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Nasal hardening and aspect allomorphy in Kaqchikel*

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The aspect prefix /n-/ in Comalapa Kaqchikel (Mayan) surfaces with a following [t] or [d] when attaching to monosyllabic, vowel-initial verbs. We refer to this process as NASAL HARDENING, and argue that it emerges from constraints barring affixal material from positions of phonological prominence; these constraints team-up with phonetically-grounded constraints on onset sonority and place licensing to produce [t]~[d] epenthesis. The analysis is supported by allophonic evidence which identifies stressed syllables and word-initial syllables as 'strong' positions in Kaqchikel and other K'ichean-branch Mayan languages. Curiously, the oral stop [d] which results from nasal hardening is otherwise quite rare in Mayan languages. We deal with with the oddity of finding [d] in this context by means of THE EMERGENCE OF THE UNMARKED: certain constraints on [NC] clusters become crucially active only in contexts of epenthesis, when IO-FAITHFULNESS is rendered inert. The paper closes with some discussion of the historical development of these patterns across dialects of Kaqchikel.

Keywords: Epenthesis, assimilation, nasals, phonological strength, Mayan

1 Introduction

In this paper we describe and analyze the prosodic conditions governing the surface form of the incompletive aspect marker /n-/ in the Mayan language Kaqchikel, as spoken in the vicinity of San Juan Comalapa, Guatemala. In this dialect, the aspect prefix /n-/ has a series of phonologically-conditioned surface variants which reveal phonotactic pressures that are otherwise largely latent in Kaqchikel. Aspect marking can produce marked /#nC/ sequences, which are often repaired by epenthesis (1a). More curiously, aspect marking also reveals a dispreference for [#nV] sequences, which are permitted in polysyllabic verbs (1b) but repaired in monosyllabic ones (1c). The repair for such [#nV...]$_\sigma$ sequences is the insertion of an oral stop [t] or [d], a process we refer to as NASAL HARDENING (1c), adapting a term from Rosenthall (1989), Padgett (1994) and others.

(1)   a.   ***n(i)tikïr*** [n(i)-tikɪr̥] '(s)he is able'

       b.   ***nanin*** [n-anin] '(s)he runs'

       c.   ***ndok*** [nd-okʰ] '(s)he enters'

In what follows we focus on nasal hardening (1c), which we argue emerges from the interaction of several phonological factors which converge in vowel-initial monosyllabic verb stems. Specifically, such stems always constitute word-initial stressed syllables, a position of particular phonological strength. We suggest that a constraint barring affixal material from positions of phonological prominence forces epenthesis (1c), and that additional constraints on onset sonority and place licensing ensure the epenthesis of [t d] over other consonants in this environment. Nasal hardening is particularly interesting from a synchronic perspective, as [d] is otherwise a highly marginal sound in Mayan languages, though its occurrence in this context can be understood as a reflection of phonological requirements which are typologically well-attested and

functionally grounded in phonetics and speech processing. (On post-nasal fortition in other languages, see Rosenthall 1989, Padgett 1994, Gouskova et al. 2011, Zsiga 2018 and references there.)

2 Kaqchikel

Kaqchikel is a K'ichean-branch Mayan language spoken by $\frac{1}{2}$-1 million people in the southern highlands of Guatemala (Fig. 1; Richards 2003, Maxwell and Hill 2010, Fischer and Brown 1996:fn. 3). This paper is primarily concerned with the variety of Kaqchikel spoken in the town of San Juan Comalapa, Chimalte-nango, which has an especially complex pattern of allomorphy in aspect marking (we briefly discuss other varieties of Kaqchikel in section 4).
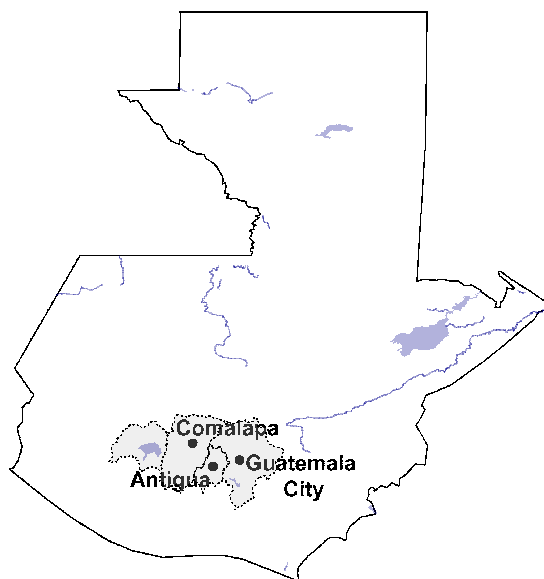

Figure 1: Map of Guatemala showing the four administrative departments in which Kaqchikel is most widely spoken as a community language (from east to west, these are the departments of Guatemala, Sacatepéquez, Chimaltenango, and Sololá) (Richards 2003, Brown et al. 2010, Maxwell and Hill 2010)

The phonemic inventory of Comalapa Kaqchikel is given in Table 1 and Figure 2. For more background on the linguistic structure of Kaqchikel, as well as its socio-linguistic context and historical development, see Cojtí Macario et al. (1998), García Matzar and Rodríguez Guaján (1997), García Matzar et al. (1999), Patal Majzul et al. (2000), Patal Majzul (2007), Brown et al. (2010), Maxwell and Hill (2010). For more on the phonology and phonetics of Kaqchikel, see Cojtí Macario and Lopez (1990), Chacach Cutzal (1990), Nasukawa et al. (2011), Bennett (2016, 2018, To appear), Bennett et al. (2018a,b, In revision) and work cited there.

2.1 Verbal morphology in Kaqchikel

Kaqchikel, like all Mayan languages, has an ergative-absolutive agreement system. Transitive subjects are cross-referenced on verbs with the ergative agreement prefixes in Figure 3. Transitive objects and intransitive subjects are cross-referenced on verbs with the absolutive agreement prefixes in Figure 4. The form of these ergative and absolutive prefixes varies with the initial segment of their stem. These alternations are essentially suppletive: for the most part, there is no synchronic phonological basis for these patterns (though see Kenstowicz 2013 for a different view).

	Bilabial	Dental/ alveolar	Post- alveolar	Velar	Uvular	Glottal
Stop	p ɓ̥	t tʔ		k kʔ	q qʔ~q̥ʼ	ʔ
Affricate		t͡s t͡sʔ	t͡ʃ t͡ʃʔ			
Fricative		s	ʃ	x ~ χ		
Nasal	m	n				
Semivowel	w		j			
Liquid		l r				

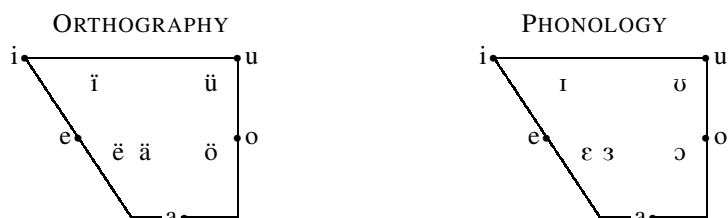**Table 1:** The phonemic consonants of Comalapa Kaqchikel

Figure 2: The vowels of Comalapa Kaqchikel (following Chacach Cutzal 1990, Patal Majzul et al. 2000:24,35,40-1, García Matzar and Rodríguez Guaján 1997:17-9, Comunidad Lingüística Kaqchikel 2004:35-44; see also Bennett To appear)

	SG _C		SG _V	PL _C		PL _V
1st	in-	~	inw-	qa-	~	q-
2nd	a-	~	aw-	i-	~	iw-
3rd	(r)u-	~	r-	ki-	~	k-

Figure 3: Ergative agreement prefixes on verbs (orthographically)

	SG _C		SG _V	PL _C		PL _V
1st	i-	~	in-	oj-		
2nd	a-	~	at-	ix-		
3rd	Ø-			e-	~	e'-

Figure 4: Absolutive agreement prefixes on verbs (orthographically)

The absolutive agreement prefixes play a special role in the analysis that follows, because the phonetically null 3S.ABS marker [Ø-] (Fig. 4) triggers aspect allomorphy, which then feeds phonological processes like vowel epenthesis and nasal hardening. When absolutive agreement is null [Ø-] 3S.ABS, the imperfective aspect prefix /n-/ is used in place of the default form /j-/. Examples (2) and (3) illustrate this alternation for transitive and intransitive verbs respectively. As should be clear, /j-/~/n-/ allomorphy is morphologically-conditioned and suppletive, rather than being phonologically predictable.

(2)   Aspect allmorphy on transitive verbs in standard Kaqchikel

    a.   ***y-a-ki-tz'ët*** [**j**-a-ki-t͡s'ˀɛtʰ]
        ASP.INCP-2S.ABS-3P.ERG-see
        'They see you.'

    b.   ***n-Ø-ki-tz'ët*** [**n**-Ø-ki-t͡s'ˀɛtʰ]
        ASP.INCP-3S.ABS-3P.ERG-see
        'They see him/her/it.'

