

# Phonology

# Phonology

- ▶ Phonology: the study of the distribution of sounds in a language and interactions between those different sounds.
- ▶ Cf. Phonetics: the study of how speech sounds are produced, what their physical properties are, and how they are interpreted
- ▶ What is the organization of sounds in a given language?
- ▶ Of all the sounds in a language, which are predictable and which are unpredictable in given contexts?
- ▶ Which sounds affect the identities of words?

# Phonotactic Constraints and Foreign Accents

- Phonotactic Constraints: restrictions on possible combinations of sounds in a given language
- English: consonants not possible word-initially?  
[s]+stop/nasal, [ʃr]

(1)	[bɪ]	<i>bring</i>	[gl]	<i>glean</i>	[mj]	<i>music</i>	[kw]	<i>quick</i>
	[θɪ]	<i>three</i>	[fl]	<i>fly</i>	[hj]	<i>humor</i>	[sw]	<i>sweet</i>
(2)	V	a	CV	no	CCV	flew	CCCV	spree
	VC	at	CVC	not	CCVC	flute	CCCVC	spleen
	VCC	ask	CVCC	ramp	CCVCC	flutes	CCCVCC	strength
	VCCC	asked	CVCCC	ramps	CCVCCC	crafts	CCCVCCC	strengths

**(3) Hawaiian**

CV

V

**Indonesian**

CV

V

VC

CVC

**Hebrew**

CV

CCV

CCVC

CVC

CVCC

➤ The phonotactic constraints of a language will generally apply to every word in the language, native or not; Languages seek to overcome problems of borrowing a foreign word that violates their phonotactics.

- English: Drop: Ptolemy, gnostic  
Insert a vowel: Gdansk, knish
- Finnish: Drop: Strand (G) → ranta 'beach' (F), glass → lasi
- Japanese: Insert a vowel:  
               /bæɾθ/ → [ba : sɯ]  
               /kəntɔɾ/ → [kontoro : rɯ]

# Foreign Accents

- ▶ Applying the phonotactic constraints of one language while speaking another is an important source of foreign accents.
- ▶ Spanish: \*[st], \*[sk], \*[sp] → insert e  
estudiante 'student', escuela 'school', espalda 'shoulder'
- ▶ French: this [zis], thin [sin] [sound substitution]
- ▶ English: Bach [bak] \*[bax], Lebkuchen [leibkukəʃn], [leibkuhəʃn]

# Phonemes and Allophones

- ▶ [k] and [g] in Kikamba (a Bantu language spoken in Kenya) and English
- ▶ Occurrence of [k] and [g] are unpredictable in English
- ▶ Occurrence of [k] and [g] are predictable in Kikamba: [g] can only come immediately after [ŋ]
  - katala 'to count'
  - [okatala] 'if you count'
  - [ŋgatala] 'if I count'
  - [k] and [g] are variants (allophones) of the same sound (phoneme)

# Allophones and Phonemes

(1) top stop little kitten hunter

It is likely that you transcribed all of these words with a [t], like the following:

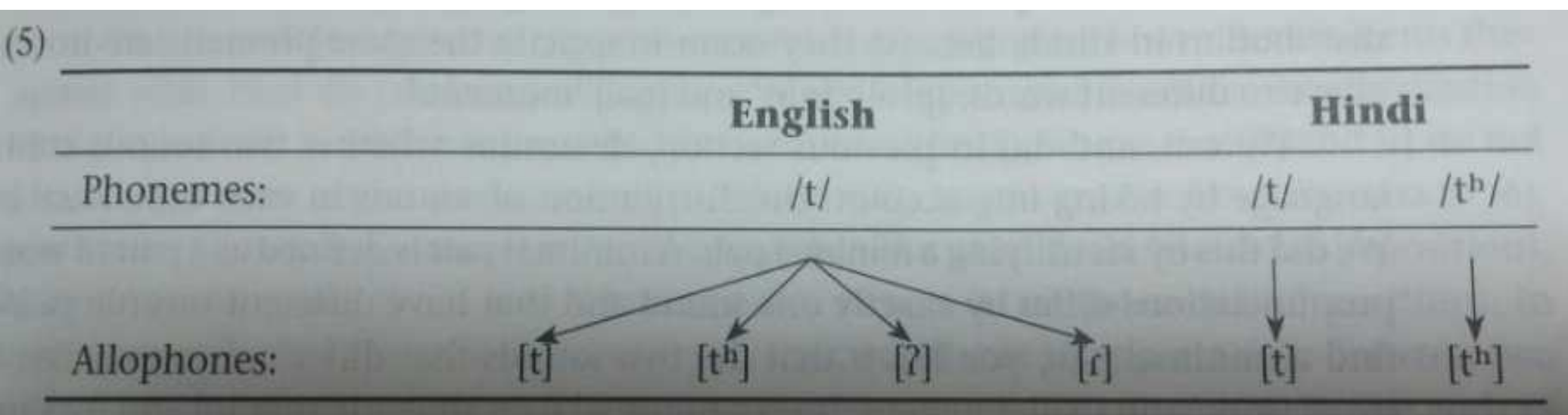
(2) [tap] [stap] [lit] [kitn] [hʌntɪ]

