User's Guide to Central Alaskan Yup'ik Stress Derivation

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1. Introduction

This guide synthesizes the stress pattern of Central Alaskan Yup'ik (henceforth: Yup'ik) into steps for deriving footing and stress. Its goal is to demonstrate how the basic patterns of Yup'ik metrics, as adjusted from the description provided in (Hayes, 1995), can be ordered to derive the stress of any given Yup'ik word.

This model was developed for, and validated by, the acoustic analysis of six recordings of spoken Yup'ik, four recordings of supplementary educational materials for a Yup'ik language textbook (Reed, 1977) and recordings of Paschal Afcan's *Napam Cuyaa* (Afcan & Hofseth, 1972) and Annie Blue's *Cikmiumalria Tan'gaurluq Yaqulegpiik-llu*, in the book *Cungauyaraam Qulirai: Annie Blue's Stories* (Blue, 2007). All recordings are available in the Alaska Native Language Archive (ANLA identifiers: ANLC3111a, ANLC3111b, ANLC3112a, ANLC3113a, CY(SCH)967A1972g, and CY970B2007) (Alaskan Native Language Archive, n.d.). Acoustic analysis found consistent phonetic correlates of stress as marked following this User's Guide (Alden & Arnhold, submitted).

2. Metrical Model of Yup'ik Stress

In Hayes' (1995) metrical model, Yup'ik stress parameters include that all feet are binary, quantity sensitive, iambic, constructed left-to-right, and iterative, with the foot's head being obligatorily heavy. Yup'ik stress assignment is additionally complicated by presence of lexical stress, automatic gemination and the influence of morphological and prosodic boundaries, as well as irregular metrical behavior of closed syllables (see Halle, 1990; Jacobson, 1984, 1985, 1990; Jacobson & Jacobson, 1995; Leer, 1985a, b); Miyaoka, 1985, 2012; Reed, 1977; Woodbury, 1987, 1995; among others). We began from Hayes' description of the stress pattern and tested the cyclical derivation's output against the recordings. Where there was a misprediction or lack of a prediction for any given word, adjustments to the Hayes model were made. Mispredictions necessitated expanding the automatic gemination environment from (C)V.CVV sequences within a foot to all (C)V.CVV sequences, contra Hayes, but in line with the rest of the Yup'ik literature, as cited above, and observations from the recordings, as well as the explicit inclusion of lexical gemination and lexical stress in the present model. Other adjustments were necessary to expand the applicability of the model to the complete data set. Thus, although Hayes does not explicitly discuss CVVC syllables, the present model follows his assumption that codas always contribute a mora, applying it also to syllables with long nuclei; it also explicates the consequences of schwa deletion in closed

syllables (see Alden & Arnhold, submitted, for a more detailed description of basic stress patterns in Yup'ik, Hayes' model and the adjustments resulting in the present model).

The resultant steps for accurately deriving the Yup'ik stress pattern, starting from the underlying form, are as follows:

0. Pre-Footing Lexical Phonology, in which lexical stress and lexical gemination are considered as part of the underlying form;
1. Foot Determination, in which the underlying form of a word (minus any clitics) is assigned iterative iambic feet from left to right;
2. Automatic Gemination, in which (C)V.CVV -> (C)VG.GVV;
3. Defooting in Double Clash, in which closed syllables lose a mora when between stressed syllables or between a stressed syllable and the right edge of a word;
4. Schwa Deletion, in which stressed schwas in open syllables are deleted and the onset of the syllable is reassigned as the coda of the preceding syllable[1];
5. Clitic Incorporation, in which clitics are added back into the derivation;
6. Iambic Lengthening, in which light, open syllables that are assigned stress are lengthened;
7. Phrase-Final Effects, wherein the final syllable of an IP is de-stressed.

This guide makes use of a metrical interpretation of the stress pattern of Yup'ik—that is, that prominent syllables are distributed by a foot level in the prosodic hierarchy. Furthermore, here Yup'ik footing is treated as cyclical: following each step in the derivation, the entire derivation begins again, cycling as many times as necessary to reach the right edge of the word. Processes 2-5 of the stress derivation trigger cyclic re-footing, i.e. returning to step 1.