(3)   Aspect allmorphy on intransitive verbs in standard Kaqchikel

    a.   ***y-e-b'ixan*** [**j**-e-ɓi̥ʃan]
        ASP.INCP-3P.ABS-sing
        'They sing.'

    b.   ***n-Ø-b'ixan*** [**n**-ɓi̥ʃan]
        ASP.INCP-3S.ABS-sing
        '(S)he/It sings.'

In what follows, we will see that /j-/~/n-/ allomorphy can create marked sequences which are repaired in some surprising ways.

2.2 The phonology of aspect marking

Aspect allomorphy for incompletive /j-/~/n-/ derives [#nC] and [#nV] sequences, some of which may be marked. In standard Kaqchikel, [#nV] sequences are permitted in all cases (4), while [nC] sequences—especially those that have differing places of articulation—frequently trigger epenthesis of the high front vowel [i] (5). (In our analysis, epenthesis into word-initial [#CC] clusters is a means of avoiding unsyllabified consonants; see section 3.4.) Standard Kaqchikel thus does not display the pattern of nasal hardening exemplified in (1c), in which [t] or [d] intrudes after the nasal aspect marker /n-/ in words like (4).

(4)   ***n-Ø-ok*** [**n**-okʰ]
    ASP.INCP-3S.ABS-enter
    'She/He entered.'

(5)   ***n-Ø-ki-tz'ët*** [**ni**-ki-t͡s'ˀɛtʰ]
    ASP.INCP-3S.ABS-3P.ERG-see
    'They see her.'

Beyond standard Kaqchikel, dialects differ as to whether and when incompletive /n-/ is realized as [nt-] or [nd-]. Regarding the realization of /n-/, Patal Majzul et al. (2000:52) and Brown et al. (2010:29) identify five distinct dialect types. This includes the Type (i) pattern instantiated by standard Kaqchikel (4)-(5), in which the aspect marker is uniformly realized as [n-], and vowel epenthesis breaks up marked #[nC] sequences.

  (i)   Use of [n-] in all contexts (with or without epenthesis)

  (ii) Use of [nt-]~[nd-] with monosyllabic verb stems, and [n-] otherwise (possibly with epenthesis)

  (iii) Use of [nd-] with all verb stems (sometimes in free variation with [n-])

  (iv) Use of [nd-]~[d-] with all verb stems, shifting toward fixed [d-] over time

  (v) Use of [nd-] with intransitives, and use of [n-] with transitives

In this paper we focus on Comalapa Kaqchikel, a Type (ii) variety. Like standard Kaqchikel, Comalapa Kaqchikel uses epenthesis to resolve certain [#nC] clusters, at least variably. Unlike standard Kaqchikel, Comalapa Kaqchikel makes frequent and predictable use of the [nd-] and [nt-] allomorphs of the incompletive aspect marker /n-/. This pattern of variation is noteworthy, in that the [nd-] and [nt-] realizations of /n-/ appear to be conditioned allophonically in Comalapa Kaqchikel, rather than just morphologically, a point we expand on below. (We comment on the remaining dialect types in section 4.)

Concretely, Comalapa Kaqchikel is somewhat unique in that the form of incompletive /n-/ depends on the syllable count of the verb stem. This is illustrated in Figs. 5-7 below. Fig. 5 shows that the aspect marker /n-/ is realized as a simple nasal [n-] with polysyllabic vowel-initial stems like *naläx* [n-alɜʃ] '(s)he was born'. Figs. 6 and 7 show that this same aspect marker is realized as [nd-] when prefixed to a monosyllabic vowel-initial stem. (Fig. 7 is from Sololá Kaqchikel, a dialect which appears to be another Type (ii) variety.) The presence of an oral stop between [n] and the following vowel in these examples is supported by the occurrence of a release burst before the vowel onset, by the lowered intensity of voicing preceding this release burst, and by a weakening of energy in the higher harmonics during the same pre-release phase. All of these features are absent at the [#nV] transition for [nalɜʃ] (Fig. 5), in which the aspect marker is realized as a simple nasal without any oral stop component. Additionally, the two instances of [#nd] in these figures are noticeably longer than the single instance of [#n] in Fig. 5, consistent with the presence of an additional stop consonant following the aspect marker when it occurs on monosyllabic vowel-initial stems. We thus fully agree with previous reports of nasal hardening /n-/ → [nt-, nd-] in Comalapa Kaqchikel, as described in sources like Patal Majzul et al. (2000) and Comunidad Lingüística Kaqchikel (2004).[1]
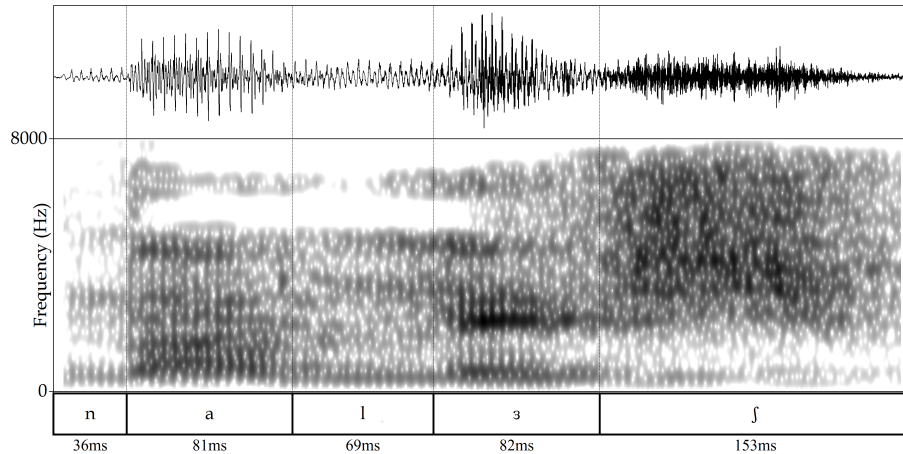

Figure 5: *naläx* [n-alɜʃ] '(s)he was born', as produced by a female speaker of Comalapa Kaqchikel

[1]These examples were excised from free narratives, and so their segmentation may not seem perfectly crisp. We are nonetheless confident that we have accurately located the boundaries of the initial [n]'s in these examples, which were all utterance-initial or preceded by clearly-definable vowels. For segmentation criteria, see Turk et al. (2006).

A reviewer correctly notes that the initial [n] in Fig. 5 seems very short. For comparison, we can consider the typical duration of [n] as it occurs in a corpus of spontaneous spoken Kaqchikel collected by one of the authors (Bennett and Ajsivinac Sian In preparation; see also Bennett et al. 2018b, Tang and Bennett Submitted). In this corpus, 70% of [n] tokens have a duration of 80ms or less, collapsed across all contexts (mean = 76ms, median = 60ms; n = 2880). In initial position, 70% of [#n] tokens have a duration of 90ms or less (mean = 88ms, median = 70ms; n = 902). While this is clearly longer than the [#n] in Fig. 5, it is also substantially shorter than the durations of [#nd] in Figs. 6 and 7. We leave a full exploration of the durational properties of initial [#n] vs. [#nd] clusters for future work. In any case, the phonological analysis we develop here does not hinge in any substantive way on the phonetic duration of initial [#n] vs. [#nd].
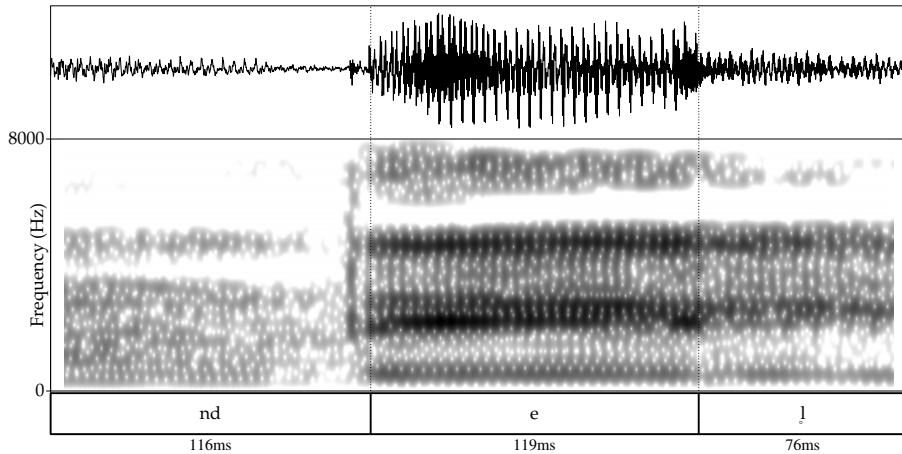
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Figure 6: *ndel* [nd-el] '(s)he leaves', as produced by a female speaker of Comalapa Kaqchikel[2]
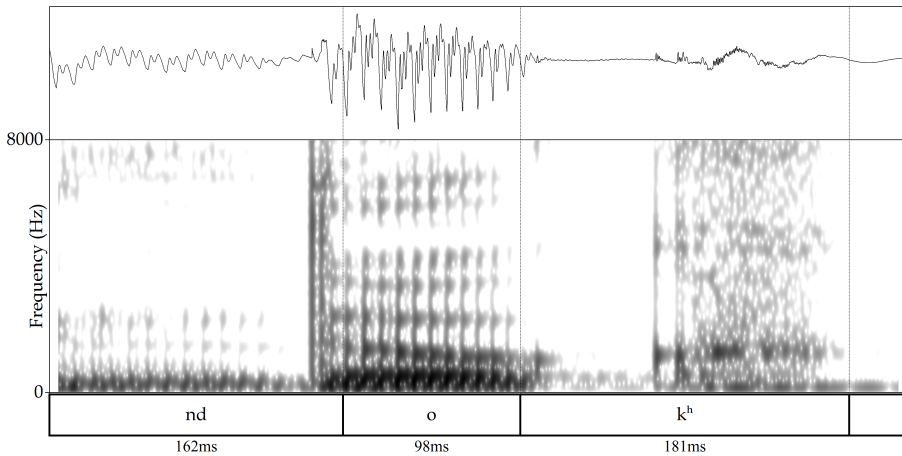

