
Week 1 – Fundamental Concepts to Analyze Sound Patterns

September 9, 2008

- (1) To do phonological analysis we need to start with (at least) four basic questions:
 - a. **What are the basic sounds of a language?**
 - a. We want a list of the contrastive sounds (=phonemes) in the language.
 - b. We also want a list of their surface variants (=allophones), especially when predictable.
 - b. **What combinations of sounds are allowed (in what positions)?**
 - a. What other kinds of factors determine whether a word is well-formed (=phonotactically legal)?
 - c. **What are the suprasegmentals involved in a language?**
 - a. What is the stress pattern?
 - b. Are there tones? Allotones?
 - d. **What are the regular sound changes that occur when sounds are placed in different contexts?**
 - a. We want to know the alternations that take place, especially the ones that are predictable.
- (2) Note that questions 2 and 4 are not necessarily completely independent. In fact, there has been much tension regarding whether constraints on legal sound combinations should take priority over rules governing alternations.
 - a. This will be a theme throughout this course.

1 Phonemes

- (3) Phonemes are said to be the sounds which are **contrastive** in the language. Intuitively, words which differ only in contrastive sounds can have different meanings.

1.1 Minimal Pairs

- (4) One way to establish contrasts in a language is by finding **minimal pairs**—words with different meanings which sound minimally different.

★ Can you prove to me that /m/ and /n/ are contrastive in English?

★ Can you refine your answer for specific contexts?

- (5) What minimal pairs do you see in this data from Tagalog?

- | | | | |
|--------------|------------|--------------|------------|
| 1. [kahon] | ‘box’ | 2. [hariʔ] | ‘king’ |
| 3. [ʔumagos] | ‘to flow’ | 4. [ʔari] | ‘property’ |
| 5. [kaʔon] | ‘to fetch’ | 6. [humagos] | ‘to paint’ |

- (6) What minimal pairs do you see in this data from Inuktitut?

- | | | | |
|---------------|-------------------------|-------------|-----------------------|
| 1. [iglumut] | ‘to a house’ | 8. [pinna] | ‘that one up there’ |
| 2. [ukiaq] | ‘late fall’ | 9. [ani] | ‘female’s brother’ |
| 3. [aiviq] | ‘walrus’ | 10. [iglu] | ‘(snow) house’ |
| 4. [aniguvit] | ‘if you leave’ | 11. [panna] | ‘that place up there’ |
| 5. [aglu] | ‘seal’s breathing hole’ | 12. [aivuq] | ‘she goes home’ |
| 6. [iglumit] | ‘from a house’ | 13. [ini] | ‘place, spot’ |
| 7. [anigavit] | ‘because you leave’ | 14. [ukiuq] | ‘winter’ |

- (7) What minimal pairs do you see for nasals in this data from Venda?

- | | | | |
|---------------------------|-----------------|--------------------------|-------------|
| 1. [hann̩u] | ‘at your place’ | 7. [ene] | ‘he’ |
| 2. [lin̩no] | ‘tooth’ | 8. [hana] | ‘childhood’ |
| 3. [mun̩ne] | ‘master’ | 9. [k ^h ono] | ‘there’ |
| 4. [nn̩ari] | ‘buffalo’ | 10. [vatanu] | ‘five’ |
| 5. [p ^f en̩ne] | ‘baboon’ | 11. [vonani] | ‘see’ |
| 6. [vanna] | ‘four’ | 12. [z ^w ino] | ‘now’ |

★ Are there any pairs that show the nasals in the same immediate context?

- (8) Compare this with English. There is no difference between *new* and *n̩ew*. Nor can we find any minimal pairs for these sounds in English. So we have failed to find evidence that they contrast. But what does this really mean? (e.g. [ʃ] and [ʒ])

new tenth
 annoy month
 onion panther
 nun chrysanthemum

★ What is special about the context for the dental variant?

★ What is complementary distribution?

