POSTVELOAR HARMONY
AMSTERDAM STUDIES IN THE THEORY AND HISTORY OF LINGUISTIC SCIENCE

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Series IV – CURRENT ISSUES IN LINGUISTIC THEORY

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Volume 225

Kimary N. Shahin

Postvelar Harmony
This study, a revision of my 1997 UBC dissertation, is the result of an initial quest to answer three questions. The first is ‘what is really going on in the colloquial Arabic vocalic system?’. The second is ‘what is really going on in the St’át’imcets Salish consonantal system?’. The third is ‘what sort of system underlies postvelar phonology in languages with postvelars, like Arabic and St’át’imcets?’. These questions were a great starting point, since they led to many further questions (such as ‘what is phonology and what is phonetics?) and interesting answers, so far as possible within the current framework of generative phonology.

Several people have helped in this research. The greatest thanks go to those who so kindly shared their language data – the late Lucien Robert Charlie, and Alice Adoph, Bucky Ned, Laura Thevarge, Gertrude Ned, Khaled Gabr, Maher Nakhala, Khaled Shahin, Ibrahim Kassas, Adam Khayu, and the Bilbesy, Masri, and Shahin families of Ramallah and New Jersey. Doug Pullyblank, Pat Shaw, and André-Pierre Benguerel took me on as doctoral student and helped me attack the questions of my initial quest. Several linguists provided data or insight for me to include in this study – I have gratefully referenced their assistance as ‘p.c.’. I am very thankful to the Benjamins reviewers for helpful feedback, and to the Benjamins editorial staff for support and help in seeing this study reach publication. Finally, thanks to Khaled for encouragement, and Alaa’, Salah, Hosam, and Sarah for easy-going attitudes.
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CHAPTER 1: INTRODUCTION

1.1. **Aims**

This is an investigation of postvelar harmony in two genetically and geographically unrelated languages: Palestinian Arabic (Semitic) and St'át'imcets (Salish). The first aim is to show that both have two distinct postvelar harmonies, pharyngealisation harmony and uvularisation harmony. This differs from previous analyses of both languages. Previous studies have described only one postvelar harmony for Palestinian: 'emphasis spread'. The same is true for Arabic in general. Only one postvelar harmony has been described for St'át'imcets: 'retraction'. The same is true for Salish in general. I will show that there is more complexity to Arabic and Salish postvelar phonology than has been previously recognised.

The second aim is to show that pharyngealisation harmony and uvularisation harmony are harmony of the feature (primary- or secondary-) [RTR], and of secondary-[DOR] + secondary-[RTR], respectively. The first is triggered by postvelar consonants, that is, gutturals and emphatics. The guttural class includes pharyngeals and uvulars and, in Arabic, laryngeals. Emphatics include segments, such as /s/, that are postvelar-articulated counterparts of non-postvelar consonants. (E.g., /s/ is the postvelar-articulated counterpart of non-emphatic /s/.) Uvularisation harmony is triggered only by emphatics. The representations I will propose for gutturals are seen in (1), those for emphatics in (2). (Only relevant specifications are shown.) I assume tongue root retraction is represented by [RTR] under [TR] (see §1.3.2). The stacked place
specifications for uvular gutturals and emphatics follows Selkirk’s (1988) representation of primary vs. secondary place (see §1.3.3).

(1) Representations of Gutturals
   a. pharyngeal and laryngeal gutturals:
      primary [TR]/[RTR]
   b. uvular gutturals:
      primary [DOR] and secondary [TR]/[RTR]

   ![](image)

(2) Representations of Emphatics: Primary [COR], [DOR], or [LAB], Secondary [DOR] and Secondary [TR]/[RTR]
   a. coronal emphatics
   ![image]
   b. dorsal emphatics
   ![image]
   c. labial emphatics
   ![image]

The third aim is to provide a formal account of the harmonies within Optimality Theory (Prince & Smolensky 1993, McCarthy & Prince 1993a). I will argue that ranked constraints on input/output Correspondence (McCarthy
INTRODUCTION

& Prince 1995), featural Alignment (McCarthy & Prince 1993b), and phonetic grounding (Archangeli & Pulleyblank 1994), both syntagmatic (Shahin 1993, Jiang-King 1996, Pulleyblank 1997a) and paradigmatic (Archangeli & Pulleyblank 1994), are responsible for the intricate properties of the harmonies in each language, and that the observed crosslinguistic variation is due to simple constraint reranking.

1.2. **Overview**

The rest of this chapter first presents my representational assumptions, then examines the articulatory and acoustic properties of postvelar segments. After that I explain harmony typology, essential for a clear understanding of the postvelar harmony to be examined in detail. I then introduce Optimality Theory and summarise the general nature of Correspondence, Alignment, and Grounded constraints. Last, I discuss the distinction between phonetics and phonology and the role of phonetics in phonology, issues which must be understood if we are to make sense of the data analysed and accounted for in this study. Chapter 2 first introduces Palestinian Arabic, clarifying its phonemic inventory. I then present evidence for its distinct postvelar harmonies and acoustic findings that support the distinction, and develop the theoretical account of the two harmonies in the language. Chapter 3, on St'át'imcets, is organised like chapter 2. We will see that the harmony properties in that language differ very interestingly from those in Palestinian although the fundamental nature of both harmonies is the same. A different constraint ranking yields St'át'imcets' own version of the two harmonies. Chapter 4 summarises the study. I suggest that Niger Congo and Nilotic [-ATR] harmony is pharyngealisation harmony but with a non-consonantal source, as predicted by the optimally vocalic nature of [RTR], and point out critical areas for future research for which this study serves as springboard.

1.3. **Representational Assumptions**

I assume the feature geometry in (3). Important assumptions bearing on (3) and other representational issues will now be laid out.

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7 I will have nothing to say about tonal features and [SUCTION]. See Archangeli & Pulleyblank (1994) and Jiang-King (1996) on the position of the former, Halle (1995) on [SUCTION] (for clicks) and its direct link to the root node. Note that (1) and (2) differ from (3) by having [COR], [DOR], or [LAB] dominate [DOR] and/or [TR]/[RTR]. The apparent mismatch is cleared up in §1.3.3.
1.3.1 Articulator Theory

I adopt Articulator Theory (McCarthy 1985, Sagey 1986, Halle 1988), which holds, as do other feature geometric theories (Clements 1985, Mester 1986), that distinctive features do not occur as unordered bundles, but in a hierarchical arrangement. Two types of evidence for this, as summarised by Kenstowicz (1994:146) are: certain features “introduc[e] a subdistinction within the category defined by another feature” (e.g., [ANT], a finer distinction of [COR]); certain features “form recurrent groupings in phonological rules and constraints” (e.g., vowels show assimilation for height features like [HI] and [LOW], but not [NAS]). Further evidence comes from place assimilation where the actual place assimilated to ranges over labial, coronal, and dorsal\textsuperscript{8} (which is also evidence for the Place node).

Articulator Theory further claims that phonological features are defined in articulatory or acoustic terms (McCarthy 1988:99) and that their hierarchical ordering “directly reflects aspects of the human anatomy used in the production of speech” (Halle & Vaux 1994:1). McCarthy (1988:105) traces the roots of this to “Jakobson’s fundamental insight in the late 1930s that the classification

---

\textsuperscript{8} See Roca & Johnson (1999b:19-20) for Spanish and Kannada examples.
of speech sounds exploited in phonology has a universal phonetic basis." Articulator Theory is widely adopted.  

There is also Vowel Place Theory (Steriade 1987, Clements 1989, 1991), so-named by Halle & Vaux (1994) to highlight its central difference from Articulator Theory. Vowel Place Theory assumes the feature geometry is primarily structured according to function. Phonetic basis is assigned a secondary role. The result is distinct ‘C-Place’ and ‘V-Place’ nodes, motivated especially to account for observed non-effect of intervening consonants in cases of vowel assimilation. Halle and Vaux reject this theory because its V-Place node “has no clear anatomical status” [p.4]. They readdress the data presumed to indicate the V-Place node and show they can be handled within Articulator Theory. (See Selkirk 1993 and Vaux 1998 for further critique.)

I assume ‘articulation’ refers to constriction by the lips or tongue. Laryngeal gesture is thus not an articulation, but an acoustic source adjustment (see §1.3.3). The four articulators used in producing speech sounds are the lips, tongue tip/blade, tongue dorsum, and tongue root. They are represented in (3) as [LAB], [COR], [DOR] and [TR].

1.3.2 The Articulator Feature [TONGUE ROOT]


---


3 These four are also assumed by, e.g., Cole (1987), McCarthy (1988, 1994), and Selkirk (1993).

4 I do not address the possibility of an Oral node under Place (see McCarthy 1994, also Clements & Hume 1995:272 and Rose 1996), as its presence or absence does not impinge on my account of postvelar harmony. Finally, see McCarthy (1988) for arguments against a possible Supralaryngeal node, but see Gussenhoven & Jacobs (1998) for arguments in its favour.
I then summarise new findings of this study which suggest that laryngeal gutturals pose no problem after all.


The natural class of pharyngeals, uvulars, and sometimes laryngeals is termed the 'guttural' class by McCarthy (1994). He presents four types of evidence for it: root co-occurrence restrictions, vowel lowering, avoidance of syllable-final gutturals, and degemination. I review his examples, below. This digression is justified by its new data and observations, though our primary aim is to see that Arabic gutturals include /? h/.

First, Arabic roots “rarely or never contain adjacent homorganic consonants” (McCarthy 1994:203). Specifically, “[r]oots combining two gutturals are significantly infrequent” [p.205]. See McCarthy’s table [p.204] showing the infrequency. For the second type of evidence, McCarthy presents lowering examples from Arabic and Tiberian Hebrew. In Modern Standard Arabic, the last vowel of the imperfect verb stem is lowered to /a/ when adjacent to a guttural. Compare (5) with (4) (from McCarthy 1994:207). (I have added the ungrammatical forms.) The braces ‘{}’ identify the data as surface phonological forms – distinct from underlying forms, standardly enclosed by slashes ‘/ ’, and phonetic forms, standardly enclosed by square brackets ‘[]’ (see §1.7.1). The examples show that the imperfect stem-final vowel is unpredictably non-low /i/ or /u/ when not adjacent to a guttural but predictably low /a/ when it is.

(4) Modern Standard Arabic Non-lowered Imperfects

<table>
<thead>
<tr>
<th></th>
<th>perfect</th>
<th>imperfect</th>
</tr>
</thead>
<tbody>
<tr>
<td>a.</td>
<td>{katab}</td>
<td>{jaktub}</td>
</tr>
<tr>
<td>b.</td>
<td>{Darab}</td>
<td>{jaDrib}</td>
</tr>
</tbody>
</table>

“to write”

“to beat”

---

13 For further evidence, see Cole (1987) on Coeur d’Alene (Southern Interior Salish), Shaw (1991a) on Nisga, and Hayward & Hayward (1989) and Rose (1996) on Cushitic.
14 I follow McCarthy with ‘j’ = palatal approximant, capital letter = emphatic consonant. Throughout this study, surface form status for data from another source is as I infer it from the other source.
(5) Modern Standard Arabic Lowered Imperfects

| perfect   | imperfect          | 7
<table>
<thead>
<tr>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>a. .fdal</td>
<td>jaf Tal</td>
</tr>
<tr>
<td>b. irda</td>
<td>jarda</td>
</tr>
</tbody>
</table>

McCarthy provides no pairs with laryngeals or uvulars but examples are:

(6) Modern Standard Arabic Lowered Imperfects with Laryngeal and Uvular Gutturals

| perfect   | imperfect          | 7
<table>
<thead>
<tr>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>a. 8ahal</td>
<td>ja8hal</td>
</tr>
<tr>
<td>b. 8ghaz</td>
<td>ja8ghaz</td>
</tr>
<tr>
<td>c. jama8</td>
<td>jajma8</td>
</tr>
<tr>
<td>d. taxam</td>
<td>jatxam</td>
</tr>
</tbody>
</table>

Relatedly, in 'Anaiza (Saudi) Bedouin the vowel of the verb or noun stem is raised to \( i \) when it does not immediately follow a guttural, but is low \( a \) when it does. Compare (8) with (7), from McCarthy (1994:212-213). (I have added the ungrammatical forms and implied URs.)

(7) 'Anaiza (Saudi) Bedouin Raised Forms

| 7
<table>
<thead>
<tr>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>a. /katab/</td>
</tr>
<tr>
<td>b. /gascal/</td>
</tr>
<tr>
<td>c. /bagar/</td>
</tr>
</tbody>
</table>

(8) 'Anaiza (Saudi) Bedouin Forms with Blocked Raising

| 8
<table>
<thead>
<tr>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>a. /?akal/</td>
</tr>
<tr>
<td>b. /hacgiin/</td>
</tr>
<tr>
<td>c. /azam/</td>
</tr>
<tr>
<td>d. /hasuud/</td>
</tr>
<tr>
<td>e. /uaSab/</td>
</tr>
</tbody>
</table>

Thanks to Dil Parkinson for help with these. The uvular lowering has exceptions (M. Elmedlaoui, p.c.).
Lowering also occurs in Tiberian. The epenthetic vowel lowers immediately preceding a guttural.\(^{16}\) Compare (10) with (9), from McCarthy (1994:210). (I have added the ungrammatical forms.) The epenthetic vowel in a CVCC noun stem is non-low \(\acute{e}\) when it does not immediately follow a guttural, but low \(\acute{a}\) when it does.

(9) Tiberian Hebrew Non-Lowered Epenthetic Vowel

<table>
<thead>
<tr>
<th>Form</th>
<th>Meaning</th>
</tr>
</thead>
<tbody>
<tr>
<td>/malk/</td>
<td>{melek} (*{melak})</td>
</tr>
<tr>
<td>/sipr/</td>
<td>{se:per} (*{se:par})</td>
</tr>
<tr>
<td>/qadʃ/</td>
<td>{qo:deʃ} (*{qo:daʃ})</td>
</tr>
</tbody>
</table>

(10) Tiberian Hebrew Lowered Epenthetic Vowel

<table>
<thead>
<tr>
<th>Form</th>
<th>Meaning</th>
</tr>
</thead>
<tbody>
<tr>
<td>/tuʔr/</td>
<td>{toʔar} (*{toʔer})</td>
</tr>
<tr>
<td>/lahb/</td>
<td>{laheb} (*{laheb})</td>
</tr>
<tr>
<td>/baʔl/</td>
<td>{baʕel} (*{baʕel})</td>
</tr>
<tr>
<td>/kaʔʃ/</td>
<td>{kaʕaf} (*{kaʕaf})</td>
</tr>
</tbody>
</table>

McCarthy does not provide examples with uvulars. Below are forms which show no lowering immediately following uvular /q/.

(11) Tiberian Hebrew Non-lowered Epenthetic Vowel Following /q/

<table>
<thead>
<tr>
<th>Form</th>
<th>Meaning</th>
</tr>
</thead>
<tbody>
<tr>
<td>/jeqʁ/</td>
<td>{jeqar} (*{jeqar})</td>
</tr>
<tr>
<td>/boqʁ/</td>
<td>{boqar} (*{boqar})</td>
</tr>
</tbody>
</table>

This suggests that Tiberian /q/ is not a guttural. Non-guttural status of a /q/ like Tiberian’s is explicable if we recognise it as emphatic [k] instead of a primary uvular like /b/ and /χ/ (see §1.4.2.).\(^{18}\) (Alternatively, Tiberian /q/ might be a guttural and the lowering triggered by gutturals that are not also stops.)

On McCarthy’s third type of evidence, avoidance of syllable-final gutturals occurs in Negev Bedouin Arabic. Compare (13) with (12), from McCarthy (1994:214). (I have added the ungrammatical forms and first

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\(^{16}\) The vowel is full in closed syllables (McCarthy 1994:210, Prince 1975, Garr 1989).

\(^{17}\) Thanks to John McCarthy for help with the data in (11).

\(^{18}\) As exception to the IPA otherwise adhered to in this book, ‘ ’ denotes ‘emphasis’, i.e., simultaneous pharyngealisation and uvularisation (see §1.4.2).
Negev Bedouin /CVCC/.../ is {CVC.C...} but {CV.CVC...} if the form is /CVGC.../, where G = guttural. The guttural surfaces in syllable-initial instead of -final position.

(12) Negev Bedouin Arabic Plain Roots: {(C)VC.C...}
   a. \{jaʃ.rab\}  \{*\{jaʃ... \}\} “he drinks”
   b. \{aʃ.rab\}  \{*\{aʃ... \}\} “I drink”
   c. \{bnaʃ.rab\} \{*\{bnaʃ... \}\} “we drink”
   d. \{taʃ.rab\} \{*\{taʃ... \}\} “you drink”

(13) Negev Bedouin Arabic Guttural Roots: *(C)VG.C...*
   a. \{ja.hardʒ\} \{*\{jah.r. \}\} “he speaks”
   b. \{a.ʃarf\} \{*\{a.ʃ.r. \}\} “I know”
   c. \{a.ḥalam\} \{*\{aḥ.l. \}\} “I dream”
   d. \{bna.ṣazil\} \{*\{bnau.z... \}\} “we spin”
   e. \{ta.ẓabar\} \{*\{taẓ.b... \}\} “you know”

Finally, guttural degemination in Tiberian is shown by (15) vs. (14), from McCarthy (1994:217). (I have added the ungrammatical forms.) In Tiberian, geminate gutturals are not observed where they are expected based on gemination of non-gutturals in parallel forms.

(14) Tiberian Hebrew Non-Guttural Roots
   a. \{dibbe:r\} “he said”
   b. \{dall:i:m\} “weak ones”
   c. /jinte:/ \{jitte:n\} “he gives”

(15) Tiberian Hebrew Guttural Roots
   a. \{me:ʔe:n\} \{*\{meʔe:n\}\} “he refused”
   b. \{ra:ʕi:m\} \{*\{raʕi:m\}\} “evil ones”
   c. /jı̂n̄hat/ \{je:hat\} \{*\{jeḥhat\}\} “he marches down”

In sum, the above patterns all require reference to a guttural natural class since without a formal way of classifying this group of segments uniquely a significant set of generalisations would not be captured.

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20 McCarthy provides no URs for the (a-b) forms. See his p.217 for data on Tigre degemination.
McCarthy’s facts, specifically (6a-b), (8a-b), (10a-b), (13a) and (15a) and his table of roots, establish laryngeals as gutturals in Arabic and Hebrew. The problem he identifies for laryngeal gutturals is that no phonetic basis for their guttural status can be found in the articulatory or acoustic literature. In particular, there is “no evidence for a pharyngeal or uvular constriction accompanying the glottal gesture” (McCarthy 1994:193). This is troublesome within Articulator Theory, since features and feature groupings are supposed to be articulatorily based. He concludes: “the difference between Arabic and Tigre laryngeals, phonologically important but phonetically invisible, may have shown us a limit in our understanding of the relation between phonetic events and phonological features” [p.225]. He thus proposes that the feature capturing the guttural class is not an articulator feature like [TR] but an orosensory feature, [PHARYNGEAL]. He defines [PHARYNGEAL] as “the orosensory pattern of constriction anywhere in the broad region of the pharynx” [p.199], after Perkell (1971), and proposes the geometry below:

(16) McCarthy (1994) Geometry With Orosensory [PHARYNGEAL]

1.3.2.2 Another Look at Laryngeal Gutturals. We now critically examine the bases for McCarthy’s (1994) conclusion that there is no evidence that Arabic laryngeals are tongue root articulated. I will show that the studies on which that conclusion is based do not provide conclusive evidence, nor does more recent work. Rather, the findings of this study (see §2.4.1) support assumption that laryngeal gutturals are so articulated.

McCarthy [p.193], noting first that there are no articulatory (that is, x-ray, fibreoptic, EMG, etc.) data on Arabic laryngeals, bases his conclusion on the fact that no acoustic data have shown Arabic laryngeals to have “formant transition or other effects on adjacent vowels”. He cites Klatt & Stevens (1969) and Younes (1982) as evidence.
Klatt & Stevens (1969) examined tokens of Arabic laryngeals, pharyngeals, and uvulars followed by tokens of short /I/, /Æ/, and /U/, each consonant-vowel sequence a single open syllable. Their subjects were speakers of various dialects; they identify one as Lebanese. They report: "[t]he /h/ and the glottal stop // differ from the pharyngeals in that there are no formant transitions at the vowel onsets" [p.211, underlining in the original]. However, no general conclusion can be based on their finding. This is because the vowel in a token of /hI/, /hÆ/, /hU/, /?I/, /?Æ/, or /?U/ occurs in stem-final position. I will show in Chapter 2 that Palestinian Arabic laryngeals trigger tongue root retraction (rtr) harmony on short vowels, resulting in a raised $F_1$ and lowered $F_2$ for the vowels. However, they do not if the vowels are stem-final because stem-final vowels do not undergo the harmony. (Beirut) Lebanese Arabic forms with stem-final short vowels are:

(17) (Beirut) Lebanese Arabic Forms

a. /b-j-ḥll/ \{ b-j-ḥ,ll \} \{(b-j-ḥ,ll)\} "he boils (something)"

b. /ḥll/ \{ ḥ,ll \} \{(ḥ,ll)\} "pretty (masc. sg.)"

c. /s-ḥmm-U/ \{ s-ḥmm-U \} \{(s-ḥmm-U)\} "they (masc.) named (someone, something)"; "they (masc.) said the words: bi-sm-illāh ir-rahman ir-raḥim ‘in the name of God, the Gracious, the Merciful’"

The stem-final vowels surface non-rtr, not rtr as would be expected if they harmonised with the guttural (17a-b) and/or rtr vowel (17a-c) in the word. (In (c), \{a\} is rtr.) These expectations are based on the behaviour of short vowels in closely related Palestinian Arabic (see §2.3, §2.4). This indicates that Lebanese stem-final vowels do not undergo rtr harmony and that Klatt and Stevens searched for effects from laryngeals in a context where none would be found for independent reasons.

Younes (1982) used laryngeals as a ‘neutral context’. He based this [p.2] on Stevens & House (1963). Stevens & House [p.116] found that "comparison of the average data for the /h-d/ and the /#-#/ [isolation] environments shows that there is no significant difference between the values of $F_1$ and $F_2$ for these two environments." They concluded [ibid.] that "the vowel in the context /h-d/ is generated with essentially the same articulatory configuration as the vowel in isolation" and that /h-d/ and /#-#/ are both ‘null’ contexts for vowels. However, they analysed English laryngeals (see their p.112) and English laryngeals are not gutturals. "In English all of the consonants are produced with a constriction in the oral cavity between the

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21 I use ‘-’ to denote a morpheme boundary; ‘#’ will denote a word boundary.
velum and the lips" (Klatt & Stevens 1969:207). Thus, English has no guttural class. The point is: given McCarthy’s phonological evidence that Arabic laryngeals do systematically behave as gutturals, Arabic laryngeals cannot be considered a neutral context unless they are established as such.

One recent study should be mentioned here. Zawaydeh (1999) conducted an endoscopic study of tokens of /ʔ h/ spoken by a Jordanian Arabic speaker. She found no indication of tongue root retraction for those segments. This could be basis for McCarthy’s conclusion. However, Zawaydeh’s laryngeals were from “nonsense utterances” [see her p.86], not real Arabic words. Given that, it is not absolutely clear that they were Arabic laryngeals because the subject was Arabic-English bilingual. In short, we still lack clear articulatory findings on natural language guttural laryngeals. This means that there is as yet no clear evidence that Arabic laryngeals are not tongue root articulated.

Chapter 2 will show that Palestinian laryngeals, like the other gutturals, trigger rtr harmony. Acoustic data will show that the effect on vowel formants is a raised F₁ and lowered F₂ for tokens of harmonising vowels. The effects are observed when the trigger is a laryngeal. This means that Palestinian laryngeals have acoustic effects on vowel formants (also found for Jordanian Arabic by Zawaydeh 1999). Since a raised F₁ and lowered F₂ are expected for segments produced with pharyngealisation articulation (see §1.4.3), this supports the assumption that Palestinian laryngeals are tongue-root articulated.²²

Based on the foregoing, I conclude that gutturals are all specified for [TR] and replace [PHARYNGEAL] with that feature.

1.3.3 Other Representational Assumptions

I assume privative features, which are traced to Trubetskoï’s (1939, 1969) privative oppositions (Hyman 1975:27).²³ I also assume that [CONS] and

²² The prediction that follows is that articulatory data from natural language carrier forms will show tongue root activity for guttural laryngeals. Two other possibilities are: solely glottal gesture, or epiglottal constriction (Lindqvist 1969, 1972, Trigo 1991, Zawaydeh 1999). Zawaydeh does not report on the aryepiglottic sphincter, which might be active for gutturals (Eling 1996a, 1996b). Following Nolan (1995:366), that activity for guttural laryngeals could be a basis for their guttural patterning, as epiglottal place could be within the range of phonetic implementation of [TR]. Both possibilities would seem due to a drive for phonetic distinction between pharyngeal vs. laryngeal gutturals.

[SON] characterise the root node (Schein & Steriade 1986, Halle 1988, McCarthy 1988). Given the evidence that the continuancy feature represents no continuancy (Shaw 1991b), I assume that feature is [STOP] (Rice & Avery 1989). I consider [STRID] to be a daughter of [COR] (Shaw 1989, 1991b, LaCharité 1993). I assume [FRONT] (McCarthy 1997), given substantial evidence for fronting rather than backing (e.g., umlaut, palatalisation), and [POSTERIOR], given the evidence that coronals are subclassified for non-anteriority. Finally, I do not assume [ROUND] (Selkirk 1993).

1.3.3.1 Laryngeal Specifications. I assume that the Laryngeal node is a daughter of the root node, not deeply embedded in the tree as argued by Halle (1995), Halle & Vaux (1994), and Vaux (1998). Halle’s (1995) geometry is seen in (18).


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25 Selkirk (1993) argues against [ROUND] on the grounds that a rounded interpretation of secondary-[LAB] is always predictable and so belongs in the phonetics.

Halle (1995:18) bases a grouping of laryngeal and tongue root features on findings that laryngeal characteristics frequently correlate with tongue root activity, e.g., Mon Khmer rtr vowels are accompanied by breathy voice, higher pitch, and voiceless initial consonants, atr vowels by creaky voice, lower pitch, and voiced initial consonants (Czaykowska-Higgins 1987:2, based on data in Gregerson 1976). In (18) this is assumed to have structural basis. Tongue Root and Larynx are dominated by the same node, Guttural.

However, connection between laryngeal and tongue root features can be understood instead as a grounded relation. Mon Khmer properties indicate paradigmatic grounded constraints RTR/SG (‘If [RTR], then [SG]’) and ATR/CG (‘If [ATR], then [CG]’), which are paradigmatically grounded in the anatomical interconnectedness of lower vocal tract structures (tongue root, hyoid bone, suprahyoid muscles, thyroid and cricoid cartilages, and laryngeal muscles—especially the cricothyroid and lateral cricoarytenoid (Saunders 1964, Zemlin 1988)). Breathy voice for rtr vowels indicates high ranking for RTR/SG.

The position of laryngeal features under the root node, structurally distant from all articulator features (i.e., laryngeal features are not sisters to any articulator feature) follows from the fundamental source/filter distinction in the acoustic signal. After Fant (1960), the signal is produced when the glottis provides a source wave and the vocal tract filters that wave. Four articulators can affect the transfer (filter) function: the lips, tongue tip/blade, tongue dorsum (‘body’), and tongue root. These four can articulate at specific places. Despite evidence that ‘articulator’, not ‘place of articulation’, is phonologically real (McCarthy 1988), the relevant node is standardly labeled ‘Place’ in the tree. It corresponds to the representation of a filter. By definition, Place dominates features that implement the articulators: [LAB], [COR], [DOR], and [TR]. The larynx, by contrast, does not filter the speech signal. It provides a source wave and passes it on for potential modification by one or more of the articulators. (Non-guttural) laryngeals, produced with only glottal gesture, are thus placeless, as expressed in several phonological analyses. Vocal fold adjustments that effect voicing, glottalisation, implosion, or aspiration are adjustments of the source, not the filter. Consider Ladefoged’s (1993)

[3] Fant (1960) also considers the ‘radiation’ function (final modification of the signal caused by outward radiation from the lips).
classification of glottalisation under ‘airstream mechanism’, not ‘secondary articulation’. His classification is consistent with the source/filter distinction. The present definition of ‘articulation’ (see §1.3.1) also reflects that distinction. The position of the Laryngeal node in (3) encodes it.

Debuccalisation, in which all Place features are lost and laryngeal or nasal specifications remain (see, e.g., Clements 1985, McCarthy 1988, Trigo 1991), are relevant here. Consider (19), from Trigo (1991:124), which shows word-final obstruent debuccalisation in Kelantan Malay. With Halle (1995:16-17), I assume the stops are redundantly [CG] and the continuants redundantly [SG], enhancing the continuancy distinctions. The forms below show retention of the laryngeal specifications.

(19) Kelantan Malay Debuccalisation

<table>
<thead>
<tr>
<th>Standard Malay</th>
<th>Kelantan</th>
</tr>
</thead>
<tbody>
<tr>
<td>a.</td>
<td>?asa?</td>
</tr>
<tr>
<td>b.</td>
<td>kila?</td>
</tr>
<tr>
<td>c.</td>
<td>balah</td>
</tr>
<tr>
<td>d.</td>
<td>negatif</td>
</tr>
</tbody>
</table>

The final Kelantin consonants have all the features of the corresponding Standard consonants minus all Place specifications. The phonological representation of the filter has been removed. What is left is the representation of source, namely, the Laryngeal node.

Final discussion concerns the glottal stop. Ladefoged & Maddieson (1996:38) state:

The larynx, among its many other functions, can also serve as place of articulation for stops. Glottal stops occur in many languages. They frequently pattern with other consonants... making it clear that glottal gestures must be taken into consideration when discussing places of articulation that are possible for stop consonants.

They conclude [p.11] that “the glottis has to be recognized as an articulator in some circumstances, forming Glottal articulations.” However, the existence of glottal stops can indicate not that the larynx is an articulator but that the phonological representation of stop manner, [STOP], is implemented in

After Pike (1943), ‘airstream mechanism’ refers to movement of a body of air for speech, corresponding to Catford’s (1977) ‘initiation’ function. Airstream mechanisms are characterised by body of air (pulmonic, glottalic, or velaric) and direction of movement (outward or inward).
association with features implemented by either laryngeal or articulator gesture (producing laryngeal or supralaryngeal constrictions, respectively). This range is encoded in (3) with [STOP] immediately dominated by the root node.

1.3.3.2 The Representation of Secondary Articulation. I assume Selkirk's (1988) representation of secondary articulation in which a primary articulation feature is immediately dominated by the Place node and a secondary articulation feature is dominated by a primary articulation feature, assuming Mester's (1986, 1988) head- vs. dependent-feature distinction. This is illustrated in (20).

32 I reject Sagey's (1986) system for representation of secondary articulation because it cannot represent a primary and secondary instance of the same feature on a single segment. This capacity is necessary for segments with primary and secondary specification for one feature (Selkirk 1993). Another case is a uvularised velar (i.e., dorsal emphatic), which I will argue is specified for both primary- and secondary-[DOR]. In Sagey's system, a pointer points to a primary articulation feature and does not point to a secondary articulation feature. Segments with dual specification for one feature require a pointer to both point and not point to the feature, impossible in Sagey's one-level representation. (Once two levels are adopted, the primary/secondary distinction is captured and the additional pointer device is unnecessary.) I reject Trigo's (1991) 1Place/2Place system (see also Davis 1995 and Zawaydeh 1999) because it posits two new nodes in the geometry: a '1Place' node for primary articulation features, a '2Place' node for secondary articulation features. This enriches the geometry, an undesirable result under generative phonology's standard Economy assumption (see, e.g., Gussenhoven & Jacobs 1998:61). I also reject Padgett's (1991, 1994) stricture-under-Place system (see also Walli-Sagey 1986), in which a primary articulation feature dominates stricture features. Padgett proposes this based on several cases of place harmony with contingent stricture harmony. However, like Sagey's system, it cannot represent primary and secondary specification of the same feature on one segment. (Stricture features would need, impossibly, to both appear and not appear under one articulator feature.) (Further grounds for rejecting Stricture-under-Place are: (i) in its geometry, multiple instances of the stricture features occur (one set under each articulator feature), a redundancy with no parallel elsewhere in the geometry; (ii) Stricture-under-Place does not capture all place harmony facts, as cases of non-structure-contingent place harmony exist, e.g., in Sanskrit (Steriade 1986) and Tahlitan (Shaw 1991b); (iii) cases of non-structure-contingent place harmony involving [COR] force Padgett 1991 to propose a distinct node called 'Site' under [COR], a type of node unparalleled in the tree.) I also reject Selkirk's (1993) 'feature-node' theory, which presumes the representation of Selkirk (1988) but claims that each articulator feature is associated with a node, the features labeling the nodes. Selkirk proposes this primarily to permit representation of null primary place, citing [p.82] Irish consonant lenition (Ni Chiosáin 1991) as indicating a need for that. However, as it posits new nodes, this enriches the geometry. Furthermore, its implications are unclear. (E.g., is a Place node dominating only an unlabelled node a well-formed representation?) Finally, a V-Place representation of secondary articulation is not an option because its elements are not necessarily anatomically grounded, that is, based on some anatomical characteristic of the
I assume that primary articulation features are in the universally-fixed arrangement of the feature geometry but that the head-dependent relations of primary and secondary articulation features are not universally-fixed. This is implicit in Selkirk (1993) but differs from Mester’s (1986) original proposal that the head-dependent relation characterises all features. Reserving it for secondary articulation captures the fact that secondary articulation features are dependent on primary articulation features for realising their secondary status. It means, e.g., that secondary-[LAB] can occur under primary-[LAB] as for /pʷ/ or primary-[DOR] as for /kʷ/ but (by stipulation) lack of a common head has no ramifications for ability of the two instances of secondary-[LAB] to function as a class. For complex representations, such as primary-[DOR]/[FRONT] + secondary-[LAB], the secondary articulation feature is immediately dominated by the primary articulation feature, as in:

1.3.3.3 Prosodic Representations.

A final set of background assumptions concerns the representation of prosodic structure. I assume Shaw’s vocal tract. As Articulator Theory holds such basis necessary, Articulator Theory cannot be maintained where a V-Place representation of secondary articulation is adopted.
Nuclear/Moraic theory, first motivated by templatic facts (Shaw 1993, 1994a) and shown to be necessary also for syllabification, including the intricate syllabification of languages like Mon Khmer, St’át’imcets Salish, and Berber (Shaw 1994b, 1996a, 1996b). Further support comes from Niger-Congo prosodic minimality (Ola 1995), Spanish segmental alternations (Valerga 1995), and Chinese tone-vowel interaction (Jiang-King 1996). A segment is moraic or non-moraic, nuclear or non-nuclear, where the mora (‘µ’) is a unit of prosodic weight and the nucleus (‘N’) is the head of a syllable (‘σ’). It can be nuclear and moraic but nuclear status does not entail moraic status. The reverse is also true. The prosodic hierarchy is seen in (22). (‘L’ = light syllable, ‘H’ = heavy syllable.)

(22) Prosodic Hierarchy in Nuclear/Moraic Theory ((b-g) from Shaw 1993, 1994a, (a) from Shaw 1996a, 1996b)

a. weightless b. non-nuclear c. open L d. closed L

1.4. Postvelars

The postvelar natural class was identified by Bessell & Czaykowska-Higgins (1991). They define postvelars [p.1] as “sounds articulated wholly or partly in the postvelar region of the vocal tract.” This identifies gutturals and emphatics. Gutturals include /(? h) \# h g q r x/ where parentheses indicate potential inclusion (see §1.3.2). Gutturals are wholly articulated in the postvelar region (McCarthy 1994). Non-guttural laryngeals such as those in Interior Salish, Tigre, and English are excluded from the postvelar class because they have no articulation. Emphatics are consonants like /δ s r k/.

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31 See Elmedlaoui (1985) and Dell & Elmedlaoui (1996) for more on Berber.
With primary non-postvelar, secondary postvelar articulation, they are partly articulated in the postvelar region.

This section first details the articulation of gutturals and emphatics as shown by the articulatory literature. ‘Articulation’ is used in this section in a static sense to refer to the position of some articulator, in an overall vocal tract configuration, by which some constriction is produced. We aim to identify just how gutturals are wholly articulated and emphatics partly articulated in the postvelar region. Although this study examines gutturals and emphatics in Salish and Arabic, focus in this section is on Arabic data, as there are no articulatory data on Salish. The predicted acoustic effects of guttural and emphatic articulation are then identified using the straightforward articulation-to-acoustics model of Stevens & House (1955). The models of Fant (1960) and Lindblom & Sundberg (1971) are also discussed. The predictions will provide a means of interpreting the acoustic findings on Palestinian and St’át’imcets to be reported in chapters 2 and 3.

The diagram in Figure 1:1, from Ladefoged (1993), will serve as reference.

1.4.1 The Articulation of Gutturals

X-ray data on gutturals are presented below. The first, in Figure 1:2, are tracings of tokens of pharyngeals in Modern Standard Arabic spoken by an

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34 The more recent Davenport & Hannahs (1998:12) has essentially the same diagram.
Iraqi Arabic speaker, from Al-Ani (1970). The tracings do not show the epiglottis or the base of the tongue root, structures also lacking from Al-Ani’s identification template [p.27].

Figure 1:3 shows sagittal sections based on tracings of pharyngeal and uvular gutturals in Lebanese Arabic, from Delattre (1971). Figure 1:4 shows tracings of the same consonants in Tunisian Arabic, from Ghazeli (1977).

The articulation of gutturals can be identified from Figures 1:2 - 1:4. To assist us, Ghazeli’s identification template [p.29] showing “rest position” is presented in Figure 1:5. Compared to rest position, Figures 1:2 - 1:4 indicate (i) tongue root retraction for pharyngeal and uvular gutturals, (ii) tongue back retraction for uvulars. Articulation (i) produces a constriction between the tongue root and rear pharyngeal wall in the lower pharynx (‘pharyngeal constriction’ in the figures); (ii) produces a constriction between the tongue back and uvula (‘uvular constriction’).

Some studies describe involvement of other structures. Ladefoged & Maddieson (1996:168-169) find evidence for involvement of the epiglottis in

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35 Al-Ani provides no tracings of uvular gutturals. He denotes ʕ as ‘e’. In Figure 1:2, I have added ‘pharyngeal constriction’. In other figures in this section I have added ‘uvular constriction’. These labels will be discussed shortly.

36 Delattre denotes ʕ as ‘h’, ʕ as ‘R’. I retain his shading of the lower pharyngeal cavity.

37 Ghazeli notes [p.30] that his subject exhibits a lingual tonsil (see Figure 1:5). The tonsil means that the epiglottis and tongue root are not independent structures for his subject, so the position of the tongue root must be inferred.

\[ a. \text{pharyngeals } [\text{ʕ}] \text{ and } [\text{ʕ}] \]

\[ b. \text{uvulars } [\text{ʁ}] \text{ and } [\text{x}] \]

Figure 1:3. Sagittal sections based on x-ray tracings of [ʕ], [ʕ], [ʁ], and [χ]
(from Delattre 1971:130)

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occur for a given token, co-operate with the tongue, but that gutturals can be defined in terms of two main articulations: tongue root retraction and tongue back retraction. (For tokens of /ᵲ ʕ/ with only epiglottal articulation I assume that shows the range of phonetic implementation of the phonological specification [TR]/[RTR].)

a. pharyngeals [ʕ] and [ʕ]

![Pharyngeal constriction](image)

b. uvular [ʊ] and [χ]

![Uvular constriction](image)

Figure 1:4. X-ray tracings of [ʕ], [ʕ], [ʊ], and [χ] (from Ghazeli 1977:40,57)
Finally, Catford (1983) documents contrasting epiglottals and pharyngeals in Caucasian, e.g., epiglottal /h/ vs. pharyngeal /ħ/ in Agul (see Ladefoged & Maddieson 1996). This shows that, besides tongue root and back retraction, gutturals can also be defined in terms of epiglottal articulation. Establishing the featural basis of this lies outside the scope of this study.

Let us define the articulation of pharyngeal and uvular gutturals more closely. We first distinguish primary from secondary articulation, based on the assumption in (23) and the definitions in (24).

(23) A segment has a maximum of one primary articulation (Anderson 1976, Selkirk 1993).

(24) a. Primary Articulation:
   the only articulation (Selkirk 1993:7) or
   the articulation with the tightest constriction (Selkirk 1993) at which
   the stricture features of the segment are realised (Sagey 1986).

   b. Secondary Articulation:
   the articulation made by two organs of speech not involved in the
   primary articulation (Ladefoged 1993:296).

'Tightest constriction' for a given vocal tract configuration is the point along the vocal tract with the smallest cross-sectional area. From an x-ray
tracing, no radius of constriction from which the cross-sectional area at a specific point can be determined is apparent because the tracing shows only the midsagittal plane. Additional information is required. In the absence of such information, the tightest constriction can be guesstimated as the point where the upper and lower vocal tract surfaces connect, or where they are closest together.\footnote{Under (24a), segments with double articulation remain problematic (see Selkirk 1993:7, Halle 1995:8).}

Based on (23) and (24), Figures 1:2 - 1:4 show that [ɨ h] have primary pharyngeal articulation, primary because it is their only articulation. For [u χ] the tightest constriction is at the uvula, and their frication is achieved there, so they have primary uvular articulation. They also have secondary pharyngeal articulation, that is, ‘pharyngealisation’, ‘-isation’ encoding the secondary nature of the articulation (Lass 1984:169, Laver 1994:335). These two articulations are ascribed to [u χ] also by Trigo (1991:122). Since neither pharyngeal(-isation) or uvular articulation produces a constriction between the velum and lips, gutturals are wholly articulated in the postvelar region of the vocal tract. Finally, the data of this section indicate that uvular articulation does not occur without pharyngealisation. This is also indicated by the tracings of French /ʁ/ in Bothorel et al. (1986). The pharyngealisation is apparently an automatic consequence of the primary uvular articulation. In the terminology of Fujimura (1990), it is a ‘resultant’ gesture of the uvular ‘control’ gesture, presumably due to the proximity of the tongue back and root.

1.4.2 The Articulation of Emphatics

Figures 1:6 - 1:8 show tracings of emphatic and non-emphatic consonants, from Al-Ani (1970), Bonnot (1977), and Ghazeli (1977).\footnote{Al-Ani's emphatic data are from Iraqi and Jordanian Arabic. He denotes ı as 'ı'. Bonnot's data are from Classical Arabic spoken by a Saudi Arabic speaker, Ghazeli's from Tunisian Arabic. Both denote emphasis with an underdot.} They show that emphatics are produced with (i) a non-postvelar articulation, (ii) tongue back retraction, (iii) tongue root retraction. Articulation (i) results in a constriction between two structures between the velum and lips, (ii) in a constriction between the tongue back and uvula, and (iii) in a constriction between the tongue root and rear pharyngeal wall in the lower pharynx. Labels which I have added identify the constrictions of (ii) and (iii).

The non-postvelar articulation identifies an emphatic as the counterpart of some non-emphatic segment, e.g., /t/, the emphatic counterpart of /t/. As
seen from segments like /ð s r k/, it produces a constriction that varies in place and manner.

\[ \text{uvular constriction} \]
\[ \text{pharyngeal constriction} \]

\[ i / i / i / i / \]
\[ i / i / i / \]

*Figure 1:6. X-ray tracings of \([t] \) and \([t] \) (from Al-Ani 1970:57)*

[Diagram of uvular and pharyngeal constriction]

\[ i / i / i / i / \]
\[ [t] \text{ in } [ata] \]
\[ [t] \text{ in } [ata] \]

*Figure 1:7. X-ray tracings of \([t] \) and \([t] \) (from Bonnot 1977:85)*

Emphatics differ from their non-emphatic counterparts by having the postvelar articulations. Both have been previously identified. Herzallah (1990:2) identifies (ii), stating that emphatic articulation involves "the back of the tongue body", as does Ghazeli (1977:72), who refers to "rearward movement of the back of the tongue", and Younes (1982:216), who describes emphasis as "a secondary articulation involving the back of the tongue". Earlier studies labeled it 'velarisation' (e.g., Obrecht 1968) or likened it to
velarisation (Lehn 1963:20). It is identified more precisely as uvularisation by Dolgopolsky (1977:1), who states: "In Arabic, the 'emphatics' are pronounced as uvularized consonants. Uvularization is the modification of consonants or vowels by moving back the rear part of the tongue towards the uvula and the back wall of the pharynx." He continues in a footnote [ibid.]: "I prefer to call it 'uvularization' and not 'velarization' (which is obviously wrong, because even the velar k, when emphasized, becomes uvular)." In agreement, Czaykowska-
Higgins (1987:2) uses 'emphatic' and 'uvularised' synonymously, and McCarthy (1994:219) states that "[t]he so-called pharyngealized consonants of Arabic should really be called uvularized."

On postvelar articulation (iii), Obrecht (1968:20) refers to emphatics as "velarized or pharyngealized". Al-Ani (1970) refers to them as 'pharyngealised', the recently standard term (e.g., Ladefoged & Maddieson 1996, Crystal 1997). Lehn (1963:31) lists "faucal and pharyngeal constriction (pharyngealization)" as an articulatory property of emphatics distinct from their 'velarisation'. The tongue root is explicitly identified as an articulator for emphatics by Ali & Daniloff (1972:98), who state, "the tongue dorsum and/or tongue root... is the primary articulator for emphatic sound production", and by Woldu (1981:117), who describes emphatic production as involving "retracting of the tongue root towards the pharyngeal wall". Root retraction is supported by the EMG findings of Kuriyagawa et al. (1986), who report no posterior genioglossus (GGP) activity for Jordanian Arabic emphatics compared to GGP activity for the non-emphatic counterparts. They interpret this [p.25] as showing that the "activity of the GGP is suppressed when the retraction of the tongue occurs and the root of tongue is brought back toward the wall of the pharynx."

Emphatic /k/ differs from all other emphatics by being produced with only tongue back retraction and tongue root retraction. It lacks non-postvelar articulation. This is seen in Figure 1:9, from Delattre (1971). (Delattre uses 'q' for /k/.)

![Figure 1:9. Sagittal section based on an x-ray tracing of [k] (from Delattre 1971:130)](image)
There are two points of view on this uvular stop. The first is that it is emphatic /k/, counterpart of non-emphatic velar /k/. The second is that it is simply uvular stop /q/, that is, not /k/, on the grounds that it has no non-postvelar articulation (Alioua 1993). However, after Dolgopolsky (1977:1), I assume that, for the variety of Arabic focused on in this study, it lacks non-postvelar articulation because its velar and uvular articulations, (i) and (ii), are phonetically fused. The evidence for its identity is its phonological behaviour. It patterns with the other emphatics in triggering uvularisation harmony (also known as 'emphasis spread') and uvulars that are not emphatics, like /χ/, do not.

Various studies have noted involvement of the lips in the production of emphatics, for protrusion or rounding (Mitchell 1960, Lehn 1963, Uldall 1992, Watson 1999). Labialisation receives some support from report of orbicularis oris activity for /b/ but not /g/ (Kuriyagawa et al. 1986:27). Lee (1995:356) reports retracted and lowered jaw for the uvular stop. Higher degree of muscular tension in the mouth and throat has also been mentioned (Lehn 1963, Bonnot 1977), although there are no EMG data to support this (Woldu 1981:116). After Ali & Daniloff (1972), I ascribe emphatic articulation primarily to the tongue. The foregoing indicates that emphatics can be defined in terms of two articulations (besides their non-postvelar one): tongue back retraction and tongue root retraction. The additional articulatory properties discussed above, to the extent which they might characterise a given token, are here considered to only co-operate with the tongue.

Emphatic articulation is defined more closely, given (23), (24), and Figures 1:6 - 1:8, as follows. Their non-postvelar articulation is primary because it produces the tightest constriction, the one where the stricture features are realised. Their uvular and pharyngeal articulations are secondary. Emphatics are thus uvularised and pharyngealised. They are postvelars because they are partly articulated in the postvelar region of the vocal tract. The /k/ is an exception.

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4 Studies with this point of view include Harrell (1957), Lehn (1963), Trubetzkoy (1939), Delattre (1971), Dolgopolsky (1977), and Jakobson (1978). Such studies usually denote the segment as 'q'.

4 This view is held by Bonnot (1977), Ghazeli (1977), Giannini & Pettorino (1982), and Alioua (1993).

4 The uvular stop is evidently not an emphatic in all Arabic dialects. See Ghazeli (1977:59-65) on Tunisian, in which it does not trigger emphasis spread. Anecdotally, /u/ is apparently emphatic in some Palestinian dialects (e.g., certain dialects have /u:/ ([u:]), (over) there' where the Abu Shusha dialect has /aːd/ ([aː:]).
1.4.3 *Postvelar Acoustics*

The aim of this section is to identify the expected acoustic effects of primary pharyngeal and uvular articulation, and pharyngealisation and uvularisation.

The models of Stevens & House (1955), Fant (1960), and Lindblom & Sundberg (1971) view the vocal tract as a sequence of cylindrical tubes of unit length, excited by an acoustic source at one end and open at the other. The variable cross-sectional area of the tract is small enough for assuming plane wave propagation. Stevens & House proposed that the resonances of such a model can be predicted if the values of three parameters are known. The parameters are the radius $r_0$ of the tube at the point of narrowest constriction, the distance $d$ of the narrowest constriction from the glottis, and the ratio $A/l$ of the cross-sectional area of the front tube of the vocal tract divided by its length. The value for $r_0$ corresponds to the cross-sectional area at the constriction as schematised in Figure 1:10. The front tube of the vocal tract is the portion in front of the teeth, for which the cross-sectional area is controlled primarily by the lips and mandible.

![Diagram of vocal tract with conversion to circle](insert diagram)

*Figure 1:10. Conversion of area at constriction to area within a circle*

Stevens & House varied the values of the three parameters between 0.3 and 1.2 cm for $r_0$, between 4 and 13 cm for $d$, and between 0.1 and 20 cm for $A/l$, thus corresponding to 306 distinct configurations. Figure 1:11 presents their schematisation [p.486] of the vocal tract configuration for four sets of values of $r_0$, $d$, and $A/l$. I have added on the right transcriptions of the sounds, all of them vowels, which the configurations would produce.

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44 See Stevens & House (1955) for justification of these values and further explication of the model and its calculations.
They implemented their model using an electrical analog, i.e., each tube element was represented by its analog electrical circuit. Each of the 306 configurations yielded a spectrum from which three formant frequencies were obtained and plotted in several ways, as a function of the three articulatory parameters, \( r_0 \), \( d \), \( A/l \). They found the output signal obtained from their model to match the expected output, acoustically and perceptually.

![Diagram of vocal tract configurations](image)

**Figure 1:11. Schematisation of vocal tract configurations for four sets of values of \( r_0 \), \( d \), and \( A/l \) (from Stevens & House 1955:486)**

The model of Fant (1960) predicts the resonances of the vocal tract from values of parameters similar to those of Stevens & House. By result, the two models are very similar. Lindblom & Sundberg’s (1971) model predicts the resonances from five parameters: the state of the lip muscles, position of the jaw, shape of the tongue body, position of the tongue body, and larynx height. Since a change in tongue body shape and/or jaw position results in a change in degree of constriction and change in degree of constriction results in a change in \( r_0 \), their model ultimately considers the effect of a change in \( r_0 \). The acoustic predictions of the Fant and Lindblom & Sundberg models are in general agreement with those to be identified in this section based on the model of Stevens and House.
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All three models consider only vocal tract configurations with a single constriction. They do not consider ones with additional constriction. We are interested in additional constrictions because some postvelars are produced with simultaneous primary and secondary articulations. I suggest a means of circumventing this limitation, below.

The values in Table 1:1 are assumed for $r_0$, $d$, and $A/\ell$ for vocal tract configurations with primary pharyngeal and uvular articulations.

<table>
<thead>
<tr>
<th>Articulation</th>
<th>$r_0$ (cm)</th>
<th>$d$ (cm)</th>
<th>$A/\ell$ (cm)</th>
</tr>
</thead>
<tbody>
<tr>
<td>primary pharyngeal</td>
<td>0.4</td>
<td>4</td>
<td>7</td>
</tr>
<tr>
<td>primary uvular</td>
<td>0.3</td>
<td>7</td>
<td>7</td>
</tr>
</tbody>
</table>

*Table 1:1. Values of $r_0$, $d$, and $A/\ell$ for vocal tract configurations with primary pharyngeal and uvular articulations*

The $r_0$ values in the table are estimates based on the tracings of gutturals in Figures 1:2 - 1:4, which indicate that $r_0$ is smaller for primary uvular than primary pharyngeal constriction. A range of 3 - 7 cm is assumed for $d$ for postvelar articulations, as assumed by Klatt & Stevens (1969) for the constriction sites of pharyngeal and uvular gutturals. This range is also indicated by Ghazeli's (1977) x-ray template in Figure 1:5. It is presented again in Figure 1:12, with cm measurements added, assuming a vocal tract length of

---

17 cm. Based on Figure 1:12, d = 4 for pharyngeal constriction and d = 7 for uvular constriction. The A/l values are estimates based on the findings of retracted and lowered jaw for gutturals as noted in §1.4.1.

The resonances predicted by the Stevens & House model for the vocal tract configurations defined by the values in Table 1:1 are given in Fig. 3 of their paper. Their Fig. 3 presents six graphs in which formant frequency is plotted vs. d for different A/l; r₀ is held constant. Those graphs can be thought of as a stack of graphs, each horizontal layer corresponding to the graph of a given r₀ value. Figures 1:13 - 1:17 are derived from their Fig. 3 and correspond to vertical slices in the stack at specific values of d, the abscissa in the six graphs of the stack. In the figures presented here, the ordinate represents formant frequency (in Hz) and the abscissa represents radius r₀ (in cm) at the constriction point. Figure 1:13 shows formant frequency vs. r₀ for primary pharyngeal articulation, i.e., d = 4, A/l = 7. Figure 1:14 shows formant frequency vs. r₀ for primary uvular articulation, i.e., d = 7, A/l = 7. Each of Figures 1:13 - 1:14 shows two curved lines, the bottom one for F₁, the top one for F₂. Along dashed vertical lines in Figure 1:13, point A marks F₁ and AA marks F₂ for primary pharyngeal articulation. In Figure 1:14, point B marks F₁ and BB marks F₂ for primary uvular articulation.

![Figure 1:13. F₁ and F₂ predicted by Stevens & House (1955) for vocal tracts of d = 4, A/l = 6.7, and varying r₀ (points for primary pharyngeal articulation plotted)](image)

46 Fig. 3 of Stevens & House (1955) does not provide data for configurations of A/l = 7 cm. Figures 1:13 and 1:4 show the data for their A/l value closest to 7 cm.

47 The curves in Figures 1:13 - 1:14 are fitted. As seen, each curve fits closely with the points along it.
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Given the degree of approximation reflected by the values in Table 1:1, I avoid precise predictions. The general $F_1$ and $F_2$ effects predicted for the two primary articulations under discussion are seen in Table 1:2.

<table>
<thead>
<tr>
<th>Articulation</th>
<th>$F_1$</th>
<th>$F_2$</th>
</tr>
</thead>
<tbody>
<tr>
<td>primary pharyngeal</td>
<td>A high</td>
<td>AA low</td>
</tr>
<tr>
<td>primary uvular</td>
<td>B medium</td>
<td>BB medium</td>
</tr>
</tbody>
</table>

*Table 1:2. Predicted acoustic effects of primary pharyngeal and uvular articulations*

Figure 1:14. $F_1$ and $F_2$ predicted by Stevens & House (1955) for vocal tracts of $d = 7$, $A/l = 6.7$, and varying $r_0$ (points for primary uvular articulation plotted)

The descriptions of $F_1$ and $F_2$ as 'high' and 'medium' are based on comparison of the frequency at each point $A(A)$ and $B(B)$ in Figures 1:13 - 1:14 with the $F_1$ and $F_2$ ranges predicted by the Stevens and House model, over all $r_0$, $d$, and $A/l$. Those ranges, delimited by their minima and maxima, are given in Table 1:3.

The ranges in Table 1:3 are similar to the $F_1$ and $F_2$ ranges found by Peterson & Barney (1952) for 33 male speakers, as shown in Table 1:4.⁴⁸

<table>
<thead>
<tr>
<th></th>
<th>$F_1$ (Hz)</th>
<th>$F_2$ (Hz)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>min</td>
<td>max</td>
</tr>
<tr>
<td></td>
<td>200</td>
<td>950</td>
</tr>
</tbody>
</table>

*Table 1:3. $F_1$ and $F_2$ ranges predicted over all $r_0$, $d$, and $A/l$ by the model of Stevens & House (1955)*

⁴⁸The individual value ranges in Table 1:4 were obtained from Peterson & Barney's raw data, which are not available in their paper but are available on the internet.
<table>
<thead>
<tr>
<th></th>
<th>$F_1$ (Hz)</th>
<th>$F_2$ (Hz)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>min</td>
<td>Max</td>
</tr>
<tr>
<td>ranges of Peterson and Barney (1952)</td>
<td>270</td>
<td>730</td>
</tr>
<tr>
<td>average values</td>
<td></td>
<td></td>
</tr>
<tr>
<td>ranges of Peterson and Barney (1952)</td>
<td>190</td>
<td>840</td>
</tr>
<tr>
<td>individual values</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

*Table 1:4. $F_1$ and $F_2$ ranges of Peterson & Barney (1952) data*

Based on Table 1:3, $F_1$ ranges between 200 and 950 Hz, $F_2$ between 700 and 2500 Hz. Dividing each range by 3 gives the sub-ranges in Table 1:5. The acoustic effects in Table 1:2 refer to the ranges in Table 1:5.

<table>
<thead>
<tr>
<th></th>
<th>$F_1$ (Hz)</th>
<th>$F_2$ (Hz)</th>
</tr>
</thead>
<tbody>
<tr>
<td>low</td>
<td>200 - 450</td>
<td>700 - 1300</td>
</tr>
<tr>
<td>medium</td>
<td>450 - 700</td>
<td>1300 - 1900</td>
</tr>
<tr>
<td>high</td>
<td>700 - 950</td>
<td>1900 - 2500</td>
</tr>
</tbody>
</table>

*Table 1:5. Ranges for $F_1$ and $F_2$*

Finally, as articulatory data indicate that velar emphatics, like uvular gutturals, are produced with primary uvular articulation, the effects for primary uvular articulation in Table 1:2 apply to both types of segments.

As for secondary postvelar articulations, Figures 1:3 - 1:4 and 1:6 - 1:8 indicate that uvular gutturals and emphatics are produced with the secondary articulations in Table 1:6.

<table>
<thead>
<tr>
<th>Segment</th>
<th>Secondary Postvelar Articulation(s)</th>
</tr>
</thead>
<tbody>
<tr>
<td>uvular gutturals</td>
<td>pharyngealisation</td>
</tr>
<tr>
<td>velar emphatics</td>
<td>pharyngealisation</td>
</tr>
<tr>
<td>non-velar emphatics</td>
<td>uvularisation, pharyngealisation</td>
</tr>
</tbody>
</table>

*Table 1:6. Secondary postvelar articulations of uvular gutturals and emphatics*

The values in Table 1:7 are assumed for $r_0$, d, and $A/l$ for vocal tract configurations with secondary pharyngeal and uvular articulations. Two configurations are defined for pharyngealisation. The first has a large $A/l$, i.e., no rounding, for uvular gutturals and velar emphatics, the second has a small $A/l$, i.e., rounding, for non-velar emphatics. The two configurations are distinguished because the $F_1$ and $F_2$ effects predicted for pharyngealisation potentially vary depending on the value of $A/l$. The $r_0$ values are estimates.
based on Figures 1:3 - 1:4 and Figures 1:6 - 1:9, which indicate larger \( r_0 \) for secondary pharyngeal and uvular articulations than for the corresponding primary articulations, and that the secondary vs. primary difference is greater for uvular than pharyngeal constrictions. (See the earlier explanation of \( d \) for pharyngeal and uvular place.)

A dynamic view of pharyngealisation and uvularisation is assumed, that is, that these secondary articulations result from decrease in \( r_0 \) from 1.2 (no constriction) to 0.6. This corresponds to the change in \( r_0 \) at \( d = 4 \) (for pharyngealisation) and \( d = 7 \) (for uvularisation) for \( A/l = 7 \) (for uvular gutturals

<table>
<thead>
<tr>
<th>Articulation</th>
<th>( r_0 ) (cm)</th>
<th>( d ) (cm)</th>
<th>( A/l ) (cm)</th>
</tr>
</thead>
<tbody>
<tr>
<td>pharyngealisation (uvular gutturals and velar emphatics)</td>
<td>0.6</td>
<td>4</td>
<td>7</td>
</tr>
<tr>
<td>pharyngealisation (non-velar emphatics)</td>
<td>0.6</td>
<td>4</td>
<td>2</td>
</tr>
<tr>
<td>uvularisation</td>
<td>0.6</td>
<td>7</td>
<td>2</td>
</tr>
</tbody>
</table>

Table 1:7. Values of \( r_0, d, \) and \( A/l \) for vocal tract configurations with pharyngealisation and uvularisation articulations

and velar emphatics) and \( A/l = 2 \) (for non-velar emphatics), which occurs when secondary pharyngeal or uvular gesture is added to a segment. In this manner, I heuristically apply the Stevens & House model to configurations with additional constrictions. The relevant data derived from Stevens & House (1955:487 Fig.3) are seen in Figures 1:15 - 1:17.⁴⁹

\[ \text{Figure 1:15. } F_1 \text{ and } F_2 \text{ predicted by Stevens & House (1955) for vocal tracts of } d = 4, A/l = 6.7, \text{ and varying } r_0 \text{ (points for pharyngealisation plotted).} \]

⁴⁹ Figures 1:16 - 1:17 show the data from Stevens & House (1955:487) for their \( A/l \) value closest to 2 cm.
Under this dynamic view, the $F_1$ and $F_2$ effects predicted for pharyngealisation and uvularisation are identified as those in Table 1:8. Direction and size of each change were determined from the nature of the curved lines in each graph for the $r_0$ interval starting at 1.2 and ending at 0.6. For example, the bottom curved line in Figure 1:17, representing $F_1$ for uvularisation, rises 70 Hz over the $r_0$ interval starting at 1.2 and ending at 0.6 (that is, ending at point E). This is recorded in Table 1:8 as a small rise.

**Figure 1:16.** $F_1$ and $F_2$ predicted by Stevens & House (1955) for vocal tracts of $d = 4$, $A/l = 1.1$, and varying $r_0$ (points for pharyngealisation plotted)

**Figure 1:17.** $F_1$ and $F_2$ predicted by Stevens & House (1955) for vocal tracts of $d = 7$, $A/l = 1.1$, and varying $r_0$ (points for uvularisation plotted)
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<table>
<thead>
<tr>
<th>Articulation</th>
<th>$F_1$</th>
<th>$F_2$</th>
</tr>
</thead>
<tbody>
<tr>
<td>pharyngealisation of uvular gutturals and velar emphatics</td>
<td>C large rise</td>
<td>CC medium drop</td>
</tr>
<tr>
<td>pharyngealisation of non-velar emphatics</td>
<td>D medium rise</td>
<td>DD medium drop</td>
</tr>
<tr>
<td>uvularisation</td>
<td>E small rise</td>
<td>EE medium drop</td>
</tr>
</tbody>
</table>

*Table 1:8. Predicted acoustic effects of pharyngealisation and uvularisation*

The particular size of each formant change was identified by first determining the difference between formant frequency at $r_0 = 1.2$ and $r_0 = 0.6$ in each of Figures 1:15 - 1:17. (For example, in Figure 1:17, the difference between $F_1$ at $r_0 = 1.2$ cm and $F_1$ at $r_0 = 0.6$ cm is 70 Hz.) Each difference was compared with the maximum difference predicted for the formant by the Stevens and House model, between $r_0 = 1.2$ and some other $r_0$ value, over all $d$ and $A/l$. Those maximum differences are seen in Table 1:9. They are the maximum changes predicted for $F_1$ and $F_2$. Dividing each by 3 gives the ranges for $F_1$ and $F_2$ change in Table 1:10. The degrees of change in Table 1:8 refer to the ranges in Table 1:10.

<table>
<thead>
<tr>
<th>$F_1$ (Hz)</th>
<th>$F_2$ (Hz)</th>
</tr>
</thead>
<tbody>
<tr>
<td>300</td>
<td>600</td>
</tr>
</tbody>
</table>

*Table 1:9. Maximum $F_1$ and $F_2$ changes predicted by the model of Stevens & House (1955)*

<table>
<thead>
<tr>
<th></th>
<th>$F_1$ (Hz)</th>
<th>$F_2$ (Hz)</th>
</tr>
</thead>
<tbody>
<tr>
<td>small</td>
<td>&lt;100</td>
<td>&lt;200</td>
</tr>
<tr>
<td>medium</td>
<td>100 - 200</td>
<td>200 - 400</td>
</tr>
<tr>
<td>large</td>
<td>200 - 300</td>
<td>400 - 600</td>
</tr>
</tbody>
</table>

*Table 1:10. Ranges of degrees of change for $F_1$ and $F_2$*

Based on Tables 1:2 and 1:8, the predicted cumulative effects of the postvelar articulations of gutturals and emphatics are those in Table 1:11. As pharyngeal gutturals have no secondary postvelar articulation, the A(A) effects in Table 1:2 transfer unmodified to the first line of Table 1:11. For uvular gutturals and velar emphatics, the B(B) effects in Table 1:2 and C(C) effects in

---

50 Based on Fig. 5 of Stevens & House (1955:487), the maximum $F_1$ difference predicted by their model is between $r_0 = 1.2$ and $r_0 = 0.4$ at $d = 4$ and $A/l = 20$. The maximum $F_2$ difference is between $r_0 = 1.2$ and $r_0 = 0.3$ for $d = 6$ and $A/l = 0.11$. 

---
Table 1:8 combine: medium \(F_1\) for \(B\) + large rise for \(C\) yields final prediction in Table 1:11 of medium or high \(F_1\); medium \(F_2\) for \(BB\) + medium drop for \(CC\) results in a final prediction in Table 1:11 of low or a medium \(F_2\). (Whether the ultimate \(F_1\) is medium or high and whether the ultimate \(F_2\) is low or medium will depend on whether \(F_1\) and \(F_2\) for the primary articulation are at the low or high end of the \(F_1\) and \(F_2\) medium ranges in Table 1:5.) For non-velar emphatics, the \(D(D)\) and \(E(E)\) effects in Table 1:8 combine in Table 1:11: for \(F_1\), the medium rise for \(D\) + small rise for \(E\) yields final prediction of a medium or large rise; for \(F_2\), the medium drop for \(DD\) + medium drop for \(EE\) yields final prediction of a large drop. No final \(F_1\) or \(F_2\) (low, high, or medium as defined in Table 1:5) is predicted for non-velar emphatics because that will depend on what is predicted for their primary (non-postvelar) articulation, which was not discussed in this section.

<table>
<thead>
<tr>
<th>Postvelar Articulation</th>
<th>(F_1)</th>
<th>(F_2)</th>
</tr>
</thead>
<tbody>
<tr>
<td>GUTTURALS:</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Pharyngeal</td>
<td>primary pharyngeal</td>
<td>high</td>
</tr>
<tr>
<td>Uvular</td>
<td>primary uvular, pharyngealisation</td>
<td>medium or high</td>
</tr>
<tr>
<td>EMPHATICS:</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Velar</td>
<td>primary uvular, pharyngealisation</td>
<td>medium or high</td>
</tr>
<tr>
<td>Non-velar</td>
<td>uvularisation, pharyngealisation</td>
<td>medium or large rise</td>
</tr>
</tbody>
</table>

Table 1:11. Predicted cumulative acoustic effects of postvelar articulations of gutturals and emphatics

In sum, we expect pharyngeal gutturals to have a high \(F_1\) and low \(F_2\), uvular gutturals to have a medium or high \(F_1\) and low or medium \(F_2\). Velar emphatics should have a medium or high \(F_1\) and low or medium \(F_2\), non-velar emphatics a medium or large rise in \(F_1\) and a large drop in \(F_2\).

These effects have been reported. For example, Butcher & Ahmad (1987) report a high \(F_1\) and medium or low \(F_2\) for pharyngeal gutturals. Ghazeli (1997) found a medium \(F_1\) and low \(F_2\) for uvular gutturals. (‘High’, ‘medium’, and ‘low’ here are as defined in Table 1:5.) A rise in \(F_1\) for non-velar emphatics (or vowels in contact with them) is reported by Bonnot (1977,
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1979), Woldu (1981), and Younes (1982). A drop in $F_2$ for non-velar emphatics is a standard finding.\(^{51}\)

This study will examine tokens of gutturals and emphatics in Arabic and Salish to see if their formant frequencies show the $F_1$ and $F_2$ predictions identified in this section. If they do, that will be taken as acoustic support for assuming that the analysed tokens were produced with the corresponding postvelar articulation(s) in Table 1:11. Tokens of consonants and vowels that undergo phonological postvelar harmony will also be examined. Where the harmony is presumably implemented with pharyngealisation, we will check for effects C(C) and D(D) in Table 1:8: a medium or large rise in $F_1$ and a medium drop in $F_2$. Where it is presumably implemented with uvularisation and pharyngealisation, we will check for the effects predicted for both those articulations, namely, the effects for non-velar emphatics in Table 1:11: a medium or large rise in $F_1$ and a large drop in $F_2$. If the formant frequencies of the tokens of harmonising segments match the predictions, that will be taken as acoustic support for assuming the tokens were produced with the corresponding secondary pharyngeal and uvular articulations.

As a final note, the findings will be interpreted as support under the hypothesis that the tokens were not produced with, instead of the postvelar articulation(s), some completely non-postvelar articulation which might result in the $F_1$ and $F_2$ effects identified in this section, e.g., lowered jaw and concomitant large mouth opening, which raises $F_1$, or lip rounding, which lowers $F_2$. It is important to note that, while the articulation-to-acoustics mapping is one-to-one, the reverse mapping is one-to-many. That is, a specific vocal tract configuration will always have the same and unique set of formant frequencies, but a given set of formant frequencies will not in general correspond to a unique vocal tract configuration (as shown by Stevens & House 1955, and later and in more detail by Atal et al. 1978).\(^{52}\) While it is true that many possible articulations can be excluded for a given segment token, the point is that particular acoustic effects cannot be considered actual evidence for a particular articulation.

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\(^{52}\) See Figures 13 - 15 and 21 - 25 in Atal et al. (1978:1548-1554), which show multiple area functions (configurations) with identical values for the first three formant frequencies for /i/, /a/, and /u/.
1.4.4 Summary
This section examined the articulatory nature of guttural and emphatic postvelars and the acoustic effects of their articulations. The pharyngeal gutturals /ʔ h/ are produced with only primary pharyngeal articulation. Tokens of /ʔ h/ are predicted to have a high F₁ and low F₂. Uvular gutturals such as / ħ/, and emphatic velar /k/, are produced with primary uvular articulation and pharyngealisation. Tokens of those consonants are predicted to have a medium or high F₁ and a low or medium F₂. Non-velar emphatics such as /t s t/ are produced with a primary non-postvelar articulation and uvularisation and pharyngealisation. Tokens of those segments are predicted to have a medium or large rise in F₁ and a large drop in F₂.

1.5. A Harmony Typology
I propose (25), in which ‘x’ is the feature for which harmony is observed. This typology is based on Selkirk’s (1993:6) three natural classes relevant to multiply-articulated segments: (i) the class for which feature x is a primary specification, (ii) the class for which it is a secondary specification, (iii) the class for which it is either primary or secondary. (See Selkirk 1993:5-20 for discussion of these classes in Ngbaka and Berber.) After Shaw (1991b), ‘harmony’ refers to assimilation and dissimilation.

(25) Harmony Typology
a. Primary Articulation (AP) Harmony: only primary instances of x are involved.
   b. Secondary Articulation (AS) Harmony: only secondary instances of x are involved.
   c. Articulation (A) Harmony: both primary and secondary instances of x are involved.

I will show that postvelar harmony can be A harmony, involving Selkirk’s natural class (iii), or AS harmony, involving class (ii). The data to be examined happen not to exemplify AP harmony, involving class (i); see Selkirk (1993:8-29) for an example of AP Dissimilation in Tashlhiyt Berber.

1.6. Optimality Theory
Optimality Theory (OT) (McCarthy & Prince 1993a, Prince & Smolensky 1993) is adopted as explanatory framework in this work. Many constraints in my account are well-established in the literature. I will propose

See also Archangeli & Langendoen (1997) and Kager (1999).
others as indicated by the data. We will see that the intricate yet entirely systematic postvelar systems of the two languages under scrutiny result from the interaction of ranked constraints, and that the crosslinguistic differences between the two languages are due to simple constraint reranking. Insights from this study which are directly due to the application of OT include our conclusion that the features of uvularisation (secondary-[RTR] and secondary-[DOR]) are referred to as a unit in the phonology (see §2.5.2), the identification of Palestinian Arabic’s two distinct contexts for pharyngealisation harmony (see §2.6), and the identification of glottalised vowels for St’át’imcets rather than transparent laryngeals (see §3.5.6).

