Coeur d'Alene Harmony[1]

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0. Underspecification Theory and Coeur d'Alene Harmony

Underspecification theory[2] (Archangeli 1984; Archangeli and Pulleyblank 1986) provides a framework for accounting for the phonology of languages by requiring minimal feature specification in underlying representation. A matrix of the features and values necessary for distinguishing the sounds of a particular language is constructed specifying only one value for each feature. Feature values not specified in the underlying matrix are supplied by language specific phonological rules or by redundancy rules (universal default rules and complement rules) which apply subject to certain constraints.

In this paper, underspecification theory is applied in an analysis of Coeur d'Alene (Salish) phonology. Coeur d'Alene has two processes of harmony which are similar in that they both lower the vowels affected. Progressive harmony is triggered by pharyngealized vowels; regressive harmony is triggered by postvelar consonants and r, r'. The distribution of the vowels resulting from harmony appears irregular: certain vowels surfacing as [a] with harmony correspond consistently with [e] when unaffected by harmony; other instances of [a] resulting from harmony correspond consistently with [i] without harmony. The remaining vowels show regular correspondence between forms affected by harmony and those not affected by harmony. Underspecification theory allows an analysis of the Coeur d'Alene vowel system as one with six underspecified vowels. Five of these have at least one feature value specified in underlying representation, while the remaining vowel is completely unspecified. The language specific rules of vowel harmony, and the redundancy rules, apply to the underspecified matrix to predict correctly the values of all full vowels in Coeur d'Alene, including those that appear irregular.

Section 1 presents a brief description of the Coeur d'Alene consonant and vowel systems. Section 2 is an application of underspecification theory to the Coeur d'Alene consonant system. An underlying matrix and a set of redundancy rules are postulated. In section 3, the vowels are described, the rules of harmony are formulated, an unspecified vowel is proposed, and a subset of the redundancy rules introduced in the discussion of the consonants is applied to the vowel matrix to accurately determine vowel feature values in all contexts.

1. Coeur d'Alene Sound System

Coeur d'Alene, like the other Salishan languages, has an elaborate consonantal system distinguishing labial, alveolar, palatal, velar, uvular, pharyngeal, and glottal points of articulation. The Cr system includes forty-two distinct sounds, produced in six manners of articulation: plain and glottalized series of voiceless stops and affricates; plain and glottalized series of voiced sonorants; a series of unglottalized voiced stops and affricate; and a series of unglottalized voiceless spirants.

The following is a chart of the Cr consonants:

p	t	c	č	kʷ	q	qʷ	ʔ
p'	t'	c'	č'	k'ʷ	q'	q'ʷ	
b	d		j	gʷ			
		ɬ	s	š	xʷ	χ	χʷ	h
m	n	l	r	y	w	ʕ	ʕʷ	
m'	n'	l'	r'	y'	w'	ʕ'	ʕ'ʷ	

In the chart (and in following examples), ɬ represents a voiceless lateral fricative; c represents a voiceless alveolar affricate; č and j represent voiceless and voiced palatal affricates; š represents a palatal fricative; χ represents a voiceless uvular fricative; ʕ represents a pharyngeal resonant; and ʔ represents a glottal stop. There are underlying glottalized (ejective) resonants, as indicated, but these may also be derived (e.g. with diminutive reduplication).

The Cr vowel system includes six surface vowels. As I will demonstrate, these represent six underlying vowels, one of which is unspecified, and an excrescent[3] schwa. The Cr surface vowels are shown below:

i		u
e	ə	o
	a	

The vowels e and o represent nonhigh lax vowels [ɛ] and [ɔ]. The phonetic range of each vowel varies with its position and the assignment of stress (cf. 3.122, 3.123).

In the following sections, the Cr consonant (section 2) and vowel (section 3) systems are described, with discussion of minimal feature specifications.

2. Consonants

The following feature matrix is adapted from Johnson (1976).[4] Ejectives are omitted for ease of presentation.

	p	b	c	t	d	s	š	l	č	ǰ	kʷ	gʷ	xʷ	q	qʷ	χ	χʷ	ʕ	ʕʷ	r	l	m	n	y	w	ʔ	h
son	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	+	+	+	+	+	+	+	+	-	-
cons	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	-	-	-	-
ant	+	+	+	+	+	+	-	+	-	-	-	-	-	-	-	-	-	-	-	-	+	+	+	-	-	-	-
cor	-	-	+	+	+	+	+	+	+	+	-	-	-	-	-	-	-	-	-	+	+	-	+	-	-	-	-
cont	-	-	-	-	-	-	+	+	+	-	-	-	+	-	-	+	+	+	+	+	+	-	-	+	+	-	+
str	-	-	+	-	-	+	+	+	+	+	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
vcd	-	+	-	-	+	-	-	-	-	+	-	+	-	-	-	-	-	+	+	+	+	+	+	+	-	-	
lat	-	-	-	-	-	-	-	+	-	-	-	-	-	-	-	-	-	-	-	-	+	-	-	-	-	-	-
nas	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	+	+	-	-	-	-
cglot	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	+	-
high	-	-	-	-	-	-	+	-	+	+	+	+	+	-	-	-	-	-	-	-	-	-	-	+	+	-	-
low	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	+	+	-	-	-	-	-	-	-	-	+	+
back	-	-	-	-	-	-	-	-	-	-	+	+	+	+	+	+	+	+	+	-	-	-	-	+	-	-	
rnd	-	-	-	-	-	-	-	-	-	-	+	+	+	-	+	-	+	-	+	-	-	-	-	+	-	-	

The present analysis differs from Johnson's in certain underlying feature values; these will be addressed in the following discussion.

2.1 Reichard's "faucal" consonants

The plain and labialized uvular and pharyngeal series, along with r and r', behave as a group in Cr with respect to regressive harmony (cf. discussion of harmony in section 3.21). Reichard (1938) refers to these as the "faucals"[5] or "faucalizing consonants", and they trigger a harmony which lowers preceding i e u to e a o, respectively. The feature representation given by Johnson suggests that the features [+back, -high] provide means for the grouping of these sounds as a set. But the features [back] and [high] present a problem in accounting for the regressive harmony: [i] drops to [e], but is not backed, suggesting only the spread of [-high]. On the other hand, [e] is nonhigh, but shifts back to [a]. No current theory of vowel harmony accounts for this type of selective application of feature specification.

The feature [+back], referring to the body of the tongue, is also unusual in the specification of the coronal liquids [r, r'] (Chomsky and Halle SPE 1968:307). In describing rhotacization, Ladefoged (1982:78) indicates that an r-like segment may be produced with "a constriction in the pharynx caused by retraction of the part of the tongue below the epiglottis." This description corresponds with that of the Cr r, suggesting that it is the root, not the body, of the tongue that is retracted.

