *sa7m 'griddle' and GLM as *sam.eht 'griddle' (Kaufman with Justeson 2003: 925–6).[9] The PCh' form *seme(h)t is likely the result of anticipatory VA; a derivational suffix is involved, represented as *.eht in forms like WM+ *7oq.eet and *r-oq.eht 'trivet', GLM *sam.eht 'griddle', and PM *pet.eht 'spindlewhorl' by Kaufman with Justeson (2003: 351, 926, 1019). We revisit this item in section 3.2.2 with regard to the Tzotzil form *semet*.

Item #134, PCh' *xinich 'ant', from PM *sanik, also exhibits anticipatory VA. Unlike the other cases from Table 3, there is no evidence that we are dealing with a root and a suffix in this case, but simply with a disyllabic root. We do not attempt to account for the seemingly sporadic PM *s > PCh' *x (or PM *s > PGTz *x) change that is in evidence here.[10]

Items 128 and 129 are related, based on the same root, PM *wa7-, also seen in PM *wa7ij(-aal) 'hungry', LM+WM *wa7inh(-aal) 'hungry, to be hungry', GLM *we7 'to eat, to eat something', PCh' *we7-el 'meat', PTz *we7-el-il (*we7.el-il) 'food', PTz *we7 'to eat' (Kaufman 1972: 121; Kaufman & Norman 1984: 135; Kaufman with Justeson 2003 :1179–80, 1195–7). Item 128 shows the following process: PM or Pre-Ch' *wa7-eel > PCh' *we7-el. Item 129 shows the following process: LM+WM *wa7inh(-aal) > Pre-Ch' *wi7inh-aal > PCh' *wi7n-al.

Next, Table 4 shows cases of partial assimilation that could be mostly described as suffix-controlled VA. The first example, Ch'orti' *sukchij* 'agave, maguey, fibre, cord, string, rope' (Hull 2016: 377), is a special case. This term is historically a compound noun, reconstructed to PCM as *saq=kiih by Kaufman with Justeson (2003: 1162), composed of *saq 'white' (PCh' *sak) and *kiih 'agave' (PCh' *chih), but it may no longer be analysable in Ch'orti': Hull (2016) does not provide an isolated entry for *chij* for 'agave', only *sukchij* 'agave'.

[9] Kaufman with Justeson (2003) utilize a period to mark'"derivational' and a hyphen for 'inflectional'. In this paper we use the hyphen for both.

[10] This resembles the evidence for GLM **sam.eht* 'griddle' in Yucatecan, with Yucatec, Itzaj, and Mopan all showing *x* instead of *s*. In both instances ('ant' in PGTz and 'griddle' in Yucatecan), the *s > x correlates with a change of *k > ch in the 'ant' case in PGTz or *t > ch in the 'griddle' case in Yucatecan. Thus, consonantal assimilation at a distance, triggered by *ch* in both cases, seems to be at work. This would be worth exploring in a future paper, but we suspect there are not that many cases, even when multiple languages are considered. What matters for now is that there is no reason to suspect that the *s > x change relates to the vowel changes.

Table 4. Partial anticipatory (raising) VA in Ch'olan.

Item no.	Gloss	Source	Changed form	Class
108	agave	PCM *saq=kiih, PCh' *sak 'white', PCh' *chih 'agave'	CHR sukchij	n
143	to hear, feel, notice	PM *7ab'-i	PCh' *7ub'-i	v
42	jaguar	PCh' *b'ahlam	CHL b'ajlum((-i)l-el)	n
14	to weed corn	**7aq'een-i >	PCh' *7ak'in-i	v
14	to weed corn	**7ak'in-i > *7ak'(i)n-i >	PCh' *7äk'n-i	v
18	to play with	**7aala7s-i > *7alas-i	PCh' *7äläs-i	v
56	in four days	PM *koonh-eej	PCh' *chun-ij	adv
57	four days ago	PM *koonh-ej-eer	PCh' *chun-ij-i	adv
54	two days ago	PGTz *cha7b'-eej-eey	PCh' *chäb'-ij-i	adv
136	purslane	GLM *xekul	PCh' *xukul	n

Item 143 is PCh' *7ub'-i 'to hear; to feel, notice', cf. PM *7ab'-i, PTz *7ab'iy. Kaufman & Norman (1984: 135) propose that '*a>u is assimilation to b' via [ä], also found in Yu [catecan]'.[11] In other words, according to those authors, *a would have assimilated to the rounding of *b', though it is not clear why it would have acquired a high place of articulation, that of *u, instead of a mid place of articulation, that of *o, if rounding had been the primary feature at play. Also, if it was assimilation to a following *b', it was a single, sporadic case: other roots with *a followed by *b' reconstructible to PCh' did not undergo such change (e.g. PCh' *7ab'äk 'charcoal', *chab' 'honey'). Instead, it seems more likely that PCh' *7ub'-i was the result of partial anticipatory VA to the height of the vowel in the following syllable: Pre-PCh' *7ab'-i > PCh' *7ub'-i.

At least one other case exhibits a similar pattern that is more suggestive of anticipatory VA: item #42, PCh' *b'ahläm 'jaguar', from PM *b'ahlam, is attested in Ch'ol, specifically, as *b'ajlum*, as well as both *b'aläm* (Tapotzingo) and *b'alum* (San Carlos) in Yokot'an/Chontal (Knowles 1984: 170, 192, 394; Keller & Luciano 1997: 39), suggesting that this is a WCh' trait (in variation with **b'aläm*), or perhaps that it was diffused between some varieties of Yokot'an (e.g. San Carlos) and Ch'ol after the differentiation of WCh'. The form appears in Ch'ol texts as *i+b'ajlum-lel* (Whittaker & Warkentin 1965: 93, 94, 95), translated as 'tiger spirit', derived by means of the suffix *-lel*. The suffix in question exhibits four allomorphs in Ch'ol: *-el*, *-il-el*, *-al-el*, and *-lel* (Aulie and Aulie 1978: 31, 35–6, 42, 49, 55–6, 64, 65, 109, 130). Some contemporary cases of *-lel* can be traced to historical cases of both *-il-el* and *-al-el*. (In Yokot'an the suffix is now uniformly *-le(l)*, whereas in Ch'ol the contracted allomorph is still undergoing generalization.) It may not be possible to know with certainty, but it is plausible that *b'ajlum-lel* is in fact /b'ajläm-il-el/ in Ch'ol or *b'ajläm-il-el in Pre-Ch'ol, and if so, the /i/ of the suffix sequence could have triggered anticipatory VA. Evidence for a suffix *-il* with the term 'jaguar' is found in Tzeltalan and Yucatecan, suggesting this could be a Greater Lowland Mayan trait.[12]

[11] Kaufman with Justeson (2003:212) have recently noted that the form *7ub'i is a LM term, attested with the assimilation in question in all four Yucatecan languages in addition to the Ch'olan languages. It is possible that Ch'olan may have been the starting point, given the greater prestige of Ch'olan speakers within the context of the Lowland Mayan area (Justeson et al. 1985), but this cannot be proven at this time.

[12] For Tzeltalan, Polian (2015: 46) attests to the term *balam-il* 'jaguarness; of/as jaguar(s)' in the Tenejepa Tzeltal dialect. Three of the four Yucatecan languages bear a form like Ch'ol *b'ajlum*: Lakantun *barum*, Itzaj *b'alum*, Mopan *b'aalum* (Kaufman with Justeson 2003: 594). Yucatec exhibits *b'áalam*. Itzaj exhibits a term *u-b'alum-il k'ab'-naab'* 'shark (lit. its-jaguar-inanimate.possessor sea)' (Hofling with Tesucún 1997: 164), where the vowel of the suffix *-il* provides evidence for a VA analysis.

Table 4 also includes four examples (cited earlier, cf. section 2.3) argued by Kaufman & Norman (1984: 86) to be cases of analogical reanalysis: items 14, 16, 18, and 54. As those authors point out, a process of reanalysis has likely taken place, rather than VA: it appears that the requirement for reanalysis is that the derived form consist of three syllables, underlyingly. Items 14, 16, and 54 all exhibit this condition prior to the application of vowel syncope in the second syllable (items 16 and 54); note that item 54 is not reconstructed with vowel syncope, but it abides by the three-syllable condition. That VA is not at work can be seen in the form *chab'-ij 'in two days', which does not exhibit evidence of raising VA despite a following syllable with a high-front vowel. If anticipatory VA were in play, one would expect to see chäb'-ij* in addition to *chäb'-ij-i; and one would expect to see also 7äk'in* in addition to *7äk'n-i. The reanalysis proposal by Kaufman & Norman (1984: 86) remains the better solution for three of these four items, the only possible exception being 18, where a two-step process can be envisioned on the basis of a Pre-Ch' *[ä] or PCh' *ä: *7alas > *7alas + -i > *7aläs-i (partial raising VA of second *a in anticipation of following *-i) > *7äläs-i (total VA of first *a to following *ä).

Items 56-57 appear to have undergone VA during PM times: Kaufman with Justeson (2003: 1473) reconstruct PM *kaanh-ib' 'four', *u-kaanh 'fourth (lit. its-four)', *koonh-eej 'in four days', and *koonh-eej-eer 'four days ago'. The derived forms, those taking derivational suffixes (i.e. *-eej, *-eej-eer), exhibit anticipatory VA, specifically raising to mid position, influenced by the mid position of the front vowel *ee.

But interestingly, the form *kaanh-ib' 'four', which takes a suffix *-ib' (~ *-iib' ~ *-oob' ~ *-uub') used with some cardinal numerals above *jun 'one', does not exhibit VA.[13] The main difference between these sets of examples is that between inflection (*-ib') and derivation (*-eej, *-eej-eer). Kaufman (1972: 99) reconstructs PTz *chan-ib' (Tzeltal) or *chan-eb' (Tzotzil) as 'four', although Kaufman & Norman (1984: 137) list only *chan-ib', and *chon-ej 'in four days' and *chon-j-ey 'four days ago'. Those authors reconstruct PCh' *chän= 'four', *chun-ij 'in four days', and *chun-ij-i 'four days ago' (Kaufman & Norman 1984: 137, 138). The PCh' form exhibits two cases of vowel raising of *ee > *ii > *i: PM *-eej > Pre-Ch' *-iij > *PCh' *-ij, and PM *-eer > PGTz *-eey > Pre-Ch' *-ii > PCh' *-i. And it also attests to a case of the vowel raising of *oo > *uu > *u: PM *koonh-eej(-eer) > PGTz *choon-eej(-eey) > PCh' *chun-ij(-i). It is possible, though, that anticipatory raising VA could have occurred, at least in the case of the root */chan/ 'four', when followed by the derivational suffixes: Pre-Ch' *chon-iij(-ii) > Pre-Ch' *chun-iij(-ii) > PCh' *chun-ij(-i). This example also provides evidence for a relative chronology: the *ee > ii shift may precede the *oo > uu shift.

In the examples in Table 5 raising VA was total, and also triggered by the following vowel, which in two cases (133, 142) is part of a derivational suffix, *-in, which derives adjectives from verbs or verbal/active nouns. Item #18 has already been discussed with regard to the vowel of the second syllable, cf. Table 4. Here it is suggested that the vowel of the first syllable experienced total anticipatory VA to that of the second syllable. Item 133 corresponds to PCh' *xihin 'disgusting'. Kaufman & Norman (1984: 136) suggest a historical derivation, 'Perhaps *xeeh + in' and add 'See *xeh (628),' which refers to PCh' *xeh 'puke, vomit', reconstructed to PM as *xeeh by those authors, and to PTz by Kaufman (1972) as *xeh 'vomit' and *xeh-en 'to vomit'. Thus, those authors were implying a process of anticipatory VA based on the vowel of the derivational suffix *-in. Kaufman with Justeson (2003: 253) reconstruct *xeh 'vomit' to 'GLL+' (GLM plus Tojolab'al, Chuj, and Tuzantek), and the

[13] Kaufman (2015b: 105–6) describes NUMERAL-V(V)b' constructions as 'generic numerals', that is, numeral words used without a numerical classifier or measure word. He surmises that 'The suffix has the general shape -Vb', with an unpredictable vowel which nevertheless agrees across subgroups (or it has an invariant shape -eb' or -e7, a patent innovation)'. He also notes that it is not used with 'one' 'in most languages, because its original meaning probably implied plurality (cf [sic] pM *eb' "third person plural Absolutive pronoun marker")'.

Table 5. Total anticipatory (raising) VA in Ch'olan.

Item no.	Gloss	Source	Changed form	Class
133	disgusting	GLM *xe(e)h-in	PCh' *xih-in	a
18	to play with	PCh' *7alas > 7aläs-i >	PCh' *7äl(ä)s-i	v
142	warm	PCM *q'ax-in > GLM *q'ix-in	PCh' *k'ix-in	a

Table 6. Total anticipatory (backing and raising) VA in Ch'olan.

Item no.	Gloss	Source	Changed form	Class
37	home	PM *7atyooty	PCh' *7otot	n
110	basilisk	PM *t'eel > PCh' *t'el 'cockscomb' + -Vk (-ok?)	PCh' *t'ohlok	n

transitive derivation *xeh-e 'to vomit' to WM based on Ch'olti', Tzeltal, Tojolab'al, Chuj, Tuzantek, and Q'eqchi'. It is worth noting that Tuzanteko is listed as having *xeeh*, and thus it is worth considering the possibility that the GLM+ form may have been *xeeh. Since Q'eqchi' has borrowed heavily from LM languages (Ch'olan, Yucatecan), it is also possible that instead of WM the form *xeh-e could be 'GLL+' instead.

The same derivational suffix is found in item 142, PCh' *k'ix-in 'warm', derived from *k'ix 'to get warm' (Kaufman & Norman 1984: 124). Further comparative evidence supports the form of this suffix as *-in, and the possibility that it also triggered anticipatory vowel assimilation of the root: Kaufman with Justeson (2003: 517) reconstruct the form *q'ix-in to 'GLL+' (GLM plus Tojolab'al, Chuj, Q'eqchi'), but they also reconstruct a form *q'ax.Vn to Q'anjob'alan Proper (based on Q'anjob'al, Tuzantek, Akatek) plus Poqom (Poqom, Poqomchi'). Indeed, while Q'anjob'al shows *q'axan* and Akatek shows *k'axan*, Tuzantek shows *q'axi7n* and Poqom and Poqomchi' show *q'axin*. Given the evidence from GLM+ and Q'anjob'alan Proper plus Poqom, we tentatively reconstruct a PCM form *q'ax-in (*q'ax.in in Kaufman's conventions to mark the suffix as derivational), which then underwent the shift of anticipatory VA, *q'ax-in > *q'ix-in within the GLM region, and perseverative VA among some of the other languages, *q'ax-in > *q'ax-an (Q'anjobal, Akatek). This suggestion supposes a relative chronology in which the anticipatory VA preceded the *q' > *k' shift of GTz: this is potentially supported by the Q'eqchi' form *q'ix(n)*, which, if borrowed from a GLM language, would have been borrowed after the VA change, but prior to the *q' > *k' shift.[14]

Table 6 presents two items as possible examples of total anticipatory VA. We only consider item 37, PM *7atyooty or *7atyuuty (Kaufman with Justeson 2003: 947) > PCh' *7otot 'house', to be a clear example of this process.[15] If Pre-PM was originally *7atyuuty, it is

[14] It seems plausible that Q'eqchi' did not borrow the form, but instead inherited PCM *q'ax-in, and then experienced anticipatory VA independently: Pre-Q'eqchi' *q'ax-in > Q'eqchi' *q'ix-in* > *q'ix* ~ *q'ixn-*. However, since Q'eqchi' borrowed heavily from GLM and LM, it is worth considering as a case of diffusion until evidence to the contrary, such as similar examples of anticipatory VA in Q'eqchi' not shared with the GTz languages, is documented.

[15] Previously, we had considered item 420, PCh' *pok 'toad', and specifically the Ch'ol form *(x-)pokok*, still included in Appendix 1, to be another example of total anticipatory VA given the PM form *peq' 'toad', itself attested in 399, PCh' *7ix-peke(h)k. But unlike item 378, PCh' *7otot, this item is problematic. As noted by John Justeson (personal communication, 2019), this item could be a case of partial reduplication based on a root *pok, given the Ch'ol form *(x-)pokok*, possibly exhibiting final reduplication, and the Ch'orti' form *popok*, possibly exhibiting initial reduplication. The data on this etymon presented in Kaufman with Justeson (2003: 646) is difficult to reconcile; add to this that the form may exhibit reduplication in some of the languages, and that it may also be onomatopoeic, and too many uncertainties have accrued to make it worth further speculation.

Table 7. Total and partial anticipatory (lowering) VA in Ch'olan.