In OT, phonological alternations are standardly assumed not to result from serially ordered rules, as was assumed in generative phonology since Chomsky & Halle (1968). Rather, they are the surface effect of the interaction of ranked violable constraints. The constraints are universal, but their ranking is language-specific. A function GEN generates candidate surface (‘output’) forms from a single underlying (‘input’) form. A function EVAL then evaluates the candidate outputs with respect to the constraint ranking of the language. Candidates are evaluated simultaneously and in parallel, in a one-step mapping from input to output. The candidate with least serious constraint violations is the actual output form.

Comparison of (27) with (26) illustrates how crosslinguistic variation results from constraint reranking.

<table>
<thead>
<tr>
<th></th>
<th>A</th>
<th>B</th>
</tr>
</thead>
<tbody>
<tr>
<td>candidate 1</td>
<td></td>
<td>![ ]</td>
</tr>
<tr>
<td>candidate 2</td>
<td>*!</td>
<td></td>
</tr>
</tbody>
</table>

54 Notice that even under Richness of the Base (Prince & Smolensky 1993, Smolensky 1996, Smolensky et al. 2001) we can assume that the actual input to GEN has specified substance (in adult phonology). There is in reality a single input per output; it’s just that the OT mechanism isn’t bound to that, rather like a sales tax, e.g., 5%, to which in reality specific bills, e.g., $10.00 for lunch, are submitted (after A. Prince, p.c.).

55 A theory of ranked and violable constraints need not be implemented in parallel. Prince and Smolensky (1993) discuss a non-parallel version of OT. Several articles (e.g., Kiparsky 2000) have argued that some serialism is necessary.
The constraints in (27) are the same as those in (26), but the ranking is reversed. Candidate 2 wins in (27) because it violates only Constraint A, which is more lowly ranked than B in this new grammar. (In ‘tableau’ displays like those in (26) and (27), constraint ranking is represented by left-to-right column order. Constraint violation is marked with ‘*’, fatal violation with ‘!’ , and the winning candidate with a pointing hand. Shading indicates that the information in the cell is irrelevant to the fate of the candidate.) The additional candidate 3 reminds us that constraint violations can accrue. It violates Constraint A twice while candidate 2 violates it only once, so candidate 2 wins in (27).

I will argue that three types of constraints figure crucially in Palestinian and St'át'imcets postvelar harmony: Correspondence, Alignment, and Grounded constraints. They are explained next.

1.6.1 Correspondence Constraints

A fundamental issue in OT is faithfulness between related representations. Faithfulness between input and output forms is understood within Correspondence Theory (McCarthy & Prince 1995), which considers input and output forms in a relation of correspondence. With both viewed as strings, Correspondence is defined by McCarthy & Prince (1995) as:

(28) Correspondence (McCarthy & Prince 1995:262)

Given two strings $S_1$ and $S_2$, correspondence is a relation $\rho$ from the elements of $S_1$ to those of $S_2$. Elements of $\alpha S_2$ and $\beta S_2$ are referred to as correspondents of one another when $\alpha \rho \beta$.

I will argue that the DEP and MAX Correspondence families, proposed by McCarthy & Prince (1995), play a central role in the surface realisation of the features responsible for postvelar harmony in Palestinian and St'át'imcets. MAX and DEP are defined by McCarthy & Prince as:\[56\]

\[56\] McCarthy & Prince (1995) also proposed base-reduplicant instantiations of MAX and DEP.
(29) The MAX Constraint Family (McCarthy & Prince 1995:264)

*General Schema*
Every segment of $S_1$ has a correspondent in $S_2$.

*Specific Instantiation*
MAX-IO
Every segment of the input has a correspondent in the output.
(No phonological deletion.)

(30) The DEP Constraint Family (McCarthy & Prince 1995:264)

*General Schema*
Every segment of $S_2$ has a correspondent in $S_1$.

*Specific Instantiation*
DEP-IO
Every segment of the output has a correspondent in the input.
(Prohibits phonological epenthesis.)

I assume that MAX and DEP govern features as well as segments, also the associations ("links") between features and segments, following Íto et al. (1995). That is, MAX-IO and DEP-IO have the further instantiations:

(31) a. MAX-F
Every feature in the input corresponds to a feature in the output.
(No feature is deleted.)

b. MAX-LINK
Every association in the input corresponds to an association in the output.
(No link is deleted.)

c. DEP-F
Every feature in the output corresponds to a feature in the input.
(No feature is added.)

d. DEP-LINK
Every association in the output corresponds to an association in the input.
(No link is added.)

The tableau in (32) illustrates satisfaction and violation of the constraints in (31). (In (32), they are equally ranked, which is indicated by the dotted column borders.)

In (32), candidate 1 has all the features and links that the input has and so satisfies MAX-F and MAX-LINK. It has no feature or link the input does not
have, so it also satisfies DEP-F and DEP-LINK. Candidate 2 is missing the underlying [DOR] and the underlying link between that feature and α. It thus violates MAX-F and MAX-LINK. Candidate 2 has no feature or link that the input does not have, so it satisfies the two DEP constraints. Candidate 3 has all the features and links of the input, so it satisfies the MAX constraints. However, it has an added feature, [RTR], and two added links (those between [DOR] and β, and [RTR] and β), so it violates DEP-F once, DEP-LINK twice.

(32)

<table>
<thead>
<tr>
<th>input: [DOR]</th>
<th>MAX-F</th>
<th>MAX-LINK</th>
<th>DEP-F</th>
<th>DEP-LINK</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. [DOR]</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>α β</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2.</td>
<td></td>
<td>*</td>
<td>*</td>
<td></td>
</tr>
<tr>
<td></td>
<td>α β</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>3. [DOR]</td>
<td></td>
<td></td>
<td>*</td>
<td>**</td>
</tr>
<tr>
<td></td>
<td>α β</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

We will see that the constraints in (31) figure crucially in Palestinian and St'át'imcets postvelar harmony. For example, MAX-RTR ('Every [RTR] in the input corresponds to an [RTR] in the output') and MAX-LINK are highly ranked in both languages. The effect is that [RTR] 'stays' on the segment to which it is underlingly linked in order to serve as a source of [RTR] harmony in the string. DEP-LINK is more lowly ranked than MAX-RTR and MAX-LINK in both languages. The effect is that new [RTR] associations, the manifestations of the harmony, occur in the output with little penalty. The role to be identified for DEP-RTR ('Every [RTR] in the output corresponds to an [RTR] in the input') mirrors that argued for by Pulleyblank (1997b) for functionally equivalent REC-F ('RECOVER-F'). Pulleyblank argues that the ranking of REC-F with respect to certain Alignment and Grounded constraints derives the effects of opacity and transparency in Yoruba and Wolof [-ATR] harmony (see also Archangeli 2000 on Pulaar). In Palestinian, for example, DEP-RTR is ranked above certain Grounded constraints but below others, where some of the Grounded constraints are Alignment constraints. This derives the observed neutrality patterns of Palestinian pharyngealisation harmony.
1.6.2  *Alignment Constraints*

Generalized Alignment, proposed by McCarthy & Prince (1993b), is a constraint schema governing the coincidence of categories at constituent edges. McCarthy & Prince formulate it as:

\[(33)\text{ Generalized Alignment (McCarthy & Prince 1993b:2)}\]

\[\text{Align(Cat}_1, \text{ Edge}_1, \text{ Cat}_2, \text{ Edge}_2) = \text{def} \]
\[\forall \text{ Cat}_1 \ni \text{ Cat}_2 \text{ such that Edge}_1 \text{ of Cat}_1 \text{ and Edge}_2 \text{ of Cat}_2 \text{ coincide.}\]

where
\[\text{Cat}_1, \text{ Cat}_2 \in \text{PCat} \cup \text{Gcat}\]
\[\text{Edge}_1, \text{ Edge}_2 \in \{\text{Right, Left}\}\]

I take PCat and GCat to be phonological categories and grammatical (morphological or syntactic) categories, respectively. Generalized Alignment provides uniform expression for constraints that reference a constituent edge. An example of a particular parameterisation of Generalized Alignment, from McCarthy & Prince (1993b:2), is:

\[(34)\text{ English Stress}\]

\[\text{Align(PrWd, L, Ft, L)}\]

This requirement is satisfied in [(Tàta)ma(góucheé)], since the left edge of the Prosodic Word coincides with the left edge of a foot.

We will see that Alignment constraints on [RTR] and [DOR] are the basic force driving postvelar harmony in Palestinian and St’át’ímcets. Some of the Alignment constraints are syntagmatically grounded, as discussed below.

1.6.3  *Grounded Constraints*

Grounded constraints provide evidence for the Grounding Hypothesis of Archangeli & Pulleyblank (1994), which says [p.172] that featural relations are “rooted in the physical properties of the vocal tract or speech signal”. That is, featural constraints are consistent with the phonetic bases of speech.

Grounding is paradigmatic or syntagmatic. Paradigmatic grounding relations hold of featural relations within a segment. An example provided by Archangeli & Pulleyblank (1994) is that between [HI] and [RTR]. In several languages, a segment specified for [HI] cannot also be specified for [RTR]. (Here, after Pulleyblank 1997b, I assume that [RTR] as just referenced corresponds to Archangeli & Pulleyblank’s ‘[-ATR]’.) As they explain, this is grounded in the anatomical proximity of the tongue body and root. Given the
proximity, raising the body makes it difficult to simultaneously retract the root. It is also based on acoustic effects: raising the body and retracting the root have contradictory $F_1$ effects. Archangeli & Pulleyblank and Pulleyblank (1997b) argue that this relation is basis for the paradigmatic grounded constraint HI/$^*$RTR ("If a segment is specified for [HI], it is not specified for [RTR]").

Syntagmatic grounding relations hold not within segments but between them. Shahin (1993) suggested that the physical properties of the tongue root are the phonetic basis for tongue root retraction harmony. Specifically, given the relative large mass and resultant sluggishness of the tongue root, tongue root articulation has a natural tendency to span more than one segment in a word. This is an instance of syntagmatic grounding. Syntagmatic grounded constraints are formulated by Jiang-King (1996), who proposes a constraint against the sequence [HI]-[LOW], and by Pulleyblank (1997a), who explains several cases of local assimilation as the effect of highly ranked constraints on Cluster-Identity.

Two syntagmatic grounded constraints to be proposed in this study are Align([RTR], L; Wd, L) and Align([RTR], R; Wd, R), which say, respectively, ‘The left edge of the word is aligned with the left edge of any [RTR]’ and ‘The right edge of the word is aligned with the right edge of any [RTR]’. These are grounded in the sluggishness of the tongue root. Data will show that they are more lowly ranked in St’át’imcets than in Palestinian. In the latter, they interact with more lowly ranked DEP-LINK to force an expanded distribution of [RTR]. In St’át’imcets, the reverse DEP-LINK $>>$ Align([RTR], L; Wd, L), Align([RTR], R; Wd, R) results in more restricted postvelar harmony.

1.7. **Phonetics and Phonology**

1.7.1 **The Distinction between Phonetics and Phonology**

There has been considerable debate over the use of phonetics in phonology, and just how we are to determine which observed sound properties are actually part of the phonology of a language and thus in need of theoretical account. This is a critical issue for the present study, for identification of the segmental inventories of the two languages under investigation and of the properties of their postvelar harmonies. (For example, in chapter 3 we ask: Is St’át’imcets $z$ an emphatic? Must we adjust our understanding of St’át’imcets phonology, and so our theoretical account of the language, to include recognition that it is? Clear indication that the $z$ is an emphatic comes, e.g., from its vowel effects: we will see that they are discrete and coincide with those of the other emphatics of that language.)

57 Those two studies phrase it as HI/ATR ("If [+high], then [+ATR], not [-ATR]").
I assume that a sound property can be identified as phonetic or phonological according to the criteria in (35).\textsuperscript{58}

(35) Necessary Criteria for Phonetic vs. Phonological Status

   The property has a phonological effect and is referenced in a constraint.
   Phonetic properties are not phonologically visible, but phonological properties are. In the absence of evidence for phonological visibility, then, based on economy considerations, the property is considered phonetic.

   The principles governing the distribution of the sound property refer to word-internal structure.
   Phonetic properties are not sensitive to word-internal structure, but (lexical) phonological properties can be.

   The property has defined edges and uniform constitution.
   Phonetic properties are non-discrete, that is, continuous. By result, they are necessarily realised with a temporal dimension so the span of presence of one property can partially overlap with that of another. By result, it is frequently difficult to group a set of phonetic properties into a larger unit that can be defined by the presence of those properties. From non-discreteness, it follows that phonetic properties are gradient, that is, showing change according to distance from the source. Phonological properties, by contrast, are discrete, and therefore not gradient. Phonological segmentation, e.g., of consonant or vowel defined by a set of phonological properties, is thus straightforward (although, as in cases of harmony, distinct phonological segments may share a single instance of a phonological property).

\textsuperscript{58} 'Phonological' here means part of the lexical or postlexical phonology (see Mohanan 1982, Kiparsky 1985, Kaisse & Shaw 1985), however that distinction is ultimately handled within OT (see Kager 1999 and Kiparsky 2000 for discussion). See Pulleyblank (1986:7-8) for discussion of criteria 2-4.
   The property arbitrarily does not hold for certain underlying forms. Phonetic properties cannot have lexical exceptions, but phonological properties can.

5. **Speaker/hearer specificity**
   The property applies to speaker and not hearer or vice versa. Phonetic properties are speaker- or hearer-specific. Phonological properties are not.

Liberman (1983) suggests number of properties as a criterion. With Liberman, I assume that phonological properties are bounded in number, on the assumption that the human brain has limited storage capacity. However, the number of phonetic properties is also bounded, if we assume that the properties of the physical world are bounded, that is, that they are in principle enumerable. Finally, as complex distributional properties might indicate cognitive control, we could expect phonetic properties to have the lesser complexity of distribution (after C. Kisseberth p.c.).

The criteria in (35) imply only one type of phonetics. However, there is evidence, since Pierrehumbert (1980), Liberman & Pierrehumbert (1982), and Liberman (1983), that some properties which are phonetic by criteria 1 - 5 vary cross-linguistically, that is, they are language-specific. They must, therefore, be cognitive and part of language. (See also Scobbie et al. 1999 on English diphthongs.)

Furthermore, Steriade (1995b, 1997, 1999) shows that certain phenomena previously assumed to be phonological cannot receive a tenable phonological account. (E.g., she shows that account of the English tap must reference timing properties.) As Steriade argues, the properties involved in such phenomena must be phonetic.

On the basis of these two types of evidence (the second type reducing to the first), I conclude with several previous works that language has a phonetic component. This means that "it is not the case that phonology can be identified with “competence” and phonetics with “performance!”" (Keating 1999:636) and that there are two types of phonetics: speech-phonetics and language-phonetics. In short, phonological analysis and explanation must be done with care; gradient phonetic properties cannot be ignored unless ruled out as speech-phonetic.

---

Two other, reductionist approaches need mention. The first is that of Hale & Reiss (2000). Citing Occam’s Razor ('less is better, so derive things from orthogonal first order primitives', see also Ohala 1978), they argue that all phonological patternings with phonetic basis should be expelled from phonology. However, where they are language-specific, such properties are part of language and cannot be expelled, since observational adequacy supercedes Economy (Wexler 1999).

Second, several studies (e.g., Ohala 1978, 1992, Flemming 2001, Silverman 1997, Boersma 1998, Hayes 1998, Steriade 1999) argue for no phonetics-phonology border. Hayes (1998) proposes that all phonetically based patterning is derived online from the phonetics by inductive grounding. For perceptual grounding, for example, this predicts different phonologies for deaf vs. hearing persons, yet to be laboratory tested (A. Marantz p.c.). Pending that testing and appealing meanwhile to Economy against all variants of this second reductionism, I adopt the more conservative approach described in this section.

Recognition of speech- vs. language-phonetics leads to the following phonetics vs. phonology distinctions. Speech phonetics is purely physical, that is, it is defined in terms of the physical (anatomical, aerodynamic, acoustic or auditory) properties of speech and lies outside cognition. Language-phonetics, although still defined in terms of the physical properties of speech, is cognitive, that is, part of the cognitive representation of language sound structure. Finally, all the phonology is cognitive – although constrained by the physics of speech (see §1.6.3). Table 1:12 summarises.
### Property Characteristics | Nature
--- | ---
**SPEECH-PHONETICS** |  
- not language-specific  
- no phonological visibility  
- no reference to word-internal structure  
- non-discrete  
- no lexical exceptions  
- speaker- or hearer-specific  

**LANGUAGE-PHONETICS** |  
- language-specific  
- no phonological visibility  
- no reference to word-internal structure  
- non-discrete  
- no lexical exceptions  
- speaker- or hearer-specific  

**PHONOLOGY** |  
- phonological visibility  
- possible reference to word-internal structure (for the lexical phonology)  
- discrete  
- possible lexical exceptions  
- not speaker- or hearer-specific  

---

Table 1:12. Necessary criteria for speech-phonetic vs. language-phonetic vs. phonological status

I assume the modular schematisation of language in (36), which follows that of Archangeli & Pulleyblank (1994:5), except that it makes the language-phonetics/speech-phonetics distinction explicit. Language-phonetics as feeding into phonology follows a suggestion by D. Steriade (p.c.).

---

I propose three types of representations for transcriptions: 1. Underlying phonological form, between slashes (/'/), which is the phonological form stripped of its predictable properties. 2. Surface ('output') phonological form, between braces ('{ }'), which is the underlying form + all properties added in the phonology. 3. Phonetic form, between square brackets ('[ ]'), which is the phonological output + additional phonetic properties, minus any word-internal morphological boundaries (their absence following from criterion 2 in (35)).

Distinction between surface and phonetic form has not been standard in generative phonology. (E.g., Roca & Johnson 1999a:697 define the two synonymously). However, the distinction permits transcription in which the analyst's claims about the sound system of the language being transcribed are made explicit.

---

61 Selected phonetic properties are included in the transcription of the phonetic form, depending on the point of discussion. A single phonetic form might thus be represented in various ways, as certain properties might be included in its transcription on one occasion but not another.
For example, the Palestinian form meaning “perfume” is as in (37), which makes the claims in (38).\(^2\)

(37) underlying: /\u't\u,\u'tur/
surface: \{\'\u,t\u,\u,\u\}r
phonetic: [\'\u,t\u,\u,\u\]r or [\'\u,t\u,\u,\u\]r, etc.

where ‘\u03b9’ denotes phonetic voicing

(38) In Palestinian,
a. Presence of ñ t r and U in a morpheme is unpredictable.
b. The form meaning ‘perfume’ is monomorphemic.
c. The properties that combine to form the sequence ñ t r U are phonological. That is, they are language-specific, phonologically visible and discrete; they have possible reference to word-internal structure, possible lexical exceptions, and apply to speaker and hearer.
d. Syllabification, stress assignment, vowel epenthesis, uvularisation of ñ, and pharyngealisation of U are predictable.
e. In the form meaning ‘perfume’, mid vowel height and devoicing of ñ are phonetic properties. That is, they are phonologically invisible and non-discrete, have no reference to word-internal structure, and no lexical exceptions. They apply only to speaker or only to hearer, and are either Palestinian-specific or non-Palestinian-specific.

1.7.2 The Use of Phonetics in Phonology

Phonetic data can provide crucial support (or countersupport) for a phonological account. The support can be articulatory or both articulatory and acoustic, as follows. A phonological account can claim that a segment is specified for a feature F. If articulatory data indicate that the segment is produced with appropriate articulation(s) (e.g., lip rounding for a segment claimed to be specified for [LAB]), then that data can be interpreted as phonetic support for the phonological claim. Additionally, the supporting articulatory data can be mapped through a reliable articulation-to-acoustics model (see §1.4.3). If acoustic data from the segment match the predictions of the model (e.g., lowered F\(_2\) for a segment shown to be produced with lip rounding), then that acoustic data can be interpreted as support for the articulation(s) on which the acoustic predictions were based, strengthening the articulatory support for

\(^2\) For (38e), further study would be needed to determine if the two properties are language-specific.
the phonological claim. In the absence of articulatory data, acoustic data by itself can strengthen presumed articulatory support but under a hypothesis that leaves the door open for other articulations that could have produced the same effects (see §1.4.3).
CHAPTER 2: POSTVELAR HARMONY IN PALESTINIAN ARABIC

2.1. The Language and the Data

Palestinian Arabic is a Palestine-Jordanian variety of Levantine Arabic (Cantineau 1940/46, Eisele 1987). It is itself a collection of dialects that are medini (urban), fellahi (rural) or bedui (bedouin) (Cadora 1992) and northern, southern, eastern, western, central, or coastal by location in the former Palestine (Shahin 2000). Unless otherwise noted, this chapter’s data are from Abu Shusha, a western central fellahi spoken in the pre-1948 village of Abu Shusha, a few kilometers south of Ramla. In it, Old Arabic /q/ is /k/ or /k/. Its most salient rural marker is Old Arabic /k/ > /t/ (Fischer & Jastrow 1980). Another rural feature is lack of /d/, /?/ occurring where urban dialects have /d/ (see Card 1983:107).

The data were gathered by the author, most over six months of fieldwork in Ramallah, West Bank, 1994-1995. The consultants were 26 fellahin (villagers, farmers), males and females aged 28-80. A large set of lexical items and phrases were tape-recorded from a female consultant, aged 45. Further fieldwork was conducted in Vancouver, Canada with a male native speaker, aged 32. Total corpus is approximately 1500 words and phrases. The acoustic study to be reported analysed both Abu Shusha and Jafa (northern coastal medini) tokens. Jafa has the urban marker of /k k/ > /? ?/ and lacks the rural markers. Relevant to postvelar harmony, Abu Shusha stem-final vowels do not pharyngealise but in Jafa they sometimes do, at least phonetically (see §2.4.5).

2.2. Phonemic Inventory

2.2.1 Consonantal Inventory

2.2.1.1 Palestinian Underlying Consonantal Inventory. The underlying consonantal inventory of (Abu Shusha) Palestinian is seen in (1). (The /w/, as in English, is phonetically labiovelar.)

Examples (2) and (3) show the underlying and surface vowels, as frame of reference for the vowels that occur this section’s data. (Note that (3) is not a phonetic inventory).
After Al-Mashaqba (1987), the rhotic /ʁ/ is classified as a resonant. Its acoustic properties (between articulatory vibrations) are vowel-like. (See Ladefoged & Maddieson 1996:218, also Figure 2:34.)

(1) (Abu Shusha) Palestinian Underlying Consonantal Inventory

<table>
<thead>
<tr>
<th>LAB</th>
<th>INTER-</th>
<th>ALV</th>
<th>ALV-</th>
<th>POST-</th>
<th>PAL</th>
<th>VEL</th>
<th>UV</th>
<th>PHAR</th>
<th>GL</th>
</tr>
</thead>
<tbody>
<tr>
<td>DENT</td>
<td>LAT</td>
<td>ALV</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Obstruents**

**stops:**
- t ̯
- b ̯
  - d
- k ̯
- ?

**affricates:**
- tʃ
- dʒ

**fricatives:**
- f
- θ
- s
- ́s
- ʃ
- ?
- h
- δ
- ŋ
- ́ŋ

**Resonants**

**nasals:**
- m
- ̩m
- n

**approximants:**
- w
- r
- ́l
- ́j
- ɣ
- ʰ

(2) (Abu Shusha) Palestinian Underlying Vocalic Inventory

<table>
<thead>
<tr>
<th>FRONT</th>
<th>BACK</th>
<th>FRONT</th>
<th>BACK</th>
</tr>
</thead>
<tbody>
<tr>
<td>HIGH</td>
<td>I</td>
<td>U</td>
<td></td>
</tr>
<tr>
<td>MID</td>
<td>E</td>
<td>O</td>
<td></td>
</tr>
<tr>
<td>LOW</td>
<td>Æ</td>
<td>Â</td>
<td></td>
</tr>
</tbody>
</table>

a. short vowels

b. long vowels

(3) (Abu Shusha) Palestinian Surface Vocalic Inventory

<table>
<thead>
<tr>
<th>FRONT</th>
<th>CENTRAL</th>
<th>BACK</th>
</tr>
</thead>
<tbody>
<tr>
<td>NON-RTR</td>
<td>RTR</td>
<td>NON-RTR</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>HIGH</th>
<th>I</th>
<th>i</th>
</tr>
</thead>
<tbody>
<tr>
<td>MID</td>
<td>e</td>
<td>ɛ</td>
</tr>
<tr>
<td>LOW</td>
<td>æ</td>
<td>æ</td>
</tr>
</tbody>
</table>

1 After Al-Mashaqba (1987), the rhotic /ʁ/ is classified as a resonant. Its acoustic properties (between articulatory vibrations) are vowel-like. (See Ladefoged & Maddieson 1996:218, also Figure 2:34.)
b. long vowels

<table>
<thead>
<tr>
<th>FRONT</th>
<th>BACK</th>
</tr>
</thead>
<tbody>
<tr>
<td>NON-RTR</td>
<td>NON-RTR</td>
</tr>
<tr>
<td>HIGH</td>
<td>i:</td>
</tr>
<tr>
<td>MID</td>
<td>e:</td>
</tr>
<tr>
<td>LOW</td>
<td>æ:</td>
</tr>
</tbody>
</table>

2.2.1.2 *Palestinian Surface Consonantal Inventory.* The surface consonantal inventory, in (4), differs from (1) by containing several additional emphatics. All underlying non-emphatic consonants, except post-alveolar /ʃ tʃ dʒ/, have surface emphatic counterparts which arise through uvularisation harmony. It also differs by containing surface non-emphatic {r}.

(4) (Abu Shusha) Palestinian Surface Consonantal Inventory

<table>
<thead>
<tr>
<th>LAB</th>
<th>INTER-</th>
<th>ALV</th>
<th>ALV-</th>
<th>POST-</th>
<th>PAL</th>
<th>VEL</th>
<th>UV</th>
<th>PHAR</th>
<th>GL</th>
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</thead>
<tbody>
<tr>
<td></td>
<td>DENT</td>
<td>LAT</td>
<td>ALV</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Obstruents**

*stops:*

<table>
<thead>
<tr>
<th></th>
<th>t</th>
<th>t</th>
<th>k</th>
<th>k</th>
<th>ʔ</th>
<th>ʔ</th>
</tr>
</thead>
<tbody>
<tr>
<td>b</td>
<td>b</td>
<td>d</td>
<td>d</td>
<td>tʃ</td>
<td>dʒ</td>
<td></td>
</tr>
</tbody>
</table>

*affricates:*

|   | ʃ | ʒ |

*fricatives:*

<table>
<thead>
<tr>
<th>f</th>
<th>f</th>
<th>θ</th>
<th>θ</th>
<th>s</th>
<th>s</th>
<th>ʃ</th>
<th>h</th>
<th>h</th>
</tr>
</thead>
<tbody>
<tr>
<td>ʔ</td>
<td>ʔ</td>
<td>z</td>
<td>ʒ</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Resonants**

*nasals:*

| m | m | n | ŋ |

*approximants:*

| w | w | r | r | l | j | j | ʋ | ʒ | ʃ |

2.2.1.3 *Postvelars.* The language has 14 postvelars: six gutturals, /ʔ h ʕ h ʊ ɣ/, and eight emphatics, /rh b l ŋ s t r k/.

---

2.2.1.3.1 Guttural Approximants. The pharyngeal and uvular gutturals /ʕ/ and /q/ are best analysed as approximants, not fricatives (Catford 1977, McCarthy 1994:194, Ladefoged & Maddieson 1996:168). In voiceless contexts they are often accompanied by frication, here considered a phonetic effect. Frication results from increased rate of airflow in the voiceless context (Stevens 1971). Because frication for voiceless /ʕ/ can be attributed to aerodynamic coincidence, as for voiced /ʕ/ in voiceless contexts, /ʕ/ are here analysed as voiceless approximants. See Catford (1977:120) on the usual frication of voiceless approximants. The findings of Esling (1996a, 1996b) suggest that the frication of Arabic pharyngeals might be produced at the aryepiglottal sphincter (see also Heap 1998).

2.2.1.3.2 No Underlying Non-emphatic /r/. Younes (1994) argues that in Dar Younes (northern fellahi) Palestinian, non-emphatic /r/ is ‘de-emphaticised’ /r/, because the trill surfaces emphatic except in certain contexts. We will see that the same is true for Abu Shusha. For example, in the Dar Younes forms in (5) the trill surfaces emphatic. Younes explains that occurrence of the (long or short) back low vowel indicates the presence of an emphatic consonant in the word, as do emphatic variants of otherwise non-emphatic consonants. In (5) these are /a:/ and /u/, which he analyses as arising through uvularisation harmony triggered by the emphatic /r/.

(5) Dar Younes Forms, from Younes (1994:218)

| a. /naːr/ | (*/nae:r/) | “fire” |
| b. /daːr/ | (*/dae:r/) | “neighbour” |

Younes (1994:220-221) (and Younes 1993) identifies three contexts for /r/-de-emphaticisation. The first is “in the neighborhood of a noninflectional, nonepenthetic, nonlow front vowel”, in other words, in a word containing root-internal /I(:)/ or /E(:)/. Forms showing non-emphatic /r/ in this context are

3 Observing this, Catford (1977:122) defines ‘approximant’ as “non-turbulent when voiced; but the flow becomes turbulent when they are made voiceless” (italics in the original). See also Ohala & Ohala (1993:232-233). Tokens of Palestinian word-initial /ʕ/ are frequently voiceless for most of their duration and accompanied by frication. In a word-medial, voiced context (i.e., flanked by vowels or voiced consonants), they are voiced throughout and high amplitude, with full formant structure.

4 In this section, I retain Younes’ transcription of vowel quality. I have added the ungrammatical forms and transcription of emphasis for surface emphatic consonants, following his description [p.218-219] of emphasis harmony in his dialect. I have added underlying forms to some of his data.
seen in (6). The Abu Shusha cognates in (7) show the same generalisation. An emphatic trill would yield the ungrammatical forms.\(^5\)

(6) Dar Younes Forms, from Younes (1994:220)

a. /xl'r:E:n/ \{xir.'fæ:n\} \{*xir.'fæ:n\} “lambs”
b. /bær.mI:l/ \{baer.'mi:l\} \{*baer.'mi:l\} “barrel”
c. /Ye:r-Æk/ \{YE:r-æk\} \{*YE:r-æk\} “other than you [masc. sg.]”

(7) Abu Shusha Forms

a. /xl'r:E:n/ \{xir.'fæ:n\} \{*xir.'fe:n\} “lambs”
b. /bær.mI:l/ \{baer.'mi:l\} \{*ba'r.'mI:l\} “barrel”
c. /ye:r-æk/ \{ye:r-æk\} \{*ye:r-æk\} “other than you (masc. sg.)”

Younes’ second context is immediately preceding one of /θ ð t d s z n ʃ tʃ ʒ j/ (non-lateral coronals) in the same stem. Dar Younes de-emphaticisation in this context is illustrated in (8), the same for Abu Shusha in (9).\(^6\)


a. /baer.'d-æ:n/ \{*bar.'d-a:n\} “cold (masc. sg.)”
b. /deer.s-æk/ \{*dar.s-ak\} “your [masc. sg.] lesson”
c. /tær.næb/ \{*tar.nab\} “rabbit”

(9) Abu Shusha Forms

a. /bar.'d-æ:n/ \{*ba'r.'d-æ:n\} “cold (masc. sg.)”
b. /dar.s-æk/ \{*dar.s-æk\} “your (masc. sg.) lesson”
c. /tar.næb/ \{*tar.næb\} “rabbit”

The third context is before a velar in the same root, as illustrated in (10).

\(^5\) The Palestinian vowel inventory and the outputs of its emphasis (uvularisation) harmony are clarified and explained in detail §2.2.2 and §2.5.

\(^6\) Forms with /w/ are potential counterexamples. E.g., the initial-syllable vowel of /wÆrd-Æ/ /'war.d-ø/ “flower” is similar to back [ʌ]. However, underlyingly non-emphatic consonants do not surface emphatic in such forms. This indicates that the non-front quality of the vowel is a coarticulatory phonetic effect from the preceding [w], yielding /wÆrd-Æ/ /'war.d-ø/ [wa*r.d-ø], where ‘*’ denotes backing and raising.
Abu Shusha has uvular /b ʕ/ instead of velar /ɣ ʕ/, but relevant forms with velar /k/ are:

(11) Abu Shusha Forms
a. \{ræː.fsk\} \{*\{reː.fək\}\} "he befriended"
b. \{mə.ʁak\} \{*\{mʌ.ɾək\}\} "he spoiled (someone/something)"

I conclude that Abu Shusha \{r\} is de-emphaticised /ɾ/ and that the underlying consonant inventory lacks non-emphatic /ɾ/.

2.2.1.3.3. High-frequency vs. Low-frequency Emphatics. Palestinian /m b l/, as in (12), occur less frequently than the other emphatics.\(^7\)

(12) a. \{mæijj\} "water" d. \{bɑ.ɾə\} "daddy"
b. \{ʕm.ɾ.ə-q\} "paternal uncle" e. \{ʔə.l.ɾəh\} "God"
c. \{mə.ɾə\} "momma" f. \{ʃl.ɾə\} "let’s go!"

There has been question as to whether they should be recognised as underlying /m b l/ (see Younes 1994). Discussion has centred around the differences between the low- and high-frequency emphatics, which are solely distributional. There are more restrictions on the occurrence of the former than the latter (Maamouri 1967, Younes 1982, 1994, Herzallah 1990). Younes (1994) shows that high-frequency \{ð s t r k\} lexically contrast with their non-emphatic counterparts (e.g., in /tI:n/ \{tiːn\} “figs” vs. /tI:n/ \{tiːn\} “mud”), have high frequency of occurrence, and occur in all positions adjacent to all vowels. These properties are not shared by the other set. On vowel contexts, he describes [p.216] \{m b l\} as occurring only with low vowels. Maamouri (1967:49) states that they occur “almost exclusively with low vowels.” However, regardless of distribution, there is a strong argument for recognising

\(^7\) Younes (1982:57) identifies (12d) as borrowing from Italian, (12e) as a borrowing from Classical Arabic. Younes (ibid.) records the initial-syllable vowel in (12c-d) as long, as does Herzallah (1990:39) for Ya`bad (northern fellähî). It is short in Abu Shusha.
\{m b l\} as underlying, namely, that their uvularisation in forms like those in (12) but not (13) is unpredictable. Since unpredictability indicates underlying status, /mj b.l/ are included in (1).

(13) a. \{'ma\} \{\{'m\}A\}' \{\{'m\}\} “with”
b. \{'da\}A\} \{\{'d\}A\} “gold”
c. \{'ne\}:.l\} \{\{'n\}e\}:.l\} “myself”

If a high-frequency emphatic occurs in a word with one of \{m b l\}, I analyse \{m b l\} as underlying /m b l/, assuming that the \{m b l\} are derived by uvularisation harmony; e.g., /bAE\} \{\{'b\}A\} “tiles”, /mAE\} \{\{'m\}AE\} “woman, wife”. This follows the procedure of Card (1983:106-107).

2.2.1.4. Epenthetic Word-initial /ʔ/. Most word-initial glottal stops in the language are epenthetic. The evidence for this is that they are not observed when another consonant can serve as onset of the word-initial syllable. Compare (14) with (15).

(14) a. /b-If\}dib/ \{\{'b\}-?tf\}dib\} \{\{'b\}-.?tf\}dib\} “he lies”
b. /b-Iktib/ \{\{'b\}-k\}tib\} \{\{'b\}-.?k\}tib\} “he writes”

(15) a. /If\}dib/ \{\{'t\}tf\}dib\} \{\{'t\}tf\}dib\} “to lie” (“to tell an untruth”) b. /Iktib/ \{\{'k\}tib\} \{\{'k\}tib\} “to write”

There are exceptions, as in (16). (An epenthetic vowel occurs in the initial syllables of the grammatical surface forms.)

(16) a. /b-?\}Æ\}\}bAE\} / b-?\}æ\}\}bÆ\} “he hugs”
b. /b-?\}æ\}æ\}bÆ\} “he causes (someone, something) to be late”

In (16), \{?\} is observed despite the \{b\} available for the onset of the initial syllable. To rephrase the analysis of (14) and (15), epenthetic \{?\} occurs at the left edge of words that would otherwise have no consonant there. Since the \{?\}s in (16) are not at that edge, they are unexpected and so require explanation. The explanation is: the \{?\}s in (16) are unexpected because they are unpredictable, thus underlying (root C). I conclude that Palestinian has both /ʔ/ and epenthetic \{ʔ\}.
Word-internally, glottal stop does not occur to provide a syllable onset. That is, word-internal vowel hiatus occurs, as in (17). Glide formation does not occur (although it does in the Dar Younes dialect, seen from Dar Younes \{\textipa{fa:š.ʃ-i} and \textipa{maeʃ.ʃ-i:n}\}).

(17) a. /fæː Boulder/ \{\textipa{fæː.ʒi-.ə} \} (**\{\textipa{fæː.ʒi-.ə}\}) “empty (fem. sg.)” (Adj)

b. /mæːʃi-.i:n/ \{\textipa{mæ.ʃi-.i:n} \} (**\{\textipa{mæ.ʃi-.i:n}\}) “walking (masc. pl.)” (Adj)

c. /fa:ru-.i/ \{\textipa{fa.ru-.i} \} (**\{\textipa{fa.ru-.i}\}) “my fur” (Adj)

d. /mæːri-.u:i/ \{\textipa{mæ.ɾi-.u:i} \} (**\{\textipa{mæ.ɾi-.u:i}\}) “apron” (Adj)

e. /wɪt-.tɪ-.st/ \{\textipa{wɪ.ɾɪ-.ts} \} (**\{\textipa{wɪ.ɾɪ-.ts}\}) “lowered (fem. sg.)” (Adj)

Hiatus does not occur in all contexts. Prefixal vowels are elided before a stem-initial vowel. This is seen from comparison of forms like \{mæ-.ʃu:t-.hæe:-ʃ\} “I didn’t see her” (no elision) with \{m-e/.cœae:-ʃ\} “he didn’t come” (elision; cf. \{?æœ.aœ\} “he came”). Important to the issue at hand, glottal stop is not inserted to break up hiatus, so the ungrammatical forms in (17) do not occur. Based on this, and on the fact that onsetless syllables are crosslinguistically highly disfavoured (see, e.g., McCarthy & Prince 1993a, Prince & Smolensky 1993), I analyse Palestinian word-initial \{?\} as not a phonetic effect but as a default consonant epenthesis in the phonology to provide an onset for the word-intial syllable. Classical Arabic is analysed the same by Prince and Smolensky (1993). I assume that word-initial epenthetic \{?\} is imposed by the constraint ‘ONSET’ (‘ONS’: ‘Syllables must have onsets”; McCarthy & Prince, 1993a, Prince & Smolensky 1993). Example (17) indicates that ONS has the decompositions ‘ONS-\textsubscript{wd}[σ]’ (‘Word-initial syllables have onsets’) and ‘ONS-σ’ (‘Syllables have onsets’), ranked in Palestinian ONS-\textsubscript{wd}[σ] >> ONS-σ.

In the spectrogram of a hiatus form, acoustic support for a syllable boundary between the two vowels is a brief pause at the point of hiatus. Also, in a form like \{mæ.ʃi-.i:n\}, \textipa{ʃ} is higher for stressed, final-syllable \{i\} than for unstressed, penultimate-syllable \{i\}. Hiatus forms in the present corpus involve \{i:i\}, \{i.a\}, \{i.u\}, \{e.i\}, \{u.e\}, and \{u.e\}. None involve \{e\}, \{o\}, or long \{a\}; presumably a coincidental result of the general lower frequency of the mid vowels. (Lack of hiatus with two long vowels is expected, since a long vowel is shortened before another long vowel in the word (Abdo 1969, Abu-Salim 1986.).)

Thanks to Munther Younes for these data.

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8 In the spectrogram of a hiatus form, acoustic support for a syllable boundary between the two vowels is a brief pause at the point of hiatus. Also, in a form like \{mæ.ʃi-.i:n\}, \textipa{ʃ} is higher for stressed, final-syllable \{i\} than for unstressed, penultimate-syllable \{i\}. Hiatus forms in the present corpus involve \{i:i\}, \{i.a\}, \{i.u\}, \{e.i\}, \{u.e\}, and \{u.e\}. None involve \{e\}, \{o\}, or long \{a\}; presumably a coincidental result of the general lower frequency of the mid vowels. (Lack of hiatus with two long vowels is expected, since a long vowel is shortened before another long vowel in the word (Abdo 1969, Abu-Salim 1986.).)

9 Thanks to Munther Younes for these data.
Finally, as Palestinian allows onsetless word-internal syllables, it is clear that not all Arabic syllables must begin with a consonant (countering assumption elsewhere, e.g., Majdi & Winston 1994:186, Lee 1995:359).

2.2.2 Vocalic Inventory

The underlying vocalic inventory is seen in (18). It has a length distinction, three degrees of height, and no underlying low front vs. low back distinction. The surface inventory is seen in (19). The surface set differs from the underlying set by containing several more short vowels. Most surface short vowels comprise non-rtr/rtr pairs: \{ɪ}/ɪ', {ɛ}/ɛ', {æ}/ɑ', {œ}/ɔ', {o}/ɔ', {u}/u'. Low back position has only rtr {ɑ}. There are two long low vowels, not one as in the underlying inventory. Finally, there are also two diphthongs: {āj} and {āw}, which always occur followed by {j} and {w}, respectively, as in {ˈsæjjɪɾd} "to hunt", {ˈkæw.ˈwæːɾm} "quickly". This indicates that they arise from an underlying /Æ/-glide. This section will now summarise previous analyses of the Palestinian/Levantine vocalic system, then present the bases for (18) and (19).

(18) (Abu Shusha) Palestinian Underlying Vocalic Inventory

\begin{center}
\begin{tabular}{llllllll}
 & \multicolumn{2}{c}{a. short vowels} & & \multicolumn{2}{c}{b. long vowels} \\
 & \multicolumn{1}{c}{FRONT} & \multicolumn{1}{c}{BACK} & & \multicolumn{1}{c}{FRONT} & \multicolumn{1}{c}{BACK} \\
HIGH & I & U & & HIGH & I: & U: \\
MID & E & O & & MID & E: & O: \\
LOW & Æ & & LOW & Æ: & & & \\
\end{tabular}
\end{center}

(19) (Abu Shusha) Palestinian Surface Vocalic Inventory

\begin{center}
\begin{tabular}{llllllllllll}
 & \multicolumn{2}{c}{a. short vowels} & & \multicolumn{2}{c}{central} & & \multicolumn{2}{c}{back} \\
 & \multicolumn{1}{c}{FRONT} & \multicolumn{1}{c}{RTR} & & \multicolumn{1}{c}{CENTRAL} & \multicolumn{1}{c}{RTR} & & \multicolumn{1}{c}{BACK} & \multicolumn{1}{c}{RTR} \\
& \multicolumn{1}{c}{NON-} & \multicolumn{1}{c}{RTR} & & \multicolumn{2}{c}{NON-} & \multicolumn{1}{c}{RTR} & & \multicolumn{2}{c}{NON-} & \multicolumn{1}{c}{RTR} \\
& & & & non-bkd & bkd & rd & non-rd & rd \\
HIGH & i & i & & & & u & & & u & \\
MID & ɛ & ɛ & ə & z & z & o & ə & & & \\
LOW & æ & a & & & & & & & & & \\
\end{tabular}
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b. long vowels

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2.2.2.1 Previous Analyses of the Palestinian/Levantine Vocalic System

2.2.2.1.1 Non-generative Analyses. Non-generative analyses typically define the Levantine vowels in terms of the Classical Arabic system of three long, three short, and no mid height. They usually do not posit underlying vs. surface inventories but imply that the back low vowels result from emphasis harmony in the context of an emphatic consonant. In so doing, they imply the system in (20).

(20) Palestinian/Levantine Arabic Vocalic System Implied by Non-Generative Studies

a. underlying inventory

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<td>LOW</td>
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b. surface inventory

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<tbody>
<tr>
<td>HIGH</td>
<td>i:</td>
<td>u:</td>
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<tr>
<td>LOW</td>
<td>æ:</td>
<td>æ</td>
</tr>
</tbody>
</table>

They note that long mid [e:] and [o:] occur in forms where Classical Arabic has the diphthongs /ai/ and /au/.

They analyse occurrences of short [e] and [o] as lowerings of /i/ and /u/, respectively, conditioned by gutturals and emphatics. Rtr short vowels are usually unrecognised. As an exception,

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11 In this section, where previous studies implicitly or explicitly ascribe a particular status to a vowel, the status is indicated by the transcription; e.g., I interpret previous non-generative studies as implying that the long mid vowels are phonetic.

12 For example, Cantineau (1960:110-111) states:
Bauer (1926/70:11) describes [i] and [u], which he assumes to be the invariant values of /i/ and /u/, respectively. He states: “i = kurzes i in Sinn, z.B. bint Tochter... u = kurzes u in Mutter, z.B. kutub Bücher” (italics mine/KNS). As a variation of (20), Palva (1988) recognises \( \text{\textasciitilde}e\) and \( \text{\textasciitilde}o\), stating [p.228] that they are “most often the reflexes of /ay/ and /aw/ respectively”. Nishio (1992) asserts long mid vowels for Jbāli (Sinai), but provides no comment. His inventory includes \{e\} and \{o\}. He states [p.xiv] that short \{e\} and \{o\} “…can be regarded as having some relevant status, at least at the surface representation” but that “[p]honologically speaking, this dialect has a familiar functionally triad system of short vowels”. He thus implies /I Æ U/.

Mattsson (1911) documents short high vowel reduction for Beirut Lebanese. Grotzfeld (1965:12-13) describes it for Damascus Syrian, citing /min/ > {men} “from”, /yiktubu/ > {yektbu} “they write”, /kutub/ > {ketob} “books” (transcriptions Grotzfeld’s). This does not occur in Abu Shusha, with cognates /\text{\textasciitilde}min/, /\text{\textasciitilde}b-t.r.ktt.b-u/, and /{\text{\textasciitilde}k.t.u.t.}\}. Nishio (1992) describes high and low short vowel reduction for Jbāli, noting the latter as less frequent. For the low vowel, he states [p.xvi]: “in the unstressed syllable, particularly at the beginning of a word, /a/ is reduced to [\text{"\textasciitilde}a\text{"}] in casual speech as in e.g. [\text{\textasciitilde}rww\text{"\textasciitilde}htu \text{"\textasciitilde}~r\text{"\textasciitilde}rw\text{"\textasciitilde}htu\text{"}] (= “you (pl.m.) went” Pf. 2 pl.m.).”

2.2.2.1.2 Generative Analyses. Pertinent generative studies are Johnson (1979, 1982), Younes (1982, 1993), Card (1983), and Herzallah (1990). The moderate

Dans les dialectes modernes de l’arabe, les timbres vocaliques semblent à première vue nombreux et variés... De fait les sujets parlants, dans la plus grande partie du monde arabe, ne distinguent actuellement comme autrefois que trois timbres phonologiques de voyelles brèves, timbres susceptibles de diverses réalisations phonétiques suivant la nature des phonèmes voisins... Les pharyngales /zet/ (£), parfois les vélaires /h/ et /g/, attirent vers /æ/ le timbre des voyelles voisines... Les consonnes emphatiques ou /mufahhama/, parfois les vélares /h/, /g/ et /q/, reportent en arrière le point d’articulation des voyelles voisines. [Cantineau denotes /h u χ as “\text{"\textasciitilde}h \text{"\textasciitilde}g \text{"}h’”, respectively.]

Bauer (1926/70:11) notes the change of short \( \text{i} \) to \( e \) and \( u \) towards \( o \)”[unter dem Einfluss eines umgebenden \( \text{\textasciitilde}h \text{"\textasciitilde}r \text{"} “. (Bauer denotes /h χ r as “\text{"\textasciitilde}h \text{"\textasciitilde}r”, respectively.)

13 Rtr short vowels are recorded for Classical Arabic. Gairdner (1978:194) quotes the traditional Arabic grammarian Ibn As Sarraj as stating: “The tongue sinks lower with the kasra, \( i \) (short \( i \)), than it does with the ye, long \( ï \)” Gairdner explains: “In other words, \( i \) was wider than \( ï \), which latter was the narrow or extreme \( i \). We have here, apparently, the same distinction between English ‘bit’ and ‘beat’; and we may reasonably assume that the same distinction held good in the \( u \) family, namely that short \( u \) was wider than \( ù \) as in the difference between English ‘foot’ and ‘school’.”
analysis is seen in (21). Younes does not recognise mid height for the short
vowels and does not mention rtr short vowels or reduced vowels.

(21) Previous Moderate Generative Analysis of the Palestinian Vocalic
System (Younes 1993)
a. underlying inventory

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<td>U: U</td>
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<tr>
<td>MID</td>
<td>E: O:</td>
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</tr>
<tr>
<td>LOW</td>
<td>æ: æ</td>
<td>a: a</td>
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b. surface inventory

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<th></th>
<th>FRONT</th>
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<tbody>
<tr>
<td>HIGH</td>
<td>i: i</td>
<td>u: u</td>
</tr>
<tr>
<td>MID</td>
<td>e: o:</td>
<td></td>
</tr>
<tr>
<td>LOW</td>
<td>æ: æ</td>
<td>a: a</td>
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Herzallah (1990) claims a smaller inventory, based on data from
Yaâbad (northern fellâhî). She omits /E: O:/, citing [p.146] the historical
diphthong argument, and also omits /U/, arguing [see her chapter 3] that
historical /U/ has merged with /I/ and /Æ/, and that surface /u/ is derivable
from /I/ or /Æ/ by morphological or phonological conditioning. Her evidence
for lack of /U/ is reviewed below. Data will show that it does not hold in full of
Abu Shusha.

A first type of evidence is leveling of historical /U/ with /I/ or /Æ/ in
CUCV(V)C nouns, seen for Yaâbad in (22) (transcriptions Herzallah’s.)

The cognates in (23) show no leveling, as the vowel of interest is /u/ (irrelevantly
rtr).

(22) Yaâbad Forms, from Herzallah (1990:161),
a. /dikkaani(t)/ “shop” (N) (compare Classical Arabic: /dukaan/)  
b. /zinaar/ “belt” (compare Classical Arabic: /zunnaar/)  

(23) Abu Shusha Forms  
a. /dutfã:t'æe:n/ (* /dutfã:t'æe:n/) “shop” (N)  
b. /zûn.ñe:r/ (* /zûn.ñe:r/) “belt”  

14 In Arabic, a final /t/ sometimes occurs in feminine nouns that otherwise end in a vowel, as
in (22a).
The second is 'dorso-pharyngeal' phonological conditioning in a/i imperfectives. In those imperfectives, in Ya'bad, stem /u/ is predictable in roots with one of /t s z ð r x y k/. This is seen in (24). (The stem vowel of interest is the final-syllable vowel). Abu Shusha /i/*/i/ occur with those consonants, indicating no general conditioning, as seen in (25). (Uvular /χ/ are cognate to Ya'bad /x/.)

(24) Ya'bad Forms, from Herzallah (1990:167,169)
   a. {yinbuy} ~ {yunbuy} “he excels”
   b. {yištub} ~ {yuštub} “he crosses out”
   (compare {yimlis} “he smooths”, {yiftim} “he bewitches”)

(25) Abu Shusha Forms
   a. {b-tb.sut} (*/b-tb.sut/, */b-ub.sut/) “he gets happy”
   b. {b-is.ruk} (*/b-is.ruk/, */b-ug.ruk/) “he steals”

The third type of evidence is the same conditioning in biliteral roots, by which Ya'bad stem /u/ is predictable in roots with one of /t s z ð r x y k/. See (26). This generalisation holds in Abu Shusha, as illustrated in (27).

(26) Ya'bad Forms from Herzallah (1990:171)
   a. {yušuff} “he lines up”
   b. {yöumm} “he annexes”
   (compare {yibizz} “he comes out”, {yöimm} “he dispraises”)

(27) Abu Shusha Forms
   a. {br.-suff} “he lines up”
   b. {br.-ūrm} “he annexes”
   (compare {br.-bizz} “he squeezes out”, {br.-ūrm} “he dispraises”)

Despite the biliteral roots, (23) and (25) indicate that Abu Shusha /u/*/u/ is not always derivable from /I/ or /Æ/. On this basis, /U/ is in the underlying inventory of (18).16

---

15 These are segments specified for primary- or secondary-[DOR] (see §2.3.1). Herzallah describes 'K' as a back velar. Its Abu Shusha cognate is /k/.
16 Herzallah's data indicate that status of /u/*/u/ is a matter of analysis for each Palestinian dialect. S. Davis (p.c.) reports underlying /U/ for the southern dialect of Davis (1993, 1995).
Johnson (1979, 1982) and Card (1983) present expanded versions of (21), recognising three degrees of height for the underlying and surface inventories and some surface rtr short vowels. Johnson (1982:63) describes /E/ and /O/ as basically /ɪ/ and /ʊ/, respectively, with "lower allophones next to a pharyngeal or in a final syllable". Card includes /ɪ/ and /ʊ/ as surface variants of underlying /i/ and /u/.\(^\text{17}\) For vowels for which they posit rtr variants, they do not posit non-rtr variants. That is, Johnson does not recognise non-rtr /e/ and /o/ as surface variants of /E/ and /O/, respectively. (He asserts that /i/ always surfaces as /ɪ/, /u/ as /ʊ/.) Card does not recognise non-rtr /i/ and /u/ as surface variants of /i/ and /u/, respectively. Finally, Herzallah, Johnson, and Card do not mention vowel reduction.

2.2.2.1.3. Summary. In sum, the vowel system has been surrounded by uncertainty. This has not been confined to Levantine, as Norlin (1987:50-51) remarks:

A comparison between the studies of Egyptian Arabic and other dialects in the eastern dialect area shows that the phonemic analysis of the short vowel systems is uncertain and surrounded by guarded arguments. It seems as if the short vowel system is in a state of flux and that phonemic oppositions are under development and not yet quite established. Another explanation of the vagueness might be the weakness in many presentations of the various phonological vowel systems in so far that they seldom go into phonetic details nor present examples of minimal pairs where the contrastive function of the phonemes is obvious. As a result, the same dialect can be said to have a different number of short vowels, depending on the author. Many dialects in the neighboring countries seem to have developed more short vowels than the classical three. Card (1983) identifies five short vowel phonemes in her investigation of the Palestinian dialect, but does not go into detail. Rice & Said (1960:xx) also recognize five short vowels in the same dialect. None presents minimal pairs.

The remainder of this section presents data in support of (18) and (19), with the aim of also following the advice of Bouquiaux & Thomas (1992:97):

Many studies show only a table summarizing the phonemes of the language with a few supplementary remarks. For us, defining each phoneme is a small problem to be resolved. Data must be presented and a solution proposed. This is the only scientifically valid procedure, we feel, since it allows the reader to verify the results. Some arbitrariness is unavoidable, but at least we limit it to the selection of data. A linguist who simply gives a list of

\(^{17}\) Johnson and Card refer to rtr vowels as 'lax'. I equate those terms (see n35).
phonemes adds the arbitrariness of his interpretations, which are not open to evaluation.

2.2.2.2 Underlying Length. An underlying length distinction in Palestinian is supported by (28). The present corpus contains no pairs for /E:/ vs. /E/ and /O:/ vs. /O/. I assume this is due to the general lower frequency of the mid vowels and that further fieldwork might yield pairs for those contrasts, too.¹⁸

(28) Data Pairs Showing Underlying Length Distinction

a. /I:/ vs. /I/
   i. /ziːr/ \{ziːr\} “large water urn”
   ii. /ziːr/ \{ziːr\} “button”

b. /Æ:/ vs. /Æ/
   i. /ˈæːlɛm/ \{ˈæːlɛm\} “world”
   ii. /ˈæːlɛm/ \{ˈæːlɛm\} “flag”

c. /U:/ vs. /U/
   i. /ˈkʊːræ/ \{ˈkʊːræ\} “forehead”
   ii. /ˈkʊːræ/ \{ˈkʊːræ\} “ball”

2.2.2.3 Three Underlying Degrees of Height for the Long Vowels. Data show three degrees of height for the underlying long vowels:

(29) Data Pairs Showing Underlying Three-way Height Distinction for the Long Vowels

a. /I:/ vs. /E:/
   i. /tiːf/ \{tiːf\} “how”
   ii. /tiːf/ \{tiːf\} “mood”

b. /I:/ vs. /Æ:/
   i. /baɛrIːd/ \{baɛrIːd\} “mail” (N)
   ii. /baɛrIːd/ \{baɛrIːd\} “coolness”

c. /I:/ vs. /O:/
   i. /doːr/ \{doːr\} “to pour”
   ii. /doːr/ \{doːr\} “turn” (as in a game; N)

d. /I:/ vs. /U:/
   i. /baɛrIːd/ \{baɛrIːd\} “mail” (N)
   ii. /baɛrIːd/ \{baɛrIːd\} “gunpowder”

¹⁸ The vowels contrast in (28) despite surface rtr/non-rtr differences because those differences arise via imposition of pharyngealisation in the input-output mapping.
Three Underlying Degrees of Height for the Short Vowels. Before data showing mid height for the short vowels can be identified, the phonetic high vowel lowering in the language must be explained. Mid vowels occur in words containing a postvelar:


After Bauer (1926/70:11) and Cantineau (1960:111), I analyse this mid height as the result of lowering conditioned by postvelars. It is phonetic because the high vowels are gradationally mid, their degree of midness depending on their degree of proximity to the postvelar. This is illustrated by (30a-b) in which, while the first-syllable vowels are [ɛ], the second-syllable vowels are perceptually a short diphthong from mid [ɛ] to high [ɪ]. Complete transcriptions for (30) are given in (31). (In a-b) an epenthetic vowel occurs for syllabification of the CVCC nouns (Abu Salim 1980, 1987a, Herzallah 1990).) The lowering in (31) contrasts with the lack of lowering in (32). The lack is expected, since the forms in (32) contain no postvelar.

(31) a. /milm/  [ˈmiɪ.lim] [ˈhe.levəm] “dream” (N)
   b. /tədəl/  [ˈtədəl] [ˈte.ɡər] “calf”
Further support for this phonetic analysis comes from the lack of evidence that the lowered height is phonologically visible, that is, referred to in the phonology.

Phonetic status for the lowering means that certain forms which appear to show three degrees of height for the short vowels must be disregarded. Examples are:

(33) Faux Amis for Underlying Three-way Height Distinction for the Short Vowels

a. i. /həɛf/  /ˈhæf/  [həɛf]  “heavy cotton cover”
   ii. /hʌf/  /ˈhʌf/  [hʌf]  “bare foot”

b. i. /hɛl/  /ˈhɛl/  [hɛl]  “it (masc.) bled” (as a dye bleeds)
   ii. /hll/  /ˈhəl/  [həl]  “to bleed” (as a dye bleeds)

In each mid form (a.ii, b.ii), the mid height can be attributed to phonetic lowering. Underlying mid height is not impossible, but if it were underlying, without some independent diagnostic, it could not be established because it would be phonetically neutralised with phonetically lowered height. The point is that mid height is best concluded from forms with no interfering postvelar.

True contrasts are seen in (34). I am aware of no pairs for /E/ vs. /O/, /E/ vs. /U/, /O/ vs. /U/, a probable sampling coincidence.

(34) Data Pairs Showing Underlying Three-way Height Distinction for the Short Vowels

a. /ɪ/ vs. /ɛ/
   i. /sɪl/  /ˈsɪl/  [ˈsɪl]  “wire”
   ii. /sɛl/  /ˈsɛl/  [ˈsɛl]  “boiled (masc. sg.)” (Adj)

b. /ɜ/ vs. /ɐ/ (1 sg. obj.)
as in, e.g.:  
\[ /\text{lsm}-\text{l} / \]  \{ '\text{i}s.m-i \}  
"my name"

ii. /-\text{Æ}/ (3 masc. sg. obj.)  
as in, e.g.:  
\[ /\text{lsm}-\text{Æ} / \]  \{ '\text{i}s.m-\text{æ} \}  
"his name"

c. /l/ vs. /o/  
i. /'lbl\/l/  \{ 'li.bi.\text{æ} \}  
"Libya"

ii. /'lbrl/  \{ 'lo.bi.\text{æ} \}  
(a type of small pea)

d. /\text{l} vs. /\text{u}/  
i. /\text{hi} /  \{ \text{hi} \}  
"she"

ii. /\text{hu} /  \{ \text{hu} \}  
"he"

e. /e/ vs. /\text{Æ}/  
i. /s\text{Elk}/  \{ 's\text{e}.\text{lk} \}  
"boiled (masc. sg.)" (Adj)

ii. /s\text{El}lk/  \{ 'sa.lk \}  
"he boiled"

f. /\text{Æ}/ vs. /o/  
i. /-\text{Æ}/ (3 masc. sg. obj.)  
as in, e.g.:  
\[ /\chi\text{\text{Æ}}l-t-\text{Æ} / \]  \{ '\text{\chi}l.-t-\text{æ} \}  
"his maternal aunt"

ii. /-\text{o}/ (endearment suffix)  
as in, e.g.:  
\[ /\chi\text{\text{Æ}}l-t-\text{o} / \]  \{ '\text{\chi}l.-t-\text{o} \}  
"maternal auntie"

g. /\text{Æ}/ vs. /\text{u}/  
i. /k\text{pr}\text{Æ}/  \{ 'k\text{\text{æ}}.\text{r} \}  
"small boat"

ii. /k\text{Ur}\text{Æ}/  \{ 'k\text{\text{u}}.\text{r} \}  
"ball"

2.2.2.5 Reduction of /\text{Æ}/. Underlying /\text{Æ}/ surfaces mid and central when not under primary lexical stress, as in (35). The alternation of interest is shown by the low vowel in the initial syllable of the stem in (a) compared to the same vowel in (b), also the stem-final vowel in (a) compared to the same vowel in (b). (Surface length of stem-final /\text{Æ}/ in (b) is the result of lengthening under shifted stress under -f suffixation. Its surface quality in (b) shows it is /\text{Æ}/.) Reduced /\text{Æ}/ has three variants: non-rtr \{ \text{æ} \}, rtr non-back \{ \text{ɔ} \}, and rtr back \{ \text{ɔ} \}, via pharyngealisation and uvularisation harmonies.

(35) a. /\chi\text{\text{Æ}}ll\text{Æ}/  \{ '\text{\chi}l.l\text{æ} \}  
"he left (something)"

b. /\text{mÆ}-\chi\text{\text{Æ}}ll\text{Æ}-\text{f} /  \{ 'm\text{\text{æ}}.-\text{\chi}l.l\text{æe}:-\text{f} \}  
"he didn’t leave (something)"

Reduction is also seen in (36) with the 3 fem. sg. obj. suffix, /-h\text{Æ}/.
POSTVELAR HARMONY

(36) a. /ʃU:ʃ-t-hÆ/ \{ 'suf-t.-hɛ\} "I saw her"
b. /mÆ-ʃU:ʃ-t-hÆ-ʃ/ \{ mə-ʃuf-t.-hæ-ʃ\} "I didn’t see her"

Prefixal /Æ/ of the negative prefix /mÆ-/ surfaces reduced in (35b) and (36b). In Abu Shusha, the vowel in that prefix never receives primary stress. Crosslinguistic data shows it is underlying /Æ/: Jafa cognates of those two forms are \{ 'mæ:.e.ðə\} (with hiatus at the left stem edge) and \{ 'ma-.fuf-t.-he\}, respectively.

Reduced \{ ø 3 ø'\} are sometimes coloured. This is seen in (37), in which ‘ø’ denotes low front colouring and ‘ø’ denotes low back colouring. The [øə] and [øʊ] are perceptually similar (but not identical) to [æ], and [ʊ'] is perceptually similar to [ɑ]. I assume that /Æ/ loses its [LOW] specification under lack of primary stress, then gradient colour is added in the phonetics.

(37) a. [zael.ø.ma] “man”
   b. [sæl.3ø.ø] “salad”
   c. [we ø.ø.ø.'dæ:.ni]' “lone, single (masc. sg.)”
   d. [wø 3ø.ø.'bɪj.jø]' “temperamental (fem. sg.)”

Alternatively, there could be no feature loss in the phonology. In that case, the robustness of /Æ/’s phonetic implementation would depend on stress. However, the problem is that reduction-with-degree-of-colour is not observed for the high and mid vowels. Stress-dependent robustness of phonetic implementation would be expected to affect all vowels to at least some degree. However, only /Æ/ reduces. High and mid vowels do not. This is evidence that [LOW] is targeted, the effect of a constraint against unstressed low vowels. (See Kenstowicz 1997 and Urbanzcyk 1996a for accounts of low vowel reduction in terms of sonority-driven metrical prominence.) In other words, Palestinian /Æ/ reduction is phonological. This disqualifies the alternative explanation.

There is two-fold evidence that the colour is gradient, depending on stress. First, it decreases gradiently as the distance between the reduced vowel and most stressed syllable increases, seen in [zael.ø.ma] in (37a), in which the second-syllable [øə] is less low and front than the initial syllable [æ], but more low and front than the final-syllable [ø]. It is seen in parallel manner (with phonetic closeness of [ʊ'] to low back [ɑ]) in (37b). This indicates phonetic Effect 1, ‘have less colour with increased distance from primary stress’. Second, the colour surfaces gradiently stronger under secondary stress.
than no stress, as seen in (37c,d). I assume that phonetic gradience is not skipping the second-syllable low vowel but that phonetic Effect 2, 'have more colour if under secondary stress', overlays and preempts Effect 1. The data are thus:

\[(38)\] a. /zÆlÆmÆ/ \{ 'zæl.ə.mə \} \[ 'zæl.ə.mə \] 'man'

b. /sÆlÆtÆ/ \{ 'səl.ə.ə \} \[ 'səl.ə.tə \] 'salad'

c. /wÆhÆdÆ:n-i/ \{ wə.ə.hə.'d.əə:n-i \} \[ wə.ə.hə.'d.əə:n-i \] 'lone,

\[ \text{single (masc. sg.)} \]

d. /rÆsÆb-l-jjÆ/ \{ rə.sə.ə.lə.jə \} \[ rə.sə.ə.lə.jə \] 'temperamental (fem.sg.)'

2.2.2.6 Pharyngealised Short Vowels. Rtr \{ t e a z ə u \} occur in forms containing a postvelar, as seen in (39). (In (d), /Æ/ surfaces short in its open syllable.) They are outputs of pharyngealisation harmony triggered by the postvelar.

\[(39)\] a. /sUÆlÆ:/ \{ sə.ə.lə : \} 'question'

b. /tUlÆ/ \{ tə.lə \} 'Ula' (fem. name)

c. /tUrÆ/ \{ tə.ə.ro \} 'corn'

d. /hÆnÆ/ \{ hə.nə \} 'here'

e. /sÆlÆtÆ/ \{ sə.lə.tə \} 'salad'

They also occur in forms containing a short vowel in a closed, that is (C)VC(C), syllable, as seen in (40). In (b-d), the initial-syllable vowel surfaces rtr by harmony with the closed-syllable vowel. In (c), the epenthetic vowel rounds under harmony with the underlying stem vowel (Kenstowicz 1981, Abu-Salim 1987b). See §2.3.3.)

\[(40)\] a. /ʃim/ \{ ʃim \} 'to smell'

b. /silk/ \{ sə.ə.lə.kə \} 'wire'

c. /kUt̪b/ \{ kə.tə.tə \} 'books'

d. /hÆlÆk/ \{ hə.ə.lə.kə \} 'he shaved'

e. /ʃem/ \{ ʃem \} 'Shem'

When /Æ/ is non-reduced and closed-syllable-pharyngealised and uvularised, it surfaces as mid back rtr \{ ʌ \}. This is shown by the vowel in the first suffix in (41a), compared to the same vowel in (41b).
2.2.2.7 *Uvularised Low Vowels.* The long and short back low vowels \{e: a\} occur in forms containing an emphatic. This is seen in the suffixal alternations in (42a-b) and (42c-d). Short mid central backed \(\varepsilon\), reduced surface variant of \(\AE\), also occurs in such forms, as seen in (42d). The \(\varepsilon:\alpha\varepsilon\) are outputs of uvularisation harmony triggered by an emphatic. (See §2.4.5 on analysis of the long backed vowel as non-rtr \(\varepsilon:\alpha\varepsilon\) instead of rtr \(\varepsilon\alpha\).)

The laryngeals and pharyngeals bear primary-[RTR]. Uvulars bear
(43) Representations of Palestinian Gutturals

<table>
<thead>
<tr>
<th>a. laryngeals</th>
<th>b. pharyngeals</th>
<th>c. uvulars</th>
</tr>
</thead>
<tbody>
<tr>
<td>/ʔ h/</td>
<td>/ʕ h/</td>
<td>/ʕ ʕ/</td>
</tr>
<tr>
<td>[CONS]</td>
<td>[CONS]</td>
<td>[CONS]</td>
</tr>
<tr>
<td>oPlace</td>
<td>oPlace</td>
<td>oPlace</td>
</tr>
<tr>
<td>[TR]</td>
<td>[TR]</td>
<td>[DOR]</td>
</tr>
<tr>
<td>[RTR]</td>
<td>[RTR]</td>
<td>[RTR]</td>
</tr>
</tbody>
</table>

primary-[DOR] and secondary-[RTR]. This is indicated by the harmonic behaviour of those segments and is supported by acoustic findings to be reported in this study. For uvulars, Cole (1987), Elorietta (1991), Trigo (1991), and Vaux (1998) provide crosslinguistic evidence for distinct [DOR] and [RTR] components from Coeur d’Alene Salish, Malay, and Nuu-chah-nulth (Nootka). Vaux provides more evidence from Turkic and Tungusic, and cites Colarusso (1988) for the same from Dididat (Nitinat), Columbian, Abkhaz, Agaza, and Northwest Semitic. (Cole proposes that the active pharyngeal feature is [TR]. Trigo and Vaux assume it to be [-ATR].) The pharyngeal and uvular gutturals are specified for [SON], based on the phonetic grounds for concluding that they are approximants (see §2.2.1). The laryngeal and pharyngeal gutturals are distinguished by the [SON] specification of the latter.

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21 Cole (1987:92), defines [TR] as the representation of the tongue root articulator, and assumes [p.94] "a rule of interpretation that adds the feature [-advanced] to any vowel that bears a tongue root articulation". Trigo (1991:114) defines [-ATR], which she refers to synonymously as ['RTR'], as representing tongue root retraction; Vaux’s definition is the same.
22 McCarthy (1994:222), following Clements (1990), proposes that /ʔ h ʕ/ bear specification for [APPROXIMANT]. I assume the sonorant classes to be distinguished without that feature, as below:

(i) **Vowels**

<table>
<thead>
<tr>
<th>Sonorant Consonants</th>
</tr>
</thead>
<tbody>
<tr>
<td>Non-lateral Approximants</td>
</tr>
<tr>
<td>[SON]</td>
</tr>
<tr>
<td>[CONS]</td>
</tr>
<tr>
<td>[LAT]</td>
</tr>
</tbody>
</table>
I propose (44) as the representation of Palestinian emphatics. (I assume additional [SON] for /ʃ/, [VOICE] for /θ/, [STOP] for /t k/, [STRID] for /s/, [LAT] for /l/, and [NASAL] for /m/.) The emphatics bear both secondary-[DOR] and secondary-[RTR]. This is based on their articulatory properties (see §1.4.2) and the acoustic findings of previous studies (see §1.4.3). It is indicated by their harmonic behaviour and supported by the acoustic findings of this study, as I will show.

(44) Representations of Palestinian Emphatics

a. coronal emphatics  
b. dorsal emphatic  
c. labial emphatics

(45) a. primary velar  
b. velarised  
c. primary uvular  
d. uvularised

A segment with primary velar articulation is specified for primary-[DOR] without accompanying specification for [RTR]. A velarised segment is specified for secondary-[DOR] without accompanying specification for [RTR]. A segment with primary uvular articulation is primary-[DOR] and secondary-[RTR]. A uvularised segment (i.e., an emphatic) is secondary-[DOR] and secondary-[RTR]. The secondary-[RTR] specification of primary uvulars
distinguishes them from primary velars. The same specification of emphatics distinguishes them from velarised segments. Primary uvulars and uvularised segments that are not specified for secondary-[RTR] are impossible because (primary or secondary-) [DOR] + secondary-[RTR] is the representation of uvular articulation. Crosslinguistic articulatory data support this: uvular articulation is evidently invariably accompanied by pharyngealisation (see §1.4.1, §1.4.2). By (45), the pharyngealisation of uvulars is an automatic result of their specification for secondary-[RTR].