Figure 7: *ndok* [nd-ok^h] '(s)he entered', as produced by a male speaker of Sololá Kaqchikel (Bennett and Ajsivinac Sian In preparation)

Before proceeding, we want to be clear that the scope of nasal hardening /n-/ → [nt-, nd-] in Kaqchikel is quite narrow—it occurs with exactly one morpheme, incompletive *n-* /n-/. The simplest analysis of these alternations, then, would be to treat nasal hardening as suppletive allomorphy, specific to incompletive *n-*, and listed in its lexical entry. This is a reasonable path to take, especially since phonologically-conditioned suppletion is common for prefixes in Kaqchikel (section 2.1 above). However, treating nasal hardening as lexical allomorphy comes with its own complications (sections 3.6, 4). For that reason, we undertake the task of developing a phonological treatment of nasal hardening here, if only to sharpen the comparison between the two approaches. While the phonological approach requires more complex analytical machinery, it also provides some insights into the nature of nasal hardening which, we think, would be lost by just lexically listing the allomorphs of incompletive *n-* /n-/. (On the general tension between phonological vs. morphological treatments of semi-predictable allomorphy, see Itô and Mester 2006.)

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[2]Word-final approximants are normally devoiced in Kaqchikel, but curiously, the final [l] of [nd-el] remains voiced in the example shown in Fig. 6.

To develop a phonological analysis of nasal hardening, we will need to identify some systematic difference between monosyllabic and polysyllabic verb stems which could plausibly be responsible for the appearance of [t d] in post-nasal position. In the following section, we argue that monosyllabic stems count as phonologically 'strong' in a variety of respects. We then argue that the phonological strength of such stems is responsible for conditioning Type (ii) allomorphy in dialects like Comalapa Kaqchikel.

3 Analysis

3.1 Stress as a strong position in Kaqchikel

Stressed syllables commonly host a wider range of segmental and suprasegmental contrasts than unstressed syllables (e.g. Trubetzkoy 1939, Beckman 1998, Smith 2005, Barnes 2006, Teeple 2009). Such asymmetries suggest that stressed syllables count, in some sense, as positions of phonological strength.

Stress in Kaqchikel is quite uniform, falling mostly on word-final syllables, with only a very small handful of exceptions showing non-final stress of any kind. The positional prominence of stressed syllables manifests itself in at least two ways in this language. First, vowels in Kaqchikel (Fig. 2) contrast for tenseness in stressed syllables (6), but neutralize to the tense series in unstressed (i.e. non-final) syllables (7) (e.g. Bennett To appear).

(6) a. *ak'* /akʔ/ → [ˈʔakʔ] 'Hyptis Suaveolens'

  b. *äk'* /ɜkʔ/ → [ˈʔɜkʔ] 'chicken'

  c. *k'ay* /kʔaj/ → [ˈkʔaj] 'bile'

  d. *k'äy* /kʔɜj/ → [ˈkʔɜj̥] 'bitter' (Cojtí Macario et al. 1998)

(7) a. *wäy* /wɜy/ → [ˈwɜj̥] 'tortilla'

  b. *wayb'äl* /wɜj-ɓɜl/ → [waj.ˈɓɜl̥] 'restaurant'

  c. *xintïk* /ʃ-in-tɪk/ → /ʃin.ˈtɪkʰ/ 'I planted it'

  d. *xitikon* /ʃ-i-tɪk-on/ → /ʃi.ti̥.ˈkon/ 'I planted (something)' (Cojtí Macario et al. 1998)

Similar restrictions on vowel distributions are found in other, related K'ichean-branch languages, such as those varieties of K'iche' which restrict long vowels to stressed syllables (e.g. Baird 2010, Bennett 2016 and references there).

The second manifestation of phonological strength in stressed syllables in Kaqchikel concerns the distribution of [VʔC] sequences. Word-final, stressed syllables may end in [ʔC] (8), but under suffixation, the pre-consonantal [ʔ] disappears (9) (e.g. García Matzar and Rodríguez Guaján 1997:32-3).

(8) a. *po't* /poʔt/ → [ˈpoʔt] 'blouse'

  b. *kuta'm* /kutaʔm/ → [ku.ˈtaʔm] 'trunk'

(9) a. *ija'tz* /iχaʔt͡s/ → [ʔi.ˈχaʔt͡s] 'seed'

  b. *rijatzul* /r-iχaʔt͡s-ul/ → [ri.χa.ˈt͡sul] 'her/his inheritance'

  c. *ajch'ame'y* /aχ-t͡ʃʔam-eʔj/ → [ʔaχ.t͡ʃʔa.ˈmeʔj] 'municipal official'

  d. *ajch'ameya'* /aχ-t͡ʃʔam-eʔj-aʔ/ → [ʔaχ.t͡ʃʔa.me.ˈjaʔ] 'municipal officials'

We take alternations like (9) as an indication that [VʔC] sequences are only licensed under stress in Kaqchikel, similar to lax vowels. Indeed, across Mayan there is independent evidence that glottal stop sometimes pat-

(13)   Stress-sensitive [ʔ]-epenthesis in Dutch (Booij 1999, Smith 2005)

    a.   *chaos* /xaɔs/ → [ˈx<u>a.ɔ</u>s] 'chaos'

    b.   *aorta* /aɔrta/ → [<u>a.ˈʔo</u>r.ta] 'aorta'

Although we are unaware of any research suggesting that [ʔ]-insertion is conditioned by stress in Kaqchikel, the Tz'utujil facts are of a kind with the vowel distributions discussed above: they provide general evidence for the positional prominence of word-final stressed syllables in K'ichean-branch Mayan languages.

3.2 Word-initial position as a strong position

Along with stressed syllables, word-initial position has also been identified as a position of phonological strength, showing either a greater range of contrasts than other positions (e.g. Beckman 1998), a resistance to alternation (e.g. Becker et al. 2012, 2017), or evidence of fortition processes (e.g. Smith 2005, Lavoie 2001), including patterns of neutralizing fortition.

    The evidence for treating word-initial position as a strong position in Kaqchikel is limited, but nonetheless clear. Descriptive sources commonly describe glide hardening for the approximant /w/, with the particular outcome of hardening varying across vowel context and position within the word (14) (Cojtí Macario and Lopez 1990:213-20, García Matzar and Rodríguez Guaján 1997:16-7, Patal Majzul et al. 2000:26-8, Comunidad Lingüística Kaqchikel 2004:32-4, etc.). (In many dialects of Kaqchikel, historical /w/ is usually realized as [v], but the point is the same in either case.)

(14)   a.   *winäq* /<u>w</u>inɜq/~/<u>v</u>inɜq/ → [<u>bi</u>.ˈnɜqˣ]

    b.   *wuj* /<u>w</u>uχ/~/<u>v</u>uχ/ → [<u>bu</u>χ]   (Cojtí Macario and Lopez 1990)

There is an important generalization to be made about the environments in which glide hardening takes place: hardening in medial positions entails hardening in initial position, but not vice-versa. In (15), for example, all combinations of hardening in the word *wawe'* /waweʔ/~/vaveʔ/ 'here' are attested, *except* the form *[vabeʔ], which hardens the medial [v] without also hardening the initial [v].

(15)   Glide hardening in Santiago Sacatepequez Kaqchikel *wawe'* 'here' (Cojtí Macario and Lopez 1990)

    a.   [vaveʔ]

    b.   [boveʔ]

    c.   [babeʔ]

    d. *[vabeʔ]

We interpret this asymmetry as evidence of the positional prominence of word-initial syllables, reflecting a preference for lower-sonority onset consonants in word-initial position (see especially Lavoie 2001, Smith 2005, and also Bennett 2013:§6.2).[4]

    Though somewhat more tenuous, [ʔ]-epenthesis can also be construed as a case of word-initial prominence. For at least some speakers of Kaqchikel, word-medial onsetless syllables in hiatus are resolved by vowel deletion (16b) rather than [ʔ]-insertion (16a) (e.g. Heaton 2016).