(3) [tʰap] [stap] [lɪɾ] [kʰɪʔn] [hʌnɾ]

(4)

Hindi	Gloss
[pʰəl]	'fruit'
[pəl]	'moment'
[bəl]	'strength'

- Contrastive: [p] and [p<sup>h</sup>] in Hindi  
[p] and [p<sup>h</sup>] do not belong to the same class → two phonemes
- Noncontrastive: [p] and [p<sup>h</sup>] in English e.g. [mæp] [mæp<sup>h</sup>]  
[p] and [p<sup>h</sup>] belong to the same class → two allophones of a phoneme



- Phonemes are abstract psychological concepts
- Allophones are physical, concrete
- a slip of the tongue shows the psychological reality of phonemes
  - rain check → chain reck, \*train shek



# The Distribution of Speech Sounds

- contrastive distribution; minimal pair → change the meaning of the word
- complementary distribution

## (6) Korean [l] versus [ɾ] alternations

Citation Form	Nominative Case	Gloss
[pul]	[puri]	'fire'
[mal]	[mari]	'language, speech'
[tal]	[tari]	'moon'
[k <sup>h</sup> al]	[k <sup>h</sup> ari]	'knife'
[pal]	[pari]	'foot'
[sal]	[sari]	'flesh'

(7)	<i>spat</i>	[spæt]	<i>pat</i>	[p <sup>h</sup> æt]
	<i>spool</i>	[spul]	<i>pool</i>	[p <sup>h</sup> ul]
	<i>speak</i>	[spik]	<i>peek</i>	[p <sup>h</sup> ik]

(8)

	<b>Contrastive</b>	<b>Allophonic</b>
<i>Relation to phonemes</i>	Allophones of separate phonemes	Allophones of the same phoneme
<i>Predictability of distribution</i>	Unpredictably distributed	Predictably distributed
<i>How you can tell</i>	Contrastive distribution; minimal pairs	Complementary distribution

# Free Variation

## ➤ Overlapping distribution

(9) *leap* [lip]  
*soap* [soup]  
*troop* [trup]  
*happy* [hæpi]

*leap* [lipʰ]  
*soap* [soupʰ]  
*troop* [trupʰ]  
 — \*[hæpʰi]

(10)

	<b>Contrastive</b>	<b>Allophonic</b>	<b>Free Variation</b>
<i>Relation to phonemes</i>	Allophones of separate phonemes	Allophones of the same phoneme	Allophones of the same phoneme
<i>Predictability of distribution</i>	Unpredictable	Predictable	Unpredictable
<i>How you can tell</i>	Contrastive distribution; minimal pairs	Complementary distribution	Overlapping distribution with no difference in meaning

# Phonological Rules

- ▶ Phonological rules: mapping between phonemic and phonetic elements

(1) Phonemic form

↓↓

rules

↓↓

Phonetic form

- ▶ Flapping

(2)	seat	[sit]	seated	[siɪd]
	loot	[lut]	looted	[luɪd]

## ► Conditioning Environment

(3) /t/ is pronounced as [r] after a stressed vowel and before an unstressed vowel  
[t] everywhere else

(4) X	→	Y	/	C	_____	D
/t/	→	[r]	/	stressed vowel	_____	unstressed vowel
/t/	→	[t]	/	everywhere else		

(5) phonemic form:	/sit/	/sit + ɪd /	/lut/	/lut + ɪd /
apply rule	_____	sɪɪd	_____	luɪd
phonetic form	[sɪt]	[sɪɪd]	[lut]	[luɪd]

# Natural Classes

- ▶ Natural class: a group of sounds in a language that share one or more articulatory or auditory property, to the exclusion of all other sounds in that language.
- ▶ Natural classes can be used to describe both the sounds affected by a rule and the environment where a rule applies.