Item no.	Gloss	Source	Changed form	Class
15	loose, drop	Pre-PGTz *7i(h)q-(i)tay	PCh' *7äktä	v
29	fingernail, claw	PM *7iSk'aq	PCh' *7ehch'ak (~ *7ihch'ak)	n
68	anona/soursop	PM *k'iwex	PCh' *k'ewex	n

possible that the vowel of the second syllable may have undergone perseverative lowering VA, based on the vowel *a of the first syllable, resulting in PM *7atyuuty ~ *7atyooty. But whatever the case may be for the Pre-PM and PM stages, the PCh' form *7otot can be said to be the result of total anticipatory VA. Ancient Mayan texts attest to three forms: **ya**-HOUSE-**ti** presumably for *y-atot* (Oxkintok Lintel 2: B3, Oxkintok Palacio Ch'ich' Lintel; Rio Azul Tomb 6 Mural Text, all three dated to the Early Classic period, between CE 250–550); **yo**-HOUSE-**ti** and **yo-to-ti** for *y-otot* (many spellings throughout lowlands, starting around CE 360–378 and thereafter); and **yo-to-che** for *y-otoch* (Xcalumkin Column 4: A3a, dated to CE 753). First, the **yo-to-che** spelling: this form attests to a Yucatecan form, cf. Yucatec *7otoch*, exhibiting the *t > ch/VCV__# shift proposed by Justeson et al. (1985: 15–16). However, despite those authors' suggestion that the shift was a Terminal Classic (ca. CE 800–900/1000) to Early Postclassic (ca. CE 900/1000–1200) innovation, the Xcalumkin spelling dates to CE 753 (Grube 1994). Moreover, the spelling attests to the form known for Yucatec, Itzaj, and Mopan, but not the Lacandon form, *7ato(o)ch*; this suggests that Proto-Yucatecan may have exhibited *7atoch ~ *7otoch. The spelling **ya**-HOUSE-**ti** could point to a Pre-Ch' form *7atoot, prior to VA, or to a Pre-Yu or PYu form *7atoot, prior to both the *t > ch shift, and VA. The spellings showing **yo**-HOUSE-**ti** and **yo-to-ti** point to PCh' *7otot as the most likely source: it is now widely accepted that the most conservative spellings in Mayan texts exhibit Ch'olan innovations overall; and the form *7otot is pan-Ch'olan, whereas Yucatecan exhibits both *7otoch (Yucatec, Mopan, Itzaj) and *7atoch (Lacandon). It is also possible that Pre-Yu or PYu speakers may have borrowed PCh' *7otot prior to the *t > ch shift, and that both the native Pre-Yu *7atoot and the borrowed form *7otot then underwent the *t > ch shift together.

Item 110, PCh' *t'ohlok 'basilisk', a species of crested lizard, is very likely derived from PM *t'eel 'cockscomb' plus a derivational suffix of the shape -*Vk*, itself probably of the shape -*ok*, in order to account for the two vowels of the PCh' term. This is a hypothesis pending documentation and illustration of more cases of such a presumably derivational suffix.

In Table 7, only one form involves a suffix, 15; the other two examples, 29 and 68, involve disyllabic roots. Item 15, PCh' *7äk-tä 'to loose, drop', is reconstructed by Kaufman (1972: 104) to PTz as *7ihk-itay 'dejar, abandonar (to leave behind)'. Kaufman with Justeson (2003: 838) reconstructs it as a GTz term #7iq.ta (i.e # 7iq-ta), with '#' used to indicate likely diffused term. Assuming for now that #7iq-ta is actually *7iq-ta, the PCh' form could be a result of total anticipatory lowering VA: Pre-GTz *7iq-ta > Pre-Ch' *7ak-ta > PCh' *7äk-tä. The last step suggests that the first vowel would be an exception to the blocking conditions to the *a > *ä change proposed by Kaufman & Norman (1984: 85). Anticipatory raising VA could explain this exception: Pre-Ch' *7ak-ta > early PCh' *7ak-tä > late PCh' *7äk-tä. Like other cases of anticipatory VA, this case appears to be suffix-controlled, in this case involving PCh' *-tä 'superactive (transitivizer)' (Kaufman & Norman 1984: 144).

Item 29, a reflex of PM *7iSk'aq 'nail', was reconstructed by Kauman & Norman (1984: 119) as *ehch'ak, while adding that '*ihch'ak [*7ihch'ak] may be a better reconstruction'. We agree with their alternative proposal: Kaufman with Justeson (2003: 364) reconstruct this form to PM as *7iSk'aq, and it is more likely that PCh' inherited the form as *7ihch'ak, and

Table 8. Total anticipatory (raising and fronting) VA in Tzeltalan.

Item no.	Gloss	Source	Changed form	Class
37	body	*b'ak'-et(-al)	TZO b'ek'-et	n
92	griddle	GLM *sam-eht, PTz *samet	TZO semet	n
108	food	*wa7el	PTz *we7-el	n
110	hunger	*wa7in-al	PTz *wi7in-al	vn
109	to be hungry	*wa7in-aj	PTz *wi7in-aj	vi
66	warm > lukewarm	PCM *q'ax-in > GLM *q'ix-in > GTz *k'ix-in	PTz *k'ix-in	a
113	disgusting	GLM *xe(e)h-in	PTz (Tze) *xih-(i)n	a
63	anona/soursop	PM *k'iwex, PCh' *k'ewex	PTz *k'ewex	n

Table 9. Total anticipatory (mid-raising) VA in Tzeltalan.

Item no.	Gloss	Source	Changed form	Class
54	I	Pre-PTz *ha7-on	PTz *ho7-on	pro
120	you (singular)	Pre-PTz *ha7-ät	PTz *hä7-ät	pro
121	we	Pre-PTz *ha7-o-tik	PTz *ho7-o-tik	pro
50	you (plural)	Pre-PTz *ha7-ex	PTz *ho7-ox (analogy)	pro
3	unfortunate, disgraced	Pre-PTz *7ahb'ol	PTz *7ohb'ol (Tze)	a

that it was Ch'ol and Ch'orti' that innovated. The process evidenced by the Ch'ol and Ch'orti' forms, *-ehk'ach* ~ *-ehch'ak* and *-ejch'ak*, respectively, is one of partial anticipatory lowering VA: PGTz *7ihch'ak > PCh' *7ihch'ak > Ch'ol and Ch'orti' -ehch'ak. This form may have diffused between Ch'ol, after the differentiation of WCh', and Ch'orti', after the differentiation of ECh'; it is possible, however, that it was already present in PCh' as a variable form, *7ihch'ak ~ *7ehch'ak.

3.2.2. Tzeltalan

Table 8 illustrates cases of total anticipatory VA in Tzeltalan. All examples also exhibit anticipatory VA in Ch'olan (cf. Table 3). One example, 92, 'griddle', is shared by PCh'/Common Ch'olan and one individual Tzeltalan language, Tzotzil.[16] Another, 37, is shared by Tzotzil and Yokot'an/Chontal, suggesting the possibility of late diffusion or independent innovation. The rest (108, 110, 66, 113, 63) are shared by PCh' and PTz, and could therefore be PGTz innovations, or subsequently spread through diffusion between PCh' and PTz, or simply innovated independently in PCh' and PTz. We offer an assessment of these options in section 3.4.

Table 9 shows several cases where a central low vowel assimilates totally to a following *ä or *o. Two (items 54, 120, 121) involve reflexes of PM *ha7- 'demonstrative/pronoun base' in which the vowel of the base assimilated completely to the vowel of the following suffix. More specifically, PTz *ho7-on 'I' is likely derived from *ha7-on, following the reanalysis of *-on 'first person plural absolutive suffix' as 'first person singular absolutive suffix'; PTz *hä7-ät 'you' from *ha7 plus *-at 'second person singular absolutive suffix'; PTz *ho7-o-tik 'we' from *ha7 plus *-o[n] 'first person plural absolutive suffix' and *-tik 'pluralizer' (Mora-Marín 2009a: 122–4). Another, item 50, may be more easily explained by paradigmatic analogy

[16] While PTz also attests to the intransitivized form *wi7n-aj 'to be hungry', derived by means of PTz *-aj ~ *-ij (Kaufman 1972: 141), and even though PCh' can be reconstructed with a cognage morpheme, *-aj 'intransitivizer' (Kaufman & Norman 1984: 109), we did not find evidence for a direct cognate of PTz *wi7n-aj in Ch'olan.

Table 10. Partial perseverative (lowering and centralizing) VA in Ch'olan.

Item no.	Gloss	Source	Changed form	Class
7	dance/ing	GLM *7ahk'ut (or *7ahk'oot)	PCh' *7ahk'ot	vn
49	body	PCh' *b'äk'-et	CHT <bakat>	n
41	fright, fear	PCh' *b'ahk'-ut[a]	ACL <bakat>	n
55	lightning, thunder	PCh' *chahuk	CHN chawäk, CHT <chahac>	n
51	mouse	PM *ch'o7h > Pre-PCh' *ch'oh-Vk >	PCh' *ch'ohok	n

[a]Aulie & Aulie (1999: 9) list *b'äk'en* 'miedo (fear)' for Ch'ol, suggesting that a root *b'äk'-* is involved, and that Ch'ol has replaced an earlier suffix *-*ut* with *-en*.

(Mora-Marín 2009a: 124). A fourth example, item 3, PTz *7ahb'ol -b'ah (Tzo) or *7ohb'ol -b'ah (Tze) '(one) is disgraced' (Kaufman 1972: 93), may be present, but is not unambiguous: no outside cognates are known, and thus it is not certain what the PTz form would be. It is much simpler to suppose PTz *7ahb'ol, with Tzeltal undergoing anticipatory VA to *7ohb'ol*, than to suppose PTz *7ohb'ol, which would leave, on its own, no obvious basis for deriving *7ahb'ol* in Tzotzil.

3.3. Perseverative VA

3.3.1. Ch'olan

In Ch'olan, most cases (10/19) of this type of VA involve disyllabic roots with possible (unproductive, derivational) suffixes of the general shapes -*Vt* and -*Vk* (or -*Vk* < *-Vq). All are nouns, one of them specifically a verbal noun, i.e. a noun denoting an activity ('dancing'). If the second syllables contain, in fact, a suffix, they would constitute examples of unproductive suffixes in PCh' (and probably earlier); it is simply not possible to reconstruct these lexemes without such presumed suffixes, except for the case of 121, PCh' **ch'ohok* 'mouse', in Table 10, which, based on pan-Mayan data, can be reconstructed to PM **ch'o7h*, lacking a suffix; the /ok/ sequence in PCh' **ch'ohok* is innovative and unaccounted for, and could very well have had a vowel other than /o/ originally. In any case, these are all instances of the vowel of the first syllable serving as the trigger, and the vowel of the second syllable serving as the target of VA. With two possible exceptions, 18 and 39, none of the vowels in either syllable was long (or glottalized). However, with both cases it is possible (18) or probable (39) that the vowel had already merged with plain vowels prior to the implementation of VA.

Table 11 presents several examples of total perseverative raising, involving fronting or backing. One of the cases is tentative, hence the parentheses: 40 was reconstructed by Kaufman & Norman (1984) to PC as *7uyuj, and by Kaufman (1972) to PTz as *7uyoj, though the PTz reconstruction was later revised in Kaufman & Norman (1984: 135) to PTz *7uyuj ~ *7uyoj. Based on the PTz form *7uyoj, a plausible scenario involving perseverative VA can be presented, involving a reconstructible PGTz form *7uyoj changing to *7uyuj by PCh' times, and perhaps independently (or through contact with Ch'olan varieties) also occurring in some varieties of Tzeltalan. The rationale for this assessment lies in the idea that it is more likely that a form [7uyuj] could be obtained from [7uyoj] through VA, than the reverse, a form [7uyoj] arising out of [7uyuj]. However, after consulting Kaufman with Justeson's (2003: 568) entry, where they reconstruct the form as WM *wayuC, a case could be made that PCh' *7uyuj and PTz *7uyuj could have arisen from anticipatory VA starting with a disyllabic form *wayuC. There are issues that complicate just about any scenario, including the fact that in Tzeltal of Bachajon the attested term is *woyo7*, while in Tzeltal of Tenejepa one finds *7uyoj* (Polian 2015: 719, 747). This variation points to the possibility of diffusion, and thus complicates matters. Even more importantly, there exist unexpected, irregular sound

Table 11. Total perseverative raising (fronting or backing) VA in Ch'olan.

Item no.	Gloss	Source	Changed form	Class
52	castor bean	PCM *ty'up-aq	PCh' *ch'upu(h)k	n
24	raccoon	WM *7ehmaC > PCh' *7ehmäch	CHL *7ejmech*	n
44	small	WM+Yu *b'ik'et >	PCh' *b'ik'it	n
34	woman	PM *7ix-oq	PCh' *7ixik	n
75	to prune	PCh' *kehk-ä	CHR *kejke*	v
76	shoulder	PCh' *kehl-äb'	CHR, CHT *kejleb'*	n
136	brush, the bush	PCM *k'opat	PCh' *k'opot	n
104	black powder	GLM+ *sib'aq, etc. < *sii7=b'aq or *sib'.aq	PCh' *sib'ik	n
126	danta, tapir	GLM *tzimen	PCh' *tzimin	n
(40	kinkajou	PGTz *7uyoj	PCh' *7uyuj	n)
130	man, person, people	PM *winaq (or *win-aq?)	PCh' *winik	n
135	horn	Pre-PCh' *xuk-ab'	PCh' *xuk-ub'	n
137	horn	Pre-PCh' *xul-ab'	PCh' *xul-ub'	n
135	dragonfly	LM *tuhli7x	PCh' *tuhlux	n

correspondences among the languages attesting to this term (e.g. PCh' *7, PTz *7, Q'anjob'alan *w, Mamean *w; PCh' *j, PTz *j, some Q'anjob'alan *b'; etc.), which could suggest that two etyma could ultimately be involved, rather than just one. Due to these complications and uncertainties, we exclude this etymon from our broader conclusions below.

Of the remaining examples in Table 11, a few others merit discussion. Item 76, exhibits variation within Ch'ol as *kejlob' ~ kejlo7 ~ kejlab'*, innovations from PCh' *kehläb', but a uniform form in Ch'olti' and Ch'orti', *kehleb'*; the latter form points to PECh' *kehleb'. There is no cognate in Chontal/Yokot'an. The PCh' form *kehläb' can be analysed as *kehl-äb': it includes the derivational suffix *-äb' 'instrument' (Kaufman & Norman 1984: 145). The Ch'olti' and Ch'orti' forms exhibit perseverative VA and are pretty straightforward. The Ch'ol forms are difficult to explain: the form *kejlab'* does not abide by the restrictions on synchronic occurrences of PCh' *ä, as it is neither 'initial' nor 'adjacent to *j* (whether from **h* or **j*)' (1984: 85); the form *kejlob'/kejlo7* would involve backing of PCh' *ä, which would not be an assimilatory process, but perhaps dissimilatory a way of distancing PCh' *ä further from *e in the first syllable.

Also worth discussing is 104, which Kaufman & Norman (1984: 130) reconstructed as PM *sib'(-aq), but Kaufman with Justeson (2003: 506) have revised to GLM+ *sib'aq, etc. < *sii7=b'aq or *sib'.aq, implying that they analyse it as a widely diffused form, rather than a Proto-Mayan form. The term is attested in Epigraphic Mayan as **sa-b'a-ki** and **sa-b'a-ka** in the Postclassic (CE 900–1521) Dresden Codex (29b, 30b), forms that agree with the Yucatecan form (e.g. Yucatec *sab'ak* 'soot'), but not the Ch'olan form. To our knowledge there is no attestation, so far, of **si-b'i-ki** spellings documenting the Ch'olan form, or **si-b'a-ki** pointing to the GLM form. The PCh' form *sib'ik can be argued to be a case of perseverative VA based on the GLM+ form *sib'aq.

The last example warranting discussion is 130, PCh' *winik 'person, man' from PM *winaq. It would appear to be a case of perseverative VA, but due to its common derivation by means of the addition of *-VVl abstractivizing (derivational) suffixes, especially suffixes of the shape *-iil, it could be the result of regressive VA to the vowel of such a suffix. In section 3.5 we discuss this possibility in more detail.

3.3.2. Tzeltalan

The forms in Table 12 are similar to the Ch' forms in section 3.3.1: they are di- or trisyllabic, and in almost all cases a derivational suffix (or inflectional suffix, in the case of the numerals),

Table 12. Total and partial perseverative (lowering and centralizing) VA in Tzeltalan.

Item no.	Gloss	Source	Changed form	Class
36	first	PTz *b'ahb'iy-el (Tzo) ~ *b'ahb'{i/a}y-el (Tze)	TZE b'ahb'ay-el	a
39	to walk, go, travel	PTz *b'eh 'road', PTz *b'eh-in (Tzo) ~ *b'eh-en (Tze)	TZE b'eh-en	v
45	death	PTz *cham 'to die', PTz *cham-ib'-al ~ *cham-eb'-al	PTz *cham-eb'-al	n
46	vertigo	PTz *chuwaj (Tzo) ~ *chawoj ~ *chawaj (Tze)	TZE chawaj	n
74	end	PTz *lahj-ib'-al ~ *lahj-eb'-al	PTz *lahj-eb'-al	n
76	exit	PTz *lok'-ib'-al ~ *lok'-eb'-al	PTz *lok'-eb'-al	n
122	to wait	PTz *mahl-iy ~ *mahl-ay	PTz *mahl-ay	v
123	raw, green	PM *tze7h, PTz *tzeh- (TZO *tzeh-il*, TZE *tzeh-el*)	TZE *tzeh-el	a
115	to be completed, to be enough	PTz *tz'ak-ay ~ *tz'ak-iy	PTz *tz'akay	v
118	entrance	PTz *y-och-ib' ~ *y-och-eb'	PTz *y-och-eb'	n
28	three	PM *7oox-ib', PTz *7ox- (TZO *7ox-ib'*, TZE *7ox-eb'*)	TZE *7ox-eb'*	num
119	spicy	PTz *yah- (TZO *yah-il*, TZE *yah-al*)	TZE *yah-al*	a
56	seven	PM *huk-uub', PTz *huk-ub'	TZE *huk-eb'* (analogy)	num
114	purslane	PTz *xekul	TZE xekol	n
(96	basilisk	PM *t'eel + -Vch?	PTz *t'ehlech	n)

whether productive or unproductive, has undergone perseverative lowering and centralizing VA; if the suffix (or suffix sequence) is disyllabic, e.g. *-ib'-al*, it is the first syllable that has undergone the change.[17] That perseverative VA is responsible for the change in the suffix sequence *-ib'-al* > *-eb'-al* (items 45, 74, 76) can be established by means of external comparisons (e.g. Ch'orti' *lok'-ib'* 'exit', comparable to item 76, and suggestive of a PGTz *lok'-ib' 'exit'), and by comparing Tzeltalan cases reconstructible with *-ib'-al ~ -eb'-al* (45, 74, 76) with cases that exhibit only the first suffix in the sequence, *-ib'* > *-eb'* (cf. 118).[18] It is possible that 96, PTz *t'ehlech 'cuatete (basilisk)', likely based on PM *t'eel 'cockscomb', could constitute an additional example of perseverative VA, but it is not clear what the original vowel of the suffix *-Vch* might have been at this time.

