24.901 Phonological vs. Phonetic Representations

1. reprise

- a speech sound is a particular combination of plus/minus choices for the distinctive features
- the features define natural classes for phonological rules and determine the grammatically controlled properties of the articulation and acoustics of the utterance
- most features are binary

2. languages make different choices among the distinctive features to encode their vocabularies

- voicing ([±voice] is not contrastive in Finnish but it is in English: (i.e. *sue* vs. *zoo*; *Lacey* vs. *lazy*; *face* vs. *phase*; no such pairs in Finnish; vowel length is contrastive in Japanese (*e:* 'yes' vs. *e* 'picture') but not in Spanish
- one goal of the phonological analysis of a language is to determine which features are contrastive
- the sounds composed of contrastive features are called **phonemes**
- pairs of lexical items that differ by a single feature value are called **minimal pairs**
- they are good clues as to which features are contrastive in the language (but cf. *writer* vs. *rider* below)
- the contrastive (nonpredictable) feature values that distinguish one lexical item from another encode the lexicon
- predictable, redundant feature values are assigned by phonological rules when the lexical item is inserted into a sentence and enters the phonological component
- the phonetic representation thus has plus/minus specified for all relevant features, telling the vocal apparatus how to articulate the sound
- for most features there is an **unmarked** (default) value that represents the optimal state for that feature
- when there is no lexical contrast for a feature, the unmarked value normally appears phonetically (unless there is assimilation to a neighboring sound): Finnish stops are voiceless [-voice], Spanish vowels are [-long]; sonorant consonants are voiced; voiceless stops and short vowels are more optimal: they are found in most/all languages
- PGG Chapter 2 assumes that such noncontrastive features are [0F] in the lexicon and the unmarked value is assigned in the phonology by default rules
- Recent research challenges this assumption and would represent unmarked optimal value in the lexicon
- We will largely sidestep this question in this class
- Typologically some features are very common sites of contrast while others are less so or rare: all languages contrast [±high] in vowels and almost all [±back]; [±nasal] is common while [±retroflex] (cf. English *bird*) is rare; almost all languages have a dental stop and a nasal; most have an /s/; many contrast [±voice]; while clicks are rare

[3]. Even if a feature is not lexically contrastive in a language, phonological rules may introduce the marked value in particular contexts; sounds that bear the marked value are **allophones** (predictable variants) of the underlying phoneme

two examples from English

Example 1

- In French [± nasal] encodes lexical contrasts in vowels: *beau* [bo] vs. *bon* [bɔ̃]
- English lacks such minimal pairs but it does have nasal vowels before a nasal consonant: cf. *see* [i] vs. *seen* [ĩ]; *sew* [o] vs. *sewn* [õ]
- The French and English nasal vowels are phonetically comparable (identical) but have phonologically different status: nasality is assigned by rule in English but is contrastive in French

French		English		
/bo/	/bɔ̃/	/so/	/so-n/	Lexical ≈ Underlying Representation
			sõn	[+ syll] -> [+ nasal] / ___ [+ cons, + nasal]
[bo]	[bɔ̃]	[so]	[sõn]	Phonetic Representation

- The nasal vowel in English [sõn] is thus an allophone of the oral phoneme /o/ while in French the nasal vowel is phonemic
- Psycholinguistic experiments show this difference is real: hearing part of a nasal vowel, English subjects expect a following nasal consonant while French (Bengali) subjects do not
- In English the oral ([-nasal]) and nasal ([+ nasal]) vowels are in **complementary distribution**: nasal vowels occur before a nasal consonant and nowhere else while oral vowels appear everywhere except before nasal consonants

Example 2

- In Mandarin [± spread gl] encodes lexical contrasts: p^hà 'to fear' vs. pà 'father'
- In English voiceless aspirated and unaspirated stops are in complementary distribution; no such minimal pairs exist: [p^h]in vs. s[p]in; aspirated stops occur at beginning of the syllable while unaspirated stops appear elsewhere;

initial		medial		final	
[p^h]in	[b]in	ra[p]id	ra[b]id	la[p]	la[b]
[t^h]ot	[d]ot	a[t]om	a[d]am	ma[t]	ma[d]
[k^h]ap	[g]ap	jac[k]et	jag[g]ed	pic[k]	pi[g]

- [± voice] is contrastive in initial, medial, and final position as seen in the above minimal pairs
- text (and most literature) assumes that [–voice] is contrastive and aspiration is a redundant (enhancing) feature

[–contin, –voice] -> [+ spread gl] / . __ (C) [+ syll] (dot = syllable boundary)

