

Handout 3:

Phonology

Sep 13–22, 2015

Phonology is the study of the way speech sounds pattern in a language, e.g., how speech sounds are combined and how speech sounds vary systematically depending on the linguistic context.

The goal for this portion of the course is for you to be able to look at natural data in a language and figure out a piece of that language’s phonological system.

- Syllable structure: how syllables are formed
- Phonotactics: the constraints on sound combinations
- Phonemes: the meaningful/contrastive speech sounds in a language
- Allophones: the surface/pronounced variants of phonemes
- Phonological rules: generalizing/predicting allophones

1 Syllables

The nature of speech sounds plays a huge role in how we put sounds together. Take, for example, the syllable.

- A **syllable** is a phonological unit comprised of one or more speech sounds.
- Every syllable has a center, the **nucleus**, which is the loudest part of the syllable.
- Leading into the nucleus (the **onset** of the syllable), prominence/loudness increases.
- Leading out of the nucleus (the **coda** of the syllable), prominence/loudness decreases.

How many syllables are there in “dripped”, “made”, “apple”, “destabilization”?

1.1 Sonority

Consonants and vowels sit on a spectrum from non-sonorant (quiet, non-prominent) to sonorant (loud, prominent):

(1) **Sonority scale**

stops/plosives < affricates < fricatives < nasals < approximants < vowels

- If syllable nuclei like to be very loud, what do you think makes the best nucleus?
- If what leads up to the nucleus (the onset) likes to increase in prominence, which sequence is better, fricative-approximant or approximant-fricative?
- If what leads away from the nucleus (the coda) likes to decrease in prominence, which sequence is better, fricative-approximant or approximant-fricative?
- The (largely) arbitrary restrictions that languages put on onsets, codas, and nuclei are called the **phonotactics** of a language.

What about these words?

- [lɛp]
- [lɛztʃ]
- [lɛfz]
- [lɛlt]
- [lɛ.ɪts]
- [lɛŋ]
- [lɛdɪ]

→ As a native speaker of a language, you know which sequences of consonants can (and can't) end a word in your native language, i.e., be a coda.

Syllable structure crosslinguistically

- No language allows only syllables of the form V
- Many languages allow only syllables of the form V or CV = (C)V
- Many languages allow only syllables of the form V, CV, VC, or CVC = (C)V(C)
- Onsets can be up to 6 consonants long (Georgian, Armenian)
- Codas can be up to 4 consonants long (Russian, Slovak)
- All languages allow vowels to be nuclei, but some languages allow consonants too (Berber, Oowekyala)

Here's a representative sampling of monosyllabic English words.

- | | | |
|----------|-----------|------------|
| • [ðe] | • [splɛj] | • [spɑːj] |
| • [ɪm] | • [tɹɛj] | • [lɔːrn] |
| • [ə] | • [stɹɛj] | • [lɑːmɪd] |
| • [frɛj] | • [smæk] | • [θəɪst] |
| • [θɪi] | • [snæk] | • [θəɪsts] |
| • [twɪn] | • [slæk] | • [lɛŋkθ] |
| • [plɛj] | • [ski] | • [lɛŋkθs] |

English phonotactic constraints:

- How small can onsets be? How big can onsets be?
- How small can codas be? How big can codas be?
- What is the basic syllable template for English?
- What sorts of sequences make good onsets in English?
- Exceptions?

The phonotactics of your own language influence how you perceive words in other languages.

- Japanese [bisuketto]
- Hawaiian [melekalikimaka]

Cool website mapping the phonotactics of the world's languages: phonotactics.anu.edu.au

3 Phonemes and allophones

3.1 Phonemes

One of the primary goals of phonology is to identify the phonemes of a language, i.e., the phonemic inventory of the language.

- Phoneme = a meaningful (“contrastive”) unit of sound in a language
- The phoneme is a speech sound as it is represented in your brain
- Phonemes are written between slashes, e.g., /x/

How to figure out whether a sound is phonemic/contrastive/meaningful in a language:

1) Minimal pairs (word-level)

- = A pair of words that differ in EXACTLY ONE sound and differ in meaning.
 - ◊ Consonant minimal pairs: “gaze” and “phase”, “pitch” and “pill”
 - ◊ Vowel minimal pairs: “meet” and “mate”, “pit” and “pat”, “boot” and “butt”
- This is the easiest way to find out whether a sound is phonemic.