Item 123 deserves mention. Kaufman (1972: 97) reconstructs this form as PTz *tzeh 'raw, green', but provides the diverging Tzeltal *tzeh-el* and Tzotzil *tzeh-il* forms. It can be traced to PM *tze7h. Kaufman & Norman (1984) reconstruct the Ch'olan cognate as *tzih, and they include it among the cases of the Ch'olan, whereby *ee, e7 > *ii > i shift. Based on Epigraphic Mayan, where the term is attested as **tzi-hi-li** (Boot 2009: 174), for *tzih-il*, it is clear that it

[17] That perseverative VA is responsible for the change seen in the suffix sequence *-ib'-al* > *-eb'-al* can be determined by means of external comparisons and by comparing Tzeltalan cases where assimilation has occurred with derived nouns that only exhibit the first suffix in the sequence, *-ib'* > *-eb'*, as well as by external comparisons. Ch'orti' (Ch'olan) *lok'ib'* 'exit' (i.e. *lok'-ib'*), derived by means of the same 'instrumental' suffix as Tzeltalan *lok'-ib'-al ~ *lok'-eb'-al, supports the existence of a GTz form *lok'-ib' 'exit', suggesting that the Tzeltalan variant *lok'-eb'-al is innovative. Also, while a form like *lahj-ib'-al ~ *lahj-eb'-al (or *lok'-ib'-al ~ *lok'-eb'-al) could at first glance seem ambiguous, since either the vowel of the syllable preceding the *-ib'* or the vowel of the syllable following it could be argued to have caused the *i of *-ib'* to have lowered to *e, the fact that the process occurs in forms lacking *-al, such as *y-och-ib' ~ *y-och-eb', demonstrates that it was the preceding vowel that triggered assimilation.

[18] While a form like *lahj-ib'-al ~ *lahj-eb'-al (or *lok'-ib'-al ~ *lok'-eb'-al) could at first glance seem ambiguous, since either the vowel of the syllable preceding the *-ib'* or the vowel of the syllable following it could be argued to have caused the *i of *-ib'* to have lowered to *e, the fact that the process occurs in forms lacking *-al, such as *y-och-ib' ~ *y-och-eb', demonstrates that it was the preceding vowel that triggered assimilation.

Table 13. Partial and total perseverative (raising and fronting) VA in Tzeltalan.

Item no.	Gloss	Source	Changed form	Class
34	small	WM+Yu *b'iq'et	PTz *b'ik'it	a
35	eleven	PM *juun=lajunh and PM *-eb' ~ *-ib', PTz *b'uluch-, TZE *b'uluch-ib'*, TZO *b'uluch-eb'*	TZE *b'uluch-ib'*	num
(111	man, people	PM *winaq	PTz *winik (cf. TZE winik-il-el 'body', TZO (numeral)+wink-il 'main part o the names of the 11th-through-14th scores of the indigenous calendar')	n)
30	tierno (tender, said of a baby)	LM+WM *7une… (from MZ)	PTz *7unin	a

could be attested with a suffix *-il*, just like the Tzotzil form *tzeh-il*.[19] Thus, it can be proposed that PGTz may have had a form *tze7h-iil, which experienced the following changes: PGTz *tze7h-iil > PTz *tzeh-il (*V7 > *VV > *V; *VV > V) > Tzeltal *tzeh-el* (perseverative VA). In turn, in section 4.1, we argue that the vowel of the suffix *-iil* may have influenced the vowel-raising change in Ch'olan via anticipatory VA.

At first, the forms for 'seven' (item 56), PTz *huk-ub' (Tzo) ~ *huk-eb' (Tze), would point toward a proposal of perseverative VA in Tzotzil. However, the reconstructed form in PM is *huuq-uub'. This means that it is more likely that Tzeltal applied *-eb'*, one of the allomorphs of the *-Vb'* default pluralizer of numerals (Kaufman 2015b: 105–6), analogically, reshaping *huk-ub' as *huk-eb'*. See discussion of item 35, 'eleven', below.

Table 13 lists three possible examples of perseverative raising VA. Items 34 and 111 are shared with PCh', and could therefore be shared innovations, traceable to PGTz *b'ik'it and *winik, respectively, or diffused between them after their differentiation. We return to this matter in section 3.4, and to the specific case of 111 in section 3.5. Item 30 involves raising and fronting of the second vowel in *7une… to PTz *7unin.

Item 35 is unfortunately ambiguous. The allomorphs *-ib', *-iib', *-oob', and *-ub' have been reconstructed to PM as default suffixes forming 'generic numerals' (Kaufman 2015b: 105–6). Kaufman with Justeson (2003) document the reconstructible PM allomorphs as follows: *-ib' with '2', '3', '4'; *-iib' with '6', '8'; *-oob' with '5'; and *-uub' with '7'. The allomorphs *-oob' and *-uub' would apply to a single case each: PM *ho7-oob' '5' and PM *huuq-uub' '7'. The allomorphs *-ib' and *-iib' seem to be the more generalizable, applying to roots with vowels *a or *aa, and *oo. Those authors do not actually reconstruct a form -eb'*, with Kaufman (2015b: 105) suggesting it is a later innovation. The cognate sets show the common occurrence of *-eb'* or *-eeb'* among some languages, and increasingly so beginning with the numerals '9' to '19'. For instance, for PM *b'elenh 'nine', the cognates in Greater K'ichee'an show *-eb'*, *-eeb'*, *-e7*, or *-ee7*; for the WM+LM form *b'alunh= 'nine', the suffix is also *-eb'* or *-e7*. Something similar applies to reflexes of PM *lajunh or *laajuunh 'ten': the suffix *-eb'* or *-e7* is attested in Tzeltalan and Greater Q'anjob'alan, while Greater K'ichee'an attests to *-eeb'*, *-eb'*, and *-iib'*. With PM *juun=lajunh 'eleven', *-eb'* and *-e7* appear with three Greater Q'anjob'alan languages while *-iib'* is found in one variety of Poqom. In Ch'olan,

[19] There exist at least seven spellings of **tzi-hi-li** or **tzi-hi-la** for *tzih-il* 'raw, fresh' in Epigraphic Mayan, functioning as adjectival modifiers of nouns referring to cacao-based drinks or foods, although perhaps twice they modify individuals' names. Five are present on texts on the following pottery vessels (K-numbers after photos by Justin Kerr (n.d.) in The Maya Vase Database at http: //research.mayavase.com/kerrmaya.html): K578, K4477, K4542, K4550, K9099. In addition, the spelling also appears twice on a pottery vessel from El Zotz (Looper and Polyukhovych 2016).

Table 14. Total perseverative (backing) VA in Tzeltalan.

Item no.	Gloss	Source	Changed form	Class
67	soft	PTz *k'un- (TZE *k'un ~ k'un-il*, TZO *k'un-ul*)	TZO *k'un-ul*	a
115	elbow	Cf. Pre-Ch' *xuk-äb'	PTz *xuhk-ub', later TZO *xuk'-ub'*	n

Tzeltalan, and Yucatecan an innovative, diffused term, *b'uluky 'eleven' was developed on the basis of **b'elenh=ka7 ('9' + '2'), according to Kaufman with Justeson (2003: 1485). Only the Tzeltalan languages, within the GLM region, attest to a suffix, specifically *-ib'* in Tzotzil and *-eb'* in Tzeltal. Similarly, for the WM *laj=ka7 ~ *laj=kab' 'twelve', all of the languages except for the one Ch'olan language that attests to it, Ch'ol, exhibit the suffix *-eb'* or *-e7*. In addition to the general tendency for *-eb' ~ -eeb' ~ -e7 ~ -ee7* to appear with numerals starting with '9', another important conclusion is that Yucatecan and Ch'olan have completely lost these *-Vb' ~ -VVb'* numerical suffixes, in what likely amounts to a LM innovation.[20] Based on the general tendency, we could propose that it is more likely that 'eleven' would have originally used *-eb'* in PTz, and that Tzotzil, specifically, experienced raising to *-ib'*.

Table 14 presents one possible case of total perseverative backing VA. Item 67 is reconstructed to PTz as *k'un- by Kaufman (1972: 107), who notes that Tzeltal attests to *k'un ~ k'un-il* and Tzotzil to *k'un-ul*. Kaufman with Justeson (2003: 1379) reconstruct the root as PCM *q'u7n. Unfortunately, there are not enough comparative data to determine whether *-il* (< *-iil) or *-ul* (< *-uul) is a more likely PTz suffix in this case, i.e. to determine whether PTz *k'un-il is more likely than PTz *k'un-ul. However, the form *-il* is the most common shape of the 'abstractivizer' suffix in Mayan languages, and this seems to be the general use of this suffix when used with *k'un*, as in *la jtabe sk'unil te lume* 'I found the softness of the ground/soil/land' (Polian 2015: 369), where *s-k'un-il* can be analysed as its-soft-ness. It thus functions as a possessed abstractivized noun based on *k'un* 'soft', and its possessor, *te+lum-e*, can be analysed as the+land-topic. Assuming this, the more likely scenario is that in Tzotzil the *-il* suffix experienced a vowel change to *-ul* due to perseverative VA. Item 115 is tentative: it is also present in Ch'olan as 'horn', analyseable as Pre-Ch' *xuk-äb' > PCh' *xuk-ub'. The Tzeltalan form, *xuhk-ub', suggests that the suffix *-äb' has already experienced perseverative VA. Whether this is a case of a shared innovation between Ch'olan and Tzeltalan traceable to PGTz times, or a borrowing from Ch'olan into Tzeltalan, is unclear.

3.4. Historical stages and conditioning factors

Tables 15 and 16 offer two alternative scenarios for the historical stages of specific instances of VA in the Ch'olan and Tzeltalan languages. They compile examples reconstructible to PCh', PTz, or PGTz only; items that experienced VA after the differentiation of PCh' and PTz are not included here, unless, in the case of Ch'olan, the change is represented in isolated languages from both branches (ECh', WCh'). In Table 15, several items are placed within parentheses when their status is somewhat uncertain, for reasons detailed in section 3.2 and section 3.3. Two items that almost certainly experienced VA, but for which it is not possible to determine whether it was anticipatory or perseverative, are among these: *winik from PM

[20] Epigraphic Mayan attests to a suffix applied to numerals in so-called Distance Number notations, but only when the counted entity was not explicitly mentioned. The suffix was spelled **-he-wa**, rather than the expected **-he-b'e**. As noted by John Justeson (personal communication, 2020), the spelling **-he-wa** could point to a suffix *-(h)ew*, with the *w* spelled by the syllabogram **wa** perhaps meant to represent a reduced form of /b'/ as [w']. But this is speculative for now, as none of the *-V(V)b'* numeral suffixes has been retained in any contemporary Ch'olan or Yucatecan language, the languages most closely affiliated with those of the ancient scribes

Table 15. Less conservative scenario.

Changes	PGTz	PCh'	PTz
Anticipatory VA	1. (*7uyuj) 2. *k'ewex 3. *k'ix-in 4. *we7-el 5. *wi7[-i]n-al 6. (*winik-iil) 7. *xi(i)h-in	8. *7äk-tä 9. *7eb'-(e)t-el 10. *7ehch'ak (~ *7ihch'ak) 11. *7otot 12. *7ub'-i(y) 13. (*7uyuj) 14. *chun-ij(-i) 15. *pek-e(h)k 16. *sem-e(h)t 17. (*t'ohl-ok) 18. *xinich 19. *xukul	20. *hä7-ät 21. *ho7-o-tik 22. *ho7-on 23. *tzemen
Perseverative VA	1. (*7ahk'ot) 2. (*7uyuj) 3. *b'ik'it 4. (*winik-iil)	5. *7ixik 6. (*ch'oh-ok) 7. *ch'upuk 8. *chah(ä/a)k (~ *chahuk) 9. *k'opot 10. *sib'ik 11. *tzimin 12. *xukub' 13. *tuhlux	14. *7unin 15. *cham-eb'-al 16. *lahj-eb'-al 17. *lok'-eb'-al 18. *mahl-ay 19. *tz'ak-ay 20. *y-och-eb'

Table 16. More conservative scenario.

Changes	PGTz or diffused between PCh'/PTz	PCh'	PTz
Anticipatory VA	1. *k'ewex 2. *k'ix-in 3. *we7-el 4. *wi7[-i]n-al 5. *winik-iil 6. *xi(i)h-in	7. *7äk-tä 8. *7eb'-(e)t-el 9. *7ehch'ak (~ *7ihch'ak) 10. *7otot 11. *7ub'-i(y) 12. *chun-ij(-i) 13. *pek-e(h)k 14. *sem-e(h)t 15. (*t'ohl-ok) 16. *xinich 17. *xukul	18. *hä7-ät 19. *ho7-o-tik 20. *ho7-on 21. *tzemen
Perseverative VA	1. *b'ik'it	2. *7ix-ik 3. *ch'upuk 4. *chah(ä/a)k (~ *chahuk) 5. *k'opot 6. *sib'ik 7. *tzimin 8. *xuk-ub' 9. *tuhlux	10. *7unin 11. *cham-eb'-al 12. *lahj-eb'-al 13. *lok'-eb'-al 14. *mahl-ay 15. *tz'ak-ay 16. *y-och-eb'

*winaq; and *7uyuj from either GTz *7uyoj or WM *wayuC. One item, *7ahk'ot is listed tentatively as a case of perseverative VA only if in fact it can be ultimately reconstructed as GLM *7ahk'ut. Another item, *t'ohlok, requires that we posit a suffix *-ok (or *-Vk) that cannot be confirmed at this time, but a suffix with such a shape is the more likely explanation given the basis of this form in a root *t'eel. Finally, *ch'ohok very likely came about through perseverative VA, but the lack of disyllabic external cognates for this form preclude confirmation. We have omitted item 46 in Tzeletalan, 'vertigo' (cf. Appendix 2), because there are no external cognates that would allow for a determination of direction of VA. Two sets of

Table 17. Cases of likely analogical change in Ch'olan and Tzeltalan. For Ch'olan item numbers see Appendix 1; for Tzeltalan see Appendix 2.

PCh'	PTz
54. *chäb'-ij-i	53. *ho7-ob' > ho7-eb' (Tze)
18. *7äl(ä)s-i?	56. *huk-ub' > huk-eb' (Tze)
14. *7äk'n-i	50. *ha7-ex ~ *ho7-ox
11. *7äk'b'-äl	60. *jay-ib'/-eb'

Ch'olan forms are reconstructed as likely exhibiting variation in PCh', item 29, *7ihch'ak ~ *7ehch'ak (from PM *7iSk'aq), and item 55, *chahuk ~ *chahak (from PM *kahoq). It is possible, though, that PCh' only had the more conservative froms, and that the innovative forms were diffused later between already differentiated Ch'olan varieties, as discussed further in section 3.6.

Table 16 eliminates most of the ambiguous or uncertain forms, except for one, *winik-iil, which is maintained in the anticipatory VA category for reasons described in section 3.5. In the more conservative scenario, all the forms reconstructed to PGTz could potentially have been diffused between PCh' and PTz.

Considering these examples, it is apparent that a majority of cases of anticipatory VA, 15/21, involve a suffixal vowel as the trigger. Most of the suffixes in question, 12/15, are derivational, with only three cases, all of them in PTz, involving inflectional suffixes (Tzeltalan items 18-20). Thus, most cases of anticipatory VA are suffix-controlled. With regard to Ch'olan, as far as perseverative VA is concerned, some cases likely involve derivational suffixes of greater (item 135, PCh' *xuk-ub') to lesser (item 34, PCh' *7ixik or *7ix-ik, from PM *7ix-oq) productivity, and one case (item 104, PCh' *sib'ik) involves a disyllabic form resulting from either derivation or compounding; nevertheless, a majority of Ch'olan cases (6/9) do not involve obvious suffixes, but instead, disyllabic roots. In contrast, in Tzeltalan, most cases (6/8) involve obvious derivational suffixes, and only two disyllabic roots. In both Ch'olan and Tzeltalan, perseverative VA is root-controlled.

Table 17 presents several cases that we initially considered as possible instances of VA, but which now seem more likely to be instances of analogy. The four Ch'olan examples were already proposed to be so by Kaufman & Norman (1984: 86), as already mentioned in section 2.3. We suggested that Ch'olan item 18 could be analysed as involving VA, but the analogical reanalysis proposal fits the evidence too. The Tzeltalan cases were discussed in section 3.2.2 and section 3.3.2.

Next, we consider cases of di- and trisyllabic forms that have not experienced VA. First, regarding Ch'olan, Appendix 1 lists thirty four items with differing vowels that did not experience VA. These thirty four cases include twelve instances showing an original i_a vowel template that did not experience VA. There are two cases with such a template that did experience VA: item 130, PCh' *winik, and item 104, PCh' *sib'ik, appear to show (perseverative) VA from an original i_a template (ignoring vowel length) to i_i, while In section 3.5 we argued that item 130 was the result of anticipatory assimilation to the vowel of a following suffix (most likely *-il* < *-iil), so that the actual pattern of relevance is a_i > i_i. This leaves PCh' *sib'ik, from GLM+ *sib'aq < *sii7=b'aq or *sib'-aq, as the only seeming exception to a constraint against VA in items with an original i_a template. No other patterns seem significant at this point. We considered intervening consonants or consonant sequences, but this also fails to be consistent. The aforementioned example, item 104, PCh' *sib'ik from GLM+ *sib'aq, is a case in point, as it underwent VA while item 26, PCh' *7ib'-ach, did not.