Broselow (1979), in discussing "Cairene Arabic Syllable Structure", also notes that "emphasis [pharyngealization] is associated . . articulatorily with a constriction in the pharyngeal cavity caused by retraction of the tongue root" (p. 345). Broselow assigns the feature [+retracted tongue root] to the [+cons, +cor] segments in Cairene Arabic that initiate pharyngealization within a syllable. In Cairene Arabic, the coronal consonants may occur with or without the feature [+RTR], distinguishing otherwise identical lexical items (1979:345). In Coeur d'Alene, regressive harmony is always triggered by the

postvelars and r without lexical variation. Thompson (1979:697) states that the Interior Salish languages "show some adaptation of vowels to retracted tongue root position, which is inherent in postvelars and r, r'." The feature [+retracted tongue root] ([+RTR]) will be used to describe the uvulars, pharyngeals and r in Cr, and will be necessary in the analysis of regressive harmony (3.21).

2.2 Pharyngeals

Broselow (footnote 2, p. 346) goes on to say that the "true pharyngeals h and ʕ are pronounced the same in emphatic [pharyngealized] and nonemphatic environments," suggesting that these segments are always marked for some feature assigning pharyngeal constriction. Thompson and Thompson (1986) describe the postvelar resonants in Thompson Salish as "basically pharyngeals, produced by retraction of the tongue root and general narrowing of the pharynx." Constriction of the pharynx may be the result of a retracted tongue root (Ladefoged 1982:78), but it may also occur independently by contraction of the superior constrictor muscle of the pharynx (Dickson and Maue 1970).[6] Ladefoged (1982:149) describes pharyngeals as produced by "pulling the epiglottis back toward the back wall of the pharynx." Thus Ladefoged recognizes two methods of pharyngeal constriction: retraction of the tongue root as in rhotacization, and pulling back the epiglottis in forming pharyngeals. The latter will be described here with the feature [+constricted pharynx] ([+CP]). The pharyngeal resonants in Coeur d'Alene, therefore, appear to require specification of both [+RTR] (as postvelars) and [+CP] (as pharyngeal resonants).

2.3 Revised consonantal system

The feature representation given below is underspecified as defined by Archangeli (1984), providing a minimal number of features and as few values as possible marked for any given feature.

	p	b	c	t	d	s	š	l	č	ǰ	kʷ	gʷ	xʷ	q	qʷ	χ	χʷ	ʕ	ʕʷ	r	l	m	n	y	w	ʔ	h
son																				+	+	+	+	+	+	+	+
cons																										-	-	-	-
ant	+	+	+	+	+	+		+														+	+	+			
cor		+	+	+	+	+	+	+	+													+	+		+		
cont				+	+	+						+				+	+	+	+	+	+			+	+		+
str		+			+	+	+	+	+																		
vcd		+		+				+		+										+	+	+	+	+	+		
lat							+															+					
nas																							+	+			
cglot																											+
RTR																		+	+	+	+						
CP																				+	+						
high																											-	-
back																					-						
rnd														+	+	+		+		+						+		

[ʔ] and [h] are presented here with the feature values [+son] and [-cons] following Chomsky and Halle (SPE 1968).[7] Again, the glottalized consonants have been omitted for ease of presentation. These segments are marked [+constricted glottis] and the rule

R17 [ ] --> [-constricted glottis]

will provide the correct specification for other segments. One consequence of the feature specifications shown is that the feature [+/-low] is not necessary in the description of any segment. The following redundancy rules apply to complete the matrix.

Redundancy Rules:

R1 [+ant] --> [-high]
R2 [+nas] --> [+cont]
R3 [+lat] --> [+cont]
R4 [+CP] --> [+RTR]
R5 [+RTR] --> [-high]
R6 [+rnd] --> [+back]

R7 [ ] --> [+cons]
R8 [ ] --> [-son]
R9 [ ] --> [-ant]
R10 [ ] --> [-cor]
R11 [ ] --> [-cont]
R12 [ ] --> [-rnd]
R13 [ ] --> [-str]
R14 [ ] --> [-vcd]
R15 [ ] --> [-lat]
R16 [ ] --> [-nas]
R17 [ ] --> [-cglot]
R18 [ ] --> [-CP]
R19 [ ] --> [-RTR]
R20 [ ] --> [+high]

R21 [αRTR] --> [αback]

The rules are intrinsically ordered by the redundancy rule ordering constraint (RROC; Archangeli and Pulleyblank 1986), which states that a default or complement rule assigning a feature value of + or - is automatically applied before reference is made to that feature value in the structural description of any other rule. For example, rule R4 must apply before R5, and both R4 and R19 must apply before R21. Rules that are not constrained by the RROC apply in any order. The fully specified feature matrix, resulting from the application of the redundancy rules to the underspecified matrix, is given below.

	p	b	c	t	d	s	š	l	č	ǰ	kʷ	gʷ	xʷ	q	qʷ	χ	χʷ	ʕ	ʕʷ	r	l	m	n	y	w	ʔ	h
son	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	+	+	+	+	+	+	+	+	+	+
cons	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	-	-	-	-
ant	+	+	+	+	+	-	-	+	-	-	-	-	-	-	-	-	-	-	-	-	+	+	+	-	-	-	-
cor	-	-	+	+	+	+	+	+	+	+	-	-	-	-	-	-	-	-	-	+	+	-	+	-	-	-	-
cont	-	-		-	-	+	+	+			-	-	+	-	-	+	+	+	+	+	+	-	-	+	+	-	+
str	-	-	+	-	-	+	+	+	+	+	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
vcd	-	+	-	-	+	-	-	-	-	+	-	+	-	-	-	-	-	+	+	+	+	+	+	+	+	-	-
lat	-	-	-	-	-	-	-	+	-	-	-	-	-	-	-	-	-	-	-	-	+	-	-	-	-	-	-
nas	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	+	+	-	-	-	-
cglot	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	+	-
RTR	-	-	-	-	-	-	-	-	-	-	-	-	+	+	+	+	+	+	+	+	-	-	-	-	-	-	-
CP	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	+	+	-	-	-	-	-	-	-	-
high	-	-	-	-	-	-	+	-	+	+	+	+	+	-	-	-	-	-	-	-	-	-	-	+	+	-	-
back	-	-	-	-	-	-	-	-	-	+	+	+	+	+	+	+	+	+	+	-	-	-	-	-	+	-	-
rnd	-	-	-	-	-	-	-	-	-	+	+	+	-	+	-	+	-	+	-	-	-	-	-	-	+	-	-

2.4 Summary

Coeur d'Alene has a large consonant inventory of 42 distinct segments which can be fully described by a minimally specified feature matrix of 15 features and a set of 21 corresponding redundancy rules. The features [retracted tongue root] and [constricted pharynx] are necessary to distinguish the postvelars and r from other consonants, and the pharyngeal resonants from other postvelars, respectively. In the following section the Coeur d'Alene vowel system is described prior to discussion of harmony.

3. Vowels

Many of the Salishan languages have three- or four-vowel systems, usually including i, u and a low vowel (a) and/or schwa. In discussing Salishan phonological systems, Thompson (1979:697-698) notes that in the Salishan family,

> . . . vowel systems are usually small, although vowels often exhibit wide variation. The central lax vowel [schwa], in particular, adapts strongly to its consonantal environments, and in many cases the foreign ear has great difficulty recognizing whether a variant of ə or one of the tense vowels is being heard. Many occurrences of unstressed lax vowels are predictable in their environments, while others contrast, making analysis complicated. Some [Salishan] languages have developed more complex vowel systems further adding to analytical problems. Interior languages all show some adaptation of vowels to retracted tongue root position, which is inherent in postvelars and r, r'; there are likewise cases where such retracted vowels appear without conditioning factors.

