Vowel Raising and Positional Privilege in Klamath

Charlie O’Hara

University of Southern California
Presented at SSILA 2015
January 11, 2015
In previous work on Klamath (Barker, 1963, 1964), several opaque alternations are explained using abstract phonemes in the underlying forms.

Specifically here, we’ll look at the phoneme /i/. This phoneme only appears in final syllables in verb stems.

According to Barker (1964), /i/ either deletes or surfaces as [i].

If Klamath has the phoneme /i/ available to the lexicon,
  - Why doesn’t it ever appear in non-verbs?
  - Why doesn’t it appear in stem-initial syllables?

CLAIM
This alternation is caused by underlying /e/.
Background on Klamath

- Klamath was spoken in south-central Oregon.
- It has been argued both to be a Plateau Penutian language (DeLancey, 2000), and a linguistic isolate (Lewis et al., 2013).
- There are no living native speakers of Klamath.
# Phonemic Inventory of Klamath

## Consonants of Klamath (Adapted from Blevins (1993))

<table>
<thead>
<tr>
<th>Consonants</th>
<th>Bilabial</th>
<th>Alveolar</th>
<th>Palatal</th>
<th>Velar</th>
<th>Uvular</th>
<th>Glottal</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Stops</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Unaspirated</td>
<td>p</td>
<td>t</td>
<td>ŋf</td>
<td>k</td>
<td>q</td>
<td></td>
</tr>
<tr>
<td>Aspirated</td>
<td>pʰ</td>
<td>tʰ</td>
<td>ŋfʰ</td>
<td>kʰ</td>
<td>qʰ</td>
<td></td>
</tr>
<tr>
<td>Ejective</td>
<td>p’</td>
<td>t’</td>
<td>ŋf’</td>
<td>k’</td>
<td>q’</td>
<td>?</td>
</tr>
<tr>
<td><strong>Fricatives</strong></td>
<td></td>
<td>s</td>
<td></td>
<td></td>
<td></td>
<td>h</td>
</tr>
<tr>
<td>Voiced</td>
<td>m</td>
<td>n</td>
<td>l</td>
<td>j</td>
<td>w</td>
<td></td>
</tr>
<tr>
<td>Voiceless</td>
<td>m̊</td>
<td>n̊</td>
<td>l̊</td>
<td>j̊</td>
<td>ẘ</td>
<td></td>
</tr>
<tr>
<td>Laryngealized</td>
<td>m’</td>
<td>n’</td>
<td>l’</td>
<td>j’</td>
<td>w’</td>
<td></td>
</tr>
</tbody>
</table>
Vowels of Klamath (Adapted from Blevins (1993))

<table>
<thead>
<tr>
<th>Vowels</th>
<th>+front</th>
<th>+long</th>
<th>+front</th>
</tr>
</thead>
<tbody>
<tr>
<td>+hi</td>
<td>i</td>
<td>u</td>
<td>+hi</td>
</tr>
<tr>
<td></td>
<td>e</td>
<td>a</td>
<td></td>
</tr>
</tbody>
</table>
Sources

- This searchable representation is available on my website.
There’s significant evidence that [a] is the default epenthetic vowel in Klamath.

\[\text{/snak'la}/ \quad [\text{snak'la}] \quad \text{‘has spots on the face’} \quad (\text{Barker, 1963, p. 379})\]

\[\text{/snak'als}/ \quad [\text{snak'als}] \quad \text{‘pregnancy spots’} \quad (\text{Barker, 1963, p. 301})\]

\[\text{/pʰɪpʰɪːk'tkʰ}/ \quad [\text{pʰɪpʰɪːk'atkʰ}] \quad \text{‘wearing a bracelet’} \quad (\text{Barker, 1963, p. 301})\]

\[\text{/pʰɪpʰɪːk's}/ \quad [\text{pʰɪpʰɪːks}] \quad \text{‘bracelet’}\]
Glottalization Effects

- The glottal stop in Klamath tends to coalesce with the previous consonant when in a C?V context.
  \[/p^{\text{hetf}}-?a:k'/]  [p^{\text{hetf}}'a:k]  ‘little foot’  (Barker, 1964, p. 54)
- The [constricted glottis] node usually deletes when not in syllable onset.
  \[/n-t^{\text{hit}}'-tqi/]  [nt^{\text{hit}}tqi]  ‘defecates’  (Barker, 1963, p. 408)
Setup

- For our purposes we will focus largely on two verb suffixes
  - /-a/: the indicative suffix
  - /-tkʰ/: having been ...-ed

