

24.901/931, 2023

Introduction to Phonology

Lecture 4

Class work and related

- Same reads: chapters 2-4 in Hayes 2009
(Canvas Module: *Features, Contrast, Processes*)
- Problem set 1 solution to be posted Friday
- *A Guide to Writing Rules* (2023, still true) under *Tools and Resources*

Current topics

- **FEATURES:** articulatory-auditory properties hypothesized to play a role in the mental representation of speech sounds.
- **PROCESSES:** systematic modifications of speech sounds that the grammar must record; we argue that they operate on features.
- **CONTRAST:** pairs of sounds perceived as categorically distinct in a phonological system (*phonemes*); able to convey meaning differences; features capable of generating contrasting pairs.
- **INVENTORY:** set of contrasting features in a phonological system

Review: IPA vs. DF stricture categories

	Sonorant	Continuant	Consonantal	Syllabic
Oral stops: ptkbdg	-	-	+	typically [-]
Fricatives: szfvθðʒ	-	+	+	
Nasals: mnŋɲ	+	-	+	
Liquids	+	+	+	
Glides (j,w, ɥ)	+	+	-	
Laryngeal Cs: h, ʔ	debated	+(h), -(ʔ)	debated	typically [+]
Vowels: aeioyiuʌ	+	+	-	

[±vowel] in Hayes 2009 is similar to [±consonantal].
Let's just use [±syllabic and ±consonantal]

Stricture continuum divided into categories by IPA vs. DFs

	i	j	r	l	n	z, ʒ	d, ɖ
consonantal	-	-	+	+	+	+	+
IPA	vowels	approximants		laterals	nasals	frics	plosives

also here [h], maybe [ʔ]

[+consonantal]: narrow *oral* constriction, so escaping air is turbulent if glottis is open
 [-consonantal]: no such constriction; the non-laryngeal ones also known as vocoids.

Stricture continuum divided into categories by IPA vs. DFs

	i	j	r	l	n	z, ð	d, ɖ
consonantal	-	-	+	+	+	+	+
sonorant	+	+	+	+	+	-	-
IPA	vowels	approximants		laterals	nasals	frics	plosives

[+sonorant]: no significant constriction in *vocal* tract to result in oral pressure buildup

[-sonorant]: such a constriction.

[±sonorant and ±obstruent are equivalent features, the different names focus on + vs. - values

Stricture continuum divided into categories by IPA vs. DFs

	i	j		r	l	n	z, ʒ	d, ɗ
consonantal	-	-		+	+	+	+	+
sonorant	+	+		+	+	+	-	-
continuant	+	+		+	(varies)	-	+	-
IPA	vowels	approximants		laterals		nasals	frics	plosives

[±continuant]: blockage to *oral* airflow vs. no such blockage

Natural classes

- Rules frequently operate on sets of sounds & are conditioned by such sets: all English voiceless stops aspirated word-initially; all voiced obstruents devoiced word-finally in Russian; all Hindi nasal Cs undergo place assimilation before all stops and affricates.
- Nat. classes are sets of speech sounds that behave identically in a rule: undergo it, provide its context (trigger), or describe the result of change.
- Not random collections of sounds. Especially if found in recurrent rules.
- These sets correspond to broad sound categories recognized by the IPA, or described by one distinctive feature or a conjunction of several.
- Observations about natural classes can be used as tests of adequacy for proposed sets of features.

The following sets are natural classes based on stricture.
 Can members of these sets be identified *without disjunction*
 (‘[αF] or [βG]’) in IPA or DF terms?

	IPA	DFs
{p, t, k, m, n}: trigger Latin place assimilation	stop or nasal	[-continuant, +consonantal]
{p, t, k, f, s, x}: have voiced counterparts		
{r, l, j, w}: follow syll.-initial plosives in Romance		
{m, n, ŋ, l, r, j, w}: can carry tone in Lithuanian		
{a, e, i, o, u, j, w, h, ʔ}: nasal harmony targets		
{a, e, i, o, u, j, w}: more nasal harmony targets		

CONSONANTS (PULMONIC)

	Bilabial	Labiodental	Dental	Alveolar	Postalveolar	Retroflex	Palatal	Velar	Uvular	Pharyngeal	Glottal
Plosive	p b		t d			ʈ ɖ	c ɟ	k ɡ	q ɢ		ʔ
Nasal	m	ɱ	n			ɳ	ɲ	ŋ	ɴ		
Trill	ʙ		r						ʀ		
Tap or Flap		ⱱ	ɾ			ɽ					
Fricative	ɸ β	f v	θ ð	s z	ʃ ʒ	ʂ ʐ	ç ʝ	x ɣ	χ ʁ	ħ ʕ	h ɦ
Lateral fricative			ɬ ɮ								
Approximant		ʋ	ɹ			ɻ	j	ɰ			
Lateral approximant			l			ɭ	ʎ	ʟ			

Symbols to the right in a cell are voiced, to the left are voiceless. Shaded areas denote articulations judged impossible.