"a voiceless stop becomes aspirated at the beginning of a syllable"

cf. [p^h]a'cific, [t^h]er'rific, [k^h]or'rupt

ra'[p^h]idity, a['t^h]omic, a'[k^h]oustic

- [–contin, –voice] -> [–spread gl] / 'V_V
- several rules of English phonology sensitive to intervocalic context V_1__V_2 where V_2 is unstressed: cf. *annual* [nj] but *annuity* [n]; ve[ ]icle but ve[h]icular
- sC clusters are site of no contrast in [voice] (and [spread gl]): s[p]in, s[t]em, s[k]in, *zbin, *bzin
- unmarked default values emerge: [–voice] [–spread gl]
- there is one qualification to the statement that no minimal pairs exist for aspiration; this is true at the level of the word; but at the level of the phrase one must know where the word-boundaries fall to assign aspiration: cf. *ice cream* [k^h] vs. *I scream* [k]
- the distribution of such features are plausibly parsing cues that allow the listener to locate word boundaries
- redundant features like aspiration and vowel nasality are commonly believed to enhance a phonemic contrast to aid in the recovery of the underlying form that allows the listener to enter the lexicon to interpret the sentence

5. vowel is lengthened before voiced consonant/ shortened before voiceless

lap vs. la:b		hit vs. hi:d		buck vs. bu:g		fuss vs. fu:zz	
[æ]	[æ:]	[ɪ]	[ɪ:]	[ʌ]	[ʌ:]	[ʌ]	[ʌ:]
rope vs. ro:be		heat vs. heed		hake vs. Hai:g		rice vs. rise	
[o]	[o:]	[i]	[i:]	[e]	[e:]	[aj]	[a:j]

6. the phoneme /t/ has a variety of realizations (allophones) in English;

[t]	plain	s**t**em
[t^h]	aspirated	**t**en
[ʈ]	retroflexed	**tr**ip
[ɾ]	flapped	a**t**om
[t^ʔ]	glottalized	hi**t**, a**t**las
[ʔ]	glottal stop	bo**tt**le
[ ]	zero	pan**t**s

[+coronal, –contin] -> [+apical, –anterior] / __ [r] /t/ -> [ʈ]

[+coronal, –contin] -> [+constricted gl] / in coda of syllable /t/ -> [t^ʔ]

[+coronal, –contin, +constricted gl] -> [–coronal] in casual speech [t^{ʔ}] -> [ʔ]

[+coronal, –contin] -> [+sonorant, +voice] / [+syllabic] __ [+syllabic] (flapping)
–stress

7. writer vs. rider and Canadian Raising (Joos 1942)

[ʌj]	type	tight	tyke	rice
[aj]	time	tide	tie	rise

[aj] -> [ʌj] / __ [–voice] ([+low] -> [–low] / _ [–syllabic] [–voice])
–cons

8.

write	[ɹʌjt]	ride	[ɹajd]
writer	[ɹʌjɾəɹ]	rider	[ɹajɾəɹ]

- if we define phonemes solely by minimal pairs then [aj] vs [ʌj] would be a phonemic contrast despite the predictable distribution of [ʌj]
- analysis follows straightforwardly from two ordered rules that are needed anyway

/ɹajt/	/ɹajt-əɹ/	/ɹajd/	/ɹajd-əɹ/	
ɹʌjt	ɹʌjtəɹ	------	--------	Canadian Raising
----	ɹʌjɾəɹ	-----	ɹajɾəɹ	flapping

- which features are contrastive can only be determined for the grammar as a whole
- **opacity**: the distribution of [aj] vs [ʌj] cannot be discerned from the surface phonetic representation: we must "undo" the flapping rule
- expected result if the phonetic representation is derived from the underlying phonological representation by locally determined rules that apply without regard to their long-range, downstream consequences
- implication: the underlying form can only be recovered by knowing the rules, raising nontrivial learnability problems

9. more opacity

ten	t[ɛ:n]	tent	t[ɛnt]	tend	t[ɛ:nd]
ten-s	t[ɛ:nz]	tent-s	t[ɛns]	tend-s	t[ɛ:nz]

vowel length and voicing of suffix depend on the /t/ vs. /d/ contrast in the cluster
but the stop is normally deleted medially in the cluster

/#tɛnt-z#/	/#tɛnd-z#/	
tɛnts	-------	suffix voicing assimilation
------	tɛːndz	vowel lengthening
tɛns	tɛːnz	cluster simplification

10. typology of complementary distribution
    - one sound in restricted context, other is elsewhere case: e.g. flap in Am English
    - more balanced distribution: vowel length and voicing of following consonant: lengthening or shortening?
    - accidental complementary distribution: In English [h] is restricted to beginning of word or stressed syllable while [ŋ] cannot begin a word or a stressed syllable
    - whether two sounds are analyzed as variants of the same underlying phoneme depends on the simplicity of the overall analysis and the plausibility and naturalness of the rules; since [h] and [ŋ] share no features in common it is implausible to derive them from the same underlying phoneme

More examples (from Odden 2006)