(6) seed[sid]    seeded[siriɪd]

(7) /t, d/ → [r] / stressed vowel \_\_\_\_ unstressed vowel

(8) /t/    voiceless alveolar (oral) stop

      /d/    voiced alveolar (oral) stop

(9) /t, d/    alveolar (oral) stop

- Sibilants: fricatives, affricates
- Labials: bilabial, labiodental
- Obstruents: stops, fricative, affricates
- Sonorants: nasals, liquids, glides, vowels
- Labial obstruent, Labial sonorant consonant, Labial consonant

# Types of Phonological Rules

## ► Assimilation

(10) Nasal Place Assimilation (English): An alveolar nasal assimilates to the place of articulation of a following consonant.

- un-: unbelievable, unstable, unclear
- Palatalization: a consonant becomes like a neighboring palatal.
  - Did you?
  - 굳이, 시계

(13) Vowel Harmony (Finnish): A back vowel becomes front when preceded by a front vowel in the same word.

- [talo] 'house' → [talossa] 'in the house'
- [metsæ] 'forest' → [metsæssa] 'in the forest'
- 빨갳다/빨갳다, 보아요/주어요



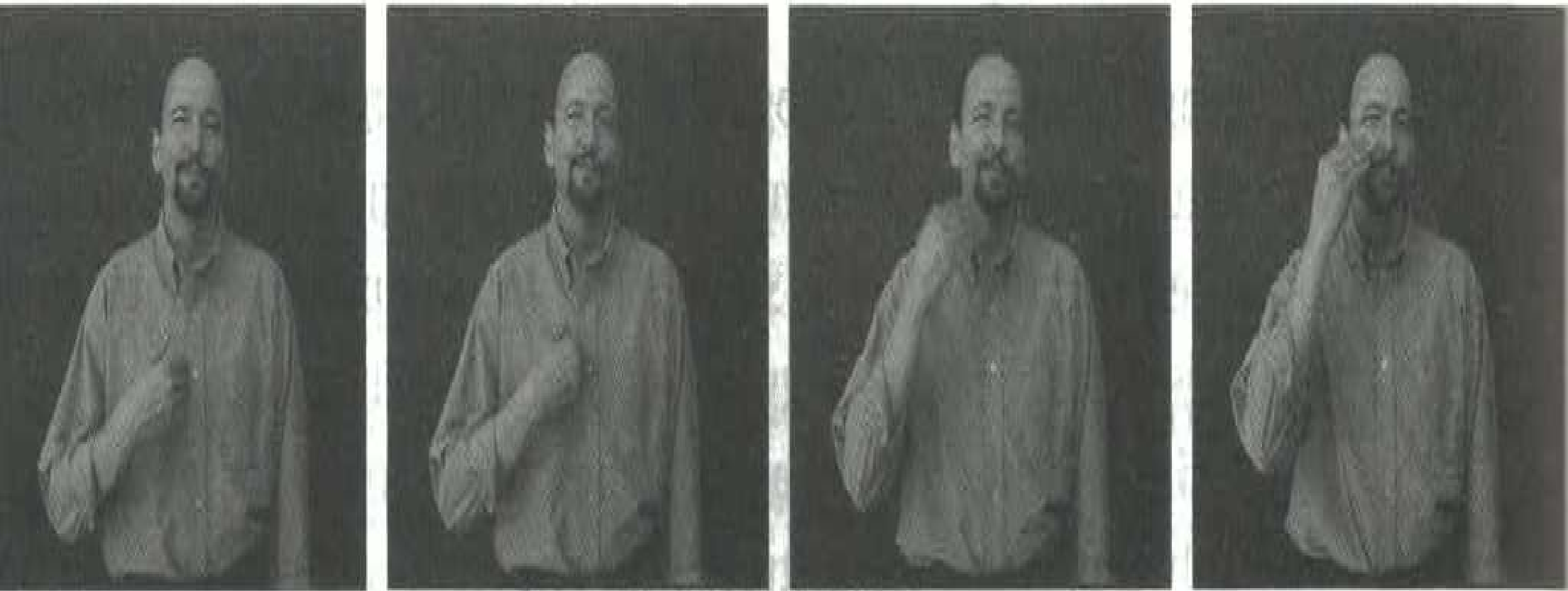
(11) The unassimilated sign for ME in ASL

(12) a. The phrase 'I am named...' in ASL, formed from the lexical items ME NAME



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b. The sentence 'I know' in ASL, formed from the lexical items ME KNOW



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## ► Dissimilation

(14) Manner dissimilation (Greek): A stop becomes a fricative when followed by another stop.