2) Minimal pairs (context-level)

- If there are no word-level minimal pairs for two sounds, you can figure out whether they are contrastive by seeing if they appear in the same linguistic context, i.e., adjacent to the same sounds.
 - ◊ “hello” and “met” (for [h,m]), “pray” and “placate” (for [ɹ,l]), “fizz” and “bliss” (for [z,s]), “fleece” and “list” (for [i, ɪ])...
- You will usually have to resort to this strategy.
- Why do these work? **Complementary distribution** (Superman and Clark Kent)
 - X and Y are in complementary distribution if and only if they never appear in the same environment.

Not all sounds that are phonetically distinct are contrastive, which brings us to...

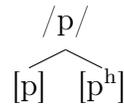
3.2 Allophones

An allophone is a phonetic/surface variant of a phoneme, i.e., the phoneme as it is actually pronounced in speech.

- Allophones are written between square brackets, e.g., [x]
- As a native speaker of English, you hear the “p” in “pit” and the “p” in “spit” as the same sound, even though they are phonetically different:
 - [p^hɪt]
 - [spɪt]

- The reason that you hear both [p] and [p^h] as one sound is because they are NOT meaningfully different in English, i.e., they are not contrastive; they are not phonemic.
 - No minimal pair will ever show [p] and [p^h] to be contrastive in English.
 - ◊ [p^hɪt] vs. [pɪt]
 - ⇒ The second one just sounds funny and does not mean something different
 - [p] and [p^h] are NOT separate phonemes. They are allophones of ONE phoneme.

Every phoneme has pronounced variants (allophones), one of which may be phonetically identical to the phoneme itself:



- You can predict when /p/ will surface as [p] and when it will surface as [p^h].

– [p ^h awt] “pout”	– [p ^h ɪləʊ] “pillow”	– [hɛlp] “help”
– [spawt] “spout”	– [p ^h rud] “prude”	– [hɛlpz] “helps”
– [sprɔwt] “sprout”	– [p ^h leɪ] “play”	– [æpəl] “apple”
– [p ^h ɪl] “peel”	– [hɒp] “hop”	– [p ^h ʊt] “put”

→ What is the pattern?

→ Which sound is the underlying/phonemic one? (Elsewhere Condition)

- Some symbols to help us: # represents a word edge, C for consonants, V for vowels
- Steps for solving a phoneme/allophone puzzle:
 - (1) Plot the environments (adjacent sounds/word boundaries/etc.)
 - (2) Check for overlapping environments
 - ◊ If there is some part of the environment that is non-overlapping (i.e., different for the different sounds), then the sounds are in *complementary distribution* and are allophones of one phoneme; proceed to step 3.
 - ◊ If all the environments are overlapping (i.e., there are minimal pairs at the context or word level), then the sounds belong to separate phonemes.
 - (3) Generalize over the non-overlapping environments using features/natural classes
 - (4) Find the *elsewhere* allophone; this is the one that corresponds to the phoneme.

Let’s practice: In English, are [k] and [k̚] allophones of one phoneme, or of separate phonemes?

- | | | |
|-----------------|-------------------|--------------------|
| • [kʊl] “cool” | • [k̚ɪk] “kick” | • [skɛtʃ] “sketch” |
| • [k̚i] “key” | • [k̚ɪs] “kiss” | • [skɑːɪ] “scar” |
| • [kʊk] “cook” | • [k̚ɪp] “creep” | • [kɔɪn] “coin” |
| • [keɪk] “cake” | • [sk̚i] “ski” | • [kæt] “cat” |
| • [k̚ɪl] “kill” | • [sk̚ɪl] “skill” | • [klæs] “class” |

3.3 Phonological rules: getting from phonemes to allophones

Phonological rules are a way of formalizing the patterns we discover about phonemes and allophones.