3. Sample Derivations

In this section, the adjusted model will be demonstrated using the words *paqequraqekek*, *itrucaaqellria-gguq-am, tuqulluki*, and *maqaruaq*. These four examples were chosen because they trigger different processes in the derivation: *paqequraqekek* demonstrates schwa deletion; *itrucaaqellria-gguq-am* undergoes cliticization, automatic gemination, and defooting in clash; *tuqulluki* is a prototypical example for iambic lengthening; and *maqaruaq* demonstrates automatic gemination and superheavy footing.

[1] Schwa deletion may optionally also apply in closed syllables, but in this case has no metrical consequences, as the coda of the syllable becomes syllabic and the onset is not reassigned.

Each Table 1-6 represents one cycle in the metrical derivation, where the input of each subsequent table is the output of the previous.

Table 1 begins the sample derivations with syllabification. The input for syllabification is the underlying form of each word. The Yup'ik spelling system reflects the phonemic form of each word, such that *paqequraqekek* is /paqəquχaqəkək/, *itrucaaqellria-gguq-am* is /itχutʃaːqəɬχiaxuqam/, *tuqulluki* is /tuquɬuki/, and *maqaruaq* is /maqaχuaq/ (note that while double vowel letters mark vowel length, double consonant letters indicate voicelessness). None of these examples feature lexical stress or lexical gemination, although if they did, these would be represented in the underlying form. Note that clitic boundaries are respected during syllabification.

Table 1: Examples of syllabification

	paqequraqekek	itrucaaqellria-gguq-am	tuqulluki	maqaruaq
Underlying Form	/pa.qə.qu.χa.qə.kək/	/it.χu.tʃaː.qəɬ.χia.xuq.am/	/tu.qu.ɬu.ki/	/maqaχuaq/
Syllabic Form	CV.CV.CV.CV.CV.CVC	VC.CV.CV:.CVC.CVV.CVC.VC	CV.CV.CV.CV	CV.CV.CVVC
Closure (Open-Closed)	O.O.O.O.O.C	C.O.O.C.O.C.C	O.O.O.O	O.O.C
Length (Short V̆ - Long V:)	V̆. V̆. V̆. V̆. V̆. V̆	V:. V̆.V:.V̆.V:.V̆.V̆	V̆.V̆.V̆.V̆	V̆.V̆.V:
Weight (Light-Heavy)	L-L-L-L-L-H	H-L-H-H-H-H-H	L-L-L-L	L-L-H

Table 2 demonstrates foot determination, following an adjusted version of Hayes' footing parameters in which CVVC syllables always constitute their own foot.

Table 2: Examples of foot determination

	paqequraqekek	itrucaaqellria-gguq-am	tuqulluki	maqaruaq
Input (Syllabic Form)	CV.CV.CV.CV.CV.CVC	VC.CV.CV:.CVC.CVV.CVC.VC	CV.CV.CV.CV	CV.CV.CVVC
Clitic Removal	---	VC.CV.CV:.CVC.CVV	---	---
Initial Foot Determination	(CV.CV).(CV.CV).(CV.CVC)	(VC).(CV.CV:).(CVC).(CVV)	(CV.CV).(CV.CV)	(CV.CV).(CVVC)

Itrucaaqellria-gguq-am ends with two clitics, *-gguq-* and *-am*, which are temporarily set aside at this step in the derivation. When determining initial footing, it is assumed that codas do contribute to weight and that heavy syllables can only occupy the head of a foot. The result is a variety of foot shapes, including (CV.CV), (VC), (CV.CV:), (CVC), and (CVV).

Table 3 represents the next stage in the derivation, automatic gemination. Automatic gemination (also called pre-long strengthening) is the process by which an open syllable

becomes closed (Jacobson, 1985, 1995; Miyaoka, 1971, 2012). Hayes (1995) correctly specifies the main trigger environment (environment 1 in Table 3) as a light-long (CV.CVV/CV:C) sequence; however, in the metrical analysis proposed in this study, this gemination can also be triggered by an unfooted open syllables preceding a long syllable (environment 2) or across foot boundaries (environment 3). These three environments, which together represent all (C)V.CVV environments, are each identified in their own row.