As far as Tzeltalan is concerned, a similar situation obtains. Appendix 2 lists thirty rwo items with differing vowels that did not undergo VA. The strongest pattern involves, as with

Ch'olan, an original i_a template (ignoring vowel length), with nine instances showing no VA, and only one, item 111, PTz *winik, exhibiting VA. Nonetheless, the same argument made for the counterpart in Ch'olan, that *winik assimilated to a following suffix (i.e. *winak-iil), applies in Tzeltalan, given the attested derivations *winik-il* and *winik-il-el*. In this light, the pattern in PTz is exceptionless: no cases with an original template i_a experience VA. As was also the case with Ch'olan, no consonantal patterns appear consistent enough at this time to merit mention.

Thus, it is clear that much more work is necessary to attempt a resolution in terms of phonological constraints. Perhaps frequency of use could play a role, in which case a corpus study might offer insights.

3.5. *Ambiguous Cases:* *winik

This item is a reflex of PM **winaq*. There are two possibilities: progressive assimilation of *a* in the second syllable to *I* in the first, or regressive assimilation of *a* in the second syllable to *I* in the third syllable of the term *winik-il(-el)*, as attested in Ch'ol, *winic-**lel*** ~ *winiqu-**il-el*** 'empleado (worker, employee)' (from *winic* 'hombre'). Epigraphic Mayan inscriptions most frequently show the term spelled **wi-WINAK/WINIK-ki-li**, **wi-WINAK/WINIK-ki**, **WINIK-ki**, **WINIK-la** (Boot 2009: 201). The problem with such examples is that a logogram (rendered in uppercase letters) is used in all cases to spell the root, and whenever a phonetic complement is available (e.g. **wi** or **ki**), it only provides evidence of the first two segments (i.e. *winik*/*winak*) or the final segment (i.e. *winik*/*winak*), and thus it is unclear whether *winak* or *winik* was intended.

Only two spellings provide a fully phonetic rendering. One spelling at Piedras Negras, first raised by Stuart et al. (1999: II–19), shows **7a-wi-na-ke-n(a)** for *a-winak-en* 'I am your man/servant (here)', where *a-* is glossed 'second person singular ergative/possessive' and *-en* 'first person singular absolutive', suggesting the form *winak* was still in use during the Classic period. The other, at Chichen Itza (Casa Colorada Inscription, Glyph 37) shows **XIII-wi-ni-ki-ji-ya** for *waxaklajun winik-(i)j-iy* 'eighteen months since/after', where *waxaklajun* means 'eighteen', *winik* is used with its meaning 'month (20 days)', and the enclitic sequence *-ij-iy* (*-ij* 'in the future', *-iy* 'in the past') means 'after/since'. Note that the spelling where the root is followed by the suffix *-en*, 'first person singular absolutive', which contains a mid-front vowel, is also the spelling pointing to a form *winak*; and note too that the spelling where the root is followed by the enclitic sequence *-ij-iy* 'since/after/ago', containing two high-front vowels, is the one pointing to a form *winik*. Thus, if we assume for the sake of argument that Epigraphic Mayan provides evidence of a relatively uniform Ch'olan linguistic variety, at least as the basis of conservative or standard spellings, such spellings point to a situation of allomorphy: *winak* was likely retained in isolation and when suffixed by -VC suffixes whose vowel was not /i/; *winik* was used when a suffix or enclitic with the vowel /i/ followed.

Either way, this term exhibits at least two *-iC* suffixes/enclitics, the suffix *-il* and enclitic sequence *-ij-iy*. The fact that the instance where it is unambiguously spelled as *winak*, with the vowel *a* in the second syllable, exhibits the suffix *-en*, with a mid-front vowel, while the instances where it is unambiguously spelled out as *winik*, with the vowel *i* in the second syllable, exhibit the suffixes *-il* and *-ij*, with a high-front vowel, supports the scenario involving suffix-controlled VA, and thus, anticipatory VA instead of perseverative VA.

3.6. *Continuities*

Table 18 attests to more recent changes, changes that followed the internal differentiation of both PCh' and PTz into their respective descendant subbranches (e.g. Ech', WCh') and

Table 18. Examples of post-PCh' differentiation changes. For item numbers see Appendix 1.

	Ch'ol	Acalan	Yokot'an	Ch'olti'	Ch'orti'
Anticipatory	29. 7ejk'ach < 7ejch'ak 42. b'ahlum(-(i)l-el)	53. <chele>	49. b'ek'et 53. che		29. 7ejch'ak
Perseverative	76. kehlob' 24. ejmech	41. <bakat>	55. chawäk	49. <bakat> 55. <chahac>	53. che 76. kejleb' 75. kejke 108. sukchij
Variable PCh' forms or late diffusion	29. 7ejk'ach < 7ejch'ak		55. chawäk	55. <chahac>	29. 7ejch'ak

Table 19. Post-PTz differentiation changes. For item numbers see Appendix 2.

Process	Tzeltal	Tzotzil
Anticipatory VA	3. 7ohb'-ol 96. t'ohlok 112. xinich	13. 7ek'en 37. b'ek'et(-al) 92. semet
Perseverative VA	21. 7ehch'ek ~ 7ehk'ech (~ 7ehch'ak ~ 7ehk'ach) 35. b'uluch-ib' 36. b'ahb'ay-el 39. b'eh-en 114. xekol 119. yah-al 123. tzeh-el	67. k'unul
Analogy	28. 7ox-eb' 53. ho7-eb' 56. huk-eb' 60. jay-eb'	60. jay-ib'
Possible diffusion from Ch'olan	96. t'ohlok (cf. PCh') 112. xinich (cf. PCh') 21. 7ehch'ek ~ 7ehk'ech (~ 7ehch'ak ~ 7ehk'ach) (cf. Ch'ol #29)	37. b'ek'et(-al) (cf. Yokot'an #49) 92. semet (cf. PCh')

languages (Ch'ol, Chontal, Ch'olti', Ch'orti'; Tzeltal, Tzotzil). Two of the etyma may have exhibited variation in PCh', as suggested in section 3.4 (cf. Tables 15 and 16): item 29 '(finger-) nail, claw' and item 55 'lightning, thunder'. But it is possible that the respective innovative forms may have diffused after the differentiation of the ECh' and WCh' branches.

Table 19 categorizes several changes in Tzeltal and Tzotzil that postdate the differentiation of PTz. Most have already been discussed in section 3.2.2 and section 3.3.2. Of particular interest here are the probable cases of diffusion from PCh'/Common Ch'olan or individual Ch'olan languages. For example, several dialects of Tzeltal exhibit forms like *7ehch'ak*, *7ehk'ach*, *7ehch'ek*, and *7ehk'ech* (Polian 2015: 183). These forms are very likely due to contact with Ch'ol, as there is significant bilingualism involving Tzeltal and Ch'ol in several communities. The starting point would have been Ch'ol *7ehch'ak ~ 7ehk'ach*, the latter variant showing metathesis of the middle and final stops, and once borrowed, Tzeltal speakers in some varieties applied perseverative VA, resulting in *7ehch'ek ~ 7ehk'ech*.

3.7. Local summary

Both the Ch'olan and Tzeltalan branches exhibit a pattern of anticipatory VA. In many cases, the vowel of the stem assimilates (wholly or partially) to the vowel of a common derivational suffix, such that, in most cases, the vowel change becomes lexicalized with the stem even when

the stem does not take the suffix that caused the assimilation, e.g. Ch'olan item 74, Yokot'an/Ch'orti' *che* < PCh' *cha7-le. It will be a topic for future work to determine the factors that conditioned total vs. partial VA.

In addition, there are lexemes that exhibit a pattern of perseverative VA. This tends to occur in di- and tri-syllabic stems that include a derivational suffix, and thus suggests that morphological conditioning factors play a role in the vowel assimilation processes of Proto-Ch'olan. There are of course lexemes in Appendix 1 that do not exhibit VA processes. Though it is beyond the scope of this paper to present a full analysis of these lexemes, we do note some promising patterns. Specifically, disyllabic lexemes with the vowel template i_a strongly resist VA in both Ch'olan and Tzeltalan, with only one clear exception. More generalizations likely await further analysis, but some narrow constraints will be presented in section 4.1 that show possible segmental blocking factors to vowel-raising processes in Ch'olan.

4. Ch'olan vowel-raising shifts and other related matters

*4.1. Ch'olan vowel raising: *oo > u, *ee > i*

More questions remain to be addressed: Can patterns of VA such as those identified in this paper explain some or even most of the cases of the so-called vowel-raising shift of Ch'olan, including those involving monosyllabic lexemes? Is it possible to define conditioning or inhibiting factors? As already noted in section 2.3, the conditions that promoted the shift, or those that blocked the shift, have proven difficult to define, as Kaufman & Norman (1984: 87) observe: 'It is important to note that this change is neither regular nor pervasive, i.e., there are more cases where it does not take place than where it does. However, the change, to the extent it occurs, has a uniform result within Cholan'. Also, worth emphasizing is the fact that Kaufman & Norman (1984) treat the mid-vowel raising as a single process for both sets of vowels.

As also noted in section 2.3, Brown and Wichmann (2004: 146, 152) have argued that PM *e/*E/*eh in their model, PM *ee/*eʔ in Kaufman & Norman's model, shifted to PCh' *i when conditioned by the presence of 'a stem-final fricative'. They also proposed that their PM *ooh, Kaufman & Norman's PM *oo/*oʔ, shifted to PCh' *u unconditionally. They thus treat each mid-vowel raising as a distinct process. Nevertheless, their stem-final fricative proposal does not apply to the following cases that Kaufman & Norman considered to be examples of the change: *=pik 'eight thousand' < *-peeq 'pataxte (type of cacao); 8,000'; *-i(y) < *-eer 'x [time] backward'; or *wich' < WM *weech' 'wing'. In addition, their claim that the *ooh > *u shift was unconditioned ignores cases of their proposed *ooh that did not experience the shift unconditionally, such as their proposed *koohnh 'four' (Kaufman's *kaanh- ~ *koonh-), which was inherited in PCh' both as *chan- and *chun-. If one abides by the previous model, most comprehensively in evidence in Kaufman with Justeson's (2003) etymological dictionary, there would be many cases – approximately 24 – where PM *oo/*oʔ (in Kaufman & Norman's model) did not experience the shift, and a very few – only nine cases – that did. Brown & Wichmann (2004: 152, note 19) are correct to take issue with the case of *chij < *chihj < pM *kehj 'deer', since by Kaufman & Norman's (1984) model this item should not have shifted, given that it bears i < *ih < *eh, not from *ee or *e7. To Brown & Wichmann (2004: 152, note 19), this case constitutes support for their contention of 'an underlying non-long vowel (**e* or **E*) rather than a long vowel (**ee*)' for the etyma that underwent this vowel raising change. However, this form is also attested in Tzeltalan as *chihj (Kaufman 1972: 100, item 166), and could very well constitute a PGTz form *chihj.

Below we offer a different alternative to explain the vowel-raising shifts, including the change in PM *kehj 'deer'. We carry out the following steps: we begin by introducing a

Table 20. Cases of PM *ee and *e7 reflected as PCh' *i or *e.

Item no.	PM	PCh'	Gloss	Class	Raising
1.	*b'eeh	*b'ih	road	adv	Yes
2.	*kehj	*chij	deer	n	Yes
3.	*-eej	*-ij	in the future	encl	Yes
4.	*-eer	*-i	in the past	encl	Yes
5.	PCM *peeq 'pataxte (type of cacao)'	*=pik	eight thousand	nc	Yes
6.	*tze7h	*tzih	raw	a	Yes
7.	WM *weech'	*wich'	wing	n	Yes
8.	LM *7ooj-eel	Ch'ol *7uj-il*, Yokot'an *7uw-i(l)*	to know	v	Yes
9.	*k'e7n	*ch'en	cave	n	No
10.	GLM *7eeq'	*7ek'	star	n	No
11.	*7eeh	*7eh	tooth	n	No
12.	*qeeb'	*keb'	belch(ing)	vn	No
13.	WM *keleem	*kelem	strong	a	No
14.	LM *meeT	*met	crown	n	No
15.	*nheeh	*neh	tail	n	No
16.	*tyee'	*te'	tree	n	No
17.	*teem	*tem	seat	n	No
18.	*t'eel	*t'el	cock(scomb)	n	No
19.	WM *xeh.e, GLM *xeeh?	*xeh	vomit(ing)	Vn, iv	No
20.	WM *xeep	*xep	kind of tamale; small people	n	No
21.	LM *xeex	*xex	shrimp	n	No
22.	*weex	*wex	trousers	n	No
23.	PCM *me7b'aa7 'bereft, poor'	*meb'a'	bereft (orphan, widow)	n	No

slightly revised dataset; then we examine the data for patterns that could point to conditioning or inhibiting factors; and finally, we consider the possibility that common or even exclusive suffixes associated with the roots and stems in question may have influenced the outcomes.

Tables 20 and 21 present the relevant data. Table 20 takes into account both Kaufman & Norman (1984) as well as Kaufman with Justeson (2003). An important issue was considered: for PCh' *xeh 'puke, vomit', Kaufman & Norman (1984: 136) had proposed PM *xeeh, but Kaufman with Justeson (2003: 251–3) have revised the PM reconstruction as *xa7 ~ *xa7w ~ *xab', and now reconstruct WM *xeh.e and GLM *xeh, the etymon of relevance for PCh' *xeh, without vowel length. We considered eliminating the example, but the cognates for GLM *xeh in Kaufman with Justeson (2003: 253) include Tuzanteko *xe: h*, which could support a GLM form *xeeh; we have retained this etymon, tentatively, pending future clarification. This means that there are seven cases that experienced vowel raising, and fourteen to fifteen that did not.

Table 21 presents the data relevant to cases of PM *oo, *o7 > PCh' *o, *u. Several revisions were necessary based on more recent reconstructions in Kaufman with Justeson (2003). Also, we were unable to verify the Lowland Mayan attribution of item *kox 'pava (bird species)' by Kaufman & Norman's (1984: 123), but it remains in the dataset tentatively. We have added GLM *qootz > PCh' *kutz among the examples exhibiting raising, which was not present in Kaufman & Norman's (1984: 123) data. Following Brown & Wichmann (2004), we have included LM *7ooj-eel 'to know', attested in Ch'ol as *7uj-il* and Yokot'an *7uw-i(l)* (Kaufman with Justeson 2003: 203), although Brown and Wichmann (2004) only cite Ch'ol, not Yokot'an/Chontal. We have excluded PCh' *k'ot 'to arrive elsewhere' (Kaufman & Norman

Table 21. Cases of PM *oo and *o7 reflected as PCh' *u or *o.

Item no.	PM	PCh'	Gloss	Class	Raising
24.	*koonh-eej	*chun-ij	in four days	adv	Yes
25.	LM *loot	*lut	twins	n	Yes
26.	*sootz'	*sutz'	bat	n	Yes
27.	GLM *qootz	*kutz	wild turkey	n	Yes
28.	*tooŋ	*tun	stone	n	Yes
29.	GLM *tzo7n	*tzun	body hair	n	Yes
30.	GLM *tzo7tz	*tzutz	head hair	n	Yes
31.	*7o7q'	*7uk'	to cry	iv	Yes
32.	*7oonh	*7un	avocado	n	Yes
33.	*7oox=	*7ux=	three	num	Yes
34.	*7amooch	*7a=much	toad	n	Yes
35.	LM *7ooj-eel	Ch'ol *7uj-il*, Yokot'an *7uw-i(l)*	to know	v	Yes
36.	*kooh	*choh	cheek	n	No
37.	#ch'ool	*ch'ol	ethnonym (ch'ol)	n	No
38.	*hoonon	*honon	bumblebee	n	No
39.	*jooj	*joj	heron	n	No
40.	*jo7l	*jol	head	n	No
41.	*q-o7nh	*kon (Ch'ol)	let's go!	Expl	No
42.	LM #koox?	*kox	pava (bird species)	n	No
43.	*q'oor	*k'oy	dough	n	No
44.	PM *moo7	*mo7	macaw	n	No
45.	*nooq'	*nok'$_1$	cloth(es/ing)	n	No
46.	Was+WM *nooq' 'animal'	*nok'$_2$	caterpilar	n	No
47.	*7ook	*7och	to enter	iv	No
48.	*7ooq	*7ok	foot	n	No
49.	PCM *7oonh-eer	*7on-i	formerly, long ago	adv	No
50.	*7oor	*7oy	house-post	n	No
51.	*7atyooty	*7otot	home	n	No
52.	PM *poom < MZ *poomɨ	*pom	copal incense	n	No
53.	PM *tyook'	*tok'	flint	n	No
54.	*t'oot'	*t'ot'	snail	n	No
55.	*7aj=tzoo7	*7aj=tzo7	tom turkey	n	No
56.	*xooch'	*xoch'	screech owl	n	No

1984: 87, 124) as it is reconstructible to PM *q'ot, with *o, not *oo (or *o7), and the same applies to PCh' *lok' 'to exit', which can be traced to WM+LM *loq', and PCh' *tokal 'cloud', which can be traced to PM *tyoq (not *tyooq). This leaves thirteen cases that experienced vowel-raising and 20 that did not.

Next, we review some constraints that could illuminate the phenomenon. Assuming that the two mid-vowels shifted as part of a single process, an obvious initial step in checking for conditioning or inhibiting factors consists of trying to identify (near) minimal pairs for comparison. One such example, the near miminal pair of PM *k'e7n > PCh' *ch'en and PM *tzo7n > PCh' *tzun: such examples would suggest that either prevocalic [k'] blocked the change, or prevocalic [tz] conditioned it. When PM *7aj=tzoo7 > PCh' *7aj=tzo7 is considered, it can be argued that [tz] in fact did not condition the change. Furthermore, the change never takes place after ejectives. Based on this, the following blocking rule may be proposed:

(1) Raising never happens directly after ejectives.