Why ‘without disjunction’?
What’s the harm in disjunction?

Lithuanian prefixes

buris	‘crowd’	sam-buris	‘assembly’
pil-nas	‘full’	sam-pil-as	‘stock’
dora	‘covenant’	san-dora	‘virtue’
kaba	‘hook’	san-kaba	‘connection’
vok-ti	‘to understand’	sa:-vok-a	‘idea’
skamb-e-ti	‘to ring’	sa:-skamb-is	‘harmony’
jun-ga-s	‘yoke’	sa:-jun-ga	‘union’
zin-o-ti	‘to know’	sa:-zin-e:	‘conscience’
raš-i-ti	‘to write’	sa:-raš-as	‘list, register’

Only 2 of the sets below are natural classes

{glides + liquids}

{stops + glides + liquids}

{fricatives + vowels}

{nasals + vowels}

{nasals + fricatives}

{glides + r} (but not l)

{vowels + liquids} (but not glides)

Can the stricture DFs characterize any of these classes? If yes, how.

Only 2 of the sets below are natural classes

{glides + liquids} can follow stops word-initially in Spanish + other lgs

{stops + glides + liquids}

{fricatives + vowels}

{nasals + vowels}

{nasals + fricatives}

{glides + r} (but not l) can surface nasalized (Moba: Ajiboye & Pulleyblank 2000)

{vowels + liquids} (but not glides)

Only 2 of the sets below are natural classes

{glides + liquids} [-syllabic, +son, +cont]

{stops + glides + liquids}

{fricatives + vowels}

{nasals + vowels}

{nasals + fricatives}

{glides + r} (but not l) [-syllabic, +son, +cont], if l is [-cont]

or [-syllabic, +son, -lateral]

{vowels + liquids} (but not glides)

Vowel features raise similar issues:
to analyze processes that target Vs, we need
general properties that can define more
intersecting sets than IPA categories offer

Standard V features (Chomsky and Halle 1968)

(all Vs are [-cons, +son, +cont]; all *can* be [+syll])

	i	y	ɨ	ʉ	u	ɪ	ʊ	e	ɛ	æ	a
high	+	+	+	+	+	+	+	-	-	-	-
low	-	-	-	-	-	-	-	-	-	+	+
tense	+	+	+	+	+	lax		+	lax		
front	+	+	-	-	-	+	-	+	+	+	+
back	-	-	-	+	+	-	+	-	-	-	-
round	-	+	-	-	+	-	+	-	-	-	-

What properties these features denote

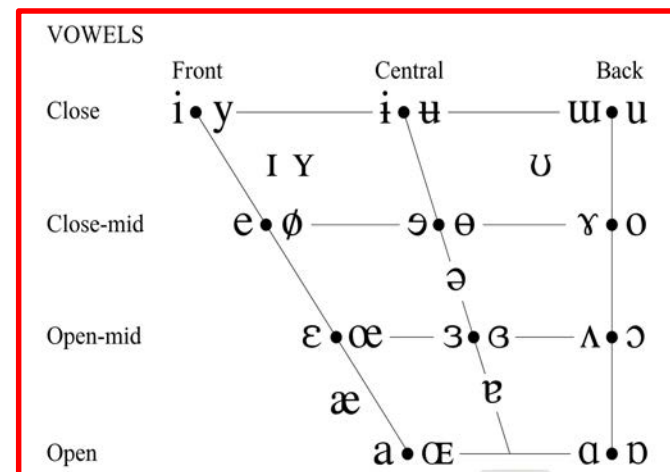
	i	y	ɪ	ʊ	u	ɪ	ʊ	e	ɛ	æ	a
high	F1 values: lower for the higher Vs (correspond to diff's in tongue body and jaw vertical position)										
low											
lax	centralized, lower wrt the higher series										
front	F2 values: higher for front (correspond to diff's in advancement/retraction of tongue body)										
back											
round	F3 values: lower for rounded (lip rounding)										

Scales vs. binary Fs in Vs

- Formants are also continuous dimensions
heed, hid, hayed, head, had contain relatively front Vs
 but *heed* has higher F2 than *hid*; *hid* higher than *head*
- But it is useful to define discrete regions corresponding to DF values, because phonological processes, e.g. Vowel Harmony rules, require use of discrete DFs:

All Vs in a word must belong to set {i ɪ e ε æ} or to {ʊ ɔ o ʊ u}
 Vs in one word can't come from both sets.