- With most consonant final morphemes, [a] epenthesis is triggered when combined with /-tkʰ/
  /taq’-a/   [taq’a]   ‘is sharp edged’ (Barker, 1963, p. 109)
  /taq’-tkʰ/  [taq’atkʰ] ‘sharp edged’

- With [i] final morphemes, the [a] of the indicative suffix is deleted.
  /stupwi-a/  [stupwi]   ‘has first menstruation’ (D-358)
  /stupwi-tkʰ/ [stupwiṭkʰ] ‘woman’
Around 50 stems show [i] before the /-tkʰ/ morpheme, but appear consonant final elsewhere.

a) [ʔeːwɑ] ‘is deep’ (D-31)
b) [ʔeːwɨtkʰ] ‘deep’

Many of these stems show glottalization on the final consonant where it would be licensed, unless the [i] surfaces.

a) [ntʰeːwɑ] ‘breaks with a round instrument’ (D-403)
b) [ntʰeːwɨtkʰ] ‘broken’
c) [ntʰewɨli] ‘breaks into’
The underlying form for these stems cannot be a surface exponent.

- If the underlying form for 'be deep' was /eːw/, it should pattern like other consonant final stems.
- We would get [eːwa] and *[eːwatkʰ]
- If the underlying form was /eːwi/, it should pattern like i final stems.
- We would get *[eːwi] and [eːwitkʰ]
Analyses

- Barker (1964) marks these stems with an abstract phoneme seen nowhere else in the grammar, /i/.
- This phoneme is specifically defined only to capture this alternation.
  - /ʔeːwiʔ-a/ → [ʔeːwa]
  - /nteːwiʔ-tkʰ/ → [nteːwitk]
- However, this analysis adds complexity to the lexicon that may not be warranted.
  - Why doesn’t it appear in other contexts?
  - /ʔiːw-a/ → ???
### [i] Epenthesis?

- In order to get [ʧimaʔas], [a] epenthesis must bleed [cg] deletion.

<table>
<thead>
<tr>
<th>U.R.</th>
<th>/ʧimaʔ-s/</th>
<th>/ntʰe:w’-tkʰ/</th>
</tr>
</thead>
<tbody>
<tr>
<td>[a]-Epen</td>
<td>[ʧimaʔas]</td>
<td>ntʰe:w’atkʰ</td>
</tr>
<tr>
<td>[cg]-Del</td>
<td>—</td>
<td>—</td>
</tr>
<tr>
<td>S.R.</td>
<td>[ʧimaʔas]</td>
<td>[ntʰe:w’atkʰ]</td>
</tr>
</tbody>
</table>

- But in order to get [ntʰe:wtkʰ], through [i]-epenthesis, [i]-epenthesis must counter-bleed [cg]-deletion.

<table>
<thead>
<tr>
<th>U.R.</th>
<th>/ʧimaʔ-s/</th>
<th>/ntʰe:w’-tkʰ/</th>
</tr>
</thead>
<tbody>
<tr>
<td>[cg]-Del</td>
<td>[ʧima:s]</td>
<td>ntʰe:wtkʰ</td>
</tr>
<tr>
<td>[i]-Epen</td>
<td>—</td>
<td>ntʰe:wtkʰ</td>
</tr>
<tr>
<td>S.R.</td>
<td>[ʧima:s]</td>
<td>[ntʰe:wtkʰ]</td>
</tr>
</tbody>
</table>
[i] Epenthesis?

- However, if we assume this ordering, [a]-Epenthesis should bleed [i]-Epenthesis, since [i]-Epenthesis occurs in contexts where we expect to see [a]-Epenthesis.

- Without some sort of abstract feature preventing [a]-epenthesis, we cannot get \[nt^h e:w'tk^h\]

<table>
<thead>
<tr>
<th>U.R.</th>
<th>/tʃimaːʔ-s/</th>
<th>/nt^h e:w’-tk^h/</th>
<th>/nt^h e:w’-tk^h/</th>
<th>No a-epen</th>
</tr>
</thead>
<tbody>
<tr>
<td>[a]-Epen</td>
<td>tʃimaːʔas</td>
<td>nt^h e:w’atk^h</td>
<td>—</td>
<td>—</td>
</tr>
<tr>
<td>[cg]-Del</td>
<td>—</td>
<td>—</td>
<td>nt^h e:wtk^h</td>
<td>—</td>
</tr>
<tr>
<td>[i]-Epen</td>
<td>—</td>
<td>—</td>
<td>nt^h e:wtk^h</td>
<td>—</td>
</tr>
<tr>
<td>S.R.</td>
<td>tʃimaːʔas</td>
<td>[nt^h e:w’atk^h]</td>
<td>[nt^h e:wtk^h]</td>
<td>[nt^h e:wtk^h]</td>
</tr>
</tbody>
</table>

- Thus, this analysis is just as abstract as the /i/ analysis, since all the same stems must be marked.
This alternation is caused by underlying /e/.