Another minimal pair, GLM *xeeh(?) > PCh' *xeh and PM *b'eeh > PCh' *b'ih, suggests that no words beginning with [ʃ] undergo the sound change. In fact, there is only one word beginning with a fricative in which the vowel raised: PM *sootz' > PCh' *sutz', which begins with [s]. Consequently, either [s] conditions the change while all other fricatives are blockers, or this word is an exception. The case of LM *7ooj-eel > P(W)Ch' *7uj-il (8 in Table 20, 35 in

Table 22. Common suffixes for items with raising. See Appendix 3 for details.

Item no.	PM	PCh'	Gloss	Contemporary languages	Epigraphic Mayan	Support outcome?
1.	*b'eeh	*b'ih	road	-i(l) -il	-il	Yes
2.	*kehj	Pre-Ch' *chihj > PCh' *chij (also PTz *chihj)	deer	-il	-il	Yes
3.	*-eej	*-ij	in the future	-i	-i(y)	Yes
4.	*-eer	*-i	in the past	—	—	—
5.	PCM *peeq 'pataxte (type of cacao)'	*=pik	eight thousand	—	*-ij-iy*	Yes
6.	*tze7h	*tzih	raw	—	-il	Yes
7.	WM *weech'	*wich'	wing	-ir -i'	—	Yes
8.	LM *7ooj-eel	Ch'ol *7uj-il*, Yokot'an *7uw-i(l)*	to know	-il -i(l)	—	Yes
24.	*koonh-eej	*chun-ij *chun-ij-i	in four days four days ago	PCh' *-ij PCh' *-ij-i	-ij-i	Yes
25.	LM *loot	*lut	twins	—	—	—
26.	*sootz'	*sutz'	bat	—	*-il*	Yes
27.	GLM *qootz	*kutz	wild turkey	—	—	—
28.	*tooŋ	*tun	stone	-il -ir	-il	Yes
29.	GLM *tzo7n	*tzun	body hair	-il	—	Yes
30.	GLM *tzo7tz	*tzutz	head hair	-el (cf. Yucatec *tz'o7otz-il* 'hairy')	—	No
31.	*7o7q'	*7uk'	to cry	PCh' *-el PCh' *-i PCh' *-esä	-esä -i	Yes? Frequency?
32.	*7oonh	*7un	avocado	Ch'olan <uniu> and Q'anjob'al <onew> (cf. Yucatec *7òon-il* 'avocado tree grove'; Ch'olan also exhibits *-Vl* < *-VVl* 'collectivizer' suffixes)	7u-ni-wa	Yes?
33.	*7oox=	*7ux=	three	PCh' *-ij-i: PCh' *-ij PTz *7ox-ib' < PGTz *7oox-ib' < PM *7oox-ib'	—	Yes?
34.	*7amooch	*7a=much	toad	—	—	—
35.	LM *7ooj-eel	Ch'ol *7uj-il*, Yokot'an *7uw-i(l)*	To know	-il -i	—	Yes

Table 21) shows an example of *ee > i after a fricative, [x] (<j>), which is the final consonant of the preceding morpheme, *7uj*. A second blocking rule follows:

(2) Vowel raising does not occur after fricatives (within the same morpheme). [s] may be an exception.

Finally, a third minimal pair, PM *nheeh > PCh' *neh and PM *b'eeh > PCh' *b'ih, suggests that PM *nh may have been a blocking segment; further review of the dataset would

Table 23. Common suffixes for items without raising. See Appendix 4 for details.

Item no.	PM	PCh'	Gloss	Contemporary languages	Epigraphic Mayan	Suffix(es) support (s) outcome
9.	*k'e7n	*ch'en	cave	-al < -aal -äl < -al	-al	Yes
10.	GLM *7eeq'	*7ek'	star	-ob'	—	—
11.	*7eeh	*7eh	tooth	-äl *-al*	-a(l)	Yes
12.	*qeeb'	*keb'	belch(ing)	-aj -e	–	Yes
13.	WM *keleem	*kelem	strong	-al < -aal	-al	Yes?
14.	LM *meeT	*met	crown	—	—	—
15.	*nheeh	*neh	tail	—	—	—
16.	*tyee'	*te'	tree	-el < -eel	-el	Yes
17.	*teem	*tem	seat	-el -eb'	*-al* or *-aal* *-ul* or *-uul*	Yes
18.	*t'eel	*t'el	cockscomb	-ok -ech	—	Yes
19.	WM *xeh.e, GLM *xeeh?	*xeh	vomit(ing)	WM *-e (.e)	—	Yes?
20.	WM *xeep	*xep	kind of tamale; small people	—	—	—
21.	LM *xeex	*xex	shrimp	—	—	—
22.	*weex	*wex	trousers	-äl -al	—	Yes
34.	PCM *me7b'aa7 'bereft, poor'	*meb'a'	bereft (orphan, widow)	/aa/ of second syllable	—	Yes
35.	*kooh	*choh	cheek	PTz *-il < **-iil	—	No
36.	#ch'ool	*ch'ol	ethnonym (ch'ol)	—	—	
37.	*hoonon	*honon	bumblebee	/o/ of second syllable	—	Yes
38.	*jooj	*joj	heron	—	—	—
39.	*jo7l	*jol	head	-äl -ir -oom	-oom	Yes
40.	*q-o7nh	*kon (Ch'ol)	let's go!	—	—	—
41.	LM #koox?	*kox	pava (bird species)	—	—	—
42.	*q'oor	*k'oy	dough	-em? -o?	—	Yes?
43.	PM *moo7	*mo7	macaw	—	—	—
44.	*nooq'	*nok'$_1$	cloth(es/ing)	-i(l)	—	No? Frequency?
45.	Was+WM *nooq' 'animal'	*nok'$_2$	caterpilar	-al -ol	—	Yes
46.	*7ook	*7och	to enter	-el -en -esä -i -V$_1$y: -oy	-i	Yes? Frequency?
47.	*7ooq	*7ok	foot	-eht -al, -el, -ol -i(l)	-e(l) -i(l) -ib'	Yes? Frequency?
48.	PCM *7oonh-eer	*7on-i	formerly, long ago	Homophony avoidance (avocado)		Yes
49.	*7oor	*7oy	house-post	-el < -eel -ir	—	Yes? Frequency?
50.	*7atyooty	*7otot	home	/a/ of first syllable -il < -iil -il-b'a 'plural'	yo-to-ti	Yes? Frequency?

(continued)

Table 23. (continued)

Item no.	PM	PCh'	Gloss	Contemporary languages	Epigraphic Mayan	Suffix(es) support (s) outcome
				-e(l) 'collective plural'		
51.	PM *poom < MZ *poomɨ	*pom	copal incense	-ol -tay -al	-*ol* or -*ool* -*al* or -*aal* -*oj* or -*ooj*	Yes
52.	PM *tyook'	*tok'	flint	—	-*al* or -*aal*	Yes
53.	*t'oot'	*t'ot'	snail	-il	—	No?
54.	*7aj=tzoo7	*7aj=tzo7	tom turkey	—	—	—
55.	*xooch'	*xoch'	screech owl	—	—	—

indicate that other nasals also blocked the change. But once again, as with the preceding blocking rule, a qualification must be made. Recall the case of 24 in Table 21, PM *koonh-eej > PCh' *chun-ij(-i): this case shows an example of the *ee > i shift, 3 in Table 20, immediately after PM *nh > PCh' *n, but this nasal phoneme is the final consonant of the preceding morpheme, not part of the morpheme (*-eej > *-ij) that experienced the shift in question. Hence, a third blocking rule follows:

(3) Vowel raising does not occur after nasals (within the same morpheme).

These three blocking rules account for half of the examples that did not undergo the shifts; the remaining examples require explanation. Having reassessed the dataset, and proposed some possible blocking constraints, we investigated the possibility that common suffixes associated with the relevant roots and stems could also illuminate the outcomes – both those of items with raising, seen in Table 22, and those without, seen in Table 23. The more complete datasets, including primarily from contemporary Ch'olan languages, but also including comparative examples from the two other subgroups making up the Greater Lowland Mayan contact region (Tzeltalan, Yucatecan), as well as relevant data from Mayan inscriptions, are found in Appendices 3–4.

Of the 20 examples of both types of vowel-raising (Table 22), 15 exhibit common or occasional suffixes with a vowel that would promote vowel-raising, while only one, PCh' *tzutz 'hair (of head)' does not, taking instead a suffix *-el*, which could have inhibited raising. Item 2, 'deer', underwent vowel-raising likely during GTz times, and is reconstructible as PGTz *chihj; thus, whatever change it experienced was likely not exclusive to Ch'olan.[21] For the four remaining examples we were unable to collect data to test the hypothesis. One case, PCh' *7uk' 'to cry', would typically take inflectional suffixes *-el* 'incompletive status' and *-i* 'completive status', with the former one likely inhibiting, while the latter likely promoting, raising; perhaps differential frequency of use (favoring *-i*, the completive status marker) could account for this.[22]

[21] Indeed, given its distribution (Ch'olan, Tzeltalan), with regard to 'deer' there are at least two alternatives to consider. One involves the influence of a suffix, in this case *-il* < *-iil, which could have induced anticipatory VA. The other, suggested by John Justeson (personal communication, 2019), would involve diffusion within the Greater Lowland Mayan area: Yucatecan **kehj > *kéej becomes diffused into GTz prior to the *k > ch of GTz; after GTz differentiate, *cheej becomes Pre-Ch' *chiij and then PCh' *chij. A third option is innovation due to anticipatory, suffix-triggered VA in either Ch'olan or Tzeltalan, followed by diffusion (from Ch'olan to Tzeltalan or vice versa). We favour the first option at this time, although a diffusion scenario is plausible.

[22] If *wich'* 'wing' is the same root as Ch'orti' *wich'*- 'to whip', then it is clear that Ch'orti' provides evidence of at least two suffixes with initial /i/ (Hull 2016: 487): *wich'-i'* 'to whip (derived transitive)'; *wich'-ir-san* 'to whip' (antipassive); *wich'-ir-nib'* 'goad stick' (instrument); and *wich'-i'-na* 'to be whipped' (passive of derived transitive).

Of the thirty six examples that did not undergo either type of vowel-raising (Table 23), 21 are correlated with contextual factors that would inhibit vowel-raising (e.g. an inhibiting vowel within the same root, or in a following suffix), with only three showing a suffix with a vowel that would have promoted it. For eleven examples we were unable to collect relevant data to test this hypothesis. Four of the twenty one examples mentioned are monomorphemic disyllabic roots in the dataset (PCh' *kelem, *honon, *7otot, *meb'a7) that could be accounted for on the basis of influence from the other vowel in the root: hence, a [-high] vowel-harmony blocking factor appears to be at work. One of these, 'home', provides evidence also of suffixes that could have either promoted (*-il*) or inhibited vowel-raising (*-el*). It is possible that one case, PCh' *7on-i 'formerly, long ago', could have been prevented from shifting in order to avoid homophony with PCh' *7un 'avocado', which underwent the shift (< PM *7oonh).

Regarding item 24, *koonh-eej > *chun-ij(-i), it would be hard to explain the raising here by referring to anything other than anticipatory VA, as in many other words raising does not happen after [k], for instance, in *keleem > *kelem, *kooh > *choh, *koox > *kox. Of course, it should be noted, the raising in *chun-ij(-i) is even more restricted: the root PM *kaanh > PCh' *chan was preserved without vowel raising in other environments, supporting anticipatory VA as responsible for the shift in *chun-ij(-i). This example also highlights a problem with Brown and Wichmann's (2004) analysis: they argue that Mayan roots with their proposed *ooh nucleus, such as their proposed *koohnh 'four', underwent the shift to *u* in Ch'olan unconditionally. But the fact is that PM *kaanh- 'four' did not undergo this shift unconditionally. This example is also crucial for the purposes of relative chronology, given that the PCh' *-ij 'in the future' and *-i 'in the past' adverbial enclitics (and their compounded form *-ij-i 'since/after/ago') also experienced the shift, cf. PM *-eej and *-eer), indicating that the *ee > i shift preceded the *oo > u shift. This is further supported by item 35, LM *7ooj-eel > WCh' *7uj-il (Ch'ol, Yokot'an), with *-il < *-eel following *7uj- < *7ooj-.[23]

We therefore find that the monosyllabic lexemes of Proto-Ch'olan provide further support for suffix-controlled anticipatory vowel assimilation as a phonological process within the Ch'olan branch that arose after its split from Proto-Mayan. We have identified segmental contexts that appear to block vowel raising. This approach is consistent with the conclusions of section 3, which demonstrated vowel assimilation processes in di- and trisyllabic stems in which both morphological structure and segmental environment play a role. As with the vowel assimilation processes discussed throughout section 3, we believe it will be fruitful for future work to explore these phonological processes in more detail to better understand the conditioning and blocking factors.

4.2. False starts, divergent developments

There is evidence for at least two instances of VA in Epigraphic Mayan that have not been documented in the modern Greater Tzeltalan languages – or the Yucatecan languages for that matter. The first involves a reflex of PCM *7ihq-atz 'cargo'. Two examples (Jonuta Panel, Piedras Negras Throne 1) show the spelling **7i-ki-tzi**, suggestive of a form *7ihkitz(-il)*, instead of the more common spellings **7i-ka-tzi** for *7ihkatz(-il)* 'cargo' and **yi-ka-tzi** for *y-ihkatz* attested in the spellings **7i-ka-tzi** (Boot 2009: 74). This term was preserved in Tzeltalan, cf. PTz *7ihkatz-il, item 124 (Appendix 2), but lost in Ch'olan and Yucatecan.

[23] The relative chronology proposed here would likely apply also to the case of Ch'olan <uniu> (32, Table 22), which likely arose from a form *7ooneew that experienced both *oo > u and *ee > i shifts, given the attested Q'anjob'al form <onew>.

A clearer example is the case of modern Yokot'an, which shows *7ib'* instead of *7eb'* for 'stair, ladder', from PCh' **7ehb'*. In Epigraphic Mayan the term for 'step' appears, when possessed, as **ye-b'u(-li)** (Copan Hieroglyphic Stairway Step, Naranjo Hieroglyphic Stairway 1 Block XI: W1) and **ye-b'a(-li)** (Yaxchilan Hieroglyphic Stairway 2 Step VIII: R2; Dos Pilas Hieroglyphic Stairway 4 Step II: J2, K2; Ek Balam Structure 1 Hieroglyphic Serpent: E) (Boot 2009: 62), the former possibly for *y-ehb'-ul*, and the latter for *y-ehb'-al*. The suffix *-ul* could have triggered the raising of *e* in *7ehb'* to *i* as a result of partial anticipatory VA to the height of the *u* of *-ul*; it may have been the source of Yokot'an *7ib'*; however, the attested spellings are in the eastern lowlands, rather than the western lowlands, and thus not in the area of contemporary Yokot'an speech. The form with *-al* would not have undergone raising.

5. Conclusions

First, there are distinct patterns of vowel assimilation, both anticipatory and perseverative, that are reconstructible to PCh' and PTz, and potentially their immediate ancestor, PGTz; some instances have occurred since the differentiation of PCh' and PTz, affecting individual, contemporary languages. Second, it is possible that some or all of the anticipatory VA changes attributable to PGTz were in fact Ch'olan innovations that diffused into Tzeltalan, given that on its own, Tzeltalan bears very few exclusive instances of this type of assimilation, whereas Ch' exhibits more instances not shared with Tzeltalan. Third, the line of investigation pursued here has proven useful in resolving the question of the Ch'olan vowel-raising shifts left open by Kaufman & Norman (1984), later addressed in part by Brown and Wichmann (2004). The results point to phonetic and morphophonological factors, that may have promoted or inhibited the 'shift'.

More specifically, we find overwhelming evidence that vowel assimilation was a productive phonological process. The most prevalent pattern in the available data is that low or mid vowels raise to match the height feature of another vowel in the lexeme; however there are also examples of vowels lowering, backing, fronting, or not changing, and these forms have made it difficult to generalize the phonological processes that were at work. We have demonstrated, partiularly in regard to the Ch'olan monosyllabic lexemes in Table 21, that there are patterns in the segmental context of vowels that do not undergo assimilation, and therefore we posit blocking rules that inhibit vowel assimilation. The Ch'olan data in Table 21 additionally supports the overall vowel assimilation analysis in that the raising of a mid-vowel in a monosyllabic root was likely conditioned by a suffix and persisted even when the root is not used with the suffix that originally conditioned the change.

Finally, much remains to be done to fully understand the vowel assimilation processes at work. Future work in analysing the conditioning and blocking factors of vowel assimilation will have implications for theories of the morphology-phonology interface, as there is evidence of suffix-conditioned vowel raising that was blocked in certain segmental contexts. In particular, more work needs to done to determing the role of prosody in the vowel assimilation processes. A more complete understanding of lexical and phrasal stress in the Mayan languages, specifically the Ch'olan and Tzeltalan languages, is likely to offer some insights. Similarly, a detailed comparison with cases of vowel assimilation in Yucatecan is called for, as it is very likely that some will be shared with Ch'olan and Tzeltalan (e.g. Yucatecan *winik 'man, person'), possibly as a result of interaction in the Greater Lowland Mayan area.

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Appendix 1: Ch'olan Di- or Tri-syllabic Roots and Stems

A total of 144 di- or trisyllabic forms are compiled from Kaufman & Norman (1984: 115-139) and Kaufman with Justeson (2003). Many Proto-Mayan (PM) reconstructions are updates or revisions based on the latter sources. Items are listed alphabetically, and item numbers are cited in the paper in the sections relevant to Ch'olan. The second column, 'PM', may include reconstructions to later stages (e.g. 'WM' for Western Mayan) or diffusion areas (e.g. 'LM' for Lowland Mayan or 'GLM' for Greater Lowland Mayan). Only vowel length and place of articulation are considered in the 'Original V' and 'Later V' columns. In the 'Assimilation' column the following abbreviations are used: VA for 'vowel assimilation' (thirty six cases), N for 'none' referring to forms with different vowels that did not experience VA (forty five), MON for 'monosyllabic' ancestral forms (six cases), N/A for 'not applicable' for cases where the vowels were identical in quality already (forty five cases), PERSV for 'perseverative' (fifteen to sixteen cases), and ANTIC for 'anticipatory' (nineteen to twenty cases).