Coeur d'Alene has one of the more complex Salishan vowel systems, and displays all of the characteristics of the systems described by Thompson. In her 1936 grammar of Coeur d'Alene, Reichard identifies eight distinct surface vowels and, in addition to these unmodified vowels, three sets of vowel variations[8]:

I	II	III	IV
a	a^a	a'^a	a'a
a	a^a	a'^a	a'a
ə			
i	i^i	i'^I	i'i
I			
u	u^u	u'^u	u'u
o	o^o	o'^o	o'o
u̯			

Sloat (1972) argues to rewrite all of Reichard's "echo vowels" as plain vowels (column II) or as sequences of vowel plus glottal stop (column III). The forms in column IV are considered sequences of three segments, not variations on single vowels. Sloat reduced the total Cr vowel count to six phonemes, /i/, /e/, /a/, /o/, /u/, and /ə/, and identified the remaining vowel sounds as the result of reduction.

3.1 Distribution of Coeur d'Alene vowels

Coeur d'Alene has six distinct surface vowels: i̲, e̲ ([ɛ]), a̲ , o̲ ([ɔ]), and u̲ and schwa. The data available do not provide minimal pairs, but the following examples[9] demonstrate that the environments for the vowels are generally unrestricted in roots and suffixes.

1	s/póc'-m	crushing
	s/i̲óm-n	scolding
2	s/t'áp-m	shooting at something
	s/c'áw-s-n	soap
	s-p/p'át'-n-t	sleet
3	s/cúw'-m	hit with fist
	s/t'úm-m	milk
	s/súl-t	to freeze
GR	k'ʷul'=cən-cút	cook
4	s/q'éc-m	to braid
	/téwš-ečt	six
	/péi̲+i̲-t	thick
5	/t'íc'-m-n	sap
	s/qʷíl-n	cheating
	s/wíš-i̲xʷ	set up a house

None of the examples above contain a faucal ([+RTR]) consonant in C2 position. In such cases, the vowel preceding the [+RTR] segment will appear as e̲, a̲, or o̲:[10]

6	s/léq'-m	baking camas in the ground
	s-t/c'éχʷ-n-t-sut	star, spark
	t/čéʕʷ-mš	to pray
7	/ʔácqeʔ	he went outside
	n/páχʷ-ət	to cough
	/cár-t	cold weather
	/ʔayáʕ	all of it
8	s/tópqs	thread
GR	yʼóqʷs	drinking
	nórs	barley

A suffix or a reduplicated morpheme containing a [+RTR] consonant will also cause a preceding vowel to assimilate, i̲ lowering to e̲, e̲ to a̲ and u̲ to o̲:

9	/cíš-t	it is long
	/céš=alqʷ	he is tall
10	/χéc'-p	he looked with great curiosity
	t-/χác'+χəc'=us	he has curious eyes
11	s-t/púm-əlxʷ	hide with fur
	s/póm=alqs	fur coat

When /a/ and /o/ appear in a root without benefit of a following [+RTR] segment, they trigger a harmony lowering a following stressed high vowel:

12	GR	c'+/c'okʷ=ups --> c'c'okʷóps	baby lice
13		/t'ap-s/čint --> t'apsčént	he shot people
14	GR	s/p'ac'-m-i --> sp'əc'mé	just dung
15	GR	n/mas+mas=it=kʷeʔ --> anmasmasátkʷeʔ	water is full of masmas

The rules of regressive and progressive harmony will be presented in sections 3.21 and 3.22, after discussion of schwa and a brief accounting of other phonetic and phonological processes affecting vowels in Coeur d'Alene.

3.12 Schwa

Sloat (1980) postulates an underlying schwa in his six-vowel system for Coeur d'Alene. But schwa does not occur stressed in Cr except in rare borrowed or onomatopoeic forms. Examples provided by Reichard (1938:534), such as:

16 GR u:/q"ə́n it is green

correspond to regular full vowels in my data (provided by Margaret Stensgar):

17 q"ín green

or are onomatopoeic:

18 GR u:/pə́s sound of Mosquito's grandmother bursting

One obviously borrowed word (Reichard 1938) also contains stressed schwa:

19 GR peləms prunes (from English: plums)

Sloat (1980) also suggests that the underlying schwa he postulates varies with surface vowels i and a under certain conditions[11], but his arguments involve global conditioning and unusual tensing of lax vowels. The rules he presents to account for the variation do not apply as he predicts to roots he earlier (1966) presented with underlying schwas. Schwa does occur in Coeur d'Alene as the result of excrescence or unstressed vowel reduction, discussed in the following sections.

3.121 Excrescent schwa

In Coeur d'Alene, a process of late phonetic epenthesis, or excrescence[12], inserts a very short vocalic segment adjacent to resonants[13].

20 s/t'um-m --> stúməm milk

21 s/cuw'-n-t-w'iš --> scúw'əntəw'Iš boxing

In some cases, the schwa may be analyzed as the audible release of glottalization (A. Woodbury, p.c.), as in 24 below, and in the next example:

22 /q"ey' poor

/q"ey'+q"ey'-t --> q"áy'əq"əy't he is poor

Cr women (and Colville women, Mattina 1986, p. c.) have a tendency to insert more of these excess schwas than do the men. The following Cr examples are presented with the form provided by Margaret Stensgar preceding that provided by Lawrence Nicodemus:

23 MS səmíl'x" smoke cigarettes, or cigarette smoke

LN smíl'x" cigarette, or tobacco, s.t. to smoke

24 MS ?ic c'əsəl'úse?m it's hailing

LN sc'slúse? hail

25[14] MS lék"ət he's far away

LN lék"t far

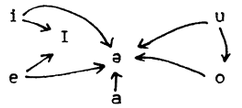
26 MS ?əniɬaq"épaw'asšIn breechcloth

These examples are presented to point out that schwa excrescence is a late rule, a rule not required but applied optionally depending on the speaker. No phonological rules apply to the excrescent segments, and the complement rules have no effect on them, allowing us to assume that these rules apply before the schwa is inserted. The excrescence rule, then, is one that optionally inserts a schwa to break up consonant clusters. The generality of the application of this rule is not yet fully understood, but it will at least include R22:

R22 0 --> ə % C ___ [+son]

3.122 Reduction

Unstressed vowels may reduce. The phonetic range of the unstressed vowels is great: i may reduce to I or e; e may reduce to I or ə; u may reduce to o; any vowel may reduce to schwa.



