

Week 0 – What is Phonology?

August 28, 2012

1 Goals of cognitive science

1. Characterize the knowledge that humans possess in various cognitive domains (perception, categorization, language, reasoning, ...). **[competence theory]**

... by a generative grammar I mean simply a system of rules that in some explicit and well-defined way assigns structural descriptions to sentences. Obviously, every speaker of language has mastered and internalized a generative grammar that expresses his knowledge of his language. This is not to say that he is aware of the rules of the grammar or even that he can become aware of them, or that his statements about his intuitive knowledge of the language are necessarily accurate ... Similarly, a theory of visual perception would attempt to account for what a person actually sees and the mechanisms that determine this rather than his statements about what he sees and why, though these statements may provide useful, in fact, compelling evidence for such a theory. (Chomsky 1965:8-9, Aspects)

2. Discover the methods by which knowledge is acquired, including a characterization of innate restrictions on the form and acquisition of knowledge. **[learning theory]**

A theory of linguistic structure that aims for explanatory adequacy incorporates an account of linguistic universals, ... The important question is: What are the initial assumptions concerning the nature of language that the child brings to language learning, and how detailed and specific is the innate schema (the general definition of “grammar”) that gradually becomes more explicit and differentiated as the child learns the language? ... Consequently, the main task of linguistic theory must be to develop an account of linguistic universals that, on the one hand, will not be falsified by the actual diversity of languages and, on the other, will be sufficiently rich and explicit to account for the rapidity and uniformity of language learning, and the remarkable complexity and range of the generative grammars that are the product of language learning. (Chomsky 1965, Aspects, 27; on explanatory adequacy see Chomsky 1965: 30-32, 34-37, ch 1, etc.)

3. Understand how knowledge is applied in particular behaviors, and what limitations prevent performance from being coextensive with competence. [**performance theory**]

There seems to be little reason to question the traditional view that investigation of performance will proceed only so far as understanding of underlying competence permits. . . . To my knowledge, the only concrete results that have been achieved and the only clear suggestions that have been put forth concerning the theory of performance, outside of phonetics, have come from studies of performance models that incorporate generative grammars of specific kinds (Chomsky 1965, Aspects, 10, in ch 1.2: Toward A Theory of Performance)

2 What is Phonology?

The study of phonology tries to answer the following questions:

- What are the sound patterns of the world's languages?
- What are the principles underlying these patterns?
- What are possible sound patterns?
- How can we characterize the knowledge speakers have about the sound patterns of their language?
- How do children learn the sound patterns of their language?
- How do language phonologies change over time?

It is a striking fact that natural languages have sound patterns. Why should this be so?

2.1 Phonological Patterns

There are three kinds of phonological patterns: phonotactics, processes, and contrasts.

2.1.1 Phonotactics

Phonotactic patterns refer to the possible words in a language. See Chomsky and Halle (1965); Halle (1978).

English speakers can coin new words. However, they could only do so with words on the left, and not with the words on the right.

- ★ If you are a native English speaker, do you agree with the statement in (0)?

flump	flunp
blick	bnick
bist	bizt
slem	srem

Table 1: Possible and impossible English words.

It is striking that many English native speakers agree with the statement in 1 even though they have zero experience with *all* of those words.

- ★ Can you think of some more possible words of English and some more impossible words of English?

Assuming agreement among the native English speakers, how did they learn to discriminate words they never heard before in the same way?

Consider the actual and hypothetical words below from Navajo (Sapir and Hojier, 1967).

Possible Navajo Words		Impossible Navajo Words
ʃi:te:ɜ	‘we (dual) are lying’	ʃi:te:z
dasdo:lɪs	‘he (4th) has his foot raised’	dasdo:lɪʃ
sokos	(hypothetical)	sokof
ʃokof	(hypothetical)	ʃokos
ki:te:p	(hypothetical)	
pi:te:k	(hypothetical)	

Note [ʃ] is like *sh* in *shoe* and [ɜ] is like *ge* in *beige*.

- ★ Why do you think the words in the right column are not possible words in Navajo?