Crosslinguistically, primary uvular segments do not always pattern phonologically with pharyngeals (Trigo 1991). For languages in which they do not, phenomena showing guttural patterning are all primary articulation (AP) phenomena, that is, they involve only primary instances of [RTR] (see §1.5). However, the uvulars in such languages are still gutturals because they are wholly articulated in the postvelar region of the vocal tract.

2.3.1.1 Acoustic Support. This section presents acoustic findings relevant to the claims in (43) and (44). The procedure of the acoustic study will first be summarised.

Acoustic data from Palestinian Arabic and Stát'imcets Salish were analysed. This chapter reports on the former, chapter 3 on the latter. Data from 26 tokens of Palestinian consonants and 481 tokens of Palestinian vowels were analysed. The tokens were from 131 audiotaped carrier forms, all real words (see Appendix II). Real instead of nonsense words were used to ensure tokens that were produced via the regular phonology and phonetics of the language. The words were spoken by two literate, adult male native speakers: KS, 32-year-old Abu Shusha speaker, and KG, 29-year-old Jafa speaker. Two tokens of each word were elicited from each speaker. Recordings were made inside a sound-treated room with a TEAC DA-P20 digital audio tape recorder. A few tokens recorded outside the soundbooth were recorded in a quiet room with a Marantz P420 analog audio tape recorder. A professional quality microphone of frequency response range 0-13,000 Hz was used. The signals were digitised on a NeXT workstation at 22.05 kHz sampling rate using the digitiser Digital Ears® by Metaresearch and stored on the NeXT in soundfiles using the program Soundworks. They were analysed on a NeXT workstation using the in-house-written Spectrogram program. Segmentation followed the procedures of Peterson & Lehiste (1960).

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23 I assume that a constraint imposing AP harmony specifies the primary status of the feature. See §2.5.2 and §3.5.2 for constraints specifying feature status.

24 The corpus and speakers for Stát'imcets are described in chapter 3.
Vowel formant values are the mean of wideband spectrograms and narrowband spectra frequency measurements obtained from the computer by visual placement of the cursor at the estimated formant centre. The measurements were taken on the spectrogram at formant maximum (for a convex formant trajectory) or minimum (for a concave formant trajectory), otherwise at durational midpoint (for all other types of trajectory), with the exception of vowels immediately following or preceding a pharyngeal (i.e., one of [ʕ ñ]). Such vowels were measured at the first quarter of the preceding vowel or third quarter of the following vowel because vowels in that environment systematically reached their target at about 1/4 of the vowel duration (for vowels preceding a pharyngeal) or 3/4 of the vowel duration (for vowels following a pharyngeal). Formants of stop consonants were measured at the VC or CV transition, that is, at the last 1-2 glottal pulses of the preceding vowel (for a consonant in coda position of its phonological syllable) or first 1-2 glottal pulses of the following vowel (for a consonant in onset position of its phonological syllable) (e.g., in a phonological \{C₁VC₂\} syllable, measurements for the token of C₁ were taken at the first 1-2 glottal pulses of the token of V, measurements for the token of C₂ at the last 1-2 glottal pulses of the token V). The \( F₂ \) values for stops reflect the mean of the VC/CV transition measurement and measurement at burst/aspiration midpoint. Formants of non-stop consonants were measured at consonant midpoint.

The data on Palestinian consonants were analysed separately for the two Palestinian speakers. However, most of their vowel data were graphed together and enclosed in a single common ellipse because the formants of their vowel tokens are similar. The two speakers are alike in physical stature and size. Because of this, their vocal tracts were hypothesised to be very similar in length. t-tests showed that differences between the formants, when significant, are highly significant (e.g., \( p > 0.001 \)), suggesting that they are due more to differences in dialect. The vowel data reported separately are a subset of that on /E/ and /O/, namely, /E/ and /O/ in stem-final position. Those data are treated separately because quality of stem-final /E/ and /O/ differs across the two dialects (see §2.4.5).

For reliability measures, a blind recheck of 10% of all the study's measurements was conducted by the author. Formant re-measurements were within an average 22 Hz of the original measurements. An external blind

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25 A check of \( F₄ \), if measurable, could have tested the hypothesis regarding vocal tract lengths. (As \( F₄ \) does not in general vary with articulation, it is expected to be more an indicator of vocal tract length than \( F₁ \), \( F₂ \), or \( F₃ \)).
recheck of 3% of the measurements was conducted by another phonetician, one with several years’ experience. In this recheck, measurements were within an average 28 Hz of the original measurements. As these values are less than the 40-Hz accuracy found by Lindblom (1962) in vowel formant measurements of male voices, the reliability of this study’s measurements was considered satisfactory.

Table 2:1 reports the $F_1$ and $F_2$ of two tokens each of pharyngeal /ʕ/ and (geminate) post-alveolar /jj/. As seen, for /ʕ/, $F_1$ is high, and $F_2$ is medium, though at the low end of medium range. These values contrast with the low $F_1$ and high $F_2$ for /jj/. (Descriptions of formant frequencies as high, medium, or low are in reference to Table 1:5.) High $F_1$ (700 - 950 Hz) and low $F_2$ (700 - 1300 Hz) are predicted for a segment with primary pharyngeal articulation (see Tables 1:2 and 1:11). The $F_1$ and $F_2$ effects for /ʕ/ in Table 2:1 almost match the predictions. The higher than usual $F_2$ of the [ʕ]s is probably due to a coarticulatory effect of the immediately preceding [I] in the carrier form. (Data on [I] indicate that its $F_2$ is about 1600 Hz. See Figure 2:1.) The data in Table 1:2 thus support the assumption that the tokens of /ʕ/ were produced with primary pharyngeal articulation. This supports the primary-[RTR] specification of /ʕ/ in (43).

<table>
<thead>
<tr>
<th>carrier form</th>
<th>token</th>
<th>$F_1$</th>
<th>$F_2$</th>
</tr>
</thead>
<tbody>
<tr>
<td>⟨bl.-'sa.ʕid⟩</td>
<td>[ʕ]</td>
<td>728</td>
<td>1482</td>
</tr>
<tr>
<td>“he helps”</td>
<td>[ʕ]</td>
<td>719</td>
<td>1497</td>
</tr>
<tr>
<td>⟨bl.-'sajjjil⟩</td>
<td>[jj]</td>
<td>289</td>
<td>2229</td>
</tr>
<tr>
<td>“it leaks”</td>
<td>[jj]</td>
<td>291</td>
<td>2228</td>
</tr>
</tbody>
</table>

Table 2:1. $F_1$ and $F_2$ of tokens of Palestinian /ʕ/ and /jj/

Table 2:2 reports the $F_1$ and $F_2$ of two tokens each of non-emphatic /t/, emphatic /t/, surface non-emphatic ⟨r⟩ (= de-emphaticised ⟨r⟩), and emphatic ⟨r⟩. We see that the tokens of /t/ and ⟨r⟩ have an $F_1$ rise which is small or just barely medium, compared to $F_1$ of the tokens of their non-emphatic counterparts. The tokens of /t/ have a large $F_2$ drop, compared to $F_2$ for /t/. The tokens of ⟨r⟩ have a medium (KS) or small (KG) $F_2$ drop, compared to $F_2$ for ⟨r⟩ (see Table 1:10). For emphatics, the predictions are a medium or large $F_1$ rise and a large $F_2$ drop (see Table 1:11). The data in Table 2:2 show a smaller $F_1$ effect than expected, and a large $F_2$ drop for /t/ but not ⟨r⟩. However, the expected directions of formant changes are observed. These data thus provide some support for the assumption that the emphatic tokens were produced with uvularisation and pharyngealisation postvelar articulations (and
that the tokens of their non-emphatic counterparts were not). This supports the secondary-[RTR] and secondary-[DOR] specifications of Palestinian /t/ and /ɾ/ in (44).

<table>
<thead>
<tr>
<th>carrier form</th>
<th>token</th>
<th>F₁</th>
<th>F₂</th>
<th>Speaker: KS</th>
<th>F₁</th>
<th>F₂</th>
<th>Speaker: KG</th>
</tr>
</thead>
<tbody>
<tr>
<td>⟨tir⟩ “figs”</td>
<td>[t]</td>
<td>248</td>
<td>2088</td>
<td></td>
<td>248</td>
<td>2085</td>
<td></td>
</tr>
<tr>
<td></td>
<td>[ɾ]</td>
<td>248</td>
<td>2179</td>
<td></td>
<td>245</td>
<td>2100</td>
<td></td>
</tr>
<tr>
<td>mean F</td>
<td></td>
<td>248</td>
<td>2134</td>
<td></td>
<td>247</td>
<td>2093</td>
<td></td>
</tr>
<tr>
<td>⟨tir⟩ “mud”</td>
<td>[t]</td>
<td>338</td>
<td>1399</td>
<td></td>
<td>335</td>
<td>1328</td>
<td></td>
</tr>
<tr>
<td></td>
<td>[ɾ]</td>
<td>333</td>
<td>1540</td>
<td></td>
<td>342</td>
<td>1246</td>
<td></td>
</tr>
<tr>
<td>mean F</td>
<td></td>
<td>336</td>
<td>1470</td>
<td></td>
<td>339</td>
<td>1287</td>
<td></td>
</tr>
<tr>
<td>difference mean F [t] vs. [ɾ]</td>
<td>+88</td>
<td>-664</td>
<td>+92</td>
<td>-806</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>carrier form</th>
<th>token</th>
<th>F₁</th>
<th>F₂</th>
<th>Speaker: KS</th>
<th>F₁</th>
<th>F₂</th>
<th>Speaker: KG</th>
</tr>
</thead>
<tbody>
<tr>
<td>⟨bræ:m⟩ “blanket”</td>
<td>[ɾ]</td>
<td>526</td>
<td>1552</td>
<td></td>
<td>463</td>
<td>1309</td>
<td></td>
</tr>
<tr>
<td></td>
<td>[ɾ]</td>
<td>542</td>
<td>1472</td>
<td></td>
<td>530</td>
<td>1305</td>
<td></td>
</tr>
<tr>
<td>mean F</td>
<td></td>
<td>534</td>
<td>1512</td>
<td></td>
<td>497</td>
<td>1307</td>
<td></td>
</tr>
<tr>
<td>⟨ɾaɾ:ɾ⟩ “shame” (N)</td>
<td>[ɾ]</td>
<td>663</td>
<td>1208</td>
<td></td>
<td>598</td>
<td>1176</td>
<td></td>
</tr>
<tr>
<td></td>
<td>[ɾ]</td>
<td>628</td>
<td>1197</td>
<td></td>
<td>591</td>
<td>1173</td>
<td></td>
</tr>
<tr>
<td>mean F</td>
<td></td>
<td>646</td>
<td>1203</td>
<td></td>
<td>595</td>
<td>1175</td>
<td></td>
</tr>
<tr>
<td>difference mean F [ɾ] vs. [ɾ]</td>
<td>+112</td>
<td>-309</td>
<td>+98</td>
<td>-132</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Table 2:2. $F_1$ and $F_2$ of tokens of Palestinian /t/, /ɾ/, /ɾ/, and /ɾ/.

2.3.2 The Derivation of the Palestinian Underlying Postvelar Inventory

Palestinian segments that can be underlyingly primary-[RTR] are those without primary specification for another articulator feature. I presume this follows from the general co-occurrence restriction in (46) (which imposes (23) in §1.4.1).

(46) *Prim, Prim
A segment is not specified for more than one primary articulation feature.

The segments that can be underlyingly secondary-[RTR] are those that are (primary- or secondary-) [DOR]: uvular gutturals and emphatics. I presume
this follows from the co-occurrence condition:\textsuperscript{26}

{(47) Sec-RTR/DOR

If secondary-[RTR], then [DOR].}

Segments that can be underlyingly secondary-[DOR] and secondary-[RTR]
exclude those specified for [FRONT]. I presume this to be the effect of
the paradigmatic grounding condition in (48), which is grounded in the antagonism
of simultaneous uvularisation and fronting gestures.

{(48) FRONT/^Sec-DOR \& Sec-RTR

A segment specified for [FRONT] is not specified for secondary-[DOR]
and secondary-[RTR].}

This condition is indicated by the distribution and behaviour of Palestinian
post-alveolar /\# t\#/, which I assume, after McCarthy (1997), to be specified
for [FRONT]. There are no underlying [FRONT] emphatics in the language, that
is, no /\# t\#/. Also, /\# t\#/ are opaque to uvularisation harmony, that is, they
do not undergo it and they block it. (Within OT, conditions like those in (47)
and (48) are actually constraints; see §2.5.3 on (48) as a constraint.) Gaps in
the underlying emphatic inventory not handled by (48), e.g., lack of coronal /\#/,
are perhaps accidental.

2.3.3 \textit{Prosodically Conditioned (Closed Syllable) Pharyngealisation}

2.3.3.1 \textit{Analysis.} Besides postvelars, there is another source of
pharyngealisation in Palestinian phonology: pharyngealisation is imposed on a
short vowel in a closed syllable. The forms in (49) show that short vowels
surface non-rtr in a word with no closed syllable (and no postvelar). Those in
(50) show closed-syllable pharyngealisation; each vowel surfaces rtr in its
closed syllable. (These are non-low short vowels. Pharyngealisation of /Æ/
is addressed in §2.4.3.)

{(49) a. /\texttt{ObIÆ}/ \{'o.b.i.a\} (a type of small pea)
b. /\texttt{sUrI-Æ}/ \{'s.u.r.i-.\#\} “Syria”
c. /\texttt{EtÆ}/ \{'t.e.t\#\} “grandma”
d. /\texttt{dU:d-Æ}/ \{'d.u.d-\#\} “worm”
e. /\texttt{sI:d-O}/ \{'s.i.d-\#\} “grandpa”}

\textsuperscript{26}Coronal emphatics might be crosslinguistically more frequent than dorsal or labial emphatics
(Bessell & Czaykowska-Higgins 1991) but, to my knowledge, no study has established that.
(50) a. /mIʃ/ \{mIʃ\} (*\{mIʃ\}) **“not”**
b. /zIft/ \{zIft\} (*\{zIft\}) **“asphalt, bad thing”**
c. /iImm/ \{iImm\} (*\{iImm\}) **“to smell”**
d. /dUll/ \{dUll\} (*\{dUll\}) **“marble” (the toy)**
e. /Ik.tib/ \{Ik.tib\} (*\{Ik.tib\}) **“to write”**


2.3.3.2. **Acoustic Support.** Figures 2:1 - 2:4 present \(F_1 - F_2\) plots for the Palestinian non-low surface short vowels. The tokens are from two speakers. \(F_1\) is plotted along the y-axis, \(F_2\) along the x-axis, on a linear scale. Ellipses enclose 90% of the tokens of a given allophone, the case for all such plots in this book. IPA symbols identify groups of tokens that are perceptually non-rtr vs. rtr allophones per vowel. (In this chapter, where no tokens are plotted for a particular vowel, e.g., none of \{\v o\} in Figure 2:3, that is due to lack of data.) The IPA symbol associates with the ellipse closest to it. The caption lists statistics for each allophone: mean \(F_1\), mean \(F_2\), and standard deviations (‘s.d.’) of \(F_1\) and \(F_2\). Standard deviations are also seen implicitly in the length of the ellipse semi-axes, equal here to 2.15 x s.d., the lengths of the axes calculated to include 90% of the data of a bivariate \((F_1, F_2)\) normal distribution. Figures 2:1 - 2:4 plot surface tokens of short /I/ or shortened /I:/, /E/ or shortened /E:/, /O/, and /U/. Some tokens are the epenthetic vowel, which always surfaces short

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27 Dudas (1976:33) explains Javanese \{i u\}, etc. as resulting from [-tense] specification on the closed-syllable vowel. Schlindwein (1988:196) assumes the feature is [-ATR], which she equates with Dudas’ [-tense]. See n35 on equating tense with nonrtr and lax ([-tense]) with rtr.

28 Recall that, since an \(F_1 - F_2\) plot reports physical (acoustic) data on phonetic vowel tokens, namely, the frequency of the first and second formants, it is not the same thing as a vowel diagram. A vowel diagram is an abstract representation of phonetic or phonemic vowels classified along abstract dimensions like high-low and front-back. The visual similarity between the two types of graphs is due to the fact that \(F_1, F_2\) plots typically present \(F_1\) downward and \(F_2\) leftward “so that the traditional form of representing vowels is preserved” (Ladefoged 1967:92). A vowel diagram is also not the same as an articulatory diagram. That third type of graph, like an \(F_1 - F_2\) plot, reports physical data, namely, measurements of a sagittal section of the vocal tract for particular speech tokens recorded instrumentally by x-ray, ultrasound, or M.R.I., etc. The high-low and front-back dimensions of a vowel diagram do not necessarily correspond to actual tongue positions reported in an articulatory diagram. (See Stevens & House 1955, Jones 1967, 1972, Ladefoged 1967, 1993.)
and high front or high back. Tokens that are underlying long or epenthetic are identified in Appendix II. For ease of reference, all will be referred to as tokens of /V/. Figures 2:1 - 2:4 include all Palestinian surface short vowel tokens analysed for this study, excluding those of /Æ/ and of Jafa stem-final /E/ and /O/. (The tokens of /Æ/ are reported on in §2.4.3, those of Jafa stem-final /E/ in §2.4.5.)

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**Figure 2:1.** $F_1 - F_2$ plot of tokens of Palestinian short /I/. Two speakers.

- [I]: $F_1$ (mean = 259 Hz; s.d. = 22 Hz); $F_2$ (mean = 2003 Hz; s.d. = 169 Hz); 24 tokens.
- [I]: $F_1$ (mean = 364 Hz; s.d. = 17 Hz); $F_2$ (mean = 1620 Hz; s.d. = 129 Hz); 41 tokens.

**Figure 2:2.** $F_1 - F_2$ plot of tokens of Palestinian short /E/. Two speakers.

- [ε]: $F_1$ (mean = 349 Hz; s.d. = 20 Hz); $F_2$ (mean = 1825 Hz; s.d. = 127 Hz); 14 tokens.
- [ɛ]: $F_1$ (mean = 526 Hz; s.d. = 31 Hz); $F_2$ (mean = 1443 Hz; s.d. = 43 Hz); 8 tokens.
In Figures 2:1 - 2:4, for each vowel, the non-rtr vs. rtr tokens fall within distinct regions of the $F_1$ - $F_2$ plane. For each vowel, the rtr tokens fall within a higher $F_1$ interval and lower $F_2$ interval than the non-rtr tokens. (The exceptional $F_2$ of the $[U]$s is discussed shortly, below.)

In Figures 2:5 - 2:8, a subset of the tokens in Figures 2:1 - 2:4 are re-
plotted according to the two phonological contexts relevant to closed-syllable pharyngealisation: in an open syllable with no trigger in the word, and in a closed syllable with no trigger in the word. A trigger for pharyngealisation harmony is a postvelar consonant or a closed-syllable pharyngealised vowel (see §2.4). Hence, the two contexts identify a vowel in $\{\text{CV.C}\}$ (e.g., $\{\text{i}\}$ in $\{\text{si.do}\}$ "grandpa") and $\{\text{CVC}\}$ (e.g., final-syllable $\{\text{t}\}$ in $\{\text{fr.lim}\}$ "movie"), respectively, in a word with no postvelar. The ellipses in the new figures are from Figures 2:1-2:4.

**Figure 2:5.** $F_1 - F_2$ plot of tokens of Palestinian short $\text{i}$ in the contexts: open syllable, no trigger; closed syllable, no trigger

**Figure 2:6.** $F_1 - F_2$ plot of tokens of Palestinian short $\text{e}$ in the contexts: open syllable, no trigger; closed syllable, no trigger
In Figures 2:5 - 2:8, the open syllable, no trigger tokens of /I E O U/ are non-rtr [i e o u]. The closed syllable, no trigger tokens of /I E U/ are rtr [ɪ ɛ u]. The relevant findings are that the closed syllable, no trigger tokens have a raised $F_1$, compared to the open syllable, no trigger tokens per vowel. For /I E/, the closed-syllable, no trigger tokens have a lowered $F_2$. For /U/ they do not. Based on comparison of the $F_1$ and $F_2$ means for the non-rtr vs. rtr allophones per vowel reported in the captions of Figures 2:1 - 2:4, the [ɪ]s have
an $F_1$ rise which is just barely medium (105 Hz); the [ε]s have a medium $F_1$ rise (177 Hz), and the [u]s a small $F_1$ rise (99 Hz). The [ɪ]s and [ɛ]s have a medium $F_2$ drop (383 and 382 Hz, respectively). The $F_1$ and $F_2$ effects predicted for a (non-velar) segment with pharyngealisation are a medium $F_1$ rise and a medium $F_2$ drop (see Table 1:8). Our data for [ɪ] and [ɛ] match the predictions. For [ʊ], the $F_1$ rise is smaller than expected but is in the expected direction. Lack of $F_2$ drop for the [u]s could be because they were produced with less lip rounding than the [u]s. The data in Figures 2:5 - 2:8 thus provide support for the assumption that the closed syllable, no trigger tokens of /I E U/ were produced with a secondary pharyngeal articulation which the open syllable, no trigger tokens lacked. This supports the phonological claim that Palestinian short vowels pharyngealise in a closed syllable.

2.3.3.3 Theoretical Account. I assume that [HI], [LOW], and [LAB] are the Place features defining the Palestinian underlying vowels. The neutrality of high vowels in Palestinian uvularisation harmony (see §2.5.5) and r-de-emphasis in the context of /I(:)/ and /E(:)/ (see §2.2.1) provide evidence for active [HI]. Vowel reduction shows active [LOW] (see §2.2.2). Evidence for active [LAB] comes from Palestinian rounding harmony, seen from the final-syllable surface vowels in (51) compared to those in (52).

(51) a. /kUtub/ \{kʰu.tuɓ\} (\*\{kʰu.tuɓ\}) “books”  
b. /mUʔur/ \{mu.ʔur\} (\*\{mu.ʔur\}) “colt”  
c. /Urn/ \{fu.run\} (\*\{fu.run\}) “oven”

(52) a. /sIlik/ \{sI.lik\} “wire”  
b. /tIɗl/ \{tI.ɗl\} “calf”  
c. /bIнт/ \{bI.n̥t\} “girl”

Each final-syllable vowel above is epenthetic, inserted for syllabification of the word-final /CC/ cluster. In (52), it surfaces as non-round 〈I〉 (as expected, rtr in its closed syllable). In (51), it is instead round 〈U〉 (likewise rtr). Because that vowel surfaces round in no other context, the rounding must result from rounding harmony with the round stem vowel (see Kenstowicz 1981, Abu-Salim 1987b).

After the Dependency Phonology of Kaye et al. (1985) and Particle Phonology of Schane (1984), I assume that [HI] and [LOW] can co-occur and that when they do they represent mid height. Departing from the works just cited, I assume no dependency relation for the two features, but that such a relation holds only between features representing primary vs. secondary articu-
I adopt combinatorial specification (Archangeli & Pulleyblank 1994). Active [HI], [LOW], and [LAB] yield $2^3 = 8$ combinatorial feature sets:

<table>
<thead>
<tr>
<th>(epenthetic vowel)</th>
<th>1/</th>
<th>2/</th>
<th>3/</th>
<th>4/</th>
<th>5/</th>
<th>6/</th>
<th>7/</th>
<th>8/</th>
</tr>
</thead>
<tbody>
<tr>
<td>HI</td>
<td>+</td>
<td>+</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>+</td>
<td>+</td>
</tr>
<tr>
<td>LO</td>
<td>+</td>
<td>+</td>
<td></td>
<td></td>
<td>+</td>
<td></td>
<td>+</td>
<td></td>
</tr>
<tr>
<td>LAB</td>
<td></td>
<td></td>
<td>+</td>
<td></td>
<td>+</td>
<td>+</td>
<td></td>
<td>+</td>
</tr>
</tbody>
</table>

The symbols ‘I’, ‘E’, ‘Æ’, ‘O’, ‘U’ for Palestinian underlying vowels, denote feature sets 2, 3, 4, 7, and 8, above, respectively (plus [SON]). The symbols’ upper case encodes the fact that the ultimate (that is, surface) sets, which are determined through the course of the phonology, potentially differ since specifications might be added or removed. The epenthetic vowel, feature set 1, is completely unspecified. It is not realized as mid, as predicted for an unspecified vowel, but as high non-round (and front) or high round (and back), as seen in (51) - (52). I assume its invariable high-ness results from specification for [HI] imposed in the input-to-output mapping to prevent it from neutralising with the mid central vowels that arise from /Æ/-reduction. Because of its [HI], it neutralises instead with underlying /I/ or /U/.

Palestinian does not make use of feature sets 5 and 6. As formulated by Archangeli & Pulleyblank, combinatorial specification assumes full instantiation of defined feature sets unless a condition rules some out or feature-insertion forces neutralisation. The former case holds here. Sets 5 and 6 are evidently ruled out by ‘LAB/HI’ (‘If [LAB], then [HI]’), suggested by the crosslinguistic dispreference for low labialised vowels (Kaun 1995).

The representations of /I EÆ O U/ are seen in (54). After Pulleyblank (1994), I assume that moras are underlying.

Data indicate that a short vowel in a closed syllable pharyngealises by receiving specification for [RTR], represented with secondary status. The [RTR] is secondary because an unconditioned vowel, to use the terminology of Ladefoged & Maddieson (1996), already has ‘major’ articulatory features. The additional feature of pharyngealisation adds a ‘minor’ articulation to its imple-

---

29 In a Dependency/Particle Phonology approach, if [HI] dominates [LOW], high mid e or o results. Opposite domination yields low mid e or o. I presume that low mid vowels result from specification for an additional feature, [RTR]. See example (55).
Representations of Palestinian Underlying Short /I E æ O U/

By combinatorial specification, additional [RTR] yields the 16 output vowels in (55). Mid central /œ æ/, which are reduced /Æ/, are included. The eight rtr vowels are boxed. Example (55) shows the epenthetic vowel's neutralization with the surface variants of /I/ and /U/ by its [HI] and [LAB]

---

Note that the requirement that a primary articulation feature be implemented with tighter stricture than a secondary articulation feature, which holds for consonants (see §1.4.1), does not hold for vowels. Fricative vowels are a striking illustration, e.g., the fricative allophone of Standard Chinese /i/, and the fricative vowel allophone of Czech /r/ (Ladefoged & Maddieson 1996:314). I assume that the reverse stricture requirement for vowels follows from the fundamental articulatory difference between consonants and vowels, namely, that (singly-articulated) consonants are produced with obstructive articulation, while (singly articulated) vowels are produced with non-obstructive articulation. For a vowel specified for both a primary and a secondary articulation feature, the primary feature will thus be the one with the least tight constriction.
specifications. Its non-round and round possibilities are  \{i\} and  \{I\}, and  \{u\} and  \{U\}, respectively. The surface variants of underlying /I/ and /U/ are  \{i\} and  \{i\}, and  \{u\} and  \{u\}, respectively. (See §2.4.3 for clarification of non-rtr vs. rtr vowels.)

Palestinian [HI] vowels freely combine with [RTR]. The paradigmatic Grounding constraint HI/*RTR (‘A segment specified for [HI] is not specified for [RTR]’), shown by Archangeli & Pulleyblank (1994) and Pulleyblank (1997b) to be highly ranked in Niger-Congo, is thus lowly ranked in Palestinian. (The two studies just referenced phrase the constraint as ‘HI/ATR’.)

The representational alteration caused by pharyngealisation is illustrated with (/I/ >)  \{I\} in (56). After Zec (1988) and Shaw (1994a), I assume that vowels project a nucleus, so a surface vowel is dominated by NUC (nucleus).

The data of (49) and (50) indicate the constraints in (57) ranked as in (58). Their interaction is illustrated in (59).

\[
\begin{array}{cccccccc}
\text{HI} & \{\emptyset\} & \{a\} & \{e\} & \{i\} & \{I\} & \{o\} & \{u\} & \{U\} \\
\text{LO} & + & + & + & + & + & + & + & + \\
\text{LAB} & + & + & + & + & + & + & + & + \\
\text{RTR} & + & + & + & + & + & + & + & + \\
\end{array}
\]
(57) a. NUC-C]/\RTR
    A NUC in a closed syllable is specified for [RTR].

b. DEP-RTR
    Every [RTR] in the output corresponds to an [RTR] in the input.

c. DEP-LINK
    Every association in the output corresponds to an association in the input.

(58) NUC-C]/\RTR >> DEP-RTR, DEP-LINK

(59)

<table>
<thead>
<tr>
<th>input: /ziift/</th>
<th>NUC-C]/\RTR</th>
<th>DEP-RTR</th>
<th>DEP-LINK</th>
</tr>
</thead>
<tbody>
<tr>
<td>&quot;ashphalt, bad thing&quot;</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1. {ziift}</td>
<td>*!</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2. {ziift}</td>
<td></td>
<td>*</td>
<td>*</td>
</tr>
<tr>
<td>[RTR]</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>3. {ziift}</td>
<td></td>
<td>*</td>
<td>**!</td>
</tr>
<tr>
<td>[RTR]</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

I propose NUC-C]/\RTR as syntagmatic Grounding constraint grounded in the phonetic undershoot of vowels in a CVC context, shown by Lindblom (1963). Lindblom examined Swedish vowels in CVC syllables and found that $F_1$ and $F_2$ did not reach their target values in that context. He summarises this undershoot effect [p.1781] as ‘centralisation’, a ‘contextual assimilation’ to schwa, because there is “less time for articulators to complete their “on-” and “off-glide” movements within the CVC syllable... the speech organs fail, as a result of the physiological limitations, to reach the positions that they assume when the vowel is produced under ideal steady-state conditions” (Lindblom 1963:1770). In closed-syllable pharyngealisation, the phonetic undershoot of

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31 In the paragraph from which this quote is taken, Lindblom begins his sentence with: “As a vowel becomes shorter, there is less and less time for the articulators to complete their...”. I interpret Lindblom’s remarks as identifying two factors in undershoot: closed syllable context
short vowels in a closed syllable is phonologised, that is, imposed in the phonology, by NUC-C[σ]/RTR. The result is new short vowel targets in a closed syllable: \{ɨ\} instead of \{i\}, \{ε\} instead of \{θ\}, etc.

In (59), candidate 2 contains a non-underlying [RTR] and a non-underlying link, in violation of DEP-RTR and DEP-LINK but in satisfaction of NUC-C[σ]/RTR. Candidate 2 wins. This shows the ranking: NUC-C[σ]/RTR >> DEP-RTR, DEP-LINK. Candidate 3’s link between [RTR] and \{f\}, yielding a pharyngealised \{f\}, is not required by any constraint in the tableau. Because of that link, 3 incurs one more violation of DEP-LINK than candidate 2 and is nonoptimal. Finally, the data we have seen so far do not indicate a ranking between DEP-RTR and DEP-LINK so we assume for now that they are equally ranked.

An implicit claim here is that Palestinian closed-syllable pharyngealisation does not affect consonants. Phonological evidence for this is explained as follows. If Palestinian consonants were also affected by closed syllable pharyngealisation, then, like vowels, they would surface [RTR] in a closed syllable. Assuming the representations in (45), this predicts that /k/ would surface as primary uvular \{q\} in a closed syllable. However, forms like those in (60) show it does not.

(60) a. /lkṭlb/ \{ʔrk.trb\} \{ʔrq.trb\} “to write”
b. /bilt-. menstr/ \{bn.t-3k\} \{bn.t-3q\} “your (masc. sg.) daughter”
c. /kūrsil/ \{kursi\} \{qursi\} “chair”

Perceptual support for concluding that the consonants are unaffected by closed-syllable pharyngealisation comes from judgments of Palestinian segments in non-pharyngealisation vs. closed-syllable pharyngealisation contexts. Consultant KS, who is literate and linguistically untrained, evaluated instances of /m/ and /l/ as seen in Table 2:3. As seen, the judgments for /m/ in both contexts were the same. This indicates that pharyngealisation does not have a categorical perceptual affect on consonants, so that no distinct rtr allophone results for a consonant in a closed syllable. However, the judgments for /l/ were not the same. The vowel was perceived differently in the two contexts. This demonstrates the categorical effect that pharyngealisation has on vowels. The result is perceptual distinction between non-rtr and rtr allophones. For the vowel of judgment 5 in the table, the rtr allophone arises in a closed

and vowel length. The quoted excerpt focuses on remarks relevant to the former. I address the influence of vowel length in §2.4.6.
syllable. The acoustic basis for the perceptual distinction was documented in Figures 2:5, 2:6, and 2:8, which show that an $F_1$ difference of about 100 Hz or more distinguishes tokens of the non-rtr vs. rtr allophones of a (non-low) vowel.

<table>
<thead>
<tr>
<th>Task: Please identify...</th>
<th>Response</th>
<th>Notes</th>
</tr>
</thead>
</table>
| 1. the first sound in *Mona* [ˈmo.nə]  
“Mona” (fem. name)]  
= /m/ in non-pharyngealisation context | “mīm.” | $mīm = m$  
tā = ʕ = t  
ḥā = ʕ = h |
| 2. the sound just before *tā* in *kimthā*  
[ˈkɪm-t-.hə] “I removed it (fem.)”)  
= /m/ in closed-syllable pharyngealisation context | “mīm.” | |
| 3. the sound immediately following  *ḥā*  
in *ʔefmil* [ˈʔeʃ.mil] “to carry”  
= /m/ in closed-syllable pharyngealisation context | “mīm.” | |
| 4. the vowel sound immediately following *sīn* in *sīdā* [ˈsi.d-o]  
“grandpa”]  
= /I/ in non-pharyngealisation context | “It [that vowel in *silik*] is different from the first one  
in *sīdā*. You would write it  
with a kasra. For the first  
vowel in *sīdā*,  
there would be a *yā* too.” | $sīn = ω = s$  
lam = ʕ = l  
*kasra = ʕ = t*  
yā = ʕ = j  
*kasra with  
yā = ʕ = t( j) or  
i( j)* |
| 5. the vowel sound immediately following *lam* in *silik* [ˈsi.t.hk]  
“wire”]  
= /I/ in closed-syllable pharyngealisation context | | |

*Table 2:3. Judgments of Palestinian /m/ and /I/ in non-pharyngealisation  
vs. closed-syllable pharyngealisation contexts*

Consider, however, that the consonants might have non-rtr vs. rtr surface variants, but the distinction between the two variants is just not perceived by speakers. We can dismiss that possibility because if there were such distinct variants, we would expect phonological evidence for them, such as the /k/ > ʕ effect shown to be ungrammatical in (60). Based on the lack of that effect, and on Table 2:3, I conclude that Palestinian closed syllable pharyngealisation does not affect consonants.
We now ask from what formal property this follows. The answer relies on Archangeli & Pulleyblank's (1994) notion 'anchor'. They describe the anchor for a harmonic feature [p.24] as "the highest significant level of structure, either organizational or prosodic." I adopt the following working definition of 'anchor': the representational element onto which a non-underlying link docks. With Archangeli and Pulleyblank [p.23 - 24], I assume that, where necessary, this docking occurs by interpolation, that is, by automatic generation of hierarchical structure between harmonic feature and anchor. I assume that anchors are root nodes, moras ('μ's), or NUCs.

Palestinian NUCs are vowels. Although the consonants can be moraic (Hayes 1995), they are non-nuclear. Consider (61), in which epenthetic vowels supply a nucleus for the word-initial syllables. This epenthesis is imposed by σNUC ('Syllables must have nuclei') (Shaw 1996b, based on Prince & Smolensky 1993:87). The vowel epenthesis indicates that the consonants do not project a nucleus. If they did, the vowel epenthesis would be unexpected, since σNUC could be satisfied without it.

(61) a. /kmÆ:j/  /k.ˈmaːːʃ/  "cloth"
b. /dʒfU:n/  /dʒ.ˈfuːn/  "eyelids"
c. /hmÆ:r/  /h.ˈmeːr/  "donkey"

Exceptional forms with a syllabic lateral or nasal sonorants occur but in free variation with ones with an epenthetic vowel; e.g., /hVÆ:ff/ /j.ˈhaff/ ~ /t.ˈhaff/ "heavy cotton cover"; /m-sÆtʃtʃər/ /m-.ˈsatʃtʃər/ ~ /t.ˈmatʃtʃər/ "closed (masc. sg.)" (Adj). The variants with a syllabic lateral or nasal violate σNUC.

The foregoing establishes the NUC as the Palestinian anchor for [RTR]. Exclusion of consonants from the phonological effects of closed-syllable pharyngealisation follows automatically and necessarily from that formal property.

2.4. **Palestinian Pharyngealisation Harmony**

2.4.1 Harmony Under Adjacency to a Postvelar

2.4.1.1 Analysis. In (62), short vowels occur adjacent to an underlying postvelar. As seen, they surface rtr in that context. This is local pharyngealisation harmony triggered by the postvelar. The triggers include

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32 Archangeli & Pulleyblank (1994) categorise anchors as organisational (root nodes) or prosodic.
laryngeal gutturals, as in (a-c). (Issues raised by the non-pharyngealising long and stem-final vowels are addressed in §2.4.5.)

(62) a. /suʔæ:i/  \{su.ʔæːi\}  (*\{su.ʔæːi\}) “question”
b. /juɬuʃ:i/  \{ju.ɦuː\}  (*\{ju.ɦuː\}) ‘what?!’
c. /hiɬæ/  \{hi.æ\}  (*\{hi.æ\}) “Hiba’ (fem. name)
d. /ˈuːlæ/  \{ˈuːlæ\}  (*\{ˈuːlæ\}) “Ula” (fem. name)
e. /ˈdʊɾæ/  \{ˈdʊɾæ\}  (*\{ˈdʊɾæ\}) “corn”
f. /kʊɾɪ/  \{kʊɾɪ\}  (*\{kʊɾɪ\}) “ball”
g. /ˈsbiɾɪɾɪ/  \{ˈsbiɾɪɾɪ\}  (*\{ˈsbiɾɪɾɪ\}) “hospital”

2.4.1.2 *Acoustic Support.* Figures 2:9 - 2:10 plot the tokens of /I/ and /U/ in Figures 2:1 and 2:4 that occurred adjacent to an underlying postvelar in a phonological open syllable. The postvelar was a guttural or emphatic. In the new figures, the tokens of /I/ and /U/ fall within the ellipses for the rtr surface vowels. They are [I] and [U], respectively. That is, the [I]s show the $F_1$ and $F_2$ effects expected for pharyngealisation articulation; the [U]s show the expected direction, with the caveat for $F_2$.) The formant effects in Figures 2:9 - 2:10 are support for the assumption that the open syllable, adjacent postvelar tokens of /I/ and /U/ were produced with pharyngealisation. This supports the phonological claim that Palestinian short vowels pharyngealise adjacent to an underlying postvelar.

Figure 2:9. $F_1 - F_2$ plot of tokens of Palestinian short /I/ in the context: open syllable, adjacent postvelar
For some tokens, the adjacent postvelar was a laryngeal. Those tokens show the same $F_1$, $F_2$ effects. This is the acoustic finding with respect to laryngeal gutturals that was anticipated in §1.3.2. It is acoustic support for the assumption that the adjacent laryngeals were produced with tongue root retraction, which supports the claim that Palestinian laryngeals are [RTR].

Figures 2:11 - 2:12 plot the tokens of /I/ and /U/ that occurred adjacent to a postvelar, and in a closed syllable. Two tokens of /U/ fall between non-rtr and rtr ellipses, but the general observation is that the tokens are, as expected, rtr.

---

**Figure 2:10.** $F_1$ - $F_2$ plot of tokens of Palestinian short /U/ in the context: open syllable, adjacent postvelar

**Figure 2:11.** $F_1$ - $F_2$ plot of tokens of Palestinian short /I/ in the context: closed syllable, adjacent postvelar
2.4.2 Theoretical Account: Part I

As Palestinian pharyngealisation harmony is triggered by segments which bear [RTR] as a primary or secondary specification, it is [RTR] A harmony.

The data of (62) indicate the constraints in (63) ranked as in (64).

(63) a. ALIGN-L[ [RTR], NUC)  
The left edge of [RTR] is aligned with the left edge of a NUC.  
(∀[RTR], ∃NUC with which it is left-aligned.)  
b. ALIGN-R([RTR], NUC)  
The right edge of [RTR] is aligned with the right edge of a NUC.  
(∀[RTR], ∃NUC with which it is right-aligned.)  
c. DEP-IO  
Every segment (that is, root node) in the output has a correspondent in the input.  
d. MAX-RTR  
Every [RTR] in the input corresponds to an [RTR] in the output.  
e. MAX-LINK  
Every association in the input corresponds to an association in the output.

(64) DEP-IO, MAX-RTR, MAX-LINK >>  
NUC-C[ [RTR], ALIGN-L([RTR], NUC), ALIGN-R([RTR], NUC) >>  
DEP-RTR, DEP-LINK
The \text{ALIGN}([\text{RTR}], \text{NUC}) constraints require the edge alignments in (65). Where these constraints are satisfied in the type of form under consideration, [RTR] gravitates from a postvelar consonant to a vowel. They thus require [RTR] to surface on a vowel. I propose them as auditory Grounding constraints grounded in the categorical effect that non-underlying pharyngealisation has on vowels but not consonants. Underlying pharyngealisation is categorical for consonants, as it identifies the postvelar class and distinguishes primary velars from primary uvulars, but the distinctiveness of the underlying pharyngealisation of consonants is optimally enhanced in the surface form by concurrent realisation on a vowel. This is imposed by the \text{ALIGN}([\text{RTR}], \text{NUC}) constraints.\(^\text{33}\)

(65) a. requirement of \text{ALIGN-L}([\text{RTR}], \text{NUC})

\[
\begin{array}{c}
\text{N} \\
\text{μ} \\
\text{C} \\
[\text{TR}] \\
[\text{RTR}]
\end{array}
\]

b. requirement of \text{ALIGN-R}([\text{RTR}], \text{NUC})

\[
\begin{array}{c}
\text{N} \\
\text{μ} \\
\text{C} \\
[\text{TR}] \\
[\text{RTR}]
\end{array}
\]

This makes two predictions: 1. There are languages with [RTR] on vowels but not on consonants. 2. If a language has [RTR] on consonants, it will have it on vowels, that is, [RTR] vowel harmony will occur in a language with underlying [RTR] consonants.\(^\text{34}\) I will argue in \textsection 4.2 that Niger-Congo and Nilotic languages bear out prediction 1. Further support is found in Maddieson's (1984) segmental inventories of 317 languages from the UCLA Phonological Segment Inventory Database (UPSID). Of the 317 languages, 139

\(^{33}\) Goad (1993) claims that [RTR] is an exclusively consonantal feature. However, under her assumptions, [RTR] represents emphatic articulation. Emphatic articulation was clarified in \textsection 1.4.2 as uvularisation (with concomitant pharyngealisation), which data indicate is represented by concurrent secondary-\{DOR\} and secondary-\{RTR\}. Goad's claim is thus not directly relevant to my claim with respect to the optimally vocalic nature of [RTR]. As for whether representation of uvularisation is exclusively consonantal, both consonants and vowels undergo Palestinian uvularisation harmony (see \textsection 2.5.1), shown previously by Card (1983), Davis (1995), Herzallah (1990) and Younes (1982, 1993, 1994). While representation of uvularisation associates only with consonants underlyingly, its surface association is not limited to consonants.

\(^{34}\) Thanks to Pat Shaw for pointing out these predictions.
44% have rtr vowels, that is, vowels like \( \{i, e, o, u\} \), but no postvelar consonants.\(^{35}\) Prediction 2 is borne out with Palestinian, as we have seen. Chapter 3 will show it is also borne out with St'át'imcets Salish. Maddieson's database seems at first to provide only slim support for Prediction 2. Of the 317, 64 have postvelar consonants. Of those, 34 = 53% have rtr vowels, 30 (47%) do not.\(^{36}\) However, close examination of the phonetics and phonology of the 30 counting languages would probably show that many of them actually do bear out Prediction 2, that is, that their vocalic inventories contain rtr vowels. This is plausible because, although Maddieson found the UPSID data adequate to test a hypothesis of vowel dispersion (see his discussion, p.136-139), he states:

> Whether or not the vowels of a particular language are represented in sufficient phonetic detail in UPSID depends greatly on the phonetic judgments and transcription methods of the field linguist. Some linguists report the auditory quality of vowels in the narrowest detail, while others simply rely on the commonest vowel symbols, often those available on any typewriter, to make all the necessary distinctions... Unfortunately, while a vowel system reported as /i e a o u/ may be faithfully representing a perfectly balanced system, it may also be concealing a wealth of unreported phonetic detail. (p.138)

\(^{35}\) The contrast between \( \{i\} \) and \( \{i\} \), \( \{e\} \) and \( \{e\} \), etc. in Germanic languages is argued by Ladefoged & Maddieson (1996:302-306) to be captured by [TENSE], not a tongue root feature. Their argument is based on the articulatory and statistical findings of Harshman et al. (1977), Ladefoged & Harshman (1979), Bolia & Valaczkai (1986), and Jackson (1988), which indicate that Germanic languages have no common tongue root setting for ‘lax’ vowels like \( \{i\}, \{e\}, \text{etc.} \), compared to ‘tense’ vowels like \( \{i\}, \{e\}, \text{etc.} \). They conclude [p.304] that tongue root position in Germanic languages is “simply one of the concomitants of vowel height” and that Germanic \( \{i\}, \{e\}, \text{etc.} \) are distinguished from \( \{i\}, \{e\}, \text{etc.} \) by non-tongue-root [TENSE]. However, with Archangeli & Pulleyblank (1994) and following Halle & Stevens (1969), I assume all instances of contrasts like \( \{i\} \) vs. \( \{i\} \) are manifestations of a tongue root feature. Archangeli and Pulleyblank base their argument on lack of evidence that a language, like English, that has been argued to use [TENSE] also uses a tongue root feature. Rather, the two types of features are in complementary distribution. Based on this, they conclude [p.450] “the complementary distribution... should be explained by analyzing the relevant cases as manifestations of a single feature [namely, a tongue root feature].” I have thus included Germanic languages in the Maddieson support for Prediction 1.

\(^{36}\) The languages reported in Maddieson (1984) to have postvelar consonants, but no rtr vowels are: Farsi, Pashto, Eastern Armenian, Tigre, Socotri, Neo-Aramaic, Shilha, Tuareg, Awiya, Sui, Mandarin, Tlingit, Klamath, Wintu, Totonac, K’ekchi, Quileute, Squamish, Hopi, Achumawi, Abipon, Jaqaru, Gununa-Kena, Greenlandic, Aleut, Kurukh, Kabardian, Lak, Burushaski, and !Xu.
Returning to our constraint account, DEP-IO says there must be no segmental epenthesis. In Palestinian, a vowel or word-initial glottal stop are frequently epenthesised to satisfy syllable structure requirements. This means that the constraints forcing segmental insertion, ONS-\_wd[σ] and σNUC, dominate DEP-IO. (I omit them from tableaux as they are not directly relevant here. For an OT account of Arabic vowel epenthesis, see Davis & Zawaydeh 1997.)

The constraint interaction responsible for local pharyngealisation harmony is illustrated in (66) and (67). ('ALIGN([RTR], NUC)' abbreviates ALIGN-L([RTR], NUC) and ALIGN-R([RTR], NUC). The non-harmonising \{u:} and \{ə} are accounted for in §2.4.6.)

![Table showing constraint interactions](image)

The ranking MAX-RTR, MAX-LINK >> ALIGN-L([RTR], NUC), ALIGN-R([RTR], NUC) is shown by the fact that in each winner the postvelar-adjacent vowel surfaces bearing [RTR] (non-harmonising final vowels ignored). Were the ranking reversed, or were the four constraints equally ranked, the ALIGN([RTR], NUC) constraints could be vacuously satisfied by deletion of [RTR] and its link with the postvelar. However, the candidates 1 show that such deletion is nonoptimal. The winners’ non-underlying links, in violation of DEP-LINK but in satisfaction of ALIGN-L([RTR], NUC) or ALIGN-R([RTR], NUC),
establish the ranking $\text{ALIGN-L([RTR], NUC)}, \text{ALIGN-R([RTR], NUC)} \gg \text{DEP-LINK}$. In the losing candidate 5 in (67), an epenthetic vowel surfaces so [RTR] can left-align with a vowel. This violates DEP-IO, but satisfies the $\text{ALIGN([RTR], NUC)}$ constraints and shows that DEP-IO dominates $\text{ALIGN([RTR], NUC)}$. The candidates 4 contain a non-underlying link between [RTR] and a consonant. Because of this they incur one more violation of DEP-LINK than the respective winners. For candidate 4 in (66), the link between [RTR] and \{\} forces a violation of $\text{ALIGN-L([RTR], NUC)}$, as [RTR] is not left-aligned with a NUC. That candidate is thus ruled out by its $\text{ALIGN-L([RTR], NUC)}$ violation. Candidate 4 in (67) is ruled out by its violation of $\text{ALIGN-R([RTR], NUC)}$. There is no evidence of ranking between DEP-IO, MAX-RTR, and MAX-LINK, so I assume equal ranking for those three. Finally, since the data examined provide no evidence for a ranking between the $\text{ALIGN([RTR], NUC)}$ constraints and NUC-$\sigma$/RTR, I assume those three to be equally ranked.

(67)

<table>
<thead>
<tr>
<th>input: /ʕULʕE/</th>
<th>\text{DEP-IO}</th>
<th>\text{MAX-RTR}</th>
<th>\text{MAX-LINK}</th>
<th>\text{NUC-$\sigma$/RTR}</th>
<th>\text{ALIGN-([RTR], NUC)}</th>
<th>\text{DEP-RTR}</th>
<th>\text{DEP-LINK}</th>
</tr>
</thead>
<tbody>
<tr>
<td>&quot;Ulɑ&quot; (fem. name)</td>
<td>1. {ʕu, lɑ}</td>
<td>*!</td>
<td>*</td>
<td>*</td>
<td>*!</td>
<td>*</td>
<td>*</td>
</tr>
<tr>
<td>2. {ʕu, lɑ}</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>**!</td>
<td>*</td>
<td>*</td>
</tr>
<tr>
<td>3. {ʕu, lɑ}</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>*</td>
<td>*</td>
<td>*</td>
</tr>
<tr>
<td>4. {ʕu, lɑ}</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>**!</td>
<td>**</td>
<td>*</td>
</tr>
<tr>
<td>5. {ʕu, lɑ}</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>*!</td>
<td>*</td>
<td>**</td>
</tr>
</tbody>
</table>

2.4.3. Non-local Harmony

2.4.3.1 Analysis. In each form in (68), an initial- (a) or medial-syllable (b-c) vowel surfaces rtr, even though it is not adjacent to a postvelar. This is
nonlocal leftward (a) and rightward (b-c) harmony with the postvelar consonant in each form.

(68) a. /lBuʔEth/ \{'l. buʔ.e\} (\{'l.l. buʔ.e\}) “lioness”
b. /uInIm-AEth/ \{'u. ni.m-e\} (\{'u.l. ni.m-e\}) “goat”
c. /uIlb-AEth/ \{'u.l. l.bǝ\} (\{'u.l.l. l.bǝ\}) “bother” (N)

Non-local harmony is also seen in (69) in which the initial-syllable vowels surface rtr, though they are not adjacent to a postvelar or in a closed syllable. This is non-local pharyngealisation harmony with the closed-syllable-pharyngealised vowel in the final syllable of each form.

(69) a. /fIlm/ \{'f. l. m\} (\{'f.f. l. m\}) “movie”
b. /kUtub/ \{'k.u. t.u.b\} (\{'k.k.u. t.u.b\}) “books”
c. /tIbn/ \{'t.i. b.n\} (\{'t.t.i. b.n\}) “straw”
d. /sElk/ \{'s.e.l.k\} (\{'s.s.e.l.k\}) “boiled (masc. sg.)” (Adj)
e. /kIr/ \{'k.i.r\} (\{'k.k.i.r\}) “peel” (N)

The data in (62) and (68) - (69) that show that the triggers for Palestinian pharyngealisation harmony are postvelar consonants and closed-syllable-pharyngealised vowels. For some (laryngeal and pharyngeal gutturals), [RTR] is primary, for others (uvular gutturals, emphatics, and closed-syllable-pharyngealised vowels), it is secondary. This means that the harmony is [RTR] ‘A’ harmony, that is, harmony of [RTR] triggered by segments specified for primary- or secondary-[RTR].

The phrases below show that the harmony does not extend beyond the word. The word is thus the harmony domain.

(70) a. /hIlm # sI:d-O/ \{'h.h.l.m # 's.i.d-o\} (\{'h.h.l.m # 's.i.d-o\}) “grandpa’s dream”
b. /tEtAE # rÆ:h-Æt/ \{t.e.t.e # r.e:h-æ‘t\} (\{t.t.e.t.e # r.e:h-æ‘t\}) “grandma went”

We now address the pharyngealisation of the low short vowel, /Æ/. In each form in (71), the initial-syllable vowel is rtr, even though it is in an open syllable and not adjacent to a postvelar. (Neither form contains a postvelar.) The initial-syllable rtr vowels can be explained if we recognise them as having arisen through pharyngealisation harmony with a closed-syllable-pharyngealised /ɔ/, which is reduced /Æ/. This indicates that /Æ/ pharyngealises, too.
Pharyngealised (/Æ/ >) ⟨ə⟩ in (71) contrasts with non-pharyngealised (/Æ/ >) ⟨a⟩ in (72). Non-rtr ⟨o i u⟩ in (72) show that the word-final reduced vowels are not pharyngealised. If they were ⟨ə⟩, we would expect rtr ⟨o i u⟩ in the non-final syllables, as /O I U/ would harmonise with pharyngealised ⟨ə⟩.

The foregoing has shown that Palestinian /Æ/ has non-rtr vs. rtr surface variants: non-rtr {æ} and non-rtr {ə} (reduced counterpart of {æ}) vs. rtr {a} and rtr {ə} (reduced counterpart of {ə}). The representations of non-reduced {æ} and {a} are seen in (73). As Palestinian /Æ/ reduction is loss of [LOW] (see §2.2.2.), the representations of ⟨æ⟩ and ⟨ə⟩ are as seen in (74).

(73) Representations of Palestinian Non-rtr {æ} and Rtr {a}

a. non-rtr \{æ\}
   \[N\]
   \[μ\]
   \[SON\]
   \[o\]Place
   \[DOR\]
   \[LOW\]

b. rtr \{a\}
   \[N\]
   \[μ\]
   \[SON\]
   \[o\]Place
   \[DOR\]
   \[LOW\]
   \[TR\]

\[37\] Goad (1991, 1993) argues that [LOW] and [-ATR] are mutually exclusive, occupying the same place in the feature geometry. However, this section has shown that non-pharyngealised and pharyngealised low vowels can contrast. Assuming that [RTR] = [-ATR], this means a segment can be [LOW] but not [-ATR], or both [LOW] and [-ATR], and that [LOW] and [-ATR] are not mutually exclusive. See Leitch (1996) for further evidence countering Goad.
When Palestinian non-reduced /Æ/ is pharyngealised and uvularised, it surfaces raised, as non-low /A/, as in (76). It loses its specification for [LOW]. However, this is only so when the pharyngealisation is from a closed syllable. This is seen also in (77), in which /Æ/ is uvularised, and pharyngealised under harmony with a closed-syllable-pharyngealised vowel. Otherwise (that is, when /Æ/ occurs under primary stress in a word with an emphatic and no closed-syllable-pharyngealised vowel), /Æ/ surfaces as low, uvularised as in (78).

The form /tʃalb/, with vowel epenthesis, usually occurs non-phrase-finally. Its epenthesis variant /tʃa.lɔkb/ usually occurs phrase-finally.

Dudas (1976:36-37) remarks on a gap in the vowel inventory of Javanese, a language shown by Dudas and Schlindwein (1988) to have phonological tongue root retraction. Dudas states: “Javanese nonlow vowels each have ‘tense/lax’ surface variants (yielding [i~ɪ, e~ɛ, o~o, u~ʊ]); the two low underlying vowels have invariant ‘lax’ forms, [a] and [ɒ].” However, Javanese low vowels might have non-rtr vs. rtr variants which are just phonetically very similar.
(76) a. /mÆstr/ \{mʌsr\} “Egypt”
b. /baÆtt-Æ/ \{bʌt-ə\} “duck”
c. /sÆt-Æt-η/ \{ɔs̪-t-ət-η\} “she gave (something) to me”

(77) a. /tÆmr/ \{tʌmr\} “date(s)” (fruit)
b. /kÆmær/ \{kʌmær\} “moon”

(78) a. /sÆtÆtÆ/ \{sʌt-ə\} \{sʌt-ə\} “salad”
b. /mÆræ/ \{mʌræ\} \{mʌræ\} “woman, wife”
c. /tÆtæ/ \{tʌtæ\} \{tʌtæ\} “soft (masc. sg.)”

2.4.3.2 Acoustic Support. Figures 2:13 - 2:15 show the tokens of /I/, /E/, and /U/ in Figures 2:1 - 2:2, and 2:4 that occurred in an open syllable, and either non-adjacent to a postvelar elsewhere in the word or in a word with a closed-syllable-pharyngealised vowel (but no postvelar).

![Diagram](image-url)

Figure 2:13. F₁ - F₂ plot of tokens of Palestinian short /I/ in the context: open syllable, non-local harmony
The tokens in these new figures are rtr. That is, they match the $F_1$ and $F_2$ effects predicted for pharyngealisation articulation. This supports the assumption that they were produced with pharyngealisation. The claim that Palestinian short vowels undergo non-local pharyngealisation harmony with a postvelar or a closed-syllable-pharyngealised vowel thus has acoustic support.
Figures 2:16 and 2:17 show the tokens of /i/ and /u/ from Figures 2:1 and 2:4 which occurred in a non-local harmony context and which are themselves in a closed syllable. As expected, they are rtr.

Figure 2:16. $F_1$ - $F_2$ plot of tokens of Palestinian short /i/ in the context: closed syllable, non-local harmony

Figure 2:17. $F_1$ - $F_2$ plot of tokens of Palestinian short /u/ in the context: closed syllable, non-local harmony
We now consider short /Æ/. Tokens of stressed /Æ/ are plotted in Figures 2:18. As seen, they cluster in distinct regions of the $F_1 - F_2$ plane. IPA symbols identify clusters that are perceptually [æ] vs. [/] vs. [α]. $F_1$ of the [æ]s and [α]s is higher than for the [/]s. $F_2$ is highest for the [æ]s, lowest for the [α]s. The [æ]s and [α]s are discussed in this section. The [α]s, which occurred in words containing an emphatic, are addressed in §2.5.1.

Figure 2:18 $F_1 - F_2$ plot of tokens of Palestinian short /Æ/. Two speakers.

[æ]: $F_1$ (mean = 638 Hz; s.d. = 48 Hz); $F_2$ (mean = 1449 Hz; s.d. = 122 Hz); 34 tokens.

[α]: $F_1$ (mean = 622 Hz; s.d. = 51 Hz); $F_2$ (mean = 1192 Hz; s.d. = 22 Hz); 4 tokens.

[/]: $F_1$ (mean = 530 Hz; s.d. = 33 Hz); $F_2$ (mean = 1288 Hz; s.d. = 30 Hz); 8 tokens.

Non-stressed, that is, reduced tokens were not analysed for this study. Preliminary acoustic investigation (Shahin 1998) supports recognition of the distinct reduced allophones {æ 3 3'}. 

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40 Non-stressed, that is, reduced tokens were not analysed for this study. Preliminary acoustic investigation (Shahin 1998) supports recognition of the distinct reduced allophones {æ 3 3'}. 

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Figure 2:19 plots a subset of the tokens in Figure 2:18, namely, those that occurred in the phonological contexts: open syllable, no trigger (e.g., in /sæm/r/ ‘sæm’ (masc. name)); closed syllable, no trigger (e.g., in /ʃæm/ ‘ʃæm’ “Shem”); open syllable, adjacent guttural (e.g., initial-syllable /æ/ in /hænæ/ ‘hænæ’ “here”); and closed syllable, adjacent emphatic (e.g., initial-syllable /æ/ in /bæt-tæ/ ‘bæt-tæ’ “duck”). The first context is not a context for phonological pharyngealisation. The second and third are. The fourth is the context for closed-syllable-pharyngealisation and uvularisation from the adjacent emphatic.

In Figure 2:19, the tokens of /æ/ in the first three contexts overlap with respect to F₁ and F₂ and fall within the ellipse for [æ]. That is, they are acoustically non-distinct and are all perceptually [æ]. This documents an acoustic basis for the apparent lack of perceptual distinction between tokens of {æ} and {a}. By contrast, the tokens which occurred in the open syllable, adjacent emphatic context have a lower F₁ and lower F₂ than the others and fall within the ellipse for [A], a non-low vowel. This is support for the assumption that they were produced with a raised tongue body, which supports the phonological claim that /æ/ surfaces without specification for [LOW] when it is both closed-syllable pharyngealised and uvularised.

Figure 2:19 F₁ - F₂ plot of tokens of Palestinian short /æ/ in the contexts:
(i) open syllable, no trigger; (ii) closed syllable, no trigger;
(iii) open syllable, adjacent guttural; (iv) closed syllable, adjacent emphatic
Further pursuing the lack of acoustic distinction between tokens of */æ/ vs. */a/*, Figure 2:20 plots all tokens in Figure 2:18 that did not occur in a phonological pharyngealisation context (tokens of */æ/*) vs. all tokens that did (tokens of */a/*). (The new tokens of */a/* are those that occurred in a non-local pharyngealisation harmony context.) As seen, the non-rtr and rtr tokens overlap with respect to $F_1$ and $F_2$. No distinct $F_1$ or $F_2$ interval can be assigned to either set. The tokens of rtr */Æ/* thus do not show the $F_1$ and $F_2$ effects expected for pharyngealisation.

![Figure 2:20. $F_1$ - $F_2$ plot of tokens of Palestinian short */Æ/*: non-rtr vs. rtr (Tokens of */Æ/* > */a/* excluded.)](image)

We saw earlier that tokens of phonologically rtr */I E U/* show the expected formant effects. Why the difference for tokens of */Æ/*? A partial answer, which addresses only lack of $F_1$ effects, is sketched as follows. Articulatory data indicate that Arabic */Æ/* is produced with large mouth opening (see, e.g., Al-Ani’s 1970:27 x-ray tracing of Arabic [æ] in an isolation context). In Palestinian, tokens of this vowel might have an $F_1$ ceiling, so to speak, so that when they are pharyngealised, the raised $F_1$ from a large mouth opening$^{41}$ raised $F_1$ from tongue root retraction cannot combine to yield super-raised $F_1$. This hypothesis predicts a smaller mouth opening for tokens of Palestinian */æ/* than for tokens of */æ/*; for less $F_1$ raising due to degree of mouth opening for the former, so the net $F_1$ effect for tokens of the two vowels would be about the same.

$^{41}$ See the graphs in Fig. 3 of Stevens & House (1955:487), which predict raised $F_1$ for all vocal tract configurations with large $A/l$ (which corresponds to a large mouth opening).
The further properties of pharyngealisation harmony identified in §2.4.3 indicate the additional constraints in (79) and the ranking in (80). (The /Æ/ > \{Æ\} change will be accounted for in §2.6.)

(79) a. ALIGN([RTR], L; Wd, L)
    ∀word, ∃[RTR], the left edge of [RTR] and the left edge of the word coincide.
    (The left edge of the word is aligned with the left edge of any [RTR].)

b. ALIGN([RTR], R; Wd, R)
    ∀word, ∃[RTR], the right edge of [RTR] and the right edge of the word coincide.
    (The right edge of the word is aligned with the right edge of any [RTR].)

(80) DEP-IO, MAX-RTR, MAX-LINK >>
    NUC-C[\{RTR\}], ALIGN-L([RTR], NUC), ALIGN-R([RTR], NUC),
    ALIGN([RTR], L; Wd, L), ALIGN([RTR], R; Wd, R) >>
    DEP-RTR, DEP-LINK

ALIGN([RTR], L; Wd, L) requires that, if [RTR] is present in a word, then the left edge of some [RTR] must be aligned with the left edge of the word. ALIGN([RTR], R; Wd, R) requires the same with respect to the right edge of [RTR] and the right edge of the word. I propose these as syntagmatic Grounding constraints. They are grounded in the slow movement of the tongue root, which is due to its relative large mass. The phonological consequence of this sluggishness is that [RTR] tends to span more than one segment in the word. ALIGN([RTR], L; Wd, L) and ALIGN([RTR], R; Wd, R) are equally ranked in this language, so together they require [RTR] to span the word.42 In §2.3.3, the NUC was identified as anchor for this harmony. The phonological evidence was that /k/ does not surface as \{q\} in a closed syllable. It is not \{q\} in forms with non-local pharyngealisation harmony either, e.g., /kUtb/ \{ku.tub\} (*\{qu.tub\}\) "books". As the NUC is the Palestinian anchor for [RTR], only presence or absence of [RTR] on vowels is considered when satisfaction of the ALIGN([RTR]; Wd) constraints is evaluated.

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42 Economy would seem to dictate that the span-the-word effect be accounted for in terms of separate left- and right-alignment rather than a single constraint, something like ‘SPANWORD(F)’. Such a constraint would be a logical conjunction of the two in (79), and so formally more complex. Thanks to M. Kenstowicz for pertinent comment.
In tableaux, I abbreviate representations as in (81). Prosodic structure (and several elements of segmental structure) are omitted, as seen from the less-abbreviated representation in (82). This is clarified here in order to point out that a representation like (81) is not a gapped configuration. A gapped configuration obtains when a multiply-linked feature is linked to segments that are not formally adjacent, where formal Adjacency for linked features is defined by Archangeli & Pulleyblank (1994:35) as in (83). The configuration in (81) is not gapped because the harmonising vowels are adjacent on the NUC tier, as shown in (82).

(81) \{\text{'tr.bin}'
         \ / 
        [RTR]

(82) N N
    \ / 
   μ μ
(\{\text{'tr.bin}'
         \ / 
        [RTR]

(83) *Adjacency for Linked Features*, from Archangeli & Pulleyblank (1994:35)

α is structurally adjacent to β iff both α and β are associated to the same anchor tier and no anchor intervenes on that tier between the anchors to which α and β are associated.

Tableaux (84) - (86) show how non-local harmony arises. (I-O FAITH abbreviates DEP-IO, MAX-RTR, and MAX-LINK. ALIGN-RTR-Wd abbreviates ALIGN([RTR], L; Wd, L) and ALIGN([RTR], R; Wd, R). All candidates in (86) violate I-O FAITH (DEP-IO), forced by dominant σNUC. Finally, the winners in (84) and (85) satisfy ALIGN([RTR], R; Wd, R) as fully as possible. Full satisfaction would entail link between [RTR] and the stem-final vowels, ruled out for reasons to be discussed later.)

The ranking MAX-RTR, MAX-LINK >> ALIGN([RTR], L; Wd, L), ALIGN([RTR], R; Wd, R) is established by the winners, in which the postvelar is linked to [RTR]. Under any other ranking, the ALIGN([RTR]; Wd) constraints could be vacuously satisfied by deletion of [RTR] and its underlying link. Each winner has a non-underlying link between [RTR] and a vowel not in a closed syllable or adjacent to a postvelar. The context of those \{t\}'s shows that their links with [RTR] are imposed solely by ALIGN([RTR], L; Wd, L) (for (84) and
Because of that link, each winner best satisfies the ALIGN([RTR]; Wd) constraints but incurs additional violation of DEP-LINK. Hence, ALIGN([RTR], L; Wd, L), ALIGN([RTR], R; Wd, R) >> DEP-LINK.\textsuperscript{43} Finally, I simply assume equal ranking for NUC-C]\textsubscript{RTR}, ALIGN([RTR], NUC) and the ALIGN([RTR]; Wd) constraints.

\textsuperscript{43} Notice that a link between [RTR] and a postvelar-adjacent vowel is required by both the ALIGN([RTR], NUC) and the ALIGN([RTR]; Wd) constraints (with adjacency irrelevant for the latter). Without evidence for both types of constraints, ALIGN([RTR]; Wd) alone could account for the new [RTR] specifications from the harmony. Distinct ALIGN([RTR], NUC) and ALIGN([RTR]; Wd) constraints implies two distinct contexts for pharyngealisation harmony: adjacency to a postvelar vs. presence of postvelar consonant or pharyngealised vowel in the word. I defer the evidence for these distinct contexts till §2.6 because explanation of it.
2.4.5 Opaque Stem-final Vowels and Long Vowels

2.4.5.1 Analysis. Both stem-final and long vowels are opaque to the harmony. That is, they do not pharyngealise and they block the progression of the harmony in the word. Consider first stem-final vowels. In (87) each form contains a word-final short vowel in a pharyngealisation context: adjacent to an underlying postvelar (a-b), non-adjacent to an underlying postvelar (c-e), or in a word with closed-syllable-pharyngealised vowel (c-d, f). As seen, the word-final vowels do not pharyngealise.

relies on the further illumination of Palestinian postvelar harmony in the remainder of §2.4 and in §2.5.
The data in (88) show that vowels at an internal right stem edge do not pharyngealise either. This is so whether the vowel is in a closed syllable (a), or whether the word contains an underlying postvelar (b-d) or a closed-syllable-
pharyngealised vowel (a-c). (Right stem edges in the surface forms are marked by an immediately following ‘|’. In (a), /kk/ degeminates and stem-internal /l/ elides.)

(88) a. /b-sÆkkIf-U-l-nÆf/ {bi-.sæk.f | -u | -l | -næ: | -f} “they (masc.)
   (*{bi-.sæk.f | -u | -l | -næ: | -f}) don’t clap for us”
   b. /wltl-Æt/ {wltl. | -æ | -t} (*{wltl. | -æ | -t}) “lowered (fem. sg.)” (Adj)
   c. /t-tÆǐmI-nÆf/ {titi-.tǐmI- | -ne: | -f} “(2 masc. sg.)
   (*{titi-.tǐmI- | -ne: | -f}) don’t feed us!”
   d. /fÆrU-l/ {fa.ru. | -i} (*{fa.ru. | -i}) “my fur”

Sensitivity to word-internal morphological structure confirms the phonological status of Palestinian pharyngealisation harmony.

The role of the right stem edge is further indicated by (89). In (a) the short vowel in the closed syllable pharyngealises as expected. In (b) the same vowel in an identical closed syllable does not pharyngealise because it sits at a right stem edge. (As both underlying and epenthetic vowels pharyngealise (see, e.g., (69)), non-harmony of /i/ in (b) cannot be due to underlying status.)

(89) a. /rÆml-nÆf/ {rAmI. | -ne} “our dirt”
   b. /b-ir-mI-nÆf/ {b-ir.mi | -l | -næ: | -f} “he’s not throwing
   (*{b-ir.mi | -l | -næ: | -f}) (something) for us”

Incompatibility between the right stem edge and rtr vowels is not unique to this language. North American English disallows rtr vowels in stem-final position (e.g., {st.ti} (*{st.ti}) “city”, {s.ti | -z} (*{s.ti | -z}) “cities”, {hep.pl-nes} (*{hep.pl-nes}) “happiness”) (Halle and Mohanan 1985:59-62); Javanese rtr /i e u/ cannot appear word-finally (Dudas 1976:36).

Next, long vowels in pharyngealisation contexts are seen in (90). They occur in a closed-syllable (a-e), adjacent to an underlying postvelar (d, f), or non-adjacent to an underlying postvelar (e). As seen, long vowels do not pharyngealise.

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44 Thanks to Bert Vaux for suggesting this point.
In (49), the forms /dU:d-/ /ˈdʊːd-/ "worm" and /si:d-O/ /ˈsɪd-/ "grandpa" illustrated how non-rtr short vowels occur in an open syllable in a word with no postvelar. We reconsider those forms now, since they contain underlyingly long vowels (cf. /dU:d/ /ˈdʊːd/ "worms" and /si:d/ /ˈsɪd/ "grandfather"). It could be that the lack of tongue root retraction for their initial-syllable vowels is due somehow to the underlying length. However, shortened vowels do pharyngealise in a pharyngealisation context, as seen in (91).

The non-rtr initial-syllable /i/ in each form in (92) is evidence that the long vowel in each form is not pharyngealised, that is, that the long vowels in (a-b) are non-rtr /æ/, not rtr /ə/; and that the long vowels in (c-d) are non-rtr /e/, not rtr /a/. If they were rtr, we would expect rtr /i/ instead of non-rtr /i/ in each form, as /I/ would harmonise with a pharyngealised long vowel. I conclude that the Palestinian long low back vowel is non-rtr and so transcribe...
it as /eː/ not /aː/. This conclusion is supported by comparison of the forms just given with (71), repeated as (93), below:

(93) a. /bEl:Ed/  /bɛ.lɛd/  (*/be.lɛd/)  “land, country”
    b. /EbÆn/  /lɛ.bɛn/  (*/le.bɛn/)  “yoghurt”

The only relevant difference between (92) and (93) is the length of the low vowel. This indicates that lack of harmony in (92) is due to that length. The language thus has no long pharyngealised vowels.