Vowels of suffixes like the reflexive -cut which follow the transitivizing suffixes often do not reduce, perhaps indicating the level at which the reduction rule(s) applies. The vowels a and o may be retained in roots and reduplicated morphemes when unstressed.

i reduced to I or e:

27 /x̣iɬ 'abandon; discard'

/x̣íɬ-t-s he delayed/abandoned him
s/x̣Iɬ=ʔíɬn feast: 'throw away food'

28 /x̣elix" 'tooth'

/x̣élex" tooth
(x̣ə+/x̣əlíx" little tooth)

e reduced to I or ə:

29 /šel 'axe'

/šél-mIn axe
šə+/šIl'-m'ín' hachet

30 /x̣ep 'overlap'

/x̣ép-n-t-s cover with boards
s-n-/x̣əp=íw'əs soul (overlap inside)

u reduced to o:

31 =us 'eye'

hIn/p'at'+p'at'=os-n-cót he dreamed

Vowel reduced to schwa:

32 s/líp firewood
/líp'+ləp'=šən Dutchman (wears wooden shoes)

33 s/t'ék'ʷ-n-cut lie (oneself) down
/t'ək'ʷ=íl't-m she gave birth

a and o may be retained without reduction:

34 šá+/šag"-t sharp
/ɨóm+ɨom-n'-n I scolded him

3.123 Phonetic assimilation

Schwas resulting from excrescence or reduction are subject to assimilation to contiguous consonant features, indicating that both processes follow the application of the redundancy rules. The effect is particularly noticeable where ə --> U/o contiguous to a labialized segment:

35 /q'ʷes wrinkled

hn-q'ʷə/q'ʷəs-m-íčn-šn dog (LN "pleated palm")

hnq'oq'osm'íčn'šn' dog (Nicodemus 1979)

36 /ɨexʷ sew

s/ɨéxʷ-m-š I am sewing
/ɨUxʷ=mín-ən sewing machine

37 /maxʷ die

máxʷ+xʷ --> máxʷ+əxʷ --> máxoxʷ he died

or where ə --> a/o contiguous to a faucal:

38 /x̣ep overlap

/x̣ap=ílxʷ-ən shingles

The spreading of features from consonants to schwas resulting from either excrescence or reduction is a very late phonetic process necessarily applying after schwa epenthesis and therefore following any complement or default rules. No schwa appears in surface forms that cannot be attributed to vowel reduction, phonetic epenthesis, or borrowed or onomatopoeic forms.

3.13 Vowel deletion

Unstressed vowels may delete in certain environments. It is often difficult to determine whether a vowel has been deleted, deleted and replaced by an excrescent schwa, or reduced. In the following examples, the suffix =iw'es 'between, together' is given in a form where it receives stress, and in two forms where it does not receive stress. In the second case, the vowel i deletes; in the third, the analysis may be either that an excrescent schwa has been inserted after i deletion, or i has reduced to schwa:

39 GR stressed /capq=iw'es-n --> capqíw'əsn
/glue=between-ls --> I stuck (them) together

40 deleted ni? /ɨqʷ=ip=iw'es=šin --> ni? ɨəqʷípw'esšən
/tie=bottom=between=leg --> breechcloth

41 schwa s-t-č/?em=iš=iw'es --> stč'əmíšəw'es
/sit=active=between --> ride a horse

Other examples of vowel deletion occur in suffixes and roots:

43 =iɨxʷ house

/nekʷe?=iɨxʷ --> nekʷə?íɨxʷ one house
/?es=iɨxʷ --> ?esíɨxʷ two houses

/mus=iɨxʷ --> músɨxʷ four houses
s/k'ʷul'=iɨxʷ --> sk'ul'ɨxʷ making a house

44 =asq'it sky; day; month

s/c'eč=asq'it --> sc'čásq'it calendar
/nekʷe?=asq'it --> nákʷə?sq'it one day

45 /t'am lick; dampen

	s/t'ám'-m	licking
	/t'm'+t'm'=yóye?	snail, leech
46	/c'éč count	
	s/c'éč-m	to count
	s/c'č=ásqit	calendar
47	/q'ec braid	
	s/q'éc-m	to braid
	s-n/q'c+q'c=íne?	braids
48	/lej stab	
	ku /léj-šeš	you stabbed us
	/lIj-p-nún	stab, pierce
	/lej=ís=g"el-n-ces	he harpooned it for me
	/ləj=ís=g"el-n	harpoon

3.14 Summary

Coeur d'Alene has five full surface vowels that appear when stressed, and which may reduce or delete when unstressed. Schwa is the result of phonetic epenthesis, or excrescence, and its frequency varies with the speaker. Schwa is also the result of vowel reduction. Both types of schwa are subject to late phonetic processes of local assimilation. The variation shown in full vowels is discussed in the following sections.

3.2 Preliminary analysis of vowel system

The five underlying Cr vowels suggested by Sloat (1980) remaining after eliminating underlying schwa are presented below with a full feature analysis:

	i	e	a	o	u
high	+	-	-	-	+
low	-	-	+	-	-
back	-	-	+	+	+
round	-	-	-	+	+
RTR	-	-	+	+	-
ATR	+	-	-	-	+
CP	-	-	+	+	-
tense	+	-	-	-	+

All of the features presented are not necessary for distinguishing the Cr vowels. The features advanced tongue root [ATR], and [low] and [tense] may be eliminated from the matrix since their values are predictable from the feature specifications for [high], which parallel [ATR] and [tense], and [back] and [round], which, when specified with opposite feature values, predict [+low].

	i	e	a	o	u
high	+	-	-	-	+
back	-	-	+	+	+
round	-	-	-	+	+
RTR	-	-	+	+	-
CP	-	-	+	+	-

The features RTR and CP are also redundant in the vowel specification, having the same feature values for each segment. Both features are necessary in describing Cr consonants, so neither is favored in the vowel analysis by a limit to the overall number of features. Many of the roots containing a̲ and o̲ are cognate with roots in Colville-Okanagan, a neighbouring Interior Salish language, that contain pharyngeal resonants in C2 position preceding Vl (CʕVC), or are cognate with other roots in Interior Salishan languages that show variation in retracted and nonretracted vowels. Mattina (1979:17) notes that in Colville and other Interior Salishan languages:

> there occur some words . . . which appear to have shifted a pharyngeal resonant from the root to a stressed suffix: the root has lost a pharyngeal, and the suffix has added one. Furthermore, the vowel of the suffix has lowered to [a], homorganic with the (immediately preceding) inserted pharyngeal.

In Colville, pharyngeal movement appears to follow stress placement. If there is residue of an earlier /CʕVC root type in Coeur d'Alene, the roots with vowels a and o, which invoke harmony, may carry and spread the feature [+constricted pharynx]. In the examples given below, the Coeur d'Alene root and general definition precedes a list of cognate forms (Coeur d'Alene forms from my own recordings or from Reichard (1938); others from Mattina (1979)).