- (9) With the alveolar vs. dental nasals, their distribution is both predictable and complementary, which, along with their similarity, indicates they are different facets of the same sound.
- (10) We call the ‘basic’ variant of a sound a **phoneme** and say that each phoneme can have multiple **allophones**. What do you think of this distinction?

★ How can you explain this to your grandma?

★ When do you expect free variation and when do you expect find patterns?

1.2 Complementary Distribution

(11) What can you tell me about the distribution of sounds in Tagalog from this data?

- | | | | |
|-----------------|---------------|---------------|-----------------------|
| 1. [datɪŋ] | ‘to arrive’ | 6. [dararɪŋ] | ‘will complain’ |
| 2. [dami] | ‘amount’ | 7. [marumi] | ‘dirty’ |
| 3. [dumi] | ‘dirt’ | 8. [marami] | ‘many’ |
| 4. [daratɪŋ] | ‘will arrive’ | 9. [daʔɪŋ] | ‘to complain’ |
| 5. [mandurukot] | ‘pickpocket’ | 10. [andukot] | ‘to go pickpocketing’ |

★ Are [d] and [r] separate phonemes? – are there minimal pairs?

[d] is found _____

[r] is found _____

★ Which has the more general distribution?

★ Give me examples of allophones in English that are phones elsewhere. And the other way around ...

(12) Consider the data from Mixe.

- a. What are the morphemes for “your” and “my”?
- b. Are aspirated stops separate phonemes from the voiceless unaspirated stops and the voiced stops? To answer this question make three columns, one per stop category; list the environments of each.

- | | | | |
|-------------------------|-----------|--------------------------|---------------|
| 1. [wet ^h] | ‘clothes’ | 9. [nbop ^h] | ‘my aunt’ |
| 2. [tɛp ^h] | ‘cold’ | 10. [ndɛʃ] | ‘my dish’ |
| 3. [pɔːn] | ‘metate’ | 11. [nboːm] | ‘my perfume’ |
| 4. [tɔt ^h] | ‘buddy’ | 12. [ngɔʃ] | ‘my knee’ |
| 5. [nɔt ^h] | ‘deaf’ | 13. [mdek ^h] | ‘your lizard’ |
| 6. [kon] | ‘shirt’ | 14. [mdɔk ^h] | ‘your mother’ |
| 7. [koʃ] | ‘knee’ | 15. [mbɔk ^h] | ‘your gourd’ |
| 8. [poːp ^h] | ‘white’ | 16. [mgiːʃ] | ‘your girl’ |

(13) **The Phonemic Principle:**

In any given language, all utterances are composed of a limited number of basic sounds called phonemes. Phonemes are the sound that speakers use to represent the morphemes of their mental lexicons. When you hear a novel word in a language you know, you immediately recognize it as a sequence of basic sounds in that language. Intuitively, this ought to make morphemes and words easier to learn.

2 Fundamental Concepts of Phonological Rules

- (14) Example from Mbabaram¹. (Dixon 1991; language from Australia with one speaker left at the time of Dixon's research.)

pír	‘emu’		
aba	‘body’		
alba	‘camp’		
nap	‘who’		
palán	‘moon’		
púmba	‘ashes’		
ńíp	‘what’	ńíb-ug	‘for what reason’
mberp	‘wild dingo’	mberb-ul	‘wild dingo-erg.’
tulbu	‘matches’		
tum	‘hard’		
kúludún	‘dove’		
adil	‘ring-tail possum’		
arək	‘magpie’	arəg-uŋg ^ə	‘magpie-erg.’
kuŋgak	‘kookaburra’	kuŋgag-ul	‘kookaburra-erg.’
kaɾúk	‘bandicoot’	kaɾúg-uŋ	‘bandicoot’s’

- ★ Do you think [p] and [b] represent different phonemes or are allophones of the same phoneme in Mbabaram? If they're allophones of the same phoneme, in what contexts does each allophone appear?

- ★ How about [t] and [d]? [k] and [g]?