Pertinent discussion at this point concerns the possible guttural status of Palestinian low vowels. Herzallah (1990) claims they are gutturals, but there are strong grounds for believing they are not. Herzallah (1990:63-66) bases her claim on sagittal sections of Delattre (1971), which she describes as showing that low “a” in several languages is produced with pharyngeal constriction, also on Perkell’s (1971) report of pharyngeal constriction for low vowels, and on the fact that Sibawayh, a medieval Arab grammarian, classified the Arabic long low vowel with the guttural consonants. However, Delattre’s data from non-Arabic low vowel tokens do not settle the issue at hand, nor do findings of Perkell, which are based on non-Arabic data, since only articulatory data from tokens of Arabic low vowels can reveal the articulatory nature of Arabic low vowels. As for Delattre’s data from Arabic low vowel tokens, they are from the context immediately following a guttural or an emphatic. There is evidence that Palestinian /ÆÆ:/ are phonologically not gutturals, as follows. The gutturals are underlyingly pharyngealised that is, underlyingly [RTR], and trigger pharyngealisation harmony. If /ÆÆ:/ were gutturals, they would be underlyingly pharyngealised and would also trigger

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46 Delattre’s sagittal sections [p.130] are of the vowel immediately following each of /s/, /h/, /w/, /x/, and /ɣ/.
the harmony. However, in (92), long /Æ:/ does not induce harmony on the initial-syllable short vowels. Forms like those in (49a,c), repeated as (94), indicate that short /Æ/ does not either. (The present corpus contains no relevant forms involving /Æ/ under primary stress.)

(94) a. /OblÆ/ \{lo.bi.æ\} (a type of small pea)
   b. /EtÆ/ \{te.te\} “grandma”

Perhaps Palestinian /Æ/ is underlyingly [RTR] but does not surface so specified in (94) because it is in stem-final position. This would predict non-rtr vowels in the initial syllables. However, we have seen that underlying [RTR] specifications persist into the surface form; underlying postvelars surface with their underlying [RTR] specification. Deletion of a hypothesised underlying link between [RTR] and /Æ/ would thus be unexpected. Furthermore, in (95), /Æ/ is not stem-final. As seen, the initial syllable vowel is non-rtr, not rtr as expected if /Æ/ were a guttural.

(95) /bOmÆII/ \{bo.ma.li\} (*\{bo.ma.li\}) “pomelo”

The behaviour of stem-final and long vowels is shown more fully by data like those in (96). In each form, a stem-final (a) or long (b-c) vowel intervenes between the initial-syllable vowel and a trigger for non-local pharyngealisation harmony. The trigger in (a) is the closed-syllable-pharyngealised \{t\}; in (b-c), it is the word-final \{f\}. As seen, the initial-syllable vowels are non-rtr. This shows that stem-final and long vowels block pharyngealisation harmony. (In the grammatical surface form in (a), an arrow points out the blocking stem-final vowel. In the same form, /Æ/ raises immediately preceding the /(t)/ feminine marker.)

(96) a. /sUr I-Æ(t)-nÆ/ \{su.ri'-\{it, -ne\}\} \{\{su.ri, -\{it, -ne\}\}\} “our Syria”
   b. /dInÆ:rf/ \{di.ne:rf\} \{\{di.ne:rf\}\} “dinar”
   c. /kInÆ:rf/ \{ki.ne:rf\} \{\{ki.ne:rf\}\} “canary”

2.4.5.2 Acoustic Support. Figures 2:21 - 2:24 plot tokens of Palestinian short /I E O U/ in Figures 2:1 - 2:4 that occurred in stem-final position. Most occurred in a pharyngealisation harmony context, that is, adjacent to an underlying postvelar, in a closed syllable, non-adjacent to an underlying postvelar, or in a word with a closed-syllable pharyngealised vowel. As seen, the stem-final tokens of /I E O U/ are non-rtr. They do not show the F₁ and F₂ effects
predicted for pharyngealisation articulation. This supports the assumption that they were not pharyngealised. With respect to those several tokens in Figures 2:21 - 2:24 that occurred in a pharyngealisation harmony context, this supports the phonological claim that Palestinian stem-final vowels do not undergo pharyngealisation harmony.\footnote{In Figure 2:21, two tokens of /ɪ/ lie outside the non-rtr region for the entire [ɪ] sample. They are tokens of stem-final /ɪ/ in the following words: "2 fem. sg. don’t cut us!". However, these outliers are within the F\textsubscript{1} region for [ɪ], seen from the [ɪ] ellipse. Based on mean F\textsubscript{2} for [ɪ] reported in the caption of Figure 2:1, F\textsubscript{2} of the outlying [ɪ]s is lowered by about 400 Hz. This is presumably because for the first part of their duration they were produced with uvularisation coarticulation with the adjacent emphatic /ʃ/. However, F\textsubscript{2} of the outliers was measured at durational midpoint and does not reflect the higher F\textsubscript{2} attained by offset. See §2.5.5 for related discussion.}

\begin{figure}[h]
\centering
\includegraphics[width=0.5\textwidth]{figure221.png}
\caption{\(F_{1} - F_{2}\) plot of stem-final tokens of Palestinian short /ɪ/ (Abu Shusha and Jafa data)}
\end{figure}
Figure 2:22. $F_1 - F_2$ plot of stem-final tokens of Palestinian short /E/ (Abu Shusha data)

Figure 2:23. $F_1 - F_2$ plot of stem-final tokens of Palestinian short /O/ (Abu Shusha data)
The acoustic support for lack of pharyngealisation articulation for tokens of stem-final /E O/ does not extend to the Jafa data. The relevant Jafa tokens are plotted in Figures 2:25 - 2:26. The ellipses in Figure 2:25 are those for the non-rtr vs. rtr tokens of /E/ in Figure 2:2; the ellipse in Figure 2:26 is that for the non-rtr tokens of /O/ in Figure 2:3. The non-rtr ellipses mark the $F_1$ - $F_2$ regions expected for non-rtr tokens of these vowels, based on the current sample.

**Figure 2:24. $F_1 - F_2$ plot of stem-final tokens of Palestinian short /U/ (Abu Shusha and Jafa data)**

**Figure 2:25. $F_1 - F_2$ plot of stem-final tokens of Jafa Palestinian short /E/.**
One speaker.

$F_1$ (mean = 424 Hz; s.d. = 21 Hz); $F_2$ (mean = 1697 Hz; s.d. = 90 Hz); 10 tokens.
As seen, several tokens of Jafa stem-final /E/ and /O/ lie outside the region of Palestinian non-rtr [e] and [o], respectively. They have higher $F_1$ and lower $F_2$ than the tokens of the non-rtr allophones per vowel and are perceptually similar to [e] and [o], respectively. They contrast with the corresponding Abu Shusha tokens: Figures 2:22 - 2:23 show that the latter lie within the region of the non-rtr allophones and are [e] and [o], respectively.

We now turn to long vowels. Tokens of long /I: E: æ: O: U:/ are plotted in Figures 2:27 - 2:31. For /æ:/, only the tokens which are [æ:] are presented. (See §2.5.1 for tokens of /æ:/ $>$ [e:].) Each figure plots tokens which did not occur in a phonological pharyngealisation context vs. those that did.

As indicated by the single IPA symbol and single ellipse in each graph, the tokens in both contexts are perceptually the same, per vowel. As seen, for each vowel, the tokens in both contexts overlap with respect to $F_1$ and $F_2$. That is, for each vowel, no distinct lower or higher $F_1$ or $F_2$ interval can be assigned the tokens in either context.\footnote{Several pharyngealisation context tokens of /O:/ in Figure 2:30 have an $F_1$ rise and $F_2$ drop, compared to $F_1$ and $F_2$ of the non-pharyngealisation context /O:/ tokens. However, some of the former fall within the same $F_1$ or $F_2$ interval as the latter, so no distinct observation for /O:/ is made.}
Figure 2:27. $F_1 - F_2$ plot of tokens of Palestinian /I:/ in the contexts: non-pharyngealisation; pharyngealisation. Two speakers. [iː]: $F_1$ (mean = 263 Hz; s.d. = 21 Hz); $F_2$ (mean = 2148 Hz; s.d. = 119 Hz); 71 tokens.

Figure 2:28. $F_1 - F_2$ plot of tokens of Palestinian /E:/ in the contexts: non-pharyngealisation; pharyngealisation. Two speakers. [eː]: $F_1$ (mean = 353 Hz; s.d. = 18 Hz); $F_2$ (mean = 1838 Hz; s.d. = 135 Hz); 67 tokens.
Figure 2:29. $F_1 - F_2$ plot of tokens of Palestinian /æ:/ > /æː/ in the contexts: non-pharyngealisation; pharyngealisation. Two speakers. 
[æː]: $F_1$ (mean = 629 Hz; s.d. = 44 Hz); $F_2$ (mean = 1487 Hz; s.d. = 125 Hz); 44 tokens.

Figure 2:30. $F_1 - F_2$ plot of tokens of Palestinian /oː/ in the contexts: non-pharyngealisation; pharyngealisation. Two speakers. 
[oː]: $F_1$ (mean = 386 Hz; s.d. = 33 Hz); $F_2$ (mean = 1100 Hz; s.d. = 97 Hz); 30 tokens.
The finding of F₁ and F₂ overlap indicates no F₁ and F₂ effects for the long vowel tokens in a pharyngealisation context. This supports the assumption that, like the non-pharyngealisation context tokens, they were not produced with pharyngealisation. This supports our phonological claim that Palestinian long vowels do not pharyngealise.

2.4.6 Theoretical Account: Part III

The opacity discussed in §2.4.5 indicates the constraints in (97) and the ranking in (98). This entails adjustment of the ranking in §2.4.4.

(97) a. NUC]stem/*RTR
A NUC at a right stem edge is not specified for [RTR].

b. NUCµµ/*RTR
A bimoraic NUC is not specified for [RTR].

(98) DEP-IO, MAX-RTR, MAX-LINK, NUC]stem/*RTR, NUCµµ/*RTR >>
NUC-CJ /RTR ALIGN-L([RTR], NUC), ALIGN-R([RTR], NUC),
DEP-RTR >>
ALIGN([RTR], L; Wd, L), ALIGN([RTR], R; Wd, R) >>
DEP-LINK
NUC]$_{\text{stem}}$/*RTR is a morphophonological constraint requiring that [RTR] not be linked to a stem-final vowel. It is part of the NON-FINALITY family of constraints (Prince & Smolensky 1993) which require that a specified phonological element not occur at a right ('final') edge of some morphological category. (See Prince & Smolensky's 1993:40,43 account of Hindi and Latin stress assignment.) NUCµµ/*RTR is a syntagmatic Grounding constraint grounded in the properties of phonetic undershoot. Lindblom (1963:1779) found that degree of vowel undershoot in a closed syllable is inversely correlated with vowel length. (The longer the vowel, the less the undershoot and vice versa.) Our data indicate that the closed syllable context and vowel length are separate factors influencing degree of undershoot. NUC-C]$_{\text{short}}$/RTR phonologises the factor of the closed syllable context, NUCµµ/*RTR that of vowel length. Lack of pharyngealisation for long vowels is syntagmatically grounded in a lack of phonetic undershoot over the longer duration of a bimoraic vowel. Correlation between length and non-rtr (or atr) vowels is not unique to Palestinian. It is observed also in Menomini (Archangeli & Suzuki 1997) and English (Halle & Mohanan 1985).

The constraint interaction is illustrated in (99) - (104). (All candidates in (99) violate IO-FAITH (DEP-IO) because of the epenthetic consonant. An epenthetic vowel forces parallel violations in (100). In (103) all candidates violate IO-FAITH (MAX-RTR, MAX-LINK) because [RTR] is delinked from /r/, resulting in /r/ de-emphaticisation.)

The winners in (100) - (102) and (104) have a final or long vowel that does not pharyngealise even though it is in a closed syllable or adjacent to an underlying postvelar (issues surrounding lack of triggering by de-emphaticised /r/ ignored). This shows that NUC]$_{\text{stem}}$/*RTR and NUCµµ/*RTR dominate NUC-C]$_{\text{short}}$/RTR, ALIGN-L([RTR], NUC), and ALIGN-R([RTR],NUC). The winners in

---

49 Archangeli & Suzuki show that only long vowels can surface atr in Menomini, which they account for as effect of ATR/µµ ('If [+ATR], then bimoraic'). Halle & Mohanan discuss the correlation between length and tenseness in English.
<table>
<thead>
<tr>
<th></th>
<th>I-O FAITH</th>
<th>NUC-$\nu$ / *RTR</th>
<th>NUC-$\mu$ / *RTR</th>
<th>ALIGN ([RTR], NUC)</th>
<th>DEP-RTR</th>
<th>ALIGN-RTR-Wd</th>
<th>DEP-LINK</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. {'?i\u0259,l\u026a}</td>
<td><strong>!</strong></td>
<td></td>
<td></td>
<td></td>
<td>*</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2. {'?i\u0259,l\u026a}</td>
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<td></td>
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<td>*</td>
<td>**</td>
<td>**</td>
</tr>
<tr>
<td>3. {'?i\u0259,l\u026a}</td>
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<td>*</td>
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<td>*</td>
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<td>4. {'?i\u0259,l\u026a}</td>
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<td>*</td>
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<td>**</td>
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<tr>
<td>5. {'?i\u0259,l\u026a}</td>
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<td></td>
<td>*</td>
<td></td>
<td>**</td>
</tr>
<tr>
<td>6. {'?i\u0259,l\u026a}</td>
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<td></td>
<td></td>
<td>*</td>
<td></td>
<td>**</td>
</tr>
</tbody>
</table>

Input: /lul/  
"to boil"
<table>
<thead>
<tr>
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<th>I-O FAITH</th>
<th>NUC_J_\text{J}_{\text{J}_1}/\text{RTR}</th>
<th>NUC_J_\text{J}_{\text{J}_2}/\text{RTR}</th>
<th>NUC_J_\text{J}_{\text{J}_3}/\text{RTR}</th>
<th>ALIGN (\text{RTR}, \text{NUC})</th>
<th>DEP-\text{RTR}</th>
<th>ALIGN-\text{RTR-Wd}</th>
<th>DEP-LINK</th>
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<td>*</td>
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<td>*</td>
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<tr>
<td></td>
<td>[RTR]</td>
<td>*</td>
<td>**</td>
<td>*</td>
<td>***</td>
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<td></td>
<td></td>
</tr>
<tr>
<td>3</td>
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<td>*</td>
<td>**</td>
<td>*</td>
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<td></td>
</tr>
<tr>
<td></td>
<td>[RTR]</td>
<td>*</td>
<td>**</td>
<td>*</td>
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<td></td>
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<td>[RTR]</td>
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<tr>
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<td>*</td>
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<td>*</td>
<td>*</td>
<td>***</td>
<td></td>
</tr>
<tr>
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<td>I-O</td>
<td>NUC</td>
<td>NUC*</td>
<td>NUC-</td>
<td>ALIGN</td>
<td>DEP-</td>
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<td></td>
<td></td>
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<td>Clam</td>
<td>*RTR</td>
<td>Clam</td>
<td>((RTR),</td>
<td>RTR</td>
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<td>*</td>
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<td>!</td>
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<td></td>
<td>[RTR]</td>
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</tr>
<tr>
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<td></td>
<td></td>
<td>!</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>[RTR]</td>
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<td>Dep-link</td>
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<td>Align- (RTR)</td>
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<table>
<thead>
<tr>
<th>NUC/Clu-*RTR</th>
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<table>
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</thead>
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</tbody>
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<table>
<thead>
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</thead>
<tbody>
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<td>1. {sil:ma:n}</td>
</tr>
<tr>
<td>2. {sil:ma:n}</td>
</tr>
<tr>
<td>3. {sil:ma:n}</td>
</tr>
<tr>
<td>4. {sil:ma:n}</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>*[RTR]</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
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</table>

<table>
<thead>
<tr>
<th>*[RTR]</th>
</tr>
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<tbody>
<tr>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>*[RTR]</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
</tr>
<tr>
<td>input: /SuR{I-A(t)-nAE/</td>
</tr>
<tr>
<td>[RTR]</td>
</tr>
<tr>
<td>&quot;our Syria&quot;</td>
</tr>
<tr>
<td>I-O FAITH</td>
</tr>
<tr>
<td>---</td>
</tr>
<tr>
<td>1. {suRi. -\R{t.} -\R{no} }</td>
</tr>
<tr>
<td>2. {suRi. -\R{t.} -\R{no} }</td>
</tr>
<tr>
<td>3. {suRi. -\R{t.} -\R{no} }</td>
</tr>
<tr>
<td>4. {suRi. -\R{t.} -\R{no} }</td>
</tr>
<tr>
<td>5. {suRi. -\R{t.} -\R{no} }</td>
</tr>
<tr>
<td>6. {suRi. -\R{t.} -\R{no} }</td>
</tr>
<tr>
<td>Input: (/d\text{ln}\text{\AE}:r/)</td>
</tr>
<tr>
<td>----------------</td>
</tr>
<tr>
<td>(\text{^{e}r}) 1. (\text{^{e}d\text{\i}n\text{\AE}}:r) (\text{[RTR]})</td>
</tr>
<tr>
<td>2. (\text{^{e}d\text{\i}n\text{\AE}}:r) (\text{[RTR]})</td>
</tr>
<tr>
<td>3. (\text{^{e}d\text{\i}n\text{\AE}}:r) (\text{[RTR]})</td>
</tr>
<tr>
<td>4. (\text{^{e}d\text{\i}n\text{\AE}}:r) (\text{[RTR]})</td>
</tr>
<tr>
<td>5. (\text{^{e}d\text{\i}n\text{\AE}}:r) (\text{[RTR]})</td>
</tr>
</tbody>
</table>

\(\text{POSTV} \text{EL} \text{HARMONY IN ARABIC}\)
(99) - (100) and (103) contain a long or stem-final vowel that does not harmonise even though it is in a context for non-local harmony. Hence, \[\text{NUC}_{\text{stem}}/*\text{RTR}, \text{NUC}_{\text{root}}/*\text{RTR} \gg \text{ALIGN}([\text{RTR}], \text{L}; \text{Wd}, \text{L}), \text{ALIGN}([\text{RTR}], \text{R}; \text{Wd}, \text{R})\]. The blocking effect of stem-final and long vowels is seen in the winning candidates in (103) - (104) in which the losing candidates 5 contain an additional [RTR] so the initial-syllable vowel can link to [RTR] in better satisfaction of \[\text{ALIGN}([\text{RTR}], \text{L}; \text{Wd}, \text{L})\].

For candidate 5 in (104), for example, the additional [RTR] avoids the gapped configuration in (105).

The configuration in (105) is gapped because [RTR] is linked to \{t\} and \{I\}, but not the anchor, \{ε\}, between them. The gapped configuration disobeys Locality (Archangeli & Pulleyblank 1994:26), Precedence in particular, which is defined as in (106).

\[
(105) \quad \begin{array}{c}
| \quad \text{\textbackslash} / \text{\textbackslash} \\
\mu \quad \mu \mu \\
\{ \text{\textbackslash} / \text{\textbackslash} \\
\{ \text{\textbackslash} / \text{\textbackslash} \\
\text{[RTR]} \\
\end{array}
\]

(106) **Precedence Principle** (Archangeli & Pulleyblank 1994:38)

Precedence relations cannot be contradictory.

Example (107) clarifies how (105) disobeys Precedence. The problem is with \text{NUC}_{\text{root}}/ \epsilon_\text{root} \}, \{ε\}. As seen, it precedes [RTR], since it precedes rootε which is specified for [RTR]. However, it also follows [RTR], since it follows [RTR]-specified NUCε/ \epsilon_\text{root}. Its precedence relations are thus contradictory and so the representation is illformed.

\[
(107) \quad \begin{array}{c}
\{ \text{d}_\alpha \ R \beta \ \text{R}_\gamma \ \text{R}_\delta \ \text{R}_\epsilon \} \\
\end{array}
\]

\[\text{Our data happen not to involve rightward blocking so doomed insertion of [RTR] for satisfaction of } \text{ALIGN}([\text{RTR}], \text{R}; \text{Wd}, \text{R}) \text{ is not illustrated here.}\]
In (103) and (104), the additional [RTR] of the losing candidates 5 means those candidates have additional violation of DEP-RTR. The respective winners lack that additional violation, but incur more violations of ALIGN([RTR], L; Wd, L) than the losing candidates 5. This establishes DEP-RTR >> ALIGN([RTR], L; Wd, L). I assume a larger dataset would establish DEP-RTR >> ALIGN([RTR], R; Wd, R) and so assume equal ranking for the word alignment constraints. This account of opacity adopts the approach of Pulleyblank (1997b) for Yoruba. Finally, equal ranking for NUC\_Stm/*RTR, NUC\_µµ/*RTR, DEP-IO, MAX-RTR, and MAX-LINK is simply assumed.

2.5. **Palestinian Uvularisation Harmony**

Palestinian uvularisation harmony has been examined, under the label 'emphasis spread', by Card (1983), Davis (1993, 1995), Herzallah (1990) and Younes (1982, 1993, 1994). This section explains its properties in the dialect of this work and proposes the constraint interaction responsible for it. (See §2.5.7 on other dialects.)

2.5.1 **Harmony with an Emphatic**

2.5.1.1 **Analysis.** Example (108) shows words containing an emphatic.

\[(108) a. \text{ /tAEzAE/} \quad \{\text{	extipa{tə.zə}}\} \quad \text{“fresh (masc./fem. sg./pl.)”} \]
\[b. \text{ /sAEhAE/} \quad \{\text{	extipa{s\textipa{fə}}}\} \quad \text{“health”} \]
\[c. \text{ /twAEl/} \quad \{\text{	extipa{twə.l}}\} \quad \text{“tall (masc. pl.)”} \]
\[d. \text{ /b-\textipa{qAE}l-nAE-\textipa{g} /} \quad \{\text{	extipa{b-\textipa{qə}.\textipa{tə}.\textipa{nə}.\textipa{g}}\} \quad \text{“he doesn’t give (something) to us”} \]
\[e. \text{ /bAEiAE:t/} \quad \{\text{	extipa{bə}.\textipa{le}.\textipa{t}}\} \quad \text{“tiles”} \]
\[f. \text{ /mAErAE/} \quad \{\text{	extipa{mə}.\textipa{re}}\} \quad \text{“woman, wife”} \]
\[g. \text{ /tAEwl-\textipa{E}l-\textipa{t/}} \quad \{\text{	extipa{təwə}.\textipa{l-\textipa{e}.\textipa{t}}\} \quad \text{“tables”} \]
\[h. \text{ /qAEjAE:t/} \quad \{\text{	extipa{qai}.\textipa{je}.\textipa{t}}\} \quad \text{“crying” (N)} \]
\[i. \text{ /sjAE:m/} \quad \{\text{	extipa{sje}.\textipa{m}}\} \quad \text{“fasting” (N)} \]
\[j. \text{ /tAEjAEh/} \quad \{\text{	extipa{raj}.\textipa{je}.\textipa{h}}\} \quad \text{“he rested”} \]
\[k. \text{ /tAEjAEb-\textipa{AE}l-nI/} \quad \{\text{	extipa{taj}.\textipa{je}.\textipa{b-\textipa{l}.\textipa{nI}}\} \quad \text{“she made me become well”} \]

These forms show that when a word contains an emphatic, long /AE:/ surfaces as backed {ε}, non-reduced short /AE/ surfaces as back {α}, reduced short /AE/ surfaces as backed {ɔ}, and underlingly non-emphatic consonants

---

51 The backed long low vowel as non-rtr {ε}, not rtr {α}, was discussed in §2.4.5.
surface emphatic. However, if the word contains a short vowel in a closed syllable, short primary-stressed /Æ/ surfaces as raised /ʌ/, as seen in (108b, k). The effects in (108) show uvularisation harmony triggered by the underlying emphatics. The consonants /ʃ tf dg/ are opaque to the harmony (see §2.5.3). Non-low vowels are transparent (see §2.5.5).

Example (109) shows that the harmony does not occur in forms without an emphatic. The triggering class excludes primary uvulars (uvular guttural /ʁ/), as seen from (109c, e-f).

(109)

a. /wːEhːEd-Æ:n-i/   \{wːh.əd-ːÆ:n-i\}   \{wːh.əd-ːÆ:n-i\}   "lone, single
\{wːh.əd-ːÆ:n-i\}   "(masc. sg.)"

b. /jÆnI/   \{jænI\}   \{jænI\}   "it means"

c. /uÆz/   \{uæz\}   \{uæz\}   "gas"

d. /hÆdI/   \{hædI\}   \{hædI\}   "that (fem.)"

e. /χÆl-t-O/   \{χæl-t-O\}   \{χæl-t-O\}   "maternal auntie"

f. /b-ʔÆχIr-nÆ\f/   \{b-ʔæχIr-nÆ\f/   \{b-ʔæχIr-nÆ\f/   "he doesn’t
\{b-ʔæχIr-nÆ\f/   \{b-ʔæχIr-nÆ\f/   "cause us to be
\{b-ʔæχIr-nÆ\f/   \{b-ʔæχIr-nÆ\f/   "late"

The phrases below show that the word is the harmony domain. The same domain is shown for other Palestinian dialects by Card (1983:60) and Younes (1982:130-137; 1993:126), and for Tunisian Arabic by Ghazeli (1977:100).

(110) a. /fÆs # tÆwI[:]/   \{fæːs # tæu.ˈwiː\}   \{fæːs # tæu.ˈwiː\}   "a long hoe"

b. /dÆr # ÆmnÆ/   \{dæːɾ # ʔæm.ˈne\}   \{dæːɾ # ʔæm.ˈne\}   "Amna’s house"

2.5.1.2 Acoustic Support. The data on short /Æ/ presented earlier in Figure 2:18 are presented again in Figure 2:32, replotted according to the contexts relevant to Palestinian uvularisation harmony: (i) with no emphatic in the word; (ii) with an emphatic in the word, with post-alveolar obstruent intervening between the vowel and an emphatic; (iii) in an open syllable with an emphatic in the word; (iv) in a closed syllable with an emphatic in the word. In the caption, these are referred to as ‘no emphatic’, ‘blocked’, ‘emphatic + open syllable’, and ‘emphatic + closed syllable’, respectively. This section examines the tokens in (i), (iii), and (iv). (The tokens in context (ii) are examined in §2.5.3.)
In Figure 2:32, IPA symbols identify clusters of tokens that are /æ/, [a], or [ʌ]. (See §2.4.3 on both /æ/ and /a/ as [æ].) As seen, the tokens in context (i) cluster together in a region characterised by higher $F_2$, and are /æ/. Those in (ii) cluster in a distinct region with lower $F_2$, and are [a]. The tokens in (iv) cluster in a third distinct region with lower $F_1$ and intermediate $F_2$, and are [ʌ].

The $F_1$ and $F_2$ effects predicted for a segment with uvularisation articulation are medium or large $F_1$ rise and large $F_2$ drop (see Table 1:11). In Figure 2:18, the tokens in context (iii) do not have raised $F_1$. This might be due to some phonetic factor mitigating against $F_1$ rise for tokens of /Æ/ in general, suggested by lack of $F_1$ rise found also of tokens of rtr /a/ (see Figure 2:20). However, the context (iii) tokens show the expected drop in $F_2$. Based on the $F_2$ means reported with Figure 2:18, $F_2$ is lowered by about 250 Hz, a medium drop. Thus, with respect to $F_2$, the data in Figure 2:32 do not exactly match the expectations for the low vowel in context (iii), but are roughly consistent with them. This provides some support for the assumption that those tokens were produced with a uvularisation articulation that the tokens in context (i) lacked. That supports the phonological claim that /Æ/ uvularises in an open syllable in a word containing an emphatic. In the figure, the context (iv) tokens have a small $F_2$ drop, based on the $F_2$ means of Figure 2:18. While not as large as expected, this lends support to the assumption that they were produced with uvularisation too. This supports the phonological claim that /Æ/ uvularises in a closed syllable in a word containing an emphatic.

---

**Figure 2:32.** $F_1$ - $F_2$ plot of tokens of Palestinian short /Æ/ in the contexts:
(i) no emphatic; (ii) blocked;
(iii) emphatic + open syllable; (iv) emphatic + closed syllable
Figure 2:33 replots the long vowel data of Figure 2:29 and also includes tokens of /Æ:/ back /e:/ back. The tokens are plotted according to the same four contexts in Figure 2:32. Those in contexts (i), (iii), and (iv) are discussed below. (See §2.5.3 on those in context (ii).) IPA symbols identify [æː]s and [eː]s. As seen, the tokens in context (i) cluster together in a region characterised by higher $F_2$, and are [æː]. Those in contexts (iii) and (iv) are in a distinct region with lower $F_2$, and are [eː].

Based on the $F_1$ means of Figures 2:29 and 2:33, the /Æ:/ tokens do not have an $F_1$ rise. This is consistent with the lack of $F_1$ rise observed for the rtr /a/ and uvularised /a/. However, based on the $F_2$ means of the same two figures, $F_2$ of the tokens in contexts (iii) and (iv) is lowered by 400 Hz, a large drop. This is as expected for uvularisation. The data thus support the assumption that those tokens were produced with a uvularisation articulation lacked by those in context (i). This is support for the claim that long /Æ:/ uvularises in a word containing an emphatic.\footnote{That no distinct intermediate $F_1$ - $F_2$ regions distinguish the open vs. closed syllable tokens of uvularised /Æ:/ supports the observation that, unlike short /Æ/, uvularised long /Æ:/ does not raise in a closed syllable.}

\begin{figure}[h]
\centering
\includegraphics[width=\textwidth]{figure2.33}
\caption{Figure 2:33. $F_1$ - $F_2$ plot of tokens of Palestinian /Æ:/ in the contexts: (i) no emphatic; (ii) blocked; (iii) emphatic + open syllable; (iv) emphatic + closed syllable. Two speakers. [eː]: $F_1$ (mean = 630 Hz; s.d. = 60 Hz); $F_2$ (mean = 1070 Hz; s.d. = 48 Hz); 12 tokens.}
\end{figure}

Four tokens of /e:/ in Figure 2:33 occurred in a word containing the uvular guttural /u/. Their lack of $F_2$ drop, and realisation as front [æː], supports
the assumption that they were not produced with uvularisation. This supports the claim that uvular gutturals do not trigger uvularisation harmony.

Figure 2:34 presents a wideband spectrogram of one token each of \( \{h\text{ræ:m}\} \) "blanket" and \( \{h\text{æ}:r\text{e}:m\} \) "shame" (N).\(^{53}\) As seen, \( F_2 \) of \( [\varepsilon:] \) is over 300 Hz lower than that of \( [æ:] \). The steady \( F_2 \) of both \( [\varepsilon:] \) and \( [æ:] \) shows that each vowel has reached and maintained its \( F_2 \) target. I interpret a distinct formant target that is reached and maintained as showing phonetic implementation of some discrete phonological property. Distinct \( F_2 \) targets reached and maintained by \( [\varepsilon:] \) and \( [æ:] \) are expected if \( [\varepsilon:] \) and \( [æ:] \) are tokens of phonologically distinct vowels: \( [\varepsilon:] \), which is phonologically uvularised, that is, secondary-[DOR] and secondary-[DOR], and \( [æ:] \), which is not. The \( F_2 \) data in the spectrogram support the claim that Palestinian /Æ:/ undergoes phonological uvularisation harmony.

![Figure 2:34. Wideband spectrogram of one token each of \( \{h\text{ræ:m}\} \) "blanket" and \( \{h\text{æ}:r\text{e}:m\} \) "shame" (N).](image)

(Formants measured at points indicated by the vertical lines.)

\([æ:]\): \( F_1 = 626 \) Hz; \( F_2 = 1503 \) Hz. \([\varepsilon:]\): \( F_1 = 630 \) Hz; \( F_2 = 1193 \) Hz.

Figure 2:35 presents a wideband spectrogram showing one token each of /t/ > \{t\} and /t/ > surface emphatic \{t\}. The resonance of the burst of the token of \{t\} is about 300 Hz lower than that of the token of \{t\}. Lower concentration of burst energy as a characteristic of an emphatic plosive has been reported elsewhere, e.g., Al-Ani (1970:45), who reports it for /t/ compared to /t/. The lowered burst here for /t/ > \{t\} is thus consistent with an assumption that the token in the figure was produced with uvularisation. This supports our phonological claim that underlying non-emphatic consonants uvularise in a word with an underlying emphatic.

\(^{53}\) We would expect /t/ in \( \{h\text{ræ:m}\} \) to surface emphatic, as it does not appear to occur in a de-emphatising context. However, de-emphatising /I/ is apparently underlyingly present in this form (cf. Classical Arabic \( \{h\text{u}:r\text{æ:m}\} \)) (Herzallah 1990:160n6).
The wideband spectrograms of Figures 2:36 - 2:40 show tokens of gutturals /h/, /h/, /h/, /h/, and /h/ in a non-uvularisation vs. uvularisation context. Arrows point out the second formants. We see that, for each guttural, the token in the uvularisation context has a medium F$_2$ drop, compared to F$_2$ of the token in a non-uvularisation context (except for [y], which shows a small drop). This does not match the large F$_2$ drop expected for segments with uvularisation, but the F change is in the expected direction. In these figures, the tokens of /h h h/ in a uvularisation context have a general downward shift in frequency of the fricative noise, compared to those in a non-uvularisation context. This is reported elsewhere as characteristic of emphatic fricatives, e.g., by Al-Ani (1970:46) for /s/, compared to /s/. These observations support the assumption that the tokens in a uvularisation context were produced with a uvularisation articulation that the others lacked. The claim that Palestinian gutturals undergo uvularisation harmony thus has acoustic support.

Younes (1993) analyses Palestinian gutturals as transparent to uvularisation harmony. McCarthy (1997) solicits instrumental findings to determine if they are transparent or do undergo it. The latter is claimed by Davis (1995). The acoustic findings here support Davis’ claim.
Figure 2:36. Wideband spectrogram of one token each of \( \text{[h]} \) and \( \text{[h]} \).

The token of \( \text{[h]} \) occurred in \( \text{[h]t.boo} \) "Hiba" (fem. name), the token of \( \text{[h]} \) in
\( \text{[b-st.-sub.-hho]} \) "she’s pouring them (fem.)". (Formants measured at points indicated
by the vertical lines.)

\[ F_2 \text{ of [h]} = 1899 \text{ Hz.} \ F_2 \text{ of [h]} = 1544 \text{ Hz.} \]

Figure 2:37. Wideband spectrogram of one token each of \( \text{[f]} \) and \( \text{[f]} \).

The token of \( \text{[f]} \) occurred in \( \text{[f]bt.5it} \) "full, satiated (masc. sg.)", the token of \( \text{[f]} \) as
rightmost \( \text{[f]} \) in \( \text{[f]n.3} \text{[f]-[b-st.-f]} \) "together". (Formants measured at points indicated
by the vertical lines.)

\[ F_2 \text{ of [f]} = 1513 \text{ Hz.} \ F_2 \text{ of [f]} = 1183 \text{ Hz.} \]
Figure 2:38. Wideband spectrogram of one token each of \( \hat{h} \) and \( \hat{h} \).

The token of \( \hat{h} \) occurred in \( \text{masa.h-a} \) "he wiped it (masc.)", the token of \( \hat{h} \) in \( \text{shame} \) (N). (Formants measured at points indicated by the vertical lines.)

\[ F_2 \text{ of } \hat{h} = 1587 \text{ Hz. } F_2 \text{ of } \hat{h} = 1308 \text{ Hz.} \]

Figure 2:39. Wideband spectrogram of one token each of \( \hat{u} \) and \( \hat{y} \).

The token of \( \hat{u} \) occurred in \( \text{b-j-tu} \) "he's boiling (something)", the token of \( \hat{y} \) in \( \text{smitr} \) "small (masc. sg.)". (Formants measured at points indicated by the vertical lines.)

\[ F_2 \text{ of } \hat{u} = 1285 \text{ Hz. } F_2 \text{ of } \hat{y} = 1186 \text{ Hz.} \]
The token of \( \chi \) occurred in \( \text{سّ-\text{تاء} \cdot \text{ة} \cdot \text{ة} \cdot \text{ة} \cdot \text{ة}} \) “we didn’t urinate/defecate”, the token of \( \chi \) in \( \text{سّ-\text{تاء} \cdot \text{ة} \cdot \text{ة} \cdot \text{ة} \cdot \text{ة}} \) “cheaper (masc. sg.)”.

(Formants measured at points indicated by the vertical lines.)

\[ F_2 \text{ of } \chi = 1587 \text{ Hz. } F_3 \text{ of } \chi = 1314 \text{ Hz.} \]

2.5.2 Theoretical Account: Part I

The representations of Palestinian emphatics and uvular gutturals, proposed earlier in (44) and (43c), are repeated in (111) - (112). Exclusion of uvular gutturals from the class of uvularisation harmony triggers shows that Palestinian uvularisation harmony is secondary-[DOR] + secondary-[RTR] AS harmony. It is triggered by segments specified for secondary-[DOR] and secondary-[RTR], a criterion met only by emphatics.

(111) Representations of Palestinian Emphatics

<table>
<thead>
<tr>
<th>a. coronal emphatics</th>
<th>b. dorsal emphatic</th>
<th>c. labial emphatics</th>
</tr>
</thead>
<tbody>
<tr>
<td>/\text{ð} / s / t / l /</td>
<td>/\text{k} /</td>
<td>/\text{m} / b /</td>
</tr>
<tr>
<td>[COR] [DOR] [TR] [RTR]</td>
<td>[DOR] [TR]</td>
<td>[DOR] [LAB] [TR] [RTR]</td>
</tr>
</tbody>
</table>
I propose that a harmonising segment receives specification for both secondary-[DOR] and secondary-[RTR], as illustrated for (\(\text{/n/} \rightarrow \text{\{\text{n}\}}\)) in (113). For the vowels, addition of [DOR] results in the eight additional feature combinations boxed in (114), which define eight uvularised vowels. They are specified for [DOR] and [RTR], represented with secondary status. Of the eight, Palestinian uses the two in double box. Given the length distinction for vowels in the language, the gain is the two short vowels \(\text{\{o A\}}\) and long \(\text{\{E:\}}\). Short \(\text{\{A\}}\) is underlying /AE/, arising through loss of [LOW] (see §2.6). Highly ranked NUC\mu\mu/*RTR prevents the long back vowel from surfacing rtr, so the uvularised long back vowel surfaces as non-rtr \(\text{\{E:\}}\). Under present representational assumptions, specifically (45), this means that the long back vowel is phonologically velarised, not uvularised. All other available additional vowels in (114) are prevented from surfacing by a highly ranked constraint, HI/*Sec-DOR \& Sec-RTR ('A segment specified for [HIGH] is not specified for secondary-[DOR] and secondary-[RTR]'), to be motivated in §2.5.6.
As [RTR] is an integral part of the representation of a uvularised segment, any uvularised segment is also pharyngealised (see §2.3.1). Palestinian short low back 〈ɑ̏〉 is thus both uvularised and pharyngealised. This is why Palestinian has no non-rtr low back short vowel.

The representations of 〈ɑ̏〉 and 〈ɛ̏〉 are seen in (115) - (116). Long 〈ɛ̏ː〉 differs from 〈æː〉 by being specified for secondary-[DOR]. An additional uvularised surface vowel not included in (114) is the uvularised variant of reduced 〈æː〉: 〈ɔ̏〉, represented as in (117). It has the same segmental representation as 〈ʌ̏〉.

(115)

\[
\begin{array}{cccccccccccc}
\{ \text{æ} \} & \{ \text{a} \} & \{ \text{ã} \} & \{ \text{u}_1 \} & \{ \text{u}_1' \} & \{ \text{u}_2 \} & \{ \text{u}_2' \} & \{ \text{o} \} & \{ \text{ɛ} \} & \{ \text{ɛ} \} \\
\text{HI} & + & + & + & + & + & + & + & + \\
\text{LO} & + & + & + & + & + & + & + & + \\
\text{LAB} & + & + & + & + & + & + & + & + \\
\text{RTR} & + & + & + & + & + & + & + & + \\
\text{DOR} & + & + & + & + & + & + & + & + \\
\end{array}
\]
The data in §2.5.1 indicate the constraints in (118) and the grammar in (119).

(118) a. ALIGN(Sec-[DOR] \& Sec-[RTR], L; Wd, L)
∀ word, ∃ secondary-[DOR] and ∃ secondary-[RTR], the left edge of secondary [DOR] and the left edge secondary-[RTR] coincide with the left edge of the word.
(The left edge of the word is aligned with the left edge of any secondary-[DOR] and the left edge of any secondary-[RTR].)
b. ALIGN(Sec-[DOR] \& Sec-[RTR], R; Wd, R)
∀ word, ∃ secondary-[DOR] and ∃ secondary-[RTR], the right edge of secondary-[DOR] and the right edge secondary-[RTR] coincide with the right edge of the word.
(The right edge of the word is aligned with the right edge of any secondary-[DOR] and the right edge of any secondary-[RTR].)
c. MAX-DOR
Every [DOR] in the input corresponds to a [DOR] in the output.
d. DEP-DOR
Every [DOR] in the output corresponds to a [DOR] in the input.
(119) DEP-IO, MAX-DOR, MAX-RTR, MAX-LINK, NUC\textsubscript{sec}/*RTR, NUC\textsubscript{μ}/*RTR, DEP-DOR !==>
ALIGN(Sec-[DOR] ∧ Sec-[RTR], L; Wd, L),
ALIGN(Sec-[DOR] ∧ Sec-[RTR], R; Wd, R) !==>
DEP-RTR !==>
DEP-LINK

ALIGN(Sec-[DOR] ∧ Sec-[RTR], L; Wd, L) requires that, if secondary-[DOR] and secondary-[RTR] are present in a word, then the left edge of some secondary-[DOR] and the left edge of some secondary-[RTR] must be aligned with the left edge of the word. ALIGN(Sec-[DOR] ∧ Sec-[RTR], R; Wd, R) requires the same for the right edge of the word. These are syntagmatic Grounding constraints grounded in the slow movement of the tongue back and root, an effect of their relative large mass. The phonological consequence is that secondary-[DOR] and secondary-[RTR] tend to span more than one segment in the word. Since ALIGN(Sec-[DOR] ∧ Sec-[RTR], L; Wd, L) and ALIGN(Sec-[DOR] ∧ Sec-[RTR], R; Wd, R) are equally ranked, together they require those two co-occurring features span the word.

These constraints are conjunctive (Hewitt & Crowhurst 1996, Crowhurst & Hewitt 2000). My account claims that uvularisation harmony is due to constraints referring to secondary-[DOR] and secondary-[RTR] as a unit, not to separate sets of constraints, one requiring alignment of secondary-[DOR], the other alignment of secondary-[RTR]. I will explain why at the end of this section. The ALIGN(Sec-[DOR] ∧ Sec-[RTR]; Wd) constraints specify the secondary status of the harmonic features [DOR] and [RTR]. I propose this as the formal machinery by which the harmony is implemented as secondary-[DOR] + secondary-[RTR] AS harmony.

Since both consonants and vowels undergo Palestinian uvularisation harmony, the anchor for secondary-[DOR] + secondary-[RTR] is the root node.\textsuperscript{54} This means that presence or absence of those co-occurring features on both consonants and vowels is considered when satisfaction of the ALIGN(Sec-[DOR] ∧ Sec-[RTR]; Wd) constraints is evaluated.

Tableaux illustrating the harmony are presented below. (IO-FAITH abbreviates DEP-IO, MAX-DOR, MAX-RTR, and MAX-LINK); ALIGN-Sec-DOR-Sec-RTR-Wd abbreviates ALIGN(Sec-[DOR] ∧ Sec-[RTR], L; Wd, L) and ALIGN(Sec-[DOR] ∧ Sec-[RTR], R; Wd, R).)

\textsuperscript{54} Recognition of distinct NUC vs. root node anchors for pharyngealisation vs. uvularisation harmony does not arbitrarily enrich the theory. The properties of the two harmonies indicate the distinct anchors.
Dominance of MAX-DOR, MAX-RTR, MAX-LINK over the \(\text{ALIGN(Sec-[DOR]} \land \text{Sec-[RTR]; Wd)}\) constraints is established by the winning candidates: in each, the emphatic surfaces linked to [DOR] and [RTR].

The winner in (120) contains a non-harmonising final vowel, in violation of the \(\text{ALIGN(Sec-[DOR]} \land \text{Sec-[RTR]; Wd)}\) constraints but in satisfaction of \(\text{NUC}_{\text{sr}}[^{*}\text{RTR}]\). Violation of the former is thus less serious than violation of the latter. The partial harmony for the final vowel in candidate 6 in (120), its link with [DOR] but not with [RTR], is non-optimal because it results in additional DEP-LINK violation. The winner in (121) contains a partially-harmonising long vowel. (The long vowel is [DOR] but not also [RTR].) This violates the \(\text{ALIGN(Sec-[DOR]} \land \text{Sec-[RTR]; Wd)}\) constraints but satisfies \(\text{NUC}_{\text{sr}}[^{*}\text{RTR}]\). Violation of alignment is thus less serious than violation of \(\text{NUC}_{\text{sr}}[^{*}\text{RTR}]\). In candidate 9 in (121), the long vowel is not linked to [DOR]. This forces a DEP-DOR violation, as an additional instance of [DOR] is then
(121)

<table>
<thead>
<tr>
<th></th>
<th>I-O FAITH</th>
<th>NUC[lsn]</th>
<th>NUC[μ]</th>
<th>DEP- DOR</th>
<th>ALIGN- Sec</th>
<th>DEP- RTR</th>
<th>DEP- RTR</th>
<th>DEP- LINK</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. {be.'a:ːːt}</td>
<td>*<em>!</em></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2. {be.'a:ːːt}</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td><strong>!</strong>**</td>
<td></td>
<td></td>
</tr>
<tr>
<td>3. {be.'aːːt}</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>**</td>
<td></td>
</tr>
<tr>
<td>4. {be.'aːːt}</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>****</td>
<td>**</td>
</tr>
<tr>
<td>5. {ba.'aːːt}</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>****</td>
</tr>
<tr>
<td>6. {ba.'aːːt}</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>****</td>
</tr>
<tr>
<td>7. {ba.'eːːt}</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>****</td>
</tr>
<tr>
<td>8. {be.'eːːt}</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>**</td>
<td>****</td>
</tr>
<tr>
<td>9. {ba.'eːːt}</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>****</td>
</tr>
</tbody>
</table>
necessary for the first three segments in the word to satisfy alignment. The fact that candidate 9 loses shows that violation of DEP-DOR is more serious than violation of the ALIGN(Sec-[DOR] \& Sec-[RTR]; Wd) constraints. These observations show that NUC]*RTR, NUC]*RTR, and DEP-DOR dominate the ALIGN(Sec-[DOR] \& Sec-[RTR]; Wd) constraints.

The winner in (121) contains an additional instance of [RTR] so the first three segments in the surface form can link to [RTR]. This satisfies ALIGN(Sec-[DOR] \& Sec-[RTR], L; Wd, L) but violates DEP-RTR. Hence, ALIGN(Sec-[DOR] \& Sec-[RTR], L; Wd, L) >> DEP-RTR. I assume that ALIGN(Sec-[DOR] \& Sec-[RTR], R; Wd, R) also dominates DEP-RTR. Here I follow Pulleyblank (1997b, who shows that transparency effects derive from dominance of constraints requiring featural alignment over constraints against feature insertion. In (121)'s winner, the surface realization of long /Æ:/ is partially transparent to uvularisation harmony: it does not link with one of the uvularisation harmony features, [RTR], but the three segments leftward of /Æ:/ nevertheless do. Lowest ranking of DEP-LINK is seen from the winning candidates in both tableaux: they contain several non-underlying links to [DOR] and [RTR] in (best possible) satisfaction of alignment but in multiple violation of DEP-LINK. This establishes ALIGN(Sec-[DOR] \& Sec-[RTR], L; Wd, L), ALIGN(Sec-[DOR] \& Sec-[RTR], R; Wd, R) >> DEP-LINK. (The ranking DEP-RTR >> DEP-LINK was established in §2.4.6.)

I now explain why uvularisation harmony must be imposed by conjunctive alignment constraints which reference secondary-[DOR] and secondary-[RTR] as a unit. An alternative account, with nonconjunctive constraints, would propose:

(122) a. ALIGN(Sec-[DOR], L; Wd, L) ∀word, 3secondary-[DOR], then the left edge of secondary-[DOR] and the left edge of the word coincide.
(The left edge of the word is aligned with the left edge of any secondary-[DOR].)

b. ALIGN(Sec-[DOR], R; Wd, R) ∀word, 3secondary-[DOR], then the right edge of secondary-[DOR] and the right edge of the word coincide.
(The right edge of the word is aligned with the right edge of any secondary-[DOR].)

c. ALIGN(Sec-[RTR], L; Wd, L) ∀word, 3secondary-[RTR], then the left edge of secondary-[RTR] and the left edge of the word coincide.
(The left edge of the word is aligned with the left edge of any secondary-[RTR].)

d. ALIGN(Sec-[RTR], R; Wd, R)
∀ word, ∃ secondary-[RTR], then the right edge of secondary-[RTR] and the right edge of the word coincide. (The right edge of the word is aligned with the right edge of any secondary-[RTR].)

(123) DEP-IO, MAX-DOR, MAX-RTR, MAX-LINK, NUC]ₚₚ/*RTR, NUC]ₚₚ/*RTR, DEP-DOR >>
     ALIGN(Sec-[DOR], L; Wd, L), ALIGN(Sec-[DOR], R; Wd, R),
     ALIGN(Sec-[RTR], L; Wd, L), ALIGN(Sec-[RTR], R; Wd, R) >>
     DEP-RTR >>
     DEP-LINK

Equally ranked, the constraints in (122) would require secondary-[DOR] and secondary-[RTR] to span the word. The ranking in (123) produces interaction like that in (124).

This alternative account is adequate for uvularisation harmony: in (124) the grammatical surface form is optimal. The problem emerges once pharyngealisation harmony is also considered. For pharyngealisation harmony, this account predicts transparency where opacity is what is actually observed. Recall that long vowels block pharyngealisation harmony; e.g. in /dlnÆ:r/ \{di.‘ne:r\} "dinar", initial-syllable \{i\} is blocked from harmonising with \{t\} by the intervening long \{b\}. This follows from the fact that [RTR] cannot align with a short vowel if there is intervening long vowel; if it did, the resulting configuration would be non-optimal because it would be gapped. Insertion of an additional instance of [RTR] so the short vowel can align with that feature is ruled out by the ranking DEP-RTR >> ALIGN([RTR], L; Wd, L), ALIGN([RTR], R; Wd, R) (see §2.4.6). Thus, assuming non-conjunctive uvularisation alignment constraints, pharyngealisation harmony would be subject to the ranking in (125).

This ranking has two sets of constraints requiring [RTR] alignment: the ALIGN(Sec-[RTR]; Wd) constraints, which require [RTR] to have secondary status, and the ALIGN([RTR]; Wd) constraints, which do not require particular (primary or secondary) status. The ALIGN(Sec-[RTR]; Wd) constraints dominate DEP-RTR. This means any blocking that might have resulted from DEP-RTR >> ALIGN([RTR]; Wd) will be nullified by ALIGN(Sec-[RTR]; Wd) >> DEP-RTR. This is illustrated in (126), which is the tableau in (104) with the ALIGN(Sec-[RTR]; Wd) constraints inserted into the pharyngealisation harmony ranking. (Secondary-[DOR] specifications and DEP-LINK violations resulting from non-underlying links with secondary-[DOR] are ignored.)
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<tr>
<th>Input:</th>
<th>I-O FAITH</th>
<th>NUC</th>
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</tbody>
</table>
(125) DEP-IO, MAX-RTR, MAX-LINK, NUC]_{sm}/*RTR, NUCμ/*RTR, >>
      ALIGN(Sec-[RTR], L; Wd, L), ALIGN(Sec-[RTR], R; Wd, R) >>
      NUC-C]_{s}/*RTR, ALIGN-L([RTR], NUC), ALIGN-R([RTR], NUC),
      DEP-RTR >>
      ALIGN([RTR], L; Wd, L), ALIGN([RTR], R; Wd, R) >>
      DEP-LINK

In (126), candidate 1, marked with ‘6°’, is the actual surface form. The alternative account thus fails. I conclude that uvulatisation harmony is imposed by constraints which reference secondary-[RTR] and secondary-[DOR] as a unit. This indicates that the phonology refers to co-occurring secondary-[RTR] and secondary-[DOR], the representation of uvulatisation articulation.

2.5.3 Opaque Post-alveolar Obstruents

2.5.3.1 Analysis. The post-alveolar obstruents /ʃ dʒ/ are opaque to uvulatisation harmony. This is shown in (127).

(127)

a. /ˈtæŋələr/  {ˈtəːnəˌrə̌}  (*{ˈtəːnəˌrə̌})  “ten”

b. /ˈtæŋələriːn/  {ˈtəːnəˌləriːnə}  (*{ˈtəːnəˌləriːnə})  “thirsty (masc. sg.)”

c. /mənˈtʃʧələn/  {maːnˈʧələnə}  (*{maːnˈʧələnə})  “he didn’t
      close it (fem.)”

d. /mənˈtʃʧədʒən/  {maːnˈʧədʒənə}  (*{maːnˈʧədʒənə})  “we didn’t
      return it”

In certain forms, non-root-internal, geminate /jj/ blocks the harmony, as in (128).\[55\] The form in (128) contrasts with ones like those in (108i-k), in which /j(j)/ undergoes the uvulatisation harmony. The behaviour of geminate /jj/ is thus variable.

(128) /tʰæbəkələnænæjəh/  {tʰəkələnæjəh}  (*{tʰəkələnæjəh})  “he cooked it
      (masc.sg.)
       for us”

\[55\] In the present corpus, the only forms of this type have affixal /-jjE-/.
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<thead>
<tr>
<th></th>
<th>input: /dlnÆːt/</th>
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</thead>
<tbody>
<tr>
<td></td>
<td>[RTR]</td>
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<tr>
<td>&quot;dinar&quot;</td>
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<tr>
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<th>NUC\textsubscript{lam} / *RTR</th>
<th>NUC\textsubscript{mu} / *RTR</th>
<th>ALIGN-Sec-RTR-Wd</th>
<th>NUC-C\textsubscript{i} / RTR</th>
<th>ALIGN-((RTR), NUC)</th>
<th>DEP-RTR</th>
<th>ALIGN-RTR-Wd</th>
<th>DEP-LINK</th>
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(126)
2.5.3.2 Acoustic Support. Let us readdress the graphs of /Æ/ and /Æ:/ in Figures 2:32 and 2:33. The tokens of interest now are those in the blocked context. Those tokens occurred in a word containing an emphatic, with a post-alveolar obstruent or /jj/ intervening between the vowel and an underlying emphatic. They fall within the higher-F2 region and are perceptually [æ] and [æː:]. They do not have a lowered F2, as observed for the emphatic + open syllable and emphatic + closed syllable tokens in Figures 2:32 and 2:33. This supports the assumption that the blocked tokens were not produced with uvularisation, which supports the phonological claim that post-alveolar obstruents and /jj/ block uvularisation harmony.

Figure 2:41 presents a wideband spectrogram showing two tokens of /t/ > /t/. The one on the right occurred in a blocked context. As seen, there is no notable downward shift in the resonance of the burst of the token of blocked /t/. This contrasts with surface emphatic /t/, for which tokens have downward shift of about 300 Hz (see Figure 2:35). This supports the assumption that the blocked token in Figure 2:41 was not produced with uvularisation. Our phonological claim that post-alveolar obstruents block Palestinian uvularisation harmony thus has acoustic support.

![Figure 2:41](image)

Figure 2:41. Wideband spectrogram of one token each of /t/ in a word with no emphatic, and blocked /t/.

The one on the left is a token of /t/ in /b-t-t-d-/ "she's counting", the one on the right a token of blocked /t/ in /b-t-t-mas/t/ "she's combing".

Burst of the [t] on the left = 1668 Hz. Burst of blocked [t] = 1625 Hz.

2.5.4 Theoretical Account: Part II

I propose the representation of Palestinian post-alveolar /ʃ tʃ dʒ/ in (129). (Irrelevant specifications are omitted).
Representation of Palestinian Post-alveolar Obstruents /

\[ \text{[CONS]} \]
\[ \text{\_Place} \]
\[ \text{[DOR]} \]
\[ \text{[FRONT]} \]

The constraint in (130) figures crucially to derive the opacity we are concerned with. It is a paradigmatic Grounding constraint grounded in the incompatibility of simultaneous fronting and uvularisation gestures. Note that vowels which can be described ‘front’ along abstract or articulatory dimensions do not block uvularisation harmony in (Abu Shusha) Palestinian. The claim here is that in Palestinian, a segment specified for the phonological feature [FRONT] cannot also be specified for secondary-[DOR] and secondary-[RTR]. Assuming the vowel specifications in (53), no Palestinian vowel is [FRONT]. Furthermore, to my knowledge, there is no evidence that the vowels ever receive specification for [FRONT]. Because the vowels do not bear [FRONT], they do not block uvularisation harmony.

\( \text{(130) FRONT/} ^{\ast} \text{Sec-DOR \& Sec-RTR} \)

A segment specified for [FRONT] is not specified for secondary-[DOR] and secondary-[RTR].

The ranking is now as seen in (131).

\( \text{(131) DEP-IO, MAX-DOR, MAX-RTR, MAX-LINK, NUC]_sec/^*RTR,} \)
\( \text{NUC}_{\mu\mu}/^*RTR, \text{DEP-DOR, FRONT/} ^{\ast} \text{Sec-DOR \& Sec-RTR} \gg \)
\( \text{ALIGN(Sec-[DOR] \& Sec-[RTR], L; Wd, L),} \)
\( \text{ALIGN(Sec-[DOR] \& Sec-[RTR], R; Wd, R) \gg} \)
\( \text{DEP-RTR} \gg \)
\( \text{DEP-LINK} \)

The tableau in (132) illustrates the opacity effects. (Each candidate contains an initial-syllable rtr \{a\} linked to the underlying [RTR] of \{\r\}. The additional instance of [RTR] linked to \{a\} and \{\r\} is omitted for all candidates.)
In the winning candidate, /f/ does not bear specification for secondary-[DOR] and secondary-[RTR], resulting in more violations of the ALIGN(Sec-[DOR] ∨ Sec-[RTR]-RTR-Wd).
Sec-[RTR]; Wd) constraints than for the losing candidates 7-9 in which /ʃ/ is linked to those features. The winner satisfies FRONT/*Sec-DOR ∧ Sec-RTR. This establishes the ranking of FRONT/*Sec-DOR ∧ Sec-RTR over ALIGN(Sec-[DOR] ∧ Sec-[RTR]; Wd). We see again that opacity derives from the ranking of DEP-F over alignment, as follows. The losing candidate 10 contains an inserted [DOR] so /ʃæ/ can link to that feature in greater satisfaction of the ALIGN(Sec-[DOR] ∧ Sec-[RTR]; Wd) constraints than the winner. The additional [DOR] violates DEP-DOR. Candidate 10's loss confirms that DEP-DOR outranks ALIGN(Sec-[DOR] ∧ Sec-[RTR]; L).

2.5.5 Transparent Non-low Vowels

2.5.5.1 Analysis. Palestinian non-low vowels are transparent to uvularisation harmony. They do not undergo it and do not block it, as seen in (133):^56 The evidence that non-low vowels do not harmonise is phonetic and is discussed next.

(133) a. /šUbb/ → ⟨šUb⟩ (⟨šub⟩) → ⟨*šUb⟩ → “to pour”
   b. /mUhr-Æ:t:/ → ⟨mUhr-Æ:t:/⟩ (⟨*mUhr-Æ:t:/⟩) → “fillies”
   c. /fɪl/ → ⟨fɪl⟩ (⟨*fɪl⟩) → “emptied (masc. sg.)” (Adj)
   d. /nɪf/ → ⟨nɪf⟩ (⟨*nɪf⟩) → “clean (masc. sg.)” (Adj)
   e. /b-ʃÆt:li-nÆ-f/ → ⟨b-ʃÆt:li-nÆ-f⟩ (⟨*b-ʃÆt:li-nÆ-f⟩) → “he doesn’t give (something) to us”

2.5.5.2 Acoustic Support. We now consider data on Palestinian non-low vowels in a uvularisation context. We focus on F₂, as the present dataset indicates that F₂ drop is the most salient effect for segments which are presumably produced with uvularisation. Contrasting with the steady lowered F₂ observed for tokens of the low vowel in a uvularisation context (see Figure 2:34), no steady lowered F₂ is observed for non-low vowels in that context. This has been noted by Al-Ani (1970) for Classical Arabic, and by Younes (1982, 1993) and Herzallah (1990) for Palestinian. Younes (1993:124) states: “two distinct variants of [the low] vowels are easily identifiable: back a (and its long counterpart aa), and front a (with its long counterpart aa). This is not the case with respect to the other vowels where emphatic influence is generally marked by a transition into or from the emphatic, rather than by an entirely different target.” (I retain Younes' underlining to denote emphasis.) Younes (1982)

^56 High vowels are blockers in some other Palestinian dialects (see §2.5.7).
POSTVELAR HARMONY IN ARABIC

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reports a lowered $F_2$ onset for non-low vowels immediately following an emphatic, but also reports that $F_2$ for those vowels rises toward its usual (non-uvularised) value after onset transition. For example, his description [p.139] of the effect of emphasis on tokens of long /I:/ is:

The influence on $ii$ is obviously phonetic, i.e., no target back $ii$ is observed but backing is manifested only in the low $F_2$ frequency in the portions of the vowel adjacent to the emphatic consonant. That frequency goes up in the rest of the vowel duration. On the other hand, the low vowels show steady state low $F_2$ values throughout their duration next to an emphatic consonant.

Interpreting the data of Younes (1982), Herzallah [p.68-69] states:

The vowels /ee/ and /ii/ are not affected to as great a degree in an emphatic environment. The vowels /ee/ [sic] in the word [see]... and the vowel /ii/ in the word [tiin]... show a sharp upward $F_2$ transition which starts at about 1000 Hz and lasts for about one third of the segmental duration of the vowel until it reaches a steady state frequency at about 2000 Hz.

Younes observes that $F_2$ onset for tokens of /U:/ shows no transition in the environment of an emphatic. The data on Palestinian /U:/ in Figure 2:31 indicate that $F_2$ is very low for an unconditioned [u:]. This observation indicates there might be some minimum $F_2$ limit for the [u:], just as there might be a maximum $F_1$ limit for Palestinian [œ].

Herzallah continues [p.69]:

Perceptually... only [æ] is distinct from [a], and no equivalent distinction is noticed in the case of /i/ and /u/... It is true that /i/ and /u/ next to the emphatic sound are auditorily darker and louder when compared to the plain non-emphatic counterparts, but no two distinct vocalic qualities are recognized by speakers of the language for either pair. It is only in the case of the low vowel that two steady state targets are recognized. The same generalisation holds of the long vowels /ii/, /ee/ and /uu/. There is only one target for these, although the first two show the sharp rise in their $F_2$ onset as mentioned before. [Herzallah denotes front œ as 'a'.]

Figures 2:42 - 2:43 show wideband spectrograms of tokens of non-emphatic/ emphatic $\{CV\}/CVC$ pairs, where $C =$ emphatic, $V =$ non-low vowel. These pairs present the non-low vowels in a non-uvularisation and uvularisation context, respectively. The figure captions record $F_2$ for the vowel in the CV token (measured at midpoint), and the vowel in the $CVC$ token, measured at vowel onset and at third quarter.

The tokens of $\{CV\}$ illustrate the usual high $F_2$ of Palestinian [i:] and [e:] in a non-uvularisation context. However, as seen, the $F_2$ trajectory of the vowel in the tokens of $\{CV\}$ is never steady, going from lower at onset to near target by third quarter. Lack of a steady lowered $F_2$ shows that those vowels did not reach and maintain a lowered $F_2$ target. This indicates that the effect of
uvularisation on non-low vowel tokens is not the implementation of a discrete phonological feature, but a non-discrete effect imposed solely in the phonetics, as concluded earlier by Younes and Herzallah. The data in Figures 2:42 - 2:43 thus support our claim that the non-low vowels do not undergo uvularisation harmony.

Figure 2:42. Wideband spectrogram of one token each of /ti:/ and /ti:/.
The token of /ti:/ occurred in /ti:n/ “figs”, the token of /ti:/ in /tiː/ “mud”.
(Formants measured at points indicated by the vertical lines.)
F₂ of [ti] in /tiː/ = 2285 Hz. F₂ of [iː] in /tiː/ at onset = 1492 Hz,
at third quarter = 2055 Hz.

Figure 2:43. Wideband spectrogram of one token each of /teː/ and /teː/.
The token of /teː/ occurred in /feːɾʃ, t-eː-ɾ-i/ “my two mattresses”,
the token of /teː/ in /feːɾʃ, t-eː-ɾ-i/ “my two combs”.
(Formants measured at points indicated by the vertical lines.)
F₂ of [eː] in /teː/ = 1922 Hz. F₂ of [eː] in /teː/ at onset = 1234 Hz,
at third quarter = 1743 Hz.
2.5.6 Theoretical Account: Part III

The transparency data require the constraints in (134) ranked as in (135). (See Padgett 1995:407 for schematic formulation of NO-GAP.)

(134) a. HI/*Sec-DOR \land Sec-RTR
   A segment specified for [HIGH] is not specified for secondary-[DOR] and secondary-[RTR].

b. NO-GAP
   A multiply-linked feature is linked to adjacent segments.

(135) DEP-IO, MAX-DOR, MAX-RTR, MAX-LINK, NUC\textsc{sum}/*RTR,
      NUC\textsc{mu}/*RTR, DEP-DOR, FRONT/*Sec-DOR \land Sec-RTR,
      HI/*Sec-DOR \land Sec-RTR >>
      ALIGN(Sec-[DOR] \land Sec-[RTR], L; Wd, L),
      ALIGN(Sec-[DOR] \land Sec-[RTR], R; Wd, R) >>
      NO-GAP, DEP-RTR >>
      DEP-LINK

HI/*Sec-DOR \land Sec-RTR is a paradigmatic Grounding constraint grounded in the incompatibility of simultaneous raising and uvularising gestures. It restricts harmonising vowels to low vowels since, under present assumptions, the high and mid vowels are [HI].

I argue in this section that in Palestinian, the optimal output can be gapped. This implies that gapped configurations are not universally illformed, and that they are produced by \textit{GEN}, countering Archangeli & Pulleyblank (1994) and Pulleyblank (1997b). It also implies that, as claimed by Padgett (1995) and McCarthy (1997), a constraint against gapping exists. That is, the fact that no gapping is sometimes not observed in Palestinian indicates that when it is observed, it is enforced by a violable constraint. NO-GAP requires that a multiply-linked feature be linked to adjacent segments. Following Archangeli & Pulleyblank (1994), adjacency is defined with respect to the anchor tier. Since the anchor for co-occurring secondary-[DOR] and secondary-[RTR] is the root node, NO-GAP requires multiply-linked secondary-[DOR] and secondary-[RTR] to be linked to adjacent root nodes.

The relevant constraint interaction is illustrated in (136). (NUC-C\textsc{j}/RTR, responsible for the optimal link between [RTR] and /U/, is omitted. Constraint violation by the geminate consonant is assigned one violation mark for the single root node.)

In candidate 7, the non-low vowel is specified for secondary-[RTR] but not secondary-[DOR]. This satisfies HI/*Sec-DOR \land Sec-RTR but violates ALIGN(Sec-[DOR] \land Sec-[RTR]; Wd), and hence the former outranks the align-
In the winner, the non-low vowel is transparent to uvularisation harmony, due to its gapped configuration with respect to secondary-[DOR]. Crucially, DEP-DOR dominates the \text{ALIGN}(\text{Sec-[DOR]} \land \text{Sec-[RTR]}; \text{Wd}) constraints (see §2.5.4), so /bb/ cannot surface specified for secondary-[DOR] via insertion of [DOR]. Candidate 6, with such insertion, is non-optimal. With undominated MAX-HI (omitted from the tableau), indicated by lack of reduction for Palestinian non-low vowels (see §2.2.2), this means the optimal candidate is gapped. In the winning candidate 7, secondary-[DOR] is linked to non-adjacent \{ṣ\} and \{bb\}. This gapping occurs in violation of NO-GAP, but in best satisfaction of the \text{ALIGN}(\text{Sec-[DOR]} \land \text{Sec-[RTR]}; \text{Wd}) constraints. This establishes the ranking \text{ALIGN}(\text{Sec-[DOR]} \land \text{Sec-[RTR]}, L; \text{Wd}, L), \text{ALIGN}(\text{Sec-[DOR]} \land \text{Sec-[RTR]}, R; \text{Wd}, R) >> \text{NO-GAP}. That the winner
violates NO-GAP once but DEP-LINK three times establishes NO-GAP >> DEP-LINK.

2.5.7 Uvularisation Harmony in Other Palestinian Dialects

Palestinian uvularisation harmony has been closely investigated for a southern dialect (Davis 1993, 1995), and the Dar Younes (Younes 1982, 1993), Ya‘f‘bad (Herzallah 1990) and Jerusalem (Card 1983) fellāhīs. The first three have distinct leftward vs. right-ward uvularisation harmonies. In the southern variety, leftward harmony extends to the word boundary and has no blockers. Rightward harmony is blocked by /l j f/. Forms showing this, from Davis (1995:474), are seen in (137). (Davis’ transcription is retained. Harmonised segments are in capitals. Underlying emphatics are in an underdot.)

(137) a. {BALLAAŞ} “thief”
   b. {kATšaan} “thirsty [masc.sg.]”
   c. {Ţiin-ak} “your [masc.sg.] mud”

In Dar Younes and Ya‘f‘bad, leftward harmony is likewise unrestricted. Younes (1993) shows that rightward harmony is blocked by /j w/ and, after ‘r’, by a morpheme boundary followed by a segment other than /Æ/, pharyngeals, and laryngeals. These properties are seen in (138), from Younes (1993:126-127). (Younes’ transcription is retained. The symbol ‘+’ denotes a morpheme boundary. Underlying emphatics are denoted by an underdot, surface uvularisation by underlining.) The blocking after ‘r’ is seen in (e), compared to (d). The form in (d) shows that leftward harmony does not always reach the beginning of the word in this dialect; Younes (1993:125) notes that emphatic influence on inflectional prefixes is variable. Davis (1995:483) differs from Younes in identifying two distinct rightward harmonies for the Dar Younes dialect.

(138) a. {ţal[aan] “broken, not working [masc. sg.]”
   b. {ţaţšaan} “thirsty [masc. sg.]”
   c. {šjaam} “fasting”
   d. {ma+hašar+haa+š} “he did not corner her”
   e. {ma+hašar+t+haa+š} “I did not corner her”

Herzallah summarises Ya‘f‘bad rightward harmony as blocked by /j f/. Card (1983:118) does not identify distinct leftward vs. rightward harmonies in the

---

57 Herzallah (1990:4) describes the Ya‘f‘bad and Dar Younes as “essentially the same...[t]he only prominent difference between the two is the realization of the reflex of the Classical Arabic /k/. This sound is exclusively an affricate /c/ in Younes’s but it varies between front velar /k/ to /c/ in mine".
Jerusalem dialect, but states: "emphasis clearly originates from one particular consonant in a word and optimally spreads throughout the word." Abu Shusha shares this property. Card shows that uvularisation harmony is blocked in her dialect by /I: j j/ and word-final /I/. An Optimality theoretic account of the cross-dialectal differences in Palestinian uvularisation harmony remains for future work. For an account of the optimisation responsible for distinct leftward vs. rightward harmonies of the colloquials studied by Davis and Younes, under different featural and correspondence assumptions than my own, see McCarthy (1997). Finally, the variation in opacity indicates a crosslinguistic reranking of the grounded constraints responsible for the various blockers: the post-alveolar obstruents /ʃ ʧ ʤ/, post-alveolar approximant /j(j)/, labiovelar approximant /w/, and underlying high vowels /I: I/.

2.6. Summary and a Final Issue

We have seen that Palestinian Arabic has two distinct postvelar harmonies, pharyngealisation harmony and uvularisation harmony. The distinction is grounded in distinct articulations: retraction of the tongue root as a primary or secondary articulation vs. retraction of tongue back as a secondary articulation. Pharyngealisation harmony in the language is [RTR] A harmony. The NUC is the anchor. Uvularisation harmony is [DOR] + [RTR] AS harmony, with the root node as anchor. Complex but entirely systematic constraint interaction underlies the complex surface effects of the harmonies.

Let us now settle an outstanding issue. This is the claim of §2.4 that Palestinian pharyngealisation harmony is imposed by two separate constraint sets, ALIGN([RTR], NUC) and ALIGN([RTR]; Wd). Explanation of the basis for this claim involves explanation of the constraint interaction responsible for the raising of Palestinian short /æ/. Recall that there are two crucial contexts for the pharyngealisation harmony. The first is adjacency to an underlying postvelar. This was seen from (62), from which some forms are repeated here:

(139) a. /šU?Æ:/ \{su.ʔæ:l\} (\{su.ʔæ:l\}) “question”
b. /hlbÆ/ \{’hi.ɓe\} (\{’hi.ɓe\}) “Hiba” (fem. name)
c. /sbı̞tÆ:t/ \{ṣbı̞.te:t\} (\{ṣbı̞.te:t\}) “hospital”

The second is presence of a postvelar in the word, which gives rise to non-local pharyngealisation harmony. The postvelar trigger for non-local harmony is an underlying postvelar as in (68), repeated here as (140), or a pharyngealised vowel, as in (69), from which some forms are repeated in (141).