Note the binary distinction between “possible” and “impossible” word is a convenient abstraction. (Albright and Hayes, 2003).

kɪp > θwɪ:k s > bɜ:ɹɪʃk

2.1.2 Processes

Evidence for phonological processes comes from *morphological alternations* which occur when the same morpheme (=smallest sequence of sounds with a particular meaning) appears different in different contexts.

The English plural provides a familiar example.

	singular	plural
cat	k ^h æt	k ^h æts
sack	sæk	sæks
dog	dæg	dægz
grub	gɹʌb	gɹʌbz
dish	dɪʃ	dɪʃəz
fudge	fʌdʒ	fʌdʒəz
pea	p ^h i	p ^h iz
cow	k ^h aʊ	k ^h aʊz
man	mæn	mɛn
foot	fʊt	fɪt
wife	wʌɪf	wʌɪvz
whiff	wɪf	wɪfs
...		

★ Ignoring irregular forms like *men* and *feet*, can you predict which form of the regular suffix *-s*, *-z*, *-əz* goes on the following made-up words:

1. lɛp
2. rɑg
3. nɪz

There is a debate whether these forms are determined by analogy to existing forms or by rule (See Albright and Hayes (2003) for details).

Consider the form of the adjectival suffix below from Georgian (Aronson, 1982):

phizik-uri	‘physical’
kimi-uri	‘chemical’
akti-uri	‘active’
phrang-uli	‘French’
german-uli	‘German’
reakti-uli	‘reactive’
real-uri	‘real’
terminal-uri	‘terminal’

★ What form of the suffix do you think would go on to a hypothetical words like

1. misato
2. pita

3. badurpi
4. ramuto
5. ralako

1. How did English and Georgian speakers learn these patterns?
2. What possible purpose could such patterns serve?

2.1.3 Contrasts

Languages differ in what makes up their underlying inventory of sounds (the **phonemes**).

- Handwriting is a useful metaphor
- “A” and “B” represent distinct categories
- Each letter has a set of major variants: uppercase/lowercase printed/cursive
- Which major variant is used depends on linguistic context (e.g., beginning of sentence, beginning of proper name are uppercase) and social context (filling out a government form with printed letters vs. writing a personal letter in cursive)
- Each major variant has infinitely many minor variants, conditioned by surrounding letters, speed/carefulness of writing, individual handwriting habits, health/mood of the writer, and random fluctuations.
- The difference between “major” and “minor” is not sharp.
- The “same” letter may tend to have different realizations in different countries/regions

Speech sounds have similar properties! /p/ and /b/ represent distinct categories—called phonemes—in many languages, including English

- Each phoneme has some major variants, called **allophones**
- English: /p/ → [p], [p^h]
- Which allophone to use can depend on linguistic context
- English: /p/ → [p^h] at the beginning of a word or beginning of a stressed syllable ([ph]otáto, a[p^h]ártment), and otherwise [p] (s[p]útter, ú[p]er)¹ (Acute accent [´] indicates main stress)

¹There are some complications we are ignoring.

- Which allophone to use can also depend on extralinguistic context.
- London English: /t/ → [t] or [ʔ] at the beginning of an unstressed, non-word-initial syllable: bu[t]er or bu[ʔ]er. The choice can depend on social context.

Each major allophone also has infinitely many minor variants that are...

- conditioned by surrounding sounds: English [p] (and [p^h]) can be realized with the lower lip touching the upper teeth instead of the upper lip if followed by an [f], as in Zipfian.
- conditioned by speech rate/carefulness: In rapid speech, English [p] (and [p^h]) may have lips closed for less time or not at all.
- conditioned by individual speech habits: Some people are more likely than others to close their lips all the way for [p]
- due to health/mood of the speaker: “scratchy” voice from inflamed larynx, loudness affected by mood...
- due to random fluctuations: how long lips are closed, how long and loud the puff of air (h) is in [p^h]

The difference between major and minor variants is not sharp: should the “labiodental” /p/ that can occur in [Zipfian] be considered a major allophone of /p/? The “same” phoneme can have different typical realizations in different languages and dialects. For example, word-initially, French /b/ has more vocal-fold vibration than English /b/.