No.	K&N no.	PM	PCh'	Class	Original V	Later V	Assimilation	Gloss
1.	152	7iinhaaj	(h)inaj	n	ii_aa	i_a	N	seed
2.	158a	(h)uulaa7	(h)ula7	n	uu_aa	u_a	N	guest
3.	003	7ab'aq	7ab'äk	n	a_a	a_ä	N/A	charcoal
4.	706	WM *7aab'ii	7ab'i	pt	aa_ii	a_i	N	it is said
5.	005	7ahiin	7ahin	n	a_ii	a_i	N	alligator
6.	688	WM+LM *7ahq'ol	7ahk'ol	rn	a_o	a_o	N	above
7.	018	WM+LL 7ahk'oot ~ 7ahk'ut	7ahk'ot	vn	a_oo, a_u	a_o	VA/persv	dance
8.	010	WM+LM+ *7ajq'.a	7ahkän	vn	a_a	a_ä	N/A	moan(ing)
9.	006	7ajn	7ajän	n	a_	a_ä	MON	roasting ear
10.	007	7aajaaw	7ajaw	n	aa_aa	a_a	N/A	king, lord
11.	014	7ahq'ab'	7ahk'äb', 7äk'b'-äl 'night', 7äk'b'-i 'yesterday'	n	a_a	a_ä	N/A Analogy	night
12.	015	7ak'	7ak'ach	n	a_	a_a	MON	turkey hen, chicken
13.	016	7aaq'a7l	7ak'al	n	aa_a	a_a	N/A	charcoal
14.	017	PCM 7aq'een ~ 7aq'iin	7ak'in, 7äk'n-i 'to weed corn'	vn	a_ee	a_i	N? Analogy	weeding corn
15.	011	GTz #7iq-ta	7äktä	tv	i_i_a	ä_ä	VA/antic	to loose, drop
16.	024	7al7iib'	7al(7)ib'	n	a_ii	a_i	N	daughter-in-law
17.	022	GLM+ 7aalaq'	7aläk'	n	a_a	a_ä	N/A	pet

APPENDIX 1: (continued)

No.	K&N no.	PM	PCh'	Class	Original V	Later V	Assimilation	Gloss
18.	023	7aala7s	7alas, 7äl(ä) s-i 'to play with'	n, tv	aa_a	a_a	N/A, Analogy	toy, game
19.	026	WM *7amay	7amäy	n	a_a	a_ä	N/A	flute
20.	031	7a7tz'aam	7atz'am	n	a_aa	a_a	N/A	salt
21.	034	7ar	7ayan	pt	a_	a_a	MON	there is/are
22.	131	7ab'-aaty-eel	7eb'(e)t-el	n	a_aa	e_e	VA/antic	messenger
23.	135	7ehq(') or 7ejq(')	7ehk'äl	adv	e_ä	e_ä	N	tomorrow
24.	137	WM *7ehmaC	7ehmäch, 7ejmech (Chl)	n	e_a	e_ä, e_e (Chl)	N, VA/ persv	raccoon
25.	685	7ety= ~ 7aty= 'fellow'	7et'ok	n/rn	e/a_	e_o	MON	companion; with, and
26.	162	7iib'	7ib'-ach	n	ii	i_a	N	armadillo
27.	164	7ikaaq'	7ichak'	n	i_aa	i_a	N	nephew, cousin
28.	165	7ikaan	7ichan	n	i_aa	i_a	N	mother's brother
29.	132	7iSk'aq	7ihch'ak ~ 7ehch'ak	n	i_a	i_a, e_a (Chl, Chr)	N, VA/ persv	claw, -nail
30.	170	GTz *7ihnam (cf. EM+ *7ix=na7m)	7ihnam	n	i_a	i_a	N	wife
31.	173	—	7ihti7an	n		i_i_a	N	man's sister
32.	175	7ihtz'iin	7ihtz'in	n	i_i	i_i	N/A	younger sibling
33.	696	—	7ila(-i)	pt		i_a	—	this
34.	177	7ix-oq	7ixik	n	i_o	i_i	VA/persv	woman
35.	176a	7ix-i7m < *7ix=e7m or *7ix.e7m	7ixim	n	i_i	i_i	N/A	grain corn
36.	374	7ojb'	7ojob' ~ 7ojb'-	n	o(_o)	o_o	N/A	cough
37.	378	7atyooty	7otot	n	a_oo	o_o	VA/antic	house
38.	597	Diffused from MZ *7uuma7	7uma7	a/n	u_a	u_a	—	deaf
39.	599	LL+WM *7une... (from MZ)	7une..	n	u_e	u_e	—	baby
40.	607	WM *wayuC	7uyuj	n	a_u	u_u	VA/antic or VA/persv	kinkajou

APPENDIX 1: (continued)

No.	K&N no.	PM	PCh'	Class	Original V	Later V	Assimilation	Gloss
41.	041	(xi7w)	b'ahk'ut, Acl <bakat>	n	—	a_u, a_a (Acl)	N, VA/ persv	fright, fear
42.	044	b'ahlam	b'ahläm, b'ahlum (Chl)	n	a_a	a_ä, a_u (Chl)	N, VA/antic	jaguar
43.	038	b'aqal	b'äkäl	n	a_a	ä_ä	N/A	corncob
44.	050	WM+Yu *b'ik'et	b'ik'it	a	i_e	i_i	VA/persv	small
45.	055	—	b'o7lay	n	—	o_a	—	spotted; jaguar
46.	671	b'elenh-eeb'	b'olon=	num	e_e	o_o	?	nine
47.	061	—	b'ulich	n		u_i	—	sweat
48.	673	GLM *b'uluky=	b'uluch=	num	u_u	u_u	N/A	eleven
49.	039a	WM+Yu *b'aq', WM *b'aq'-et	b'ak'et, b'ek'et (Yok), <bakat> (Cht)	n	a_e	a_e, e_e (Yok), a_a (Cht0	N, VA/ antic, VA/ persv	body
50.	108	kaj(aa)nh	ch'ajan	n	a_aa	a_a	N/A	rope, vine
51.	121	ch'o7h	ch'ohok	n	o	o_o	N, VA?	mouse
52.	128	PCM *ty'up-aq	ch'upu(h)k	n	u_aa	u_u	VA/persv	castor bean
53.	074	GTz *cha7-le	cha7-le, <chele> (Ac), che (Yok, Chr)	tv	a_e	a_e, e_e (Ac), e_ (Yok, Chr)	N, VA/antic	to do, make
54.	681a	GTz *cha7b'-eej-eey	chäb'-ij-i	adv	a_ee	ä_i	Analogy	two days ago
55.	071	kahoq	chahuk, chawäk (Yok), <chahac> (Cht)	n	a_o	a_u, a_ä (Yok), a_a (Cht)	N, VA/ persv	lightning, thunder
56.	683	koonh-eej	chun-ij	adv	oo_ee	uu_ii	VA/antic	In four days
57.	683a	koonh-ej-eer	chun-ij-i	adv	oo_ee	uu_ii	VA/antic	Four days ago
58.	146	hahlaaw	ha(h)law	n	a_aa	a_a	N/A	agouti, paca
59.	707	—	ha7el	pt		a_e	—	also
60.	147	*hat'is ~ *hat'ix ~ *hach'ix, etc.	ha7tzih	vn	a_i	a_i	N	a sneeze, sneezing

Appendix 1: (continued)

No.	K&N no.	PM	PCh'	Class	Original V	Later V	Assimilation	Gloss
61.	148	haya/um	hayäb'/m	vn	a_a/u	a_ä	N/A	yawn(ing)
62.	153	hoonon	hon(h)on	n	oo_o	o_o	N/A	bumblebee
63.	183	LM *jalal	jaläl	n	a_a	a_ä	N/A	reed
64.	189	jawan	jawän	n	a_a	a_ä	N/A	woman's sister-in-law
65.	204	pM *joCo…	jomoch'	n	o_o	o_o	N/A	cornhusk
66.	209	jukuub'	jukub'	n	u_uu	u_u	N/A	dugout
67.	244	GLM *k'aab'aa7	k'ab'a7	n	aa_aa	a_a	N/A	name
68.	258	k'iwex	k'ewex	n	i_e	e_e	VA/antic	soursop
69.	264	GTz *k'ojoj	k'ojoj	a	o_o	o_o	N/A	stinking
71.	272a	GLM #k'uk'um?	k'uk'um	n		u_u	—	feather
72.	218	GTz *kahlam	kahlam	n	a_a	a_a	N/A	jaw, chin
73.	217	MZ *kakawa (diffused)	käkäw	n		ä_ä	N/A	cacao
74.	220	PM *qanhaanh	känän-tä	tv	a_aa	ä_ä	N/A	to watch over
75.	222	—	kehkä, kejke (Chr)	tv		e_ä, e_e (Chr)	N, VA/ persv	to prune
76.	225	—	kehläb', kejleb' (Chr)	n		e_ä, e_e (Chr)	N, VA/ persv	shoulder
77.	226	WM+LM *keleem	kelem	a	e_ee	e_e	N/A	strong
78.	229	Yu #kisin 'devil'	kisin	n	i_i	i_i	N/A	shame
79.	234	—	kolom	vn		o_o	—	hunt(ing), game
80.	239	PM *kuhka7y (diffused)	kuhkay	n	u_a	u_a	N	firefly
81.	672	laajuunh	läjun=	num	aa_uu	ä_u	N	ten
82.	301	WM+LM+ luqum	lukum	n	u_u	u_u	N/A	worm
83.	312	mahtaan	mahtan	n	a_aa	a_aa	N/A	gift
84.	305	majaan	majan	n	a_aa	a_a	N/A	borrowing
85.	313	matzaab'	mätzab'	n	a_aa	ä_a	N/A	eyebrow
86.	316	me7b'aa7	meb'a7	a/n	e_aa	e_a	N	bereft (orphan, widow)
87.	332	—	muku(h)k	n		u_u	—	gunny sack
88.	354	—	nejep'	a		e_e	—	old man, half ripe < aged

APPENDIX 1: (continued)

No.	K&N no.	PM	PCh'	Class	Original V	Later V	Assimilation	Gloss
89.	358	nhii7	ni7-äl	n	ii_	i_ä	N	son-in-law
90.	394	PM *páta (from MZ *patajaC)	päta(h)	n	a_a	ä_a	N/A	guava
91.	395	pataan	patan	n	a_aa	a_a	N/A	work [Cht 'tributo']
92.	401	pehpen	pehpem	n	e_e	e_e	N/A	butterfly
93.	403	peteht	peteht	n	e_e	e_e	N/A	spindle
94.	405	—	pi7-äl	n		i_ä	—	companion, friend
95.	413	WM+LM *pixan	pixan	n	i_a	i_a	N	soul
96.	418	pojw	pojow, pojw-	n	o	o_o	N/A	pus
97.	427	MZ *puʔhuyu	pujuy	n	u_u	u_u	N	roadrunner
98.	444	saqb'iin	sahb'in	n	a_ii	a_i	N	weasel
99.	447	sakiil	säkil	n	a_ii	a_i	N	squash seed
100.	448	LM *saku7n	säkun	n	a_u	ä_u	N	elder sibling
101.	456	WM *sawin	säwin	n	a_i	ä_i	N	jealousy, envy
102.	458	GTz *seh.k.ub'	sehkub'	n	e_u	e_u	N	liver
103.	459	GLM *sam-eht	seme(h)t	n	a_e	e_e	VA/antic	griddle
104.	463	GLM+ *sib'-aq < *sii7=b'aq or *sib'.aq	sib'ik	n	i_a	i_i	VA/persv	soot, black powder
105.	465	—	sik'äb'	n	—	i_ä	N	sugar cane[a]
106.	468	siina7nh	sina(m)	n	i_a	i_a	N	scorpion
107.	476	LM *sot'-ot'	sot'ot'	n	o_o	o_o	N/A	liver
108.	—	saq=kiih	sukchij (Chr)	n	a_ii	u_i (Chr)	VA/antic	agave, rope
109.	489	—	sutz'ul	n		u_u	—	mahogany
110.	544b	*t'eel	t'ohlok	n	e_...	o_o	VA/antic	crested lizard
111.	490a	LM *taa7=q'iinh	tak'in	n	aa_ii	a_i	N	metal
112.	496	tyaq-i7nh	täkin	a	a_i	ä_i	N	dry
113.	692	—	tamal	rn	—	a_a	—	in(side)
114.	510	Cf. Q'eqchi' *tehlom* 'male'	tehlom	n		e_o	N	boy, girl
115.	524	—	tihti	tv	—	i_i	—	to shake

APPENDIX 1: (continued)

No.	K&N no.	PM	PCh'	Class	Original V	Later V	Assimilation	Gloss
116.	517	tiqaw	tikäw	a	i_a	i_ä	N	hot
117.	521	GLM *tyiinh-am	tinäm	n	ii_a	i_ä	N	cotton
118.	527	GTz+ *tyoq (-al)	tokal	n	oo_a	o_a	N	cloud
119.	537	LM *tuhli7x	tuhlux	n	u_i	u_u	VA/persv	dragonfly
120.	700	tu	tuk'a~	pt	u(_)	u_a	MON	what
121.	535	tuq'ub'	tukub'	n	u_u	u_u	N/A	hiccups
122.	588	tz'uunu7n	tz'unun	n	uu_u	u_u	N/A	hummingbird
123.	589	tz'usub'	tz'usub'	n	u_u	u_u	N/A	grape
124.	590	tz'utuuj	tz'utuj	n	u_uu	u_u	N/A	corn tassel
125.	560	tzima(7)	tzima(h)	n	i_a	i_a	N	gourd
126.	520	GLM *tzimen	tzimin	n	i_e	i_i	VA/persv	mountain cow, tapir
127.	670	waqxaq-iib'	waxäk=	num	a_a	a_ä	N/A	eight
128.	612a	wa7-eel	we7-el	n	a_ee	e_e	VA/antic	meat
129.	612b	wa7inh(-aal)	wi7nal	iv	a_i	i_ø_i	VA/antic	hunger
130.	620	winaq	winik	n	i_a	i_i	VA/antic or VA/persv	Man
131.	634	xi7(w) ~ xib'	xib'a(h)	n	i	i_a	MON	devil, witch; hell
132.	635a	xih-ab'	xihäb'	instr	i_a	i_ä	N	comb
133.	636	xe(e)h-in	xihin	a	ee_i	i_i	VA/antic	disgusting
134.	637	sanik	xinich	n	a_i	i_i	VA/antic	ant
135.	644a	Pre-Ch' *xuk-äb	xukub'	instr	u_ä	u_u	VA/persv	horn
136.	645	GLM *xekul	xukul	n	e_u	u_u	VA/antic	purslane
137.	647	WM+LM *xulub'	xulub'	instr	u_u	u_u	N/A	horn
138.	649	xuxub'	xuxub'	vn	u_u	u_u	N/A	whistling
139.	359a	—	nich-im	n	i_i	i_i	N/A	flower
140.	382	pahar	pahäy	n	a_a	a_ä	N/A	skunk
141.	240	GLM #kuket < MZ *kuk 'middle'	kukt-al	n	u_e	u_Ø	?	trunk of body
142.	261a	GLM *q'ix-in, GQ' & GK' *q'ax-in	k'ixin	a	a_i	i_i	VA/antic	warm
143	591	*7ab'-i	7ub'-i	tv	a_i	u_i	VA/antic	to hear, feel notice
144.	268	PCM *k'opat	k'opot	n	o_a	o_o	VA/persv	brush, the bush

[a]Kaufman & Norman (1984: 130) note that'"Original meaning must be some other kind of cane'.

Appendix 2: Tzeltalan Di- or Tri-syllabic Stems

This appendix compiles a total of 124 di- or trisyllabic Tzeltalan forms reconstructed by Kaufman (1972: 91–124) that have experienced vowel-assimilation changes. Data for specifically Tzotzil or Tzeltal forms are provided only when one of the two differs from PTz in terms of the vowels. Items are listed alphabetically, and item numbers are cited in the body of the paper in sections relevant to Tzeltalan. A few PTz forms are proposed here and justified in footnotes. Same conventions as in Appendix 1 apply here. The "K no." refers to the entry number in Kaufman (1972). The 'Assimilation' column includes the following abbreviations and figures: VA for 'vowel assimilation' (thisty six cases), N for 'none' referring to forms with different vowels that did not experience VA (forty two), MON for 'monosyllabic' ancestral forms (two cases), N/A for 'not applicable' for cases where the vowels were identical in quality already (forty four cases), PERSV for 'perseverative' (eighteen cases), and ANTIC for 'anticipatory' (eighteen cases).