- The 4-way vowel contrast in Klamath exists only in privileged positions.
- /e/ deletes when possible, else it raises to [i].
Distribution of e

- [e] is never found as the last segment in a multisyllabic verb stem in Barker (1963)
- This is not true for the other vowels.
  - /?ampu/ ‘is thirsty’ (D-26)
  - /sq'h:e:ti/ ‘be on the left’ (D-390)
  - /swaqsna/ ‘straighten out’ (D-399)
Out of over 3100 verb surface forms in Barker’s dictionary, only 71 show non-initial e.

Of these, 56 are caused by reduplication of a stem-initial [e].

\[p’etqp’etq’a\] blinks (D-308)

The remaining 15 forms get their [e]s from just four morphemes. The low frequency of these leads me to believe that these are lexical exceptions.

Thus, I claim [e] is not found normally in verb non-initial position.
If /e/ always surfaces faithfully, then it would need to be an accidental gap in Klamath’s lexicon that /e/ never surfaces in non-initial positions in verbs.

- /?eːwe-tkʰ/ → ?? *[/?eːwetkʰ]

Under the abstract phoneme analysis, /i/ only appears in the final syllable of multisyllabic verb stems, either as the last segment, or only followed by a glottal stop.

- /e/ and /i/ are in complementary distribution.

- Both can be represented by the same underlying phoneme, /e/, minimizing the abstractness of the Klamath lexicon.
Abstractness

- Under the abstract phoneme analysis, there must be lexical rules
  - /e/ is not allowed in noninitial syllables of verb stems
  - /i/ is only allowed at the right edge of multisyllabic verb stems (or 50 verb stems are memorized exceptions)
- Under this /e/ analysis,
  - 4 verb stems with noninitial syllable /e/ are exceptional
- This analysis is far less lexically abstract.
Positional Privilege

- Phonological contrasts are more likely to be maintained in privileged positions. (Beckman, 1998)
- Privilege can come from phonetic or psycholinguistic grounds.
  - Verbs are less privileged than non-verbs. (Smith, 1998, 2011)
  - Initial syllables are privileged over non-initial syllables. (Steriade, 1995; Walker, 2011; Trubetzkoy, 1969)
  - Long vowels are privileged over short vowels. (Steriade, 1995)
Klamath typically has a four-way vowel quality contrast, but in the least privileged position, non-initial syllables of verbs, only a three way contrast is preserved.

Barnes (2002) shows that it is rather cross-linguistically common for a language to lose some height contrasts in unstressed syllables.

- Many five vowel-systems shrink to three vowel systems.
- This effect happens in unstressed syllables because they are less privileged than stressed syllables. (Walker, 2011; Crosswhite, 2004; Beckman, 1998)
  - So we should expect to see similar vowel inventory shrinking in other unprivileged positions.
[e] is the most marked of the vowels in Klamath

A three vowel inventory with [i a u] is much more likely than [i e a] or any other combination, because these ‘corner vowels’ are maximally acoustically distinct, (Crosswhite, 2004).
Repairs

- Since [e] is marked in this unprivileged position, there needs to be some repair.
  - If deletion is feasible, it deletes.
    /?eːwe-a/ → [?eːwa]
  - If the phonotactics prevent deletion of the vowel, it raises.
    /?eːwe-tkʰ/ → [?eːwtkʰ], *[?eːwtkʰ]
Richness of the Base

- Under this analysis, verbs with /e/ in non-initial positions have either /e/ raising or /e/ deletion.
  - Typically, non-initial /e/ deletes.
  - If deletion would create a phonotactically illicit cluster, /e/ raises instead.

- \([\text{Ctk}^h]\) is an illicit coda in Klamath.

- If the /e/ is morpheme final, we see the \([i] \sim [\emptyset]\) alternation, because /e/ must raise to avoid \([\text{Ctk}^h]\).
  - 
  - /...Ce-a/ → [...Ca]
  - /...Ce-tk^h/ → [...Citk^h], * [...Ctk^h]
Richness of the Base II

- If a glottal stop intervenes between /e/ and the end of the stem, the glottal stop will delete in order to avoid the [ʔtkʰ] coda, so /e/ will raise before /-tkʰ/.
  - /...Ceʔ-a/ \(\rightarrow\) [...C’a]
  - /...Ceʔ-tkʰ/ \(\rightarrow\) [...Citkʰ],[* [...Ctkʰ]

- If any other consonant intervenes between /e/ and the end of the stem, this alternation will not appear, because epenthesis will break up the [Ctkʰ] cluster.
  - /...CeC-a/ \(\rightarrow\) [...CCa]
  - /...CeC-tkʰ/ \(\rightarrow\) [...CCatkʰ]

- These stems will be lexicalized as having no /e/, since this /e/ deletes in all contexts.

