Features and natural classes
(*Tiêu chí khu biệt và phân loại tự nhiên*)

Cơ sở âm vị học và ngữ âm học

Lecture 7

Generalizing phonological rules

- In English, /t/ has (at least) two allophones:
  1. [t^h] occurs at the beginning of words
  2. [t] occurs after [s]

Generalizing phonological rules

- But exactly the same pattern occurs with /p/ and /k/:

[k^hɒt]	cot	[skɒt]	scot
[p^hɒt]	pot	[spɒt]	spot

Common features

What do the phonemes /p/, /t/, and /k/ all have in common?

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They are all voiceless stops

Natural classes (*phân loại tự nhiên*)

What do the phonemes /p/, /t/, and /k/ all have in common?

They are all voiceless stops

- /p/ /t/ /k/ form a natural class of voiceless stops (một *phân loại tự nhiên*).
- We can describe the general pattern by appealing to this natural class as opposed to having to write three rules for the three different stops.

Natural classes (*phân loại tự nhiên*)

Rules act not on arbitrary sets of sounds, but on systematic classes of sounds.

- It's not surprising that /p t k/ vary in similar ways...
- ...but it would be surprising if /s ɯ ɣ ɗ/ did.
- These systematic, or natural, classes can be defined in terms of phonetic features.

Another example

- In Vietnamese, there are two rules that apply after rounded vowels: /k/ > [k͡p] and /ŋ/ > [ŋ͡m].

/ɔk/ > [ɔk͡p]	*óc*	/oŋ/ > [oŋ͡m]	*ông*
/uk/ > [uk͡p]	*Úc*	/uŋ/ > [uŋ͡m]	*ung*

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/uk/ > [uk͡p]	*Úc*	/uŋ/ > [uŋ͡m]	*ung*

What do the sounds /k/ and /ŋ/ have in common?

Another example

- In Vietnamese, there are two rules that apply after rounded vowels: /k/ > [k͡p] and /ŋ/ > [ŋ͡m].

/ɔk/ > [ɔk͡p]	*óc*	/oŋ/ > [oŋ͡m]	*ông*
/uk/ > [uk͡p]	*Úc*	/uŋ/ > [uŋ͡m]	*ung*

They are both of the velar stops that occur in Vietnamese.

Distinctive features (*tiêu chí khu biệt*)

- We use distinctive features to characterise segments in terms of natural classes (*phân loại tự nhiên*)
- Features help us write short, simple phonological rules
- Features are usually defined in phonetic terms.

Feature values

- Most features are binary (+/−, *lưỡng phân*)
- e.g. [±voice] [±sonorant], [±consonantal]
- This implies that there are natural classes of e.g. both [+voice] segments and [-voice] segments.

Major class features

[±consonantal]

Segments which have a narrow constriction somewhere along the centre of the vocal tract.

[+cons]	[-cons]
stops	vowels
fricatives	glides
affricates	[h, ɦ, ʔ]
nasals	
laterals	
trills	

For [h, ɦ, ʔ] the constriction is in the larynx.

Major class features

[±consonantal]

Segments which have a narrow constriction (thắt) somewhere along the centre of the vocal tract.

[+cons]	[-cons]
âm tắc	nguyên âm
âm xát	
âm tắc-xát	bán nguyên âm
âm mũi	
âm bên	[h, ɦ, ʔ]
âm rung	

For [h, ɦ, ʔ] the constriction is in the larynx.

Major class features

[±sonorant]

Segments with no build-up of pressure in the vocal tract.

[+son]	[-son]
vowels	stops
glides	fricatives
nasals	affricates
liquids	

[-son] are obstruents.

Major class features

[±sonorant]
(*âm vang*)

Segments with no build-up of pressure in the vocal tract.

[+son]	[-son]
nguyên âm	âm tắc
bán nguyên âm	âm xát
âm mũi	âm tắc-xát
âm lỏng	

[-son] are obstruents (*phụ âm ồn*).

Major class features

[±syllabic]

Segments which can form a syllable peak.

e.g. Swahili *mbuni* ‘ostrich’ vs *m̩buni* ‘coffee plant’

[+syll]	[-syll]
vowels	stops
syllabic liquids	fricatives
syllabic nasals	affricates
	liquids
	glides
	nasals

Major class features

[±syllabic]

Âm đoạn làm đỉnh âm tiết (*âm tiết tính*).

e.g. Swahili *mbuni* ‘ostrich’ vs *m̩buni* ‘coffee plant’

[+syll]	[-syll]
nguyên âm	âm tắc
âm lỏng	âm xát
tiết tính	âm tắc-xát
âm mũi	âm lỏng
tiết tính	bán nguyên âm
	âm mũi

Tashlhiyt Berber (Afro-Asiatic, Berber)

ks	‘feed on’
kks	‘take off’
kkstt	‘take it off (fem.)’
tkkststt	‘you took it off (fem.)’
tɕtft	‘it dried’
fqqs	‘irritate’
ftsχt	‘you cancelled’
sfqqst	‘irritate him’
tftχtstt	‘you dried it (fem.)’
tsskɕftstt	‘you dried it (fem.)’