49	/p'ac' squirt, defecate	
	Sp /p'a̲c'15	loose bowels
	Cv /p'ʕac'	shoot out, squirt
	Cm /p'ac'	
	Ka /p'ac	
	Sh /pic'	
50	/p'at' sleet (be mushy)	
	Sp /p'a̲t'	gravylike substance
	Cv /pʕat'	pour in, overflow
	Sh /pat'	overflow
51	/t'am lick	
	Cv /t'ʕam	(unattested)
	k'əɨ/t'əm-ʕas-s-əlx	they kiss them
	Ka /t'am	
	təmám	he sucks

	Sh	stam'ált	cattle
52	/t'ap'	shoot	
	Cv	t'ʕap	shoot
	Ka	t'aap	
	Sp	t'ap(í)	
53	/san	tame; drowsy	
	Cv	sən-sʕ(')an-t	tame, gentle
	Sp	/san	
	Ka	/san'	
54	/nas	soak	
	Sp	/nos	snot

The following examples demonstrate the effect of a̲ and o̲ on following vowels in Coeur d'Alene:

55	GR	s/p'ac'-m-i --> sp'ac'mé	just dung
56	GR	t/p'at'=iʔs(t)-n-t-s --> tp'at'áʔsnts	he poured cement on rock
57	GR	/t'am=ilg"es=cin-m --> t'amelg"escénm	he licked his lips
58	GR	/t'ap-s/čint --> t'apscént	he shot people
59	GR	s/sn'+sn'-t-il'š-s-t-m-s --> səsən'sən'tél'šstus	he broke it (horse)
60	GR	ač/nas+nas=us/čint --> ačnasnasusčént	he wets people's eyes

Proto-Salish roots reconstructed by Kuipers (1981) with retracted vowels are not cognate with the pharyngeal forms, but rather indicate the retraction of r̲ in Cr and its correlation with l̲ in (Cr and) other Interior Salishan languages:

61	*tu/al	Cr	teɬ 'be straight' tar 'undo tor 'stretched out, extended'
62	*c'u/al	Cr	c'iɬ 'weather is cool' c'ar 'feel cold to the touch'
63	*k'əl	Cr	č'ar 'cut flimsy object with shears'

In these examples, the development indicated is that the retracting feature associated with these roots merged with the lateral segment, producing r̲ from Proto-Salish *l in Cr. The r̲ thus derived then triggers assimilation in Cr, lowering the preceding vowel. This lowered vowel does not trigger the harmony that the underived constricted vowels trigger (examples 55-60) .

Since the Coeur d'Alene roots containing a̲ and o̲ without a following r̲ correspond to pharyngeal roots in Colville and other Interior languages, I suggest that the appropriate feature specification for these vowels is [+CP]. The resulting feature specifications for Cr vowels are thus:

	i	e	a	o	u
high	+	-	-	-	+
back	-	-	+	+	+
round	-	-	-	+	+
CP	-	-	+	+	-

The following discussion will provide evidence for unspecified feature values as well as the necessity for four features in describing the Coeur d'Alene vowel system.

3.21 Regressive harmony

Regressive harmony in Cr is triggered by the segments r, r', x̣, x̣", q, q', q", q'", ʕ, ʕ', ʕ" and ʕ'". These segments are marked by the feature [+RTR] in the alphabet proposed here (see sec. 2.1). Sloat (1972:238) writes the rule:

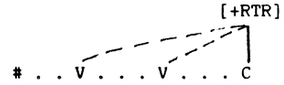
(i) i, e, u --> e, a, o, respectively, / ____ . . . faucalizing consonant

64	/cíš-t	it is long
	/céš=alq"	he is tall
65	/x̣éc'-p	he looked with great curiosity
	t-/x̣ác'+x̣əc'=us	he has curious eyes
66	s-t/púm-əlx"	hide with fur
	s/póm=alqs	fur coat

The rule then is one that spreads the feature [+RTR] from any consonant so marked to any preceding vowel[16] within the word.

Regressive Harmony:

R23 [+RTR]



Apparent exceptions to this rule include the following forms, taken from Reichard (1938:530;562;616):

67	GR	ni? /láj=i?qs-ənts	he stabbed her nose
68	GR	ni? /sátč=i?qs-ən	crank, what twists nose
69	GR	ni? /?áp'=i?qs-ən	handkerchief
70	GR	s-ni? /č'ám+č'am=i?qs	nostrils
		s-ni? /č'ám=i?qs	nose
71	GR	/t'ápq=i?qs	snipe
72	GR	ni? k'ʷé?=i?qs-ənts	he bit his (somebody else's) nose

The suffix =i?qs 'nose, beak' may be analysable as =y'qs and thus would not be subject to the rule of regressive harmony.[17] I have found no other exceptions to the rule of regressive harmony. The rule applies postlexically, and appears to be blocked only by a word boundary.

3.22 Progressive harmony

Progressive harmony in Cr is triggered by roots without a faucal ([+RTR] consonant) in C2 (or C3) that appear with a or o when stressed. A vowel of a stressed suffix is lowered following such a root, the root vowel deleting or appearing unstressed or reduced. The following examples and glosses are taken from Reichard (1938); some forms have been verified in my own work.

73	GR	/tam-ən-cót	he scorched himself
		-cut	reflexive
74	GR	/pəs+pəs-ól	he is timid
		-ul	habitually
75	GR	/po?s	joke
		či?c-po?s-cén	I am joking hither
		=cin	mouth
76	GR	/p'ac'	squirt, defecate, urinate
		čeɨ-hIs-t/pəc'=ós-əm	I will squirt him in the eye
		=ús	eye
		s/p'əc'-əm-é	just dung
		-í	exaggeration
77	GR	cen/p'at'=šén-ən	cement, under foot pour mushy stuff
		=šin	foot

		hIn/p'at'+p'at'=cén'-təm'	mush stuff was applied to his little mouth
		=cin	mouth (plus glottalized diminutive)
78	GR	/san'	tame
		sə/sən'+sən'-t-él'š-s-t-us	he broke it (horse)
		-il'š	grow
79	GR	u/yəc'=ó::p	it held firm
		=up	bottom (?)
80	GR	/t'ap	shoot
		/t'ap+s/čént	he shot
		s/čint	people
		č/t'ap=ɨnéw'-əncexʷ	(if) you shoot alongside me
		-ɨniw'	alongside

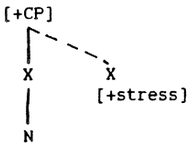
The vowels a and o are specified with the feature [+CP], and the examples above indicate that this feature spreads to a following stressed vowel. In some cases, such as 82 and 83 below, the spread seems to affect intervening vowels, the result of either cyclic application of the harmony rule and stress assignment, or unstressed vowel reduction.

81	GR	/nas	wet
		a-č/nas+nas=us/čént	he wets people's eyes
		s/čint	people
		=us	eye, unchanged
82	GR	/t'am=elgwes=cén-m	he licked his lips
		=ilgwes	heart [internals?]
		=cin	mouth
83	GR	hIn/p'at'+p'at'=os-n-cót	he dreamed, self-poured mushy stuff in eyes
		=us	eye
		-cut	reflexive

I have found no examples where e lowers with a [+CP] vowel preceding, but neither are there examples of suffixes with stressed e that are not the result of regressive harmony (3.21), where stressed e is derived from stressed i. The vowels [a] and [o] also occur stressed in suffixes only as a result of regressive harmony.[18] The rule of progressive harmony thus appears to be one that applies only to stressed vowels. The rule of progressive harmony may be written as follows.