(140) a. /šlbdÆ:/ \{’l.ɓu.ʔe\} (\{’l.ɓu.ʔe\}) “lioness”
b. /šlnı̞mÆ/ \{’l.nı̞.m-ə\} (\{’l.nı̞.m-ə\}) “goat”
If there were no basis for the distinction between the two harmony contexts, the harmony could be analysed as arising in a single context, namely, in a word containing a postvelar (more precisely, [RTR], which groups underlying postvelar consonants and pharyngealised vowels). Further, such data could all be accounted for with the ALIGN([RTR]; Wd) constraints, which impose harmony throughout the word.

The evidence for the distinct contexts comes from Palestinian /Æ/ raising. Recall that /Æ/ raises to /Æ/ when it is both pharyngealised and uvularised (and non-reduced), but only if the /Æ/ undergoes closed syllable pharyngealisation. This is seen from the forms in (142) and (143) (seen earlier in (76) - (78)). In both these examples, /Æ/ is pharyngealised and uvularised. In (142) it undergoes pharyngealisation from a closed syllable (in a closed syllable itself in (a), under non-local harmony with a closed-syllable-pharyngealised vowel in (b-c)). In (143) it undergoes pharyngealisation harmony with an adjacent underlying postvelar. As seen, it surfaces as /Æ/ in the first set but not the second.

\[
\begin{align*}
(142) \quad & a. /mÆθr/ \quad \{mΛθr\} \quad \text{"Egypt"} \\
& b. /tΛmr/ \quad \{tΛΛmr\} \quad \text{"date(s)" (fruit)} \\
& c. /kΛmrΛr/ \quad \{kΛmΛrΛr\} \quad \text{"moon"}
\end{align*}
\]

\[
\begin{align*}
(143) \quad & a. /sΛ.Λθ.tΛ/ \quad \{sΛΛ.sΛ.Λθ.tΛ\} \quad \text{"salad"} \\
& b. /mΛθΛrΛ/ \quad \{mΛΛΛrΛΛ\} \quad \text{"woman, wife"}
\end{align*}
\]

The /Æ/ > /Λ/ results from deletion of /Æ/’s underlying [LOW] specification. The representation of Palestinian /Λ/ is seen in (144). This contrasts with that of /α/, which is specified for [LOW]. The representation of /α/, from (115), is repeated in (145).

The claim with respect to Palestinian /Λ/ and [LOW] has some crosslinguistic support. As will be seen in §3.5, the St’át’ímcets epenthetic vowel surfaces as /Λ/ when it undergoes uvularisation harmony with an emphatic. I will argue that St’át’ímcets’ uvularised epenthetic vowel has the representation in (144). Its secondary-[DOR] and secondary-[RTR] result from its uvularisation, its primary-[DOR] through interpolation. Since a primary-[DOR], secondary-[DOR], secondary-[RTR] vowel in St’át’ímcets is /Λ/, it might be reasonable to assume that the same specifications yield /Λ/ in
Palestinian. Since Palestinian /Æ/ must lose specification for [LOW] to surface as (144), [LOW] must be the deleted specification for Palestinian /Æ/ > {∧}.

(144)

\[
\begin{array}{c}
N \\
\{∧\} \\
\mu \\
[S\text{ON}] \\
\quad \quad \quad \text{Place} \\
[D\text{OR}] \\
\quad \quad \quad [D\text{OR}] [T\text{R}] \\
\quad \quad \quad \quad [R\text{TR}] \\
\end{array}
\]

(145)

\[
\begin{array}{c}
N \\
\{ο\} \\
\mu \\
[S\text{ON}] \\
\quad \quad \quad \text{Place} \\
[D\text{OR}] \\
\quad \quad \quad [L\text{OW}] [D\text{OR}] [T\text{R}] \\
\quad \quad \quad \quad [R\text{TR}] \\
\end{array}
\]

An account of the vowel raising requires the constraints in (146). LO*/Sec-DOR ∧ Sec-RTR is a *COMPLEX constraint (Prince and Smolensky 1993, Benua 1995, Padgett 1995) grounded in cognitive processing considerations, namely, that simultaneous specification for [LOW], secondary-[DOR], and secondary-[RTR] is feature overload.\(^{58}\) The fact that laden (145) rarely occurs in Palestinian seems to be support for this claim. It occurs only when /Æ/ occurs under primary stress in those infrequent words with an

\(^{58}\) See Nusbaum (2002) for recent appeal to cognitive load in explanation of speech/language processing.
emphatic but no short vowel in a closed syllable. In all other contexts, /Æ/ surfaces as \{æ\}, \{a\}, \{ʌ\}, \{e\}, \{ɔ\}, or \{ɔ^\}59.

(146) a. LO/*Sec-DOR ^ Sec-RTR
    A segment specified for [LOW] is not specified for secondary-[DOR], and secondary-[RTR].

b. MAX-LO
    Every [LOW] in the input corresponds to a [LOW] in the output.

c. MAX-LINK\textsubscript{LO}
    Every association with [LOW] in the input corresponds to an association with [LOW] in the output.

The /Æ/ raising, and /Æ/ reduction (see §2.2.2), indicate that in this language deletion of a link with [LOW], as distinct from links with other features, like [DOR] and [RTR], is sometimes optimal. This implies that MAX-LINK is a constraint family, of MAX-LINK\textsubscript{e} constraints. In other words, deletion of links is varyingly constrained, depending on the feature with which the link is associated.60

Since the /Æ/ > \{ʌ\} raising does not occur when /Æ/ is pharyngealised under adjacency to a postvelar, it occurs in only a subset of pharyngealisation harmony contexts. McCarthy (1997) discusses a similar problem with respect to uvularisation harmony in the Dar Younes dialect. The properties of uvularisation harmony in Dar Younes differ depending on whether the harmony is leftward or rightward (see §2.5.7). McCarthy argues that the different properties result from constraint ranking. I will now argue the same for Abu Shusha /Æ/ > \{ʌ\}. Specifically, lack of /Æ/ > \{ʌ\} raising under pharyngealisation from an adjacent underlying postvelar indicates that /Æ/ is immune to the deletion of [LOW] imposed by LO/*Sec-DOR ^ Sec-RTR when its pharyngealisation is imposed by an ALIGN([RTR], NUC) constraint. However, when it is imposed by NUC-C\textsubscript{σ}/RTR, the constraint requiring pharyngealisation in a closed syllable, LO/*Sec-DOR ^ Sec-RTR must also be satisfied. This yields the ranking in (147).61

---

59 Operation of both LO/*Sec-DOR ^ Sec-RTR and HI/*Sec-DOR ^ Sec-RTR in Palestinian uvularisation harmony is at first glance contradictory. However, the one is grounded in cognitive processing, the other in physical phonetics.

60 All relevant references to MAX-LINK earlier in this chapter are now clarified as MAX-LINK for links with features other than [LOW].

61 Notice this new ranking promotes the ALIGN([RTR], NUC) constraints so they now dominate NUC-C\textsubscript{σ}/RTR. This does not affect the outcome of any tableaux in this chapter.
Dominance of NUC-Cσ/RTR over the ALIGN([RTR]; Wd) constraints was established in §2.4.6 by transitivity based on NUC-Cσ/RTR >> DEP-RTR and DEP-RTR >> ALIGN([RTR]; Wd). The more complete ranking relevant to the discussion at hand is thus:

(148) ALIGN-L([RTR], NUC), ALIGN-R([RTR], NUC) >>
    LO/*Sec-DOR ∧ Sec-RTR >>
    NUC-Cσ/RTR >>
    DEP-RTR >>
    ALIGN([RTR], L; Wd, L), ALIGN([RTR], R; Wd, R)

The important finding is that the constraints which impose harmony under adjacency to a postvelar – the ALIGN([RTR], NUC) constraints – crucially dominate the constraints that impose harmony throughout the word – the ALIGN([RTR]; Wd) constraints. This is evidence that harmony with an adjacent underlying postvelar and harmony with a postvelar in the word are imposed by separate constraints. The two contexts are referred to distinctly in the phonology. There are thus two distinct contexts for the pharyngealisation harmony.

The distinct phonological properties of the postvelar harmonies in the language are listed in Table 2:4 with the constraints that require them. The final ranking is seen in (149). No full integration of (a) and (b) was concluded in this chapter. For that, we would need to consider a range of more complex data.

(149) Constraint Ranking Responsible for Postvelar Harmony in Palestinian Arabic
   a. Pharyngealisation Harmony
       DEP-IO, MAX-RTR, MAX-LINK (for features other than [LOW]),
       NUC]Sm*/RTR, NUCμμ/*RTR >>
       ALIGN-L([RTR], NUC), ALIGN-R([RTR], NUC) >>
       LO/*Sec-DOR ∧ Sec-RTR >>
       NUC-Cσ/RTR >>
       DEP-RTR >>
       ALIGN([RTR], L; Wd, L), ALIGN([RTR], R; Wd, R) >>
       DEP-LINK, MAX-LOW, MAX-LINKLO
   b. Uvularisation Harmony
       DEP-IO, MAX-DOR, MAX-RTR, MAX-LINK, NUC]Sm*/RTR,
NUCμμ /*RTR, DEP-DOR, FRONT*/Sec-DOR ∧ Sec-RTR,
HI/*Sec-DOR ∧ Sec-RTR >>
   ALIGN(Sec-[DOR] ∧ Sec-[RTR], L; Wd, L),
   ALIGN(Sec-[DOR] ∧ Sec-[RTR], R; Wd, R) >>
   NO-GAP, DEP-RTR >>
   DEP-LINK
<table>
<thead>
<tr>
<th>PHARYNGEALISATION HARMONY</th>
<th>UVULARISATION HARMONY</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. triggers</td>
<td></td>
</tr>
<tr>
<td>emphatics</td>
<td>emphatics</td>
</tr>
<tr>
<td>gutturals</td>
<td></td>
</tr>
<tr>
<td>closed-syllable-pharyngealised vowels</td>
<td></td>
</tr>
<tr>
<td>MAX-RTR, MAX-LINK (for features other than [LOW]), NUC-C [^/RTR]</td>
<td>MAX-DOR, MAX-RTR, MAX-LINK (for features other than [LOW])</td>
</tr>
<tr>
<td>2. undergoers</td>
<td></td>
</tr>
<tr>
<td>short vowels</td>
<td>(short and long) low vowels</td>
</tr>
<tr>
<td>consonants</td>
<td></td>
</tr>
<tr>
<td>ALIGN([RTR], NUC)</td>
<td>ALIGN(Sec-[DOR] \∧ Sec-[RTR]; Wd)</td>
</tr>
<tr>
<td>ALIGN([RTR]; Wd)</td>
<td></td>
</tr>
<tr>
<td>3. transparent segments</td>
<td></td>
</tr>
<tr>
<td>(none)</td>
<td>non-low vowels</td>
</tr>
<tr>
<td>/Æ:/ (partially transparent)</td>
<td></td>
</tr>
<tr>
<td>HI/*Sec-[DOR] \∧ Sec-[RTR]), NUC^[low]/^[RTR]</td>
<td></td>
</tr>
<tr>
<td>4. opaque segments</td>
<td></td>
</tr>
<tr>
<td>stem-final vowels</td>
<td>post-alveolar obstruents /ʃ ʧ ʤ/</td>
</tr>
<tr>
<td>long vowels</td>
<td></td>
</tr>
<tr>
<td>NUC^[stem]/^[RTR], NUC^[low]/^[RTR]</td>
<td></td>
</tr>
<tr>
<td>FRONT/*Sec-[DOR] \∧ Sec-[RTR])</td>
<td></td>
</tr>
</tbody>
</table>

Deleted [LOW] for closed-syllable-pharyngealised and uvularised /Æ/ ~> /Æ/; LO/*Sec-[DOR] \∧ Sec-[RTR]|

Table 2.4 Distinct properties of Palestinian's two postvelar harmonies
3.1. The Language and the Data

St'át'imcets (Lillooet) is an Interior Salish language. Its two clearly distinct dialects, Upper and Lower St'át'imcets, differ in syntax, phonology, and lexicon (see van Eijk 1987, 1997). Salish is a family of indigenous North American languages spoken in a geographic region spanning western Canada and northwestern U.S, from coastal B.C. (British Columbia) and Washington through central B.C., Washington, and Oregon, to Western Montana. See Appendix III for the classification of Salish languages.¹

The St’á’t’imcets data were gathered by the author during periodic fieldwork in Vancouver, Lillooet, and Mission, B.C., 1995-1996. The consultants were six native speakers, three females, aged 50-65, and three males, aged 45-55. The total corpus is approximately 500 words. About half were tape-recorded from one female and two male consultants. Given the small corpus, van Eijk (1987, 1997) were consulted for further data. Where data are van Eijk’s, that is indicated. Unless otherwise noted, data on postvelar harmony are in the Lower dialect. Glosses are from van Eijk (1987). For forms not found in that dictionary, the glosses are as provided by my consultants. The acoustic data were tape-recorded from a male native speaker of the Lower

¹ All Salish languages are extremely endangered. I use ‘endangered’ in the sense of Shaw (1996c), who defines it as ‘up to 600 speakers’, and in the sense of Krauss (1992), whose definition is in terms of the viability classes in (i). Transmission to children as most important factor is stressed also by Nettle & Romaine (2000).

(i) Language Viability Classes (Krauss 1992)

- **safe**: 100,000 or more speakers; being acquired by children
- **endangered**: presently being acquired by children, but will cease to be acquired by children in the next century
- **moribund**: no longer being acquired by children
- **extinct**: no speakers

(See Levine & Cooper 1976, Gardner 1989, and Duff 1998 on the former suppression of Salish languages, a large factor in their present endangerment. First language acquisition of St’á’t’imcets is now rare, but many revitalisation efforts are currently in place.)
dialect, aged 52, and a male native speaker of the Upper dialect, aged 45. Both Upper and Lower data were analysed for the sake of dialectal differences that might show up. See Appendix IV for the carrier forms. Finally, for the sake of documentation, all St’át’imcets data for this chapter are listed together in Appendix V, in underlying, surface, and phonetic form, and orthography.

3.2. Phonemic Inventory
3.2.1 Consonantal Inventory
3.2.1.1 St’át’imcets Underlying Consonantal Inventory. The Lower St’át’imcets underlying consonantal inventory is seen in (1). That of the Upper dialect is the same, except that it has underlyingly /s/ instead of /ʃ/. Post-alveolar /ʃ/ are apical unlike, e.g., English /ʃ/, which are laminal. Glottalised /tʃ/ and emphatic /ʃ/ are alveolar, that is, phonetically [ts'] and [ʃ], respectively. The relative large size of this inventory is due in part to use of labialisation, e.g., for /k'w/, and glottalic egressive airstream ('glottalisation'/'ejection'), e.g., for /k'/, which are sometimes combined, e.g., for /k'w/. I will argue, based on phonological evidence and supporting acoustic and perceptual findings, that St’át’imcets also uses uvularisation, ('emphasis'), e.g., for /k/ (transcribed in other works on St’át’imcets, e.g., van Eijk 1997, as /q/). Uvularisation is sometimes combined with labialisation and/or glottalisation, e.g., on /k'w/ (transcribed elsewhere as /q'w/).

Tables 3:1 and 3:2 present the IPA symbols for St’át’imcets consonants alongside their correspondents in North American (NA) transcription. NA is used by most previous studies of the language, the foremost of which is van Eijk (1997). IPA is used here primarily for its broader set of symbols for encoding phonological and phonetic distinctions. However, most data in this chapter are presented in both IPA and NA to facilitate comparison of my observations and arguments with those of previous works on Salish: as my analysis differs much from previous analyses of St’át’imcets, accessibility for

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1 What do show up are a distinction between emphatic /ʃ/ in the Lower dialect vs. non-emphatic /ʃ/ in the Upper dialect (see §3.2.1), differences in epenthesis (see §3.2.2), and some lexical variation.


3 Consonants not in the tables are denoted by the same symbol in both systems.

4 Where both transcriptions are presented side by side in the text, they are separated by ‘|’. Where appropriate, the dental approximants are NA-transcribed with a ‘retraction’ underdot. (Previous studies have standardly not transcribed retraction for those segments.) My IPA transcriptions will usually exclude syllable breaks and lexical stress, as those properties do not immediately bear on the postvelar harmony to be examined. The NA transcriptions include stress, as standard.
(1) (Lower) St'át'imcets Underlying Consonantal Inventory

<table>
<thead>
<tr>
<th>LAB</th>
<th>DENT</th>
<th>ALV-</th>
<th>POST-</th>
<th>PAL</th>
<th>VEL</th>
<th>UV</th>
<th>GL</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>LAT</td>
<td>ALV</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Obstruents**

**stops:**
- p, t
- p', t'

**affricates:**
- tʰ, tʃ, tʃ'
- tʃ'

**fricatives:**
- ɬ, ʃ, ʃ
- ʃ, ʃ

**Resonants**

**nasals:**
- m, n
- m', n'

**approximants:**
- j, l, l', j, u, u', h
- j, l, l', j, u', u', h
- u', u', u', u'

Salishanists is important. I will argue for reinterpretation of certain St'át'imcets consonants as noted in the tables.

The underlying and surface vowels are presented in (2) and (3). St'át'imcets has an epenthetic vowel, the variant surface quality of which is represented by the following six symbols: non-rtr mid central non-rd /ə/, non-rtr mid central rd /θ̩/, rtr mid central non-rd /ə intimately, rtr mid central rd /θ̩ intimately, rtr mid back non-rd /ʌ intimately, and rtr mid back rd /ɔ intimately. These are discrete surface phonological variants that occur in specific phonological contexts.

(2) St'át'imcets Underlying Vocalic Inventory

<table>
<thead>
<tr>
<th>FRONT</th>
<th>BACK</th>
</tr>
</thead>
<tbody>
<tr>
<td>HIGH</td>
<td>I</td>
</tr>
<tr>
<td>LOW</td>
<td>Æ</td>
</tr>
</tbody>
</table>
### Table 3:1. Correspondence between IPA and NA transcription: obstruents

<table>
<thead>
<tr>
<th>analysis in this chapter</th>
<th>IPA</th>
<th>NA</th>
<th>van Eijk (1997) analysis</th>
</tr>
</thead>
<tbody>
<tr>
<td>a.</td>
<td>/tʃ/</td>
<td>/cʰ/</td>
<td></td>
</tr>
<tr>
<td>b.</td>
<td>/θʃ/</td>
<td>/kʰ/</td>
<td></td>
</tr>
<tr>
<td>c.</td>
<td>/tʃ/</td>
<td>/c/</td>
<td></td>
</tr>
<tr>
<td>coronal emphatic</td>
<td>d.</td>
<td>/tʃ/</td>
<td>/cʰ/ retracted</td>
</tr>
<tr>
<td>e.</td>
<td>/ʃ/</td>
<td>/s/</td>
<td></td>
</tr>
<tr>
<td>coronal emphatic</td>
<td>f.</td>
<td>/ʃ/</td>
<td>/s/ retracted</td>
</tr>
<tr>
<td>g.</td>
<td>/k/</td>
<td>/q/</td>
<td></td>
</tr>
<tr>
<td>h.</td>
<td>/kʰ/</td>
<td>/qʰ/</td>
<td>uvulars</td>
</tr>
<tr>
<td>i.</td>
<td>/kʷ/</td>
<td>/qʷ/</td>
<td></td>
</tr>
<tr>
<td>j.</td>
<td>/kʰʷ/</td>
<td>/qʰʷ/</td>
<td></td>
</tr>
<tr>
<td>k.</td>
<td>/χ/</td>
<td>/ʁ/</td>
<td></td>
</tr>
<tr>
<td>l.</td>
<td>/χʷ/</td>
<td>/ʁʷ/</td>
<td></td>
</tr>
</tbody>
</table>

### Table 3:2 Correspondence between IPA and NA transcription: resonants

<table>
<thead>
<tr>
<th>analysis in this chapter</th>
<th>IPA</th>
<th>NA</th>
<th>van Eijk (1997) analysis</th>
</tr>
</thead>
<tbody>
<tr>
<td>a.</td>
<td>/u/ (Upper dialect)</td>
<td>/z/</td>
<td></td>
</tr>
<tr>
<td>b.</td>
<td>/u'/ (Upper dialect)</td>
<td>/z'/</td>
<td></td>
</tr>
<tr>
<td>c.</td>
<td>/u/ (Lower dialect)</td>
<td>/z/</td>
<td>retracted (implied)</td>
</tr>
<tr>
<td>coronal emphatics</td>
<td>d.</td>
<td>/u'/ (Lower dialect)</td>
<td>/z'/</td>
</tr>
<tr>
<td>e.</td>
<td>/i/</td>
<td>/ɪ/</td>
<td>retracted</td>
</tr>
<tr>
<td>f.</td>
<td>/i'/</td>
<td>/ɪ'/</td>
<td></td>
</tr>
<tr>
<td>g.</td>
<td>/i/</td>
<td>/ɪ/</td>
<td></td>
</tr>
<tr>
<td>h.</td>
<td>/i'/</td>
<td>/ɪ'/</td>
<td></td>
</tr>
<tr>
<td>i.</td>
<td>/u/</td>
<td>/ʊ/</td>
<td></td>
</tr>
<tr>
<td>j.</td>
<td>/u'/</td>
<td>/ʊ'/</td>
<td></td>
</tr>
<tr>
<td>k.</td>
<td>/uʷ/</td>
<td>/ʊʷ/</td>
<td>rounded laryngeal glides</td>
</tr>
<tr>
<td>l.</td>
<td>/uʷ'</td>
<td>/ʊʷ'/</td>
<td>(approximants)</td>
</tr>
<tr>
<td>m.</td>
<td>/u/</td>
<td>/ʊ/</td>
<td></td>
</tr>
<tr>
<td>n.</td>
<td>/u'/</td>
<td>/ʊ'/</td>
<td></td>
</tr>
<tr>
<td>o.</td>
<td>/uʷ/</td>
<td>/ʊʷ/</td>
<td></td>
</tr>
<tr>
<td>p.</td>
<td>/uʷ'</td>
<td>/ʊʷ'/</td>
<td></td>
</tr>
</tbody>
</table>
(3) St'át'imcets Surface Vocalic Inventory

<table>
<thead>
<tr>
<th></th>
<th>FRONT</th>
<th>CENTRAL</th>
<th>BACK</th>
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</thead>
<tbody>
<tr>
<td>NON-</td>
<td>RTR</td>
<td>NON-</td>
<td>RTR</td>
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<td>RTR</td>
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<td>RTR</td>
<td>non-</td>
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<tr>
<td>rd</td>
<td>rd</td>
<td>rd</td>
<td>rd</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th></th>
<th>HIGH</th>
<th>MID</th>
<th>LOW</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>i</td>
<td>æ</td>
<td>a</td>
</tr>
<tr>
<td></td>
<td>u</td>
<td>e</td>
<td>o</td>
</tr>
<tr>
<td></td>
<td>u</td>
<td>æ</td>
<td>æ</td>
</tr>
<tr>
<td></td>
<td>æ</td>
<td>æ</td>
<td>æ</td>
</tr>
</tbody>
</table>

The IPA chart in (4) shows the placement of the St'át'imcets surface vowel symbols in the IPA vowel space, as indirect indication of the impressionistic articulatory distinctions between the St'át'imcets vowels. However, St'át'imcets \( \alpha \) actually seems to correspond to the symbol '\( \Box \)', which I have placed in open central position (see §3.2.2).

(4) IPA Vowels (Revised to 1993)

<table>
<thead>
<tr>
<th></th>
<th>FRONT</th>
<th>CENTRAL</th>
<th>BACK</th>
</tr>
</thead>
<tbody>
<tr>
<td>CLOSE</td>
<td>i • y</td>
<td>ü • u</td>
<td>ü</td>
</tr>
<tr>
<td>CLOSE-MID</td>
<td>æ • Φ</td>
<td>æ • æ</td>
<td>æ • Φ</td>
</tr>
<tr>
<td>OPEN-MID</td>
<td>æ • Æ</td>
<td>æ • æ</td>
<td>æ • Æ</td>
</tr>
<tr>
<td>OPEN</td>
<td>æ • æ</td>
<td>Æ • Æ</td>
<td>Æ • Æ</td>
</tr>
</tbody>
</table>

3.2.1.2 St’át’imcets Surface Consonantal Inventory. St’át’imcets non-emphatic \( /\text{tf}/ \) surfaces as emphatic \( \{\text{tf}\} \) via uvularisation harmony with an underlying emphatic consonant. Exhaustive investigation of the effect of St’át’imcets uvularisation harmony on consonants was not undertaken for this study. Such investigation might reveal that consonants other than \( /\text{tf}/ \) undergo the harmony, and that the surface consonantal inventory then contains additional emphatics. Because this issue is unsettled, the complete surface consonantal inventory remains unclarified here.

Contrary to van Eijk's analysis, data indicate that the Lower dialect surface inventory has two types of dental approximants: non-emphatic \( \{\text{j} \} \) and emphatic \( \{\text{j}’\} \). I will argue that \( \{\text{j}’\} \) arise through de-emphaticisation of \( /\text{j}’/ \) in the context of \(/\text{l}/ \).
3.2.1.3 Previous Analyses of the St’át’ímcets Consonantal System. Van Eijk (1997) analyses the surface consonantal inventory as seen below:

(5) van Eijk (1997) Analysis of the St’át’ímcets Surface Consonantal Inventory

<table>
<thead>
<tr>
<th></th>
<th>LAB</th>
<th>DENT-LAT</th>
<th>DENT-PAL</th>
<th>VEL</th>
<th>UV</th>
<th>LAR</th>
</tr>
</thead>
<tbody>
<tr>
<td>Obstruents</td>
<td>Plos</td>
<td>plain</td>
<td>p</td>
<td>t</td>
<td>c</td>
<td>GHz</td>
</tr>
<tr>
<td></td>
<td>glot</td>
<td>p’</td>
<td>X</td>
<td>c’</td>
<td>k</td>
<td>k’</td>
</tr>
<tr>
<td>Fric</td>
<td></td>
<td>¼</td>
<td>s</td>
<td>x</td>
<td>x’</td>
<td>x’</td>
</tr>
<tr>
<td>Resonants</td>
<td>Nas</td>
<td>plain</td>
<td>m</td>
<td>n</td>
<td>m</td>
<td>m’</td>
</tr>
<tr>
<td></td>
<td>glot</td>
<td>l</td>
<td>l’</td>
<td>l’</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Liq</td>
<td>plain</td>
<td>Z</td>
<td>Y</td>
<td>Y</td>
<td>ʕ</td>
<td>ʕ’</td>
</tr>
<tr>
<td></td>
<td>glot</td>
<td>Z’</td>
<td>Y’</td>
<td>Y’</td>
<td>ʕ’</td>
<td>ʕ’</td>
</tr>
</tbody>
</table>

The major classificational division in (5), and (1), is between obstruents and resonants. Obstruent or resonant status is determined by two phonological criteria, as identified by van Eijk (1997). First, obstruents are not targeted by morphologically-conditioned glottalisation but resonants are. This is illustrated by /m/ in the reduplicative form: /RED, mÆt-k/ {mæ-m’-t-øk} → /RED, mÆt-q/ {má-m’-t-øq} “to go for a walk” (cf. non-reduplicative: /mÆt-k/ {mæt-øk} → /mÆt-q/ {mat-øq} “to walk, go on foot”). Second, obstruents occur interconsonantally and post-consonantally in word-final position but resonants do not. However, the usefulness of this second criterion is diminished by the fact that both obstruents and resonants are frequently immediately preceded by an epenthetic vowel when they are C2 in a /C1C2C3/ or /C1C2/ cluster (see §3.2.2).

The consonants which van Eijk analyses as rounded laryngeal approximants I analyse instead as rounded velar approximants. This is because

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6 In underlying representations, ‘RED’ = reduplicative morpheme. See van Eijk (1997) on St’át’ímcets reduplicative morphology.
7 Van Eijk (1997:4) claims a third criterion, stating “[t]he dental, velar and uvular glides (z z’ y y’ ʕ ʕ’ ʕ’ w ʕ’ w’) are classed as resonants, rather than as voiced fricatives, because... they oppose plain vs. glottalized members (like m m’ n n’ l l’ l’ y y’ w w’, but unlike the fricatives).” However, as noted by Remnant (1990:46-47), this is non-sufficient because the stops and affricates also oppose plain and glottalized members. See Blake (1992, 1995) for phonological criteria for determining the obstruent or resonant status of consonants in Sliammon (Central Salish).
perceptual and acoustic observations indicate they are phonetically labiovelar [w w']. They are not [h[w h'w]] (rounded laryngeals), as would follow from van Eijk's classification. (Van Eijk 1997:253 in fact suggests my analysis, stating in a note: "[w]e could also class w w' as the rounded counterparts of \( \gamma \gamma' \).")

St'át'imcets is one of the supposedly very few languages of the world that have velar approximants. Ladefoged & Maddieson (1996:322) state that /u/ is crosslinguistically more rare than other rare approximants such as labial-palatal /u/, which occurs in less than 2% of the world's languages.

We now examine the articulation of the consonants which I claim are emphatics, i.e., (d,f-l) in Table 3:1, (c-f) in Table 3:2. The description will be based on perceptual observations, primarily those of van Eijk (1997), since there are no articulatory data on Salish. I then summarise previous theoretical accounts of those consonants.

Van Eijk (1997:10) describes the articulation of the uvular obstruents as follows. "The articulation point of the uvulars is quite close to that of the velars; the fricatives \( \times^{\text{w}} \times^{\text{w}} \) have a rather sharp friction (and a rather high degree of stridency) which sets them apart from the velars x x'w (in the same way, q' q'w are distinguished mainly by their fricative off-glide from q' q'w)."

Regarding vowel quality in the environment of these segments, he states [p.11]: "the main variants of ...a i u are [\( \varepsilon \varepsilon \varepsilon \)] when not in the position \(?Q\), but [a \( \varepsilon /\varepsilon \varepsilon \)] when in the position \(- (?Q)\)". (He states [p.3] that [\( \varepsilon \)] "resembles the vowel of German 'Mehl'".) The qualities [a \( \varepsilon /\varepsilon \varepsilon \)] are the same as those he ascribes [p.3] to \( \{a \ i \ u\ \} \), which he refers to as 'retracted' vowels. His generalisation, then, is that /a i u/ surface retracted when \(- (?Q)\). He explains [p.8] that he uses 'Q' to denote "any uvular". His description of vowel quality implies that /\( I \ AE \ U/\) have retracted quality immediately preceding all uvulars.

The phonological and acoustic database for this study indicates otherwise for /\( I \ AE /\). We will see that /\( I \ AE /\) surfaces as backed \( \{a \} \) immediately preceding uvular obstruents (to be reanalysed as emphatic velars) but not uvular approximants. In the latter context, it surfaces as front \( \{\varepsilon \} \).

The St'át'imcets dental approximants are rhotics.\(^8\) Van Eijk (1997:4) describes them as:

lax fricatives, varying from a purely dental articulation (with the tongue-tip more forward than in English 'z') to an interdental pronunciation (where z z' sound somewhat like lax variants of English voiced "th"). The former pronunciation is generally more common in the Fountain dialect (F) [Upper St'át'imcets], whereas the latter is more common in the Mount Currie dialect.

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8 Rhotics vary in manner and place. See Ladefoged & Maddieson (1996:244-245) on the elusiveness of the phonetic property that might unite this class.
POSTVELAR HARMONY

(M) [Lower St'át'ímcets]... after vowels, z' in M allows the variant [l'] besides [z']...9

The frication frequently observed for these segments is attributable to aerodynamic coincidence or to their rhoticity. The former is possible because frication is frequently observed for approximants in a voiceless context, that context inducing phonetic devoicing of the approximant, resulting in turbulent airflow (see §2.2.1). The latter is possible because, as observed by Ladefoged & Maddieson (1996:232), “[t]he family of rhotics also includes [besides trills] members in which there is no contact, but instead only an approximation between the articulators. In some instances the typical production is accompanied by friction, in others an approximant is produced.” Based on Ladefoged & Maddieson’s survey, frication for a rhotic is not unusual. I leave for future study determination of whether the frication of St'át'imcets approximants is confined to a voiceless context or a free variable property. Finally, I assume that the dental approximants’ lateral articulation follows from the fact that they are rhotics, as rhotics in several languages have been documented with varying lateral and rhotic articulation.10

Van Eijk (1997:8) notes that in the Lower dialect, retracted \( \langle a u \rangle \) are observed immediately preceding the dental approximants, but retracted \( \langle i o \rangle \) are not. Based on this generalisation with respect to \( \langle a u \rangle \), Egesdal & Thompson (1993) refer to the St’át’ímcets dental approximants as ‘retracting’ consonants and describe them as ‘velarised’. Egesdal & Thompson note a dialectal variation, namely, that in certain St’át’ímcets forms, the low vowel does not occur retracted immediately preceding a dental approximant. Van Eijk’s (1997) descriptive generalisation is: the Lower dialect has \( \langle a \rangle \) where the Upper dialect has \( \langle a' \rangle \) immediately preceding one of those consonants. Egesdal & Thompson’s (1993:100,103) analysis is: “Li [Lillooet, i.e., St’át’ímcets] z retracts preceding vowels” and the Upper dialect pattern results from a dental approximant that “may be losing its retractive effect on a preceding vowel.”

Van Eijk (1997:3) describes post-alveolar \( \langle c s \rangle \) and alveolar lateral \( \langle l l' \rangle \) as velarised, stating that \( \langle s \rangle \) “resembles” Arabic \( s a d \) (ﻮ = /s/). This

9 Van Eijk (p.c.) defines ‘lax’ as meaning that “there is an almost complete relaxing of the tongue muscles, with just enough energy left to make the required articulation”. I interpret this as a description of one aspect of approximant manner. Should it refer to retraction of the tongue (back and root), such implementational properties are consistent with the postvelar identity of the z(') for which I argue.

10 See Ladefoged & Maddieson (1996:243) for examples of this in several West African languages discussed by Ladefoged (1968), and in Japanese as described by Shimizu and Dantsuji (1987).
identification of Salish retraction with Arabic emphasis suggests that van Eijk (and Egesdal and Thompson) may have used 'velarised' to mean 'uvularised'. (See §1.4.2 on 'velarised' as a term formerly used for emphatics.)

Following Kuipers (1973, 1981), van Eijk (1997) describes \{c s I'} as occurring in 'retracted roots', of which he distinguishes four types:11

(6) van Eijk's (1997:29) Four Types of Retracted Roots

a. roots in which retraction affects all phonemes that take part in the retraction, i.e., vowels and /c s l l'/: e.g., \{qe I'} "bad"

b. roots in which retraction is only partially applied, that is, in which phonemes that occur retracted in other forms do not occur retracted; e.g., \{c'ip'-em\} "to pinch", which contains \{i\}, not \{i\}

c. roots with a retracted vowel and only neutral consonants, i.e., consonants other than /c s l l'/; e.g., \{pe m\} "fast"

d. one root with only neutral consonants but which acts as a retracted root, e.g., \{n-c'n'-a'-us-em\} "to take aim, intr.", in which root \{c'n\} co-occurs with a suffix that contains retracted segments

His analysis implies that words with retracted vowels or \{c s I'} for which the retraction of those segments cannot be attributed to any segmental source, that is, to an immediately following uvular obstruent or Lower dialect dental approximant, must be analysed as 'retracted roots'.

Previous theoretical accounts of St'át'imcets retracted consonants and uvulars, Remnant (1990) and Bessell (1992), focus on the retracted consonants. They assume that the underlying consonantal inventory contains all segments in (5), except \{c s l l\}. They analyse \{c s l l\} as surface retracted consonants, outputs of morphemic retraction triggered by retracted roots as identified by van Eijk, and analyse vowel alternations in the context of an immediately following uvular obstruent or dental approximant as retraction of the vowels induced by those consonants.

3.2.1.4 Guttural Postvelars. St'át'imcets has 16 underlying postvelars. Of them, four are gutturals: /h u' u'w u'w'/. The laryngeals /h ?/, lacking any articulation, are excluded from the guttural, and the postvelar, class (see §1.3.1). The uvular approximants /h u' u'w u'w/ are gutturals because they are wholly articulated in the postvelar region of the vocal tract. Van Eijk (1997) classifies them as uvulars but describes them [p.4] as "lax... pharyngeal glides

\[11\] In this chapter, where data are presented from a source other than my fieldnotes, the transcription of the other source is retained.
pronounced with a wide aperture (the articulation of \( \k, \k' \) is farther back than that of the uvular obstruents).” The present database indicates their articulation is sometimes post-uvular but usually uvular. (An example of a form in which the less frequent post-uvular articulation often occurs is /\( \w u \)\( u \)\( j \)'t/ \( \sim \) /\( \w u o \)\( j \)'t/ \( \sim \) /\( \w u y \)\( u \)'t/ \( \sim \) /\( \w u y \)\( o \)'t/ “to sleep,” where ‘\( j \)' denotes a more posterior articulation.) I assume the post-uvular articulation is a phonetic effect, though further research is needed to confirm this and to identify its context(s) of occurrence. (Alternatively, there could be a phonologically determined complementary distribution between the two articulations, indicating that the post-uvular variant is part of the surface consonantal inventory.) The approximant manner of articulation of Salish /\( b'  b'  b'  w' \) was observed by Kinkade (1967) and is documented and discussed by Bessell (1992, 1993a, 1993b). In the present acoustic study, tokens of St’át’imcets /\( b'  b'  b'  w' \) were observed to be high amplitude, with robust formant structure (see Figure 3:7), which supports their classification as approximants. Word-initially, they are occasionally initially devoiced and, in the voiceless interval, produced with frication.\(^{12}\)

3.2.1.5 Emphatic Postvelars. The aim of this section is to show that St’át’imcets has 12 emphatics: /\( t  j  j'  j' \) /\( k  k'  k'  k'  w  x  w' \). The /\( j  j' \) occur only in the Lower dialect. The label ‘emphatic’ has an analytical implication. It implies that the segments just listed form a phonological class which is found in other languages, such as Arabic. It has a theoretical implication, too, that, as emphatics, they have certain phonological representations grounded in particular presumed articulations: a primary non-postvelar articulation, uvularisation, and pharyngealisation (see §1.4.2). Emphatics are postvelars because, given the last two gestures just listed, they are partly articulated in the postvelar region of the vocal tract. The emphatic velars /\( k  k'  k'  k'  w  x  w' \) are exceptions, as they are produced with primary uvular articulation and pharyngealisation. I assume that, for each of /\( k  k'  k'  k'  w  x  w' \), the phonological primary velar and secondary uvular components are phonetically realised as a single primary uvular articulation. The same is assumed for Arabic /\( k' \). (See §1.4.2 for more on this fusion explanation, which is not at all original to me.). Thus, although /\( k  k'  k'  k'  w  x  w' \) are phonologically emphatics, they are wholly articulated in the postvelar region.

\(^{12}\) See Bessell (1992, 1993b) for spectrograms showing these properties for voiced gutturals in Shuswap (Northern Interior Salish), and Colville, Nxa’amxcin, Spokane, Kalispel, and Coeur d’Alene (Southern Interior Salish).
This identification of St'át'imcets' emphatics clarifies the segmental system of the language and reveals its greater simplicity than heretofore recognised. It is based on phonological evidence and supporting acoustic and perceptual findings. It is essential if we are to identify the true phonological nature of the segments at issue. In what follows I first clarify preliminary issues relevant to the emphatic status of the Lower dialect dental approximants and the consonants previously analysed as retracted \( \text{\textsuperscript{\textprime}} \text{c s l} \). I then present the perceptual support and, most importantly, the phonological evidence. Two remaining issues are then discussed: de-emphatisation of Lower dialect \( \text{\textprime} \text{i} / \), and exceptional forms with a floating uvularisation ('emphasis') feature. Finally, I present the acoustic support.

3.2.1.5.1 Dialectal Variation in Dental Approximant Retraction. In the Lower and Upper dialect forms in (7) and (8), /Æ/ occurs immediately preceding a dental approximant. (For pre-analytic presentation, the consonants at issue are transcribed in (7) and (8) without any retraction diacritic.) The first set shows that Lower dialect /Æ/ surfaces as backed \( \{ \text{a} \} \) immediately preceding a dental approximant. The second shows that in the same context Upper dialect /Æ/ surfaces front \( \{ \text{e} \} \) or \( \{ \text{a} \} \).

(7) Lower St'át'imcets Forms (without any retraction diacritic)

| a. IPA /\textipa{fi}l\textipa{Ei}/ | \{\textipa{fi}l\textipa{au}'\} | \{\textipa{fi}l\textipa{eau}'\} | canoe |
| NA /\textipa{xe}l\textipa{Ez}'/ | \{\textipa{xe}l\textipa{az}'\} | \{\textipa{xe}laz\} |
| b. IPA /\textipa{xn}l\textipa{Ei}'/ | \{\textipa{xn}j\textipa{-au}'\} | \{\textipa{xn}j\textipa{-eau}'\} | gooseberry |
| NA /\textipa{xn}l\textipa{Ez}'/ | \{\textipa{xn}j \textipa{z}-az'\} | \{\textipa{xn}j\textipa{z}-az\} | bush |
| c. IPA /\textipa{mx}\textipa{Ei}'/ | \{\textipa{mx}\textipa{au}'\} | \{\textipa{mx}\textipa{eau}'\} | huckleberry |
| NA /\textipa{mx}\textipa{Ez}'/ | \{\textipa{mx}\textipa{az}'\} | \{\textipa{mx}az\} | (Lower dialect) |

(8) Upper St'át'imcets Forms (without any retraction diacritic)

| a. IPA /\textipa{fi}l\textipa{Ei}/ | \{\textipa{fi}l\textipa{eau}'\} | \{\textipa{fi}l\textipa{au}'\} | canoe |
| NA /\textipa{xe}l\textipa{Ez}'/ | \{\textipa{xe}l\textipa{az}'\} | \{\textipa{xe}laz\} |
| b. IPA /\textipa{xn}l\textipa{Ei}'/ | \{\textipa{xn}j\textipa{-eau}'\} | \{\textipa{xn}j\textipa{-au}'\} | gooseberry |
| NA /\textipa{xn}l\textipa{Ez}'/ | \{\textipa{xn}j \textipa{z}-az'\} | \{\textipa{xn}j\textipa{z}-az\} | bush |
| c. IPA /\textipa{-u}\textipa{Ei}x\textipa{Ei}/ | \{\textipa{-u}\textipa{eau}\textipa{-x}\textipa{eau}\} | \{\textipa{-u}\textipa{au}\textipa{-x}\textipa{eau}\} | something that |
| NA /\textipa{s}\textipa{Ez}x\textipa{Ei}/ | \{\textipa{s}\textipa{z}-x\textipa{al}\} | \{\textipa{s}\textipa{z}-x\textipa{al}\} | one has piled up |

Observing this dialectal difference, Egesdal & Thompson (1993:103) analyse lack of \( \text\{\text{a}\} \) preceding Upper \( \text\{\text{u}\} \) as indicating a dental approximant that is "losing velarisation". Avoiding diachronic claim, I analyse the variation between (7) and (8) as showing that the synchronic nature of these consonants
differs across the two dialects, namely, in the terms of van Eijk and Egesdal & Thompson, and under the analysis ‘a retracted consonant retracts an immediately preceding vowel’, that only underlyingly retracted /t̚ ʃ/ O /z̚ z̚/ occur in the Lower dialect and only underlyingly non-retracted /t̚ ʃ/ O /z̚ z̚/ occur in the Upper dialect.

3.2.1.5.2 Underlying Retracted /ɛ ʂ / I/. Previous analyses of St'át'imcets have claimed that the retracted /ɛ ʂ / I/' occur in ‘retracted roots’. Remnant (1990) and Bessell (1992) account for them as products of morphemic retraction, that is, as underlying non-retracted /ɛ ʂ / I' which surface as /ɛ ʂ / I/ via a floating retraction feature lexically associated with specific roots. A retraction feature associated with certain root morphemes was proposed by Kuipers (1973, 1981, 1989) for Salish languages including Nxa'amxcin, Okanagan, Colville, Spokane and Coeur d'Alene (all Southern Interior Salish). However, Bessell & Czaykowska-Higgins (1991:5-7) argue, based on distributional evidence, that Salish retracted consonants are actually underlyingly retracted. Discussing retracted roots in Nxa'amxcin, they state:

In Nxa'amxcin retraction on alveolar consonants and on vowels... is not predictable in roots... Of these 56 roots [their retracted root corpus], 22 contain no underlying vowel. The existence of so many vowelless retraction roots indicates that retraction cannot be underlyingly associated with vowels. There thus remain two options: 1) that it is a floating feature; 2) that it is associated with consonants underlyingly... [E]very retracting root in Nxa'amxcin contains at least one alveolar consonant... Given the correlation between retraction and the presence of an alveolar in the root, we suggest that retraction is an underlying property of alveolar consonants, and that, therefore, Nxa'amxcin has two series of alveolars, one retracted and the other unretracted.

Retracted morphemes in the van Eijk (1987) St'át'imcets dictionary are as summarised in (9). 13

---

13 The count of retracted morphemes in (9) excludes Lower dialect forms with a retracted vowel immediately preceding a dental approximant, e.g., /pazi'snək/ "young bird of any kind" (Lower dialect) (van Eijk 1987:40), as retraction of such a vowel is attributable to the immediately following /z̚/. (Van Eijk 1987 contains no retracted roots in which a retracted vowel immediately precedes a uvular obstruent, in which vowel retraction would be attributable to the uvular.) Roots were identified as vowelless if their only vowel is transcribed by van Eijk as ə or ø, based on the evidence of Kinkade (1993, 1996), Czaykowska-Higgins (1993), Matthewson (1994), Shaw (1996b), and Willet & Czaykowska-Higgins (1995) that those vowels are not underlying. See §3.2.2.
(9) St’át’imcets Retracted Morphemes

175 (172 roots, 3 suffixes)

vowelless
44 (all roots)

vowelful
131 (128 roots, 3 suffixes)

with one without any with one without any
of \{ç š \}' \} of \{ç š \}' \} of \{ç š \}' \} of \{ç š \}' \}
29 15 104 (102 roots, 2 suffixes) 27 (26 roots, 1 suffix)

The 29 vowelless retracted roots with one of \{ç š \}' \} are listed in (10).
(For roots which are not glossed in the dictionary, an example word containing
the root is given. The symbol \("\) marks a rarely used form. Page numbers refer
to van Eijk 1987. The other retracted roots will be discussed later in this
section.) The data in (10) of course contrast with a great number of forms with
one of \{ç š \}' \} and no retracted segments, e.g., \{tʃuʃin\} \{cúcin\} “mouth”;
\{kætæ\} \{katás\} “three”; \{n-kəl-kl-uʃ\} \{n-kəl-kl-us\} “to go in front
of the houses”; \{k’æel’-æn’\} \{k’al’-án’\} “to listen (intr.)”, etc.

(10) St’át’imcets Vowelless Retracted Roots Containing One of \{ç š \}' \} (from van Eijk 1987)

a. /pʃ/ (?!) cf. \{n-pə ſ- pə ſ- ſ- ni w’t\} “soft spot on side of body,
between lowest rib and hip” [p.29]

b. /plxʷ/ cf. \{pə ſ-xʷ-án\} “to stick something out (from something)
(tr.)” [p.34]

c. /p’s/ “protruding (?)” [p.42]

d. /m’s/ cf. \{m’ə ſ- m’ə ſ\} “willow grouse, ruffed grouse” (Lower
dialect) [p.48]

e. /ts/ cf. \{t ſ- ſ-p\} “to trill, vibrate (like something hollow being
struck or a table when hit with a fist; sound made by a
squirrel” [p.56]

f. /tʃ/ cf. \{tʃ ʃ- ʃ-an\} “to spin string from a ball (tr.)” [p.58]

g. /cm’qʷ/ cf. \{c ʃ- m’c ʃ-m’qʷ\} “to sink into the mud; (road) is
muddy” [p.68]

h. /ççʃ/] cf. \{ʃ- ç ʃ- ç ʃ- ʃ\} “(deerhoof) rattle” [p.69]
A third hypothesis with respect to retracted roots in general is that the retraction observed in each root is underlyingly the property of the retracted consonants, in other words, that the \( /ç\) are underlyingly \( /ç\). This is the conclusion of Bessell & Czaykowska-Higgins (1991) for Nxa’amxcin retracted roots, as discussed above, based on their examination of parallel Nxa’amxcin data. A second hypothesis is that the retraction is underlyingly a floating feature associated with the root morpheme, as proposed by Kuipers.\(^{14}\)

\(^{14}\) A third hypothesis with respect to retracted roots in general is that the retraction is underlyingly the property of a vowel. The roots in (10) are vowelless so this is disqualified with
The crucial observation is that each root in (10) contains one of \{c $\approx$ l $\prime$\}. A floating feature analysis would claim that (i) the St'át'imcets underlying consonantal inventory contains non-retracted /c s l $\prime$/ and does not contain /c $\approx$ l $\prime$/; (ii) each underlying root in (10) contains a floating retraction feature; (iii) /c s l $\prime$/ participate in a phonological alternation whereby they surface retracted in roots which contain a floating retraction feature and as non-retracted in roots which do not.

However, the problem is that St'át'imcets /c s l $\prime$/ do not form a natural class. Consider the representations in (11), which I assume for the St'át'imcets coronals /t tf' $\tilde{t}$ tf' $\tilde{t}$ n n' l $\prime$/ (The [STRID] specification for affricates follows Shaw 1989, 1991b and LaCharité 1993.)

Assuming (11), /t tf' $\tilde{t}$ tf' $\tilde{t}$ n n' l $\prime$/ are not a natural class: they are not the class of (primary) [COR] consonants, as /t tf' $\tilde{t}$ tf' $\tilde{t}$ n n' l $\prime$/ are also specified for [COR]. Nor are they a natural [COR] subclass. St'át'imcets has several [COR] subclasses: e.g., those specified for ([COR] and) [STOP], [LAT], [CG], [STRID], or [SON]. As seen, /t tf' $\tilde{t}$ tf' $\tilde{t}$ n n' l $\prime$/ are not all specified for a certain one, or set, of these features, where that feature or set of features is not borne by any of /t tf' $\tilde{t}$ tf' $\tilde{t}$ n n' l $\prime$/.

Natural classes define the set of segments participating in a phonological alternation or define a conditioning environment for the alternation (Kenstowicz 1994:19). Stated differently, claim (iii) of a floating feature analysis is that /t tf' $\tilde{t}$ tf' $\tilde{t}$ n n' l $\prime$/ is the set of segments participating in a retraction alternation conditioned by the environment of a floating retraction feature. The obvious problem is that since /t tf' $\tilde{t}$ tf' $\tilde{t}$ n n' l $\prime$/ are not a natural class, they cannot participate in an alternation. A floating feature analysis is thus untenable.

On the other hand, the fact that /t tf' $\tilde{t}$ tf' $\tilde{t}$ n n' l $\prime$/ are not a natural class confirms a consonantal analysis. Since they are not a natural class, the St'át'imcets phonology cannot reference them to the exclusion of all other segments, and a retraction feature thus cannot become associated with them in the phonology. In other words, the association between a retraction feature and each of /t tf' $\tilde{t}$ tf' $\tilde{t}$ n n' l $\prime$/ is not predictable. Because unpredictable properties are underlying, I conclude that \{c $\approx$ l $\prime$\} in (10) are underlyingly retracted /c $\approx$ l $\prime$/.

Now we wonder if \{c $\approx$ l $\prime$\} are underlyingly retracted also in morphemes that contain an underlying vowel, or if the retraction in such respect to those forms. I discuss the possibility that St'át'imcets retraction might be underlyingly the property of a vowel in some roots shortly.
(11) Representations of St'át'imcets Coronals /t t̓ tf tf̓ tf̓ t̓ n n̓ l l̓ /

\[
\begin{array}{ccc}
/t/ & /t̓/ & /tf/ \\
| \text{oPlace} & | \text{oPlace} & | \text{oPlace} \\
| \text{[CG]} & | \text{[COR]} & | \text{[COR]} \\
| \text{[COR]} & | \text{[STRID]} & | \text{[STRID]} \\

/t̓f/ & /tf̓/ & /tf̓/ \\
| \text{oLaryngeal} & | \text{oLaryngeal} & | \text{oLaryngeal} \\
| \text{[CG]} & | \text{[COR]} & | \text{[COR]} \\
| \text{[COR]} & | \text{[STRID]} & | \text{[STRID]} \\

/n/ & /n̓/ & /l/ \\
| \text{oPlace} & | \text{oPlace} & | \text{oPlace} \\
| \text{[COR]} & | \text{[COR]} & | \text{[COR]} \\

/
̓/ & /l̓/ \\
| \text{oPlace} & | \text{oPlace} \\
| \text{[COR]} & | \text{[COR]} \\
| \text{[SON]} & | \text{[SON]} \\
\end{array}
\]
forms could be underlingly the property of the vowel. Some of the 104 vowelful retracted morphemes with one of \{ç s š l\} are presented in (12).\textsuperscript{15}

Younes (1982:41-46,60-71) addresses this issue with respect to emphasis in Palestinian Arabic. He rejects a vocalic analysis of Palestinian emphasis on two grounds. The first is acoustic and concerns non-low vowels. Data, which he provides, show that in the context of an emphatic, the Arabic non-low vowels do not have a steady lowered F\textsubscript{2}. (See also our Figures 2:42 and 2:43.) He interprets a steady lowered F\textsubscript{2} as an emphatic acoustic target (as have we). His finding, then, is that tokens of the non-low vowels do not have an emphatic target. He argues that this is a problem for a vocalic analysis because if the non-low vowels were the underlying source of the emphasis, an emphatic target would be expected. Because the acoustic data show no emphatic target, he concludes that the non-low vowels are not underlingly emphatic. For St'át'imcets, underlingly retracted high vowels in roots like (12b) would predict that tokens of such high vowels would have a retracted acoustic target. We will see in §3.5.3 that they do not (see Figure 3:58). This counters a vocalic analysis of forms like those in (12).

(12) St'át'imcets Vowelful Retracted Roots with One of \{ç s š l\}
(from van Eijk 1987)

\begin{align*}
a. \text{/pÆ l/} & \quad (?) \text{ cf. \{p a l - p ø l - t\} “stubborn” [p.33]} \\
b. \text{/mU l/} & \quad (?) \text{ cf. \{m u l-k\} “to stand or lie back to back” [p.51]} \\
c. \text{/q’yÆ s/} & \quad “protruding (?)” [p.229] \\
d. \text{/x wÆ s/} & \quad \text{ cf. \{x w-a - x w-s \} “forked (e.g., frame of a slingshot)” [p.259]} \\
\end{align*}

Younes' second ground is distributional and concerns the low vowels. The backed variants of the Palestinian low vowels occur in a word containing an emphatic; the front variants do not (blocked contexts ignored). That is, the two variants are in complementary distribution. He takes this as strong indication that the backing of the low vowels is due to the emphatic consonant. For St'át'imcets non-high vowels, (13) presents pairs of forms from van Eijk (1987) in which the epenthetic vowel and /Æ/ occur immediately preceding one of non-retracted \{ç s š l\}, vs. immediately preceding one of retracted \{ç s š l\} in a retracted root.

\textsuperscript{15} The two retracted suffixes in this set are \{-alín\ “container (?)” [p.347] and \{-ulya?\ “matter (?)” [p.349].
The generalisation is: the epenthetic vowel and /Æ/ surface non-retracted when immediately preceding one of non-retracted \( \text{i}c \ s \ l \ l' \). When immediately preceding one of retracted \( \text{i}c \ s \ l \ l' \) in a retracted root, they surface retracted. That is, for each non-high vowel, the non-retracted and retracted variants are in complementary distribution. Given this, following Younes, I analyse the retracted vowels in each (ii) form in (13) as conditioned by the immediately following retracted consonant. This further counters a vocalic analysis of (12).

(13) (data from van Eijk 1987)

a. i. /c'l/ \( \{c's\l\} \) “edge, rim, fence” [p.84]
   ii. /c' l s/ \( \{c'o l s\} \) “kingfisher” [p.85]

b. i. /4c-xÅl/ \( \{4oc-xâl\} \) “to pile up big objects (intr., tr.)” [p.135]
   ii. /4ç/ \( \{4o ç\} \) “to cave in, get caved in” [p.135]

c. i. /m/Ål-n/ \( \{mâl-en\}\) “to raid (them) (tr.)” [p.50]
   ii. /m/Ål-ÅlUs/ \( \{m'a]-alus\} \) “raccoon” [p.51]

d. i. /4Åsm/ \( \{4ás-em\}\) “Indian rice” [p.135]
   ii. /4Ås/ \( \{4a s\} \) “driftnet” [p.135]

However, the following grounds alone are sufficient to disqualify a vocalic analysis. That analysis would claim that /c s l l'/ participate in a phonological alternation whereby they surface as retracted \( \{c s l l'\} \) in roots with an underlying retracted vowel. As shown earlier, /c s l l'/ cannot participate in a phonological alternation because they are not a natural class. I conclude that vowels in retracted roots like those in (12) are not underlyingly retracted and that \( \{c s l l'\} \) are underlying /c s l l' in retracted roots that contain a vowel.

3.2.1.5.3 Perceptual Support for the Claim that the Retracted Consonants and Uvular Obstruents are Emphatics. There is perceptual support for the claim that the St'át'imcets retracted consonants and uvular obstruents are emphatics. In a pilot perceptual study, four literate adult native Arabic speakers (three Palestinian speakers, one Syrian speaker) judged whether tokens of St'át'imcets retracted consonants, and uvular and velar obstruents were Arabic \( \text{s}ln (\text{s} = /s/) \) or \( \text{s}d (\text{d} = /\text{d}/) \), \( \text{dål} (\text{d} = /\text{d}/) \) or \( \text{då} (\text{d} = /\text{d}/) \), \( \text{lam} (\mathfrak{z} = \mathfrak{n}) \) or \( \text{lam} (\mathfrak{z} = \mathfrak{n}) \) or \( \text{lam} (\mathfrak{z} = \mathfrak{n}) \)
mfuΧΧama (ลม in \{?ΛΛ. s^h\} ‘God’, denoted by the judges as ‘J’),\(^{16}\) kāf (ках = /k/) or qāf (ق = /k/). (Recall that St’át’imcets /ʃ/ is produced with phonetic alveolar articulation like Arabic /s/.) All the judges were linguistically untrained. They were presented with two tokens each of nine real St’át’imcets words, each of which contained a retracted consonant, or a uvular or velar obstruent. The words were spoken by a native speaker of Lower St’át’imcets.\(^{17}\) The judges were instructed to pay attention to a specified consonant sound in each word and to write the Arabic letter corresponding to what they perceived it to be. They were permitted to listen to the tokens of each word up to four times. The carrier words and the judges’ written responses are presented in Table 3.3. (*J* = judge.)

<table>
<thead>
<tr>
<th>CARRIER WORD</th>
<th>JUDGMENT</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Task:</strong> Please write the Arabic sound you hear...</td>
<td>J1</td>
</tr>
<tr>
<td>1. right after n in {n-*q^o^} {n-s^a^}</td>
<td>“to drool, slobber (e.g., like cows)”</td>
</tr>
<tr>
<td>2. that’s like l in the middle of {n-*q^o^} {n-s^a^}</td>
<td>“to drool, slobber (e.g., like cows)”</td>
</tr>
<tr>
<td>3. at the end of {m^e^x} {m^e^x}</td>
<td>“huckleberry” (Lower dialect)</td>
</tr>
<tr>
<td>4. at the end of {f^i^k} {c^i^k}</td>
<td>“fish, (any kind of) salmon”</td>
</tr>
<tr>
<td>5. at the beginning of {k^o^} {q^o^}</td>
<td>“bad; old, worthless (e.g., clothing)”</td>
</tr>
<tr>
<td>6. at the end of {k^o^} {q^o^}</td>
<td>“rose”</td>
</tr>
<tr>
<td>7. at the end of {m^a^k} {m^o^q}</td>
<td>“to get stuffed, to eat too much” (fem. name)</td>
</tr>
<tr>
<td>8. at the beginning of {k^o^u} {k^o^}</td>
<td>“constipation”</td>
</tr>
<tr>
<td>9. right after n in {n-k^a^x} {n-k^a^x}</td>
<td>“constipation”</td>
</tr>
</tbody>
</table>

\(^{16}\) There is no Arabic letter to denote /l/ as distinct from non-emphatic /n/.

\(^{17}\) The speaker also acquired the Upper dialect as an adult. Her bidialectal speech showed up in the tape-recorded words in a varying alveolar lateral ~ interdental articulation of the dental approximants (the former typical for the Upper dialect, the latter typical for the Lower dialect).
As seen, the judgments were identical for all the judges, except for minor disagreement over /j/ /j/. The important result is that the overall emphatic identification was very strong. This is preliminary indication that it makes sense to describe the St'át'imcets retracted consonants and uvular obstruents as emphatics, and constitutes some support for assuming that they are produced with articulation similar to that of Arabic emphatics. The procedure of a fuller perceptual study could involve elicitation of acceptability judgments from Arabic speakers for Arabic words into which St'át'imcets /j j j' j' j' j' / and /k k k k k x x x x x x x x/ had been spliced, and from St'át'imcets speakers for St'át'imcets words with spliced-in Arabic emphatics. I expect such further testing would confirm the preliminary results here.

3.2.1.5.4 Phonological Evidence. Most important is the phonological evidence that St'át'imcets retracted consonants and uvular obstruents are a class of underlying coronal and velar emphatics, /tʃ tʃ tʃ tʃ tʃ tʃ tʃ / and /

\[k k' k w k' w k' w k' w k' w /, respectively. This claim, with respect to the retracted consonants, is not entirely new. Previous literature has suggested a connection between Salish retracted consonants and Arabic emphatics. Van Eijk (1997:3) describes St'át'imcets' retracted /s/ as velarised, resembling the Arabic emphatic s ā d. ‘Velarised’, used also by Egesdal & Thompson (1993), was an early term for Arabic emphatics. Bessell (1992:74) states that Salish and Arabic both have ‘pharyngealised’ consonants, another term previously used for Arabic emphatics. (See §1.4.2.) Bessell & Czaykowska-Higgins (1991:7) describe the phonetic and phonological effects of retraction as “similar to those of Arabic emphasis”, retracted consonants being “parallel” to Arabic emphatics. The phonetic similarity is observed also by Bessell (1997). My claim that the uvular obstruents are emphatic velars is new.

First consider independent evidence that St'át'imcets retracted consonants and uvular obstruents form a natural class. St'át'imcets has what van Eijk (1997:9) refers to as a morpheme structure constraint banning roots of

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18 An alternative interpretation of the results is that they do not show that the retracted consonants and uvulars were perceived as emphatics, only that, given the forced-choice task, the Arabic emphatics were just the closest thing around. I dismiss this interpretation because the judgments for /j j j' j' k k' / were absolutely clear. That indicates they were not adjustments to the closest available category, as for an English speaker categorising French [y] as [iu] (see Paradis & LaCharité 1997), but assignment to an available category, ‘emphatic’, one on which native Arabic speakers are experts since their Arabic sound categorisation in infancy (Jusczyk 1997).
the type CVQ, where ‘Č’ = a retracted consonant, ‘Q’ = uvular obstruent.\textsuperscript{19} This indicates that the retracted consonants and uvular obstruents share some phonological feature(s) on the basis of which they form a natural class to the exclusion of all other consonants, including uvular resonants.

Acoustic findings which support the assumption that the retracted consonants are produced with the postvelar gestures of emphatics will be reported at the end of this section. Anticipating those findings and based on the perceptual support reported above, I claim that the retracted consonants are emphatics with the representation in (14). They have specification for secondary-[DOR] and secondary-[RTR]. This was proposed in chapter 2 as representation of secondary uvular articulation. As it includes representation of secondary pharyngeal articulation (secondary-[RTR]), the pharyngealisation follows automatically from the uvularisation.

\begin{equation}
\text{(14) Representations of St'át'imcets Coronal Emphatics /}^*\text{ } /\text{ }^*\text{ } /\text{ }^*\text{ } /\end{equation}

\begin{center}
\begin{tikzpicture}
  \tikzstyle{place}=[circle, draw, inner sep=0pt, minimum size=0.5cm, fill=white]
  \tikzstyle{features}=[rectangle, draw, inner sep=0pt, minimum size=0.5cm, fill=white]
  \node [place] (p) at (0,0) {$0\text{ Place}$};
  \node [features] (f1) at (0.5,0) {$[\text{COR}]$};
  \node [features] (f2) at (1,0) {$[\text{DOR}]$};
  \node [features] (f3) at (1.5,0) {$[\text{TR}]$};
  \node [features] (f4) at (2,0) {$[\text{RTR}]$};
  \draw [->] (p) -- (f1);
  \draw [->] (f1) -- (f2);
  \draw [->] (f2) -- (f3);
  \draw [->] (f3) -- (f4);
\end{tikzpicture}
\end{center}

The representations of primary velar and primary uvular segments, seen earlier in §2.3.1, are repeated in (15).

\textsuperscript{19} In van Eijk's formulation of this constraint, ‘Q’ denotes any uvular. However, data like those in (i) show that the Q class is limited to obstruents. In (i), below, /l/, /l/ is C\textsubscript{1} and a uvular resonant is C\textsubscript{2}, so uvular resonants are excluded from the constraint.

(i) Lower dialect forms
\begin{enumerate}
\item a. \{\textit{jəm-ən}\} \quad \{\textit{zəm-ən}\} \quad "to growl at someone, to fight with someone (tr.)(Vəm)"
\item b. \{\textit{ji'-jəm\textsuperscript{ə}}\} \quad \{\textit{zəm\textsuperscript{ə}-fəm\textsuperscript{ə}}\} \quad "each one, every one" (with de-emphaticised /l/) (Vəm\textsuperscript{ə})
\item c. \{\textit{jəməm-ən-mən\textsuperscript{ə}}\} \quad \{\textit{zəməm-ən-mən\textsuperscript{ə}}\} \quad "sidehill" (Vəm)\textsuperscript{ə}.
\end{enumerate}
(15) a. primary velar  

<table>
<thead>
<tr>
<th>Place</th>
</tr>
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<tbody>
<tr>
<td>[DOR]</td>
</tr>
<tr>
<td>[TR]</td>
</tr>
<tr>
<td>[RTR]</td>
</tr>
</tbody>
</table>

b. primary uvular

<table>
<thead>
<tr>
<th>Place</th>
</tr>
</thead>
<tbody>
<tr>
<td>[DOR]</td>
</tr>
<tr>
<td>[TR]</td>
</tr>
<tr>
<td>[RTR]</td>
</tr>
</tbody>
</table>

Assuming (14) - (15), there are two ways for emphatic coronals and uvular obstruents to form a natural class. The uvulars could be just that: primary uvular consonants, (15b). In that case, they would pattern with emphatics by virtue of their secondary-[RTR]. Alternatively, they could be emphatic velars, that is, dorsal emphatics, represented as (16). As such, they could pattern with other emphatics based on secondary-[DOR] and/or secondary-[RTR].

(16) Representation of Dorsal Emphatics

<table>
<thead>
<tr>
<th>Place</th>
</tr>
</thead>
<tbody>
<tr>
<td>[DOR]</td>
</tr>
<tr>
<td>[TR]</td>
</tr>
<tr>
<td>[RTR]</td>
</tr>
</tbody>
</table>

The question is thus: are the uvular obstruents primary uvulars or dorsal emphatics? As we will see, acoustic findings on the uvular obstruents support the assumption that they are produced with primary uvular articulation and pharyngealisation. However, primary uvulars and dorsal emphatics are both assumed to be produced with those articulations. Thus the answer to the question will need to be based on phonological evidence.

Phonological evidence is provided by forms like those in (17), compared to (18). In (17), the coronal emphatics and uvular obstruents function as a natural class in triggering a harmony. The harmony affects the epenthetic vowel, /Æ/, and /ʃ/. When immediately preceding a uvular obstruent or coronal

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20 Note that the uvular obstruents could not pattern exclusively with emphatics based on [DOR], as [DOR] patterning between them would be A harmony and would necessarily include primary velars, as seen from (15a).
emphatic, the epenthetic vowel surfaces as backed \( \ddot{\alpha} \) or \( \ddot{o} \), \( \dot{AE} \) surfaces as backed \( \ddot{a} \), and /ťʃ/ surfaces as emphatic \( \ddot{tʃ} \).

(17)

a. IPA /tʃ/ \( \{ \ddot{tʃ} \} \) “bitter”
   NA /t ʃ/ \( \{ t \ ə \ ʃ \} \)

b. IPA /mʃ/ \( \{ m ʃ \} \) “to get stuffed, to eat too much”
   NA /mq/ \( \{ m \ \ddot{q} \} \)

c. IPA /ʃ-pʃxʷ/ \( \{ ʃ-p\dddot{a}xʷ \} \) “to stick out from something (e.g.,
   NA /s-p \dddot{j}xʷ/ \( \{ s-p \ ə \ j \ ʃ \} \) from a pocket or a house)

   d. IPA /mÆkʷ/ \( \{ m ʌ \dddot{k} \} \) “snow”
   NA /mÆqʷ/ \( \{ m \ \ddot{a} \ q \} \)

e. IPA /mxÆ/ \( \{ mxʌ \} \) “huckleberry” (Lower dialect)
   NA /mxÆz/ \( \{ mx \ \ddot{a} \ ʃ \} \)

f. IPA /ʃkʷ-ÆnÆ/ \( \{ ʃkʷ-ænæ \} \) “lynx”
   NA /cqʷ-ÆnÆ/ \( \{ cq \ ñ\dddot{a}næ \} \)

g. IPA /RED, n-Æl-tʃ/ \( \{ n-æl-ʃ \} \) “to drool, slobber (e.g., like
   NA /RED, n-s Æ c-ʃ/ \( \{ n-sæ \ ʃ \} \) cows)”

No other consonants trigger this harmony, including uvular /غا وا/ as seen in (18). See §3.5 for more details.

(18)

a. IPA /pʃkʷ/ \( \{ pʃkʷ \} \) \( \{ pʃkʷ , pʃk \} \) “leaf”
   NA /pckʷ/ \( \{ p ckʷ \} \) \( \{ p \ ə \ k \ \ddot{c} \} \)

b. IPA /kÆčÆʃ/ \( \{ kæčæʃ \} \) \( \{ kæčæʃ , kæč \} \) “three”
   NA /kÆčÆs/ \( \{ kæčæs \} \) \( \{ kæčæs , kæč \} \)

c. IPA /tip̪-Æp̪/ \( \{ tip̪æp̪ \} \) \( \{ tip̪æ \} \) “marrow”
   NA /kÆp̪Æ/ \( \{ kÆp̪æ \} \) \( \{ kÆp̪æ \} \)

d. IPA /tʃu-ño/ \( \{ tʃu-ño \} \) \( \{ tʃu-ño \} \) “to rip, tear
   NA /cño/ \( \{ cño \} \) something,

---

21 See §3.5.1 for evidence that \( \ddot{tʃ} \) in (17f) is underlyingly non-emphatic. Van Eijk (1987) records (17f) as cuqʷ-ana?. The consultants of this study produced it as recorded here (and also as (32c) in §3.2.2).
Exclusion of /b _w_ b'_w/ from the triggering class shows that the uvular obstruents have some feature specification(s) that the coronal emphatics also have but the uvular resonants do not. In other words, there are two kinds of uvulars. One patterns with emphatics, e.g., in triggering the harmony in (17). The other does not. Crosslinguistic evidence for these two types of uvulars comes from Arabic. Palestinian Arabic uvular resonants /χ _w_ χ'_w/ do not pattern with coronal emphatics in triggering a harmony similar to that in (18), but the segment which is phonetically uvular [q] does (see §2.5.1). On this basis, following the conclusions of Trubetzkoy (1939), Jakobson (1978), and Delattre (1971) (see §1.4.2), Palestinian [q] was analysed in chapter 2 as velar emphatic /k/. To account for the fact that S’t’át’imcets /b _w_ b'_w/ do not pattern with emphatics but the segments that are phonetically [q q’ q'_w q’_w χ χ’_w] do, I conclude that the latter set, like Palestinian [q], are phonologically uvularised, not primary uvular. That is, they are dorsal emphatics /k’ k’ w k’_w χ _w/, represented as in (19).

(19) Representation of St’t’át’imcets Dorsal Emphatics

\[
/ k' k' w k'_w x' x'_w /
\]

\[
[\text{CONS}]
\]

\[
[\text{Place}]
\]

\[
[\text{DOR}]
\]

\[
[\text{TR}]
\]

\[
[\text{RTR}]
\]
The uvular resonants are phonologically primary uvulars, represented as in (20).