(Carrier phrase *innajas . . . jat twalt* ‘he told him . . . once’)

Major class features

	Vowels	Glides	Syllabic Nas/Liq	Sonorants	Obstruents
	[a i u]	[j w (h)]	[r̩ l̩ m̩]	[r l m]	[s z p b]
[syll]	+	-	+	-	-
[son]	+	+	+	+	-
[cons]	-	-	+	+	+

Russian devoicing

How can we characterise the class of segments that devoice?

Plural	Singular	
[gribɯ]	[grip]	'mushroom'
[sadɯ]	[sat]	'garden'
[razɯ]	[ras]	'time'
[doma]	[dom]	'house'
[tsentri]	[tsentr]	'centre'

Russian devoicing

[b d z] = [+cons, -son] (obstruents)

Plural	Singular	
[gribɯ]	[grip]	'mushroom'
[sadɯ]	[sat]	'garden'
[razɯ]	[ras]	'time'
[doma]	[dom]	'house'
[tsentri]	[tsentr]	'centre'

English (RP)

- How can we characterise the class of consonants that may occur after [sp, st, sk] in the same syllable?

[skɪp]	[spɹeɪ]	[stjuː]	[əˈspaɪə]
[stɔp]	[skjuːd]	[sklə'ɹəʊsɪsː]	[skɹæp]
[skwɒd]	[spɹeɪn]	[spjuː]	[stɹeɪt]
[stæk]	[stɹɔː]	['splɛndɪd]	[skʌl]

English (RP)

[ɹ, l, j, w] = [-syl, +son]

[skɪp]	[spɹeɪ]	[stjuː]	[əˈspaɪə]
[stɔp]	[skjuːd]	[sklə'ɹəʊsɪsː]	[skɹæp]
[skwɒd]	[spɹeɪn]	[spjuː]	[stɹeɪt]
[stæk]	[stɹɔː]	['splɛndɪd]	[skʌl]

English (RP)

[ɹ, l, j, w] = [-syl, +son]
...but *skn, *skm?

[skɪp]	[spɹeɪ]	[stjuː]	[əˈspaɪə]
[stɔp]	[skjuːd]	[sklə'ɹəʊsɪsː]	[skɹæp]
[skwɒd]	[spɹeɪn]	[spjuː]	[stɹeɪt]
[stæk]	[stɹɔː]	['splɛndɪd]	[skʌl]

English (RP)

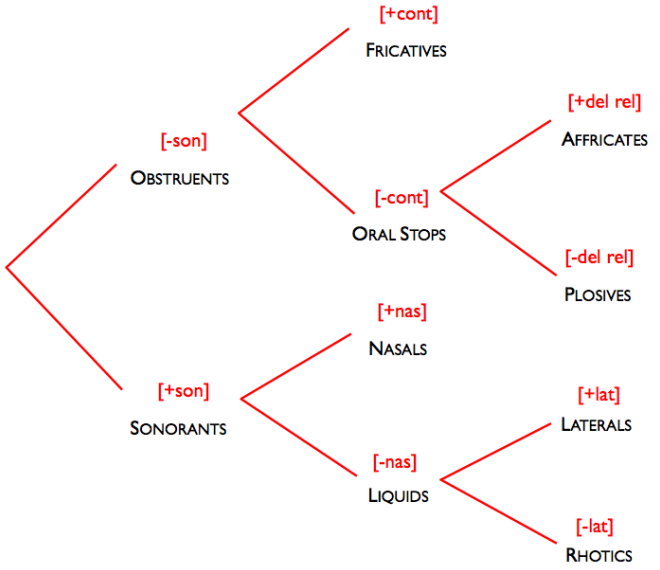
[ɹ, l, j, w] = [-syl, -son]
...but then we incorrectly prohibit <scr-> and <scl->

[skɪp]	[spɹeɪ]	[stjuː]	[əˈspaɪə]
[stɔp]	[skjuːd]	[sklə'ɹəʊsɪsː]	[skɹæp]
[skwɒd]	[spɹeɪn]	[spjuː]	[stɹeɪt]
[stæk]	[stɹɔː]	['splɛndɪd]	[skʌl]