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[4]Word-initial glide hardening is also attested in other Mayan languages, including those of the K'ichean branch. Q'eqchi' (K'ichean) has a particularly notable process of word-initial hardening which derives pre-stopped glides, e.g. *winq* [ᵏwiŋqʰ] 'man' and *yu'am* [ˡjuʔam] 'life' (England 2001, Tzul and Cacao 2002, Caz Cho 2007). Co-author Bennett has observed the same process in Tila Ch'ol (Western Mayan, Mexico); see too England (1983:29) on Mam and Bruce (1968:22) on Lacandon, among various others.

(16) *yixb'e'intz'ub'aj* /j-iʃ-ɓe-in-t͡sˀuɓ-aχ/ 'I go kiss y'all' (Heaton 2016:320)

    a.   [jiʃ.ɓe̥.ʔin.t͡sˀu.ˈɓaχ] (epenthesis)

    b.   [jiʃ.ɓe̥n.t͡sˀu.ˈɓaχ] (deletion)

Word-initial onsetless syllables are never resolved through vowel deletion, only through [ʔ]-epenthesis (see also Bennett 2016:§2.4.4). This asymmetry may also reflect the phonological prominence of word-initial position in Kaqchikel, as strong positions are typically resistant to weakening and lenition processes like deletion.[5]

3.3 Nasal hardening as cumulative phonological strength

We can now assess why the phonetic realization of the aspect marker *n-* /n-/ is conditioned by the syllable count of its stem—or more precisely, by stress. Drawing a parallel with the discussion of glide hardening above, we assume that the realization of /n-/ as [nt-]~[nd-] serves to provide a better (lower sonority) onset for stressed syllables, particularly those which appear in word-initial position. As noted in the preceding section, there is a cross-linguistic preference for low-sonority onsets, particularly in prominent positions like stressed and word-initial syllables (e.g. Lavoie 2001, Gurevich 2004, Smith 2005, Gordon 2005). Stopping of /n-/ → [nt-]~[nd-] in forms like [ndokʰ] '(s)he entered' could therefore be driven by sonority-related pressures. Specifically, we take the process of nasal hardening which derives [nt-]~[nd-] from /n-/ to be a species of consonant epenthesis, driven by a preferences for low-sonority onsets.

    Implementing this intuition requires several ingredients. First, we need to specify the contexts in which hardening of the nasal aspect marker /n-/ occurs. In Comalapa Kaqchikel, nasal hardening is restricted to monosyllabic verb stems; these are precisely those stems in which the nasal aspect marker /n-/ → [n-] would *simultaneously* occur in both word-initial position and in the onset of a stressed syllable (17).

(17) a.   [n.ˈtokʰ.]

     b. *[.nokʰ.]

We emphasize that nasal hardening does not in general occur in initial position in Kaqchikel (18a), nor does it occur in stressed syllables more broadly (18b). It is the *joint* effect of word-initial position and stress that appears to drive nasal hardening; neither condition is on its own sufficient to produce the epenthesis of [t]~[d].

(18) a.   *nint'is* [nin.ˈtˀis], *[n.tin.ˈtˀis.] 'I sew it'

     b.   *yinel* [ji.ˈne̥l.], *[jin.ˈtel̥] 'I leave'

In our analysis, nasal hardening is thus an instance of a *gang effect*, typically modeled using constraint conjunction (e.g. Itô and Mester 2003a, Smolensky and Legendre 2006, Crowhurst 2011) or the numerically-weighted constraints of Harmonic Grammar (e.g. Smolensky and Legendre 2006, Pater 2016) (see also Padgett 2002, Shih 2017 for relevant discussion). For simplicity of exposition, we adopt constraint conjunction here, acknowledging that the Kaqchikel facts themselves do not distinguish between these two

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[5]An interesting fact about [ʔ]-insertion in Kaqchikel, and in Mayan languages more generally, is that [ʔ] is very often realized phonetically as creakiness on adjacent vowels and sonorants, and *not* as a true stop (e.g. Bennett 2016, England and Baird 2017 and references there). This is notable because the distribution of [ʔ]-insertion is easily understood as a strategy for providing onset consonants in otherwise onsetless syllables, despite the fact that [ʔ] does not necessarily function as an onset consonant in the phonetics. We believe that [ʔ]-insertion in initial positions can be understood as a case of phonetic/phonological strengthening in either case, as initial laryngealization (including creakiness) is quite broadly conditioned by strong positions cross-linguistically (e.g. Borroff 2007, Garellek 2013, 2014).

alternatives. (For other cases of cumulative prominence effects in phonology, which can also be modeled using local constraint conjunction, see Parker 1998, de Lacy 2001, and references there.)

(19)   Constraints on onset sonority in strong positions (see Lavoie 2001, Parker 2002, Smith 2004, 2005, 2008, Gordon 2005, Flack 2007, 2009)

     a.   *ONSET$\geq_{son}$N/σ_1:
         Assign one violation for every syllable σ_x such that σ_x is initial within its containing prosodic word, and begins with an onset consonant with sonority greater than or equal to a nasal stop.

     b.   *ONSET$\geq_{son}$N/$\acute{\sigma}$:
         Assign one violation for every syllable $\acute{\sigma}_x$ such that $\acute{\sigma}_x$ is stressed, and begins with an onset consonant with sonority greater than or equal to a nasal stop.

(20)   STRONGONSET (=*ONSET$\geq_{son}$N/σ_1 &$_{syll}$ *ONSET$\geq_{son}$N/$\acute{\sigma}$)
     Assign one violation for every syllable σ_x such that σ_x is a stressed, word-initial syllable and begins with an onset consonant with sonority greater than or equal to a nasal stop (i.e. is a locus of violation for both *ONSET$\geq_{son}$N/σ_1 and *ONSET$\geq_{son}$N/$\acute{\sigma}$).

(21)   STRONGONSET ≫ DEP-C

/n-ok/	STRONGONSET	DEP-C
a. ☞ .n.'t<u>ok</u>.		*
b. .'n<u>ok</u>.	*! W	L

nok /n-ok/ → [n.'tok^h]~[n.'dok^h] (Fig. 7) '(s)he enters'

     The positional privilege of word-initial, stressed syllables in Kaqchikel can in fact be seen in the historical development of nasal hardening in Kaqchikel. The distal source of this phenomenon lies in the tense-aspect system of Colonial Kaqchikel, as recorded in the 16th century, during the post-conquest period (Maxwell and Hill 2010). Colonial Kaqchikel marked present tense on verbs with /t-/ whenever the absolutive argument was 3S.ABS (e.g. *t-i-xib'-in* 'it (3S.ABS) was frightening'), and with /k-/ (or /q-/ 1P.ABS) otherwise (e.g. *k-e-achij-ïr* 'they (3P.ABS) were becoming warriors'; Robertson 1992:66,131-6, Maxwell and Hill 2010:53-6). Incompletive aspect was marked with an independent pre-verbal morpheme *tan* (e.g. *tan k-e-q'aq'-är* 'they (3P.ABS) were becoming powerful'). Over time, *tan* underwent phonological weakening, yielding *tan t-...* > *nt-/nd-...* > *n-...*, and *tan k-...* > *nk-/ng-...* > *y-....*

     The retention of *nt-/nd-...* in all verb paradigms (Type (iii) systems) is thus conservative when compared to those dialects which mark 3S.INCP with *n-* across the board (Type (i) systems). The question, then, is why dialects like that of Comalapa Kaqchikel (Type (ii)) neutralized *nt-/nd-...* with *n-...* in all verb forms *except* those which were both monosyllabic and vowel-initial. We suggest that this resistance to simplification reflects the phonetic and phonological prominence of word-initial, stressed syllables invoked above.

     We hasten to add that the distribution of *n-* vs. *nt-/nd-* has clearly been reanalyzed in diverse ways by different Kaqchikel dialects (section 4). As such, the existence of a historical source for modern *n-~nt-/nd-* alternations does not obviate the need for a synchronic analysis of these same facts (see Anderson 1992, Mester 1994, Blevins 2004 for related discussion).

3.4 Morphological conditioning of nasal hardening

As it currently stands, our analysis wrongly predicts nasal hardening for *all* monosyllabic words, not just verbs. Monomorphemic /n/-initial words like *nïm* [nɪm] 'large' show no evidence of nasal hardening in any dialect of Kaqchikel. The generalization to be captured here concerns a specific morpheme, the aspect marker /n-/, and not word-initial /n/ *tout court*. Some reference to morphology is clearly key.