- ★ Do you think [p] and [b] represent different phonemes or are allophones of the same phoneme in Mbabaram? If they're allophones of the same phoneme, in what contexts does each allophone appear?

- ★ How about [t] and [d]? [k] and [g]?

¹The data are simplified! See the original for a fuller description of voicing

2.0.1 Making our observation explicit

(15) We can write rules to describe a phoneme turning into some allophone in some environment.

(16) To express $XAY \rightarrow XBY$, we extract the redundant X and Y and write

$$A \rightarrow B / X \text{ ____ } Y$$

(17) Write rules for what we observed in Mbabaram.

(18) The sequence XAY is called the **structural description** of the rule, and the change from A to B is the **structural change**. A is sometimes called the rule's **target**, and X____ Y is called A's **environment** or **context**.

(19) The rule is a **context-sensitive** rule because $A \rightarrow B$ in the context of X and Y.

(20) If the rule applies in all contexts, it is **context-free** and instead of writing

$$A \rightarrow B / \text{ ____ }$$

we just write

$$A \rightarrow B$$

(21) A change like [n^íp] to [n^íb] is called an **alternation**: the same morpheme is realized two different ways, depending on context. More specifically, it is an allophonic alternation (Can you think of an example of a non-allophonic alternation?)

2.0.2 Grouping sounds

(22) If you have studied phonetics, you may notice that [b], [d], and [g] have something in common that [p], [t], and [k] lack: vocal-fold vibration.

(23) This feature (trait) is usually called [voice]. [b,d,g] are said to be [+voice], and [p,t,k] are [-voice].

(24) We will discuss features in more detail next week. For, now it is enough to think of them as a articulatory or acoustic property that picks out a set of sounds—exactly those sounds that have that articulatory or acoustic property.

(25) We can rewrite our rules with the feature:

$$\left\{ \begin{array}{c} p \\ t \\ k \end{array} \right\} \rightarrow [+voice] / [+voice] \text{ ____ } [+voice]$$

(26) A set of sounds in some language that can be defined by the values of one or more features is called a **natural class**. In Mbabaram, [p,t,k] form a natural class (the [-voice] sounds), as do [b,d,g] (the [+voice, -sonorant] sounds—the feature [sonorant] distinguishes [b,d,g] from the language's other voiced sounds.²

²Actually, there are several other [-sonorant] sounds...

(27) So we can make our rule even more general:

$$[-voice] \longrightarrow [+voice] / [+voice] \text{ — } [+voice]$$

(28) The above is actually redundant (why?)—we could just say

$$X \longrightarrow [+voice] / [+voice] \text{ — } [+voice]$$

(29) ... or even (at least for the data we have)

$$X \longrightarrow [+voice] / X \text{ — } X$$

where X indicates any consonant or vowel.

- ★ Think of hypothetical Mbararam words that would be consistent with the above data, but would tell us that the rule in (28) is the right rule, not the one in (29)?

2.1 Common Rules

(30) Natural and or common rules and or processes:

- a. Assimilation - e.g. intervocalic voicing (cf. Mbararam)
- b. Dissimilation - e.g. manner dissimilation (for adjacent C's)
- c. Strengthening - e.g. aspiration in English
- d. Insertion - e.g. voiceless stop insertion in English *strength*
- e. Weakening - e.g. flapping in English
- f. Deletion - e.g. vowel deletion in word medial unstressed syllables (cf. Tonkawa) or consonant cluster simplification
- g. Metathesis - e.g. Kwara'ae: Citation form [ketalaku] but Discourse form [kɛatlaʊk].

2.2 Principles of Rule Making

(31) Given two rules that are descriptively adequate, how do we choose between them?