No.	K no.	PM	PTz	Class	Original V	Ch V	Assimilation	Gloss
1.	—	WM *7aab'ii	7ab'i[a]	pt	aa_ii	a_i	N	it is said
2.	002	7ab'-aaty-eel	7ab't-el (cf. *7ab'at 'servant')	vn	a_aa	a_(a)	N	work
3.	004	—	7ahb'ol [-b'ah] (Tzo) 7ohb'ol [-b'ah] (Tze)	a [+pt]	o_a	o_o	VA/persv	(one) is disgraced
4.	020	WM+LM *7ahq'ol	7ahk'ol	rn	a_o	a_o	N	above
5.	015	7ahq'ab'	7ahk'ab'-al[b]	n	a_a	a_ä	N/A	night
6.	021	WM+LL 7ahk'oot ~ 7ahk'ut	7ahk'ot	vn	a_oo, a_u	a_o	VA/persv?	dance
7.	010	WM+LM+ *7ajq'.a	7ahkan	vn	a_a	a_a	N/A	moan(ing)
8.	045	7ahiin	7ahyin	n	a_ii	a_i	N	alligator
9.	043	7ajn	7ajan	n	a_	a_a	MON	roasting ear
10.	044	7aajaaw	7ajaw-, 7äjäw	n	aa_aa	a_a	N/A	king, lord
11.	017	7aaq'a7l	7ak'al	n	aa_a	a_a	N/A	charcoal
12.	019	PCM 7aq'een ~ 7aq'iin	7ak'in ~ 7ak'en	vn	a_ee	a_i	N	weeding corn
13.	018	PCM *7aq'een	7ak'en (with Zi Tzo *7ek'en*)	n	a_ee	a_e	N, VA/antic	Platform
14.	024	GLM+ 7aalaq'	7alak'	n	a_a	a_a	N/A	pet
15.	026	7al7iib'	7alib'-al(-tak)	n	a_ii	a_i	N	daughter-in-law
16.	029	WM *7amay	7amay	n	a_a	a_a	N/A	flute
17.	005	7a7tz'aam	7atz'am	n	a_aa	a_a	N/A	salt
18.	046	7ar	7äy (also *7ay-)	pt	a_	ä/a_	MON	there is/are

APPENDIX 2: (continued)

No.	K no.	PM	PTz	Class	Original V	Ch V	Assimilation	Gloss
19.	263	7ikaaq'	7ichäk'il 'sister's son, cross-cousin'	n	i_aa	i_ä	N	nephew, cousin
20.	262	7ikaan	7ichan-il(-ab')	n	i_aa	i_a	N	mother's brother
21.	266	7iSk'aq	7ihch'ak-il, *7ehch'ek ~ 7ehk'ech* (Tze)	n	i_a	i_a, e_e (e_a > e_e) (Tze)	N, VA/antic and /persv (Tze)	claw, -nail
22.	268	GTz #7iq-ta	7ihk-itay	tv	i_i_a	i_i_a	N	To loose, drop
23.	273	GTz *7ihnam (cf. EM+ *7ix=na7m)	7ihnam-il 'woman' (Tze)	n	i_a	i_a	N	wife
24.	260	7ihtz'iin	7ihtz'in-al(-ab')	n	i_ii	i_i	N/A	younger sibling
25.	280	7ix-i7m < *7ix=e7m or *7ix.e7m	7ixim ~ 7ixin (Tzo)	n	i_i	i_i	N/A	grain corn
26.	491	7ojb'	7ohb'-al < **7ojb'-al (Chm. 7ohob'ah < **7ojob'.aj)	n	o(_o)	o(_o)	N/A	cough
27.	493	7ooq	7ok-il, y-ok.et	n	o_i	o_i	N	foot
28.	499	PM *7oox-ib'	7ox-ib' (Tzo), 7ox-eb' (Tze)	num	oo_i	o_e	Analogy	three
29.	714	MZ *7uuma7 (diffused)	7uma7	a/n	uu_a	u_a	N	dumb
30.	715	LL+WM *7une..	7unin	n	u_e	u_i	VA/persv	tierno (tender)
31.	718	WM *wayuC, PCh' *7uyuj	7uyoj	n	a_u	u_o	N?	kinkajou
32.	063	b'ahlam	b'ähläm	n	a_a	ä_ä	N	jaguar
33.	056	b'aqal	b'akal	n	a_a	ä_ä	N/A	corncob
34.	078	WM+Yu *b'ik'et	b'ik'it	a	i_e	i_i	VA/persv	small
35.	087	GLM *b'uluky=	b'uluch-ib'	num	u_u	u_u	N/A	eleven
36.	053	WM *b'ah.b'V...	b'ahb'iy(-al) (Tzo) b'ahb'{i/a}y-el (Tze)	n	a_i	a_a	VA/persv	first

APPENDIX 2: (continued)

No.	K no.	PM	PTz	Class	Original V	Ch V	Assimilation	Gloss
37.	058	WM+Yu *b'aq', WM *b'aq'-et	b'ak'et (Tzo b'ek'et)	n	a_e	a_e	N, VA/antic	body
38.	064	b'elenh-eeb'	b'alun(-eb')	num	e_e_ee	a_u (_e)	?	nine
39.	071	PM *b'eh.i.n	b'eh-en (Tze) b'eh-in (Tzo)	iv	e_i	e_e	VA/persv	to walk, go, travel
40.	190	kaj(aa)nh	ch'äjän	n	a_aa	ä_ä	N/A	rope, vine
41.	208	ch'upaaq	ch'upak	n	u_aa	u_a	N	castor bean
42.	147	GTz *cha7b'-eej-eey	cha(7)b'-jey, cha7b'-ej	adv	a_ee	a_e	N	Two days ago
43.	—	GTz *cha7-le	cha7le[c]	tv	a_e	a_e	N	To do, make
44.	139	kahoq	chahuk	n	a_o	a_u	N	lightning, thunder
45.	141	PM *kam 'to die'	cham-ib'-al ~ cham-eb'-al	n	a_i_a	a_e_a	VA/persv	death
46.	183	—	chawaj ~ chawoj (Tze), chuwaj (Tzo)	n			?	vertigo
47.	142	koonh-eej	chon-ej	adv	oo_ee	oo_ee	N	in four days
48.	142	koonh-ej-eer	chon-j-ey	adv	oo_ee	oo_ee	N	four days ago
49.	229	hahlaaw	hä(h)läw	n	a_aa	a_a	N/A	agouti, paca
50.	230	PM *ha7-	ha7-ex ~ ho7-ox	pr	a_e	a_o > o_o	VA/antic, analogy	you all
51.	—	*hat'is ~ *hat'ix ~ *hach'ix, etc., GLM #ha7-tzihaam	ha7tziham (Tze)	vn	a_i	a_i	N	a sneeze, sneezing
52.	—	haya/um	hahb' (Tze)	vn	a_a/u	a_(a)	N/A	yawn(ing)
53.	241	PM *ho7-oob'	ho7-ob' (Tzo), ho7-eb' (Tze)	num	o_oo	o_e	Analogy	Five
54.	230	PM *ha7-	ho7-on	pr	a_ii[d]	o_o	VA/antic	I
55.	239	hoonon	honon 'wasp'	n	oo_o	o_o	N/A	bumblebee
56.	245	PM *huuq=uub'	huk-ub' (Tzo) huk-eb' (Tze)	Num	uu_uu	u_e	Analogy	seven
57.	250	(h)uulaa7	hulä7 (Tzo) 7ulä7 ~ 7uläb' (Tze)	n	uu_aa	u_a	N	guest
58.	252, 755	LM *jalal	halal (Tze), jalal (Tze)	n	a_a	a_a	N/A	reed
59.	760	jawan-il(-tak)	jawan	n	a_a	a_a	N/A	woman's sister-in-law

APPENDIX 2: (continued)

No.	K no.	PM	PTz	Class	Original V	Ch V	Assimilation	Gloss
60.	762	PM *jar-ub'	jay-, jay-ib' (Tzo), jay-eb' (Tze)	Num	a_u	a_i, a_e	Analogy	How many
61.	784	pM *joCo…	jojoch	n	o_o	o_o	N/A	cornhusk
62.	788	jukuub'	jukub'	n	u_uu	u_u	N/A	dugout
63.	338	k'iwex	k'ewex	n	i_e	e_e	VA/antic	soursop
64.	—	GTz *k'ojoj	k'ojoj^{e} 'smell of tobacco smoke'	a	o_o	o_o	N/A	stinking
65.	355	GLM #k'uk'um?	k'uk'um	n	u_u	u_u	N/A	feather
66.	345	GLM *q'ix-in, GQ' & GK' *q'ax-in	k'ixin 'lukewarm'	a	a_i	i_i	VA/antic	warm
67.	358	PM *q'uun	k'un: k'un ~ k'un-il (Tze), k'un-ul (Tzo)	a	uu_	u_i, u_u	N, VA/ persv	soft
68.	286	MZ *kakawa (diffused)	käkäw	n		ä_ä	N/A	cacao
69.	288	PM *qanhaanh	kanan	n	a_aa	a_a	N/A	cuidado (care)
70.	295	WM+LM *keleem	kelem 'young man; rooster'	a	e_ee	e_e	N/A	strong
71.	—	GTz *kahlam	kolom (Tzo)	n	a_a	a_a	N/A	jaw, chin
72.	311	PM *kuhka7y (diffused)	kukay	n	u_a	u_a	N	firefly
73.	312	GLM #kuket < MZ *kuk 'middle'	kuket-al (Tze)	N	u_e_a	u_e_a	N	trunk of body
74.	371	PCM *laj or *laaj, PTz *lahj	lahx-ib'-al ~ lahx-eb'-al	n	a_i_a	a_e_a	VA/persv	end
75.	373	laajuunh	lajun-eb'	num	aa_uu	a_u	N	ten
76.	388	WM+LM *loq', PTz *lok'	lok'-ib'-al ~ lok'-eb'-al	n	o_i_a	o_e_a	VA/persv	exit
77.	397	WM+LM+ luqum	lukum	n	u_u	u_u	N/A	worm
78.	419	majaan	majan	n	a_aa	a_a	N/A	borrowing
79.	416	mahtaan	mähtän-il	n	a_aa	ä_ä	N/A	gift
80.	401	matzaab'	mätzäb'-il 'eyelash'	n	a_aa	ä_ä	N/A	eyebrow

APPENDIX 2: (continued)

No.	K no.	PM	PTz	Class	Original V	Ch V	Assimilation	Gloss
81.	423	me7b'aa7	me7b'a7 (Tze)	a/n	e_aa	e_a	N	bereft (orphan, widow)
82.	478	nhii7	ni7-al-il(-tak) 'father-in-law' ni7-il(-tak) 'son-in-law'	n	ii_	i_ä	N	son-in-law
83.	470	GTz *nich-im	nich-im (unposs) -nich (poss)	N	i_i	i_i	N/A	flower
84.	507	pahar	pähäy	n	a_a	ä_ä	N/A	skunk
85.	—	PM *páta (from MZ *patajaC)	pätä(h)	n	á_a	ä_ä	N/A	guava
86.	517	pataan	patan	n	a_aa	a_a	N/A	work [Cht 'tributo']
87.	527	pehpen	pehpen	n	e_e	e_e	N/A	butterfly
88.	530	peteht	petet	n	e_e	e_e	N/A	spindle
89.	—	WM+LM *pixan	<pixan-il> (Tzo)	n	i_a	i_a	N	soul
90.	550	pojw	pojow	n	o	o_o	N/A	pus
91.	570	saqb'iin	sahb'in	n	a_ii	a_i	N	weasel
92.	575	GLM *sam-eht	samet, semet (Tzo)	n	a_e	a_e, e_e (tzo)	N, VA/antic	griddle
93.	579	GTz *seh.k.ub'	sehkub' ~ sehk'ub'	n	e_u	e_u	N	liver
94.	582	sib'(-aq)	sib'ak	n	i_a	i_a	N	soot, black powder
95.	594	LM *sot'-ot'	sot'ot'	n	o_o	o_o	N/A	liver
96.	694	*t'eel	t'ehlech, *t'ohlok* (Tze)	n	ee_	e_e, o_o	VA/antic	crested lizard
97.	636	tyaq-i7nh	tak-in	a	a_i	a_i	N	dry
98.	641	LM *taa7=q'iinh	tak'in (< LL)	n	aa_ii	a_i	N	metal
99.	669	tyoq(-al)	tok(al)	n	oo_a	o_a	N	cloud
100.	135	tz'uunu7n	tz'unun	n	uu_u	u_u	N/A	hummingbird
101.	136	tz'usub'	tz'usub'	n	u_u	u_u	N/A	grape
102.	137	tz'utuuj	tz'utuj-te7 (type of tree); tz'utuj (Tze), tz'utoj (Tzo)	n	u_uu	u_u	N/A	corn tassel
103.	115	PM *tz'aq 'to complete' (tv)	tz'akay ~ tz'akiy	iv	a_i	a_a	VA/persv	To be completed; to suffice

APPENDIX 2: (continued)

No.	K no.	PM	PTz	Class	Original V	Ch V	Assimilation	Gloss
104.	689	GLM *tyiinh-am	Tze *tunim* ~ *tumin*	n	ii_a	u_i	?	cotton
105.	101	GLM *tzimen	tzemen	n	i_e	e_e	VA/antic	mountain cow, tapir
106.	—	tzima(7)	tzima	n	i_a	i_a	N	gourd
107.	727	waqxaq-iib'	waxak-ib'	num	a_a	a_ä	N/A	eight
108.	738	wa7-eel	we7 'to eat' tv/iv, we7-el-il 'food'		a_ee	e_e	VA/antic	meat
109.	744	wa7inh(-aal)	wi7n-aj	Iv	a_i	i_ø_a	VA/antic	to be hungry
110.	744	wa7inh(-aal)	wi7n-al	n	a_i	i_ø_a	VA/antic	hunger
111.	742	winaq	winik	n	i_a_i	i_i_i	VA/antic	man, people
112.	607	sanik	xan(7)ich ~ xanich' (K1972); xanich (Tzo) ~ xinich (Tze) (PMED)	n	a_i	i_i (Tze)	N, VA/antic	ant
113.	617	xe(e)h-in	xihn, xihn-al	a	ee_i	i_i	VA/antic	disgusting
114.	610	GLM *xekul	*xekul[f] > xekol ~ xchekul (Tze)	n	e_u	e_o (tze)	N, VA/persv	purslane
115.	625	Cf. Pre-Ch' *xuk-äb, PCh' *xuk-ub'	xuhk-ub' (Tze), xukub' (Tzo) 'elbow'	instr	u_ä/a	u_u	VA/persv	horn
116.	628	WM+LM *xul-ub'	xul-ub'[g]	instr	u_u	u_u	N/A	horn
117.	630	xux-ub'	xux-ub'	vn	u_u	u_u	N/A	whistling
118.	492	PM *7ook 'entrar'	y-och-ib' ~ y-och-eb'	n	oo_i	o_e	VA/persv	entrance
119.	794	PM *raah or *ra7h 'pain (ful)	yah-al (Tze), yah-il (Tzo)	a	a(a)_i	a_a	VA/persv	spicy
120.	230	PM *ha7-	hä7-ät	pr	a_ä	ä_ä	VA/antic	you (sg)
121.	230	PM *ha7-	ho7-o-tik	pr	a_o	o_o	VA/antic	we
122.	409	Chiapas sphere (Toj, Tuz, Tzo, Tze) *mah.la, etc.	mahl-iy ~ mahl-ay	iv	a_i	a_a	VA/persv	to wait

APPENDIX 2: (continued)

No.	K no.	PM	PTz	Class	Original V	Ch V	Assimilation	Gloss
123.	098	PM *tze7h	tzeh- 'raw, green', tzeh-il (Tzo), tzeh-el (Tze)	a	e_i	e_e	VA/persv	raw
124.	267	PCM *7ihq-atz 'cargo'	7ihkatz-il	n	i_a	i_a	N	cargo

[a]This reconstruction is based on the Tzeltal form cited in Kaufman with Justeson (2003: 740).
[b]This reconstruction is based on forward reconstruction taking into account both PM and PCh'. Kaufman (1972: 93) reconstructs *7ahk'{a/u}b'.al 'noche (night)'. Given the reconstruction *7ahk'ab'-al, Tzotzil *7ahk'ub'-al* would be innovative.
[c]Kaufman & Norman (1984: 117) note that Tzotzil attests to the form *cha7le* likely related to PCh' *cha7-le 'to do, make', hence its proposed reconstruction to PTz here.
[d]Analogy resulted in a reshuffling of the absolutive suffixes of Tzeltalan, with PM *-onh 'first person plural' becoming reanalyzed as 'first person singular'. Vowel assimilation applied after this reanalysis had already occurred.
[e]Reconstruction to PTz is based on Tzeltal attestation and PCh' attestation.
[f]Kauman with Norman (1984 :137) cite the PTz reconstruction as *xekol - *xchekul, the second form seemingly exhibiting *x= 'female/small/inactive classifier prepound' which may have triggered dissimilation (by means of affrication) from the initial *x of *xekol. We reconstruct the form as *xekol based on forward reconstruction.
[g]Kauman with Norman (1984: 137) only cite Tzeltal as attesting to this form; using forward reconstruction it can be postulated to PTz.

APPENDIX 3: ITEMS THAT EXPERIENCED CH'OLAN VOWEL-RAISING SHIFTS

This appendix contains a listing of the Ch'olan etyma that experienced the vowel-raising shifts of *ee/*e7 > PCh' *i and *oo/*o7 > PCh' *u. The fourth and fifth columns compile examples of common inflectional and/or derivational suffixes that could be responsible for either promoting or blocking the shift, both in the Colonial and Modern languages, labeled here 'Contemporary', as well as in the Pre-Columbian hieroglyphic texts, labelled here 'Epigraphic Mayan'. The final column assesses whether the evidence from the common suffixes supports the hypothesis of suffix-controlled vowel assimilation. For one item we were not able to collect relevant data from the Ch'olan languages, but instead, only from a closely related Tzeltalan language.