Here is an example from Mbabaram². (Dixon 1991; language from Australia with one speaker left at the time of Dixon’s research.)

pir	‘emu’		
aba	‘body’		
alba	‘camp’		
nap	‘who’		
palán	‘moon’		
púmba	‘ashes’		
ɲíp	‘what’	ɲíb-ug	‘for what reason’
mɛɾp	‘wild dingo’	mɛɾb-ul	‘wild dingo-erg.’
tulbu	‘matches’		
tum	‘hard’		
kúludún	‘dove’		
adil	‘ring-tail possum’		
arək	‘magpie’	arəg-uŋg ^o	‘magpie-erg.’
kuŋgak	‘kookaburra’	kuŋgag-ul	‘kookaburra-erg.’
kaɾúk	‘bandicoot’	kaɾúg-uŋ	‘bandicoot’s’

²The data are simplified! See the original for a fuller description of voicing

- ★ 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]?

2.1.4 Cross-linguistic patterns

There are interesting patterns cross-linguistically as well. Most of these are tendencies.

- If a language has phonemes {b,d,g}, it tends to have {p,t,k}.
- The word-initial triple consonant clusters a language allows is a subset of the double consonant clusters it allows (Greenberg, 1978).
- Example: In English, every initial triple consonant cluster (like *str*) is decomposable into clusters of length two; in this case, *st* and *tr*. Note not all initial clusters of length two which are combinable form legal initial triple clusters. I.e. **stwek*, though *st* and *tw* are OK.
- If a language palatalizes consonants before [e], they also do before [i] but not vice versa (and people generalize this way in experimental conditions) (Wilson, 2006).

3 Course Methodology

3.1 Dealing with theories

1. Theories are *composite* entities.
 - Every serious theory of phonology has many, many components.
 - SPE: rule notation, rule application, ordering, morpheme structure rules, ...
 - OT: richness of the base, universal constraints, factorial typology; ...
2. Therefore, the goal of theory evaluation is therefore very rarely wholesale endorsement or rejection.
 - Instead we focus on identifying the components that lead to specific incorrect predictions, and on replacing them with better alternatives. This is impossible without first understanding the individual components and their interactions.

3. It is very useful to suspend commitment and disbelief.
 - Do not commit fully to any particular theory, nor reject theories on general grounds.
 - Focus instead on working out the specific predictions of any given theory, looking for new connections among facts as well as internal contradictions and falsifications.

3.2 Course goals

1. Develop an awareness and knowledge of the empirical phenomena.
2. Develop simple methods of analysis.
3. Understand the analytical techniques and their failings.

We will focus first on basic cases, then on more difficult problems with the aim of approximating the important qualitative aspects of a phenomenon.

4 Summary

1. Phonological patterns are **sound patterns**. We will focus mainly on phonological processes, phonotactics, and contrast.
2. In addition to developing an awareness of empirical facts, We will evaluate concentrate on evaluating theories and developing principles for phonological analysis.

References

- Albright, Adam, and Bruce Hayes. 2003. Rules vs. analogy in English past tenses: A computational/experimental study. *Cognition* 90:119–161.
- Aronson, Howard. 1982. *Georgian, A Reading Grammar*. Slavica Publishers, Inc.
- Chomsky, Noam. 1965. *Aspects*. Cambridge, MA: MIT Press.
- Chomsky, Noam, and Morris Halle. 1965. Some controversial questions in phonological theory. *Journal of Linguistics* 1:97–138.
- Greenberg, Joseph. 1978. Initial and final consonant sequences. In *Universals of Human Language: Volume 2, Phonology*, edited by Joseph Greenberg, 243–279. Stanford University Press.
- Halle, Morris. 1978. Knowledge unlearned and untaught: What speakers know about the sounds of their language. In *Linguistic Theory and Psychological Reality*. The MIT Press.
- Sapir, Edward, and Harry Hojier. 1967. The phonology and morphology of the Navaho language. *University of California Publications* 50.
- Wilson, Colin. 2006. Learning phonology with substantive bias: An experimental and computational study of velar palatalization. *Cognitive Science* 30:945–982.