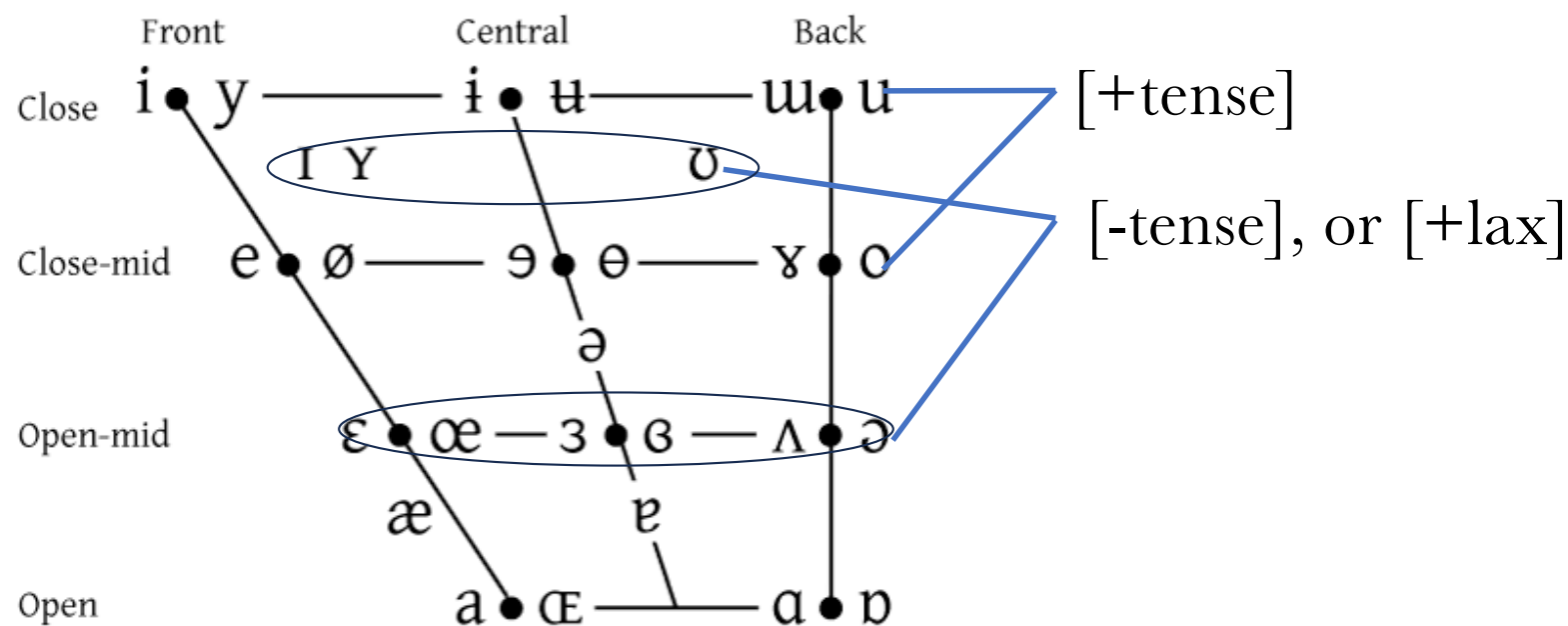
- Or V in some context must belong to the set {i, ɪ, u, ʊ, u}, otherwise to the complement set {e ε æ, ʊ ɔ o}



F2 values for British English Vs

- /i:/ (heed): ~ 2241 Hz
- /ɪ/ (hid): ~ 1839 Hz
- /e/ (head): ~ 1656 Hz
- /æ/ (had): ~ 1565 Hz
- /ʌ/ (hud): ~ 1296 Hz
- /ɑ:/ (hard): ~ 1193 Hz
- /ɒ/ (hod): ~ 1019 Hz
- /ɔ:/ (hoard): ~ 857 Hz
- /ʊ/ (hood): ~ 1408 Hz
- /u:/ (who'd): ~ 1587 Hz

Intermediate degrees of height: $[\pm \text{tense}]$, aka $[\pm \text{lax}]$



The following are vowel natural classes

Can they be analyzed without disjunction in IPA or DF terms?