Table 3: Examples of automatic gemination (pre-long strengthening)

	paqequraqekek	itrucaaqellria-gguq-am	tuqulluki	maqaruaq
Input	(CV.CV).(CV.CV).(CV.CVC)	(VC).(CV.CV:).(CVC).(CVV)	(CV.CV).(CV.CV)	(CV.CV).(CVVC)
Environment 1	---	(VC).(**CV.CV:**).(CVC).(CVV)	---	---
Environment 2	---	---	---	---
Environment 3	---	---	---	(CV.**CV).(CVV**C)
Gemination	---	(VC).(CV**G.G**V:).(CVC).(CVV)	---	(CV.CV**G).(G**VVC)
Refooting	---	(VC).(CVG).(GV:).(CVC).(CVV)	---	---

In the example words, *itrucaaqellria-gguq-am* contains environment 1: in the second foot of the word, composed of the syllables *ru.caa* (CV.CV:), the Hayes condition is met and the long syllable geminates, resulting in a (CVG.GV:) foot. This violates the constraint that heavy syllables cannot occupy weak foot positions, and so cyclical footing applies and the sequence is divided into two feet instead, (CVG).(GV:). Automatic gemination also applies to *maqaruaq*, only this time, it occurs across the foot boundary (environment 3) and does not trigger refooting.

Adjusting syllable shape has consequences, one of those being the introduction of a CVC syllable in a double clash environment, i.e. between two stressed syllables or between a stressed syllable and the rightmost edge of the word. Table 4 shows how this is resolved: by de-footing the CVC syllable in clash.

Table 4:Examples of defooting in double clash

	paqequraqekek	itrucaaqellria-gguq-am	tuqulluki	maqaruaq
Input	(CV.CV).(CV.CV).(CV.CVC)	(VC).(CVG).(GV:).(CVC).(CVV)	(CV.CV).(CV.CV)	(CV.CVG).(CVVC)
CVC Foot in Clash	---	(VC).**(CVG)**.(GV:).**(CVC)**.(CVV)	---	---
Defoot in Clash	---	(VC).CVG.(GV:).CVC.(CVV)	---	---

The result of automatic gemination on *itrucaaqellria-gguq-am* is several clash environments in which CVC syllables occur between other stressed syllables. These CVC syllables are then de-footed, resulting in the syllables *ru, qell,* and *gguq* becoming de-footed and defooted. The mechanism for achieving this, following Hayes, is that the coda loses its mora, which means the CVC syllable becomes light and cannot form a foot by itself anymore. In *maqaruaq*, which also featured gemination, the newly created closed syllable is not a CVC syllable, but a CVVC syllable. This means that even if its coda becomes non-moraic, the syllable still has a bimoraic vowel and remains heavy. Thus, it maintains its footing even between a stressed syllable and the right word edge.

Next in the derivation is schwa deletion. Table 5 demonstrates how schwas that are set to receive stress are instead obligatorily deleted in open syllables.

Table 5: Examples of schwa deletion

	paqequraqekek	itrucaaqellria-gguq-am	tuqulluki	maqaruaq
Input	(CV.CV).(CV.CV).(CV.CVC)	(VC).CVG.(GV:).CVC.(CVV)	(CV.CV).(CV.CV)	(CV.CVG).(CVVC)
Schwa Deletion Environment	(CV.C**V**).(CV.CV).(CV.CVC)	---	---	---
Schwa Deletion	(CV.C).(CV.CV).(CV.CVC)	---	---	---
Refooting	(CVC).(CV.CV).(CV.CVC)	---	---	---

Paqequraqekek has, up until this point in the derivation, not met any of the criteria for any metrical processes beyond initial footing. The result of initial footing, however, is the second syllable *qe* becoming stressed. The nucleus of this syllable is a schwa. Therefore, schwa deletion is triggered, and the result is two neighboring stops, *pa.qe.qur -> paq.qur*. While this does result in a geminate stop, it is not necessarily an instance of gemination as a phonological process: rather, it is a result of the stressed schwa deleting and the circumstance of two identical stops coming together, rather than one stop extending leftwards. Another example illustrating the deletion of a stressed schwa in an open syllable is *atepik* /ɑ.tə.pɪk/ ‘real name’ (Hayes 1995:253). In this example, initial footing also makes the syllable *tə* the head of an iamb. Rather than stressing the schwa, it is deleted, resulting in [ˈɑt.pɪk].

At this point, clitics are re-introduced back into the derivation and footed accordingly. Table 6 shows the last three steps, cliticization, iambic lengthening, and phrase-final defooting. The final three steps of the derivation process can all be discussed together, as there is only one branch that leads to cyclical refooting.