(20) Representation of St'át'imcets Uvular Resonants

\[
\begin{array}{c}
/\mathrm{u} \quad \mathrm{u}' \quad \mathrm{u}^{\mathrm{w}} \quad \mathrm{u}'^{\mathrm{w}}/ \\
[\text{CONS}] \\
[\text{SON}] \\
[\text{Place}] \\
[\text{DOR}] \\
[\text{TR}] \\
[\text{RTR}] \\
\end{array}
\]

St'át'imcets /\mathrm{u} \quad \mathrm{u}' \quad \mathrm{u}^{\mathrm{w}} \quad \mathrm{u}'^{\mathrm{w}}/ are excluded from the natural class comprised of the coronal and dorsal emphatics because they lack specification for secondary-[DOR]. By result, they do not trigger the harmony illustrated in (17).  

Support for this claim that the uvular obstruents are dorsal emphatics comes from the following observation. The harmony in (17) gives rise to backed non-high vowels and surface emphatic consonants. Palestinian

22 One might ask if the difference between the two types of uvulars is necessarily representational. Could it instead be the surface effect of the constraint responsible for the harmony? An account which assumes the latter would claim that the two types of uvulars are both (20) (without [SON] for the obstruents) and that the harmony in (17) is [DOR] A harmony, that is, harmony of [DOR] triggered by consonants specified for [DOR] as either a primary specification (the ‘two types’ of uvulars) or secondary specification (coronal emphatics). The harmonic constraint, however, would require that the trigger bear [DOR] but not [SON], unless it bear both [COR] and [SON], as is here assumed for the resonant /\mathrm{j} \quad \mathrm{j}'/. The resonants /\mathrm{u} \quad \mathrm{u}' \quad \mathrm{u}^{\mathrm{w}} \quad \mathrm{u}'^{\mathrm{w}}/ would be excluded from the triggering class because they bear [SON] but not also [COR]. However, this alternative account predicts that the velar obstruents /k \quad k' \quad k^{\mathrm{w}} \quad k'^{\mathrm{w}} \quad x \quad x^{\mathrm{w}}/ will also trigger the harmony because, assuming (15a), they bear [DOR] and not [SON]. This prediction is not borne out, as illustrated by (18f-g). I conclude that the difference between the two types of uvulars is representational.

Finally, one might argue that identification of St'át'imcets [\mathrm{q} \quad \mathrm{q}^{\mathrm{w}} \quad \mathrm{q}' \quad \mathrm{q}'^{\mathrm{w}}] as emphatics is undesirable because it is unclear that the same is true of their cognates in other Interior Salish languages. However, uvular obstruents elsewhere in Interior Salish could very well be emphatic velars. Even if they are not, closely related languages are known to vary in the guttural vs. emphatic nature of phonetic uvulars. (See n43 on p.28 on this for Arabic.)
uvularisation harmony is triggered by emphatics, and has parallel surface effects. Based on the crosslinguistic similarity, I identify the harmony in (17) as uvularisation harmony (‘emphasis spread’) triggered by emphatics.

3.2.1.5.5 /ɪ, ɨ/ De-emphaticisation in Lower St’át’imcets. In the Lower dialect forms in (21), /ɪ/ occurs immediately preceding one of /ːfʃ ːl/ k k’ kʷ x’ xʷ/. (‘GLOT’ denotes a morpheme which surfaces as infixal ‘-i’). See van Eijk 1997 for further discussion.23

(21) Lower dialect forms

<table>
<thead>
<tr>
<th>Example</th>
<th>IPA</th>
<th>Surface Form</th>
</tr>
</thead>
<tbody>
<tr>
<td>a. IPA /n-ʃ-p’xɬl’/</td>
<td>n-ʃ-p’xɬl’</td>
<td>“stingy”</td>
</tr>
<tr>
<td></td>
<td>NA /n-s-p’ x I’/</td>
<td>n-s-p’ x I’</td>
</tr>
<tr>
<td>b. IPA /m̥ɪx̆e+’/</td>
<td>mix̆e+’</td>
<td>“black bear”</td>
</tr>
<tr>
<td></td>
<td>NA /m̥ i x̆ a+’/</td>
<td>m̥ i x̆ a+’</td>
</tr>
<tr>
<td>c. IPA /tʃɪk’-ɪn’/</td>
<td>tʃɪk’-ɪn’</td>
<td>“to stab some-”</td>
</tr>
<tr>
<td></td>
<td>NA /cɪq’-ɪn’/</td>
<td>cɪq’-ɪn’</td>
</tr>
</tbody>
</table>
| d. IPA /GLOT, kɪx/ | kɪ-x | “cranky (child),
|       | NA /GLOT, k ɪ x/ | k ɪ-x | (*k ɪ-x) fussing (because it wants attention or is sick)” |

These forms show that Lower dialect /ɪ/ surfaces as rtr ‘ɪ’ immediately preceding an emphatic. (In §3.4, this effect will be analysed as due to tongue-root-retraction (pharyngealisation) harmony with the following emphatic. St’át’imcets pharyngealisation harmony is triggered by gutturals and emphatics.) In (22), /ɪ/ occurs immediately preceding one of /ʃ/ and surfaces as non-rtr ‘i’. The generalisation is that Lower dialect /ɪ/ surfaces as rtr ‘ɪ’ immediately preceding an emphatic, except when the emphatic is /ʃ/ or /ʃ/. This is observed also by van Eijk (1997:8) and Egesdal & Thomspson (1993:103) (both referring to rtr ‘ɪ’ as ‘retracted i’).

(22) Lower Dialect Forms

<table>
<thead>
<tr>
<th>Example</th>
<th>IPA</th>
<th>Surface Form</th>
</tr>
</thead>
<tbody>
<tr>
<td>a. IPA /xni’-a ɬ I’/</td>
<td>xni’-a ɬ I’</td>
<td>“gooseberry”</td>
</tr>
<tr>
<td></td>
<td>NA /xni’z’-a ɬ I’/</td>
<td>xni’z’-a ɬ I’</td>
</tr>
</tbody>
</table>
| b. IPA /GLOT, ɪb’/ | ɪb’ | “each one,
|       | NA /GLOT, ɪ ɬ I’/ | ɪ ɬ I’ | (*ɪ ɬ I’) |

23 Van Eijk (1987, 1997) transcribes forms with a GLOT morpheme as containing a glottal stop rather than a glottalised vowel, implying, e.g., transcription ‘ki-ʔ-x’ for (21d). The reason why I transcribe them with a glottalised vowel is explained in §3.5.6.
I analyse the exceptional behaviour of Lower dialect /I/ in (22) as the result of de-emphaticisation of Lower /I/ in the context of an immediately preceding /I/. This is supported by forms like those in (22a) and (23) in which /I/ functions as an emphatic by triggering uvularisation harmony on the immediately preceding /Æ/. This shows that Lower /I/ behaves as an emphatic when not in the context of an immediately preceding /I/.\(^{24}\)

(23) Lower Dialect Forms

a. IPA /mxÆ]/′ /′ məxəz]′ /′ (məxəz]′) “huckleberry”
   NA /mxÆ]/′ /′ məzəz]′ /′ (məzəz]′)  

b. IPA /tʃ.uk’wÆ]/′ /′ tʃ.uk’wəz]′ /′ (tʃ.uk’wəz]′) “fish, (any kind
   NA /c’Uq’wÆ]/′ /′ c’uq’wəz]′ /′ (c’uq’wəz]′) of salmon”

The behaviour of the Lower dialect rhotics is similar to that of Palestinian rhotic /r/, which also de-emphaticises in the context of /I/ (see §2.2.1). For St’át’imcets, it means that the Lower dialect surface consonantal inventory contains both emphatic /I/ and non-emphatic /I/. Finally, van Eijk (1997:8) states that of retracted ‘ə’ and ‘ə’, only the latter occurs immediately preceding a dental glide in both dialects. Close investigation of Lower /I/ and Upper /I/ in the context of the epenthetic vowel and /U/ will not be pursued here (but see (37) in §3.2.2.3 for preliminary observation on Lower /I/ in the environment of /U/).

3.2.1.5.6 Forms with Floating Emphasis Feature. We now address the 15 vowelless retracted roots without /I/’/. They are listed in (24). The surface forms show the vowel effects documented by van Eijk, on which basis he classifies these roots as retracted.

(24) St’át’imcets Vowelless Retracted Roots without /I/’/. They are listed in (24). The surface forms show the vowel effects documented by van Eijk, on which basis he classifies these roots as retracted.

a. /pm/ cf. /p ə m-p/ “(to go) fast, (to be) quick” [p.27]
   b. /pt/ (1); cf. /k a - p ə t - a/ “to get squished, squashed” [p.27]
   c. /pt/ (2); cf. /p ə t - a - ə t/ “to make a bubbling, gurgling noise” [p.27]

\(^{24}\) Alternatively, the effects in (23) could be analysed as showing emphaticisation of an underlyingly non-emphatic /I/ in the context of an immediately preceding /Æ/. The effects in (22) would not show de-emphaticisation, but the expected non-emphatic behaviour of a non-emphatic /I/. However, as discussed earlier, St’át’imcets /Æ/, like the other vowels, cannot be underlyingly emphatic.
We also address the 27 vowelful retracted morphemes without /tʃʃ/ ʃ ʃ/.
Seventeen are in (25). The other 10, 9 relatively unassimilated borrowings and one interjection, can be considered outside the regular phonology.\textsuperscript{25}

\footnotesize
\textsuperscript{25} The 9 borrowings and one interjection are:  
(i) a. /pEH\textsuperscript{3}k/  
\hspace{1em} cf. /pəz\textsuperscript{3}k/ “potato” (borrowing from French) [p.28]  
b. /p\textsuperscript{3}j\textsuperscript{3}/  
\hspace{1em} cf. /p\textsuperscript{3}j\textsuperscript{3}/ “pie” (borrowing from English) [p.40]  
c. /p\textsuperscript{3}j\textsuperscript{3}p/  
\hspace{1em} cf. /p\textsuperscript{3}j\textsuperscript{3}p/ “five” (borrowing from English) [p.40]  
d. /p\textsuperscript{3}j\textsuperscript{3}\textsuperscript{3}/  
\hspace{1em} cf. /p\textsuperscript{3}j\textsuperscript{3}t/ “to fight” (Lower dialect; borrowing from English) [p.40]  
e. /\textsuperscript{3}\textsuperscript{3}\textsuperscript{3}E\textsuperscript{3}n/  
\hspace{1em} cf. /\textsuperscript{3}\textsuperscript{3}t\textsuperscript{3}n/ “town” (borrowing from English) [p.57]  
f. /\textsuperscript{3}\textsuperscript{3}\textsuperscript{3}E\textsuperscript{3}\textsuperscript{3}/  
\hspace{1em} cf. /\textsuperscript{3}\textsuperscript{3}k\textsuperscript{3}t/ “doctor” (borrowing from English) [p.59]  
g. /\textsuperscript{3}\textsuperscript{3}\textsuperscript{3}\textsuperscript{3}E\textsuperscript{3}n\textsuperscript{3}/  
\hspace{1em} cf. /\textsuperscript{3}\textsuperscript{3}t\textsuperscript{3}Am\textsuperscript{3}/ “to knot (intr.)” (borrowing from English ‘(knitted) stocking’) [p.59]  
h. /k\textsuperscript{3}\textsuperscript{3}Eh/  
\hspace{1em} cf. /k\textsuperscript{3}\textsuperscript{3}H/ “car, train” (borrowing from English) [p.161]  
i. /k\textsuperscript{3}\textsuperscript{3}\textsuperscript{3}E\textsuperscript{3}\textsuperscript{3}/  
\hspace{1em} cf. /k\textsuperscript{3}\textsuperscript{3}t/ “quarter (coin)” (borrowing from English) [p.176]  
j. /w\textsuperscript{3}\textsuperscript{3}/  
\hspace{1em} cf. /w\textsuperscript{3}/ (expression of disbelief, used by men) [p.284]
The morphemes in (24) and (25) contain no perceptually emphatic consonants. I conclude that the vowel effects observed in their surface forms are due to a floating emphasis feature which surfaces linked to an epenthetic vowel. Under present assumptions, it is actually two co-occurring features: secondary-[DOR] and secondary-[RTR].

3.2.1.5.7 Acoustic support. This section presents acoustic findings that bear on the presumed postvelar gestures of emphatic /\j/ and /\j/' de-emphaticisation in the Lower dialect, and lack of emphatic /\j/ in the Upper dialect. The corpus and data for the Stát'imcets acoustic study are described first. (See §2.3.1 for procedural details.)
This chapter reports on data from 35 tokens of St'át'imcets consonants and 169 tokens of St'át'imcets vowels recorded in 37 carrier forms. The carrier forms were all real St'át'imcets words, to ensure tokens that resulted from the regular phonology and phonetics of the language. They were tape-recorded from two literate, adult male native speakers: LC, a 52-year-old Lower speaker, and LN, a 45-year-old Upper speaker. Two tokens of each of the 37 forms were elicited from each speaker. The data from LC and LN were analysed separately, since the formant frequencies of their vowel tokens were very different.

Table 3:4 reports $F_1$ and $F_2$ of tokens of St'át'imcets non-emphatic /k/, emphatic /k/, non-emphatic /l/, emphatic /l/, and, for LC, the Lower dialect speaker, non-emphatic \{l'\} (= de-emphaticised /l'/), and emphatic \{l''\}. The mean $F$ values show that for both speakers, $F_1$ for /k/ is medium, almost high. For both speakers, $F_2$ for /k/ is low. (See Table 1:5.) However, since a medium or high $F_1$ and low or medium $F_2$ are expected for a segment that is produced with primary uvular articulation and pharyngealisation (see Table 1:11), the useful observation is that, for both speakers, $F_1$ is higher for /k/ than for /k/, $F_2$ is lower. This supports the assumption that the tokens of /k/ were produced with postvelar articulation (here assumed to be primary uvular and secondary pharyngeal) which the tokens of /k/ lacked. Table 3:4 does not bear on the identity of St'át'imcets /k/ as velar emphatic vs. primary uvular, as both types of segments are presumably produced with the same articulation. Given this, St'át'imcets /k/ [q] is identified as an emphatic based on the phonological evidence presented in §3.2.1.5.4.

The difference between mean $F$ values for /l/ and /l/ show that $F_1$ for /l/ has a large rise, $F_2$ a large drop, compared to $F_1$ and $F_2$ for /l/ (see Table 1:10). The difference between those values for \{l'\} and \{l''\} show that $F_1$ for \{l'\} has a large rise and $F_2$ has a drop which is almost medium. A medium or large $F_1$ rise and a large $F_2$ drop are expected for segments produced with uvularisation and pharyngealisation (see Table 1:11). These expectations are roughly met by our data on /l/ and \{l''\}. The data in the table thus provide some support for the assumption that the tokens of /l/ and Lower /l'/ were produced with those articulations. This supports the phonological claim that they are emphatics. Acoustic effects which are generally consistent with those found here have been reported in previous studies of Salish (in which these consonants are described as retracted). Bessell & Czaykowska-Higgins (1991) and Bessell (1992) observe a raised $F_1$ and lowered $F_2$ for vowels in the context of Nxa'amxcin coronal emphatics, which they interpret as indicating the same effects for the coronal emphatics; Thompson (1993) reports a lowered $F_2$ for Lower St'át'imcets \{l''\}.
In Table 3:4, the tokens of Lower dialect $\{j^\prime\}$ and $\{\jmath^\prime\}$ are from the carrier form /xni'aj/-\[email protected]'/ /xni'aj/-\[email protected]’/ “gooseberry bush”. The lower $F_1$ and higher $F_2$ of the $[\jmath^\prime]$s supports the assumption that they were not produced with uvularisation and pharyngealisation. This supports our claim that Lower /j/ de-emphaticises immediately following /l/.

The wideband spectrogram in Figure 3:1 shows the bursts of one token each of St’tát’imcets /k/ and /k/. It shows a 300 Hz downward shift in energy concentration in the burst of [k] compared to that of [k]. This is consistent with the finding of previous studies, e.g., Al-Ani (1970), on the burst properties of emphatic plosives. (See Figure 2:35.) The raised $F_1$ and lowered $F_2$ for /l/ are seen in Figure 3:2.

<table>
<thead>
<tr>
<th>carrier form</th>
<th>token</th>
<th>Speaker: LC</th>
<th>Speaker: LN</th>
</tr>
</thead>
<tbody>
<tr>
<td>${\text{koe}^\prime\text{e}t\text{u}}$ (fem. name)</td>
<td>[k]</td>
<td>471</td>
<td>1059</td>
</tr>
<tr>
<td></td>
<td>[k]</td>
<td>465</td>
<td>1142</td>
</tr>
<tr>
<td>mean $F$</td>
<td>468</td>
<td>1101</td>
<td>468</td>
</tr>
<tr>
<td>${\text{kope}-\text{on}}$ “to put something away, to bury”</td>
<td>[k]</td>
<td>670</td>
<td>990</td>
</tr>
<tr>
<td></td>
<td>[k]</td>
<td>651</td>
<td>985</td>
</tr>
<tr>
<td>mean $F$</td>
<td>661</td>
<td>988</td>
<td>672</td>
</tr>
<tr>
<td>${\text{diju}-\text{uf}ee}$ “fresh fruit”</td>
<td>[l]</td>
<td>--</td>
<td>--</td>
</tr>
<tr>
<td></td>
<td>[l]</td>
<td>--</td>
<td>--</td>
</tr>
<tr>
<td>mean $F$</td>
<td>302</td>
<td>1519</td>
<td></td>
</tr>
<tr>
<td>${\text{klu}-\text{uf}i'x}$ “to get spoiled, to break down”</td>
<td>[l]</td>
<td>--</td>
<td>--</td>
</tr>
<tr>
<td>(leftmost ${l}$)</td>
<td>[l]</td>
<td>--</td>
<td>--</td>
</tr>
<tr>
<td>mean $F$</td>
<td>516</td>
<td>988</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>difference mean $F$</th>
<th>[l] vs. [l]</th>
</tr>
</thead>
<tbody>
<tr>
<td>${\text{xni}'-\text{aj}}$ “gooseberry bush”</td>
<td>+214</td>
</tr>
<tr>
<td>${\text{xni}'-\text{aj}}$ “gooseberry bush”</td>
<td>355</td>
</tr>
<tr>
<td></td>
<td>420</td>
</tr>
<tr>
<td>mean $F$</td>
<td>388</td>
</tr>
<tr>
<td>${\text{xni}'-\text{aj}}$ “gooseberry bush”</td>
<td>586</td>
</tr>
<tr>
<td></td>
<td>557</td>
</tr>
<tr>
<td>mean $F$</td>
<td>634</td>
</tr>
</tbody>
</table>

Table 3:4. $F_1$ and $F_2$ of tokens of St’tát’imcets /k/, /k/, /l/, /l/, /j'/ ($= \text{de-emphaticised} /\jmath'/), and /\jmath'/

In Table 3:4, the tokens of Lower dialect $\{j^\prime\}$ and $\{\jmath^\prime\}$ are from the carrier form /xni'aj/-\[email protected]'/ /xni'aj/-\[email protected]’/ “gooseberry bush”. The lower $F_1$ and higher $F_2$ of the $[\jmath^\prime]$s supports the assumption that they were not produced with uvularisation and pharyngealisation. This supports our claim that Lower /j'/ de-emphaticises immediately following /l/.
Figure 3:1. Wideband spectrogram of St'át'imcets \([k]\) and \([\mathcal{k}]\).

The token of \([k]\) occurred in ‘\(\text{kaum̓əʔtə}u\)’ (fem. name), the token of \([\mathcal{k}]\) in ‘\(\text{kw̓et-ən}\)’ “to put something away, to bury something (tr.).”

Burst of \([k]\) = 1514 Hz. Burst of \([\mathcal{k}]\) = 1210 Hz.

Figure 3:2. Wideband spectrogram of St'át'imcets \([l]\) and \([\mathcal{l}]\).

The token of \([l]\) occurred in ‘\(\text{fj̓i-tl̓u}\)’ “fresh fruit”, the token of \([\mathcal{l}]\) as leftmost \([l]\) in ‘\(\text{ka̓l̓-l̓ul̓x}\)’ “to get spoiled (meat, potatoes), to break down (car, wagon)”.

(Formants measured at points indicated by the vertical lines.)

\([l]\): \(F_1 = 285\) Hz; \(F_2 = 1583\) Hz. \([\mathcal{l}]\): \(F_1 = 507\) Hz; \(F_2 = 970\) Hz.
Figure 3:3 shows a spectrogram of a token of Lower dialect \{xniu'-a\}'t\}, showing the raised $F_1$ and lowered $F_2$ for \{\x\}'t, compared to $F_1$ and $F_2$ of \{\x\}'t. Arrows draw attention to the first and second formants of interest.

![Figure 3:3. Wideband Spectrogram of a token of Lower St'at'imcets \{xniu'-a\}'t "gooseberry bush". (Formants measured at points indicated by the vertical lines.)\n
\[\{\x\}'t: F_1 = 388 \text{ Hz}; F_2 = 1291 \text{ Hz.}\]

\[\{\x\}'t: F_1 = 586 \text{ Hz}; F_2 = 1163 \text{ Hz.}\]

Figure 3:4 shows a wideband spectrogram of one token of Upper dialect /xniu'-e\a\}'t \{xniu'-e\a\}'t. A medium rise for $F_1$ of the \{\x\}'t on the right is

![Figure 3:4. Wideband Spectrogram of a token of Upper St'at'imcets \{xniu'-e\a\}'t "gooseberry bush". (Formants measured at points indicated by the vertical lines.)\n
\[\{\x\}'t on the left: F_1 = 285 \text{ Hz}; F_2 = 1376 \text{ Hz.}\]

\[\{\x\}'t on the right: F_1 = 463 \text{ Hz}; F_2 = 1544 \text{ Hz.}\]
apparent, but $F_2$ of the two $[\text{ ]}'s$ is almost the same. I interpret the raised $F_1$ of the $[\text{ ]}'$ on the right as a coarticulatory effect from the preceding [a]. With that, the data in the figure support the assumption that neither token was produced with uvularisation and pharyngealisation. This, in turn, supports the phonological claim that Upper dialect /$\text{ ]}'$/ is not an emphatic.

3.2.2 Vocalic Inventory

The Stát’imcets underlying vowel system is seen in (26), an analysis consistent with van Eijk (1997). It has two degrees of height, no underlying length, and no underlying low front vs. low back distinction.

(26) Stát’imcets Underlying Vocalic Inventory

<table>
<thead>
<tr>
<th></th>
<th>FRONT</th>
<th>BACK</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>HIGH</td>
<td>I</td>
<td>U</td>
<td></td>
</tr>
<tr>
<td>LOW</td>
<td>æ</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

The surface inventory is seen in (27). A major difference between the surface and underlying inventories is the inclusion of six mid vowels in the latter. The surface inventory has a low front vs. low back distinction. All surface vowels, except those which are non-high and back, occur in non-rtr/rtr pairs: $\{i, I\}, \{æ, æ\}, \{e, e\}, \{ø, ø\}, \{u, u\},$ and $\{æ, æ\}$. At mid back and low back position, only rtr $\{ø, ø\}$ and $\{æ, æ\}$ occur (see §3.5). Acoustic data (see Figure 3:55) indicate that Stát’imcets $\{æ, æ\}$ is phonetically central. That is, it corresponds phonetically to some vowel symbol which could appear in the position of ‘û’ in (4), rather than to back ‘a’. We will see that rtr $\{i, æ, æ, u\}$ comprise a set of pharyngealised vowels phonologically distinct from non-high back rtr $\{æ, æ, æ\}$, which are phonologically uvularised vowels. Below, I summarise previous analyses of the surface vowels, then justify the one in (27).

(27) Stát’imcets Surface Vocalic Inventory

<table>
<thead>
<tr>
<th></th>
<th>FRONTr</th>
<th>CENTRAL</th>
<th>BACKr</th>
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<tr>
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<td>RTR</td>
<td>NON-</td>
<td>RTR</td>
</tr>
<tr>
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<td>rtr</td>
<td>non-</td>
</tr>
<tr>
<td>non-</td>
<td>rd</td>
<td>non-</td>
<td>rd</td>
</tr>
<tr>
<td>rd</td>
<td>rd</td>
<td>rd</td>
<td>rd</td>
</tr>
<tr>
<td>HIGH</td>
<td>i</td>
<td>I</td>
<td>u</td>
</tr>
<tr>
<td>MID</td>
<td>æ</td>
<td>æ ø ø æ</td>
<td>æ ø æ</td>
</tr>
<tr>
<td>LOW</td>
<td>æ æ æ</td>
<td>æ æ æ æ æ</td>
<td>æ æ æ æ æ</td>
</tr>
</tbody>
</table>


3.2.2.1 *Previous Analyses of the St'át'imcets Surface Vocalic System.* Van Eijk (1997) analyses the surface system as:

(28) Van Eijk (1997) Analysis of the St'át'imcets Surface Vocalic System

<table>
<thead>
<tr>
<th>FRONT</th>
<th>BACK</th>
</tr>
</thead>
<tbody>
<tr>
<td>HIGH</td>
<td>i i</td>
</tr>
<tr>
<td></td>
<td>u u</td>
</tr>
<tr>
<td>MID</td>
<td>ë ë</td>
</tr>
<tr>
<td>LOW</td>
<td>a a</td>
</tr>
</tbody>
</table>

His analysis claims that the surface inventory contains pairs of non-retracted vs. retracted vowels, \{i, ë\}, \{u, û\}, \{a, æ\}, \{i, ë\}, \{u, û\} and thus that \{i, ë\} and \{u, û\} comprise a single set of retracted vowels. Under that analysis, the retracted set occurs immediately preceding a uvular, a Lower dialect dental approximant, and in a retracted root. Previous theoretical accounts, Remnant (1990) and Bessell (1992), assume his analysis, and claim that retracted vowels in retracted roots are the effect of a floating retraction feature. See §3.2.1 for evidence disqualifying that for the majority of roots previously assumed to involve a floating feature.

Van Eijk (1997:13) documents a [ɔ] quality for /U/ in the context of an immediately following /b/ b' b'w/ b'w'. Remnant (1990:17,130) observes that /I/ occurs as \{ë\} in that context. Van Eijk (1997:12-13) describes vowels immediately preceding one of /b/ b' b'w/ as phonetically pharyngealised, although he does not note this effect for /l/. Remnant refers to such vowels as epiglottalised. Finally, van Eijk (1997:27-28) describes reduction of root vowels in some forms. Vowel reduction is not observed in the corpus of this study.

3.2.2.2 *The Epenthetic Vowel.* I analyse the vowel which van Eijk transcribes as ‘ë’ or ‘œ’ as epenthetic. Departing from previous studies, I analyse it as having six phonological surface variants: \{ë\}, \{œ\}, \{æ\}, \{ə\}, \{ʌ\}, and \{ɔ\}. The vowel under discussion is observed immediately preceding non-initial consonants (obstruents and resonants) in a consonant cluster, as in:

(29) a. IPA /RED, jx/ \{œx-œx\} “partly crazy”
    NA /RED, sx/ \{sëx-sëx\}

b. IPA /mx,Æj/ \{mœxəj\} “huckleberry” (Lower dialect)
    NA /mx,Æz/ \{m œ x a z\}

c. IPA /RED, kl/ \{kœ-kær\} “good for nothing, useless (persons, horses, etc.)”
    NA /RED, q ñ / \{q ë-q ë\}
d. IPA /ʔÆtfˈx-n/ \{ʔætfˈx-ən\} “to see something, someone
    NA /ʔacˈx-n/ \{ʔacˈx-ə n\} (tr.)

c. IPA /RED, tuˈw/ \{teuˈw-evuˈw-utˈwet\} “(young) boy”
    NA /RED, twt/ \{tew-əw-wət\}

It is not observed if the non-initial consonant in such a cluster is syllabifiable as syllable onset. This is seen in (30) in which periods clarify the syllabification of the grammatical surface forms.

(30)

a. IPA /RED, jx/ \{səx-səx\} \(^*/səx-səx/\) “partly crazy”
   NA /RED, sx/ \{səx-səx\} \(^*/səx-səx/\)

b. IPA /ʔÆtfˈx-n/ \{ʔætfˈx-ən\} \(^*/ʔætfˈx-ən/\) “to see something, someone
   NA /ʔacˈx-n/ \{ʔəcˈx-ən\} \(^*/ʔəcˈx-ən/\) someone (tr.)

c. IPA /RED, kl-nUxʷ-mln/ \{kl-kl-nuxʷ-mln\} “to be unfriendly
   NA /RED, /ql-nuxʷ-mln/ \{ql-ql-nuxʷ-mln\} “to someone (tr.)
   \(^*/ql-ql-nuxʷ-mln/\)

Because this vowel is predictable, it must be epenthetic, as concluded in previous work (van Eijk 1997, Matthewson 1994, Roberts & Shaw 1994, and Shaw 1996b). The present corpus indicates that St'át'imcets speakers differ in phonological tolerance of consonant clusters and that this difference might be dialectal. The epenthetic vowel was not observed for LC, Lower speaker, in forms where it was observed for LN, Upper speaker, as seen from comparison of (31) with (32). For a theoretical account of this difference, see Shaw (1996b). More fieldwork is necessary to determine if the difference is idiolectal.

(31) Lower Dialect Forms

a. IPA /RED, wiˈtʃj/ \{ui-ˈu-ˈtʃj\} “small rainbow trout”
   NA /RED, fi-qs/ \{fi-ˈi-ˈq s\}

b. IPA /tʃˈkʷʔikʷ/ \{tʃˈkʷʔikʷ\} “salmon stretcher”
   NA /cˈqʷʔiłqʷ/ \{cˈqʷʔiłqʷ\}

c. IPA /tʃˈkʷʔenəʔ/ \{tʃˈkʷʔenəʔ\} “lynx”
   NA /cˈqʷʔenəʔ/ \{cˈqʷʔənəʔ\}

Van Eijk (1997) describes several different qualities for the epenthetic vowel, which he transcribes as [u ə θ ʌ 5], where ‘ ^ ’ denotes what he refers to as a ‘pharyngealisation’ effect. Matthewson (1994) describes the various qualities as determined by phonetic coarticulation. I make a different claim, namely, that much of the variation is phonological. I will show that three phonological harmonies, rounding, pharyngealisation, and uvularisation harmony, give rise to six surface variants of the epenthetic vowel. The last two harmonies are the subject of §3.4 and §3.5. Regarding the first, the epenthetic vowel surfaces as round 〈 θ 〉, 〈 θ 〉, or 〈 θ 〉 under adjacency to a rounded consonant. This is seen in (33). It does not surface rounded under adjacency to a non-rounded consonant, as seen in (34). When nonround, the epenthetic vowel is one of 〈 Θ 〉. (In this chapter, no NA transcription is provided where NA does not encode the distinctions at issue.)

(33) a. IPA /tʃ‘xʷ-xÆl/  \{ tʃ‘əxʷ-xæl\} “to hit (as a bush to make the berries fall off)”
NA /x‘xʷ-xÆl/  \{ x‘əxʷ-xæl\} “to hide something (intr., tr.)”

b. IPA /lθ‘-n/  \{ lθ‘-ən\} “to rip, tear something (tr.)”
NA /θ‘-n/  \{ θ‘-ən\} “(breaking) daylight”

(34) a. IPA /pUn-tľ/  \{ pun-təp\} “Rocky Mountain Juniper”
NA /pUn-tľ/  \{ pun-təp\} “to rip, tear something (tr.)”

b. IPA /tʃ‘-n/  \{ tʃ‘-ən\} “to rip, tear something (tr.)”
NA /c‘-n/  \{ c‘-ən\} “(breaking) daylight”

c. IPA /mθ‘-’/  \{ mθ‘-’/ \} “to get stuffed, to eat too much”
NA /mq‘/  \{ mq‘\}“(breaking) daylight”
There are two reasons for concluding that this rounding is phonological, not phonetic. First, when rounded, the epenthetic vowel is perceptually fully round, not rounded for only part of its duration. That is, when rounded, it is perceptually not a non-round-round diphthong or round-non-round diphthong (with the rounded portion occurring adjacent to the rounded consonant), e.g., [æ9] or [ə9], respectively. Second, acoustic data indicate that tokens of the round variants have and maintain a round target (see Figure 3:16). This supports ascribing phonological status to the rounding.

St'át'imcets’ epenthetic vowel is distinct from the solely phonetic inserted vowel in the language, as pointed out by Matthewson (1994) and Shaw (1996b), who label the latter ‘excrescent’, consistent with the suggestions of Kinkade (1997) on Salish vowels in general. The excrescent vowel is seen in the phonetic forms in (35), in which periods mark the syllable breaks in the surface forms. The qualities of the excrescent vowel mirror those of the epenthetic vowel. (IPA [æ] in (c) is the lowered counterpart of [ə]. See p.211 for relevant discussion.)

(35)

a. IPA /RED, tʃil-UʃəE?/ \{ tʃi-tʃi.l-u.əE? \} [tʃitʃeuləE?] “fresh fruit”
   NA /RED, cill-UșəE?/ \{ ci-c.i.l-ú.șa? \} [cičiľúsa?] “(young) boy”
b. IPA /RED, təw衙t/ \{ tə.w衙w衙w衙t \} [təw衙w衙w衙t]
   NA /RED, twt/ \{ tə.w衙w衙w衙t \} [tew衙w衙w衙t]
c. IPA /RED, əl/ \{ əl.əl \} [ələəl] “strong, healthy,
   NA /RED, əl/ \{ əl.əl \} [ələəl] vigorous”

In (35), the vowel observed in each phonetic form but not in the respective surface form occurs between surface coda and onset consonants, where the onset is a resonant. This environment is identified for excrescent vowels in Nxa’axmxcin Salish by Willett & Czaykowska-Higgins (1995). The St’át'imcets excrescent vowel is audible but does not serve as nucleus of any phonological syllable: the consonants that flank it are perceptually coda and onset of distinct syllables. Given this, I conclude with Matthewson (1994:5) that “the appearance of [the excrescent] vowel is independent of syllable structure.” The phonological invisibility of this vowel shows its phonetic status. It is excrescent/enunciative/anatyptic, that is, a vowel that occurs only in the phonetics and serves as transitional element (Matthewson 1994, Shaw 19996b). The present corpus indicates that forms like those in (35) occur with or without the excrescent vowel. That is, the vowel is optional, as also observed by Matthewson (1994:5).
3.2.2.3 *Phonetic Mid Height.* Mid height is observed for high vowels adjacent to a postvelar. This is also observed in Arabic (see §2.2.2). The effect in St’át’imcets is seen in the phonetic forms in (36). Lack of lowering for non-postvelar-adjacent /I/ in (f) illustrates the adjacency requirement.

(36) a. IPA /k’jɪl/ \rightarrow {k’ɪl} \rightarrow [k’ɪl] “to run”
    NA /q’ɪl/ \rightarrow {q’ɪl} \rightarrow [q’ɪl]

b. IPA /k’wɪl/ \rightarrow {k’wɪl} \rightarrow [k’wəl] “green, yellow”
    NA /k’wɪl/ \rightarrow {k’wɪl} \rightarrow [k’wɪl]

c. IPA /wɪ]\rightarrow {wɪ}\rightarrow [wɪ] “to shrink”
    NA /wɪ/ \rightarrow {wɪ}

d. IPA /k’wʊ/ \rightarrow {k’wʊ} \rightarrow [k’wʊ] “water”
    NA /k’wʊ/ \rightarrow {k’wʊ}

e. IPA /wʊj’t/ \rightarrow {wʊj’t} \rightarrow [wʊj’t] “sleep”
    NA /wʊj’t/ \rightarrow {wʊj’t}

f. IPA /wɪj–ɪn’/ \rightarrow {wɪj–ɪn’} \rightarrow [wɪj’in’] “to shrink something (tr.)”
    NA /wɪj–ɪn’/ \rightarrow {wɪj–ɪn’}

g. IPA /mɪx’æ/ \rightarrow {mɪx’æ} \rightarrow [mɪx’æ] “black bear”
    NA /mɪx’æ/ \rightarrow {mɪx’æ}

h. IPA /tʃɪk–ɪn’/ \rightarrow {tʃɪk–ɪn’} \rightarrow [tʃɪk’in’] “to stab someone (tr.)”
    NA /clq–ɪn’/ \rightarrow {c ɪ q–ɪn’}

Mid height is not observed under adjacency to non-postvelars, as seen in (37). The form in (h) contains an underlying postvelar, /j/. Lack of phonetic lowering in (h) suggests that Lower dialect /j/ might de-emphaticise in the context of /U/, besides when immediately following /I/.

(37) a. IPA /tUp–Un’/ \rightarrow {tup–un’} \rightarrow [tupun’] “to punch someone, hit someone with the fist (intr., tr.)”
    NA /tUp–Un’/ \rightarrow {tup–un’} \rightarrow [tupun’]

b. IPA /ʃɪt/ \rightarrow {ʃɪt} \rightarrow [ʃɪt] “night”
    NA /ʃɪt/ \rightarrow {ʃɪt}

c. IPA /ʃɪx’w/ \rightarrow {ʃɪx’w} \rightarrow [ʃɪx’w] “to arrive (over there), to reach (over there)”
    NA /ʃɪx’w/ \rightarrow {ʃɪx’w} \rightarrow [ʃɪx’w]

d. IPA /RED, n-k’wUtʃÆ/ \rightarrow {n-k’wUtʃÆ} \rightarrow [nk’wuk’wʃæ] “downstream”
    NA /RED, n-k’wUcÆ/ \rightarrow {n-k’wUcÆ} \rightarrow [nk’wuk’wca] “area”

e. IPA /kɪʃ–ɪn’/ \rightarrow {kɪʃ–ɪn’} \rightarrow [kɪʃ’in’] “to lay something down”
    NA /kɪʃ–ɪn’/ \rightarrow {kɪ ɪn’} \rightarrow [kɪ ɪn’]
I analyse the mid height in (36) as an effect from the adjacent postvelar. The fact that /hɔ/ do not condition the lowering, seen from (37g-h), is further evidence that St'át'imcets laryngeals are not gutturals (and thus not postvelars). That is, unlike Palestinian laryngeals, they lack articulation (see §1.3.3). I analyse the lowering as phonetic for reasons parallel to those discussed in §2.2.2. First, in several forms it is impressionistically gradient: e.g., in (36a-c,f,h), the lowered vowel is perceptually a short diphthong from mid [e] to high [i]. This indicates that the lowering is non-discrete. Second, to my knowledge, there is no evidence that the lowered height is phonologically visible.

An alternative analysis would claim that the mid height results from [LOW] harmony triggered by the adjacent postvelar. For example, under a [LOW] analysis, (36h) would be:

(38) /tʃ̆k̆-In/  { tʃ̆k̆-en'}  [tʃ̆k̆e'ın']  "to stab someone (tr.)"

We would observe that the post-emphatic /I/ is [e], that is, in its phonetic form it is gradiently less low than the pre-emphatic /I/, which is [ɛ]. The account would claim: (i) when under [LOW] harmony, /I/ surfaces as {ɛ}; (ii) both /I/s in /tʃ̆k̆-In/ harmonise, yielding {tʃ̆k̆-en'}; (iii) assuming a phonetic mid-to-high continuum starting at [ɛ] and ending at [i], the lesser degree of phonetic lowering for the post-emphatic /I/ is a phonetic effect due to greater strength of anticipatory than perseveratory phonetic coarticulation.

I reject this on two grounds. First, it entails claim that St'át'imcets postvelars are specified for [LOW] on which basis they trigger [LOW] harmony on an adjacent vowel. Given the ample evidence that the postvelars are specified for [RTR], additional [LOW] is undesirable on economy grounds. That is, as the range of data involving postvelars can be accounted for assuming they bear [RTR] and not [LOW], positing their specification for
[LOW] is an unnecessary and so undesirable enrichment. Second, under the alternative analysis, the absence of phonetic [j] in (38) remains a mystery. That is, why is the phonetic form not [tʃɛkən']? Claim that the lowness of a post-trigger vowel is gradiently interpreted in the phonetics along a mid-to-high continuum starting at [e] and ending at [i] predicts that [j] might be observed for some tokens of this word. However, it is not. Tokens of the post-trigger vowel in words like /tʃlək-ln'/ are exclusively non-rtr for their duration.  

By contrast, absence of [j] in (38) is no surprise when explained under my account, which is as follows. The harmony observed in a word like /tʃlək-ln'/ is [RTR] harmony, whereby harmonising vowels surface rtr. In Stát'imcets, this harmony only affects a vowel immediately preceding a postvelar. The fact that the post-trigger vowel never receives specification for [RTR] predicts its complete non-rtr colouring in the phonetic form.

A final note concerns the epenthetic vowel. The present database indicates that its surface variant {ə} is phonetically lowered to [ə] immediately following a postvelar, as in:

(39)
a. IPA /kən/ \{kət-ən\} [kətən] ([kətən]) “to put something away,
NA /qən/ \{qət-ən\} [qətən] to bury something”
b. IPA /ɛtʃn/ \{ɛtʃ-ən\} [ɛtʃən] ([ɛtʃən]) “to stab someone (tr.)”
NA /ɛc-n/ \{ɛc-ən\} [ɛcən]
c. IPA /RED, ŋl/ \{ɛl-ŋəl\} [ɛlŋəl] ([ɛlŋəl]) “strong, healthy,
NA /RED, ɬl/ \{ɬəl-ɬəl\} [ɬəlɬəl] vigorous”

3.2.2.4 Phonetic Epiglottalisation. Van Eijk (1997:12-13) describes /ʔ ʔ' ə'' ə''''/ as having a phonetic pharyngealisation effect on an immediately preceding epenthetic vowel, /ɛ/, or /U/. He denotes a pharyngealised epenthetic vowel and /ɛ/ as ‘[ ʔ ]’, a pharyngealised /U/ as ‘[ʔ ʔ’]’. He does not mention this effect for /I/. Following Remnant (1990), I interpret the effect as epiglottalisation, that is, superimposition of epiglottal constriction from the following uvular resonant. Acoustic data providing potential preliminary support for this are presented below. An outstanding issue is whether or not the

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27 Note that this implies that [ɛt] and [eij] are in principle distinct diphthongs, and that lowness and r-tr-ness (along some abstract dimension) are distinct. This is not new. It is implicit, e.g., in the IPA vowel chart. In that chart, [e], which is lower than [i] and [t], occupies a position distinct from [ɛ], which is also lower than [i] and [t] and in addition, is rtr. That lowness and r-tr-ness are represented distinctly in the chart implies that they are distinct.
epiglottalisation has any role in the phonology. With van Eijk (1997), I assume it does not, pending further investigation.

3.2.2.4.1 Acoustic Support. Ladefoged & Maddieson (1996:307) report lowered $F_3$ for epiglottalised vowels, based on Tsakhur and Udi data. For this study, St'át'imcets vowels were investigated for possible $F_3$ effects in the epiglottalisation environment identified by van Eijk (1997). Table 3:5 reports the first three formants of tokens of /I/ and the epenthetic vowel which did not occur immediately preceding one of /u u' u'' u''/ and of tokens which did.\textsuperscript{28} As seen, $F_3$ is lower for the latter (I.B, II.B) than for the former (I.A, II.A). This matches Ladefoged and Maddieson's finding. The data of Ladefoged & Maddieson (1996:306-310) and Esling (1996a, 1996b) indicate that epiglottalisation is a secondary articulation producing a constriction in the very low pharynx in the region of the epiglottis. Under the appropriate articulation-to-acoustic assumptions (left unexplored here), the data in Table 3:5 are potential preliminary support for the assumption that the tokens of /I/ and the epenthetic vowel immediately preceding a uvular resonant were produced with epiglottal constriction (and that the other tokens were not). This lends support to the possibility that St'át'imcets vowels are epiglottalised immediately preceding one of those consonants.

The wideband spectrogram of Figure 3:5 shows two tokens of /I/, one immediately preceding [k], the other immediately preceding [u']. The lowered $F_3$ for the token immediately preceding [u'] is evident. The same is seen for the epenthetic vowel in Figure 3:6.

\textsuperscript{28}Although van Eijk (1997) does not mention an epiglottalisation effect for /I/, that vowel was analysed just in case an effect might be found. The forms /t'-u'/ “to scatter” (I.B) and /pa'-u'/ “pale, faded” (II.A) each contain a glottalised vowel. The glottalised vowels are phonetically broken, that is, two consecutive phonetic tokens of the vowel separated by a glottal stop. No tokens of /Æ/ or /U/ immediately preceding one of /u u' u'' u'''/ were analysed, due to lack of data.
<table>
<thead>
<tr>
<th>I. /l/</th>
<th>Speaker: LC</th>
</tr>
</thead>
<tbody>
<tr>
<td>carrier form</td>
<td>token</td>
</tr>
<tr>
<td>A. not immediately preceding /u(·)(w)/</td>
<td></td>
</tr>
<tr>
<td>{ Ṋx̱k̓ [ṭx̱eq] } “to arrive (here)”</td>
<td>[e]</td>
</tr>
<tr>
<td></td>
<td>[e]</td>
</tr>
<tr>
<td>B. immediately preceding /u(·)(w)/</td>
<td></td>
</tr>
<tr>
<td>{ Ṋx̱w’w’ } [ṭx̱w’eq’] “to scatter”</td>
<td>[e]</td>
</tr>
<tr>
<td>(rightmost phonetic token)</td>
<td>[e]</td>
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<tr>
<td>mean F</td>
<td>563</td>
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</tbody>
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<table>
<thead>
<tr>
<th>II. Epenthetic Vowel</th>
<th>Speaker: LC</th>
</tr>
</thead>
<tbody>
<tr>
<td>carrier form</td>
<td>token</td>
</tr>
<tr>
<td>A. not immediately preceding /u(·)(w)/</td>
<td></td>
</tr>
<tr>
<td>{ p̃x̱w’ } [p̃x̱aw’ ] “pale, faded”</td>
<td>[ə]</td>
</tr>
<tr>
<td>(leftmost phonetic token)</td>
<td>[ə]</td>
</tr>
<tr>
<td>B. immediately preceding /u(·)(w)/</td>
<td></td>
</tr>
<tr>
<td>{ ʃ̃x̱̃w’̃ } [ʃ̃x̱̃aw’̃ ] “to rip, tear”</td>
<td>[ə]</td>
</tr>
<tr>
<td>(leftmost phonetic token)</td>
<td>[ə]</td>
</tr>
<tr>
<td>mean F</td>
<td>616</td>
</tr>
</tbody>
</table>

Table 3:5. F₁, F₂, and F₃ of tokens of St’át’imcets vowels not immediately preceding /u(·)(w)/ vs. immediately preceding /u(·)(w)/
Figure 3:5. Wideband spectrogram showing $F_3$ for St’át’imcets /l/ immediately preceding a uvular resonant. The token on the left is /l/ > /i/ in /t̕əhɪk/ “to arrive (here)”, the one on the right is /l/ > /ɛ/ in /t̕u-ɛʔ/ [t̕uɛʔ] “to scatter (e.g., people leaving from a gathering)” (rightmost token). (Formants measured at points indicated by the vertical lines.) $F_3$ of [i] on the left = 2267 Hz. $F_3$ of [ɛ] on the right = 1986 Hz.

Figure 3:6. Wideband spectrogram showing $F_3$ for the St’át’imcets epenthetic vowel immediately preceding a uvular resonant. The token on the left is a token of /ə/ in /t̕əʔʔkən-ʔəm/ “to lead horses by tying them to the tail of the horse in front”. The token on the right is a token of /ə/ in /t̕əʔʔkən/ “to rip, tear something (tr.)”. (Formants measured at points indicated by the vertical lines.) $F_3$ of [ə] = 2152 Hz. $F_3$ of [ɛ] = 1988 Hz.
3.2.2.5 *Pharyngealised Vowels.* Rtr \{I a ə o u\} occur immediately preceding a postvelar, as seen in (40). (This generalisation is based solely on distributional evidence. I know of no forms showing it in which \{I a ə o u\} arise via morphological alternation.)

(40) a. IPA /ʃ-sh əʊw/  \{ʃ-sh əʊw\}  “stripe”
    NA /s-ssh əʊw/  \{s-ssh əʊw\}

b. IPA /mɪš ə Ꚉ/  \{mɪʃ ə Ꚉ\}  “black bear”
    NA /mɪʃ Ꚉ/  \{mɪʃ Ꚉ\}

c. IPA /ʃɪk -iən/  \{ʃɪk -iən\}  “to stab someone (tr.)”
    NA /cɪq -iən/  \{cɪq -iən\}

d. IPA /ʃɪŋ -ən/  \{ʃɪŋ -ən\}  “to rip, tear something (tr.)”
    NA /cɪŋ -ən/  \{cɪŋ -ən\}

e. IPA /lʊw -ən/  \{lʊw -ən\}  “to hide something (intr., tr.)”
    NA /lʊw -ən/  \{lʊw -ən\}

f. IPA /RED, mæu/  \{mæu-mæu\}  “light, bright”
    NA /RED, mæʊ/  \{mæʊ-mæʊ\}

I analyse this as pharyngealisation of /I æ U/ and the epenthetic vowel triggered by the following postvelar. As seen in (e), rounded \{ə\} occurs where the epenthetic vowel undergoes both pharyngealisation and rounding harmony.

3.2.2.6 *Uvularised Non-high Vowels.* Backed \{ʌ o ə\} occur immediately preceding an emphatic, as in (41). (This is also based on distributional evidence.)

(41) a. IPA /kl/  \{kl\}  “bad; old, worthless”
    NA /q ə l/  \{q ə l\}

b. IPA /ʃ-tʃxw/  \{ʃ-tʃxw\}  “really, very (much); “to be in the way”
    NA /s-tʃxw/  \{s-tʃxw\}

c. IPA /ʔɛlʃ-m/  \{ʔɛlʃ-m\}  “sick, ill”
    NA /ʔɛɨʃ-m/  \{ʔɛɨʃ-m\}

d. IPA /mæxɛ ɻ/  \{mæxɛ ɻ\}  “huckleberry” (Lower dialect)
    NA /mæxɛ ɻ/  \{mæxɛ ɻ\}

e. IPA /mækɛ ɻɛ/  \{mækɛ ɻɛ\}  “snow”
    NA /mæqɛ ɻɛ/  \{mæqɛ ɻɛ\}

I analyse \{ʌ o ə\} as outputs of uvularisation harmony triggered by the following emphatic. High /I U/ do not undergo that harmony (see §3.5.3).
seen in (b), round \( \circ \) occurs where the uvularised epenthetic vowel also undergoes rounding harmony.

3.2.2.7 Summary. The distribution of the St'át'ímcets surface vowels is summarised in (42). Shading means the particular underlying vowel does not have the corresponding variant. A single vowel can undergo more than one harmony and so surface, e.g., both rounded and pharyngealised.

(42)

<table>
<thead>
<tr>
<th>Surface Variants</th>
<th>NON-RD</th>
<th>RD</th>
<th>NON-RD UVULARISED</th>
<th>RD UVULARISED</th>
</tr>
</thead>
<tbody>
<tr>
<td>(/i/)</td>
<td>i</td>
<td>1</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>(/æ/)</td>
<td>æ</td>
<td>a</td>
<td>æ</td>
<td>æ</td>
</tr>
<tr>
<td>(epenthetic vowel)</td>
<td>ø</td>
<td>ø</td>
<td>ø</td>
<td>ø</td>
</tr>
<tr>
<td>(/u/)</td>
<td>u</td>
<td>1</td>
<td>0</td>
<td>0</td>
</tr>
</tbody>
</table>

3.3. Preliminary Issues

3.3.1 Underlying Pharyngealisation, Underlying Uvularisation

The representations of the St'át'ímcets gutturals and emphatics, proposed earlier in §3.2.1.5.4, are repeated in (43) and (44). (Additional specifications are, e.g., [SON] for /\(\text{ʃ}\)/, [LAT] for /\(\text{l}\)/, [CG] for /\(\text{k}'\)\(\text{k}'\)\(\text{w}\)\(\text{ʃ}\)\(\text{l}'\)\(\text{u}'\)\(\text{u}'\)\(\text{w}\)/, [STRID] for /\(\text{j}'\)/, and secondary-[LAB] for /\(\text{k}'\)\(\text{w}\)\(\text{x}'\)\(\text{w}\)\(\text{w}\)\(\text{w}\)/.)

(43) Representation of St'át'ímcets Gutturals

\(/\text{ʃ}\text{ʃ} \text{ʃ} \text{w} \text{ʃ} \text{w}/

\([\text{CONS}]\)
\([\text{SON}]\)

\(\text{Place}\)
\([\text{DOR}]\)
\([\text{TR}]\)
\([\text{RTR}]\)

The gutturals bear primary-[DOR] and secondary-[RTR], which defines them as primary uvulars. The emphatics bear secondary-[DOR] and secondary-
[RTR], which defines them as uvularised. Both gutturals and emphatics are
underlyingly pharyngealised. The uvular component of the gutturals vs.
emphatics differs in that it is primary for the former, secondary for the latter.
The properties of postvelar harmony in the language indicate these
representations. Acoustic support for secondary-[DOR] and secondary-[RTR]
for the emphatics was presented in §3.2.1.5.7. Acoustic support for primary-
[DOR] and secondary-[RTR] for the gutturals is presented next.

(44) Representations of St’át’imcets Emphatics

\[ \begin{align*}
\text{a. dorsal emphatics} & \quad \text{b. coronal emphatics} \\
\left[\text{CONS}\right] & \quad \left[\text{CONS}\right] \\
& \quad \left[\text{CONS}\right] \\
\left[\text{DOR}\right] & \quad \left[\text{DOR}\right] \\
\left[\text{TR}\right] & \quad \left[\text{TR}\right] \\
\left[\text{RTR}\right] & \quad \left[\text{RTR}\right] \\
\end{align*} \]

3.3.1.1. Acoustic Support. Table 3:6 reports \( F_1 \) and \( F_2 \) of two tokens each of
palatal /j'/ and uvular guttural /u'/\( \). As /j'/ is non-postvelar, it is useful contrast
for /u'/\( . We see that \( F_1 \) for /u'/\( is medium, \( F_2 \) is low. For /j'/, \( F_1 \) is low and \( F_2 \) is high. A medium or high \( F_1 \) and low or medium \( F_2 \) is expected for a primary
uvular such as /u'/\(, which is presumed to be produced with primary uvular and
secondary pharyngeal articulation. The data here match the expectations and so
support the assumption that the [u']\(s were produced with those gestures. This,
in turn, supports the primary-[DOR] and secondary-[RTR] specifications in
(43). (As a lowered \( F_2 \) is also expected for segments with lip rounding, the low
\( F_2 \) observed for each [u']\( is also consistent with their rounded production.)
The medium \( F_1 \) and low \( F_2 \) for /u'/\( are seen in Figure 3:7.

3.3.2 The Derivation of the St’át’imcets Underlying Postvelar Inventory

The derivation of the underlying postvelar inventory is governed by
*Prim, Prim and Sec-RTR/DOR (see §2.3.2). Note that St’át’imcets has two
underlying post-alveolar emphatics, /tʃ/, and that St’át’imcets /tʃ/ undergoes
uvularisation harmony, as was seen in (17). St’át’imcets post-alveolars thus
contrast with Palestinian post-alveolars. In Palestinian, there are no
underlying post-alveolar emphatics and /tʃ/ do not undergo uvularisation
Table 3.6. $F_1$ and $F_2$ of tokens of St'át'imcets /j/' and /u'/

<table>
<thead>
<tr>
<th>carrier form</th>
<th>token</th>
<th>$F_1$</th>
<th>$F_2$</th>
</tr>
</thead>
<tbody>
<tr>
<td>/w'uj't/</td>
<td>[j]'1</td>
<td>296</td>
<td>2157</td>
</tr>
<tr>
<td>“to sleep”</td>
<td>[j]'2</td>
<td>321</td>
<td>2002</td>
</tr>
<tr>
<td>/w'uj't/</td>
<td>[u']1</td>
<td>574</td>
<td>1000</td>
</tr>
<tr>
<td>“to sleep”</td>
<td>[u']2</td>
<td>543</td>
<td>1000</td>
</tr>
</tbody>
</table>

Figure 3.7. Wideband spectrogram of a token of /w'uj't/ “to sleep”.
(Formants measured at points indicated by the vertical lines.)

[j']: $F_1 = 296$ Hz; $F_2 = 2157$ Hz. [j'']: $F_1 = 574$ Hz; $F_2 = 1000$ Hz.

harmony (see §2.3.2, §2.5.1). This crosslinguistic difference indicates a representational difference, namely, that St'át'imcets post-alveolars bear [COR] as in (44b), whereas Palestinian post-alveolars bear [DOR]/[FRONT] (see §2.5.4) and are subject to FRONT/*Sec-DOR $\land$ Sec-RTR. The fact that St'át'imcets post-alveolars are apical, whereas Palestinian post-alveolars are laminal supports the representational difference. Finally, lack of emphatic glottalised /tʃ'/ indicates that the St'át'imcets underlying postvelar inventory is governed by the condition in (45).

(45) CG/*Sec-DOR $\land$ Sec-RTR

A segment specified for [CG] is not specified for secondary-[DOR] and secondary-[RTR].
3.4. St’át’îmctęs Pharyngealisation Harmony

3.4.1 Pharyngealisation under Adjacency to a Postvelar

3.4.1.1 Analysis. Example (46) shows that /I/, /Æ/, /U/, and the epenthetic vowel surface non-rtr in forms with no postvelar.  

(46) a. IPA /klɪf-In’/  
   NA /klɛ̬n’/  
   {kitʃ-in’}  
   “to lay something down”  
   (intr., tr.)

b. IPA /ʃUtʃIn/  
   NA /cUcIn/  
   {tʃutʃin}  
   “mouth”

c. IPA /ʃIʃt/  
   NA /sitʃ/  
   {ʃɪtʃt}  
   “night”

d. IPA /pun-ʃp/  
   NA /pun-ʃp/  
   {pun-ʃep}  
   “Rocky Mountain Juniper”

e. IPA /tʃ‘eI-ⅼ/  
   NA /‘eI-ⅼ/  
   {tʃ‘eI-ⅼ}  
   “to keep still, to sit still without moving”

f. IPA /mulx/  
   NA /mUlx/  
   {mulx}  
   “stick” (N)

g. IPA /RED, n-kwUʃ‘æ/  
   NA /RED, n-kwUCæ/  
   {n-kw‘u-kw‘æ}  
   “downstream area”

h. IPA /RED, sx/  
   NA /RED, sx/  
   {ʃeX-ʃeX}  
   “partly crazy”

i. IPA /RED, tuqʷt/  
   NA /RED, twt/  
   {teuqʷ-teuqʷwet}  
   “(young) boy”

j. IPA /tʃ‘xʷ-xæl/  
   NA /X‘xʷ-xæl/  
   {tʃ‘exʷ-xæl}  
   “to hit (as a bush to make the berries fall off)”

k. IPA /ʃ-p’I-ⅼ-uqʷæʃ/  
   NA /s-p’I-ⅼ-wæʃ/  
   {s-p’I-ⅼ-uqʷwæʃ}  
   “squeezed in the middle”

l. IPA /RED, ?UʃÆʔ/  
   NA /RED, ?UsÆʔ/  
   {?u-ʔʃæʔ}  
   “egg”

Example (47) shows that vowels surface rtr immediately preceding a guttural. This effect is observed by van Eijk (1997:13), who records [ɔ] qualities for /U/ immediately preceding one of /b ˈu̯ ʌ ˈw/. Remnant (1990:17,113) records /U/ as [ɛ] in the same context. However, till now it has not been incorporated into an analysis that considers the full range of

---

29 These forms also show that a closed syllable does not trigger pharyngealisation of vowels in St’át’îmctęs, unlike Palestinian.
St'át'imcets postvelar harmony. (I analyse the mid height documented by van Eijk and Remnant as phonetic.)

(47)

a. IPA /t'ʌwʷ-ɪn'/ \[t'ʌwʷ-i'n'] \[(*) t'ɪwʷ-i'n'] "to untie something, to turn an animal loose (tr.)"
   NA /t'ɪwʷ-ɪn'/ \[t'ɪwʷ-i'n'] \[(*) t'ɪwʷ-i'n']

b. IPA /RED, [Iwʷ]/ \[ʃeʌwʷ-ʃɪwʷ] \[(*) ʃeʌwʷ-ʃɪwʷ] "loose (objects, also ways of behaviour)"
   NA /RED, [ʃɪwʷ]/

c. IPA /ʃ-ʃụwʷ/ \[ʃ-ʃụwʷ] \[(*) ʃ-ʃụwʷ] "stripe"
   NA /s-ʃụwʷ/ \[s-ʃụwʷ] \[(*) s-ʃụwʷ]

d. IPA /tʃu-ən/ \[tʃeʌ-ən] \[(*) tʃeʌ-ən] "to rip, tear something (tr.)"
   NA /ə-ən/

e. IPA /GLOT, mʊ/ \[mə-ʊ'] \[(*) mə-ʊ'] "(breaking) daylight"
   NA /GLOT, mʊf/  

f. IPA /ləwʷ-ən/ \[ləwʷ-ən] \[(*) ləwʷ-ən] "to hide something (intr., tr.)"
   NA /ləwʷ-ən/

g. IPA /RED, məw/ \[məw-məw] \[(*) məw-məw] "light, bright"
   NA /RED, məw/  

h. IPA /RED, ləwʷ/ \[ləwʷ-ləwʷ] \[(*) ləwʷ-ləwʷ] "room, spaces in between things"
   NA /RED, ləwʷ/  

The forms in (48) show that vowels surface rtr immediately preceding an emphatic.

(48)

a. IPA /mɪxæt/ \[mɪxæt] \[(*) mɪxæt] "black bear"
   NA /mɪ ɪ x ət/ \[mɪ ɪ x ət] \[(*) mɪ ɪ x ət]

b. IPA /tı'ɪk/ \[tɪ'ɪk] \[(*) tɪ'ɪk] "to arrive (here)"
   NA /tɪ'ɪq/ \[tɪ'ɪq] \[(*) tɪ'ɪq]

c. IPA /ʃɪk-ɪn'/ \[ʃɪk-ɪn'] \[(*) ʃɪk-ɪn'] "to stab someone (intr.)"
   NA /clq-ɪn'/ \[clq-ɪn'] \[(*) clq-ɪn']

d. IPA /ʔuxʷ-xæl/ \[ʔuxʷ-xæl] \[(*) ʔuxʷ-xæl] "to smoothen something (wood) by shaving it (intr.)"
   NA /ʔuxʷ-xæl/ \[ʔuxʷ-xæl] \[(*) ʔuxʷ-xæl]

e. IPA /n-tukʷ-xit/ \[n-ɪtukʷ-xit] \[(*) n-ɪtukʷ-xit] "to serve food to someone (tr.)"
   NA /n-tuqʷ-xit/ \[n-ɪtʊqʷ-xit] \[(*) n-ɪtʊqʷ-xit]

f. IPA /kʷuʃ/ \[kʷuʃ] \[(*) kʷuʃ] "pig" (borrowing from Chinook)
   NA /kʷuʃ/ \[kʷuʃ] \[(*) kʷuʃ]
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The data in (48) involve only high vowels. When immediately preceding an emphatic, the epenthetic vowel surfaces as rtr back and \(/Æ/ \) surfaces as rtr back. In §3.5.1 we will see that arise through uvularisation harmony with the following emphatic. Because those two vowels undergo that distinct harmony, forms in which they occur immediately preceding an emphatic will not be examined further until §3.5.

Vowels immediately following a postvelar surface non-rtr:

\[
\begin{align*}
\text{g. IPA } & /\text{GLOT, kǐx}/ \quad \{ k\text{'-x}\} \quad (\ast \{ k\text{'-x}\}) \\
& \text{NA/ GLOT, kǐ } \tilde{x} \quad \{ k \text{'-}\tilde{x}\} \quad (\ast \{ k \text{'-}\tilde{x}\}) \\
& \text{Jargon) } \quad \text{"cranky (child), it wants attention or is sick")}
\end{align*}
\]

\[
\begin{align*}
\text{h. IPA } & /\text{GLOT, } \?\text{UX}\text{'-U}\hat{æ}/ \quad \{ \text{'u}\text{-x}'-\hat{æ}\} \quad (\ast \{ \text{'u}\text{-x}'-\hat{æ}\}) \\
& \text{NA/ GLOT, } \text{?U } \tilde{x}'\text{-Us}/\hat{æ}/ \quad \{ \text{'u}\text{-}'-\tilde{x}'\text{-usa}\} \quad (\ast \{ \text{'u}\text{-}'-\tilde{x}'\text{-usa}\}) \\
& \text{"to peel fruit (intr., tr.")}
\end{align*}
\]

The generalisation is that Stát'imcets vowels surface rtr immediately preceding a postvelar. In any other context, they surface non-rtr. I analyse the rtr effect as due to pharyngealisation harmony triggered by the immediately following postvelar.

The data in (50) show that vowels do not surface rtr immediately preceding a laryngeal. (The /\l/ de-emphaticises in (c).) Lack of effect
immediately preceding a laryngeal further indicates that the laryngeals are not gutturals.

(50)

a. IPA /ʃ-p'Iʔ-ʔiʔ-wēj/ \{ʃ-p'Iʔ-ʔiʔ-wēj\} (*ʃ-p'Iʔ-ʔiʔ-wēj\})
   NA /s-p'Iʔ-ʔwēs/ \{s-p'Iʔ-s-lwēs\} (*s-p'Iʔ-s-lwēs\})
   "squeezed in the middle"

b. IPA /ʔUj-wēʔ/ \{ʔUj-wēʔ\} (*ʔUj-wēʔ\}) "egg"
   NA /ʔUs-ʔaʔ/ \{ʔUs-ʔaʔ\} (*ʔUs-ʔaʔ\})

c. IPA /juh-ən/ \{juh-ən\} (*juh-ən\}) "to warn"
   NA /züh-ən/ \{züh-ən\} (*züh-ən\}) someone,
   to tell someone to be careful (intr., tr.)"

Finally, (51) - (52) show that St'át'ímcets pharyngealisation harmony does not extend beyond the word, whether the words involved are bound morphemes (clitics), as in (51), or free morphemes, as in (52). This shows that the word is the harmony domain. (Clitic word boundaries are marked below by ‘_/’.)

(51)

a. IPA /ni_/ # wIʃ-mn/ \{ni_/ # wIʃ-mn\} (*ni_/ # wIʃ-mn\})
   NA /ni_/ # ʃIc-mn/ \{ni_/ # ʃIc-mn\} (*ni_/ # ʃIc-mn\})
   "the tooth (absent, known)"

b. IPA /ʔI_/ # wIʃ-ʔwēʔ/ \{ʔI_/ # wIʃ-ʔwēʔ\} (*ʔI_/ # wIʃ-ʔwēʔ\})
   NA /ʔI_/ # ʃIc-wēʔ/ \{ʔI_/ # ʃIc-wēʔ\} (*ʔI_/ # ʃIc-wēʔ\})
   "last night"

c. IPA /k’em’p # wIʃ-iʔ-xwʔʔUʔʃin/ \{k’em’p # wIʃ-iʔ-xwʔʔUʔʃin\} (*k’em’p # wIʃ-iʔ-xwʔʔUʔʃin\})
   "fourteen"
   NA /q’em’p # wIʃ-xwʔʔUʔcin/ \{q’em’p # wIʃ-xwʔʔUʔcin\} (*q’em’p # wIʃ-xwʔʔUʔcin\})

(52) IPA /k’Iʃ’-U # k’Iʃ’-ap/ \{k’Iʃ’-U # k’Iʃ’-ap\} (*k’Iʃ’-U # k’Iʃ’-ap\})
   NA /k’Iʃ’-U # q’c’-ap/ \{k’Iʃ’-U # q’c’-ap\} (*k’Iʃ’-U # q’c’-ap\})
   "until it got tangled up"

3.4.1.2 Acoustic Support. Figures 3:8 - 3:15 present F1 - F2 plots for the four St'át'ímcets vowels. The tokens plotted in these graphs are all the St'át'ímcets vowels analysed for this study, except for a handful reported on instead in a spectrogram or table. The tokens produced by LC, Lower speaker, and those produced by LN, Upper speaker, are in separate graphs. IPA symbols identify
clusters of tokens that are perceptually non-rtr vs. rtr allophones, per vowel. For allophones for which less than six tokens are plotted, ellipses are calculated assuming a s.d. of 40 Hz, based on Lindblom (1962). Such ellipses are presented in dotted line. (Throughout this chapter, where no tokens of a vowel in a particular context are plotted, that is due to lack of data.)

In Figures 3:8 and 3:9, the non-rtr vs. rtr tokens of /I/ fall within distinct regions of the $F_1$ - $F_2$ plane: for each speaker, the rtr tokens are within a higher $F_1$ and lower $F_2$ region than the non-rtr tokens. The same is observed for the non-rtr vs. rtr back tokens of /Æ/ in Figures 3:12 - 3:13 (for which the $F_1$ difference is greatest for LN). A higher $F_1$ interval is observed for the rtr, compared to non-rtr, tokens of /U/ in Figure 3:10.

Figures 3:14 - 3:15 show that the tokens of the epenthetic vowel fall within distinct regions, which can be described three different ways, corresponding to the three-way distinction that cuts across the surface variants of this vowel, namely, non-rtr/rtr, non-back/back, non-round/round. For LC, the non-rtr [ə]s are mostly in a lower $F_1$, higher $F_2$ region than the rtr [ɔ]s. For LN, the non-rtr [ə]s are within a lower $F_1$, higher $F_2$ region than the rtr [ɔ Λ]s. For both speakers, the non-rtr [ɛ]s are within a lower $F_1$ interval than the rtr back [ɔ]s. For LN the [ɛ]s are in a distinct lower $F_1$, higher $F_2$ region. The non-back [ə ɔ 3]s are within a higher $F_2$ interval than the back [ɔ]s and, for LN, back [Λ]s (with the $F_2$ difference slight for LN’s [Λ]s). Finally, for both speakers, the non-rd [ə 3]s and, for LN, [Λ]s, are within a higher $F_2$ interval than the rd [ɛ ɔ]s. (For LN, the $F_2$ difference between the [Λ]s and [ɛ]s is small.)

Some [ə]s in the last two figures occurred immediately following a postvelar. They are in the lower part of the ellipses for /e ə/ (that is, the part where $F_1$ is higher than average) and are more precisely ‘[ə]’. Their lowered position is consistent with the assumption that the epenthetic vowel is produced with a lowered tongue position immediately following a postvelar (see §3.2.2). The data in Figure 3:14 are also consistent with such lowering, as two of LC’s [ɛ]s are in a position in the graph which is lower than that of LC’s other two [ɛ]s. The former pair occurred immediately following a rounded postvelar.

Figure 3:16 shows a wideband spectrogram of rd [ɔ] and non-rd [Λ]. $F_2$ of [ɔ] is about 200 Hz lower than it is for [Λ]. For each vowel, $F_2$ is steady. This shows that each vowel has reached and maintained its distinct $F_2$ target. This indicates phonetic implementation of a discrete phonological property. The distinct steady $F_2$ of [ɔ] vs. [Λ] in Figure 3:16 are expected if rnd [ɔ] and non-rnd [Λ] are tokens of phonologically distinct vowels: /ɔ/, specified for.

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30 A further limitation is that sometimes only two tokens of a particular allophone are plotted.
[LAB], and \( ^\frac{1}{2} \Lambda \), not so specified. The data in the figure thus support the claim that the St’át’imcets epenthetic vowel undergoes phonological rounding harmony.

![Diagram](https://example.com/diagram.png)

**Figure 3:8.** \( F_1 - F_2 \) plot of tokens of St’át’imcets /i/. Speaker: LC.

\[
\begin{align*}
[i]: & \quad F_1 \text{ (mean } 315 \text{ Hz; s.d. } 39 \text{ Hz); } F_2 \text{ (mean } 1910 \text{ Hz; s.d. } 118 \text{ Hz); } 12 \text{ tokens.} \\
[i]: & \quad F_1 \text{ (mean } 582 \text{ Hz; s.d. } 46 \text{ Hz); } F_2 \text{ (mean } 1514 \text{ Hz; s.d. } 186 \text{ Hz); } 6 \text{ tokens.}
\end{align*}
\]

![Diagram](https://example.com/diagram.png)

**Figure 3:9.** \( F_1 - F_2 \) plot of tokens of St’át’imcets /I/. Speaker: LN.

\[
\begin{align*}
[i]: & \quad F_1 \text{ (mean } 286 \text{ Hz; s.d. } 44 \text{ Hz); } F_2 \text{ (mean } 2329 \text{ Hz; s.d. } 114 \text{ Hz); } 16 \text{ tokens.} \\
[i]: & \quad F_1 \text{ (mean } 606 \text{ Hz; s.d. } 50 \text{ Hz); } F_2 \text{ (mean } 1744 \text{ Hz; s.d. } 168 \text{ Hz); } 6 \text{ tokens.}
\end{align*}
\]
Figure 3:10. $F_1 - F_2$ plot of tokens of St'át'imcets /U/. Speaker: LC.
[U]: $F_1$ (mean = 381 Hz; s.d. = 73 Hz); $F_2$ (mean = 1053 Hz; s.d. = 95 Hz); 14 tokens.
[U]: $F_1$ (mean = 554 Hz; s.d. = 39 Hz); $F_2$ (mean = 1048 Hz; s.d. = 32 Hz); 2 tokens.