	IPA	DFs
{a, e, ε, o, ɔ}: 1 st member of diphthong in A.Greek		
{ε, ɔ, ɪ, ʊ}: can't occur word finally in English		
{e, o, i, u}: are long in English		
{ε, ɔ, a}: see French, below		

European (Île de France) French vowels

	±High	±Low	±Tense
[se] <ces>	-	-	+
[sɛt] <cette>	-	-	-
[so] <sot>	-	-	+
[sɔt] <sotte>	-	-	-
[abi] <habit>	+	-	+
[abit] <habite>	+	-	+
[ʁy] <rue>	+	-	+
[ʁys] <Russe>	+	-	+
[gu] <gout>	+	-	+
[gut] <goutte>	+	-	+

[pa] <pas>
[pat] <patte>

Québec French vowels (Poliquin 2005)

	±High	±Low	±Tense
[se] <ces>	-	-	+
[sɛt] <cette>	-	-	-
[so] <sot>	-	-	+
[sɔt] <sotte>	-	-	-
[ali] <Ali>	+	-	+
[alɪs] <Alice>	+	-	-
[ʁy] <rue>	+	-	+
[ʁys] <Russe>	+	-	-
[gu] <gout>	+	-	+
[gɔt] <goutte>	+	-	-

What are the rules?

Québec French:

Île-de-France French:

Active articulators

The full set of place features

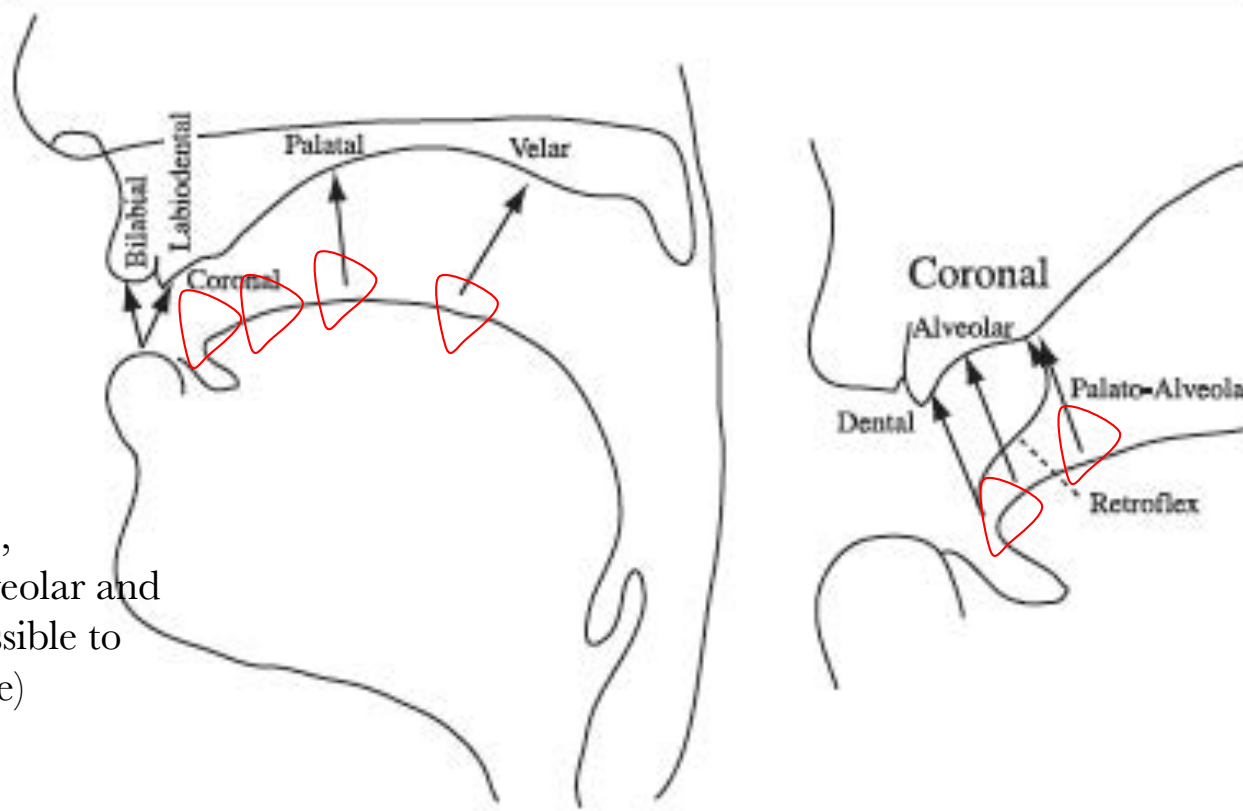
	Bilabial	Labiodental	Dental	Alveolar	Postalveolar	Retroflex	Palatal	Velar	Uvular	Pharyngeal	Glottal
Plosive	p b			t d		ʈ ɖ	c ɟ	k ɡ	q ɢ		ʔ
Nasal	m	ɱ		n		ɳ	ɲ	ŋ	ɴ		
Trill	ʙ			r					ʀ		
Tap or Flap		ⱱ		ɾ		ɽ					
Fricative	ɸ β	f v	θ ð	s z	ʃ ʒ	ʂ ʐ	ç ʝ	x ɣ	χ ʁ	ħ ʕ	h ɦ
Lateral fricative				ɬ ɮ							
Approximant		ʋ		ɹ		ɻ	j	ɰ			
Lateral approximant				l		ɭ	ʎ	ʟ			