- /epta/ 'seven' [efta], /ktizma/ 'building' [xtizma]

## ► Insertion

(15) Voiceless stop insertion (English): Between a nasal consonant and a voiceless fricative, a voiceless stop with the same place of articulation as the nasal is inserted.

- dance [dænts], strength [strenkθ], hamster [hæmpstr.]

## ► Deletion

(16) /h/-Deletion (English): /h/ may be deleted in unstressed syllables.

- He handed her his hat. [r. iz]
- 좋아요

## ► Metathesis

(17) CV metathesis (Leti): When three consecutive consonants occur, the first consonant trades places with the preceding vowel.

- /danat + kviali/ 'millipede' → [dantakviali], /ukar + ppalu/ 'index finger' → [ukrappalu]

## ► Strengthening

(18) Aspiration (English): Voiceless stops become aspirated when they occur at the beginning of a stressed syllable.

- pat [p<sup>h</sup>æt], top [t<sup>h</sup>ap]

## ► Weakening

(19) Flapping (English): An alveolar (oral) stop is realized as [r] when it occurs after a stressed vowel and before an unstressed vowel.

- letter, seated/seeded
- voicing

# Multiple Rule Application

## ► Plural nouns in English

- Add –s /z/
- cats, dogs, foxes

(20) Schwa insertion (English): Insert [ə] between two sibilants.

(21) Voicing assimilation (English): /-z/ takes on the voicing specification of the preceding sound.

## (22) Sample derivations of English plurals

## a. Schwa insertion ordered before voicing assimilation

<b>phonemic form:</b>	/kæt-z/	/dɒg-z/	/faks-z/	/bɪdʒ-z/
<b>schwa insertion:</b>	—	—	faksəz	bɪdʒəz
<b>voicing assimilation:</b>	kæts	—	—	—
<b>phonetic form:</b>	[kæts]	[dɒgz]	[faksəz]	[bɪdʒəz]

## b. Voicing assimilation ordered before schwa insertion

<b>phonemic form:</b>	/kæt-z/	/dɒg-z/	/faks-z/	/bɪdʒ-z/
<b>voicing assimilation:</b>	kæts	—	fakss	—
<b>schwa insertion:</b>	—	—	faksəs	bɪdʒəz
<b>phonetic form:</b>	[kæts]	[dɒgz]	*[faksəs]	[bɪdʒəz]

# Obligatory and Optional Rules

- ▶ Obligatory rules are often very subtle and difficult to notice, but they are an important part of a native accent: not applying the rule of vowel nasalization would make someone sound like a non-native speaker of English.
  - aspiration, vowel nasalization, vowel lengthening, and liquid and glide devoicing.
  - The existence of obligatory rules is what causes people to have foreign accents.
- ▶ Optional rules are responsible for variation in speech.
  - /h/-deletion
  - He handed her his hat.

# Implicational Laws

## Sound Inventories

(1)

Less common	More common
[ã]	[a]
[a̤]	[a]
[x]	[k] or [s]
[s]	[t]
[d]	[t]
[ð]	[d] or [z]
voiced stops	voiceless stops
fricatives in place X	stops in place X



# How to Solve Phonology Problems

## ► How to Do a Phonemic Analysis

(1)

'pray' [p<sup>h</sup>ɪeɪ]

'fresh' [fɪɛʃ]

'gray' [ɡɪeɪ]

'regain' [ɹɪɡeɪn]

'crab' [k<sup>h</sup>ɪæb]

'shriek' [ʃɪɪk]

'par' [p<sup>h</sup>ɑɪ]

'tar' [t<sup>h</sup>ɑɪ]

'broker' [bɹoukɪ]

(2)

[ɪ]

[ɪ̯]

[g\_eɪ]

[p<sup>h</sup>\_eɪ]

[a\_#]

[k<sup>h</sup>\_æ]

[b\_ou]

[f\_ɛ]

[#\_i]

[ʃ\_i]

(3) [ɪ] appears after voiceless consonants.

(4) [ɪ] appears following voiceless consonants;

[ɪ] appears following voiced consonants or vowels, or at the beginning or end of a word.

(5) [ɪ] appears following voiceless consonants;  
[ɪ] appears elsewhere.

(6) /ɪ/ → [ɪ̥] / after voiceless consonants;  
 /ɪ/ → [ɪ] / elsewhere.

(7) [g] appears in *gray* [gɹeɪ], *regain* [ɹɪgeɪn]

generalization: [g] appears between vowels or at the beginning of a word.

[ʃ] appears in *fresh* [frɛʃ], *shriek* [ʃɹɪk]

generalization: [ʃ] appears at the beginning or end of a word.

A  
chart  
ntifying  
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ounds