Item no.	PM	PCh'	Gloss	Contemporary languages	Epigraphic Mayan	Support outcome?
1.	*b'eeh	*b'ih	road	-i(l): Yokot'an *u-b'ij-i(l)* 'its road' (Keller & Luciano 1997 :45) -il: Acalan <bihil> 'camino a (road to (ward))' (Smailus 1975: 130)	**b'i-hi** (Boot 2009: 37) **b'i-ji/hi-li** (Grube & Nahm 1994: 710)	Yes

APPENDIX 3: (continued)

Item no.	PM	PCh'	Gloss	Contemporary languages	Epigraphic Mayan	Support outcome?
2.	*kehj	*chij	deer	-il: Tzeltal *chij-il chan* 'boa constrictor (deer snake)' (Polian 2015: 118) -il: Yucatec *u-kéeh-il k'áax* (its-deer-abstractivizer forest) 'the deer of rthe forest' (Bricker et al. 1998: 125)	**chi-ji-li** (Boot 2009: 51)	Yes
3.	*-eej	*-ij	in the future	-i: PCh' *chun-ij-i 'four days ago'	**-ji-ya** spells sequence of enclitics *-ij-iy* (Boot 2009: 73–4) Explicit spellings of *-*ij* involve a preceding **Ci** syllabogram (cf. NUMERAL-**ni-ji-ya** attested in support of *-ij-i) (Stuart et al. 1999: II-34)	Yes
4.	*-eer	*-i	in the past	(possibly last morpheme in relevant words)	**-ji-ya** spells sequence of enclitics *-ij-iy* (Boot 2009: 73–4)	—
5.	PCM *peeq 'pataxte (type of cacao)'	*=pik	eight thousand	—	**pi-ki** (Boot 2009:149) **pi-ki-ji-ya** (Quirigua Stela D, Zoomorph P) with *-ij-iy* 'after/since' enclitic sequence	Yes
6.	*tze7h	*tzih	raw	—	**tzi-hi-li**, **tzi-hi-la** (Boot 2009: 174) for *-il* suffix	Yes
7.	WM *weech'	*wich'	wing	Ch'orti' *wich'* 'fin, wing', *wich'-ir-nib'* 'goad stick', *wich'-i'* 'to whip'	—	Yes

APPENDIX 3: (continued)

Item no.	PM	PCh'	Gloss	Contemporary languages	Epigraphic Mayan	Support outcome?
				(Hull 2014: 486–7)		
8.	LM *7ooj-eel	Ch'ol *7uj-il*, Yokot'an *7uw-i(l)*	to know	-il (Ch'ol) -i(l) (Yokot'an)	—	—
24.	*koonh-eej	*chun-ij *chun-ij-i	in four days four days ago	PCh' *-ij PCh' *-ij-i	Logographic or logosyllabic spellings; spelled syllabographically by the sequence **(Ci)-ji-ya**	Yes
25.	LM *loot	*lut	twins	—	—	—
26.	*sootz'	***sutz'**	bat	—	**su-tz'i**, **SUTZ'-tz'i**, **su-tz'i-la** all likely representing *sutz'-il* with *-il* < *-iil* 'abstractivizer' for name of 4th month (Boot 2009: 161)	Yes
27.	GLM *qootz	*kutz	wild turkey	—	**ku-tzu** (Boot 2009: 99)	—
28.	*tooŋ	***tun**	stone	-il < PCh' *-il < Pre-Ch' *-iil: Ch'ol *tun-il* (Aulie & Aulie 2009: 94) -ir < PCh' *-il < Pre-Ch' *-iil: Ch'orti' *tun-ir* (Hull 2014 :417)	**7u-TUN-ni-li** with-*il* suffix, **TUN-(ni-) chi** with *-ich* suffix (Boot 2009: 171–2)	Yes
29.	GLM *tzo7n	*tzun	body hair	-il: Ch'ol *tzun-il* 'pubic hair' (Hopkins et al. 2011: 243)	—	Yes
30.	GLM *tzo7tz	*tzutz	head hair	-el: Ch'ol -tzutz-el 'bird feather; hair (of head); hair (of body)' (Aulie & Aulie 2009: 99)	—	No
31.	*7o7q'	*7**uk'**	to cry	PCh' *-el 'incompletive status of intransitives' PCh' *-i 'completive	**yu-k'e-sa** for *y-uk'-esä* 's/he made it/him/her cry', in item 0519 of Justin Kerr's Portfolio (Kerr n.d.), cf.	Yes? Frequency?

Appendix 3: (continued)

Item no.	PM	PCh'	Gloss	Contemporary languages	Epigraphic Mayan	Support outcome?
				status of intransitives' PCh' *-esä 'causativizer'	Zender (1999: footnote 48) **7u-k'i-yi** for *7uk'-i* 's/he cried' (carved pottery plate)	
32.	*7oonh	***7un**	avocado	Ch'olan <uniu> and Q'anjob'al <onew> point to PCh' *7uniw from earlier *7ooneew (Justeson 1989: 27); if based on *7oonh 'avocado', then *7oonheew	**7u-ni-wa** for 17th month name (Boot 2009: 186–7)	Yes?
33.	*7oox=	***7ux=**	three	*-ij-i: PCh' *7ux-ij 'in three days', *7ux-ij-i 'three days ago' (Kaufman & Norman 1984: 138) Ch'orti' *ux-i'* 'three days ago', *ux-ij* 'in three days', *ux-yajr* 'three times' (Hull 2014: 474) PTz *7ox-ib' < PGTz *7oox-ib' < PM *7oox-ib'	Logographic spelling, never followed immediately by **-ji-ya** in texts	Yes?
34.	*7amooch	*7a=much	toad	—	**mu** syllabogram acrophonically derived from *much* 'toad'	—
35.	LM *7ooj-eel	Ch'ol *7uj-il*, Yokot'an *7uw-i(l)*	to know	-il (Ch'ol) -i(l) Yokot'an	Yes	Yes

Appendix 4: Items that did not experience Ch'olan vowel-raising shifts

This appendix contains a listing of the Ch'olan etyma that did not experience the vowel-raising shift despite exhibiting reflexes of either pM *ee/*e7 or *oo/*o7. The fourth and fifth columns compile examples of common inflectional and/or derivational suffixes that could be responsible for either promoting or blocking the shift, both in the Colonial and Modern languages, labelled here 'Contemporary', as well as in the Pre-Columbian hieroglyphic texts, labelled here 'Epigraphic Mayan'. For five etyma we were not able to collect relevant data from the Ch'olan languages, but instead, only from the closely related Tzeltalan languages, or from the more distantly related Yucatecan languages which were in very close contact with Ch'olan.

Item no.	PM	PCh'	Gloss	Contemporary languages	Epigraphic Mayan	Suffix(es) support(s) outcome
9.	*k'e7n	*ch'en	cave	-al < -aal Ch'ol *ch'eñ-al* 'hole of tree', *ch'eñ-al ~ ch'eñ-ä l* 'grave' (Aulie & Aulie 2009: 32); Ch'orti' -ch'en-ar 'hole of...; grave of...' (Hull 2014: 118–19)	**CH'EN-(n)a-l(a)** (Boot 2009: 61)	Yes
10.	GLM *7eeq'	*7ek'	star	-ob': Ch'orti' 7ek'-ob' 'stars' (Hull 2014:135) -etik: Tzeltal 7ek'-etik 'stars' (Polian 2015: 184–5)	**7e-k'e** (Boot 2009: 63)	Yes
11.	*7eeh	*7eh	tooth	-äl Ch'ol *7ej-äl* 'mouth' (Aulie & Aulie 2009:34) *-al*: Yokot'an *k'ux=7ej-a(l)* 'tooth pain' (Keller & Luciano 1997:343)	**7e-ya** possibly for 'tooth' suggestive of *7e (h/y)-a(l/s)* (on vase text 1892 of Justin Kerr's Maya Vase archive (Kerr n.d.)	Yes
12.	*qeeb'	*keb'	belch(ing)	-aj: Tzeltal *keb'-aj* – 'to burp' (intransitivized) (Kaufman with Justeson 2003: 321)	–	Yes

Appendix 4: (continued)

Item no.	PM	PCh'	Gloss	Contemporary languages	Epigraphic Mayan	Suffix(es) support(s) outcome
				-e (-V1): Ch'orti' *u-ke'b'-e* 'he burped (it)' (active transitive) (Hull 2014: 196)		
13.	WM *keleem	*kelem	strong	-al < -aal -al: Tzeltal s-kelem-al 'male (its-male-ness)' (Polian 2015: 308) -al: Col. Yucatec <kelem> 'strong, youthful', <kelemal> 'age or young age when (a person) has strength and vigor; youth', <kelemil> 'youth', <kelemal> 'work that one has done [handiwork]' (Barrera Vázquez et al. 1980: 310)	**ke-le-ma**, **ke-le**, **ke-KELEM**, **KELEM-ma** (Boot 2009: 95–6)	Yes?
14.	LM *meeT	*met	crown	—	—	—
15.	*nheeh	*neh	tail	—	—	—
16.	*tyee'	*te'	tree	-el: Yokot'an *te'* 'tree', *te'-el* 'of the brush/woods; wild', e.g. *te'-el ajmis* 'wild cat' (Keller & Luciano 1997:235) -el: Tzeltal dialects *te'-el*, e.g. *s-te'-el* 'its tree/trees/trunk/	**TE7-le** (81 cases), **TE7-7e-le** (6 cases), **TE7-li** (2 cases) (Mora-Marín 2004)	Yes

APPENDIX 4: (continued)

Item no.	PM	PCh'	Gloss	Contemporary languages	Epigraphic Mayan	Suffix(es) support(s) outcome
				stem' (Polian 2015: 611) -el: Col. Yucatec <che> 'tree' and <cheel> 'tree (of a type) as in <u cheel abal> 'the plum tree' (Ciudad Real 2001:194)		
17.	*teem	*tem	seat	-el: San Lorenzo Zinacantan Tzotzil *tem* 'bed, corpse stretcher', *s-tem-al te'-al kaxlan* 'the chicken coop perch' (Laughlin 1975:46) -eb': Col. Yucatec <temeb> 'common stair steps' (Barrera Vázquez et al. 1980: 783)	*-al* or *-aal*: **7u-te-ma** for *u-teem-a(a)l* 'his/her bench' (Boot 2009: 165) *-ul* or *-uul*: **7u-te-mu-l(i)** for *u-teem-u(u)l* 'his/her bench' (Boot 2009: 165)	Yes
18.	*t'eel	*t'el	cockscomb	-ok: Ch'orti' *t'ohrok* 'cockscomb, crest' (Kaufman with Justeson 2003: 388; Wisdom 1950: 686) -ok: Tzeltal variety *t'ohlok* 'basilisk' (Kaufman with Justeson 2003: 388) -ech: Tzeltal variety *t'ehlech* ~ *t'erech* 'basilisk' (Kaufman with Justeson 2003: 388)	—	Yes

APPENDIX 4: (continued)

Item no.	PM	PCh'	Gloss	Contemporary languages	Epigraphic Mayan	Suffix(es) support(s) outcome
				-ech: Tzotzil *t'elech* 'basilisk' (Kaufman with Justeson 2003: 388)		
19.	WM *xeh.e, GLM *xeeh?	*xeh	Vomit(ing)	WM *-e (same as *.e), as a transitivizer (derivational) suffix	—	Yes?
20.	WM *xeep	*xep	kind of tamale; small people	—	—	—
21.	LM *xeex	*xex	shrimp	—	—	—
22.	*weex	*wex	trousers	-äl: Tumbalá Ch'ol *wex-äl* 'pants' vs. *k-wex* 'my pants' (Vázquez Álvarez 2011: 116) -al: Tzeltal dialects *wex-al* 'pants (unpossessed)' (Polian 2015:734)	—	Yes
23.	PCM *me7b'aa7 'bereft, poor'	*meb'a'	bereft (orphan, widow)	/aa/ of second syllable		Yes
36.	*kooh	***choh**	cheek	PTz *-il < **-iil, cf. PTz *choh-il (Kaufman 1972: 100)	Syllabogram **cho** is acrophonically derived from *choh	No
37.	#ch'ool	*ch'ol	ethnonym (ch'ol)			
38.	*hoonon	*honon	bumblebee	/o/ of second syllable		Yes
39.	*jooj	*joj	heron	—	—	—
40.	***jo7l**	***jol**	head	-äl: Ch'ol *-jol* 'head; hair' (possessed)', *jol-äl* 'head; hair'	**jo-l(o)** for GLM *jo7l > Pre-Ch' *jool > PCh' *jol 'head'; **JOL-ma**	Yes

APPENDIX 4: (continued)

Item no.	PM	PCh'	Gloss	Contemporary languages	Epigraphic Mayan	Suffix(es) support(s) outcome
				(unpossessed)' (Aulie and Aulie 2009:45) -ir: Ch'orti' *u-jor-ir* 'the boss, leader', *-ir* 'abstractivizer' (Hull 2016:178) EM+Hue (Eastern Mayan and Huehuetenango Sphere) *jool-oom 'head', *-oom is derivational suffix, several Greater K'ichee'an languages show *-aj* or *-aaj* with unpossessed form (Kaufman with Justeson 2003:275)	likely for *jooloom(-aj)* 'head' (cf. EM+Hue), otherwise unattested in Ch'olan, Tzeltalan, or Yucatecan (Boot 2009: 85–6)	
41.	*q-o7nh	*kon (Ch'ol)	let's go!	—	—	—
42.	LM #koox?	*kox	pava (bird species)	—	—	—
43.	*q'oor	*k'oy	dough	*q'oor-em? PM *q'oor (Kaufman with Justeson 2003: 1188), but note Huastec *k'oye* 'dough', and Yucatecan *k'oyem (Itzaj *k'eyem* 'atole', Mopan *k'oyem* 'posol) point to a possible PM form *q'oorem. If Pre-Ch'	—	Yes?

Appendix 4: (continued)

Item no.	PM	PCh'	Gloss	Contemporary languages	Epigraphic Mayan	Suffix(es) support(s) outcome
				preserved the second syllable (i.e. Pre-Ch' k'ooyem*), the vowel /e/ could have prevented the raising of the *oo to *uu > *u. Ch'orti' *k'oyomach'* 'balls of corn dough' (Hull 2014: 240)		
44.	PM *moo7	***mo7**	macaw	—	—	—
45.	*nooq'	***nok'**$_1$	cloth(es/ing)	-i(l): Yokot'an *u-nok'-i(l)* 'its cloth/clothes' (Keller & Luciano 1997:174)	—	No? Frequency?
46.	Was+WM *nooq' 'animal'	*nok'$_2$	caterpilar	-al: Yokot'an *u-nok'-a(l)* 'its worm' (Keller & Luciano 1997: 173) -ol: Yucatec Maya *nòok'-ol* 'caterpillar' (Bricker et al. 1998: 200)	—	Yes
47.	*7ook	***7och**	to enter	-el: incompletive status of intransitives -en: imperative status of intransitives -esä: causativizer, PCh' *7och-esä 'to put in' (Kaufman and Norman 1984:127) -i: completive status of	-i: **7o-chi**, **7o-chi-ya** (Boot 2009: 138)	Yes? Frequency?

APPENDIX 4: (continued)

Item no.	PM	PCh'	Gloss	Contemporary languages	Epigraphic Mayan	Suffix(es) support(s) outcome
				intransitives (PCh', WCh') -V_1y: -oy, completive status of intransitives (ECh')		
48.	*7ooq	***7ok**	foot	-eht: PCh' *y-ok-eht 'trivet' Yokot'an *k'ux=7ok-a(l)* 'foot pain' (Keller & Luciano 1997: 343) -al, -el, -ol: Tzeltal *7ok-al ~ 7ok-ol ~ 7ok-il* 'foot (unpossessed)', *y-ok-el* 'motive, reason' (Polian 2015: 493) -i(l): Yokot'an *tä 7ok-i(l)* 'on foot' (Keller & Luciano 1997: 296)	-e(l): **7o-ke** (Boot 2009: 140) -i(l): **yo-7OK-ki** (Boot 2009:140) -ib': **yo-ki-b'i** (Boot 2009: 140)	Yes? Frequency?
49.	PCM *7oonh-eer	*7on-i	formerly, long ago	Homophony avoidance (avocado)		Yes
50.	*7oor	*7oy	house-post	-el < -eel -el: Ch'ol *iy-oy-el iy-otot* 'the post of his/her house' (Aulie & Aulie 2009:6 8) *Uw-oy-ir* 'its posts (of a house)' (Wisdom 1950: 755) *Uy-oy-ir* 'its posts (of a house)' (Hull 2016: 482)	—	Yes

Appendix 4: (continued)

Item no.	PM	PCh'	Gloss	Contemporary languages	Epigraphic Mayan	Suffix(es) support(s) outcome
51.	*7atyooty	***7otot**	home	/a/ of first syllable -il < -iil (unpossessed) -il-b'a 'plural' -e(l) 'collective plural' -e(l): Yokot'an *7otol-e* 'houses' (Knowles 1984: 203-204), 'collective plural' -il-b'a: Yokot'an *7otot-il-b'a* 'abundance of houses' (Knowles 1984: 204), 'plural'	**yo-to-ti** (Boot 2009: 142–4)	Yes? Frequency?
52.	PM *poom < MZ *poomɨ	***pom**	copal incense	-ol: Yucatec Maya pòom 'incense' and *(x) pom-ol che7* 'incense tree' (Bricker et al. 1998: 220) -tay: Bachajón Tzeltal *pom* 'incense' and *pom-tay* 'to incense something' (Slocum et al. 1999: 95) -al: Tzotzil *pom* 'incense' vs. (*s-*)*pam-al* '(his/her/its) incense (possessed by saint)' (Laughlin 1975: 117)	-*ol* or -*ool*: **-[po]mo**, **-[po]mo-li** (Boot 2009: 151) -*al* or -*aal*: **po-ma** (Boot 2009: 151) -*oj* or -*ooj*: **po-mo-ja** (Boot 2009: 151)	Yes
53.	PM *tyook'	***tok'**	flint	—	-*al* or -*aal*: **to-k'a-la** for *took'-aal* 'flint (unpossessed)' as opposed to **7u-**	Yes

APPENDIX 4: (continued)

Item no.	PM	PCh'	Gloss	Contemporary languages	Epigraphic Mayan	Suffix(es) support(s) outcome
					to-k'(a) for *u-took'* 'his/her flint (possessed)' (Mora-Marín 2010: 145–6, Figures 13c-e)	
54.	*t'oot'	*t'ot'	snail	-il: Itzaj *t'ot'-il* '(water/sea/land) snail' (Hofling with Tesucún 1997: 620)	—	No?
55.	*7aj=tzoo7	*7aj=tzo7	tom turkey	—	—	—
56.	*xooch'	*xoch'	screech owl	—	—	—