- *bilabial, alveolar, uvular* are some of the *place* features
- IPA system classifies Cs only by *where* the oral tract is constricted.
- It is also necessary to name the *active articulator* that moves to create a constriction (*tongue tip, tongue blade, tongue body, uvula, lower lip*).

The unmovable parts (*alveolar ridge, hard palate, teeth*) against which constrictions are made are *passive articulators*.

- Both passive and active articulators are needed to describe attested place contrasts and phonological processes.

Figure 1.7 A sagittal section of the vocal tract, showing the places of articulation that occur in English. The coronal region is shown in more detail at the right.



Active articulators =
red triangles

By *coronal region* (far right),
Ladefoged means the alveolar and
hard palate regions accessible to
the *corona* (= tongue blade)

Binary features for place

Corresponding to passive articulators (incomplete, more later)

[$\pm$ alveolar]: constriction made at alveolar ridge vs. somewhere else

[$\pm$ dental]: at the teeth vs. not there

[$\pm$ anterior]: at or in front of alveolar ridge vs. elsewhere

Features corresponding to active articulators

[$\pm$ labial]: constriction made by moving lower lip

[$\pm$ coronal]: ...by tongue tip or blade

[$\pm$ apical]: ...by tongue tip (*apex*) vs. tongue blade

or [$\pm$ laminal]: ...by tongue blade, not tip

[$\pm$ dorsal]: ...by tongue body

[$\pm$ root]: ...by tongue root (as in uvulars)

Place: active and passive articulator features

[illegible]

Labiodentals vs. bilabials

- Tend not to contrast:

	English	Spanish
labiodental	f, v	f, v
bilabial	p, b	p, b~β

- But do in a few African languages
(Ladefoged 1990, on Canvas)

	Ewe	Venda	Kukuya (Teke)
labiodental	f,v	pf, bv, f, v	pf, bv, ɱ
bilabial	ɸ,β	p, b, ɸ,β	p, b, m

- The labial Cs of Ewe, Venda, Kukuya must be described by identifying both to the active articulator (labial, as opposed to coronal) and the passive articulator (upper lip for ɸ,β, m vs. teeth for f, v, ɱ). Moral: active articulators are not enough either.

Linguo-labials and lamino-alveolars

- In V'enen Taut, linguo-labials contrast with labials and apicals
- In Bulgarian, lamino-alveolars contrast with apico-alveolars.
- To describe these, we need to refer to active vs. passive articulators

V'enen Taut	p	t̚	t	k
passive	labial	labial	alveolar	velar
active	labial	apical	apical	dorsal

Bulgarian	p	t̚	t	k
passive	labial	alveolar	alveolar	velar
active	labial	laminal	apical	dorsal

V'enen Taut or Big Nambas

<https://www.phonetics.ucla.edu/course/chapter7/venet/vent.html>

to hear linguolabials vs. labials vs. apicals

<https://www.youtube.com/watch?v=jrBnN5wTRFg>

More information on the language.

Combinatorics: attested pairings of active and passive articulators

Passive \ Active		Upper lip (= Labial)	Teeth (Dental)	Hard palate		Velum	Uvula
				At ridge (Alveolar)	Behind ridge (Postalveolar)		
Lower lip (= Labial)		p, ϕ	f				
Coronal	Apical	ɬ	θ	t	ʈ		
	Laminal			ɬ̺	ʈ̺		
Dorsal					c	k	
T. Root (Radical)							q

Comments

- All physiologically doable combinations of active-plus-passive articulators are attested as phonemes in some language
- The passive articulator is frequently predictable from the active, or vice-versa: e.g. any English contrastive stop made against upper lip uses lower lip; and any stop made by the tongue tip is made against the alveolar ridge
- That creates a false impression that either passive or active articulators are always predictable from the other set, so that other set is dispensable with.