- General format: $/X/ \rightarrow [Y] / W _ Z$

\rightarrow = “becomes”

$/$ = “in the context of”

$_$ = placeholder for X in the linguistic context

= “X becomes Y in the context of following W and preceding Z”

- You don’t need both W and Z, just one
- W and Z could be anything from features to syllables to segments
- Basically, this rule says WXZ is pronounced as WYZ
- The Elsewhere allomorph does not need a rule

Let’s write a phonological rule to capture the alternation we found between [p] and [p^h].

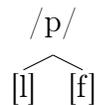
Let’s write a phonological rule to capture the alternation we found between [k] and [k̚].

A note about crosslinguistic variation:

- In Thai, we find the following two words: [paa] (“forest”) and [p^haa] (“to split”).
- Are [p] and [p^h] separate phonemes (contrastive) in Thai, or allophones of one phoneme?

A note about phonetic similarity:

- The following phoneme/allophone configuration would be really strange:



- Why is this strange?
- Allophones usually differ from each other in just one phonetic feature.

As we’ll see, there are lots of different things that cause allophonic variation, but the same general strategy that we applied here will work for solving these puzzles.

What you as a native speaker have stored in your brain: phonemes and phonological rules (NOT allophones, NOT phonetic pronunciations)

4 Problem sets

4.1 Simple starters

In English, are [ɛj] and [ej] allophones of one phoneme or are they separate phonemes? Draw the relevant allophone/phoneme diagram(s) and write any necessary phonological rules.

- [sejv] “save”
- [mɛjt] “mate”
- [sɛjʃ] “safe”
- [ɛjtʃ] “H”
- [mejz] “maze”
- [hejg] “Haig”
- [ejdʒ] “age”
- [mɛjs] “mace”
- [ɛjk] “ache”
- [ejb] “Abe”
- [mejd] “made”
- [ɛjp] “ape”

In Korean, are [ɾ] and [l] allophones of one phoneme or are they separate phonemes? Draw the relevant allophone/phoneme diagram(s) and write any necessary phonological rules.

- [ɾubi] “ruby”
- [mul] “water”
- [kiri] “road”
- [pal] “arm”
- [saram] “person”
- [seul] “Seoul”
- [ilgop] “seven”
- [ratio] “radio”
- [ibalsa] “barber”

In English, are [aɪ] and [ej] allophones of one phoneme or are they separate phonemes? Draw the relevant allophone/phoneme diagram(s) and write any necessary phonological rules.

- [sejv] “save”
- [sajð] “scythe”
- [tɹajd] “tried”
- [mejz] “maze”
- [hejg] “Haig”
- [ejdʒ] “age”
- [səmaɪz] “surmise”
- [aɪdz] “ides”
- [ejb] “Abe”
- [laɪbrɛɪ] “library”
- [əlaɪv] “alive”
- [tɹeɪd] “trade”

4.2 Some relevant concepts

Free variation: This is when two (or more) sounds vary with each other in the exact same environment, but do not make a change in meaning. Rather, the sound may be pronounced in any of those ways freely.

- (4) a. [stap] ~ [stap̃] ~ [stapʔ] “stop”
 b. [ikənaməks] ~ [ɛkənaməks] “economics”
 c. [iðər] ~ [ajðər]

Broad/narrow transcription: Different amount of detail in the transcription

- Broad: phonemic, /x/
 - Narrow: phonetic/allophonic, [x]
- (5) a. /pɪl/ vs. [p^hɪl] “pill”
 b. /spɪl/ vs. [spɪl] “spill”
 c. /kil/ vs. [ḳɪl] “keel”

Types of phonological rules:

- Assimilation

(6) /n/ → [+velar] / ___[+velar] (“think”)

- Dissimilation

(7) /r/ → [+dorsal] / ___(C*)(V*)(C*)(V*)(C*)(V*)[+coronal] (“February”)

- Feature-changing

(8) /p/ → [+aspirated] / #___ (“pin”)

- Insertion

(9) ∅ → [p] / m___s (“Chomsky”)

- Deletion

(10) /f/ → ∅ / ___θ (“fifth”)

4.3 More than two allophones

Look at the distribution of [p], [p^h], and [p^ɾ] in the following English data. Draw the relevant allophone/phoneme diagram(s) and write any necessary phonological rules.