Figure 3:11. $F_1 - F_2$ plot of tokens of St'át'imcets /U/. Speaker: LN.
[U]: $F_1$ (mean = 361 Hz; s.d. = 97 Hz); $F_2$ (mean = 991 Hz; s.d. = 155 Hz); 12 tokens.
[U]: no tokens.
Figure 3:12. $F_1$ - $F_2$ plot of tokens of St'át'imcets /Æ/. Speaker: LC.

[œ]: $F_1$ (mean = 641 Hz; s.d. = 74 Hz); $F_2$ (mean = 1562 Hz; s.d. = 123 Hz); 16 tokens.

[a]: $F_1$ (mean = 696 Hz; s.d. = 52 Hz); $F_2$ (mean = 1234 Hz; s.d. = 35 Hz); 6 tokens.

[a]: no tokens.

Figure 3:13. $F_1$ - $F_2$ plot of tokens of St'át'imcets /Æ/. Speaker: LN.

[œ]: $F_1$ (mean = 653 Hz; s.d. = 51 Hz); $F_2$ (mean = 1658 Hz; s.d. = 51 Hz); 20 tokens.

[a]: $F_1$ (mean = 813 Hz; s.d. = 89 Hz); $F_2$ (mean = 1521 Hz; s.d. = 13 Hz); 4 tokens.

[a]: no tokens.
Figure 3:14. F₁ - F₂ plot of tokens of the St’át’imcets epenthetic vowel. Speaker: LC.
[ə]: F₁ (mean = 541 Hz; s.d. = 72 Hz); F₂ (mean = 1472 Hz; s.d. = 125 Hz); 12 tokens.
[θ]: F₁ (mean = 507 Hz; s.d. = 63 Hz); F₂ (mean = 1083 Hz; s.d. = 123); 4 tokens.
[œ]: F₁ (mean = 652 Hz; s.d. = 52 Hz); F₂ (mean = 1355 Hz; s.d. = 61); 4 tokens.
[œ]: F₁ (mean = 677 Hz; s.d. = 15 Hz); F₂ (mean = 1087 Hz; s.d. = 12); 2 tokens.
[A]: no tokens.[œ]: no tokens.

Figure 3:15. F₁ - F₂ plot of tokens of the St’át’imcets epenthetic vowel. Speaker: LN.
[ə]: F₁ (mean = 552 Hz; s.d. = 102 Hz); F₂ (mean = 1687 Hz; s.d. = 138 Hz); 12 tokens.
[θ]: F₁ (mean = 477 Hz; s.d. = 4 Hz); F₂ (mean = 1114 Hz; s.d. = 10); 2 tokens.
[œ]: F₁ (mean = 702 Hz; s.d. = 0 Hz); F₂ (mean = 1273 Hz; s.d. = 2); 2 tokens.
[œ]: F₁ (mean = 517 Hz; s.d. = 0 Hz); F₂ (mean = 960 Hz; s.d. = 36); 2 tokens.
[A]: F₁ (mean = 689 Hz; s.d. = 4 Hz); F₂ (mean = 1192 Hz; s.d. = 36); 2 tokens.
[œ]: no tokens.
Figure 3:16. Wideband spectrogram of St'át'imcets [ɔ] and [ʌ].

The [ɔ] is a token of epenthetic rd /ɔ/ in /ʔ əxι/ “to cough”, the [ʌ] a token of epenthetic non-rd /ʌ/ in /k ʌ/ “to get spoiled (meat, potatoes), to break down (car, wagon)”. (Formants measured at points indicated by the vertical lines.)

[ɔ]: $F_1 = 517$ Hz; $F_2 = 997$ Hz. [ʌ]: $F_1 = 685$ Hz; $F_2 = 1191$ Hz.

Subsequent graphs in this section replot the vowel tokens in Figures 3:8 - 3:15 according to the contexts relevant to St’át’imcets pharyngealisation harmony: (i) with no postvelar in the word, (ii) immediately preceding a guttural, (iii) immediately following a guttural, (iv) immediately preceding an emphatic, and (v) immediately following an emphatic. Figures 3:17 - 3:24 replot the tokens in context (i). As seen, the tokens in these new figures are all non-rtr. That is, they do not have a raised $F_1$ and lowered $F_2$, compared to the corresponding rtr tokens per vowel in Figures 3:8 - 3:10 and 3:12 - 3:15. (The ellipses in the new figures are from Figures 3:8 - 3:15. The empty rtr ellipses remind us of the higher $F_1$, lower $F_2$ regions of the rtr tokens in the earlier graphs.) The formant effects expected for a vowel with pharyngealisation articulation are medium $F_1$ rise and a medium $F_2$ drop (see Table 1:8). The tokens in Figures 3:17 - 3:24 do not show those effects. This is consistent with the assumption that they were not produced with pharyngealisation. This supports our phonological claim that St’át’imcets vowels are not pharyngealised when there is no postvelar in the word.

Figures 3:25 - 3:32 replot the tokens in context (ii) vs. context (iii), i.e., immediately preceding a guttural vs. immediately following a guttural (but not both). Those tokens that immediately preceded a guttural are all rtr. Those that
Figure 3:17. $F_1$ - $F_2$ plot of St'át'ímcets /i/ in the context:
(i) with no postvelar in the word. Speaker: LC.

Figure 3:18. $F_1$ - $F_2$ plot of St'át'ímcets /i/ in the context:
(i) with no postvelar in the word. Speaker: LN.
Figure 3:19. $F_1 - F_2$ plot of St'át'ímcets /U/ in the context:
(i) with no postvelar in the word. Speaker: LC.

Figure 3:20. $F_1 - F_2$ plot of St'át'ímcets /U/ in the context:
(i) with no postvelar in the word. Speaker: LN.
Figure 3:21. $F_1 - F_2$ plot of St'át'imcets /Æ/ in the context:
(i) with no postvelar in the word. Speaker: LC.

Figure 3:22. $F_1 - F_2$ plot of St'át'imcets /Æ/ in the context:
(i) with no postvelar in the word. Speaker: LN.
Figure 3:23. $F_1 - F_2$ plot of the St'át'imcets epenthetic vowel in the context: (i) with no postvelar in the word. Speaker: LC.

Figure 3:24. $F_1 - F_2$ plot of the St'át'imcets epenthetic vowel in the context: (i) with no postvelar in the word. Speaker: LN.
immediately followed a guttural are all non-rtr. That is, the former have a raised $F_1$ and lowered $F_2$. The latter do not. Based on the formant means in the earlier figures, the size of the $F_1$ rise of the rtr tokens in these new figures ranges from medium to large, the $F_2$ drop from small to large (tokens of round allophones excepted). A medium $F_1$ rise and medium $F_2$ drop are expected for vowels with pharyngealisation articulation. The formant effects of the rtr tokens are not exactly as anticipated. However, the changes are in the expected directions. This is some support for the assumption that the tokens immediately preceding a guttural were pharyngealised, the others not. This supports our phonological claim that St’át’imcets vowels pharyngealise immediately preceding a guttural but not immediately following one.

![Figure 3:25. $F_1 - F_2$ plot of tokens of St’át’imcets /I/ in the contexts: (ii) immediately preceding a guttural; (iii) immediately following a guttural. Speaker: LC.](image-url)
Figure 3:26. $F_1 - F_2$ plot of tokens of St'át'ímects /l/ in the contexts:
(ii) immediately preceding a guttural; (iii) immediately following a guttural.
Speaker: LN.

Figure 3:27. $F_1 - F_2$ plot of tokens of St'át'ímects /u/ in the contexts:
(ii) immediately preceding a guttural; (iii) immediately following a guttural.
Speaker: LC.
Figure 3:28. $F_1 - F_2$ plot of tokens of St'át'ímcets /U/ in the context: (iii) immediately following a guttural. Speaker: LN.

Figure 3:29. $F_1 - F_2$ plot of tokens of St'át'ímcets /Æ/ in the context: (iii) immediately following a guttural. Speaker: LC.
Figure 3:30. $F_1$ - $F_2$ plot of tokens of Stát'ímcets /Æ/ in the context:
(iii) immediately following a guttural. Speaker: LN.

Figure 3:31. $F_1$ - $F_2$ plot of tokens of the Stát'ímcets epenthetic vowel in the contexts:
(ii) immediately preceding a guttural; (iii) immediately following a guttural.
Speaker: LC.
Figures 3:32-3:36 replot the tokens of /I/ and /U/ in context (iv) vs. (v), i.e., immediately preceding an emphatic vs. immediately following an emphatic. (Data on /Æ/ and the epenthetic vowel in those contexts will be discussed in §3.5.1.) The tokens that immediately preceded an emphatic are rtr. They have an $F_1$ rise and $F_2$ drop. Those that immediately followed an emphatic are non-rtr. That is, they do not show those formant effects. This is consistent with the assumption that the former set were produced with a pharyngealisation articulation lacked by the latter. This supports our claim that the vowels pharyngealise immediately preceding an emphatic but not immediately following one.

Finally, Figures 3:37 - 3:43 replot the vowel tokens that immediately preceded or immediately followed a laryngeal (but not both). (As exceptions, the tokens of /U/ occurred in both contexts, in `?u-?fœʔ?` "egg".) Here the tokens are all non-rtr. That is, they do not show the $F_1$ and $F_2$ effects expected for vowels produced with pharyngealisation. This supports the assumption that the tokens in both contexts were not pharyngealised. Recall that, earlier, tokens which occurred immediately preceding a guttural were observed to be rtr. The fact that the tokens immediately preceding a laryngeal are not rtr supports our claim that St’át’imcets laryngeals are not gutturals.
Figure 3.33. $F_1 - F_2$ plot of tokens of St'át'ímcets /i/ in the contexts:
(iv) immediately preceding an emphatic; (v) immediately following an emphatic.
Speaker: LC.

Figure 3.34. $F_1 - F_2$ plot of tokens of St'át'ímcets /i/ in the contexts:
(iv) immediately preceding an emphatic; (v) immediately following an emphatic.
Speaker: LN.
Figure 3:35. $F_1 - F_2$ plot of tokens of St'át'ímcets /U/ in the context:
(v) immediately following an emphatic. Speaker: LC.

Figure 3:36. $F_1 - F_2$ plot of tokens of St'át'ímcets /U/ in the context:
(v) immediately following an emphatic. Speaker: LN.
Figure 3.37. $F_1 - F_2$ plot of tokens of St’át’imcets /l/ in the context: immediately preceding a laryngeal. Speaker: LC.

Figure 3.38. $F_1 - F_2$ plot of tokens of St’át’imcets /l/ in the context: immediately preceding a laryngeal or immediately following a laryngeal. Speaker: LN.
Figure 3:39. $F_1 - F_2$ plot of tokens of St'át'imcets /U/ in the (simultaneous) context: immediately preceding a laryngeal and immediately following a laryngeal. Speaker: LC.

Figure 3:40. $F_1 - F_2$ plot of tokens of St'át'imcets /U/ in the (simultaneous) context: immediately preceding a laryngeal and immediately following a laryngeal. Speaker: LN.
Figure 3.41. \( F_1 - F_2 \) plot of tokens of St'át'имцетс /æ/ in the context: immediately preceding a laryngeal or immediately following a laryngeal.

Speaker: LC.

Figure 3.42. \( F_1 - F_2 \) plot of tokens of St'át'имцетс /æ/ in the context: immediately preceding a laryngeal or immediately following a laryngeal.

Speaker: LN.
3.4.2 Theoretical Account

I assume that [HI], [LOW], and [LAB] define the St’át’imičets underlying vowels. Evidence for active [HI] comes from the fact that high vowels in the language do not undergo uvularisation harmony (see §3.5.3).

Evidence for active [LOW] comes from the following property of St’át’imičets vowel distribution documented by van Eijk (1997). Epenthetic (NA) \( \hat{a} \) never occurs immediately preceding a glottal stop. In that context, only (NA) \( \hat{a} \) occurs. Van Eijk’s data indicate that \( \hat{a} \) in that context is epenthetic, suggesting that the lack of \( \hat{a} \) there is due to lowering of, that is, insertion of [LOW] on, the epenthetic vowel. Evidence for active [LAB] comes from rounding harmony (see §3.2.2).

By Combinatorial Specification, [HI], [LOW], and [LAB] yield:

(53) 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8

<table>
<thead>
<tr>
<th>(epenthetic vowel)</th>
<th>/I/</th>
<th>*</th>
<th>/æ/</th>
<th>*</th>
<th>*</th>
<th>/U/</th>
<th>*</th>
</tr>
</thead>
<tbody>
<tr>
<td>HI</td>
<td>+</td>
<td>+</td>
<td></td>
<td></td>
<td></td>
<td>+</td>
<td>+</td>
</tr>
<tr>
<td>LO</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>LAB</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td></td>
<td>+</td>
</tr>
</tbody>
</table>
Of these eight vowels, St’át’ímcets makes use of four. Combinations 5 and 6 are evidently excluded by the markedness condition LAB/HI (see §2.3.3). I hypothesise that 3 and 8 are ruled out by a markedness condition on complexity of height specifications. The epenthetic vowel is 1, the null feature set. I assume it arises via insertion of [SON] in the input-output mapping, where necessary to satisfy σNUC.

The representations of the underlying vowels are seen below:

(54) Representations of St’át’ímcets Underlying Vowels

Following Shaw (1996d), I analyse the epenthetic vowel as weightless, that is, not dominated by a mora. Evidence for its weightlessness comes from stress assignment. In St’át’ímcets, basic primary lexical stress is assigned to the leftmost vowel, as shown by (55).

(55) a. IPA /tʃUtʃIn/  
    NA /cUcin/  
    ‘tʃu.tʃin’  
    “mouth”

b. IPA /ʃ-nUwÆ/  
    NA /s-núwa/  
    ‘ʃ-nú.waə’  
    “you (sg.)”

c. IPA /RED, n-kʷUtʃÆ/  
    NA /RED, n-kʷUcÆ/  
    ‘ŋ.-kʷú-kʷ.ʃee’  
    “downstream area”

d. IPA /pʃkt/  
    NA /pckt/  
    ‘pʃk.t’  
    “leaf”

e. IPA /RED, ʃx/  
    NA /RED, sx/  
    ‘ʃex-.ʃex’  
    “partly crazy”

---

31 I assume that mid vowels bear two height features, [HI] and [LOW]. Chapter 2 argued that Palestinian has underlying mid vowels, with complex height specifications. The underlying vowel inventory of that language is thus marked with respect to height.
However, if the word contains one of /IÆU/ and an epenthetic vowel, then primary stress falls on the leftmost /I/, /Æ/, or /U/:

(56) a. IPA /m($('x'Æ)'j')/ \{m$('x'Æ)'j'}\ “huckleberry” (Lower NA /m$('x'Æ)z')/ \{m$('x'Æ)z'}\ dialect)
b. IPA /l$('h'Æ)'j'/ \{l$('h'Æ)'j'}\ “otter” NA /l$('h'Æ)z'/ \{l$('h'Æ)z'}\\
c. IPA /ku('w'Æ)'tU'/ \{k$('w'Æ)'tU'}\ (fem. name) NA /kw$('w'Æ)'tU'/ \{k$('w'Æ)'tU'}\

Shaw (1996b:5) states the relevant generalisation: “[.ê... ø] but [*ë... ø.]”; ‘ø’ = one of \{ø ø 3 ø ø ø\}, ‘V’ = one of /IÆU/. Following Shaw, I analyse the lack of primary stress on the leftmost vowels in (56) as showing that the epenthetic vowel differs in prosodic weight from /IÆU/, that is, that it is weightless, whereas /IÆU/ have weight, and that stress falls preferentially on a syllable with weight. In forms with only epenthetic vowels, weight is not a determining factor and stress falls on the leftmost vowel, as in (55d-e). Note that although the epenthetic vowel bears no mora, it is nevertheless syllabified as a nucleus. That is, it is represented as in (57).

(57) \n\n| [SON] 
Since the epenthetic vowel does not bear [CONS], it is a vowel. It can be syllabified as a nucleus because vowels project a nucleus.

St’át’imcets pharyngealisation harmony introduces the feature [RTR] into the basic combinatorial system. This yields the new output vowels seen double-boxed in (58). All are put to use. The [RTR] specification resulting from pharyngealisation harmony is added as a secondary specification (as is the [LAB] from rounding harmony).

(58)

<table>
<thead>
<tr>
<th>ø</th>
<th>ë</th>
<th>ø</th>
<th>ø</th>
<th>i</th>
<th>i</th>
<th>æ</th>
<th>a</th>
<th>u</th>
<th>u</th>
</tr>
</thead>
<tbody>
<tr>
<td>HI</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>+</td>
</tr>
<tr>
<td>LO</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>+</td>
</tr>
<tr>
<td>LAB</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>+</td>
</tr>
<tr>
<td>RTR</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>+</td>
</tr>
</tbody>
</table>
As seen, [HI] freely combines with [RTR] in St’át’imcets. This shows that HI/*RTR is lowly ranked in the language, as in Palestinian (see §2.3.3).

The representational change resulting from pharyngealisation is illustrated with (/U/ >) \{u\} in (59). A harmonising epenthetic vowel receives specification for [DOR] under a Place node by interpolation.

(59)

\[
\begin{array}{c}
\text{N} \\
\text{\{u\}} \\
\text{[SON]} \\
\text{\{Place\}} \\
\text{[LAB]} \\
\text{[DOR]} \\
\text{[HIGH]} \\
\text{[RTR]}
\end{array}
\]

All the postvelars trigger pharyngealisation harmony. Assuming (43) and (44), [RTR] is a secondary specification for all the triggers. This means that St’át’imcets pharyngealisation harmony is [RTR] AS harmony.

Consider, alternatively, that the underlying vocalic inventory might be defined by [DOR], [TR], and [LAB]. An analysis along these lines is proposed by E. Pulleyblank (1989) for Coeur d’Alene (Southern Interior Salish). (Under Pulleyblank’s assumptions, [TR] is ‘[RADICAL]’ which dominates [±RTR].) Evidence that [DOR], [TR], and [LAB] are active in St’át’imcets comes from the distinctions within the consonantal inventory, e.g., between its underlying postvelars. The alternative account would claim:

(60)

<table>
<thead>
<tr>
<th></th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>6</th>
<th>7</th>
<th>8</th>
</tr>
</thead>
<tbody>
<tr>
<td>epenth. vowel</td>
<td>/I/</td>
<td>*</td>
<td>/Æ/</td>
<td>*</td>
<td>*</td>
<td>/U/</td>
<td>*</td>
<td></td>
</tr>
<tr>
<td>DOR</td>
<td>+</td>
<td>+</td>
<td></td>
<td></td>
<td>+</td>
<td>+</td>
<td></td>
<td></td>
</tr>
<tr>
<td>TR</td>
<td>+</td>
<td>+</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>LAB</td>
<td></td>
<td></td>
<td>+</td>
<td>+</td>
<td>+</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Combinations 5 and 6 would be hypothesised to be ruled out by a marked-
ness condition LAB/DOR (‘If [LAB], then [DOR]’), which is supported by the inventory of rounded consonants in the language. The only rounded ones are velar /kʷ kʰ kʷʰ xʷ xʰ u˨˩˦ u˨˦˦/ and uvular /uʷ uʰʷ/. Both sets are [DOR].

However, the claim that /Æ/ bears [TR] is problematic. If it did, we would expect it to trigger pharyngealisation harmony. Relevant data are presented in (61). In each form, /U/ or /I/ precedes /Æ/ with a laryngeal intervening between it and the /Æ/. As seen, the non-low vowels surface non-rtr.

(61)

\[
\begin{align*}
\text{a. IPA }& /kÆ-p'U?-Æ/ \quad \{kæ-p'ú?-æ\} \quad \{kæ-p'ú?-æ\} \quad \{kæ-p'ú?-æ\} \\
\text{NA }& /kÆ-p'U?-Æ/ \quad \{ka-p'ú?-a\} \quad \{ka-p'ú?-a\} \quad \{ka-p'ú?-a\}
\end{align*}
\]

\[
\begin{align*}
\text{b. IPA }& /hI?-ÆtkʷÆ?/ \quad \{hi?-ætkʷæ\} \quad \{hi?-ætkʷæ\} \quad \{hi?-ætkʷæ\} \quad \{hi?-ætkʷæ\} \\
\text{NA }& /hI?-ÆtkʷÆ?/ \quad \{hi?-áʔwʔa\} \quad \{hi?-áʔwʔa\} \quad \{hi?-áʔwʔa\} \quad \{hi?-áʔwʔa\}
\end{align*}
\]

\[
\begin{align*}
\text{c. IPA }& /ʔI?Æj/ \quad \{ʔi?-æj\} \quad \{ʔi?-æj\} \quad \{ʔi?-æj\} \quad \{ʔi?-æj\} \\
\text{NA }& /ʔI?Æy/ \quad \{ʔi?-áy\} \quad \{ʔi?-áy\} \quad \{ʔi?-áy\} \quad \{ʔi?-áy\}
\end{align*}
\]

Forms such as /GLOT, ṭm₃/ \{ ṭm₃-ʔ \} show that glottalised vowels which precede a postvelar surface rtr (see also Table 3:5). In the present database, St’át’imcets glottalised vowels are phonetically implemented as two consecutive tokens of the vowel separated by a glottal stop, yielding, e.g., \{ ṭm₃-ʔ \} \{ ṭm₃ʔu \}. The rtr-ness of both phonetic tokens indicates that the intervening phonetic laryngeal is transparent to the harmony. (The laryngeals are also transparent to phonetic lowering, as in /xʷʔU[tʃɪn]/ \{ xʷʔʊ[tʃɪn] \} \{ xʷʔʊ[tʃɪn] \} \{ xʷʔʊ[tʃɪn] \} “fourteen”.) A phonological laryngeal would be expected to be transparent to pharyngealisation harmony, too. Given this, I analyse the lack of pharyngealisation in (61) as showing that St’át’imcets /Æ/ does not trigger pharyngealisation harmony. If it did, assuming laryngeal transparency, the non-low vowels would be expected to surface rtr. The prediction made by the specifications in (60) is not borne out. On this basis, I reject the alternative account.

The patterns in (46) - (52) indicate the ranking in (62).

(62) DEP-IO, MAX-RTR, MAX-LINK >>

\[
\begin{align*}
\text{ALIGN-L([RTR], NUC)} \quad \text{DEP-LINK} >> \\
\text{ALIGN-R([RTR], NUC)}
\end{align*}
\]
This results in constraint interaction as illustrated in (63) and (64).

<table>
<thead>
<tr>
<th>(63)</th>
<th>input: /tIb'w-In'/</th>
</tr>
</thead>
<tbody>
<tr>
<td>[RTR]</td>
<td>DEP-IO</td>
</tr>
<tr>
<td>“to untie something, to turn an animal loose (tr.),”</td>
<td></td>
</tr>
<tr>
<td>1. /tiw'/</td>
<td>*!</td>
</tr>
<tr>
<td>2. /tIb'w-In'/</td>
<td>*!</td>
</tr>
<tr>
<td>3. /tIb'w-In'/</td>
<td>*</td>
</tr>
<tr>
<td>4. /tIb'w-In'/</td>
<td>**!</td>
</tr>
<tr>
<td>5. /tIb'w-In'/</td>
<td>*!</td>
</tr>
</tbody>
</table>

The ranking MAX-RTR, MAX-LINK >> ALIGN-L((RTR), NUC) is established, e.g., by the winning candidate in (63). In the winner, the vowel leftward of the postvelar surfaces bearing [RTR]. Any other ranking would permit vacuous satisfaction ALIGN-L((RTR), NUC) by deletion of [RTR] and its link with the postvelar. However, a form with such deletion is non-optimal, as shown by the losing candidate 1. In the losing candidate 3 in (64), a vowel is epenthesised to supply a leftward vowel which can align with [RTR], in satisfaction of ALIGN-L((RTR), NUC). Candidate 3's loss shows that DEP-IO is ranked with the MAX constraints above ALIGN-L((RTR), NUC). The winning candidate 3 in (63) contains a non-underlying link between [RTR] and the vowel leftward of the postvelar in violation of DEP-LINK but in satisfaction of ALIGN-L((RTR), NUC). This establishes ALIGN-L((RTR), NUC) >> DEP-LINK. In the candidates 4 in both tableaux, the rightward vowel pharyngealises. By result, each of those candidates incurs one more violation of DEP-LINK than
the winner in its tableau. The candidates 4 lose, hence DEP-LINK >> ALIGN-R([RTR], NUC). Candidate 5 in (64) contains a non-underlying link between [RTR] and \( \tilde{t} \). Because of that link, it violates ALIGN-L([RTR], NUC) because [RTR] is left-aligned with \( \tilde{t} \), not with a NUC. (That also violates DEP-LINK.) Finally, equal ranking for DEP-IO, MAX-RTR and MAX-LINK is simply assumed.

(64)

<table>
<thead>
<tr>
<th>input: /uI]/</th>
<th>DEP-IO</th>
<th>MAX-RTR</th>
<th>MAX-LINK</th>
<th>ALIGN-L([RTR], NUC)</th>
<th>DEP-LINK</th>
<th>ALIGN-R([RTR], NUC)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. {uI] }</td>
<td>![</td>
<td>*!</td>
<td>![</td>
<td>![</td>
<td>![</td>
<td>![</td>
</tr>
<tr>
<td>2. {uI] }</td>
<td>![</td>
<td>*!</td>
<td>![</td>
<td>![</td>
<td>![</td>
<td>![</td>
</tr>
<tr>
<td>3. {əuI] }</td>
<td>![</td>
<td>![</td>
<td>*!</td>
<td>![</td>
<td>![</td>
<td>![</td>
</tr>
<tr>
<td>4. {uI] }</td>
<td>![</td>
<td>![</td>
<td>![</td>
<td>![</td>
<td>![</td>
<td>![</td>
</tr>
</tbody>
</table>

The claim here is that candidate 5 in (63) is non-optimal because St’át’imcets consonants do not undergo pharyngealisation harmony. The same was asserted for Palestinian in chapter 2. The basis of this claim for St’át’imcets is explained as follows. First, for the present acoustic study, tokens of St’át’imcets consonants in a pharyngealisation context were examined for possible formant effects, compared to tokens in a non-pharyngealisation context. The focus was on \( F_1 \), as the present data indicate it is the most salient acoustic effect of pharyngealisation. An \( F_1 \) rise of up to 200 Hz was observed for tokens of a consonant in a pharyngealisation context, compared to \( F_1 \) of tokens of the same consonant not in that context, e.g., for a token of the leftmost \( \tilde{t} \) in \{uI]-uI\} “strong, healthy, vigorous” compared to a token of \( \tilde{t} \) in \{tʃI]-tʃI\} “fresh fruit”. A raised \( F_1 \) is observed for tokens of St’át’imcets vowels under pharyngealisation harmony (see §3.4.1.2). However, unlike the \( F_1 \) effect for vowels, I consider the effect for consonants as due not to St’át’imcets phonology, but solely to the phonetics.
Perceptual data support this. AA, an adult female native speaker of Stʼátʼímcets was asked to identify certain sounds in Stʼátʼímcets words. She is literate in both English and Stʼátʼímcets. (Stʼátʼímcets is written using the ‘van Eijk orthography’; see van Eijk 1997:251-252.) She is linguistically trained to recognise vowels vs. consonants and to analyse words in terms of syllables. The sounds for which judgments were elicited were instances of /I/ and /I/ in non-pharyngealisation vs. pharyngealisation contexts. The judgments are reported in Table 3:7.

<table>
<thead>
<tr>
<th>Task: Please identify...</th>
<th>Response</th>
<th>Notes</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. the sound at the beginning of the second syllable in tsitsíusa? [{tʃtʃ]-tʃ-u[ɛ] ?} “fresh fruit”] = /I/ in a non-pharyngealisation context</td>
<td>“I.”</td>
<td></td>
</tr>
<tr>
<td>2. the sound at the end of the first syllable in gégel [leftmost [I] in {wʃl-wʃl} “strong, healthy, vigorous”] = /I/ in a pharyngealisation context</td>
<td>“I.”</td>
<td></td>
</tr>
<tr>
<td>3. the vowel sound in the first syllable in kʼišin’ [leftmost [i] in {kɪʃ-ı’} “to lay something down (intr., tr.)”] = /I/ in a non-pharyngealisation context</td>
<td>“The vowel in tʼiiq is different from the vowel in kʼišin’. They’re not close. They’re not even cousins. I think they would be written differently.”</td>
<td>orthographic $i = i$, $ii = \varepsilon$ (Stʼátʼímcets [ɛ] = {i̯} with phonetic lowering)</td>
</tr>
<tr>
<td>4. the vowel sound in tʼiiq [{t̠’i; ’ɪ} “to arrive (here)”] = /I/ in a pharyngealisation context</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Table 3:7. Judgments of Stʼátʼímcets /I/ and /I/ in non-pharyngealisation vs. pharyngealisation contexts

As seen, the judgments for /I/ in both non-pharyngealisation and pharyngealisation context were the same. However, those for /I/ were different. This parallels the results reported for Palestinian in Table 2:3. The results in Table 3:7 indicate that, as in Palestinian, Stʼátʼímcets pharyngealisation does not have a categorical effect on consonants, that is, no distinct rtr allophone results for a consonant in a pharyngealisation context. This contrasts with the categorical effect on vowels, as reported in the table. For vowels, the result is a
perceptual distinction between non-rtr and rtr vowel allophones. The
categorical effect on vowels but not consonants supports our claim that a raised
$F_1$ for St’át'imcets consonants in a pharyngealisation context is phonetic. On
this basis I claim that the consonants do not undergo pharyngealisation
harmony.

Since they do not, the St’át'imcets anchor for [RTR] is the NUC, as in
Palestinian. The constraint that imposes St’át'imcets pharyngealisation
harmony, ALIGN-L([RTR], NUC), requires alignment of [RTR] only with a
NUC.

Finally, in Palestinian Arabic, pharyngealisation harmony usually
affects all vowels in the word, the effect of ALIGN([RTR], L; Wd, L) and
ALIGN([RTR], R; Wd, R) (see §2.4.4). The effects of these constraints are not
observed in St’át'imcets. For example, candidate 4 in (63), ⟨tuw^-r in⟩, in
which all vowels in the word pharyngealise, loses. This shows that ALIGN(Wd,
L; [RTR], L) and ALIGN(Wd, R; [RTR], R) are at least as lowly ranked as
ALIGN-R([RTR], NUC). The more complete ranking responsible for the
properties of St’át'imcets’ harmony is thus:

(65) DEP-IO, MAX-RTR, MAX-LINK >>
    ALIGN-L([RTR], NUC) >>
    DEP-LINK >>
    ALIGN-R([RTR], NUC), ALIGN(Wd, L; [RTR], L),
    ALIGN(Wd, R; [RTR], R)

3.5. St’át'imcets Uvularisation Harmony
3.5.1 Harmony with an Emphatic
3.5.1.1 Analysis. The words in (66) contain none of emphatic
/ʔ/ or /ə/. In such forms, the epenthetic vowel surfaces as
one of non-back ⟨ə ə ə ə⟩, /æ/ surfaces as one of non-back ⟨æ a⟩, and /tʃ/
surfaces as non-emphatic ⟨tʃ⟩. (Rtr variants of the epenthetic vowel ⟨ə ə ə⟩)
and /Æ/ ⟨a⟩ in (c-d, i-k) are the effects of pharyngealisation harmony.
Rounded variants of the epenthetic vowel ⟨ə ə ə⟩ in (d-e, k) are the effects of
rounding harmony. The ⟨h⟩ in (m) is epenthetic; see §3.5.6.)

(66)
a. IPA /RED, x/  ⟨ə ə ə⟩  “partly crazy”
    NA /RED, sx/
b. IPA /pʃk+/  ⟨pʃkət⟩  “leaf”
    NA /pɛk+/ c. IPA /ʃw-n/  ⟨ʃw-ən⟩  “to rip, tear something (tr.)”
However, as seen in (67), the epenthetic vowel surfaces as backed \( \{ \text{Æ} \} \) or \( \{ \text{o} \} \), \( \{ \text{Æ} \} \) surfaces as backed \( \{ \text{a} \} \), and \( /\text{tf}/ \) surfaces as emphatic \( \{ \text{t}\} \) immediately preceding an emphatic consonant. The backing effect occurs under strict leftward adjacency. (Underlying non-emphatic \( /\text{tf}/ \) in (k) is shown by the variant \( /\text{f}\text{ak}/ \), produced by LN, Upper dialect speaker.)

(67)

a. IPA /m\text{ak}/
   \{ m\text{ak} \} \quad (\ast \{ m\text{ak} \}) \quad “to get stuffed, to eat too much”

b. IPA /\text{f}\text{p}\text{l}x\text{w}/
   \{ /\text{f}\text{p}\text{l}x\text{w}/ \} \quad (\ast \{ /\text{f}\text{p}\text{l}x\text{w}/ \}) \quad “to stick out from something (e.g., from a pocket or a a house)”

c. IPA /\text{f}\text{t}\text{f}/
   \{ /\text{t}\text{t}\text{f}/ \} \quad (\ast \{ /\text{t}\text{t}\text{f}/ \}) \quad “to cave in, to get caved in”

d. IPA /\text{t}\text{x}/
   \{ /\text{t}\text{x}/ \} \quad (\ast \{ /\text{t}\text{x}/ \}) \quad “bitter”

e. IPA /\text{f}\text{t}\text{x}\text{w}/
   \{ /\text{f}\text{t}\text{x}\text{w}/ \} \quad (\ast \{ /\text{f}\text{t}\text{x}\text{w}/ \}) \quad “really, very much”; “to be in the way”

f. IPA /\text{j}\text{x}/
   \{ /\text{j}\text{x}/ \} \quad (\ast \{ /\text{j}\text{x}/ \}) \quad “drunk”
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NA / s-qyÆ x/ { s-qya x } (*{ s-qya x }) “to have a nightmare, to sleep-walk”

- IPA /RED, k wÆx/ { kʷq-a-kʾx } (*{ kʷæe-kʾx })
- NA /RED, q wÆ x/ { qʷa-qʷ x } (*{ qʷə-qʷ x })

h. IPA /?Æl[ǐ]-m/ { ?al[-em] } (*{ ?æl[-em] }) “sick, ill”
- NA /Æl[ǐ]-m/ { ?al [-em] } (*{ ?a [-em] })

i. IPA /mXÆʾr/ { məxʾr } (*{ mæxʾr }) “huckleberry”
- NA /mXÆʾr/ { mə xʾr } (*{ mæ xʾr }) { (Lower dialect)

j. IPA /mAkÆʾ?/ { makʾ? } (*{ mækʾ? }) “snow”
- NA /mAkÆʾ?/ { màqʾ? } (*{ màqʾ? })

k. IPA /tfkʷ-ÆnÆʾ?/ { tfkʷ-ænæʾ? } (*{ tfkʷ-ænæʾ? }) “lynx”
- NA /cqw-ÆnÆʾ?/ { cqw-ána? } (*{ cqw-ána? })

l. IPA /uft-kIn-Up?-Æm/ { uft-kin-up?-æm } (*{ uft-kin-up?-æm })
- NA /c-qIn-Up?-Æm/ { c-qin-úp?-am } (*{ cæ-qin-úp?-am }) “to lead horses by tying them to the tail of the horse in front”

The forms in (66c-d, i-k) show that the epenthetic vowel and /Æ/ surface non-backed immediately preceding one of uvular guttural /u u’ uʷ uʷ/>. That is, gutturals do not trigger the harmony. The same holds in Arabic (see §2.5.1). Further evidence on this for Salish comes from Nxa’amxcin: the forms in (68) show that Nxa’amxcin Salish /Æ/ surfaces non-back immediately preceding pharyngeal guttural /h/. That is, pharyngeal /h/ does not trigger uvularisation harmony in that language.

(68) a. /lÆh-p/ { lah-p } (*{ ləh-p }) “flow” (V)
- b. /nÆ-nUj-nÆʾ?/ { na-ŋuj-naʔ? } (*{ na-ŋuj-naʔ? }) “get annoyed by a noise”
- c. /RED, pÆh/ { pah-pah } (*{ pəh-pəh }) “Plymouth Rock (chicken)”

Example (69) shows that the St’át’imcets’ epenthetic vowel and /Æ/ surface non-back and /tf/ surfaces non-emphatic immediately following an emphatic.

(69)
- a. IPA /xʷÆʔs/ { xʷæʔs } (*{ xʷəʔs }) “sockeye salmon”
- NA /xʷÆʔs/ { xʷəʔs } (*{ xʷəʔs })

I thank M.D. Kinkade for these data.
I analyse the effects in (67) as uvularisation harmony triggered by the immediately following emphatic.\textsuperscript{33} The documentation of van Eijk indicates that in certain St’át’imcets forms, the harmony pattern differs from that described above: one or more segments following an emphatic are sometimes affected. Examples from van Eijk (1987) are:

\begin{itemize}
  \item [(70) a.] \{k a-X’] → p-a\} “to get sprained”
  \item [(70) b.] \{q e]-a’m\} “undertaking something one cannot accomplish”
  \item [(70) c.] \{q e]-w j’] x\} “to get spoiled (e.g., meat, potatoes), to break down (car, wagon)”
\end{itemize}

The present database contains only one such form, (70c). That it is underlyingly /\textit{k}’\textit{li}’/, with non-emphatic suffixal /\textit{li}/, is seen from forms like \{?\textit{em}e\textit{a}-\textit{u}’\textit{li}’\}, in which the same suffix, /-\textit{u}’\textit{li}/, “to get into a certain state”, occurs but with non-emphatic \{l\}. Due to lack of more relevant data, I discuss rightward harmony no further.

St’át’imcets leftward uvularisation harmony is not observed across a word boundary. For example, in (71), a (clitic-) word-final /\textit{æ}/ is followed by a word-initial emphatic and does not uvularise. This shows that the word is the harmony domain.

Finally, (72) shows that the harmony does not affect all eligible leftward segments (the epenthetic vowel, /\textit{æ}/ and /\textit{ʃ}/), only the one immediately preceding the underlying emphatic. St’át’imcets thus differs from Palestinian Arabic, in which uvularisation harmony affects all eligible segments to the left edge of the word.

\begin{itemize}
  \item [(71) a.] \IPA{\textit{æ}/} \# \textit{kmUt-Æ}/ \{\textit{næ} \# \textit{qmUt-æ}\} (*\textit{næ} \# \textit{qmUt-æ} ) “the hat (absent, known)” (Upper dialect)
  \item [(71) b.] \IPA{\textit{æ}/} \# \textit{kmUt-Æ}/ \{\textit{na} \# \textit{qmUt-æ}\} (*\textit{na} \# \textit{qmUt-æ} )
\end{itemize}

\textsuperscript{33} As noted earlier, more study could determine if consonants other than /\textit{ʃ}/ undergo this harmony.
POSTVELAR HARMONY IN SALISH

3.5.1.2 Acoustic Support. Figures 3:44 - 3:47 replott the tokens of /Æ/ and the epenthetic vowel from Figures 3:12 - 3:15 according to the contexts: immediately preceding an emphatic, or preceding an emphatic with a phonetic laryngeal intervening between the vowel and the emphatic vs. all other contexts. (Data on /U/ in a uvularisation context will be discussed in §3.5.3.)

We see that the tokens immediately preceding an emphatic, or preceding an emphatic with intervening phonetic laryngeal, cluster together and are perceptually the back allophones of the respective vowels: back /æ/ for /Æ/, back /ʌ/ or /ɔ/ for the epenthetic vowel. The tokens in all other contexts cluster together and are perceptually the non-back allophones: non-back /æ/ for /Æ/, and non-back /ɤ/, /ɜ/, or /œ/ for the epenthetic vowel. The tokens of the back variants cluster in a region of the F₁ - F₂ plane characterised by a lower F₂, compared to the region of the relevant non-back variants. In Figure 3:45, the tokens of LN’s back /æ/ are within a higher F₁ interval than those of front /æ/. In particular, based on the F means of Figures 3:12 – 3:15, the F₁ rise of the /æ/s compared to the /æ/s ranges from small to medium, the F₂ drop the same. The F₁ rise for the /æ/s compared to /œ/s is medium; the F₂ is drop large. The F₁ rise for /ɔ/ compared to /œ/ ranges from small to medium. A small F₂ drop for the /ɔ/s compared to the /œ/s is observed for LN. (No drop is observed for LC; this might be expected since both vowels are round.) A segment which is both uvularised and pharyngealised is expected to have a medium or large F₁ rise and large F₂ drop. The expected F effects are only roughly met by our data. However, we see the expected direction of formant
Figure 3:44. $F_1 - F_2$ plot of tokens of St'at'imcets /Æ/ in the contexts:
immediately preceding an emphatic, or preceding an emphatic with intervening phonetic laryngeal vs. all other contexts.
Speaker: LC.

Figure 3:45. $F_2$ plot of tokens of St'at'imcets /Æ/ in the contexts:
immediately preceding an emphatic, or preceding an emphatic with intervening phonetic laryngeal vs. all other contexts.
Speaker: LN.
Figure 3:46. $F_1 - F_2$ plot of tokens of the St'át'imcets epenthetic vowel in the contexts: immediately preceding an emphatic vs. all other contexts.
Speaker: LC.

Figure 3:47. $F_1 - F_2$ plot of tokens of the St'át'imcets epenthetic vowel in the contexts: immediately preceding an emphatic vs. all other contexts.
Speaker: LN.
changes. The data thus provide some support for the assumption that the tokens immediately preceding an emphatic, or preceding an emphatic with intervening phonetic laryngeal, were produced with a uvularisation that the tokens in all other contexts lacked. This supports the claim that /Æ/ and the epenthetic vowel uvularise immediately preceding an emphatic. (For more on the cases with intervening laryngeal, see §3.5.5.)

Some tokens of the epenthetic vowel plotted as occurring in 'all other contexts' occurred immediately preceding one of /u' u'w u'w/. They do not cluster with the tokens that occurred immediately preceding an emphatic, but are perceptually a non-back variant of the epenthetic vowel. This supports the assumption that they were not uvularised, which supports our claim that St'át'ímcets uvular gutturals do not trigger uvularisation harmony.

Figures 3:48 and 3:49 replot the tokens of the epenthetic vowel that occurred preceding an emphatic with a non-laryngeal consonant intervening between the vowel and the emphatic (e.g., the epenthetic vowel in /utʃ-kIn- Up?-Æm/ / uʃtʃ-kIn-up?-æm/ "to lead horses by tying them to the tail of the horse in front"). (See §3.5.5 for data on /Æ/ in this context.) The context 'preceding an emphatic with an intervening non-laryngeal' is a subcontext of 'all other contexts'. As seen, the tokens are non-back. In the familiar indirect manner, this supports our claim that the epenthetic vowel uvularises only immediately preceding an emphatic (or preceding an emphatic with an intervening laryngeal).

![Figure 3:48. F₁ - F₂ plot of tokens of the St'át'ímcets epenthetic vowel in the context: preceding an emphatic with intervening non-laryngeal. Speaker: LC.](image-url)
The wideband spectrogram of Figure 3:50 shows two tokens of /tf/. One occurred in a word with no emphatic; the other occurred preceding an emphatic with a vowel intervening between the /tf/ and the emphatic. The caption reports the frequency of the spectral peaks of each [tf].
As seen, the [tʃ]s have very similar peaks. In particular, compared to data on surface emphatic /tʃ/ to be seen in Figure 3:57, no lowered resonance in the second formant region is observed for the [tʃ] which occurred preceding an emphatic with intervening vowel. This supports the assumption that both [tʃ]s in Figure 3:50 were not produced with uvularisation. The phonological claim that St'át'imcets /tʃ/ does not uvularise when not immediately preceding an emphatic thus has acoustic support.

Figures 3:51 - 3:54 replot the tokens in Figures 3:44 - 3:47 that occurred immediately preceding an emphatic vs. immediately following an emphatic. As seen, those in the former context are back; those in the latter are non-back. The back tokens have a lowered F₂, compared to the non-back tokens, per vowel. This is indirect support for our phonological claim that /Æ/ and the epenthetic vowel uvularise immediately preceding an emphatic and not immediately following one.

![Graph](image)

*Figure 3:51. F₁ - F₂ plot of tokens of St'át'imcets /Æ/ in the contexts: immediately preceding an emphatic vs. immediately following an emphatic. Speaker: LC.*
Figure 3:52. $F_1 - F_2$ plot of tokens of St'át'ímcets /Æ/ in the contexts: immediately preceding an emphatic vs. immediately following an emphatic. Speaker: LN.

Figure 3:53. $F_1 - F_2$ plot of tokens of the St'át'imcets epenthetic vowel in the contexts: immediately preceding an emphatic vs. immediately following an emphatic. Speaker: LC.
The wideband spectrogram of Figure 3:55 shows two tokens of /Æ/: one of non-back /æ/ and one of back /ə/. Figure 3:56 shows two tokens of the epenthetic vowel: one of non-back /æ/ and one of back /ə/. In the first figure, $F_1$ of [ə] is about 100 Hz higher than $F_1$ of [æ]. The $F_2$ difference is small (96 Hz). This illustrates the finding of this study, that tokens of St'át'ímcets /ə/ are phonetically central rather than back. In Figure 3:56, $F_1$ of [ə] is 180 Hz higher than $F_1$ of [æ]; $F_2$ is about 950 Hz lower, some of which can be attributed to rounding. The spectrograms show that the lowered $F_2$ of uvularised [ə] and [ə] are reached and maintained for a steady state. (See Figure 3:16 on this for uvularised [ʌ].) This supports ascribing their uvularisation to the phonology.

Figure 3:57 shows two tokens of /tʃ/. One, seen earlier in Figure 3:50, occurred in a word with no emphatic. The other occurred immediately preceding an emphatic, and is a token of surface emphatic /tʃ/. The spectral peaks of the tokens are different. While both have a low peak just below 600 Hz, a peak corresponding to that at 1895 Hz for [tʃ] is at 1600 Hz for [tʃ]. In addition, a peak that is absent for non-emphatic [tʃ] is observed for [tʃ] at 1050 Hz, in the region of a second formant. The arrow in the spectrogram points it out. I analyse the 1050 Hz peak as a lowered $F_2$ in the context of the immediately following emphatic /k/. This is indirect support for our
phonological claim that St’at’imcets /tʃ/ uvularises immediately preceding an emphatic.

Figure 3:55 Wideband spectrogram of tokens of St’at’imcets /æ/ in a non-uvularisation vs. uvularisation context. The one on the left is a token of /æ/ in /ɪ ˈmɜ j ˈtʃɪfæ?/ “pajamas, nightie”, the one on the right a token of /æ/ in /ˈmi tʃa -ˈk/ “to assume a sitting position”. (Formants measured at points indicated by the vertical lines.)

[æ]: \( F_1 = 581 \text{ Hz}; F_2 = 1439 \text{ Hz} \) [ɑ]: \( F_1 = 692 \text{ Hz}; F_2 = 1343 \text{ Hz} \).

Figure 3:56. Wideband spectrogram of tokens of the St’at’imcets epenthetic vowel in a non-uvularisation vs. uvularisation context. The one on the left is a token of epenthetic /ə/ in /ʃ əx ʃəx/ “partly crazy”, the one on the right a token of epenthetic /ɑ/ in /ʃ ? əx ˈm u n/ “to cough”. (Formants measured at points indicated by the vertical lines.)

[ə]: \( F_1 = 353 \text{ Hz}; F_2 = 1950 \text{ Hz} \) [ɔ]: \( F_1 = 533 \text{ Hz}; F_2 = 1004 \text{ Hz} \).
Figure 3:57. Wideband spectrogram of tokens of St'át'imcets /tʃ/ in a non-uvularisation vs. uvularisation context. The one on the left is a token of /tʃ/ /tʃ in /'wəɬ-fən/ "to tie something (intr., tr.)". The one on the right is a token of /tʃ/ /tʃ / in /'wəɬ-kin-upʔ-ən/ "to lead horses by tying them to the tail of the horse in front".
(Spectral peaks measured at points indicated by the vertical lines.)
Spectral peaks of [tʃ]: 588 Hz, 1895 Hz. Spectral peaks of [ʃ]: 565 Hz, 1050 Hz, 1600 Hz.

3.5.2 Theoretical Account: Part I

The representations of the St'át'imcets emphatics and uvular gutturals are repeated in (73) - (74).

(73) Representations of St'át'imcets Emphatics
a. dorsal emphatics

\[
\begin{array}{c}
\text{[CONS]} \\
\text{Place} \\
\text{[DOR]} \\
\text{[TR]} \\
\text{[RTR]}
\end{array}
\]

b. coronal emphatics

\[
\begin{array}{c}
\text{[CONS]} \\
\text{Place} \\
\text{[COR]}
\end{array}
\]

Because uvular gutturals do not trigger uvularisation harmony, St'át'imcets uvularisation harmony is identified as [DOR] + [RTR] AS harmony, that is, harmony of [DOR] and [RTR] triggered by segments with
[DOR] and [RTR] as secondary specifications. This criterion is met only by the emphatics.

(74) Representation of St'át'imcets Uvular Gutturals

\[
/\text{y} \quad \text{y}' \quad \text{w} \quad \text{w}'/
\]

Both consonants and vowels undergo the harmony, so the anchor is the root node. An undergoer receives specification for both secondary-[DOR] and secondary-[RTR], the representation of secondary uvular articulation. The representational change is illustrated with (/\text{y}/ > \{\text{y}'\}) \{\text{y}'\} in (75).

(75)

\[
\{\text{y}'\}
\]

For vowels, addition of [DOR] yields the five new output vowels boxed in (76). Their [DOR] and [RTR] are represented with secondary status. Of the five, only those in double box are licit. I will argue in §3.5.4 that feature sets 9 and 15 are ruled out by highly ranked HI/*Sec-DOR \& Sec-RTR.
The representations of the uvularised variants of the epenthetic vowel and $\AE$ are seen in (77) - (78).

(77) Representations of the Uvularised Variants of the St'át'imcets Epenthetic Vowel

As secondary-[RTR] is an integral part of the representation of a uvularised segment, any uvularised segment is also pharyngealised. This means that uvularised $\{\tilde{\iota} \circ \tilde{\alpha}\}$ are also pharyngealised, and so St'át'imcets has no non-rtr back vowels as claimed in §3.2.2.
(78) Representation of the Uvularised Variant of St'át'imcets /Æ/

\[
\begin{align*}
N & \quad \mu \\
\{ \alpha \} & \quad [\text{SON}] \\
& \quad \text{Place} \\
& \quad [\text{DOR}] \\
& \quad [\text{LOW}] \quad [\text{DOR}] \quad [\text{TR}] \\
& \quad [\text{RTR}] 
\end{align*}
\]

The harmony properties detailed in §3.5.1 indicate the constraints in (79). ('S₁' and 'S₂' refer to the input and output string, respectively.)

(79) a. \(\alpha—\text{Sec-[DOR]} \land \text{Sec-[RTR]}/\text{ALIGN-L}(	ext{Sec-[DOR]} \land \text{Sec-[RTR]}, \text{Rt}_\beta)\)
Let \(\alpha\) be a root node in \(S_1\) or its correspondent in \(S_2\). Let \(\beta\) be a different root node. If \(\alpha\) is secondary-[DOR] and secondary-[RTR] in \(S_1\), then the left edge of secondary-[DOR] and the left edge of secondary-[RTR] are aligned with the left of \(\beta\).

b. \(\alpha—\text{Sec-[DOR]} \land \text{Sec-[RTR]}/\text{ALIGN-R}(	ext{Sec-[DOR]} \land \text{Sec-[RTR]}, \text{Rt}_\beta)\)
Let \(\alpha\) be a root node in \(S_1\) or its correspondent in \(S_2\). Let \(\beta\) be a different root node. If \(\alpha\) is secondary-[DOR] and secondary-[RTR] in \(S_1\), then the right edge of secondary-[DOR] and the right edge of secondary-[RTR] are aligned with the right edge of \(\beta\).

These constraints are two-level wellformedness constraints; they are context-sensitive but refer to the input as well as the output. (See, e.g., Archangeli and Suzuki 1997b for proposal of this sort of constraint, and Kager 1999:378-381 for relevant discussion.) They require the edge alignments in (80). ('C' = emphatic consonant. 'F' = some articulator feature.)

For a feature specified on \(\alpha\) to be left aligned with a particular edge of \(\beta\), \(\beta\) must be leftward of \(\alpha\), and \(\alpha\) and \(\beta\) must be adjacent (in a language like St'át'imcets in which NO-GAP is obviously very highly ranked). The \(\alpha—\text{Sec-[DOR]} \land \text{Sec-[RTR]}/\text{ALIGN-L}(	ext{Sec-[DOR]} \land \text{Sec-[RTR]}, \text{Rt}_\beta)\) constraint thus requires secondary-[DOR] and secondary-[RTR] to surface left-aligned with a segment (that is, a root node) which immediately precedes an underlying
emphatic. In parallel manner, \(\alpha - \text{Sec-[DOR]} \land \text{Sec-[RTR]}/\text{ALIGN-R}([\text{Sec-[DOR]} \land \text{Sec-[RTR]}], R_t)\) requires those features to surface right-aligned with an underlying emphatic. These constraints are conjunctive. Their conjunctive formulation is based on the evidence that co-occurring secondary-[DOR] and secondary-[RTR] are referred to as a unit in phonology; see §2.5.2.

(80) a. requirement of
\[
\alpha - \text{Sec-[DOR]} \land \text{Sec-[RTR]}/\text{ALIGN-L}([\text{Sec-[DOR] \land \text{Sec-[RTR]}}, R_t) 
\]

b. requirement of
\[
\alpha - \text{Sec-[DOR]} \land \text{Sec-[RTR]}/\text{ALIGN-R}([\text{Sec-[DOR]} \land \text{Sec-[RTR]}], R_t) 
\]

The data of §3.5.1 indicate the ranking in (81).

(81) \text{DEP-IO, MAX-DOR, MAX-RTR, MAX-LINK} >> \\
\(\alpha - \text{Sec-[DOR]} \land \text{Sec-[RTR]}/\text{ALIGN-L}([\text{Sec-[DOR]} \land \text{Sec-[RTR]}], R_t) >> \text{DEP-LINK} >> \alpha - \text{Sec-[DOR]} \land \text{Sec-[RTR]}/\text{ALIGN-R}([\text{Sec-[DOR]} \land \text{Sec-[RTR]}], R_t)\)

The resulting interaction is illustrated in (82) and (83). (All candidates in the first tableau violate IO-FAITH (DEP-IO) because of the epenthetic vowel immediately preceding /χ/. That violation is forced by very highly ranked σNUC, omitted from the tableaux.)

The underlying postvelar features of the postvelar segments are not free to delete as in the candidates 1. Rather, the features remain and some harmony results. This shows that MAX-F and MAX-LINK dominate alignment. In candidates 4 and 5 in (83), a vowel is epenthised to provide a segment left-adjacent to the emphatic. The vowel harmonises, in satisfaction of \(\alpha - \text{Sec-[DOR]} \land \text{Sec-[RTR]}/\text{ALIGN-L}([\text{Sec-[DOR]} \land \text{Sec-[RTR]}], R_t)\). However, those candidates incur a violation of DEP-IO not incurred by the winners. The losing status of those candidates establishes DEP-IO >> \(\alpha - \text{Sec-[DOR]} \land \text{Sec-[RTR]}/\text{ALIGN-L}([\text{Sec-[DOR]} \land \text{Sec-[RTR]}], R_t)\). The data examined provide no evidence for crucial ranking between the MAX con-
(82)

<table>
<thead>
<tr>
<th>Input: /təx/</th>
<th>I-O FAITH</th>
<th>α—Sec-[DOR] ^ Sec-[RTR]/ALIGN-L(Sec-[DOR] \ Sec-[RTR], Rtblers)</th>
<th>DEP-LINK</th>
<th>α—Sec-[DOR] ^ Sec-[RTR]/ALIGN-R(Sec-[DOR] \ Sec-[RTR], Rtblers)</th>
</tr>
</thead>
<tbody>
<tr>
<td>/ \ [DOR] [RTR]</td>
<td>“bitter”</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1. \təx\</td>
<td>*!***</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2. \təx\</td>
<td>*</td>
<td>*!</td>
<td></td>
<td></td>
</tr>
<tr>
<td>3. \təx\</td>
<td>*</td>
<td></td>
<td></td>
<td>**</td>
</tr>
<tr>
<td>4. \təx\</td>
<td>*!</td>
<td></td>
<td></td>
<td>****</td>
</tr>
</tbody>
</table>

Restrains and DEP-IO, so I assume they are equally ranked. The winner in (82) contains non-underlying links between a left-adjacent segment and [DOR] and [RTR] in satisfaction of left alignment but in multiple violation of DEP-LINK. The losing candidate 2 in the same tableau lacks such non-underlying links. By result, it violates left alignment but satisfies DEP-LINK. This shows that α—Sec-[DOR] ^ Sec-[RTR]/ALIGN-L(Sec-[DOR] ^ Sec-[RTR], Rtblers) outranks DEP-LINK. In the losing candidate 3 in (83), the segment right-adjacent to the emphatic harmonises, in satisfaction of right alignment. However, that entails three violations of DEP-LINK not incurred by the winner. This establishes DEPLINK >> α—Sec-[DOR] ^ Sec-[RTR]/ALIGN-R(Sec-[DOR] ^ Sec-[RTR], Rtblers).

In §2.5.2 we saw that ALIGN(Sec-[DOR] ^ Sec-[RTR], L; Wd, L) and ALIGN(Sec-[DOR] ^ Sec-[RTR], R; Wd, R) are responsible for the across-the-word effects of Palestinian uvularisation harmony. The data in (72) showed that the leftward harmony does not extend to the left edge of the word. This indicates that ALIGN(Sec-[DOR] ^ Sec-[RTR], L; Wd, L) is lowly ranked in Stát’imcets, as in (84). I assume it is equally ranked with α—Sec-[DOR] ^ Sec-[RTR]/ALIGN-R(Sec-[DOR] ^ Sec-[RTR], Rtblers), and assume the same for ALIGN(Sec-[DOR] ^ Sec-[RTR], R; Wd, R), though further investigation of the potential rightward harmony might reveal otherwise.
(83)

<table>
<thead>
<tr>
<th>input: /xʷæʔj/</th>
<th>POSTVELAR HARMONY</th>
<th>α—Sec-[DOR] \ Sec-[RTR] ALIGN-L(Sec-[DOR] \ Sec-[RTR], Rₚ)</th>
<th>DEP-LINK</th>
<th>α—Sec-[DOR] \ Sec-[RTR] ALIGN-R(Sec-[DOR] \ Sec-[RTR], Rₚ)</th>
</tr>
</thead>
<tbody>
<tr>
<td>&quot;sockeye salmon&quot; (Upper dialect)</td>
<td>I-O FAITH</td>
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<tr>
<td>1. \xʷæʔj\</td>
<td>*</td>
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<td>**</td>
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<tr>
<td>2. \xʷæʔj\</td>
<td>*</td>
<td>*</td>
<td></td>
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<tr>
<td>3. \xʷəʔj\</td>
<td>*</td>
<td>*</td>
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<td></td>
</tr>
<tr>
<td>4. \ʌxʷəʔj\</td>
<td>*!</td>
<td>****</td>
<td></td>
<td></td>
</tr>
<tr>
<td>5. \ʌxʷæʔj\</td>
<td>*!</td>
<td>**</td>
<td>*</td>
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</tbody>
</table>

(84) DEP-IO, MAX-RTR, MAX-DOR, MAX-LINK >>

\[ α—Sec-[DOR] \ Sec-[RTR] ALIGN-L(Sec-[DOR] \ Sec-[RTR], Rₚ) >> DEP-LINK >> α—Sec-[DOR] \ Sec-[RTR] ALIGN-R(Sec-[DOR] \ Sec-[RTR], Rₚ), ALIGN(Sec-[DOR] \ Sec-[RTR], L; Wd, L), ALIGN(Sec-[DOR] \ Sec-[RTR], R; Wd, R) \]

The surface effect is seen in (85). (‘ALIGN-Sec-DOR-Sec-RTR-Wd’ abbreviates ALIGN(Sec-[DOR] \ Sec-[RTR], L; Wd, L) and ALIGN(Sec-[DOR] \ Sec-[RTR], R; Wd, R). Violation of these constraints is evaluated for each non-harmonising vowel or /æ/. Each candidate violates DEP-IO because of the vowel epenthesis.)
3.5.3 **Neutral High Vowels**

3.5.3.1 *Analysis.* St'át'imcets high vowels do not undergo uvularisation harmony. This claim is based on phonetic findings. Non-harmonising high vowels are seen in (86): the high vowels surface rtr due to pharyngealisation harmony with the immediately following emphatic, but not backed. As the harmony affects only the left-adjacent segment, high vowels are not opaque or transparent.

(85) | Input: | \[\text{mxæè} /\text{È} /\text{f} \] | I-O FAITH | α—Sec-[DOR] | α—Sec-[DOR] | ALIGN-Align-L | ALIGN-Align-R |
<table>
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<tbody>
<tr>
<td>1. (\text{məxæə}^{+})</td>
<td>**</td>
<td></td>
<td></td>
<td>**</td>
<td>**</td>
<td></td>
</tr>
<tr>
<td>2. (\text{məxæə}^{+})</td>
<td>*</td>
<td>*!</td>
<td>**</td>
<td>*</td>
<td>**</td>
<td></td>
</tr>
<tr>
<td>3. (\text{məxəu}^{+})</td>
<td>*</td>
<td>*</td>
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<td>*</td>
<td>*</td>
<td></td>
</tr>
</tbody>
</table>
| 4. \(\text{məxəu}^{+}\) | *|***|*|*|*

3.5.3.1.1 **Neutral High Vowels**

3.5.3.1.1.1 *Analysis.* St'át'imcets high vowels do not undergo uvularisation harmony. This claim is based on phonetic findings. Non-harmonising high vowels are seen in (86): the high vowels surface rtr due to pharyngealisation harmony with the immediately following emphatic, but not backed. As the harmony affects only the left-adjacent segment, high vowels are not opaque or transparent.

(86) a. IPA /mɪxæə/ → \{mɪxæə\} (*\{mɪxæə\} “black bear”
NA /mɪxə/ → \{mɪxə\}
b. IPA /tʃ'ɪk/ → \{tʃ'ɪk\} (*\{tʃ'ɪk\} “to arrive (here)”
NA /ʃ'ɪq/ → \{ʃ'ɪq\}
c. IPA /tʃ'uţk\w'æʃ/ → \{tʃ'uţk\w'æʃ\} (*\{tʃ'uţk\w'æʃ\} “fish, (any kind of)”
NA /c'uţq\w'æʃ/ → \{c'uţq\w'æʃ\} salmon”
3.5.3.2 Acoustic Support. The wideband spectrogram of Figure 3:58 shows three tokens of St'át'imcets /I/. The one on the left is a token of /I/ in a non-uvularisation context. The other two tokens are /I/ in a uvularisation context. The caption reports F2 of each vowel, measured at onset, and at third quarter (that is, at halfway between midpoint and offset.) For the middle token, a second formant maximum is observed between onset and third quarter. F2 at that maximum is also reported. None of the [I]s has a steady F2. That is, the second formant of each is a trajectory from higher at onset to lower at third quarter, or lower at onset to higher at third quarter. For the middle [I], F2 varies from lower at onset to higher at the second formant maximum to lowest at third quarter. Lack of steady F2 for the two uvularisation context [I]s indicates that /I/ has no emphatic target. High /I/ thus contrasts with the non-high vowels, which have an emphatic target (see Figures 3:16, 3:55 and 3:56). This supports the phonological claim that, like Palestinian non-low vowels, St'át'imcets high vowels do not harmonise.

Figure 3:58. Wideband spectrogram of tokens of St'át'imcets /I/ in a non-uvularisation vs. uvularisation context.

The one on the left is a token of /I/ in "to scatter (e.g., people leaving from a gathering)" (rightmost [I]), the one in the middle a token of /I/ in "to arrive (here)", the one on the right a token of /I/ in "to get spoiled (e.g., meat, potatoes), to break down (car, wagon)". (Formants measured at points indicated by the vertical lines.)

F2 of [e] on the left: at onset = 1848 Hz, at third quarter = 1571 Hz. F2 of [e] in the middle: at onset = 2027 Hz, at maximum = 2062 Hz, at third quarter = 1777 Hz. F2 of [e] on the right: at onset = 1681 Hz, at third quarter = 1764 Hz.
3.5.4 Theoretical Account: Part II

The non-harmony of high vowels shows the effect of HI/*Sec-DOR ∧ Sec-RTR, motivated in §2.5.6. This constraint dominates α—Sec-[DOR] ∧ Sec-[RTR]/ALIGN-L(Sec-[DOR] ∧ Sec-[RTR], Rt₉). The adjusted ranking for St’át’imcets uvularisation harmony is seen in (87).

(87) DEP-IO, MAX-DOR, MAX-RTR, MAX-LINK, HI/*Sec-DOR ∧ Sec-RTR >> α—Sec-[DOR] ∧ Sec-[RTR]/ALIGN-L(Sec-[DOR] ∧ Sec-[RTR], Rt₉) >> DEP-LINK >> α—Sec-[DOR] ∧ Sec-[RTR]/ALIGN-R(Sec-[DOR] ∧ Sec-[RTR], Rt₉), ALIGN(Sec-[DOR] ∧ Sec-[RTR], L; Wd, L), ALIGN(Sec-[DOR] ∧ Sec-[RTR], R; Wd, R)

The tableau in (88) illustrates the neutrality. (The interaction for pharyngealisation of the initial-syllable vowel is ignored.)

(88)

| input: /mɪxæf/ | HI/ *Sec-DOR ∧ Sec-RTR | α—Sec-[DOR] ∧ Sec-[RTR]/ALIGN-L(Sec-[DOR] ∧ Sec-[RTR], Rt₉) | DEP-LINK | α—Sec-[DOR] ∧ Sec-[RTR]/ALIGN-R(Sec-[DOR] ∧ Sec-[RTR], Rt₉), ALIGN(Sec-[DOR] ∧ Sec-[RTR], R; Wd, R) |
| "black bear" | I-O FAITH | I-O FAITH | I-O FAITH | I-O FAITH | I-O FAITH |
| 1. {mixæf} | !*** | | | | |
| 2. {mixæf} \ [DOR] [RTR] | | | | | |
| 3. {mixæf} \ [RTR] | | | | | |
3.5.5 'Transparent' Laryngeals

3.5.5.1. Analysis. Consider (89), van Eijk’s transcription of forms in which, under his analysis, /Æ/ surfaces backed despite the laryngeal intervening between it and /k/ and /q/. Remnant (1990) and Bessell (1992), adopting that analysis, analyse such forms as showing that the laryngeals are transparent to uvularisation harmony. I transcribe such forms as illustrated in (90). Ones like that in (91) are different, as they involve /?-reduplication.\(^{34}\)

The present OT account entails a glottalised vowel for forms like those in (90). I will explain how in §3.5.6. Glottalisation on the vowel is implemented in the phonetics as a glottal stop.

(89) a. /mIcÆ?q/ \{ m'i ca?q \} “to assume a sitting position”
   b. /GLOT, nÆq/ \{ na?-q \} “to rot, get rotten”

(90) a. IPA /mitfÆ?k/ \{ mitf'ə'k \} [mitə?k] “to assume a sitting position”
   NA /mIcÆ?q/ \{ m'i ca?q \} [m'i ca?q] “to assume a sitting position”
   b. IPA /GLOT, nÆk'/ \{ na?-k' \} [naʔ'k'] “to rot, get rotten”
   NA /GLOT, nÆq'/ \{ na?-q' \} [naʔq']

(91) IPA /RED, ?UÆ?/ \{ ðu?-æ? \} “egg”
   NA /RED, ?UsÆ?/ \{ ðuʔ-æ? \}

3.5.5.2 Acoustic Support. Figures 3:59 and 3:60 replot the tokens of St’át’imcets /Æ/ from Figures 3:44 and 3:45 which occurred preceding an emphatic with a phonetic laryngeal intervening between the /Æ/ and the emphatic. The second figure also replots the tokens of LN’s /Æ/ that occurred preceding an emphatic with an intervening non-laryngeal. The tokens with an intervening laryngeal fall within the \(F_1 - F_2\) region of the back allophone \(\ddot{a}q\). In Figure 3:60, the tokens with an intervening non-laryngeal fall within the \(F_1 - F_2\) region of non-back \(\ddot{æ}\). The lowered \(F_2\) of the former supports the assumption that they were produced with uvularisation.

3.5.6 Theoretical Account: Part III

The apparent transparency of St’át’imcets laryngeals is explicable if such forms are recognised as containing glottalised vowels, as in (90). Perceptual support for this reinterpretation comes from description provided by St’át’imcets consultant AA for /GLOT, kl ꞉/ \{ kl- ꞉ \} “cranky (child), fussing (because it wants attention or is sick)”. In her descrip-

\(^{34}\) That the glottal stop is picked out for reduplication shows it is underlying.
Figure 3:59. $F_1 - F_2$ plot of tokens of St'át'imcets /Æ/ in the context: preceding an emphatic with intervening phonetic laryngeal. Speaker: LC.

Figure 3:60. $F_1 - F_2$ plot of tokens of St'át'imcets /Æ/ in the contexts: preceding an emphatic with intervening phonetic laryngeal vs. preceding an emphatic with intervening non-laryngeal. Speaker: LN.
tion, AA did not identify a ‘7’. (A ‘7’ is used in the van Eijk orthography to denote a glottal stop.) Rather, she said: “The vowel is a little more complicated. There’s more sound in it.” I hypothesise that a larger set of native speaker judgements of forms like \{ kir\-
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(96) DEP-IO, MAX-DOR, MAX-RTR, MAX-LINK, HI/*Sec-DOR ∧ Sec-RTR,
      DEP-Place >>
     α—Sec-[DOR] ∧ Sec-[RTR]/ALIGN-L(Sec-[DOR] ∧ Sec-[RTR], Rtₚ) >>
      DEP-LINK >>
     α—Sec-[DOR] ∧ Sec-[RTR]/ALIGN-R(Sec-[DOR] ∧ Sec-[RTR], Rtₚ),
     ALIGN(Sec-[DOR] ∧ Sec-[RTR], L; Wd, L),
     ALIGN(Sec-[DOR] ∧ Sec-[RTR], R; Wd, R) >>
      DEP-DOR, DEP-RTR

The non-underlying Place node a harmonising laryngeal might receive by interpolation would be prohibited by highly ranked DEP-Place. The segment
left-adjacent to the laryngeal could still harmonise, however, as in candidate 4. Candidate 4 better satisfies $\text{ALIGN}($Sec-[DOR] $\wedge$ Sec-[RTR], L; Wd, L) than candidate 3, which has no such harmony, although it violates DEP-DOR and DEP-RTR.

However, crucially, the ranking $\text{DEP-LINK} >> \text{ALIGN}($Sec-[DOR] $\wedge$ Sec-[RTR], L; Wd, L) was established in §3.5.2, based on the lack of uvularisation harmony to the left edge of the word. Thus, the problem with this account is that it predicts the actual output form to be ungrammatical. Candidate 2 wins because it incurs less violations of DEP-LINK than candidate 4, but candidate 4 is the actual output form. On this basis, I conclude that the phonetic vowel-laryngeal sequence in the forms at issue is a single surface segment, a glottalised vowel. Each harmonising vowel in (90) is left-adjacent to an emphatic and its harmony follows mundanely from the uvularisation harmony ranking already established.

3.6. **Summary**

This chapter has shown that St’át’ímcets Salish, like Palestinian Arabic, has two distinct postvelar harmonies: pharyngealisation harmony and uvularisation harmony. St’át’ímcets pharyngealisation harmony is [RTR] AS harmony. The triggers thus include all its postvelars: the uvular gutturals and emphatics. It is implemented with retracted tongue root articulation. The uvularisation harmony is [DOR] + [RTR] AS harmony, triggered by the emphatics. This second harmony is implemented with tongue back retraction, with automatic concomitant retraction of the tongue root. The distinct properties of the two harmonies were shown, with supporting acoustic data. The anchor for [RTR] in St’át’ímcets is the NUC. The anchor for simultaneous secondary-[DOR] and secondary-[RTR] is the root node.

Table 3:8 lists the distinct properties of St’át’ímcets’ two postvelar harmonies with the constraint that requires each property. The rankings that produce the two harmonies are repeated in (98). They remain separate, as we have not examined how they might interact.