- a. Generally, less rules with fewer symbols are preferred ...
 - (i) These will often be the rules that make the strongest predictions (which is desirable)
 - (ii) This has been called the **evaluation metric** by ?. It relates to ideas on Minimal Description Length (MDL) in information theory.
- b. ... But not at the expense of accuracy!
 - (i) If there are forms in the language not predictable by your rule, that is a problem for your proposed rule. Perhaps they are just listed exceptions... but perhaps not.
 - (ii) Corpus-external evidence (loanwords, 'blick'/'wug' tests, brain-imaging?) are all other ways we may be able to find out what is the right generalization that the rule is aiming to represent.

3 Practice

(32) What is going on in Zoque?

Rule1:

1

2

(33) What is going on in Papago?

Papago has a 5 vowel system with three high and two non-high.

The dental stops [t] and [d] contrast with the palatal affricates č and ĵ in what way?

Rule 1:

What about the other way round?

(34) What is going on in Chatino?

Upper case letters indicate voiceless vowels. What is their distribution?

Should we make a rule?

If so what?

How about a stress rule?

(35) What principles govern the light and dark [l] in Georgian?

(36) What principles govern the distribution of aspiration in Sierra Popoluca? ([tʰ] is an alveolopalatal stop)

(37) What are the three underlying vowels of Greenlandic Eskimo?

(in the data [r] is a uvular trill)

(38) What's going on with the vowels in Mohawk?

Zoque: spoken in Mexico (Wonderly 1951)

<i>pata</i>	'mat'	<i>ɣɣunu</i>	'you fell'
<i>tatah</i>	'father'	<i>sis</i>	'meat'
<i>tʰʰy</i>	'little'	<i>šohšahu</i>	'they cooked it'
<i>cima</i>	'calabash'	<i>kama</i>	'cornfield'
<i>cehcu</i>	'he cut it'	<i>nas</i>	'earth'
<i>kamu</i>	'he fell'	<i>nanah</i>	'his mother'
<i>kenba</i>	'he sees'	<i>kay</i>	'jaguar'
<i>myagdamu</i>	'you came'	<i>lybba</i>	'he slashes'
<i>ʔɣdʰoʔpya</i>	'he is sleepy'	<i>wɪn</i>	'face'
<i>njehcu</i>	'you cut brush'		

Voiceless plosives	p	t, c	tʰ, ʈ	k
Voiced plosives	b	d, dz	dʰ, ɟ	g
Fricatives		s	ʃ	
Nasals	m	n	ɳ	ŋ
Liquids		l, r		
Glides	w	y		ʔ, h

Papago (Tohono O'odham): spoken in Arizona (Saxton & Saxton 1969)

<i>tatai</i>	'tendon'	<i>činig</i>	'to move the lips'
<i>tatal</i>	'mother's younger brother'	<i>čikpan</i>	'work'
<i>tamš</i>	'gums'	<i>daswua</i>	'to pile'
<i>tohnto</i>	'degenerate'	<i>doqjida</i>	'healing'
<i>tokih</i>	'cotton'	<i>ḡgos</i>	'storm'
<i>todsid</i>	'to frighten'	<i>ḡwikon</i>	'to scrape'
<i>čuaɣia</i>	'net bag'	<i>juɳi</i>	'dried cactus fruit'
<i>čučul</i>	'chicken'	<i>dakpon</i>	'to slip'
<i>čukna</i>	'dark'	<i>doʔag</i>	'mountain'
<i>čiposid</i>	'to brand'	<i>juɳikal</i>	'lizard sp.'
<i>čilwin</i>	'to rub'	<i>juhki</i>	'rain'
<i>čigitog</i>	'to think'	<i>ḡwhiadag</i>	'arrival'

Chatino: another language of Mexico (Gleason 1955)

<i>kata</i>	'you will bathe'	<i>stiyú</i>	'juice'
<i>kisú</i>	'avocado'	<i>sulá</i>	'open!'
<i>kusuʔwá</i>	'you will send'	<i>tiyé</i>	'stomach'
<i>seʔé</i>	'place'	<i>laʔá</i>	'side'
<i>šɪʔi</i>	'sad'	<i>loʔó</i>	'where'
<i>taʔá</i>	'festa'	<i>ndiki</i>	'you are burning'
<i>tihí</i>	'water'	<i>nguší</i>	'tomato'
<i>tuʔwá</i>	'mouth'	<i>kiʔ</i>	'fire'
<i>kinó</i>	'sandal'	<i>háʔ</i>	'grass mat'