We suggest that the nasal hardening observed in Comalapa Kaqchikel and other varieties owes to a grammatical pressure which prefers morphological boundaries to coincide with prosodic boundaries (Prince and Smolensky 1993/2004, McCarthy and Prince 1993a). In particular, we assume a constraint demanding that stressed syllables contain only those segments which belong to a morphological root (22). This constraint is functionally grounded in the fact that stressed syllables and roots are both important for lexical access (Smith 2005).

(22)   MATCH($\acute{\sigma}$, ROOT) (inspired by Itô and Mester 1999, 2015, Selkirk 2011, Elfner 2012)
         Assign one violation for every segment $\mathbb{S}$ contained in a stressed syllable $\acute{\sigma}_x$, such that $\mathbb{S}$ belongs to an affix (i.e. a morpheme other than a root morpheme).

The workings of (22) can be seen in (23). In (23a), we see that nasal hardening has the effect of pushing the aspect marker /n-/ into a separate syllable, leaving the root (underlined) as the sole morpheme contained within the stressed syllable. The post-nasal [t], being epenthetic (see below) has no morphological affiliation of its own ('consistency of exponence', e.g. Pyle 1972, McCarthy and Prince 1993b, 1994). For this reason, the presence of epenthetic, post-nasal [t] (in boldface) in the same stressed syllable as the root in (23a) does not contribute to violations of MATCH($\acute{\sigma}$, ROOT) (22), but rather serves to resolve them.[6]

(23)   MATCH($\acute{\sigma}$, ROOT) ≫ DEP-C ≫ STRONGONSET

a.

/n-ok/	MATCH($\acute{\sigma}$, ROOT)	DEP-C	STRONGONSET
a. ☞ .n.ˈ**t**<u>ok</u>.		*	
b. .ˈn<u>ok</u>.	*! W	L	* W

nok /n-ok/ → [n.ˈtokʰ]~[n.ˈdokʰ] (Fig. 7) '(s)he enters'

b.

/nɪm/	MATCH($\acute{\sigma}$, ROOT)	DEP-C	STRONGONSET
a. ☞ .nɪm.			*
b. .n.tɪm.		*! W	L

nïm [nɪm] → [nɪm] 'big'

Tableau (23b) further demonstrates the failure of nasal hardening in monosyllabic /n/-initial roots. Note that this analysis requires the ranking DEP-C ≫ STRONGONSET, which is in direct contradiction to the proposal made in section 3.3. We return to this issue in section 3.7, where we argue that it is in fact the *joint* influence of STRONGONSET and MATCH($\acute{\sigma}$, ROOT) which triggers nasal hardening in Kaqchikel.

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[6]There are thus theory-internal reasons for treating post-nasal [t]~[d] as being inserted rather than 'fissioned' off from underlying /n_i/ → [n_i d_i]: fissioned [t]~[d] would have a morphological affiliation, being associated with input /n-/, and thus would not resolve violations of MATCH($\acute{\sigma}$, ROOT). (On consonant fission and epenthesis in OT, see Staroverov 2014.)

In contrast with monosyllabic roots, polysyllabic roots and stems do not induce nasal hardening (24), because the stressed syllable is never at risk of containing anything other than root material. Additionally, polysyllabic roots and stems will never violate STRONGONSET (20), because [n-] will never be contained in the stressed syllable. Epenthesis of [d] is thus gratuitous in this case, and therefore prohibited as a standard economy effect (e.g. McCarthy 2002:23-4,134-8).[7]

(24)

/n-alʒʃ/	MATCH($\acute{\sigma}$, ROOT)	DEP-C	STRONGONSET
a. .n.**ta**.ˈlʒʃ.		*! W	
b. ☞ .n<u>a</u>.ˈlʒʃ.			

naläx /n-alʒʃ/ → [na.ˈlʒʃ] (Fig. 5) '(s)he is born'

This analysis also correctly predicts that monosyllabic roots, when suffixed, will suddenly fail to evince nasal hardening (25). In this case, stress being word-final, there is no way to satisfy MATCH($\acute{\sigma}$, ROOT), because the stressed syllable will necessarily contain affixal material.

(25)

/n-ok-is-ʒʃ/	MATCH($\acute{\sigma}$, ROOT)	DEP-C	STRONGONSET
a. ☞ .n<u>o</u>.<u>ki</u>.ˈsʒʃ.	*		
b. .n.**t<u>o</u>**.<u>ki</u>.ˈsʒʃ.	*	*! W	

nokisäx /n-ok-is-ʒʃ/ → [no.ki.ˈsʒʃ] 'it was used'

3.4.1 The syllabification of [#nC] clusters

We are presuming here that the pre-consonantal nasal in hardening contexts (24a) is syllabic [#n̩.t], or at least external to the syllable which contains the root and epenthetic [t]~[d]—otherwise, nasal hardening would not lead to satisfaction of MATCH($\acute{\sigma}$, ROOT). Evidence supporting this claim comes from the broader distribution of consonant clusters in Kaqchikel.

Word-medially, clusters are mostly heterosyllabic [C.C], as in *saqsöj* [saqˣ.ˈsɔχ] 'whiteish'. But prefixation frequently derives initial consonant clusters which are impossible in word-medial position, e.g. *xtqab'än* [ʃ-t-qa-ɓən] 'they will do it' (García Matzar and Rodríguez Guaján 1997:21-5, Comunidad Lingüística Kaqchikel 2004:57-60; see also Bennett 2016, DiCanio and Bennett To appear on other Mayan languages). If tautosyllabic, these clusters would seem to implicate complex onsets which are otherwise unattested in the language: compare e.g. *jantape* [χan.ta.pe] 'always' with *ntik* [ntikʰ] 'it is planted'.

A reasonable alternative is that these word-initial clusters involve syllabic underparsing, i.e. extra-metricality: [ʃt(qa)$_\sigma$(ˈɓən)$_\sigma$], [n(tikʰ)$_\sigma$], and so on. Contextual extrametricality explains why these complex

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[7]Monosyllabic verbs in Kaqchikel are always bare roots, while polysyllabic verbs are typically morphologically complex, derived verb stems (e.g. Coon 2016 and references there). For example, the stem *-aläx* [-alʒʃ] 'to be born' can probably be decomposed into a root [-al] and a valence-determining suffix [-ʒʃ] (or even possibly [-ʒ-ʃ]). The analytical point goes through in either case, because the ostensible root [-al], by virtue of its position, cannot be the unique morpheme which contributes segmental material to the word-final stressed syllable. See also (25).

clusters are limited to initial position, under the assumption that syllabic underparsing may only occur at the edges of words (see Itô 1986, 1989, Gouskova 2012 and references there). Extrametricality also accounts for the fact that clusters derived by prefixation routinely violate the sonority sequencing principle, which is otherwise obeyed in roots and in word-medial positions in Kaqchikel (e.g. [t-kamisaχ] 'kill it!'). Furthermore, vowel epenthesis, which variably splits up initial /#nC/ clusters in words like [nqaɓən]~[niqaɓən] 'we do it', can be understood as a strategy for avoiding unparsed initial consonants.

It thus seems credible that the nasal in initial [#nt] sequences is *not* parsed into the same syllable as epenthetic [t]~[d] under nasal hardening, as [nt] onset clusters are otherwise unattested in the language. We don't know of any further evidence internal to Kaqchikel which would help assess the syllabification of initial [#nC] clusters. In particular, there are no syllable-sensitive allophonic processes which clearly indicate how these word-initial clusters are parsed (see again Bennett 2016). We thus leave further investigation of this aspect of our analysis to another occasion.[8]

3.5 Why epenthetic [t d]?

We have not yet explained the *quality* of the epenthetic consonant in this context. Why does it surface as [t]~[d], when the default epenthetic consonant of Kaqchikel is clearly [ʔ] (section 3.1)? Both [n.**t**okʰ] and [n.**ʔ**okʰ] equally satisfy MATCH($\acute{\sigma}$, ROOT), and along with the language-internal evidence suggesting that [ʔ] is the preferred epenthetic segment in Kaqchikel, epenthetic [ʔ] arguably has the virtue of being less phonologically marked than an oral stop like [t] or [d] (see de Lacy 2006:Ch.3, Staroverov 2014 for discussion).

The answer, we contend, has to do with phonological conditions on the licensing of nasal place features. Cross-linguistically, nasals frequently undergo place neutralization word-finally and before consonants; often, nasals in these contexts assimilate in place to a following segment. This pattern is extremely widespread, and has been analyzed as the effect of a broad prohibition on coda nasals which sponsor independent, phonologically-specified place of articulation features (26) (Itô 1986, 1989, Goldsmith 1990, Padgett 1994). Place assimilation subverts this restriction because the coda nasal 'borrows' its place of articulation from a consonant in the syllable onset—a position where place of articulation features *are* independently licensed (on 'indirect licensing', see also Itô et al. 1995, Beckman 1997, 1998).