Phonological uses of the distinction between active and passive articulators.

And a process different from assimilation.

Prefixes in Tashlhiyt Berber (Agadir, Morocco)

reflexive				agentive			
ṃ-xazar	scowl	ṇ-fara	disentangle	am-las	shear	an-ṛ ^ʃ mi	tire
ṃ-saggal	look	ṇ--ḥaʃʃam	be shy	am-kṛz	plow	an-bur	celibate
ṃ-ʃ ^ʃ awar	ask	ṇ--xalaf	place	am-agur	remain	an-ḍ ^ʃ fur	follow
mṃ-ʒla	lose	ṇ--kaddab	liar	am-zug	hide	an-ẓ ^ʃ um	fast
		ṇ--faʃ ^ʃ al	arrange			an-ḍ ^ʃ alab	beg
		ṇ--ḅ ^ʃ dan	separate			an-ṛzif	invite

Berber phoneme inventory

	t	t ^ʕ		k	k ^w	q	q ^w		
b	d	d ^ʕ		g	g ^w				
m	n	n ^ʕ							
f	s	s ^ʕ	ʃ	ʃ ^ʕ		x	x ^w	ħ	
	z	z ^ʕ	ʒ	ʒ ^ʕ		ɣ	ɣ ^w	ʕ	h
w	l	l ^ʕ	r	r ^ʕ	j				
u				i				a	

bilabial labiodental alveolar postalveolar velar uvular pharyngeal glottal

Rule distributing n and m in Berber?

reflexive		agentive	
ṃ-xazar	scowl	ṇ-fara	disentangle
ṃ-saggal	look	ṇ--ħaʃʃam	be shy
ṃ-ʃ ^ɛ awar	ask	ṇ--xalaf	place
mṃ-ʒla	lose	ṇ--kaddab	liar
		ṇ--faʃ ^ɛ al	arrange
		ṇ--b ^ɛ dan	separate
		am-las	shear
		am-krz	plow
		am-agur	remain
		am-zug	hide
		an-r ^ɛ _i mi	tire
		an-bur	celibate
		an-d ^ɛ _i fur	follow
		an-z ^ɛ _i um	fast
		an-d ^ɛ _i alab	beg
		an-rzif	invite

A.English [ju]

cube	[kjub]	tube	[tub], BE [tjub]
puny	[pjuni]	dew, due	[du], BE [dju]
music	[mjuzɪk]	sue	[su], BE [sju]
beauty	[bjuri]	new	[nu], BE [nju]
fury	[fjuɹi]	lewd	[lud], BE [ljud]
hue	[hju]	rude	[rud]
view	[vju]	shoe	[ʃu]

Note: ‘broad’ and ‘narrow’ transcriptions. These are very broad.

Sudanese possessed nouns

kitaab ‘book’

bit ‘daughter’

samak ‘fish’

kitaaf Fathī

bit Fathī

samak Fathī

kitaap Samir

bis Samir

samak Samir

kitaap ʃariif

biʃ ʃariif

samak ʃariif

kitaap Xaalid

bit Xaalid

samax Xaalid

kitaap ḥasan

bit ḥasan

samak ḥasan

Sudanese possessed nouns

kitaab ‘book’ bit ‘daughter’ samak ‘fish’

kitaaf Fathī	bit Fathī	samak Fathī
kitaap Samir	bis Samir	samak Samir
kitaap ʃariif	biʃ ʃariif	samak ʃariif
kitaap Xaalid	bit Xaalid	samax Xaalid
kitaap ḥasan	bit ḥasan	samak ḥasan

IPA description of CCs undergoing rule

b f $\rightarrow$ f f

t s $\rightarrow$ s s

tʃ $\rightarrow$ ʃʃ

k x $\rightarrow$ x x

bilabial+labiodental

alveolar+alveolar

velar+velar

alveolar+post-alveolar

Using the active/passive articulator distinction

Two senses of ‘labial’

	f	ϕ	p	t̚
labial _{ActiveArt}	+	+	+	-
labial _{PassiveArt}	-	+	+	+

‘Labial’ without qualification refers to the active articulator.

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