- If an /e/ exists stem internally breaking up a large cluster, it should always raise, no matter what suffixes are applied.
  - /...CCeCC-a/ \(\rightarrow\) [...CCiCCa],[* [...CCCCa]
  - /...CCeCC-tkʰ/ \(\rightarrow\) [...CCiCCatkʰ]

- These stems will always be lexicalized as containing /i/. 
Richness of the Base III

- With this analysis, any gaps in the distribution of \(/e/\) throughout the lexicon are caused by total neutralization with \(/i/\) or \(/∅/\).

- No abstract phonemes have highly specific distributions in the lexicon.
This phenomenon can be modeled easily using Positional Faithfulness constraints. (Beckman, 1998).

With the constraint ranking:
Positional Faithfulness $\gg$ Markedness $\gg$ General Faithfulness
this type of positional neutralization falls out.
Constraints

- **Dep[hi]** - Violated by epenthesis of a [hi] node. /e/ → [i]
- **Max-V** - Violated by deleting a vowel. /e/ → [∅]
- ***MidV** - Violated by mid vowels in output. [e].
- **PhTAC** - Violated by illicit clusters. [Ctkʰ]
- **F/P** - Violated by violations of a faithfulness constraint F in a position P.
In order for noninitial /e/ to delete in most situations, *MidV and Dep[hi] must dominate Max-V.

<table>
<thead>
<tr>
<th></th>
<th>*MidV</th>
<th>Dep[hi]</th>
<th>Max-V</th>
</tr>
</thead>
<tbody>
<tr>
<td>/tʃ’uːjeʔ-a/</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>a. tʃ’uːj’a</td>
<td></td>
<td></td>
<td>*e</td>
</tr>
<tr>
<td>b. tʃ’uːjeʔa</td>
<td>*e W</td>
<td></td>
<td>L</td>
</tr>
<tr>
<td>c. tʃ’uːjiʔa</td>
<td></td>
<td>*iW</td>
<td>L</td>
</tr>
<tr>
<td>/skʰumεʔ-ʔa/</td>
<td>*MidV</td>
<td>Dep[hi]</td>
<td>Max-V</td>
</tr>
<tr>
<td>d. skʰumta</td>
<td></td>
<td></td>
<td>*e</td>
</tr>
<tr>
<td>e. skʰumeta</td>
<td>*e W</td>
<td></td>
<td>L</td>
</tr>
<tr>
<td>f. skʰumita</td>
<td></td>
<td>*iW</td>
<td>L</td>
</tr>
</tbody>
</table>
In order for deletion to be prevented and raising to occur, $\text{PhTAC}$ and $\text{*MidV}$ must dominate $\text{Dep[hi]}$.

<table>
<thead>
<tr>
<th>/tʃ'uːjeʔ-tkʰ/</th>
<th>PhTAC</th>
<th>*MidV</th>
<th>Dep[hi]</th>
<th>Max-V</th>
</tr>
</thead>
<tbody>
<tr>
<td>a. tʃ'uːjitkʰ</td>
<td></td>
<td>*i</td>
<td></td>
<td></td>
</tr>
<tr>
<td>b. tʃ'uːjt{k}</td>
<td>*j{k}</td>
<td>W</td>
<td>L</td>
<td>*eW</td>
</tr>
<tr>
<td>c. tʃ'uːjetkʰ</td>
<td></td>
<td>*eW</td>
<td>L</td>
<td></td>
</tr>
</tbody>
</table>
/e/ is protected in initial syllables, by having $\text{DEP}[\text{HI}]/\sigma_1$ and $\text{MAX-V}/\sigma_1$ dominate $*\text{MIDV}$.

<table>
<thead>
<tr>
<th></th>
<th>$\text{DEP}[\text{HI}]/\sigma_1$</th>
<th>$\text{MAX-V}/\sigma_1$</th>
<th>$*\text{MIDV}$</th>
</tr>
</thead>
<tbody>
<tr>
<td>a. te.ju:.wa</td>
<td></td>
<td></td>
<td>$^*_e$</td>
</tr>
<tr>
<td>b. tju.wa</td>
<td>$^*_e$ $W$</td>
<td></td>
<td>$L$</td>
</tr>
<tr>
<td>c. ti.ju.wa</td>
<td></td>
<td>$^*_i$ $W$</td>
<td>$L$</td>
</tr>
</tbody>
</table>
Non-initial /e/ is not protected by these constraints.