(26)

[PLACE]

N . C
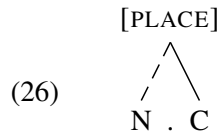
A second, though related line of thinking takes nasal place assimilation to reflect phonetic facts about the perceptual salience of nasal place features in different segmental contexts (e.g. Steriade 1994, 2001, Jun 1995, 2004, Kawahara and Garvey 2011). Nasal place is most perceptible in [V-N-V] sequences, where it can be identified on the basis of acoustic properties of the nasal during closure (e.g. spectral structure and duration), as well as in more salient cues on the flanking vowels (e.g. formant trajectories; Malécot 1956 and others). [C-V] transitions are particularly important for identifying nasal place, as they seem to provide more reliable cues to consonant place than [V-C] transitions (at least for most places of articulation; see e.g. Fujimura et al. 1978, Repp and Svastikula 1988, Recasens 1988, Steriade 2001 and references there). In word-final position, nasal place can only be cued by the weaker information in [V-N#]

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[8]The extended duration of the nasal murmur in Figs. 6 and 7 is consistent with an initial syllabic nasal in [#n̩.C], but evidence of this kind must be treated with care, especially since we have not conducted a systematic study of nasal duration in Kaqchikel. See also footnotes 1 and 11, and Byrd (1993), Pouplier and Beňuš (2011).

transitions, as well as steady-state properties of closure, and possibly properties of consonant release.[9] Pre-consonantal nasals [VNC] are even worse off: place may be cued in the [V-N] transition, and by properties of the nasal resonance, but pre-consonantal nasals are unlikely to be released (Jun 2004 and references there). Worst of all, perhaps, are initial, pre-consonantal nasals: in [#NC], nasal place is solely cued by properties of the nasal resonance, a singularly unhelpful perceptual cue (e.g. Johnson 2012:Ch. 9.2).

We contend that epenthetic [t]~[d] is a superior epenthetic consonant to [ʔ] following the word-initial aspect marker /n-/ because [d] *redundantly cues the nasal place features of the aspect marker* in an environment—[#NC]—-in which those features are difficult to reliably perceive. We implement this intuition with the PRESERVE constraint (27) (Flemming 1995, Jun 2004):

(27)   PRESERVE[PLACE,NASAL]:
        Assign one violation for every nasal consonant N_x present in the output, such that N_x is also present in the input and its place features are not perceptually recoverable in the output.

The workings of (27) can be seen in tableau (28). Candidate (28b), [nʔok], fails to robustly cue the [CORONAL] place feature of the aspect marker [n-]: [n] is in pre-consonantal position, a perceptually weak position, and [ʔ] provides no information about the [CORONAL] place feature of the nasal. In contrast, candidate (28a) [ntok] signals the [CORONAL] feature of the nasal well, because it is redundantly specified on the following, pre-vocalic [t], which carries perceptible [PLACE] features. (The idea that perceptually weak features are more likely to undergo spreading has precedent in research on vowel harmony systems; see especially Kaun 1995, Walker 2011, Rose and Walker 2011.)

(28)   PRESERVE[PLACE,NASAL] ≫ *[t d]

/n-ok/	PRESERVE[PLACE,NASAL]	*[t d]
a. ☞ .n.<u>tok</u>.		*
b. .n.<u>ʔok</u>.	*! W	

nok /n-ok/ → [n.ˈtokʰ]~[n.ˈdokʰ] (Fig. 7) '(s)he enters'

Provided that PRESERVE[PLACE,NASAL] is satisfied whenever [n] is vowel-adjacent, we derive the fact that epenthesis in [nC] clusters is limited to word-initial position.[10]

We close this section with a brief comment the assumption that nasal hardening involves consonant epenthesis. This is not the only conceivable treatment of the 'intrusive' [t]~[d] seen in nasal hardening environments. For example, [t]~[d] could be oral transitions out of a singleton nasal stop [nᵗ], rather than fully-fledged, independent segments of their own (see e.g. Anderson 1976, Steriade 1993, Stanton 2016, 2017, To appear and references there).[11] However, there is a technical problem with this analysis: it provides little insight into the morphological conditioning of this pattern. If both *[.nokʰ.] and [.nᵗokʰ.] begin with a unitary onset consonant, they involve exactly the same syllabification, and we can no longer invoke

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[9]Languages differ as to whether nasal stops are produced with a salient release burst, at least in word-final position (e.g. Peperkamp et al. 2008 and references there).

[10]Intriguingly, the initial [#nt]~[#nd] clusters derived by nasal hardening never seem to undergo further vowel epenthesis: neither *[<u>ni.</u>tokʰ] nor *[<u>ni.</u>ʔokʰ] are attested alternative realizations of /n-ok/ → [n.tokʰ]~[n.dokʰ], despite their avoidance of unparsed consonants. Perhaps the joint application of *both* consonant and vowel epenthesis is simply too unfaithful to be permitted; see e.g. Farris-Trimble (2010).

[11]As we noted above, the [nd] sequences derived by nasal hardening in Comalapa Kaqchikel do seem to be longer than single segments. However, Ladefoged and Maddieson (1996:Ch. 4.3) point out that segmental duration alone may not be a good way of distinguishing mixed oral+nasal stops from corresponding clusters.

MATCH($\acute{\sigma}$, ROOT) to explain why nasal hardening is strictly limited to the initial aspect marker /n-/. For this reason, it seems to us that treating [t]~[d] as epenthetic rather than transitional is a more promising analytic option.

3.6 Nasal hardening is phonology, not suppletive allomorphy

An alternative analysis of nasal hardening in Kaqchikel might be to treat [n-]~[nt-/nd-] alternations as suppletive allomorphy rather than phonology *per se*. Under this analysis, the underlying form of the incompletive would be as in (29) (following Paster 2006, Bye 2007 and others): the more specific allomorph /nt-, nd-/ subcategorizes for stems beginning in a stressed vowel (i.e. vowel-initial, monosyllabic stems), and the less specific allomorph /n-/ occurs in all other environments.[12]

(29)   a.   INCOMPLETIVE.3S.ABS → /nt-, nd-/   / ____ – ˈV

    b.   INCOMPLETIVE.3S.ABS → /n-/   / elsewhere

One argument against treating nasal hardening as allomorph selection, rather than a phonological process, concerns the form of the aspect marker when realized as [nd-]. Voiced obstruents like [d] are only sparsely attested in Kaqchikel: there are no voiced obstruents at all in the native vocabulary (Table 1), and there are no allophonic processes which regularly derive voiced obstruents from other segments. Most importantly, there is no general process of post-nasal voicing which could account for the occurrence of [d] in [nd-] (section 3.8). To the extent that voiced stops like [d] occur in the language, they are limited to relatively recent, unassimilated loanwords from Spanish; older loanwords tend to be phonologically nativized (e.g. Stenson 1998, Adell 2014).

    As far as we are aware, [nd-] is the *only* morpheme in the native Kaqchikel vocabulary which contains [d]. At best, [d] is a marginal phoneme in Kaqchikel—in fact, it is literally as marginal as a sound can be while still being present in a language, as part of the native vocabulary (see e.g. Hall 2013). For these reasons, it seems highly suspect to us to set up an underlying form like /nd-/ for the incompletive marker, even if only as a contextually-conditioned suppletive allomorph.[13] The alternative is to take the analytical path we follow here, and analyze [nt-, nd-] realizations of the incompletive marker as phonologically-derived variants of a single underlying form, /n-/.

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[12]Monosyllabic verb stems are exclusively bare roots in Kaqchikel, while polysyllabic verb stems are mostly morphologically complex. This follows from the fact that roots are in general /CVC/ in shape in Mayan languages (e.g. Coon 2016, Bennett 2016 and references there). It is thus conceivable that [n-]~[nt-, nd-] allomorphy for the incompletive aspect marker is directly conditioned by the morphological distinction between root and derived verbs, rather than by syllable count or other phonological factors. We believe that the arguments laid out here in favor of a phonological treatment of [n-]~[nt-, nd-] allomorphy apply equally to this alternative analysis.

[13]Shigeto Kawahara asks whether the existence of [d] in some loanwords might provide native speakers with a sufficient basis to postulate underlying /d/ in the aspect marker [nd-]. In raising this question, he points us to the interesting case of Japanese [p]. In the historical development of the native Japanese vocabulary, singleton [p] shifted to [h pː b], depending on its position (e.g. McCawley 1968:77-79, Itô and Mester 2003a:11). This gave rise to [h]~[pː]~[b] alternations which arguably implicate underlying /p/—a sound which never surfaces in the native Japanese vocabulary, but which *does* surface in loanwords (e.g. [paːtiː] 'party'; Itô and Mester 2008).