Kenyang (Cameroon). The velar stop [k] and the uvular [q] are in complementary distribution. What are the contexts where each occurs? Are there reasons for deriving one stop from the other?

enɔq	‘tree’	enoq	‘drum’
eket	‘house’	ntʃiku	‘I am buying’
nek	‘rope’	eywɑrek	‘sweet potato’
ŋgɑq	‘knife’	ekɑq	‘leg’
ayuk	name	ku	‘buy’
kebwep	‘stammering’	nkɔq	‘chicken’
ŋkɑp	‘money’	kɔ	‘walk’

Gen (Togo) The liquids [l] and [r] are in complementary distribution. Which occurs in in a more restrictive context?

aŋɔli	‘ghost’	agoŋglo	‘lizard’
alɔ	‘hand’	sra	‘strain’
avlɔ	‘bait’	edrɔ	‘dream’
exlɔ	‘friend’	hlɛ	‘read’
ŋlɔ	‘write’	ɲrã	‘be ugly’
klɔ	‘wash’	tre	‘glue’
mla	‘pound drum’	zro	‘fly’
lɔ	‘like’	d^{3}ro	‘hint’

Kikuyu infinitive prefix

ɣo-tɛŋɛra	‘to run’	ɣo-kuua	‘to carry’
ɣo-koora	‘to root out’	ko-ruya	‘to cook’
ko-oria	‘to ask’	ko-mɛɲa	‘to know’
ko-hɔta	‘to be able’	ko-ina	‘to dance’
ko-niina	‘to finish’	ɣo-kaya	‘to cut’
ɣo-tʃuuka	‘to slander’	ko-ɣaya	‘to divide’

Palauan Part of the analysis of any language is decomposing complex words into their constituent morphemes: in the simplest cases roots, suffixes, and prefixes. Examine the following paradigms to isolate the roots. What must the underlying lexical representation be?

present	future-1	future-2	
məˈdaŋəb	dəŋəˈball	dəˈŋobl	‘cover’
məˈteʔəb	təʔəˈball	təˈʔibl	‘pull out’
məˈŋetəm	ŋətəˈmall	ŋəˈtoml	‘lick’
məˈtabək	təbəˈkall	təˈbakl	‘patch’
məˈʔarəm	ʔərəˈmall	ʔəˈroml	‘taste’
məˈsesəb	səsəˈball	səˈsobl	‘burn’

Tibetan numerals. This is a more tricky case of the same morphological parsing problem. Look for recurring forms to isolate the morphemes composing these numbers. What is the phonological rule that derives the surface form?

dʒig	‘1’	dʒu	‘10’	dʒugdʒig	‘11’
ʃi	‘4’	dʒubʃi	‘14’	ʃibdʒu	‘40’
gu	‘9’	dʒurgu	‘19’	gubdʒu	‘90’
ŋa	‘5’	dʒuŋa	‘15’	ŋabdʒu	‘50’

Interacting rules in two Bantu languages

Lamba (Zambia) č = affricate [tʃ]

Base	Passive	Neuter	Applied	Reciprocal	
čita	čitwa	čitika	čitila	čitana	‘do’
tula	tulwa	tulika	tulila	tulana	‘dig’
četa	četwa	četeka	četela	četana	‘spy’

soŋka	soŋkwa	soŋkeka	soŋkela	soŋkana	‘pay tax’
pata	patwa	patika	patila	patana	‘scold’
fisa	fiswa	fiʃika	fiʃila	fisana	‘hide’
česa	česwa	čeʃika	čeʃila	česana	‘cut’
kosa	koswa	koseka	kosela	kosana	‘be strong’
lasa	laswa	laseka	lasela	lasana	‘wound’
ʃika	ʃikwa	ʃičika	ʃičila	ʃikana	‘bury’
seka	sekwa	sekeka	sekela	sekana	‘laught at’
poka	pokwa	pokeka	pokela	pokana	‘receive’
kaka	kakwa	kačika	kačila	kakana	‘tie’
fuka	fukwa	fučika	fučila	fukana	‘creep’

Lomongo (Congo)

Imper	1sg	2sg	3sg	1pl	2pl	3pl	
saŋga	nsaŋga	osaŋga	asaŋga	tosaŋga	losaŋga	basaŋga	‘say’
kamba	ŋkamba	okamba	akamba	tokamba	lokamba	bakamba	‘work’
ǰila	nǰila	oǰila	aǰila	toǰila	loǰila	baǰila	‘wait’
ɛna	nǰɛna	wɛna	ɛna	tˢwɛna	ǰwɛna	bɛna	‘see’
isa	nǰisa	wisa	isa	tˢwisa	ǰwisa	bisa	‘hide’
usa	nǰusa	wusa	usa	tˢwusa	ǰwusa	busa	‘throw’
ina	nǰina	wina	ina	tˢwina	ǰwina	bina	‘dance’

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