Georgian (Robins and Waterson 1952)

<i>tamazad</i>	'pretily'	<i>zarrali</i>	'loss'	<i>xeli</i>	'hand'
<i>letó</i>	'goal'	<i>kata</i>	'tin'	<i>xoto</i>	'however'
<i>saxtši</i>	'at home'	<i>pepeta</i>	'butterfly'	<i>čʰecʰyli</i>	'fire'
<i>txena</i>	'joy'	<i>kleba</i>	'reduce'	<i>vxlɛčʰ</i>	'I split'
<i>kbits</i>	'tooth'	<i>ertʰɛt</i>	'once'	<i>čʰoli</i>	'wife'

Sierra Popoluca (Elson 1947)

<i>petʰkuy</i>	'broom'	<i>hu : tʰh</i>	'where'
<i>petta : pʰ</i>	'it is being swept'	<i>ikapun</i>	'his barrow'
<i>kekʰpaʔ</i>	'it flies'	<i>ti : tiitʰ</i>	'mestizo'
<i>kekgakʰpaʔ</i>	'it flies again'	<i>nipʰ</i>	'mouth'
<i>nikʰpaʔ</i>	'he goes'	<i>ikkaʔ</i>	'he killed it'
<i>tʰu : kiʔ</i>	'turtle'	<i>makʰtiʔ</i>	'ghost'
<i>šiš</i>	'cow'	<i>ho : ppaʔ</i>	'it rolls'
<i>hos</i>	'hole'	<i>petʰpaʔ</i>	'he sweeps'
<i>ca : m</i>	'very'	<i>witʰʰpaʔ</i>	'he walks'
<i>kuy</i>	'wood'	<i>ičič</i>	'he jerked it'
<i>toc</i>	'tongue'	<i>mičpaʔ</i>	'he is playing'
<i>mokʰ</i>	'corn'	<i>pikʰʂiʔ</i>	'bow'

Greenlandic Eskimo (Schultz-Lorentzen 1945)

<i>ivnaq</i>	'bluff'	<i>gasalooq</i>	'bark'
<i>iperaq</i>	'harpoon strap'	<i>ikusik</i>	'elbow'
<i>imaq</i>	'sea'	<i>qilaluvaq</i>	'white whale'
<i>tuluvaq</i>	'raven'	<i>qatigak</i>	'back'
<i>itumaq</i>	'palm of hand'	<i>sakiak</i>	'rib'
<i>sava</i>	'sheep'	<i>ugsik</i>	'cow'
<i>nuna</i>	'land'	<i>orpik</i>	'tree'
<i>ine</i>	'room'	<i>nerdloq</i>	'goose'
<i>nanooq</i>	'bear'	<i>marrag</i>	'clay'
<i>iseraq</i>	'ankle'	<i>iga</i>	'pot'
<i>isse</i>	'eye'	<i>igallo</i>	'house'
<i>sermeq</i>	'glacier'	<i>sako</i>	'tool'

Mohawk (Postal 1968)

<i>wísk</i>	'five'	<i>ké : saks</i>	'I look for it'
<i>rayáthos</i>	'the plants'	<i>royóʔreʔ</i>	'he works'
<i>yékrɛks</i>	'I push it'	<i>i : raks</i>	'he eats it'
<i>raké : tas</i>	'he scrapes'	<i>nikanúhzakɛh</i>	'houses'
<i>rehyá : raʔa</i>	'he remembers'	<i>wahoyóʔdaʔ</i>	'he worked'
<i>rá : kas</i>	'he sees her'	<i>ranú : weʔs</i>	'he likes it'