We believe that the presence of [d] under nasal hardening in Kaqchikel represents a fundamentally different phenomenon. The evidence for underlying /p/ in the native Japanese vocabulary comes from [h]~[pː]~[b] alternations which can be easily reduced to general phonological patterns (e.g. post-nasal voicing) if underlying /p/ is assumed. These [h]~[pː]~[b] alternations are also exemplified by a diverse set of morphemes. In contrast, [d] occurs in exactly *one* morpheme in Kaqchikel; it cannot be accounted for by independent phonological processes in the language (section 3.8); and it is not particularly well-attested even in recent loans, as far as we can tell. See Fries and Pike (1949), Hall (2013), and references there for related discussion.

3.7 Other affixes

In our analysis, nasal hardening in Kaqchikel reflects the confluence of several factors: the cumulative phonological strength of stressed and word-initial syllables; and a morpho-phonological pressure to exclude affixal material from stressed syllables, which are positions of psycholinguistic and phonological prominence. These assumptions jointly account for the fact that nasal hardening is restricted to a single morpheme, the aspect marker /n-/.

To illustrate, Kaqchikel has two other aspect markers which can attach directly to monosyllabic verb stems (section 2.1): these are /ʃ-/ COMPLETIVE and /t-/ IRREALIS.3ABS. Since both of these aspect markers are voiceless obstuents, they will satisfy the conjoined constraint STRONGONSET (=*ONSET$\geq_{son}$N/σ_1 &$_{syll}$ *ONSET$\geq_{son}$N/$\acute{\sigma}$) even when attaching to vowel-initial, monosyllabic stems.

(30)   STRONGONSET ≫ DEP-C

/ʃ-ok/	STRONGONSET	DEP-C
a. .ʃ.'t<u>ok</u>.		*! W
b. .'ʃt<u>ok</u>.		*! W
c. ☞ .'ʃ<u>ok</u>.		

xok /ʃ-ok/ → ['ʃokʰ] '(s)he entered'

However, the simple ranking MATCH($\acute{\sigma}$, ROOT) ≫ DEP-C (23) would suggest that these non-nasal aspect markers should still trigger epenthesis with monosyllabic verb stems. Indeed, this ranking predicts, quite incorrectly, that consonant epenthesis should target *all* words with the underlying form /C-V(C)/.

Our resolution to this problem involves another layer of constraint cumulativity. It appears that MATCH($\acute{\sigma}$, ROOT), on its own, is insufficient to trigger epenthesis (though it remains *necessary* for explaining the morphological conditioning of nasal hardening; tableau (23)). Hardening occurs only when the outcome of epenthesis is to displace affixal material from stressed position, while *also* reducing onset sonority in strong, word-initial stressed syllables. Forms like (30b,c) fail on this latter count, as non-epenthetic *xok* [.'ʃokʰ.] already contains a relatively low-sonority onset.

These intutions can be formally implemented through multiple constraint conjunction: the conjoined constraints demanding low-sonority onsets in strong positions, when conjoined further with MATCH($\acute{\sigma}$, ROOT) (31), will produce the observed cumulativity effects (32).

(31)   AFFIXHARDENING = *ONSET$\geq_{son}$N/σ_1 &$_{syll}$ *ONSET$\geq_{son}$N/$\acute{\sigma}$ &$_{syll}$ MATCH($\acute{\sigma}$, ROOT)

(32)   AFFIXHARDENING ≫ DEP-C

/ʃ-ok/	AFFIXHARDENING	DEP-C
a. .ʃ.'t<u>ok</u>.		*! W
b. .'ʃt<u>ok</u>.		*! W
c. ☞ .'ʃ<u>ok</u>.		

xok /ʃ-ok/ → ['ʃokʰ] '(s)he entered'

(For related discussion, see Itô and Mester 2003a:Ch.2.)

We must also consider the /n/-final ergative and absolutive markers, which can also attach to vowel-initial, monosyllabic stems (i.e. 1S.ERG /in(w)-/ and 1S.ABS /i(n)-/; Figs. 3, 4). In fact, the analysis developed above to account for the lack of epenthesis with non-nasal aspect markers straightforwardly extends to these cases as well. The final nasal in these prefixes can occur as the onset of a stressed syllable, but *never* occurs in word-initial position. The constraint AFFIXHARDENING (32) is thus trivially satisfied by these agreement markers, leaving epenthesis wholly unmotivated.

(33)   AFFIXHARDENING ≫ DEP-C

/j-in-ok/	AFFIXHARDENING	DEP-C
a. .jin.ˈt<u>ok</u>.		*! W
b. ☞ .ji.ˈn<u>ok</u>.		

yinok /j-in-ok/ → [ji.ˈnok^h] 'I entered'

Similar reasoning explains the failure of epenthesis with /n/-final verb stems and suffixes, e.g. *kanonïk* /kan-on-ɪk/ → [ka.no.nɪk^h] 'hunting', *[ka<u>n</u>.to<u>n</u>.tɪk^h].

3.7.1 Noun prefixes

Our analysis still overgenerates consonant epenthesis in certain contexts. AFFIXHARDENING predicts the insertion of [t]~[d] in /C-VC/ words whenever the prefixal consonant is at least as sonorous as a nasal. Two prefixes are relevant here, both of them possessive prefixes on nouns (possessive prefixes are largely, but not entirely homophonous with the verbal ergative prefixes in Table 3). The possessive prefixes 1S.ERG /w-/ and 3S.ERG /r-/ are both more sonorous than nasals, but neither prefix conditions consonant epenthesis (34):

(34)   a.   /w-ɜkʔ/ → [wɜkʔ], *[wpɜkʔ] 'my chicken'
        b.   /r-ɜkʔ/ → [rɜkʔ], *[rtɜkʔ] 'his/her/its chicken'

One possibility is that the initial clusters produced by consonant epenthesis in forms like (34) are simply too marked, in some respect, to be tolerated. This seems reasonable, though it is complicated by the fact that Kaqchikel does allow at least some marked clusters in initial position (section 3.4.1).

Alternatively, the lack of epenthesis with possessive prefixes (34) may be rooted in deeper facts about the morpho-phonology of Kaqchikel. Morphological roots in Mayan languages tend to be /(C)VC/ in shape (see Bennett 2016, Bennett et al. In revision, Coon 2017 and references there). This /(C)VC/ root template is imposed more strictly on some lexical categories than others: verb roots are overwhelmingly /(C)VC/, while noun roots are frequently larger in size (e.g. /at͡ʃin/ 'man').

We speculate that one of the constraints driving consonant epenthesis in our analysis—-MATCH($\acute{\sigma}$, ROOT)—is grounded in the templatic character of the verbal root in Kaqchikel. Consonant epenthesis always produces a [CVC] sequence consisting of root material and an epenthetic C, but no affixal material. We might assume, then, that epenthetic [n-tVC] better satisfies the templatic requirements of verb roots than non-epenthetic [n-VC], perhaps because the affixal character of initial [n] is more transparent in [n-tVC] than in [n-VC]. If this is on the right track, the fact that prefixes undergo hardening in verbs, but not in nouns (34), then reduces to the independent fact that templatic requirements are more stringent for verbs than for nouns.

3.8 Voicing

In section 3.6 we noted a surprising fact about nasal hardening: in some dialects of Kaqchikel, hardening co-occurs with post-nasal voicing, /#n-ˈV.../ → [#nt̪-ˈV...]~[#nd̪-ˈV...]. To our knowledge, this is the only context in which post-nasal voicing occurs in Kaqchikel, as voiceless obstruents of all types are robustly attested following nasal consonants in the language (35).

(35)   a.   *jampe* [χam.pe] 'how many'
       b.   *ntix* [n-tiʃ](~[ni-tiʃ]) 'it was eaten'
       c.   *xintij* [ʃ-in-tiχ] 'I ate it'
       d.   *xinkanoj* [ʃ-in-kan-oχ] 'I looked for it'

We believe that post-nasal voicing follows directly from the epenthetic status of the post-nasal, coronal stop. In underlying /NC̥/ clusters, post-nasal voicing is blocked by high-ranked DEP[VOI] (36a).[14] In contrast, the coronal stop which appears in nasal hardening contexts is inserted rather than underlying. As a result, its form is regulated only by phonological markedness constraints, and not by faithfulness constraints (e.g. Lombardi 2002a,b, de Lacy 2006). DEP[VOI] is therefore unable to prevent post-nasal voicing from occurring (36b). Post-nasal voicing in nasal hardening contexts thus emerges as a textbook case of THE EMERGENCE OF THE UNMARKED (McCarthy and Prince 1994, Becker and Flack Potts 2011, and many others). (On the phonology of post-nasal voicing, see Itô and Mester 1986, Itô et al. 1995, Itô and Mester 2003a, Pater 1999, Hayes 1999.)

(36)   DEP[VOI] ≫ *NC̥ and TETU in nasal hardening

a.

/ʃ-in-kanoχ/	DEP[VOI]	*NC̥
a. ☞ .ʃin.ka.ˈnoχ.		*
b. .ʃin.ga.ˈnoχ.	*! W	L

xinkanoj /ʃ-in-kan-oχ/ → [.ʃin.ka.ˈnoχ.] 'I searched for it'

b.