(98) **Constraint Ranking Responsible for Postvelar Harmony in St’át’ímcets Salish**

a. Pharyngealisation Harmony

\[
\begin{align*}
\text{DEP-IO, MAX-RTR, MAX-LINK} & >> \\
\text{ALIGN-L([RTR], NUC)} & >> \\
\text{DEP-LINK} & >>
\end{align*}
\]
b. Uvularisation Harmony

\[ \text{DEP-IO, MAX-DOR, MAX-RTR, MAX-LINK, HI/*Sec-DOR} \land \text{Sec-RTR} \gg \]
\[ \alpha \rightarrow \text{Sec-[DOR] } \land \text{Sec-[RTR] } / \text{ALIGN-L(} \text{Sec-[DOR] } \land \text{Sec-[RTR]} , \text{Rt}_b) \gg \]
\[ \text{DEP-LINK} \gg \]
\[ \alpha \rightarrow \text{Sec-[DOR] } \land \text{Sec-[RTR] } / \text{ALIGN-R(} \text{Sec-[DOR] } \land \text{Sec-[RTR]} , \text{Rt}_b) , \]
\[ \text{ALIGN(} \text{Sec-[DOR] } \land \text{Sec-[RTR]} , \text{L}; \text{Wd, L}) , \]
\[ \text{ALIGN(} \text{Sec-[DOR] } \land \text{Sec-[RTR]} , \text{R}; \text{Wd, R}) \]
<table>
<thead>
<tr>
<th>PHARYNGEALISATION HARMONY</th>
<th>UVULARISATION HARMONY</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>1. triggers</strong></td>
<td>emphatics gutturals</td>
</tr>
<tr>
<td>MAX-RTR, MAX-LINK</td>
<td>MAX-DOR, MAX-RTR, MAX-LINK</td>
</tr>
<tr>
<td><strong>2. undergoers</strong></td>
<td>one leftward vowel</td>
</tr>
<tr>
<td>ALIGN-L([RTR], NUC)</td>
<td>α—Sec-[DOR]∧Sec-[RTR]/ALIGN-L([DOR]∧Sec-[RTR], Rₜₜ)</td>
</tr>
<tr>
<td><strong>3. neutral segments</strong></td>
<td>(none)</td>
</tr>
<tr>
<td>HI/*Sec-DOR ∧ Sec-RTR</td>
<td></td>
</tr>
</tbody>
</table>

(gutturals = /u u′ u′ w u′ w/  \(\tilde{a}\) \(\tilde{a}′\) \(\tilde{a}′ w\) \(\tilde{a}′ w/\), emphatics = /tʃ tʃ′ dʃ dʃ′ l′ k k′ k′ w k′ w x x′ w/  \(\tilde{a}\) \(\tilde{a}′\) \(\tilde{a}′ s\) \(\tilde{a}′ z\) \(\tilde{a}′ z′\) \(\tilde{a}′ q\) \(\tilde{a}′ q′ q′ w q′ w x x′ w/\)

*Table 3.8. Distinct properties of St'át'imcets' two postvelar harmonies*
 CHAPTER 4: CONCLUSION

4.1. Summary

This study had three aims. The first was to show that both Palestinian Arabic and St’át’imcets Salish have two distinct postvelar harmonies: pharyngealisation harmony and uvularisation harmony. This went unnoticed in previous analyses. For each language, the distinct harmonies were shown from an array of phonological data, with supporting acoustic data.

The second aim was to identify the features responsible for each harmony. The harmonic feature of pharyngealisation harmony is [RTR]. Co-occurring secondary-[DOR] and secondary-[RTR] are the harmonic features of uvularisation harmony. Palestinian pharyngealisation harmony is [RTR] A (Articulation) harmony, triggered by segments specified for primary- or secondary-[RTR]. The triggering class thus comprises guttural and emphatic postvelars and closed-syllable-pharyngealised vowels. St’át’imcets pharyngealisation harmony is [RTR] AS (Articulation Secondary) harmony, triggered by segments bearing secondary-[RTR]. Gutturals and emphatics are the triggers. In Palestinian, which has both short and long vowels, this harmony affects only short vowels. The feature [RTR] (when not co-occurring with secondary-[DOR]) is optimally a vocalic feature. Although it enters the phonology on postvelar consonants, the harmony patterns in Arabic and Salish indicate that its lexical distinctiveness on consonants is optimally enhanced by its surface realisation on a vowel. The harmonic features of uvularisation harmony are (co-occurring) secondary-[DOR] + secondary-[RTR]. In both languages, it is AS harmony. That is, it is triggered by segments co-specified for DOR] and [RTR] as secondary specifications, namely, emphatics. It affects both consonants and vowels. The data show two distinct anchors in both languages: NUC for [RTR], and the root node for co-occurring secondary-[RTR] and secondary-[DOR].

The third aim was to provide a formal account of the harmonies. Correspondence, Alignment, and Grounded constraints have a central role in the account. The proposed constraints are listed in Table 4:1. Most are phonetically grounded, as indicated. The intricacies of Palestinian postvelar harmony result systematically from the ranking in (1), those of the St’át’imcets
### Constraint | Requires that... | Grounding
--- | --- | ---
a. NUC\_\text{STM}\times[RTR] (NON-FINALITY) | a NUC at a right stem edge is not [RTR] | 

b. NUC\_\text{µµ}\times[RTR] | a bimoraic NUC is not [RTR] | articulatory: phonetic undershoot

c. NUC-C\_\text{RTR} | a NUC in a closed syllable is [RTR] | articulatory: phonetic undershoot

d. ALIGN-L([RTR], NUC), ALIGN-R([RTR], NUC) | [RTR] is aligned with the \{L,R\} edge of a NUC | auditory: the acoustic effects of (non-underlying) pharyngealisation are categorical only for vowels

e. ALIGN([RTR], L; Wd, L), ALIGN([RTR], R; Wd, R) | [RTR] in a word is specified on all NUCs to the \{L,R\} edge of the word | articulatory: sluggishness of the tongue root

f. ALIGN(Sec-[DOR] \& Sec-[RTR], L; Wd, L), ALIGN(Sec-[DOR] \& Sec-[RTR], R; Wd, R) | where co-specified on a segment, secondary-[DOR] and secondary-[RTR] are specified on all segments to the \{L,R\} edge of the word | articulatory: sluggishness of the tongue root

g. α—Sec-[DOR] \& Sec-[RTR], ALIGN-L(Sec-[DOR] \& Sec-[RTR], R\_\text{tp}), α—Sec-[DOR] \& Sec-[RTR], ALIGN-R(Sec-[DOR] \& Sec-[RTR], R\_\text{tp}) | secondary-[DOR] and secondary-[RTR] are aligned with the \{L,R\} edge of the segment \{L,R\}-adjacent, respectively, to an underlying emphatic | articulatory: sluggishness of the tongue back

h. FRONT/^Sec-DOR \& Sec-RTR | a segment that is [FRONT] is not secondary-[DOR] and secondary-[RTR] | articulatory: incompatibility of simultaneous front and uvularised articulation

i. HI/^Sec-DOR \& Sec-RTR = | a segment that is [HI] is not secondary-[DOR] and secondary-[RTR] | articulatory: incompatibility of simultaneous high and uvularised articulation

j. LO/^Sec-DOR \& Sec-RTR (*COMPLEX) | a segment that is [LOW] is not secondary-[DOR] and secondary-[RTR] | cognitive: feature overload

---

Table 4:1. Postvelar constraints

harmonies from the reranking in (2). (In (1), and (2), constraints for which effects are observed in one language but not the other are bottom-ranked for the language with no observed effects.) The major crosslinguistic difference from (1) and (2) is in harmonic range. In the Arabic, postvelar harmony has
wide extent in the word. In the Salish, it maximally extends to one leftward
segment. The wider extent in Palestinian results in a more complex array of
neutrality properties for both harmonies in that language.

(1) Postvelar Grammar: Palestinian Arabic
a. Pharyngealisation Harmony
   DEP-IO, MAX-RTR, MAX-LINK (for features other than [LOW]),
   NUC\text{\textsubscript{STM}}/*RTR, NUC\text{\textsubscript{STM}}/*RTR >>
   ALIGN-L([RTR], NUC), ALIGN-R([RTR], NUC) >>
   LO/*Sec-DOR \wedge Sec-RTR >>
   NUC-C\text{\textsubscript{STM}}/*RTR >>
   DEP-RTR >>
   ALIGN([RTR], L; Wd, L), ALIGN([RTR], R; Wd, R) >>
   DEP-LINK, MAX-LOW, MAX-LINK\textsubscript{LO}

b. Uvularisation Harmony
   DEP-IO, MAX-DOR, MAX-RTR, MAX-LINK, NUC\text{\textsubscript{STM}}/*RTR,
   NUC\text{\textsubscript{STM}}/*RTR, DEP-DOR, FRONT/*Sec-DOR \wedge Sec-RTR,
   HI/*Sec-DOR \wedge Sec-RTR >>
   ALIGN(Sec-[DOR] \wedge Sec-[RTR], L; Wd, L),
   ALIGN(Sec-[DOR] \wedge Sec-[RTR], R; Wd, R) >>
   NO-GAP, DEP-RTR >>
   DEP-LINK,
   \alpha—Sec-[DOR] \wedge Sec-[RTR]/ALIGN-L(Sec-[DOR] \wedge Sec-
   [RTR], R_t), \alpha—Sec-[DOR] \wedge Sec-[RTR]/ALIGN-R(Sec-
   [DOR] \wedge Sec-[RTR], R_t)

(2) Postvelar Grammar: St’át’imcets Salish
a. Pharyngealisation Harmony
   DEP-IO, MAX-RTR, MAX-LINK >>
   ALIGN-L([RTR], NUC) >>
   DEP-LINK >>
   ALIGN-R([RTR], NUC), ALIGN([RTR], L; Wd, L),
   ALIGN([RTR], R; Wd, R), NUC\text{\textsubscript{STM}}/*RTR, NUC\text{\textsubscript{STM}}/*RTR,
   LO/*Sec-DOR \wedge Sec-RTR, NUC-C\text{\textsubscript{STM}}/*RTR, DEP-RTR

b. Uvularisation Harmony
   DEP-IO, MAX-DOR, MAX-RTR, MAX-LINK, HI/*Sec-DOR \wedge Sec-RTR >>
   \alpha—Sec-[DOR] \wedge Sec-[RTR]/ALIGN-L(Sec-[DOR] \wedge Sec-[RTR], R_t) >>
4.2. A Residual Issue

In several studies of Niger-Congo and Nilotic tongue root harmony, the active feature for cases involving tongue root retraction has been identified as [-ATR] (see, e.g., Archangeli & Pulleyblank 1989, 1994, 2001, Clements 1985, 1991, and Odden 1991). I have assumed privative features organised under Place as seen in (3). Assuming (3), the privative expression of [-ATR] is [RTR]. It follows that [-ATR] = [RTR] because the two features label the same thing. Which label is used depends on working assumptions with respect to privative vs. binary features.

(3)

Direct comparison of [RTR] (that is, pharyngealisation) harmonies in the African languages with those in Arabic and Salish is thus possible. Previous work has shown that the harmony in Niger-Congo and Nilotic has a non-consonantal source. It is triggered by a floating [RTR] or a low vowel. It affects only vowels. Those languages bear out the prediction of §2.4.2 that there are languages with [RTR] on vowels, either underlingly or via the input-output mapping, but not on consonants. The fact that their harmony affects only vowels also supports the conclusion of this study that [RTR] optimally surfaces on a vowel. Examination of the 30 languages of interest in Maddieson’s (1984) database, expected to clinch support for that conclusion (see §2.4.2), is anxiously awaited. We also await investigation of the possible systemic differences between pharyngealisation harmony with a consonantal vs. non-consonantal source, that is, the phonological consequences of source type.
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Steriade, Donca. 1986. “A Note on Coronal”. Ms., MIT.


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Appendix I. Abbreviations

[ATR] [ADVANCED TONGUE ROOT]
[CG] [CONSTRICTED GLOTTIS]
[CONS] [CONSONANTAL]
[COR] [CORONAL]
[DISTR] [DISTRIBUTED]
[DOR] [DORSAL]
[HI] [HIGH]
[LAB] [LABIAL]
[LAT] [LATERAL]
[NAS] [NASAL]
[POST] [POSTERIOR]
[RTR] [RETRACTED TONGUE ROOT]
[S] [SPREAD GLOTTIS]
[SON] [SONORANT]
[STRID] [STRIDENT]
[TR] [TONGUE ROOT]
\[^{\text{stem}}\] right stem edge
1 first person
2 second person
3 third person
A harmony articulation harmony
A/\alpha cross-sectional area of front resonating tube of the vocal tract/length of front resonating tube; i.e., area/length
Adj. adjective
ALV alveolar
ALV-LAT alveolar lateral
AP harmony primary articulation harmony
AS harmony secondary articulation harmony
bkd backed
C consonant
Ç emphatic consonant
d distance of the articulatory constriction from the glottis
DENT dental
F phonological feature
F frequency
f_0 fundamental frequency
F_1 first formant frequency
F_2 second formant frequency
F_3 third formant frequency
fem. feminine
Fric fricative
G guttural consonant
Gl glide
GL glottal
APPENDICES

glot  glottalised
GLOT  glottalisation morpheme
H  heavy syllable
Hz  Hertz
INTER-DENT  interdental
intr.  intransitive
L  light syllable
LAB  labial
LAR  laryngeal
LAT  lateral
Liq  liquid
masc.  masculine
N  noun
N  nucleus
NUC  nuclear mora
NUCµ  bimoraic nucleus
obj.  object
OT  Optimality Theory
PAL  palatal
PHAR  pharyngeal
pl.  plural
Plos  plosive
POST-ALV  post-alveolar
r  radius of the resonating tube at point of constriction
rd  round
RED  reduplicative morpheme
Rt  root node
rtr  retracted tongue root
s.d.  standard deviation
sg.  singular
subj.  subject
tr.  transitive
UV  uvular
V  vowel
VEL  velar
Appendix II: Palestinian Carrier Forms For Vowel Tokens

In each carrier form, the analysed vowel is bolded. Where glosses are identical in the two dialects, they are listed once. Occasionally, accidentally, only one token of a form was recorded from the consultant; in such cases only one token of the particular vowel was analysed for one of the speakers. Some carrier forms are marked with the following symbols:

- the analysed vowel is underlyingly long (for surface short vowels)
- the analysed vowel is underlyingly short (for surface long vowels)
□ the analysed vowel is epenthetic
⊗ the lexical item is undocumented for the other dialect

/i/ - Pharyngealisation Harmony Contexts

<table>
<thead>
<tr>
<th>CONTEXT</th>
<th>CARRIER FORMS</th>
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</thead>
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<tr>
<td></td>
<td>Abu Shusha dialect</td>
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<tr>
<td></td>
<td>FORM</td>
</tr>
<tr>
<td>open syllable</td>
<td></td>
</tr>
<tr>
<td>no trigger</td>
<td>'{ši.d-o}'</td>
</tr>
<tr>
<td>adjacent guttural</td>
<td>'{hr.bə}'</td>
</tr>
<tr>
<td>adjacent emphatic</td>
<td>'{fr.ɟ.i}'</td>
</tr>
<tr>
<td>non-local harmony</td>
<td>'{fr.lım}'</td>
</tr>
<tr>
<td></td>
<td>'{fr.bir}'</td>
</tr>
<tr>
<td></td>
<td>'{ru.ʃɪt}'</td>
</tr>
<tr>
<td></td>
<td>'{ur.ini.ə}'</td>
</tr>
</tbody>
</table>

| closed syllable  |                      |        |              |
| no trigger       | '{fr.lım}'\textsuperscript{12} | "movie" | '{fr.lım}'\textsuperscript{12} |

\footnote{The Jafa form for "comb" (N) is '{ru.jut}'.}
In Abu Shusha and Jafa, 2 subj./t-/ is frequently elided in forms beginning with /t/; e.g., this form is 
\[\text{\textit{b-tu\textita\textit{j}-l}}\].

Jafa has one form for "(2 masc./fem. sg.) don't wipe us!": 
\[\text{\textit{a-t-	extita\textit{s-	extita\textit{n-a}}}}\].

Jafa has one form for "(2 masc./fem. sg.) don't cut us!": 
\[\text{\textit{a-t-	extita\textit{c-	extita\textit{n-a}}}}\].

\(\text{/E/ - Pharyngealisation Harmony Contexts}\)

<table>
<thead>
<tr>
<th>Abu Shusha dialect</th>
<th>GLOSS</th>
<th>Jafa dialect</th>
</tr>
</thead>
<tbody>
<tr>
<td>FORM</td>
<td></td>
<td>FORM</td>
</tr>
<tr>
<td>open syllable</td>
<td></td>
<td></td>
</tr>
<tr>
<td>{\textit{dge.b-	extit{a}}}</td>
<td>&quot;pocket&quot;</td>
<td>{\textit{dge.b-	extit{e}}}</td>
</tr>
</tbody>
</table>

\(^2\) In Abu Shusha and Jafa, 2 subj./t-/ is frequently elided in forms beginning with /t/; e.g., this form is /t-t-	extit{Irms\textita\textit{N-	extita\textit{H-a-	extita\textit{E-	extita\textit{j}}}}/.  
\(^3\) Jafa has one form for "(2 masc./fem. sg.) don't wipe us!": \{\textit{a-	extit{t-	extit{Irms\textita\textit{N-	extita\textit{H-a-	extita\textit{E-	extita\textit{j}}}}}}\}.  
\(^4\) Jafa has one form for "(2 masc./fem. sg.) don't cut us!": \{\textit{a-	extit{t-	extit{Irms\textita\textit{N-	extita\textit{H-a-	extitala}}}\}}\}.  

APPENDICES
<table>
<thead>
<tr>
<th>Harmony Type</th>
<th>Trigger</th>
<th>Abu Shusha Dialect</th>
<th>Jafa Dialect</th>
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<td><strong>/æ/ - Pharyngealisation Harmony Contexts</strong></td>
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<tr>
<td>open syllable</td>
<td>no trigger</td>
<td>{‘sæ.mi}</td>
<td>{‘sæ.mi}</td>
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<tr>
<td></td>
<td>adjacent guttural</td>
<td>{‘hæ.nə}</td>
<td>“here”</td>
</tr>
<tr>
<td></td>
<td>adjacent emphatic</td>
<td>{‘mæ.rə}</td>
<td>“woman, wife”</td>
</tr>
<tr>
<td></td>
<td>non-local harmony</td>
<td>{‘sæ.mir}</td>
<td>(masc. name)</td>
</tr>
<tr>
<td>closed syllable</td>
<td>no trigger</td>
<td>{‘ma.-məl.l-e-.næ:⁻}</td>
<td>{‘ma.-məl.l-e-.næ}</td>
</tr>
<tr>
<td></td>
<td>adjacent guttural</td>
<td>no form recorded</td>
<td>no form recorded</td>
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<tr>
<td></td>
<td>adjacent emphatic</td>
<td>no form recorded</td>
<td>no form recorded</td>
</tr>
<tr>
<td></td>
<td>non-local harmony</td>
<td>no form recorded</td>
<td>no form recorded</td>
</tr>
<tr>
<td>stem-final</td>
<td>{‘ma.-məl.l-e-.næ:⁻}</td>
<td>“we didn’t fill (something)”</td>
<td>{‘ma.-məl.l-e-.næ}</td>
</tr>
<tr>
<td></td>
<td>{‘ma.-məl.l-e-.næ:⁻}</td>
<td>“we didn’t urinate/defecate”</td>
<td>{‘ma.-məl.l-e-.næ}</td>
</tr>
<tr>
<td></td>
<td>{‘ma.-məl.l-e-.næ:⁻}</td>
<td>“we didn’t boil (something)”</td>
<td>{‘ma.-məl.l-e-.næ}</td>
</tr>
<tr>
<td></td>
<td>{‘mə.məl.l-e-.næ:⁻}</td>
<td>“we didn’t jump”</td>
<td>{‘mə.məl.l-e-.næ}</td>
</tr>
<tr>
<td></td>
<td>{‘mə.məl.l-e-.næ:⁻}</td>
<td>“we didn’t feed (someone/something)”</td>
<td>{‘mə.məl.l-e-.næ}</td>
</tr>
</tbody>
</table>

\(^5\) The Jafa form for “here” is {‘ho:n}. 
APPENDICES

"he flaked (something) off"
"he wiped it (masc.)"

closed syllable
no trigger
adjacent guttural
adjacent emphatic
non-local harmony
adjacent emphatic
non-local harmony
emphatic (masc. name)
stem-final

\[\text{\text{"ka.fα\text{a}t\text{\text{"}}} \]
\[\text{\text{"ma.s3.h-o\text{}} \]
\[\text{\text{"fstm.h-at.-l-i\text{}} \]
\[\text{\text{"safj.təz\text{\text{"}}} .\text{\text{\text{\text{h\text{\text{"}}} \]
\[\text{\text{"sək.kəz\text{\text{"}}} .\text{\text{\text{\text{h\text{\text{"}}} \]
\[\text{\text{"fstm.h-at.-l-i\text{}} \]
\[\text{\text{"šəd.d-at.-l-i\text{}} \]
\[\text{\text{"təj.jəz\text{\text{"}}} .\text{\text{\text{\text{h\text{\text{"}}} \]
\[\text{\text{"məf.jəz\text{\text{"}}} .\text{\text{\text{\text{h\text{\text{"}}} \]
\[\text{\text{"məf.jəz\text{\text{\text{"}}} .\text{\text{\text{\text{h\text{\text{"}}} \]

\[\text{\text{"fstm.h-at.-l-i\text{}} \]
\[\text{\text{"šəd.d-at.-l-i\text{}} \]

/Æ/ - Uvularisation Harmony Contexts

\[\text{\text{"səe.mi\text{}} \]
\[\text{\text{"hən\text{\text{\text{\text{h\text{\text{"}}} \]
\[\text{\text{"ma.s3.h-o\text{}} \]
\[\text{\text{"fstm.h-at.-l-i\text{}} \]
\[\text{\text{"fstm.h-at.-l-i\text{}} \]

Abu Shusha dialect

GLOSS
(masc. name)
"here"
"he wiped it (masc.)"
"Shem"
(masc. name)
"she opened (something) for me"
(somthing for me"
"she counted for me"

Jafa dialect

FORM
\[\text{\text{"səe.mi\text{}} \]
\[\text{\text{"səe.mi\text{}} \]
\[\text{\text{"ma.s3.h-o\text{}} \]
\[\text{\text{"fstm.h-at.-l-i\text{}} \]
\[\text{\text{"fstm.h-at.-l-i\text{}} \]

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<table>
<thead>
<tr>
<th>Block Type</th>
<th>Abu Shusha Dialect Form</th>
<th>GLOSS</th>
<th>Jafa Dialect Form</th>
<th>GLOSS</th>
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<tbody>
<tr>
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<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>No Trigger</td>
<td>{'mo.na}</td>
<td>(fem. name)</td>
<td>{'mo.na}</td>
<td>(fem. name)</td>
</tr>
<tr>
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<td></td>
<td>no form recorded</td>
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<tr>
<td>Adjacent Emphatic</td>
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<td></td>
<td>no form recorded</td>
<td></td>
</tr>
<tr>
<td>Non-local Harmony</td>
<td>no form recorded</td>
<td></td>
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<tr>
<td><strong>Closed Syllable</strong></td>
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<tr>
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<tr>
<td>Non-local Harmony</td>
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<td></td>
<td>no form recorded</td>
<td></td>
</tr>
<tr>
<td>Stem-Final</td>
<td>{'si.d-o}</td>
<td>“grandpa”</td>
<td>{'si.d-o}</td>
<td></td>
</tr>
<tr>
<td></td>
<td>{'χαl.-t-o}</td>
<td>“maternal auntie”</td>
<td>{'χαl.-t-o}</td>
<td></td>
</tr>
<tr>
<td></td>
<td>{'ηαʌ.t-o}</td>
<td></td>
<td>{'ηαʌ.t-o}</td>
<td>“they (masc.) jumped”</td>
</tr>
</tbody>
</table>

6 The 3 masc. pl. subj. suffix is /'-U/ in Abu Shusha, /'-O/ in Jafa. For Abu Shusha cognates of these Jafa carrier forms for stem-final /O/, see the carrier forms for stem-final /U/.
<table>
<thead>
<tr>
<th>/U/ - Pharyngealisation Harmony Contexts</th>
</tr>
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<tbody>
<tr>
<td><strong>Abu Shusha dialect</strong></td>
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<tr>
<td><strong>FORM</strong></td>
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<tr>
<td>non-local harmony</td>
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<td>non-local harmony</td>
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<tr>
<td>stem-final</td>
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<tr>
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<td></td>
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</table>

"they (masc.) don’t feed us"
"they (masc.) don’t give us a cold"
"they (masc.) don’t open (something) for us"
POSTVELAR HARMONY

/ɪː/- Pharyngealisation Harmony Contexts

<table>
<thead>
<tr>
<th></th>
<th>Abu Shusha dialect</th>
<th>GLOSS</th>
<th>FORM</th>
<th>Jafa dialect</th>
<th>GLOSS</th>
</tr>
</thead>
<tbody>
<tr>
<td>open syllable</td>
<td></td>
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<td></td>
<td></td>
<td></td>
</tr>
<tr>
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<td>{sa.'fiː:nə}</td>
<td>&quot;boat&quot;</td>
<td>{sa.'fiː:ne}</td>
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<tr>
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<td>&quot;tahini&quot;</td>
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<td></td>
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<td>&quot;clean (fem. sg.)&quot;</td>
<td>{n.'qīː:f-e}</td>
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<td></td>
</tr>
<tr>
<td>non-local harmony</td>
<td>{χ3.'fiː:f-e}</td>
<td>&quot;weak (fem. sg.)&quot;</td>
<td>{χ3.'fiː:f-e}</td>
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<td></td>
</tr>
<tr>
<td></td>
<td>{τa.'wiː:l-e}</td>
<td>&quot;tall (fem. sg.)&quot;</td>
<td>{τa.'wiː:l-e}</td>
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<td></td>
</tr>
<tr>
<td></td>
<td>{θə.'ʃiː:d-e}</td>
<td>(fem. name)</td>
<td>{θə.'ʃiː:d-e}</td>
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<tr>
<td>closed syllable</td>
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<td></td>
</tr>
<tr>
<td>no trigger</td>
<td>{tiːn}</td>
<td>&quot;figs&quot;</td>
<td>{tiːn}</td>
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<td></td>
</tr>
<tr>
<td>adjacent guttural</td>
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<td>&quot;flour&quot;</td>
<td>{θθiːn}</td>
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<tr>
<td>adjacent emphatic</td>
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<td>{n.'qīː:f}</td>
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<td>(Adj)</td>
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<tr>
<td>non-local harmony</td>
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<td>&quot;weak (masc. sg.)&quot;</td>
<td>{χ3.'fiː:f}</td>
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### APPENDICES

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<thead>
<tr>
<th>Abu Shusha dialect</th>
<th>Jafa dialect</th>
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<tbody>
<tr>
<td><strong>FORM</strong></td>
<td><strong>GLOSS</strong></td>
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<tr>
<td>open syllable</td>
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</tr>
<tr>
<td>no trigger</td>
<td>&quot;my two doors&quot;</td>
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<tr>
<td>adjacent guttural</td>
<td>&quot;my two keys&quot;</td>
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<tr>
<td>adjacent emphatic</td>
<td>&quot;my two combs&quot;</td>
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<tr>
<td>non-local harmony</td>
<td>&quot;my two summers&quot;</td>
</tr>
<tr>
<td></td>
<td>&quot;my two mattresses&quot;</td>
</tr>
<tr>
<td></td>
<td>&quot;my two beloveds&quot;</td>
</tr>
<tr>
<td>closed syllable</td>
<td></td>
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<tr>
<td>no trigger</td>
<td>&quot;two doors&quot;</td>
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---

**/E:/ - Pharyngealisation Harmony Contexts**

- **Abu Shusha dialect**
  - open syllable
    - no trigger: \{ba.'b-e:n-i\}
    - adjacent guttural: \{mu-f.ts.'h-e:n-i\}
    - adjacent emphatic: \{mu.f.t.e:n-i\}
    - non-local harmony: \{sc.f.e:n-i\}, \{fa.rf.'t-e:n-i\}, \{ha.bi.'b-e:n-i\}
  - closed syllable
    - no trigger: \{ba.'b-e:n\}

- **Jafa dialect**
  - open syllable
    - no trigger: \{ba.'b-e:n-i\}
    - adjacent guttural: \{mu-f.ts.'h-e:n-i\}
    - adjacent emphatic: \{mu.f.t.e:n-i\}
    - non-local harmony: \{sc.f.e:n-i\}, \{fa.rf.'t-e:n-i\}, \{ha.bi.'b-e:n-i\}
  - closed syllable
    - no trigger: \{ba.'b-e:n\}
**Pharyngealisation Harmony Contexts**

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<td>Jafa dialect</td>
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</tr>
<tr>
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<td></td>
</tr>
<tr>
<td>no trigger</td>
<td>‘snae:n-i’</td>
<td>‘snae:n-i’</td>
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<tr>
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<td>‘la.:hæ:li’</td>
<td>‘la.:hæ:li’</td>
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<td>non-local harmony</td>
<td>‘n3:`s-æ:n-a’</td>
<td>‘n3:`s-æ:n-a’</td>
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<tr>
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</tr>
<tr>
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<td>‘snae:n’</td>
<td>‘snae:n’</td>
</tr>
<tr>
<td>adjacent guttural</td>
<td>‘tm:`sæ:h’</td>
<td>‘tm:`sæ:h’</td>
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### non-local harmony

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<th>FORM</th>
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<td>3af./s-æ:n/</td>
<td>&quot;sleepy (masc. sg.)&quot;</td>
<td>3af./s-æ:n/</td>
</tr>
<tr>
<td>{3af./s-æ:n/}</td>
<td>&quot;sprinkler&quot;</td>
<td>{3af./s-æ:n/}</td>
</tr>
<tr>
<td>{3af./s-æ:n/}</td>
<td>&quot;he came to me&quot;</td>
<td>{3af./s-æ:n/}</td>
</tr>
<tr>
<td>{3af./s-æ:n/}</td>
<td>&quot;he's cutting it (masc.) for you (masc. sg.)&quot;</td>
<td>{3af./s-æ:n/}</td>
</tr>
<tr>
<td>{3af./s-æ:n/}</td>
<td>&quot;he boiled (something) for me&quot;</td>
<td>{3af./s-æ:n/}</td>
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### stem-final

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<td>&quot;he came to me&quot;</td>
<td>?ə.'dğ-æ:n-i/&gt;</td>
</tr>
<tr>
<td>{3af./s-æ:n-i/&gt;</td>
<td>&quot;he's cutting it (masc.) for you (masc. sg.)&quot;</td>
<td>{3af./s-æ:n-i/&gt;</td>
</tr>
<tr>
<td>{3af./s-æ:n-i/&gt;</td>
<td>&quot;he boiled (something) for me&quot;</td>
<td>{3af./s-æ:n-i/&gt;</td>
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### /Æ/z/ - Uvularisation Harmony Contexts

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<td>FORM</td>
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</tr>
<tr>
<td>`snae:n-i/&gt;</td>
<td>&quot;my teeth&quot;</td>
<td>`snae:n-i/&gt;</td>
</tr>
<tr>
<td>`læ-.'hae:li/&gt;</td>
<td>&quot;by myself&quot;</td>
<td>`læ-.'hae:li/&gt;</td>
</tr>
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<td>3af./s-æ:n-ə/&gt;</td>
<td>&quot;sleepy (fem. sg.)&quot;</td>
<td>3af./s-æ:n-ə/&gt;</td>
</tr>
<tr>
<td>snae:n/</td>
<td>&quot;teeth&quot;</td>
<td>snae:n/</td>
</tr>
<tr>
<td>tm.'sæ:h/&gt;</td>
<td>&quot;crocodile&quot;</td>
<td>tm.'sæ:h/&gt;</td>
</tr>
<tr>
<td>3af./s-æ:n/&gt;</td>
<td>&quot;sleepy (masc. sg.)&quot;</td>
<td>3af./s-æ:n/&gt;</td>
</tr>
<tr>
<td>?ə.'dğ-æ:n-i/&gt;</td>
<td>&quot;he came to me&quot;</td>
<td>?ə.'dğ-æ:n-i/&gt;</td>
</tr>
<tr>
<td>{3af./s-æ:n-i/&gt;</td>
<td>&quot;he boiled (something) for me&quot;</td>
<td>{3af./s-æ:n-i/&gt;</td>
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<table>
<thead>
<tr>
<th>FORM</th>
<th>FORM</th>
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</thead>
<tbody>
<tr>
<td>`3af./s-æ:n-i/&gt;</td>
<td>&quot;my sprinkler&quot;</td>
</tr>
<tr>
<td>`bə.'kus-ı-lə k-əj.'jae:-h/&gt;</td>
<td>&quot;he's cutting it (masc.) for you (masc. sg.)&quot;</td>
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<tr>
<td>`3af./s-æ:n/&gt;</td>
<td>&quot;sprinkler&quot;</td>
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## Emphatic + Open Syllable

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<th>GLOSS</th>
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<td>{šærə:ˌt-i}</td>
<td>“my rash”</td>
<td>{šærə:ˌt-i}</td>
<td>“my rash”</td>
</tr>
<tr>
<td>{ʔā.ˌt-eː-ŋi}</td>
<td>“he gave (something) to me”</td>
<td>{ʔā.ˌt-eː-ŋi}</td>
<td>“he gave (something) to me”</td>
</tr>
<tr>
<td>{tə Ɂ.ˌt-eː-ŋi}</td>
<td>“he fed me”</td>
<td>{tə Ɂ.ˌt-eː-ŋi}</td>
<td>“he fed me”</td>
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## Emphatic + Closed Syllable

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<tbody>
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<td>{n.ˌdə:fw}</td>
<td>“clean (masc. pl.)”</td>
<td>{n.ˌdə:fw}</td>
<td>“clean (masc. pl.)”</td>
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<tr>
<td>{təwɛ:}</td>
<td>“tall (masc. pl.)”</td>
<td>{təwɛ:}</td>
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### /Oː/: Pharyngealisation Harmony Contexts

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</tr>
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<td>No Trigger</td>
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<td>{ʔə.ˌkə.ˈmoː:n-i}</td>
<td>{ʔə.ˌkə.ˈmoː:n-i}</td>
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<td>Adjacent Guttural</td>
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<td>{mə.ˌtɔː:r-i}</td>
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<td>Non-Local Harmony</td>
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<td>{hə.ˌbɔː:l-ə}</td>
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</table>

| Closed Syllable    |              |
| No Trigger         |              |
| \{ʔə.ˌkə.ˈmoː:n\}  | \{ʔə.ˌkə.ˈmoː:n\} |
| Adjacent Guttural  |              |
| \{ʔoː.ˌh\}        | \{ʔoː.ˌh\} |
| Adjacent Emphatic  |              |
| \{mə.ˌtɔː:r\}      | \{mə.ˌtɔː:r\} |
| Non-Local Harmony  |              |
| \{hə.ˌd-oːl\}     | \{hə.ˌd-oːl\} |

---

7 Jafa has one form for “those (masc./fem.)”: \{hə.ˌd-oːl\}.
<table>
<thead>
<tr>
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### /U:/ - Pharyngealisation Harmony Contexts

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<td>{çô. 'mu: s-e}</td>
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<td>{ʔ3. 'χu: -i}</td>
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<td>{f3. 'ʔ. 'u: s-e}</td>
</tr>
<tr>
<td>Non-Local Harmony</td>
<td>{h3. 'nu: n-o}</td>
<td>{h3. 'nu: n-e}</td>
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<table>
<thead>
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<th>Closed Syllable</th>
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<td>{du:d}</td>
</tr>
<tr>
<td>Adjacent Guttural</td>
<td>{m3. 'u: l}</td>
<td>{m3. 'u: l}</td>
</tr>
<tr>
<td>Adjacent Emphatic</td>
<td>{f3. 'k. 'ku: s}</td>
<td>{f3. 'ʔ. 'u: s}</td>
</tr>
<tr>
<td>Non-Local Harmony</td>
<td>{h3. 'nu: n}</td>
<td>{h3. 'nu: n}</td>
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<table>
<thead>
<tr>
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<tbody>
<tr>
<td>{fɔ. 'f-u: h}</td>
<td>{fɔ. 'f-u: h}</td>
<td></td>
</tr>
<tr>
<td>{bɾ. 'kus. 's-u: h}</td>
<td>{bɾ-j. 'ʔus. 's-u: h}</td>
<td>{bɾ-j. 'ʔus. 's-u: h}</td>
</tr>
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</table>
The Jafa cognates for this and the next three Abu Shusha carrier forms for stem-final /U:/ are \{\text{\texttt{\textbackslash m\text{-}\texttt{\textbackslash t\text{-}\texttt{i}}} \text{\texttt{\textbackslash t\text{-}\texttt{\textbackslash s}}} \text{\texttt{\textbackslash m\text{-}\texttt{u}}}}\}, \{\text{\texttt{\textbackslash m\text{-}\texttt{\textbackslash j\text{-}\texttt{\textbackslash r}}} \text{\texttt{\textbackslash t\text{-}\texttt{\textbackslash u}}}}\}, \{\text{\texttt{\textbackslash m\text{-}\texttt{\textbackslash j\text{-}\texttt{\textbackslash m\text{-}\texttt{\textbackslash s}}} \text{\texttt{\textbackslash h\text{-}\texttt{\textbackslash u}}}}\}, \{\text{\texttt{\textbackslash m\text{-}\texttt{\textbackslash j\text{-}\texttt{\textbackslash w}}} \text{\texttt{\textbackslash i\text{-}\texttt{\textbackslash u}}}}\}.  

\footnote{The Jafa cognates for this and the next three Abu Shusha carrier forms for stem-final /U:/ are \{\text{\texttt{\textbackslash m\text{-}\texttt{\textbackslash t\text{-}\texttt{\textbackslash s}}} \text{\texttt{\textbackslash m\text{-}\texttt{u}}}}\}, \{\text{\texttt{\textbackslash m\text{-}\texttt{\textbackslash j\text{-}\texttt{\textbackslash r}}} \text{\texttt{\textbackslash t\text{-}\texttt{\textbackslash u}}}}\}, \{\text{\texttt{\textbackslash m\text{-}\texttt{\textbackslash j\text{-}\texttt{\textbackslash m\text{-}\texttt{\textbackslash s}}} \text{\texttt{\textbackslash h\text{-}\texttt{\textbackslash u}}}}\}, \{\text{\texttt{\textbackslash m\text{-}\texttt{\textbackslash j\text{-}\texttt{\textbackslash w}}} \text{\texttt{\textbackslash i\text{-}\texttt{\textbackslash u}}}}\}.}
Appendix III: Salish Language Classification

This classification is based on Kinkade (1991), van Eijk (1997) and (1987:viii-x), and p.c. from M.D. Kinkade, S. Blake, and D. Gerds. Extinct languages or dialects are marked with "*". Slashes separate alternate labels.

<table>
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<th>Division</th>
<th>Branch</th>
<th>Language</th>
<th>Major Dialect</th>
<th>Minor Dialect</th>
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<tbody>
<tr>
<td>Bella Coola</td>
<td></td>
<td>Nuxalk/Bella Coola</td>
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Appendix IV: St’át’imcets Carrier Forms For Vowel Tokens

Occasionally only one token of a carrier form was recorded from the consultant, so only one token of the particular vowel was analysed for one of the speakers. The symbol ‘∅’ means the lexical item is undocumented for the other dialect.

/ɪ/ - Pharyngealisation Harmony Contexts

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<th>GLOSS</th>
<th>Upper dialect</th>
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<tr>
<td>no postvelar</td>
<td>/?æmæ-w'i'll'x/</td>
<td>“to get better, to recover (e.g., from a sickness)”</td>
<td>/ɪ̩'æmin/ ∅</td>
<td>“wool, fur”</td>
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<tr>
<td>immediately preceding a laryngeal</td>
<td>/tʃ-tʃl-ufæʔ?/</td>
<td>“fresh fruit”</td>
<td>/tʃ-tʃl-ufæʔ?/</td>
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<tr>
<td>immediately following a laryngeal</td>
<td>/?æmh-in'æk/</td>
<td>“good gun”</td>
<td>no form recorded</td>
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<td>immediately following a guttural</td>
<td>/uʃʃ/</td>
<td>“to shrink”</td>
<td>/uʃʃ/</td>
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<tr>
<td>immediately following an emphatic</td>
<td>/uʃʃ-in'ʃ/</td>
<td>“to shrink something (tr.)”</td>
<td>/uʃʃ-ʃin-up'-æm/</td>
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<td>/k'ɪhil/</td>
<td>“to lead horses by tying them to the tail of the horse in front”</td>
<td>/k'ɪhil/</td>
<td>“to run”</td>
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<tr>
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<td>Lower dialect</td>
<td>GLOSS</td>
<td>Upper dialect</td>
<td>GLOSS</td>
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<tr>
<td>no trigger</td>
<td>{ kaeʔ-aemhsae-tkæn-æe }</td>
<td>“I’ve become better”</td>
<td>{ kaeʔ-aemhsae-tkæn-æe }</td>
<td>“wool, fur”</td>
</tr>
<tr>
<td>immediately preceding a laryngeal</td>
<td>{ kaeʔ-aemhsae-tkæn-æe }</td>
<td>“at all”</td>
<td>{ tʃʰæmmin }</td>
<td>“marrow”</td>
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<tr>
<td>immediately following a laryngeal</td>
<td>{ tʃʰæmmin }</td>
<td>“marrow”</td>
<td>{ kaeʔ-aemhsae-tkæn-æe }</td>
<td>“I’ve become better”</td>
</tr>
<tr>
<td>immediately following a guttural</td>
<td>{ kaeʔ-aemhsae-tkæn-æe }</td>
<td>“I’ve become better”</td>
<td>{ kaeʔ-aemhsae-tkæn-æe }</td>
<td>“something that one has piled up”</td>
</tr>
<tr>
<td>immediately preceding an emphatic</td>
<td>{ mɪxæh̃ }</td>
<td>“black bear”</td>
<td>{ mɪxæh̃ }</td>
<td>“salmon stretcher”</td>
</tr>
<tr>
<td>immediately preceding a guttural</td>
<td>{ tʃʰwʔɪkʰw }</td>
<td>“to scatter (e.g., people leaving from a gathering)”</td>
<td>{ tʃʰwʔɪkʰw }</td>
<td>“something that one has piled up”</td>
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###Trigger Immediately Preceding a Gutural

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<td>“black bear”</td>
<td>{mixæ-}</td>
<td>“snow”</td>
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<td>Preceding an emphatic with intervening non-laryngeal</td>
<td>{makæ?}</td>
<td>“to see something, someone (tr.)”</td>
<td>{makæ?}</td>
<td>“no form recorded”</td>
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<td>Other no trigger forms</td>
<td>{kæ?æmhae-\ææ-}</td>
<td>“I’ve become better”</td>
<td>{kæ?æmhae-\ææ-}</td>
<td>“I’ve become better”</td>
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<td>{kæ?æmhae-\ææ-}</td>
<td>“I’ve become better”</td>
<td>{kæ?æmhae-\ææ-}</td>
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<td>{kæ?æmhae-\ææ-}</td>
<td>“I’ve become better”</td>
<td>{kæ?æmhae-\ææ-}</td>
<td>“I’ve become better”</td>
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<tr>
<td></td>
<td>{kæ?æmhae-\ææ-}</td>
<td>“I’ve become better”</td>
<td>{kæ?æmhae-\ææ-}</td>
<td>“I’ve become better”</td>
</tr>
<tr>
<td></td>
<td>{tìpaæ?}</td>
<td>“marrow”</td>
<td>{tìpaæ?}</td>
<td>“no form recorded”</td>
</tr>
<tr>
<td></td>
<td>{kae-\ti}</td>
<td>“at all”</td>
<td>{tìæmin}</td>
<td>“wool, fur”</td>
</tr>
</tbody>
</table>
### Epenthetic vowel - Pharyngealisation Harmony Contexts

<table>
<thead>
<tr>
<th>Trigger</th>
<th>Lower dialect</th>
<th>GLOSS</th>
<th>Upper dialect</th>
<th>FORM</th>
</tr>
</thead>
<tbody>
<tr>
<td>no trigger</td>
<td>no postvelar</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>immediately preceding an emphatic</td>
<td>{makæʔ}</td>
<td>“snow”</td>
<td>{makæʔ}</td>
<td></td>
</tr>
<tr>
<td>preceding an emphatic with intervening phonetic laryngeal</td>
<td>{mitʃaʔ-ʃ} [mitʃaʔʔ]</td>
<td>“to assume a sitting position”</td>
<td>{mitʃaʔ-ʃ} [mitʃaʔʔ]</td>
<td></td>
</tr>
</tbody>
</table>

### POSTVELAR HARMONY

\{fish-æʔ-æn\} \{ʃ-iʔ-æʔ-æn\}  
“something that one has piled up”
### Epenthetic vowel - Uvularisation Harmony Contexts

<table>
<thead>
<tr>
<th>FORM</th>
<th>GLOSS</th>
<th>FORM</th>
<th>GLOSS</th>
</tr>
</thead>
<tbody>
<tr>
<td>{ kət-ən }</td>
<td>“to put something away, to bury something (tr.)”</td>
<td>{ kət-ən }</td>
<td>“to see something, someone (tr.)”</td>
</tr>
<tr>
<td>{ mə-\u0143 }</td>
<td>“(breaking) daylight”</td>
<td>{ mə-\u0143 }</td>
<td>“to see something, someone (tr.)”</td>
</tr>
<tr>
<td>{ kət-ən }</td>
<td>“to lead horses by tying them to the tail of the horse in front”</td>
<td>{ kət-ən }</td>
<td>“to lead horses by tying them to the tail of the horse in front”</td>
</tr>
<tr>
<td>{ jəx-jəx }</td>
<td>“partly crazy”</td>
<td>{ jəx-jəx }</td>
<td>“partly crazy”</td>
</tr>
<tr>
<td>trigger</td>
<td>immediately preceding an emphatic</td>
<td>preceding an emphatic with intervening phonetic laryngeal</td>
<td>no form recorded</td>
</tr>
<tr>
<td>---------------------------------</td>
<td>-----------------------------------</td>
<td>----------------------------------------------------------</td>
<td>------------------</td>
</tr>
<tr>
<td>POSTVEolar HARMONY</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>ʼpun-leep</td>
<td>&quot;Rocky Mountain juniper&quot;</td>
<td></td>
<td></td>
</tr>
<tr>
<td>ʼkəuʃʷəʔtu</td>
<td>(fem. name)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>ʼma-ʔ[maʔ]</td>
<td>&quot;(breaking) daylight&quot;</td>
<td></td>
<td></td>
</tr>
<tr>
<td>ʼuʔʧ-ʔn</td>
<td>&quot;to tie something (intr., tr.)&quot;</td>
<td></td>
<td></td>
</tr>
<tr>
<td>ʼj-pʔʔʔ-lʔʔʔʔʔʔʔ</td>
<td>&quot;squeezed in the middle&quot;</td>
<td></td>
<td></td>
</tr>
<tr>
<td>ʼuʔʔʔʔʔʔʔʔʔʔʔʔʔ</td>
<td>&quot;to burn something, set something on fire (intr., tr.)&quot;</td>
<td>&quot;to rip, tear something (tr.)&quot;</td>
<td></td>
</tr>
<tr>
<td>ʼʔʔʔʔʔʔʔʔʔʔʔʔʔ</td>
<td>&quot;to cough&quot;</td>
<td></td>
<td></td>
</tr>
<tr>
<td>ʼʔʔʔʔʔʔʔʔʔʔʔʔʔ</td>
<td>&quot;to get spoiled (e.g., meat, potatoes), to break down (car, wagon)&quot;</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
### /U/ - Pharyngealisation Harmony Contexts

<table>
<thead>
<tr>
<th>Trigger Condition</th>
<th>Lower Dialect</th>
<th>GLOSS</th>
<th>Upper Dialect</th>
</tr>
</thead>
<tbody>
<tr>
<td>No trigger, no postvelar</td>
<td>/pun-təp/</td>
<td>&quot;Rocky Mountain juniper&quot;</td>
<td>/pun-təp/</td>
</tr>
<tr>
<td>Immediately preceding a laryngeal</td>
<td>/tʃi-tʃ-uʃæʔ?/</td>
<td>&quot;fresh fruit&quot;</td>
<td>/tʃi-tʃ-uʃæʔ?/</td>
</tr>
<tr>
<td>Immediately following a laryngeal</td>
<td>/uʔ-ʔʃæʔ?/</td>
<td>&quot;egg&quot;</td>
<td>/ʔuʔ-ʔʃæʔ?/</td>
</tr>
<tr>
<td>Immediately following a guttural</td>
<td>/u̯u̯u̯j’t/</td>
<td>&quot;to sleep&quot;</td>
<td>/u̯u̯u̯j’t/</td>
</tr>
<tr>
<td>Immediately following an emphatic</td>
<td>/u̯u̯u̯j’t-ilʃ’æʔ?/</td>
<td>&quot;pajamas, nightie&quot;</td>
<td>/u̯u̯u̯j’t-ilʃ’æʔ?/</td>
</tr>
<tr>
<td></td>
<td>/ʔuʔ-χʍ_uʃæʔ?/</td>
<td>&quot;to peel fruit (intr., tr.)&quot;</td>
<td>no form recorded</td>
</tr>
<tr>
<td></td>
<td>/χuʍn/</td>
<td>&quot;big, large, great, important&quot;</td>
<td></td>
</tr>
</tbody>
</table>

### Trigger

- Immediately preceding a guttural:
  - /ʃʃuə/ | "stripe" | no form recorded |
- Immediately preceding an emphatic: no form recorded | no form recorded |
Appendix V: St'át'imcets Word List

Below are the St'át'imcets forms cited in chapter 3, excluding those only from van Eijk (1987) or (1997) and including the acoustic study carrier forms. Underlying, surface, and phonetic forms are listed, also the van Eijk orthography (see van Eijk 1997:251-252 and van Eijk 1995). Data are Lower dialect unless noted.

<table>
<thead>
<tr>
<th>Underlying</th>
<th>Surface</th>
<th>Phonetic</th>
<th>Orthography</th>
</tr>
</thead>
<tbody>
<tr>
<td>/kÆ-tiʔ/</td>
<td>{ kæ-tiʔ }</td>
<td>[kæ-tiʔ]</td>
<td>ká-tiʔ</td>
</tr>
<tr>
<td>/kl/</td>
<td>{ kl̚ /</td>
<td>[q̚l̚ ]</td>
<td>q̚l̚</td>
</tr>
<tr>
<td>/x̑Um/</td>
<td>{ x̑um }</td>
<td>[x̑um]</td>
<td>x̑um</td>
</tr>
<tr>
<td>/tx/</td>
<td>{ tx̚ }</td>
<td>[tx̚]</td>
<td>tx</td>
</tr>
<tr>
<td>/mXÆ4/</td>
<td>{ mXæ4 }</td>
<td>[mXæ4]</td>
<td>m̕i'xalh</td>
</tr>
<tr>
<td>/k̕Ẅ-it/</td>
<td>{ k̕Ẅ-it }</td>
<td>[k̕Ẅ-it]</td>
<td>k̕wit</td>
</tr>
<tr>
<td>/GLOT, mβ/</td>
<td>{ mβ-'/u'}</td>
<td>[mβ-'au']</td>
<td>sp'ag'</td>
</tr>
<tr>
<td>/t̕l̚Æ4'/</td>
<td>{ t̕l̚æ4' }</td>
<td>[t̕l̚æ4']</td>
<td>t̕l̚'laz'</td>
</tr>
<tr>
<td>/n-k'Æx-Ætʃ'Æʔi/</td>
<td>{ n-k'æx-ætʃ'æʔi }</td>
<td>[nk'æxætʃ'æʔi]</td>
<td>nk'ácalhts'áʔ</td>
</tr>
<tr>
<td>/GLOT, klx/</td>
<td>{ klx }</td>
<td>[klx]</td>
<td>kii7x</td>
</tr>
<tr>
<td>No.</td>
<td>Term</td>
<td>IPA</td>
<td>Notes</td>
</tr>
<tr>
<td>-----</td>
<td>-------------------------------------------</td>
<td>----------------------------</td>
<td>--------------------------------------------</td>
</tr>
<tr>
<td>12</td>
<td>&quot;downstream area&quot;</td>
<td>/RED, n-kʷu-kʷÁϕ/</td>
<td>nkwúkwtša</td>
</tr>
<tr>
<td>13</td>
<td>&quot;drunk&quot;</td>
<td>/ʃ-kj/</td>
<td>sqyax</td>
</tr>
<tr>
<td>14</td>
<td>&quot;each one, every one&quot;</td>
<td>/RED, GLOT, jɪ́̂s/</td>
<td>ziʔzeg'</td>
</tr>
<tr>
<td>15</td>
<td>&quot;egg&quot;</td>
<td>/RED, ?uÁϕ/?</td>
<td>tʔiʔšaʔ</td>
</tr>
<tr>
<td>16</td>
<td>(exclamation, used to urge a storyteller to continue his story)</td>
<td>/ʔʔiʔÁj/</td>
<td>tʔiʔáy</td>
</tr>
<tr>
<td>17</td>
<td>(fem. name)</td>
<td>/kwuÁϕʔtu/</td>
<td>kewáʔtu</td>
</tr>
<tr>
<td>18</td>
<td>&quot;finger&quot;</td>
<td>/xʷu-l-Ák/</td>
<td>xwulákaʔ</td>
</tr>
<tr>
<td>19</td>
<td>&quot;fish, (any kind of) salmon&quot;</td>
<td>/ʃ̬̬'u-kʷÁϕʔ/</td>
<td>ts'úqwaz'</td>
</tr>
<tr>
<td>20</td>
<td>&quot;fourteen&quot;</td>
<td>/kʷ'mp # uʷì#</td>
<td>q'em'p wi</td>
</tr>
<tr>
<td></td>
<td></td>
<td>xʷuÁϕtʃin/</td>
<td>xwʔúsain</td>
</tr>
<tr>
<td>21</td>
<td>&quot;fresh fruit&quot;</td>
<td>/RED, tʃi-l-Áϕʔ/</td>
<td>tsitshúšaʔ</td>
</tr>
<tr>
<td>22</td>
<td>&quot;good for nothing, useless persons, horses, etc.&quot;</td>
<td>/RED, k/</td>
<td>q̱gq̱l'</td>
</tr>
<tr>
<td>23</td>
<td>&quot;good gun&quot;</td>
<td>/ʔÁm-Áϕ-In/</td>
<td>ʔamḥi'n'ak</td>
</tr>
<tr>
<td>24</td>
<td>&quot;gooseberry bush&quot;</td>
<td>/xn̬'u'-Áϕ/</td>
<td>cniz'az'</td>
</tr>
<tr>
<td></td>
<td>English</td>
<td>Kwakiutl</td>
<td></td>
</tr>
<tr>
<td>---</td>
<td>---------------</td>
<td>-----------</td>
<td>---</td>
</tr>
<tr>
<td>25</td>
<td>“green, yellow”</td>
<td>/kʷelʔ/</td>
<td>{kʷelʔ}</td>
</tr>
<tr>
<td>26</td>
<td>“handsome (in face)”</td>
<td>/ʔæməʔ/</td>
<td>{ʔæməʔ}</td>
</tr>
<tr>
<td>27</td>
<td>“hat”</td>
<td>/kmut/</td>
<td>{kmut}</td>
</tr>
<tr>
<td>28</td>
<td>“huckleberry”</td>
<td>/mxəʔ/</td>
<td>{mxəʔ}</td>
</tr>
<tr>
<td>29</td>
<td>“I’ve become better”</td>
<td>/kæʔ-ʔæmæʔ-ʔəʔən-ʔeʔ/</td>
<td>{kæʔ-ʔæmæʔ-ʔəʔən-ʔeʔ}</td>
</tr>
<tr>
<td>30</td>
<td>“last night”</td>
<td>/ʔiʔ-ʔəʔəʔəf/</td>
<td>{ʔiʔ-ʔəʔəʔəf}</td>
</tr>
<tr>
<td>31</td>
<td>“leaf”</td>
<td>/pətʃkəʔ/</td>
<td>{pətʃkəʔ}</td>
</tr>
<tr>
<td>32</td>
<td>“light, bright”</td>
<td>/RED, mæʔ/</td>
<td>{mæʔ}</td>
</tr>
<tr>
<td>33</td>
<td>“loose (objects, also ways of behaviour)”</td>
<td>/RED, /luʔ/</td>
<td>{ʃəʔ-ʃuʔ}</td>
</tr>
<tr>
<td>34</td>
<td>“lynx”</td>
<td>/ʃuʔkʷ-ʔæn-ʔeʔ/</td>
<td>{ʃuʔkʷ-ʔæn-ʔeʔ}</td>
</tr>
<tr>
<td>35</td>
<td>“marrow”</td>
<td>/tʃ'pæʔ/</td>
<td>{tʃ'pæʔ}</td>
</tr>
<tr>
<td>36</td>
<td>“mouth”</td>
<td>/ʔuʃtʃən/</td>
<td>{ʔuʃtʃən}</td>
</tr>
<tr>
<td>37</td>
<td>“night”</td>
<td>/ʃitʃt/</td>
<td>{ʃitʃt}</td>
</tr>
<tr>
<td>38</td>
<td>“not at all”</td>
<td>/xʷʔæʔ/</td>
<td>{xʷʔæʔ}</td>
</tr>
<tr>
<td>39</td>
<td>“otter”</td>
<td>/həʔʃtʃ/</td>
<td>{həʔʃtʃ}</td>
</tr>
<tr>
<td>40</td>
<td>“pajamas, nightie”</td>
<td>/uʔwujʃ-ʔiʔʃ-ʔæʔʔ/</td>
<td>{uʔwujʃ-ʔiʔʃ-ʔæʔʔ}</td>
</tr>
<tr>
<td>41</td>
<td>“pale, fading, faded”</td>
<td>/GLOT, puʔ/</td>
<td>{pə-ʔuʔ}</td>
</tr>
<tr>
<td>42</td>
<td>“partly crazy”</td>
<td>/RED, ʃx/</td>
<td>{ʃx-ʃəx}</td>
</tr>
</tbody>
</table>
43. “pig” (Chinook Jargon borrowing)  \(k'w'U\)  \{k'w'\}  \[k'w'os\]  kwogó
44. “really, very (much); to be in the way”  \(\jmath\-t\chi\)  \{\jmath-t\chi\}  \[\jmath\text{t\chi}\]  stexw
45. “Rocky Mountain juniper”  \(\pi\text{Un-}\pi\)  \{\pi\text{un-}\pi\}  \[\pi\text{un}\text{-}\pi\]  punt\pi
46. “room, spaces in between things”  \(\text{RED, }\lambda\text{E}r\)  \{\lambda\text{er}\}  \[\lambda\text{er}\]  legwlág 'w
47. “rose”  \(\kappa\ell\)  \{\kappa\ell\}  \[\kappa\ell\]  qvl’q
48. “salmon head”  \(\lambda\text{m}U\text{m-}\lambda\)  \{\lambda\text{m}\text{um-}\lambda\}  \[\lambda\text{m}\text{omqee}\]  xwúimaq\text{a}7
49. “salmon stretcher”  \(\jmath\-\kappa\text{r}\)  \{\jmath-\kappa\text{r}\}  \[\ts'q\text{w}\text{q}\text{w}\]  ts'qw7i\text{iqw}
50. “sick, ill”  \(\pi\text{El}-\mathbf{m}\)  \{\pi\text{el}-\mathbf{m}\}  \[\pi\text{el}\text{-}\mathbf{m}\]  \(\text{áolsem}\)
51. “sidehill”  \(\lambda\text{m}-\mathbf{m}\text{m}'\)  \{\lambda\text{m}-\mathbf{m}\text{m}'\}  \[\lambda\text{m}\text{rmn}\text{eek}\]  \(\text{zegmänm'ek}\)
52. “small rainbow trout”  \(\text{RED, }\text{uhf}-\mathbf{k}\)  \{\text{uhf}-\mathbf{k}\}  \[\text{w}\text{iw}7\text{q}\text{q}\]  \(\text{gig'qsqs}\)
53. “snow”  \(\lambda\text{m}\text{e}k\)  \{\lambda\text{m}\text{e}k\}  \[\lambda\text{m}\text{e}k\]  \(\text{maq}\text{a}7\)
54. “sockeye (salmon)”  \(\lambda\text{w}\text{e}k\)  \{\lambda\text{w}\text{e}k\}  \[\lambda\text{w}\text{e}k\]  \(\text{xwa7s}\)
55. “something that one has piled up”  \(\jmath-\mathbf{u}\text{-}\lambda\text{E}\)  \{\jmath-\mathbf{u}\text{-}\lambda\text{E}\}  \[\mu\text{dq}\text{e}\text{x}\text{e}\]  \(\text{sgázcal}\)
56. “squeezed in the middle”  \(\text{s-p}'\text{-l-}\	ext{w}\	ext{AE}\)  \{\jmath-p'\text{-}\text{ol}\text{-}\w\text{AE}\}  \[\jmath\text{p'ol\w}\text{e}\text{e}\]  \(\text{sp'7el'wás}\)
57. “stick” (N)  \(\text{mulx}\)  \{\text{mulx}\}  \[\text{mulx}\]  \(\text{mulc}\)
<table>
<thead>
<tr>
<th>No.</th>
<th>Word/Phrase</th>
<th>Expression</th>
<th>Pronunciation</th>
<th>Meaning</th>
</tr>
</thead>
<tbody>
<tr>
<td>58</td>
<td>&quot;stingy&quot;</td>
<td>ʼn-ʃ-pʼxl’</td>
<td>[nʃpʼxeɭ]</td>
<td>nspʼxiʃ’</td>
</tr>
<tr>
<td>59</td>
<td>&quot;stripe&quot;</td>
<td>ʃ-ʃwʼwʼ</td>
<td>[ʃʃwʼwʼ]</td>
<td>stsugw</td>
</tr>
<tr>
<td>60</td>
<td>&quot;strong, healthy, vigorous&quot;</td>
<td>RED, ʊl</td>
<td>[ʊel-ʊel]</td>
<td>gĕlgel</td>
</tr>
<tr>
<td>61</td>
<td>&quot;supernatural being, powerful spirit&quot;</td>
<td>/hɪʔ/</td>
<td>{hiʔ}</td>
<td>hiʔ</td>
</tr>
<tr>
<td>62</td>
<td>&quot;the hat (absent, known)&quot;</td>
<td>/næ ʃ # əmʊt-æ/</td>
<td>{næ ʃ # əmʊtæ}</td>
<td>na qmúta</td>
</tr>
<tr>
<td>63</td>
<td>&quot;the tooth (absent, known)&quot;</td>
<td>/ni ʃ # ʊɪf-ʃmɛn/</td>
<td>{ni ʃ # ʊɪf-ʃmɛn}</td>
<td>ni ɡiʼtsmen</td>
</tr>
<tr>
<td>64</td>
<td>&quot;three&quot;</td>
<td>/kætæʃ/</td>
<td>{kætæʃ}</td>
<td>kalhás</td>
</tr>
<tr>
<td>65</td>
<td>&quot;to arrive (here)&quot;</td>
<td>/tɪʔɪq/</td>
<td>{tɪʔɪq}</td>
<td>tlʼiq</td>
</tr>
<tr>
<td>66</td>
<td>&quot;to arrive (over there)&quot;</td>
<td>/tʃɪxʼwʼ</td>
<td>{tʃɪxʼwʼ}</td>
<td>tsicw</td>
</tr>
<tr>
<td>67</td>
<td>&quot;to assume a sitting position&quot;</td>
<td>/mɪtʃæʔʃ/</td>
<td>{mɪtʃæʔʃ}</td>
<td>mɪʼtsaʔʃ</td>
</tr>
<tr>
<td>68</td>
<td>&quot;to be unfriendly to some one (tr.)&quot;</td>
<td>/RED, kɪ-ʃl-ʊnxʼ-mɪn/</td>
<td>{kɪ-ʃl-ʊnxʼ-mɪn}</td>
<td>qviqvlůwncwmin</td>
</tr>
<tr>
<td>69</td>
<td>&quot;to bleed&quot;</td>
<td>/ɡlot, tʃɪbʼwʼ/</td>
<td>{tʃɪbʼwʼ}</td>
<td>tsiʼ7ɪgʼw</td>
</tr>
<tr>
<td>70</td>
<td>&quot;to burn something, set something on fire (intr., tr.)&quot;</td>
<td>/ʃwɪl-n/</td>
<td>{ʃwɪl-n}</td>
<td>gwélen</td>
</tr>
</tbody>
</table>
71. “to cave in, to get caved in” /ɛtʃ/ {ɛtʃ} [ɛtʃ] lhwis
72. “to cough” /?ɛxw?un/ {?ɛxw?un} [?ɛxw?on] exw7un
73. “to drool, slobber (e.g., like cows)” /RED, n-ʃə[-ʔ]/ {n-ʃə[-ʔ]} [nsəl'ʃə] nsəl'ʃə
74. “to fart audibly” /kæ-p'uʔ-æ/ {kæ-p'uʔ-æ} [kæp'ıʔ-a] ka-p'ú7-a
75. “to get better, to recover (e.g., from a sickness)” /?æmæ-ɛw7il'x/ {?æmæ-ɛw7il'x} [?æmæwil'x] 7amawi'l'c
76. “to get spoiled (e.g., meat, potatoes), to break down (car, wagon)” /kəl-ɛw7il'x/ {kəl-ɛw7il'x} [qəlwe7il'x] qvlwii'l'c
77. “to get stuffed, to eat too much” /mək'/ {mək'} [məq'] meq'
78. “to go for a walk” /RED, mæt-k'/ {mæ-ɛt-k'} [mæm'teq] mám'teq
79. “to go in front of the houses” /RED, n-kəl-UJ/ {n-kəl-kəl-UJ} [nkəlkluʃ] nkklkus
80. “to go (not always in a specified direction)” /tʃəæk/ {tʃəæk} [tʃəæk] t'l'ak
81. “to growl at someone, to fight with someone” /ɛr-n/ {ɛr-n} [dəræn] zégen
82. "to have a nightmare, to sleepwalk"  /RED, kʷÆx/  \{ kʷo-kʷx \}  [qʷoaqʷx]  qwaqx
83. "to hide something (intr., tr.)"  /lœw-n/  \{ lœw-œn \}  [lœwœn]  lègewen
84. "to hit (as a bush to make the berries fall off)"  /tʰ'xʷ-Æxl/  \{ tʰexʷ-xœl \}  [tʰexʷœl]  tl'ecwcál
85. "to keep still, to sit still without moving"  /tʰ 'l-ilx/  \{ tʰ 'l-ilx \}  [tʰ'ilx]  tl'il'c
86. "to lay something down (intr., tr.)"  /kitʃ-in'/  \{ kitʃ-in' \}  [kitʃin']  kítsin'
87. "to lead horses by tying them to the tail of the horse in front (intr.)"  /œtf-kiñ-up?-Æm/  \{ œtf-kin-up?-œm \}  [œtfqenupœm]  getsqinúp7am
88. "to listen"  /k'ÆlÆn'/  \{ k'æl'æn' \}  [k'æl'æn']  k'ál'an'
89. "to peel fruit (intr., tr.)"  /GLOT, ?Uxʷ-UfÆ?/  \{ ?u'-xʷ-uʃœ? \}  [?oʃœ?]  ú7xwusa7
90. "to punch someone, hit someone with the fist (intr. tr.)"  /tUp-Un'/  \{ tup-un' \}  [tupun']  típun'
91. "to put down a container with the opening upwards, to put"  /tʃk-n/  \{ tʃk-œn \}  [tʃqœn]  tséqen
92. "to put something away to bury something (tr.)"
   \[\text{/kt-rt/} \quad \{\text{kət-ən}\} \quad [\text{qətən}] \quad \text{qēlhen}\]

93. "to rip, tear something (tr.)"
   \[\text{/tʃə-n/} \quad \{\text{tʃə-ən}\} \quad [\text{tʃəən}] \quad \text{tségen}\]

94. "to rot, get rotten"
   \[\text{/GLOT, nÅk/} \quad \{\text{na-`k}\} \quad [\text{naʔq}] \quad \text{naʔq'}\]

95. "to run"
   \[\text{/k'ıhil/} \quad \{\text{k'ıhil}\} \quad [\text{q'ejil}] \quad \text{q'ılhil}\]

96. "to scatter (e.g., people leaving from a gathering)"
   \[\text{/GLOT, p такое/} \quad \{\text{tə-`u}\} \quad [\text{təʔu'}] \quad \text{lhī7ig'}\]

97. "to see something, someone (tr.)"
   \[\text{/ʔɛtf`x-n/} \quad \{\text{ʔɛtf`x-ən}\} \quad [\text{ʔɛts`xən}] \quad \text{ʔáts`xen}\]

98. "to serve food to someone (tr.)"
   \[\text{/n-4Ukʷ-xIt/} \quad \{\text{n-4ukʷ-xIt}\} \quad [\text{nʔopʷxIt}] \quad \text{nlhúqweit}\]

99. "to shrink"
   \[\text{/uɪʃ/} \quad \{\text{uɪʃ}\} \quad [\text{uɛʃ}] \quad \text{gis}\]

100. "to shrink something (tr.)"
    \[\text{/uɪʃ-in/} \quad \{\text{uɪʃ-in}\} \quad [\text{uɛʃin}] \quad \text{gisin'}\]

101. "to sleep"
    \[\text{/uʍUjʷ/} \quad \{\text{uʍUjʷ}\} \quad [\text{uʍoʃjʷ}] \quad \text{gway'it}\]

102. "to smoothen something (wood) by shaving it (intr.)"
    \[\text{/ʔuxʷ-xÅl/} \quad \{\text{ʔuxʷ-xÅl}\} \quad [\text{ʔɔxʷxÅl}] \quad \text{7uxweal}\]
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<tbody>
<tr>
<td>103.</td>
<td>&quot;to stab all over&quot;</td>
<td>/RED, ʃʃʃk- In/</td>
<td>ʃʃʃk-ʃʃʃk-in’</td>
<td>[tʃʃqʃʃqeʃin’]</td>
<td>tsvqts’qin’</td>
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<td>104.</td>
<td>&quot;to stab someone (tr.)&quot;</td>
<td>/ʃʃk-In/</td>
<td>ʃʃk-in’</td>
<td>[ʃʃqeʃin’]</td>
<td>tsiqin’</td>
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<td>105.</td>
<td>&quot;to stick out from something (e.g., from a pocket or a house)&quot;</td>
<td>/ʃ-pɬxʷ/</td>
<td>ʃ-pɬxʷ</td>
<td>[ʃpɬxʷ]</td>
<td>spvlcw</td>
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<td>106.</td>
<td>&quot;to tie something (intr., tr.)&quot;</td>
<td>/ʃʃ-ʃn/</td>
<td>ʃʃʃ-ʃn</td>
<td>[ʃʃʃn]</td>
<td>gėtsen</td>
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<td>107.</td>
<td>&quot;to tie something, someone&quot;</td>
<td>/ʃʃʃ-Un/</td>
<td>ʃʃʃ-un’</td>
<td>[ʃʃʃun’]</td>
<td>zusun’</td>
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<td>108.</td>
<td>&quot;to untie something, to turn an animal loose (tr.)&quot;</td>
<td>/tɬːʷ-In/</td>
<td>tɬːʷ-in’</td>
<td>[tɛwʷeʃin’]</td>
<td>tīg’wīn’</td>
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<td>109.</td>
<td>&quot;to walk, go on foot&quot;</td>
<td>/mɑːʃ-k/</td>
<td>ʃmæt-k</td>
<td>[ʃmætq]</td>
<td>mætq</td>
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<td>110.</td>
<td>&quot;to warn someone, tell someone to be careful (intr., tr.)&quot;</td>
<td>/ʃ̆u-h-n/</td>
<td>ʃ̆u-h-n</td>
<td>[ʃ̆u-hen]</td>
<td>zūhen</td>
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<td>111.</td>
<td>&quot;until it got tangled up&quot;</td>
<td>/ʃtʰU # kʷ-ʃʃ-ʃ/</td>
<td>ʃtʰu # kʷetʃ-ʃ</td>
<td>[ʃtʰu # q’etʃ’ep]</td>
<td>t’su q’etʃep</td>
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<td>112.</td>
<td>&quot;water&quot;</td>
<td>/kʷuʔ/</td>
<td>kʷuʔ</td>
<td>[qʷoʔ]</td>
<td>qwuʔ</td>
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<td>113.</td>
<td>&quot;water inhabited by hiʔ?&quot;</td>
<td>/hIʔ-ætʃʷæʔ/</td>
<td>hIʔ-ætʃʷæʔ</td>
<td>[hIʔætʃʷæʔ]</td>
<td>hiʔatqwaʔ</td>
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114. "wind-dried salmon" /ts'wan/  
115. "wool, fur" (Upper dialect) /t'äm/  
116. "you (sg.)" /snúwa/  
117. "(young) boy" /twéww'et/
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