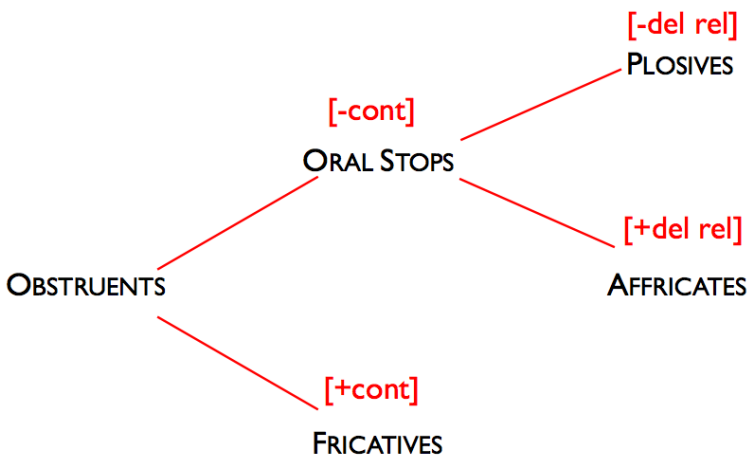
Distinctive features (*tiêu chí khu biệt*)

- Need a set of features which distinguish phonemes.
- We want the smallest set possible...
- ...but one that is also grounded in phonetic reality.

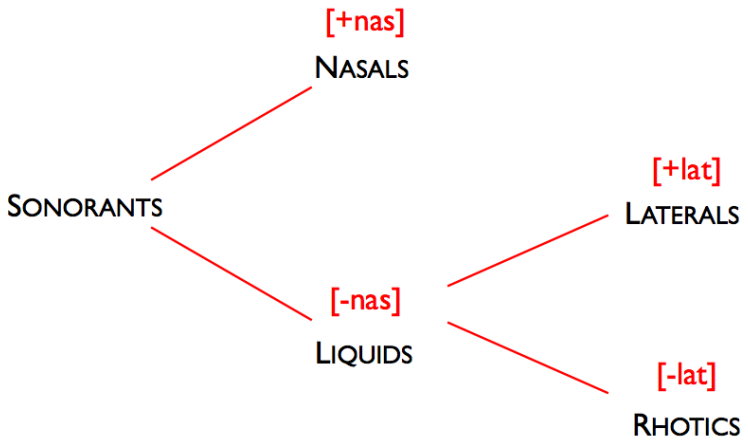
Manner features



Manner features



Manner features



Manner features

	[p d g]	[s ð v]	[ts dʒ]	[m n ŋ]	[l ʎ]
[continuant]	-	+	-	-	(+)
[lateral]	-	-	-	-	+
[nasal]	-	-	-	+	-
[delayed rel.]	-	-	+	-	-

Which sounds match the feature?

[+syll] w p i m h u g v a

[-cont] p t ʃ v d z l m k

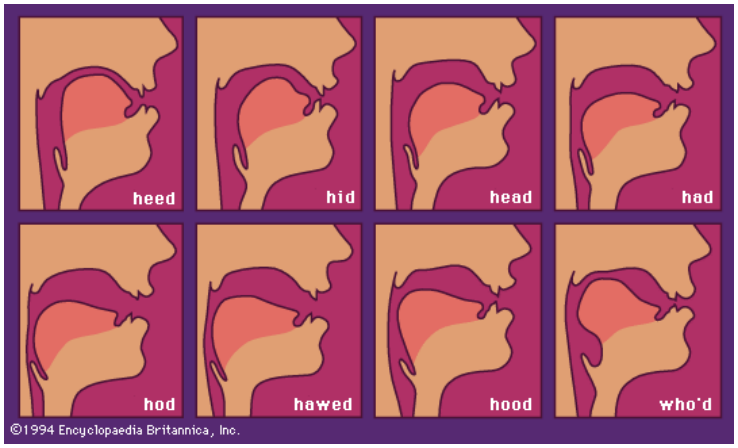
[-cons] k l w p j o u g ŋ ʒ

[+son] a r p q j ŋ b v tʃ ʌ

Which sounds match the feature?

[+syll]	w p i m h u g v a
[-cont]	p t ʃ v d z l m k
[-cons]	k l w p j o u g ŋ ʒ
[+son]	a r p q j ŋ b v tʃ ʌ

Tongue body features



Tongue body features

	[-back]	[+back]
[+high]	[i]	[u]
[-high]	[e]	[o]
	[a]	[ɑ]

[-low]	
[+low]	

[+round]	[y u o]
[-round]	[i e ɑ]

South Kongo (Kikongo)

What conditions the distribution of [t s z] vs. [t͡ʃ ʃ ʒ]?
(Chúng ta được miêu tả phân bố của [t s z] vs. [t͡ʃ ʃ ʒ] thế nào?)