Progressive Harmony:

R24



3.3 Underspecified vowel matrix and rules

In the Cr vowel system the features [high] and [back] are necessary, and are predictable by the assignment of the feature [RTR] through regressive harmony (R23):

R5 [+RTR] --> [-hi]
R19 [ ] --> [-RTR]
R21 [αRTR] --> [αbk]

The vowels i and e must be marked distinct from one another in the feature matrix to assure that the result of assimilation and the [RTR] rules does not render them indistinguishable. The effect of the rules of assimilation is to lower i to e and e to a, but not to cause underlying i to lower all the way to a. Therefore, i must be specified as [-back], preventing the rule R21 from applying. The feature matrix need specify [-back] for i only:

	i	e	a	o	u
high	+	-	-	-	+
back	-				
rnd	-	-	-	+	+
CP	-	-	+	+	-

In the consonant system it was determined that segments marked [+CP] were by rule (R4) also [+RTR]. The same rule will apply to vowels marked [+CP], and the vowels thus assigned [+RTR] will undergo the rules given with [+RTR] in their structural description.

	i	e	a	o	u
high	+	-			+
back	-				
rnd	-	-	-	+	+
CP			+	+	

R4 [+CP] --> [+RTR]
R5 [+RTR] --> [-hi]

R19 [ ] --> [-RTR]
R18 [ ] --> [-CP]
R21 [αRTR] --> [αbk]

This set of rules may be simplified by eliminating the assignment of [+RTR] to [+CP] segments, and instead requiring [+CP] to become [-high] and by rewriting the [RTR] rules as follows:

R25 [+CP] --> [-high]
R18 [ ] --> [-CP]
R26 [αCP] --> [αback]

But these [CP] rules are redundant, adding to the complexity of both the consonant and vowel systems. The [RTR] rules are necessary for consonant specification and for deriving the correct values for vowels subject to assimilation. The [CP] rules are not necessary for the consonant specifications nor for harmony or assimilation if the [RTR] rules apply.

Archangeli and Pulleyblank (1986:A352-3) suggest that universal grammar will have context-free default rules assigning the feature values [+high] and [-round]. There are no contradictory indications to this in Coeur d'Alene, allowing specification of the values [-high] and [+round] in the matrix. Segments specified as [+round] will also be assigned the feature value [+back] by rule R6:

	i	e	a	o	u
high		-			
back	-				
rnd				+	+
CP			+	+	

R4 [+CP] --> [+RTR]
R5 [+RTR] --> [-hi]
R6 [+rnd] --> [+back]
R19 [ ] --> [-RTR]
R18 [ ] --> [-CP]
R12 [ ] --> [-rnd]
R20 [ ] --> [+high]
R21 [αRTR] --> [αbk]

3.31 Motivation for an unspecified vowel

In the environment of progressive or regressive harmony, a also occurs as an alternant of a vowel that otherwise appears as i.19

Regressive harmony:

84	-ip	'bottom'
	s/c'm-íp-n-s	chin
	s/tq-áp-w'as-qn	beard

85	/tɨ́ʔ	'to hit'
	/tɨ́ʔ+iʔ=us	he got hit on the face
	/tá́ʔ+aʔ=eqs	he got hit on the nose

Progressive harmony:

86	s-c'+/c'əx̌-ɨ́ʔst	gravel
	t/p'at'-á́ʔs(t)-ən-t-s	he poured it (cement) on rock
	=iʔst	
87	/t'am	make damp, dampen
	sye/t'am-á́ləmxʷ	one who licks people
	=ilmxʷ	person
88	/pəs	be astonishing
	/pəs=á́č-stmən	I will play a trick on him
	=ič	deceive [?]
	s/pəs-á́ya	folly, error
	-iyaʔ	playingly
89	/p'at'	be mushy, pour mushy stuff
	t/p'at'=á́ʔs-n-t-s	he poured cement on rock
	=iʔs(t)	surface of round object
90	/yac'	be tight, firm
	č/yəc'+yəc'-am=á́čt-əm	hold on tight
	=ičt	finger
91	/mas-mas	kind of vegetable
		"vile-smelling vegetable much liked
		by the Coeur d'Alene"
	an/məs-məs=á́tkʷeʔ	water is full of mas-mas
	-it	use
	(=kʷeʔ	water)
92	/tam	scorch
	ač/təm=á́w'es	it exists scorched on the surface
	=iw'es	together
	ku ʔIn/təm=á́w'es=us	thou scorched eyebrow, name of ridicule
		for Coyote
	=iw'es	together
93	/c'om	suck
	niʔ/c'om'-á́w'es-ən-t-s	he sucked amongst
	=iw'es	together
94	/kʷar	be yellow
	hIn/kʷar+kʷar-á́w'es-ən	crossbills

	-iw'es	together
95	/mal'	bubble
	čIniʔ/məl-p-á́w'as [sic]	it bubbles in from between
	=iw'es	together
96	/mal'	heat
	a/məl'=á́čt-mən-celIs	he is making us too warm
	=ičt	fingers (?)
97	/moʔt	?
	hIn/mo't=á́ɨc'eʔ	it (chimney) is smoking
	=iɨc'eʔ	inside
98	/coʔt	sob
	/coʔot=á́l'Umxʷ	dwarf
	=ilmxʷ	person

These variations cannot be accounted for by use of a system with only five partially specified vowels. None of the rules in the system presented in section 3.3 can provide for the variation apparent in the forms just listed. If we postulate an additional unspecified vowel, however, the rules already established will predict the correct values for all the vowels.

3.32 Application of rules

In the following matrix, X indicates an unspecified vowel, a vowel that is assigned no underlying feature values. The redundancy rules are those that were established in analysing regular vowel variation.

	X	i	e	a	o	u
high			-			
back		-				
round					+	+
CP				+	+	

R4 [+CP] --> [+RTR]
R5 [+RTR] --> [-hi]
R6 [+rnd] --> [+back]
R19 [ ] --> [-RTR]
R18 [ ] --> [-CP]
R12 [ ] --> [-rnd]
R20 [ ] --> [+high]
R21 [αRTR] --> [αbk]

Application of the redundancy rules to the underlying feature matrix, including the unspecified vowel, without influence of either harmony will result in the following fully specified matrix:

	X	i	e	a	o	u
high	+	+	-	-	-	+
back	-	-	-	+	+	+
round	-	-	-	-	+	+
CP	-	-	-	+	+	-
RTR	-	-	-	+	+	-
Value	i	i	e	a	o	u

With progressive harmony (R24), the feature [+CP] may be assigned to any stressed vowel not otherwise specified for the feature, and the redundancy rules will supply the following values. There is no evidence that [a] and [o] occur underlyingly in suffixes, nor is there ecidence that [e] occurs stressed in suffixes (see note 18). If underlying [a o e] in suffixes were subject to progressive harmony, the rule would apply vacuously to [a o], and would predict [a] as the value for underlying [e].

	X	i	e	a	o	u	
high	-	-	-	-	-	-	
back	+	-	+	+	+	+	
round	-	-	-	-	+	+	
CP	(+)	(+)	(+)	+	+	(+)	(progressive harmony)
RTR	+	+	+	+	+	+	
value	a	e	a	a	o	o	

With the application of regressive harmony (R23) spreading [+RTR], the redundancy rules will provide the following values. The [e] derived form underlying i via progressive harmony will no lower to [a] with the application of regressive harmony since the derived [e] will already be specified as [+RTR].

	X	i	e	a	o	u	
high	-	-	-	-	-	-	
back	+	-	+	+	+	+	
round	-	-	-	-	+	+	
CP	-	-	-	+	+	-	
RTR	+	+	+	+	+	+	(regressive harmony)
value	a	e	a	a	o	o	

It is clear from the matrices presented that the processes of progressive and regressive harmony derive vowels differing in the value for the feature constricted pharynx, a distinction that is not always apparent to the nonnative ear. This analysis predicts that the results of progressive harmony will be articulatorily or acoustically analysable as distinct from the results of

regressive assimilation. This prediction will need to be experimentally tested.