- [p^hawt^ɾ] “pout”
- [spawt^ɾ] “spout”
- [spɹawt^ɾ] “sprout”
- [p^hil] “peel”
- [p^hɪlɔw] “pillow”
- [p^hɹud] “prude”
- [p^hleɪ] “play”
- [hɑp^ɾ] “hop”
- [hɛlp^ɾ] “help”
- [hɛlps] “helps”
- [æpəl] “apple”
- [p^hʊt^ɾ] “put”

4.4 Generalizing across allophones and phonemes

Look at the distribution of [t], [t^h], and [t^ɾ] in the following English data. Draw the relevant allophone/phoneme diagram(s) and write any necessary phonological rules.

- [t^hawt^ɾ] “tout”
- [stawt^ɾ] “stout”
- [stɹɑ] “straw”
- [t^hɪl] “till”
- [hit^ɾ] “heat”
- [t^hɹu] “true”
- [t^hɹej] “tray”
- [hɑt^ɾ] “hot”
- [hʊɪt^ɾ] “hurt”
- [hʊɪts] “hurts”
- [ætɪk^ɾ] “attic”
- [t^hʊt^ɾ] “toot”

Look at the distribution of [k], [k^h], and [k^ɹ] in the following English data. Draw the relevant allophone/phoneme diagram(s) and write any necessary phonological rules.

- [k^haw] “cow”
- [skaw.ɪ] “scour”
- [sk.ɹætʃ] “scratch”
- [k^hɪl] “kill”
- [p^hɪk^ɹ] “peek”
- [k^h.ɹu] “crew”
- [k^hleɪ] “clay”
- [mɪlk^ɹ] “hot”
- [mɪlks] “milks”
- [k^hɪkt] “kicked”
- [ejkɪŋ] “aching”
- [k^hup^ɹ] “coop”

What generalizations can we make about /p, t, k/? (Note: ʔ is not a phoneme of English.)

4.5 More things that can condition allophony

Look at the distribution of [t] and [r] in this English data. (Note that we’re ignoring aspiration and unreleasedness here to make the pattern more apparent.) Draw the relevant allophone/phoneme diagram(s) and write any necessary phonological rules.

- [t.ɹɪk] “trick”
- [fɪt] “feet”
- [lɪt] “lit”
- [lɪrəl] “little”
- [fɪrɪŋ] “fitting”
- [bɛrɛɹɪ] “better”
- [bʊrɪ] “booty”
- [pɪts] “pits”
- [kɪlts] “kilts”
- [st.ɹeɪt] “straight”
- [tʊt] “toot”
- [stəlɔwn] “Stalone”

Look at the distribution of [i] and [j] in Mokilese (Austronesian). Draw the relevant allophone/phoneme diagram(s) and write any necessary phonological rules.

- [pᵢsan] “full of leaves”
- [kᵢsa] “we two”
- [kamwəkᵢti] “to move”
- [pokᵢ] “to strike something”
- [pil] “water”
- [paid] “outrigger support”

Look at the distribution of [e] and [a] in the following data from Epira (Niger-Congo). Draw the relevant allophone/phoneme diagram(s) and write any necessary phonological rules.

- [mezi] “I expect”
- [meze] “I am well”
- [meto] “I arrange”
- [metu] “I beat”
- [mazi] “I am in pain”
- [mazε] “I agree”
- [matɔ] “I pick”
- [matu] “I send”

Look at the distribution of [θ], [ð], and [d] in Palauan. Draw the relevant allophone/phoneme diagram(s) and write any necessary phonological rules.

- [kəða] “we (inclusive)”
- [ðiak] ~ [diak] “negative verb”
- [tɲoθ] “tattoo needle”
- [ðiosəʔ] ~ [diosəʔ] “place to bathe”
- [kuθ] “louse”
- [moat] “visit”
- [ɲərarəðe] “a village”
- [ieðl] “mango”
- [kəðeb] “short”
- [uðouθ] “money”
- [bəðuk] “my stone”
- [maθ] “eye”
- [ðe:l] ~ [de:l] “nail”
- [ðik] ~ [dik] “wedge”
- [ʔoðiŋəl] “visit”
- [baθ] “stone”
- [olðak] “put together”
- [ʔəðip] “ant”
- [məðəŋei] “knew”