1.	[tobolɑ]	'to bore a hole'	9.	[nselele]	'termite'
2.	[t͡ʃinɑ]	'to cut'	10.	[lolonʒi]	'to wash'
3.	[kesokɑ]	'to be cut'	11.	[zevo]	'then'
4.	[nkoʃi]	'lion'	12.	[ɑʒimolɑ]	'alms'
5.	[zengɑ]	'to cut'	13.	[nzwetu]	'our house'
6.	[ʒimɑ]	'to stretch'	14.	[kunezulu]	'to heaven'
7.	[kɑsu]	'emaciation'	15.	[tɑnu]	'five'
8.	[t͡ʃibɑ]	'banana'			

South Kongo (Kikongo)

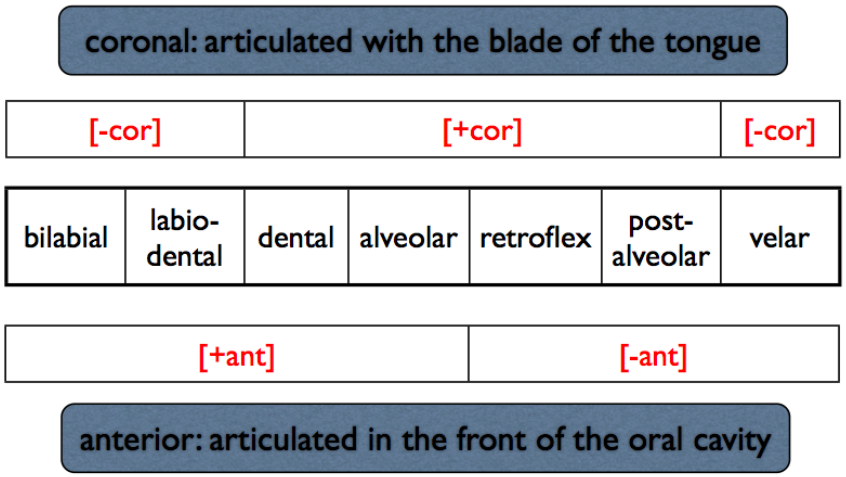
[t͡ʃ ʃ ʒ] / ___ [+high, −back] vowels

1.	[tobolɑ]	‘to bore a hole’	9.	[nselele]	‘termite’
2.	[t͡ʃinɑ]	‘to cut’	10.	[lolonʒi]	‘to wash’
3.	[kesokɑ]	‘to be cut’	11.	[zevo]	‘then’
4.	[nkoʃi]	‘lion’	12.	[ɑʒimolɑ]	‘alms’
5.	[zengɑ]	‘to cut’	13.	[nzwetu]	‘our house’
6.	[ʒimɑ]	‘to stretch’	14.	[kunezulu]	‘to heaven’
7.	[kɑsu]	‘emaciation’	15.	[tɑnu]	‘five’
8.	[t͡ʃibɑ]	‘banana’			

Other features

- Place of articulation
- Laryngeal state (voicing, glottal constriction)
- Prosody (length, stress)

Place features



Classical Arabic

To what class of consonants does [l] assimilate?

1.	ʔal baab	‘the door’	9.	ʔat taxt	‘the bed’
2.	ʔal faras	‘the horse’	10.	ʔad daar	‘the house’
3.	ʔal kalb	‘the dog’	11.	ʔas sanduuq	‘the box’
4.	ʔal xaatam	‘the ring’	12.	ʔaz zajt	‘the oil’
5.	ʔal qalb	‘the heart’	13.	ʔar raʒul	‘the man’
6.	ʔal ħarb	‘the war’	14.	ʔan naas	‘the people’
7.	ʔal ʔab	‘the father’	15.	ʔaʃ ʃams	‘the sun’

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7.	ʔal ʔab	‘the father’	15.	ʔaʃ ʃams	‘the sun’

Classical Arabic

[-cor] [+cor]

1.	ʔal baab	‘the door’	9.	ʔat taxt	‘the bed’
2.	ʔal faras	‘the horse’	10.	ʔad daar	‘the house’
3.	ʔal kalb	‘the dog’	11.	ʔas sanduuq	‘the box’
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Features and classes

- Every feature specification defines a class of segments.
- The generality of the class is inversely related to the number of features:
- The more features, the fewer members of the class.

Specificity and generality

[+cons]	[+cons, -son]	[+cons, -son, +voi]	[+cons, -son, +voi, +cor]	[+cons, -son, +voi, +cor, +cont]
p t k b d g f s x v z ɣ m n ŋ l r	p t k b d g f s x v z ɣ	b d g v z ɣ	d z	z

Summary

- We use distinctive features to characterise segments in terms of natural classes (*phân loại tự nhiên*)
- Features help us write short, simple descriptions
- (Phonological) features are defined in phonetic terms.