3.4 Summary of vowel system

Minimal feature specification and a correspondingly small set of redundancy rules apply to predict regular feature values of Coeur d'Alene vowels:

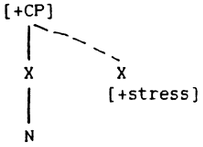
	X	i	e	a	o	u
high			-			
back		-				
round					+	+
CP				+	+	

R4 [+CP] --> [+RTR]
R5 [+RTR] --> [-hi]
R6 [+rnd] --> [+back]
R19 [ ] --> [-RTR]
R18 [ ] --> [-CP]
R12 [ ] --> [-rnd]
R20 [ ] --> [+high]
R21 [αRTR] --> [αbk]

The two harmonies apply to the underspecified matrix to determine the application of redundancy rules and the surface forms of the vowels.

Progressive Harmony: Progressive harmony is a lexical rule spreading the feature [+CP] from a root vowel to a following stressed vowel.

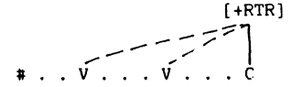
R24



The rule of progressive harmony predicts that consonants specified as [+CP] will block the spread of the same feature. Blocking is discussed in the following section (3.5).

Regressive Harmony: Regressive harmony is a postlexical rule spreading the feature [+RTR] from a consonant to all preceding vowels within the word.

R23



Consonants marked [+RTR] are opaque to regressive harmony; though their feature specification blocks the spread of the harmony, the same feature specification reinitiates the harmony.

3.5 Blocking harmony

Progressive harmony should be blocked by faucals marked [+CP] (i.e., ʕ ʕ") since they have the same feature specification as the harmony trigger. Examples of roots ending in r, q and χ but still triggering harmony occur in the Coeur d'Alene data, but no such examples occur with ʕ:

99 GR hn/k"ar+k"ar=íw'es-n --> hInk"ark"aráw'əsən crossbill

100 /łaq"=ip=iw'es=šin --> łaq"épəw'əsšn MS breechcloth
łaq"ípəw'əsšn LN

101 GR hn/č'aχ"+č'aχ"=ip-n'-m --> hInčəχ"čəχ"ápən'əm he retired

Even though these examples indicate that the suffix =ip 'bottom' or the root /łaq" is being reanalysed by Coeur d'Alene speakers, it is evident that r, q and χ do not necessarily block harmony. This supports the analysis that the faucals are not all marked with the feature [+CP], but that only the pharyngeal resonants carry this feature and are thus the only segments that necessarily block harmony.[20]

4. Summary

The Coeur d'Alene phonological system has been analysed here as one requiring minimal feature specifications and a corresponding set of redundancy rules. A lexical rule of progressive harmony spreads the feature [+constricted pharynx] to a following stressed vowel. A postlexical rule of regressive harmony spreads the feature [+retracted tongue root] to all preceding vowels. The features necessary in the harmony rules differ and allow the predictions that progressive harmony will be blocked by consonants marked [+CP], and that consonants marked [+RTR] will be opaque to regressive harmony. The redundancy and harmony rules apply to determine feature values of a set of six minimally specified vowels, including one completely unspecified vowel. The result of rule application to the unspecified vowel accounts for the apparent irregular distribution of i/a. The set of redundancy rules applicable to the vowel system is a subset of the rules necessary to describe the consonant system, thus allowing a relatively simple analysis of Coeur d'Alene phonology.

Notes

1. This research was supported by grants from The Jacobs Research Funds, Whatcom Museum Society, Bellingham, Washington and the Phillips Fund, American Philosophical Society, Philadelphia.

2. The major definitions, principles, and constraints of underspecification theory are:

Alphabet: The language specific inventory of possible sounds. The alphabet is composed of a matrix component consisting of a partially specified set of distinctive features, and a rule component consisting of a set of redundancy rules supplying the feature values not specified in the matrix (Archangeli 1984:43-4). The feature minimization principle and complement rule formation determine the content of the alphabet.

Feature Minimization Principle: A grammar is most highly valued when underlying representations include the minimal number of features necessary to make different the phonemes of the language (Archangeli 1984:50).

Complement Rule Formation: Given an opposition [αF]/[-αF] in an environment Q in underlying representation, one value β is selected as the matrix value for F in Q, and the other value is specified by an automatically formed complement rule (Archangeli 1984:65):

[ ] --> [-βF] / Q

Features not specified underlyingly in the matrix are assigned default values by universal default rules.

Default Ordering Principles (Archangeli and Pulleyblank 1986:14-5):

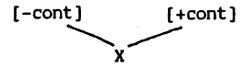
A. Redundancy rules begin their application in the latest possible stratum.
B. Redundancy rules apply as early as possible within their stratum.

The "latest possible stratum" may be phonological, postlexical or phonetic. Early application is determined by the Redundancy Rule Ordering Constraint.

Redundancy Rule Ordering Constraint: A default or complement rule assigning the value [αF] where α is + or - is automatically applied before any rule with reference to [αF] applies (Archangeli and Pulleyblank 1986:15).

3. Here I am following the use of the term excresence as presented by Levin (1986). Epenthesis and excresence are two different types of vowel insertion, distinguished by the properties of the vowel inserted, which are determined by the point at which the vowel is inserted. Epenthetic vowels result from the insertion of an empty vowel slot prior to and subject to the application of redundancy rules. Excrescent vowels are also argued to be the result of vowel slot insertion, but this insertion follows the application of the redundancy rules. Features of the excrescent vowel are supplied by a late component of the grammar not subject to influence from phonological rules.

4. The affricates [c, č, ǰ] in Johnson's chart are marked with the feature [-cont]. Affricates are usually described as complex segments composed of a stop and fricative; for example, [c] is the sequence of the features of [t] followed by those of [s] in a single consonantal timing slot. The features [-cont] and [+cont] distinguish the two components of the complex segment.



In the following matrices, the affricates will be left unmarked for either feature value.

5. The 1980 Random House College dictionary defines faucal as pertaining to the fauces or opening of the throat, or as pharyngeal. Pei and Gaynor's 1954 Dictionary of Linguistics defines faucal as produced in the area between the pharynx and glottis.

6. The muscles of the tongue (the genioglossus) and the pharynx (the superior constrictor) are controlled independently by cranial nerves 12 and 10, respectively (Netter XXXX).

7. The underlying feature specifications would be much simpler if [h] and [ʔ] were considered [-son]. If this were the case, the feature [+voiced] would be predictable for all sonorants. This analysis may also be desirable since the [h] and [ʔ] do not function as glides in Coeur d'Alene.

8. [I] in this and later discussion is substituted for Reichard's iota, and represents a lax high front vowel.

9. The following symbols are used in the examples given in text:
/ root, = lexical suffix, - morpheme boundary, + reduplication

Examples taken from Reichard's grammar and later papers are presented here in modern orthography, but have not been reinterpreted.

10. r̲ appears only in C2 position, only following a or o.