<table>
<thead>
<tr>
<th>/wkʰumeʔ-a/</th>
<th>MAX-V/σ₁</th>
<th>*MIDV</th>
<th>MAX-V</th>
</tr>
</thead>
<tbody>
<tr>
<td>a. wkʰu.m’a</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>b. wkʰumeʔa</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

* L
With this ranking, short /e/ exhibits the [i] ~ [∅] alternation, in verbs as expected.

\[
\text{MAX-V}/\sigma_1 \quad \text{DEP[HI]}/\sigma_1
\]

\[
\text{*MidV} \quad \text{PHTAC}
\]

\[
\text{DEP[HI]} \quad \text{MAX-V}
\]
Short /e/ in noninitial syllables of nouns is protected

\[
\text{MAX-V}_{\text{NOUN}}, \text{DEP}[\text{HI}]_{\text{NOUN}} \gg *\text{MidV}
\]

<table>
<thead>
<tr>
<th></th>
<th>MAX-V\text{NOUN}</th>
<th>DEP[HI]\text{NOUN}</th>
<th>*MidV</th>
</tr>
</thead>
<tbody>
<tr>
<td>/sq^h u.l’e/\text{NOUN}</td>
<td>*_e W</td>
<td></td>
<td>L</td>
</tr>
<tr>
<td>a. sq^h u.l’e</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>b. sq^h u.l’i</td>
<td></td>
<td></td>
<td>L</td>
</tr>
<tr>
<td>c. sq^h u.l’i</td>
<td></td>
<td>*_iW</td>
<td>L</td>
</tr>
</tbody>
</table>
Conclusion

- Analyzing the [i]~[∅] alternation as a loss of vowel contrasts in unprivileged positions simplifies the grammar of Klamath.
- This analysis not only explains this phenomenon but explains gaps in the distribution of [e].
- While /e/ never surfaces in these verb stems, we should posit that a language learner would be able to discover it in these positions.

\[1\] It also explains some interesting behavior with long e:
I would like to thank Karen Jesney, Rachel Walker and the USC PhonLunch for their insights on this project. None of this work would be possible without M.A.R. Barker’s thorough work on the Klamath language. All errors are my own.
Works Cited


Works Cited II


Crosswhite, Katherine. 2004. Vowel Reduction. Chap. 7 of: Hayes, Bruce, Kirchner, Robert, & Steriade, Donca (eds), *Phonetically Based Phonology*. Pearson Education.


STERIADE, DONCA. 1995. Positional Neutralization. ms. UCLA.


However, most of the verb stems in Barker (1963) with noninitial long /e/ have allomorphs where the /e:/ deletes.

An investigation of this allomorphy shows that these /e:/-less forms surface in the same environments where short /e/ deletes.

- /nt’useː?-tkʰ/ → [nt’useːtkʰ], but
- /nt’useː?-a/ → [nt’usʔa]
Long /e/s in verbs are not totally protected

PhTac, Dep[hi]/V:≫*MidV≫Max-V/V:

<table>
<thead>
<tr>
<th>/nt'use:?-tkʰ/</th>
<th>PhTac</th>
<th>Dep[hi]/V:</th>
<th>*MidV</th>
<th>Max-V/V:</th>
</tr>
</thead>
<tbody>
<tr>
<td>🌐 a. nt'u.se:tkʰ</td>
<td></td>
<td></td>
<td>*e:</td>
<td></td>
</tr>
<tr>
<td>b. nt'u.si:tkʰ</td>
<td></td>
<td>*i: W</td>
<td>L</td>
<td></td>
</tr>
<tr>
<td>c. nt'ustk</td>
<td>*stk W</td>
<td>L</td>
<td>*e:W</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>/nt'use:?-a/</th>
<th>PhTac</th>
<th>Dep[hi]/V:</th>
<th>*MidV</th>
<th>Max-V/V:</th>
</tr>
</thead>
<tbody>
<tr>
<td>🌐 d. nt'us?a</td>
<td></td>
<td></td>
<td>*e:</td>
<td></td>
</tr>
<tr>
<td>e. nt'u.si:?a</td>
<td></td>
<td>*i: W</td>
<td>L</td>
<td></td>
</tr>
<tr>
<td>f. nt'use:?a</td>
<td></td>
<td></td>
<td>*e:W</td>
<td></td>
</tr>
</tbody>
</table>