Table 6: Examples of cliticization, iambic lengthening, and phrase-final defooting

	paqequraqekek	itrucaaqellria-gguq-am	tuqulluki	maqaruaq
Input	(CVC).(CV.CV).(CV.CVC)	(VC).CVG.(GV:).CVC.(CVV)	(CV.CV).(CV.CV)	(CV.CVG).(CVVC)
Cliticization	---	(VC).CVG.(GV:).CVC.(CVV).CVC.CV	---	---
Refooting	---	(VC).CVG.(GV:).CVC.(CVV).(CVC).CV	---	---
Iambic Lengthening	('CVC).(CV.'CV·).(CV.ˈCVC)	---	(CV.'CV·).(CV.'CV·)	(CV.'CVG).(ˈCVVC)
Phrase-Final Defooting	('CVC).(CV.'CV·).(CV.CVC)	---	(CV.'CV·).(CV.CV·)	(CV.'CVG).(CVVC)
Output (Syllabic)	('CVC).(CV.'CV·).(CV.CVC)	('VC).CVG.('GV:).CVC.('CVV).('CVC).CV	(CV.'CV·).(CV.CV·)	(CV.'CVG).(CVVC)
Output (Phonetic)	['paq.qu.'χaˑ.qə.kək]	['it.χut͡ʃ.'t͡ʃaː.qəɬ.'χia.'xuq.am]	[tu.'quˑ.ɬu.kiˑ]	[ma.ˈqaχ.χuaq]

Following the schwa deletion in Table 5, the clitics set aside early in the derivation are re-introduced in Table 6. In *itrucaaqellria-gguq-am*, there are two clitics, and the first can be footed. It is a CVC syllable, but is not in double clash; therefore, the clitic *-gguq-* does receive stress. This does not cause any change to any of the feet to the left of the clitic. However, it is often the case, as it is in *itrucaaqellria-gguq-am*, that the new word-final syllable is not in a position to be footed, since the resultant foot would contain a heavy syllable not being the head, *(CVC.CV). In these instances, the last syllable simply is not footed and the derivation moves forward into iambic lengthening. Sometimes, however, a clitic will attach to a word that previously ended with a light syllable, as with the clitic *-mi* in *upnerkami* /up.nəχ.ka.mi/. In these cases, the syllable *ka* and clitic *-mi* form a foot of their own, with the clitic receiving stress, as shown in Table 7.

Table 7: Example of a footed clitic receiving stress

Input	/up.nəχ.ka.mi/ VC.CVC.CV.CV
Clitic Removal	VC.CVC.CV
Footing	(VC).(CVC).CV
Cliticization	(VC).(CVC).CV.CV
Refooting	(VC).(CVC).(CV.CV)
Iambic Lengthening	(VC).(CVC).(CV.CVˑ)
Output	(ˈVC).(ˈCVC).(CV.ˈCVˑ) [ˈup.ˈnəχ.ka.ˈmi]

Table 7 demonstrates that a clitic can receive stress when it can form the head of a foot with a previously unfooted light syllable, although this stress would be deleted phrase-finally. Note that the output of Table 7 features a closed syllable with a stressed schwa, *ner* /nəχ/: the presence of this schwa is optional, and its deletion would not impact the metrical derivation of the word.

In addition to cliticization, Table 6 above also demonstrates iambic lengthening and phrase-final defooting. Iambic lengthening ensures that no light syllable bears stress: only heavy syllables may be stressed, and so any CV syllable that is derived to be stressed must be lengthened. For *paqequraqekek*, this affects the second foot (qu.χa). For *tuqulluki*, this affects both feet, such that the alternating stress rhythm (tu.ˈqu)(lu.ˈki) is achieved. Iambic lengthening is marked with the half-long diacritic in the output forms, so as to avoid implying equivalence with phonemically long vowels. Lastly, any stressed IP-final syllables are defooted. For the sake of example, we will assume the words in this section are spoken in isolation, and therefore constitute their own IPs: as a result, *paqequraqekek* loses its stress on *kek*, *tuqulluki* loses its stress on *ki* and *maqaruaq* loses its stress on *ruaq*. The end result of the full derivation is the surface forms [ˈpaq.qu.ˈχaˑ.qə.kək], [ˈit.χutʃ.ˈʧaː.qəɬ.ˈχia.ˈxuq.am], [tu.ˈquˑ.ɬu.ki], and [ma.ˈqaχ.χuaq].

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