11. Sloat postulates the following underlying forms to account for the corresponding variations resulting from assimilation.

underlying	strong	faucally weak
e	e	a
a	a	a
i	i	a
ə	i	e
u	u	o
(o	o	o)

(The last set is not provided by Sloat)

To account for the surface forms of underlying schwa (ə), Sloat (1980) posits the following rules:

(iii) tense ə --> i

"The ə is tense under two conditions in Cr: (1) it is stressed, or (2) it precedes a stressed vowel and is separated from that vowel by one consonant" (Sloat 1980:16).

(iv) i [from schwa] --> e / ____ . . . faucal

(v) lax ə --> I / ____ nonnasals

Rules (iii) and (v) are expensive in that they only apply to underlying schwa. None of the other vowels raise when stressed or in the lengthening environment, and none of the other reduced vowels depend on nasals to determine their form.

Sloat (1966) and Johnson (1975) postulate approximately 18 Cr roots with underlying schwa. (Both authors postulated these roots prior to Sloat's 1980 analysis of schwa given above [rules iii-v].) The 18 postulated schwa roots do not all behave according to these rules; the following are examples:

	Root	Affix	Expected	Real
a	/q'ʷəd black	u-	(iii) u:q'ʷíd	u:q'ʷéd it is black
		=alqs clothing	(iv) q'ʷédalqs	q'ʷádalqs blackrobes (priests)

The underlying vowel here must be postulated as one other than schwa since the rules raising schwa to i̲ and lowering schwa to e̲ do not operate as expected.

b	/qʷən blue		(iv) qʷín	qʷín green
		t-, =sqit sky	(iv) tqʷénsqit	tqʷánsqit blue sky

The change in definition from blue to green may represent a case of ablaut rather than the application of a stress + raising rule. Again, the extreme lowering of schwa to a̲ rather than e̲ suggests a different underlying vowel.

c	/yenəqʷ coil	(v) yánIqʷ	yánqʷ coiled

In example c, the postulated schwa deletes rather than assimilate to a following nonnasal.

d /ʔekʷən (v) ʔékʷən ʔékʷ(ə)n
say he said

-s-t-us (iii, v) ʔəkʷístus ʔəkústus
3-3 tran he told him

The schwa in parentheses in d indicates that this segment is optional; the root-final -n is lost before the 3s-3s transitivizing suffix.

Postulating underlying schwa, as Sloat (1980) has done, for one of these series is expensive, and not supported by the data: Sloat has introduced the features 'lax' and 'tense' into a system which otherwise functions without them, and has postulated a rule with global conditioning.

12. Refer to note 3.

13. Thompson and Thompson (1986:11.02) point out that resonants in such positions may occur either as syllabic or as a sequence schwa-resonant.

14. These two forms may show morphological differences, not just phonetic variation. The suffix -ut stative, with its vowel reduced, may be part of the construction provided by Margaret Stensgar.

15. Underlined segments in the Spokan forms indicate retraction (Mattina 1979; from Carlson 1973). Sp Spokan; Cv Colville; Cm Columbian; Ka Kalispel Sh Shuswap.

16. It is possible that the feature spreads to all segments in the word, not just to the vowels. If such were the case, one would expect segments unmarked for [RTR] to take the feature. Reichard (1938:563) note only two examples where a consonant appears to take the RTR feature:

/axus axʕ́os=qən-əm he deloused
/seʔg In/seʔg̣=ós=alpqʷ he got food in the wrong throat

In all other cases where the feature [+RTR] spreads it does not affect consonants.

17. Cognate suffixes in Colville are presented by Mattina (1987) as =aqs$_1$ or =qs$_4$ 'food' and =aqs$_4$ or =qs$_7$ 'nose, point'.
Reichard (1938:616) provides two additional forms that she analyses with the suffix for nose/beak:

ʔi-t-/xʕ́es=iʔqs he enjoys food immensely
čeɬ-In-/šíʔt-əm-aʔqs-ən it will be thy first course

In both forms the root vowel is unaffected by the following uvular, but in the second form the uvular appears to lower the vowel preceding in the same morpheme. Other forms in my own data (see example 85) suggest that the suffix for nose/beak may be analysed with an underlying vowel rather than a glide, perhaps indicating a recent reanalysis. The suffix analysed by Reichard as iʔqs may also be analysable as a sequence of two suffixes. Haeberlin (Thompson

1974:252) suggests that the suffix -qs 'nose, point' is "sometimes compounded with another suffix -əl- without any difference in meaning". Many of his examples are from Interior Salish languages. Thompson (1978:697;705) notes that in several Salish languages laterals l, l' have shifted to glides y, y'. The possibility that the suffix sequence -əl(')=qs has been converted to -y'=qs in Cr will need to be investigated.

18. Roots and suffixes in Cr appear to have different phonologies. Roots may have any underlying vowel, but suffixes are limited to the unspecified vowel or [i e u] underlyingly. [a] and [o] are always derived in suffixes. Unstressed [e] in suffixes may be the result of unstressed vowel reduction. [e] never occurs stressed in suffixes unless it is the result of regressive harmony applied to underlying i.

19. The following suffixes alternate i and a: =iɬc'eʔ inside, =ilmxʷ person, =iʔst surface of round object, =ič deceive, =it-kʷeʔ water, =iyaʔ playingly, =ip bottom, =iwʼes together/between.
The following show i lowering to e: =ic'eʔ all over, =cin mouth, =ilš grow, =ineʔ ear, =i exaggeration, -sčint people, =šin foot, =ɬniw along side.
Two suffixes lower to either e or a: =ičn ridge, =ičt hand, as in:

č/təm+təm=áčn' Scorched Mountain (Lawrence)
č/təm+təm=éčn' Scorched Mountain (Susan Antelope)
=ičn' ridge

Some roots also behave unpredictably, sometimes lowering a following suffix:

/ɬap mark, make welt
čIn/ɬəp'+ɬəp'-ep'=éčt my hand became welted
=íčt hand

Two other forms demonstrate that this root does not always lower a following stressed vowel.

/ɬəp'-el'-s-číče?-n-t-s he welted his horse
=sčíče? horse

/č/ɬəp'-íʔs-ən-t-s he surface-marked it, made mark on rock
=iʔst surface of round object

The following form also shows variation in effecting harmony, and may indicate reanalysis:

/ɬal sprinkle
hIn/ɬəl+ɬəl=íneʔ-en-t-əm he was ear-sprinkled in (to waken him)
hIn/ɬəl+ɬəl-éneʔ-en-t-əm "he heard sprinkling of rain while he slept"

20. Mattina (1979:19) presents two Spokan roots that "exhibit variation between lowered and intact suffixes":

Sp /loʕ'ʷ to fit

Cv /liʕʷ
Cr /léʕʷ
Ka /ləw'
Sh /liʕʷ
Cr /laʕʷ plunge head first
Ka /loo dip, fall into a hole

Sp: ləʕ'ʷóp, hes čló? it fits together
ləʕ'ʷáčstən thimble; =éc'st, hand
loʕ'ʷəntén I put it together

Sp /coʕ'ʷ fringed

Cv cəʕʷ
Ka co
Sh s-cuʕʷ

Sp: scowáčst or scowéčst finger

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