/n-ok/	DEP[VOI]	*NC̥
a. ☞ .n.ˈd̪okʰ.		
b. .n.ˈt̪okʰ.		*! W

nok /n-ok/ → [n.ˈd̪okʰ] (Fig. 7) '(s)he enters'

For those dialects which do not show post-nasal voicing in nasal hardening contexts, we assume that a context-free constraint against voiced obstruents (*VOIOBS) outranks *NC̥ (37) (see also Gouskova et al. 2011). This constraint is clearly active in Kaqchikel, given the general lack of voiced obstruents in the language (Table 1) (i.e. *VOIOBS ≫ MAX[VOI]).

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[14]We follow Mester and Itô (1989), Lombardi (1991, 1995, 1999, 2001), Kehrein and Golston (2004), and Beckman et al. (2013) (among others) in assuming a privative [VOICE] feature, rather than binary [±VOICE] (Jakobson et al. 1952, Chomsky and Halle 1968). The voicing of underlyingly voiceless consonants is banned by DEP[VOICE], and devoicing is banned by MAX[VOICE].

(37) a. No TETU voicing in some dialects: {DEP[VOI],*VOIOBS} ≫ *NC̥

/n-ok/	DEP[VOI]	*VOIOBS	*NC̥
a. .n.ˈdokʰ.		*! W	
b. ☞ .n.ˈtokʰ.			* L

  b. TETU voicing in other dialects: DEP[VOI] ≫ *NC̥ ≫ *VOIOBS

/n-ok/	DEP[VOI]	*NC̥	*VOIOBS
a. ☞ .n.ˈdokʰ.			* L
b. .n.ˈtokʰ.		*! W	

We speculate that post-nasal voicing may play an additional functional role: the presence of otherwise unattested [d] in nasal hardening environments prevents surface merger between underlyingly vowel-initial and /t/-initial roots, and serves as a possible signal of the epenthetic origin (synchronically speaking) of the [d] itself. (The idea that phonological 'misapplication' is useful for identifying underlying forms can also be found in the literature on opacity; see e.g. Itô and Mester 2003b, Baković 2011 and references there.)

The voicing of post-nasal [t] → [d] in nasal hardening environments is, we think, another clue to the epenthetic status of this consonant. As noted in section 3.6, post-nasal voicing is not otherwise attested in Kaqchikel, including in those dialects which allow initial [#NC-] clusters under affixation of the aspect marker /n-/ (e.g. [n-tiχ-ɔx] '(s)he teaches', Comunidad Lingüística Kaqchikel 2004:204). Furthermore, voiced [nd-] is actually innovative when compared to historical [nt-] (section 3.3), meaning that post-nasal voicing must have developed in this context even in the complete absence of post-nasal voicing elsewhere in the language (and indeed, the complete absence of surface [d]). We conjecture that this otherwise surprising development can be rationalized as an instance of the emergence of the unmarked, but only if the post-nasal stop is taken to be epenthetic, and thus exempt from the faithfulness pressures which prevent post-nasal voicing in other environments.

4 Other varieties of Kaqchikel

In section 2.2 we observed that dialects of Kaqchikel differ in the conditions governing [n-]~[nt-, nd-] allomorphy in the incompletive aspect. We repeat the basic classification here:[15]

 (i) Use of [n-] in all contexts (with or without epenthesis)

 (ii) Use of [nt-]~[nd-] with monosyllabic verb stems, and [n-] otherwise (possibly with epenthesis)

 (iii) Use of [nd-] with all verb stems (sometimes in free variation with [n-])

 (iv) Use of [nd-]~[d-] with all verb stems, shifting toward fixed [d-] over time

 (v) Use of [nd-] with intransitives, and use of [n-] with transitives

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[15]Comunidad Lingüística Kaqchikel (2004:50-1) suggest that [nt-V…] has, in some sporadic cases, been reanalyzed as [n-tV…] (e.g. *xojtel* [ʃ-oχ-teḷ] 'we left' < historical [ʃ-oχ-eḷ] 'we left' + [nt-eḷ] '(s)he leaves'). Such cases of reanalysis do not appear to be systematic.

Our primary focus in this paper has been Type (ii) dialects, particularly the dialect of San Juan Comalapa Kaqchikel. We nonetheless feel that we are in a position to comment briefly on the distribution of [nt-]~[nd-] in other dialects of the language.

As discussed previously, Type (iii) dialects are in fact conservative (apart from the voicing of post-nasal [t], which we return to below). We take it, then, that the task before us is to explain the historical development of all other dialect types. There is a clear affinity between Type (i) (standard Kaqchikel) and Type (iv): these are dialects in which the complex initial cluster [#nd-] has been simplified across the board, albeit in different ways in Type (i) [n-] vs. Type (iv) [d-] languages. Type (ii) languages are a special case of Type (i), in which [#nd-] has simplified to [#n-], *except* when protected by the positional privilege of stressed, word-initial syllables (sections 3.3, 3.7).

This leaves only the Type (v) varieties in need of explanation. In these varieties, nasal hardening appears to be conditioned by transitivity rather than phonology, as in Type (ii) systems like Comalapa. In fact, we take Type (v) systems to be a further development of Type (ii) systems. True monosyllabic verb stems are always intransitive in Kaqchikel; this follows from the fact that the ergative agreement markers, which cross-reference transitive subjects, almost always contribute an extra syllable to the verbal stem (e.g. intransitive *nel* /n-el/ '(s)he left' vs. intransitive *naya'* /n-a-jaʔ/ 'you give it'). Comalapa Kaqchikel (Type (ii)) draws a line between monosyllabic—always intransitive—verb stems (e.g. *-el* /-el/ 'to leave') and polysyllabic stems of any class (e.g. intransitive *-atin* /-atin/ 'to bathe' or transitive *-elesaj* /-el-es-aχ/ 'to remove'). Type (v) dialects may have simply reanalyzed this pattern in morphological terms.[16]

One aspect of this landscape remains mysterious under our analysis. In sections 3.6 and 3.8 we argued that surface voiced [d] indicates that epenthesis has occurred, since [d] is not in general a phoneme of the language, and is conditioned by a process of post-nasal voicing that *only* applies after the aspect marker /n-/. The distribution of surface [d] in allomorphs of the incompletive aspect marker in Type (iii), (iv), and (v) dialects is surprising under this view.

To unpack why, we assume (temporarily, for the sake of argument) that surface [d] is always the result of consonant epenthesis. For Type (iii) dialects, we must then explain why epenthesis occurs after *all* instances of incompletive /n-/, but never after any other instance of word-initial [#n]. (In our analysis of Comalapa Kaqchikel (Type (ii)), this follows from constraints like MATCH($\acute{\sigma}$, ROOT), which are sensitive to *both* prosody and morphology; note that these constraints will not produce epenthesis on polysyllabic verb roots.) Type (iv) dialects pose the same problem, with the additional complication that incompletive aspect is sometimes marked *only* with 'epenthetic' [#d-], even though neither [t d]-epenthesis nor stop voicing are motivated (in our analysis) in the absence of initial [#n-] (which is perhaps present underlyingly, but lost in some opaque process of [n]-deletion). For Type (v) dialects, we would appear to be committed to the view that epenthesis is conditioned by verb transitivity directly.

The alternative, of course, is to assume that Type (iii), (iv), and/or (v) dialects have simply innovated /d/ as a highly marginal phoneme (despite our protestations in section 3.6). The phonemicization of /d/ would immediately explain why this segment occurs in contexts in which its appearance lacks any clear phonological motivation. If correct, this strikes us a surprising development, given that [d]—even in these dialects—is entirely unattested outside of incompletive aspect marking. These issues seem to us worthy of further investigation.

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[16]Alternatively, Type (v) varieties are a direct reanalysis of the more conservative Type (iii) varieties, though we are unsure why Type (iii) dialects would give rise to an immediate split in terms of transitivity distinctions without an intervening stage in which transitivity is correlated with some other factor conditioning allomorphy, such as syllable count in Type (ii) systems.

5 Conclusion

Nasal hardening in Kaqchikel is a morpheme-specific phenomenon which can be straightforwardly analyzed as run-of-the-mill suppletive allomorphy. In that light, nasal hardening seems to be nothing more than a minor issue in the morpho-phonology of Kaqchikel. But as we have often learned from Junko and Armin's work, sustained engagement with seemingly simple problems can reveal new puzzles, as well as deep insights into the workings of grammar.

The phonological analysis of nasal hardening is considerably more complex than simple lexical listing of allomorphs. Readers might reasonably favor lexical listing on those grounds alone. Still, crafting a phonological model of nasal hardening is, we think, a useful exercise: it has forced us to make connections between phonetics, phonology, and morphology which we might not have otherwise made. And in drawing those connections, we cannot help but think of Junko and Armin, who always encouraged us to consider the bigger picture.

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