

Phonology: Study of Sound Patterns

Today

- Distinct(ive)ness
- Complementarity
- Phoneme
- Allophone

1 Phonology

So far, we focused on Phonetics. In phonetics, we investigated the physical properties of the speech sounds. For example, [p] is a speech sound. [p] consists of at least three features. It is bilabial because producing it involves two lips. It is a stop because the air is completely blocked in the mouth when we produce it. Finally, it is voiceless because vocal cords are tight and there is no (or little) vibration in the vocal cords. We can test this by putting our hands against our throat.

Phonology is interested in the representation of these speech sounds in the mind. As we will see, physical properties do not always map to mental representations one by one. Phonology is also interested in contextual properties of sound segments. Certain sound segments change their features in certain contexts. Phonology aims to generalize these features and contexts and predict their occurrences. This will become clearer as we go along.

2 Distinct(ive)ness and Complementarity – *Phonemes and Allophones*

In the previous lecture, we discussed **aspiration** in English. We observed that English, in fact, has (at least) two [voiceless bilabial stops], i.e. [p] and [p^h].

- [p] : **unaspirated** voiceless bilabial stop
- [p^h] : **aspirated** voiceless bilabial stop

Physically, [p] and [p^h] are different sounds. Nevertheless, native speakers of English do not think that they are different sounds. We know this because native speakers of English would not consider [pɒt] and [p^hɒt] as different words. Many native speakers of (American) English would think that someone who says [p^hɒt] has a slightly different accent but the word still means *pot*. This means that, in English, [p] and [p^h] are not **distinct** sounds. Although these two sounds are physically different, native speakers of English do not treat them psychologically distinct. Underlyingly, they are treated as the same sound.

Let us compare this to the following two sound pairs: [p^h] and [b].

- [p^h] : aspirated voiceless bilabial stop
- [b] : unaspirated voiced bilabial stop

Note that aspiration does not contribute any difference in these examples. So we can ignore it completely.

Again, [p^h] and [b] are two physically distinct sounds. What is more, these are also psychologically **distinct**. We have evidence for this. Native speakers distinguish the two sounds. [p^hɪl] and [bɪl] are two different words (*pill* vs. *bill*). With the same type of reasoning, we can say that [d] and [b] are distinct sounds in English because we can find minimal pairs like [bɪl] and [dɪl].

Phonemes

These sounds that contribute to a meaningful distinction are **phonemes**. A phoneme is a mental representation of one or more physical sounds. We know that [p], [b], and [d] are **distinct** sounds in English. Thus,

- /p/ is a phoneme in English.
- /b/ is a phoneme in English.
- /d/ is a phoneme in English.

Allophones

Let's go back to [p] and [p^h]. We said [p] and [p^h] are physically different but they do not create different words. In fact, they cannot. This is because a native speaker of American English would never say:

- [pɔt]
- [sp^hɔt]

Instead, they would say:

- [p^hɔt]
- [spɔt]

This is because [p^h] occurs only at the beginning of words (in fact syllables); whereas, [p] occurs in other positions. Such sounds that do not contribute to a meaningful difference and cannot be used in the same **environment** are called **allophones**. Environment here refers to the position of sounds. [p^h] occurs at the beginning of words. This is its environment. [p] cannot occur in this environment. On the other hand, [p^h] cannot occur in environments other than the beginning of the words while [p] can. This is called **complementary distribution**.

Sound	Environment
[p ^h]	beginning of the word
[p]	<i>elsewhere</i>

In a way, allophones are different reflections of one phoneme. They are different variants of the same phoneme and we can predict where to find them. In English, / p / is a **phoneme** and it has two **allophones**, [p] and [p^h].

Phonemes are represented between slashes / /. Their allophones are represented between square brackets [].

/ /	Phoneme
[]	Allophone

3 Identifying Phonemes

Minimal Pairs

Minimal pairs are two words with a minimal difference between them. In other words, they are two words where only one segment is different.

The easiest way to determine whether two sound segments are *distinct phonemes* is to find a minimal pair.

[bɪn]	[pɪn]
[sɪn]	[pɪn]
[sɪn]	[sɪn]

Near Minimal Pairs

Sometimes, it is impossible to find a minimal pair. A near minimal pair will also do. In a near minimal pair, the difference is almost minimal but not as minimal as in minimal pairs.

For Example

heathen [hiðən] adhesion [ædhiʒən]

Note that minimal pairs and near minimal pairs are just some of the tools that help to determine whether two sound segments are phonemically distinct. You can determine whether two segments are distinct phonemes or not without using any minimal pairs or near minimal pairs. If two sounds can occur in the same environment,

they are most probably two distinct phonemes. They cannot be allophones of one sound because allophones are complementary, i.e. they never occur in the same environment.

Practice

Determine if the following sounds are phonemes in English.

[s] [ʃ]
[w] [v]

Practice from another language

Identify the phonemes in Kurmanji. [^h] indicates that a sound is aspirated.

[ba] *by (location)*
[bɛ] *say*
[b^ha] *expensive*
[pɛ] *with (instrumental)*
[b^hɛ] *wind*

Phonemes and Allophones – *continued*

A **phoneme** is abstract. It has psychological reality. It is stored in the mind, specifically in the phonological module. Phonemes are sound segments that contribute to a meaning difference.

An **allophone** is concrete. It has physical reality. It is the real sound produced by the articulators. It is the physical realization of a phoneme.

In some cases, there is a one to one mapping between a phoneme and its allophone.

For example:

/ b / is a phoneme in English. It has one allophone, which is itself [b].

The phoneme / b / is always pronounced as [b] regardless of the context.

Similarly, / g / is a phoneme in English. It has one allophone, which is itself [g].

Crucially, / b / and / g / are distinct phonemes. They are distinct because they can occur in **contrastive environments**. A contrastive environment is a position where two sound segments cause a meaning contrast. The best cases of contrastive environments are minimal pairs.

[bɑj] *buy* [gɑj] *guy*

The position before the sound [ɑj] is a contrastive environment for / b / and / g /. It shows us that / b / and / g / are two distinct phonemes.

In some cases, a phoneme can have more than one allophone. In other words, it can have different pronunciations depending on the environment. / p / is a phoneme in English. It has (at least) two allophones.

[p] and [p^h] are allophones of / p /.

Allophones of the same phoneme do not occur in contrastive environments. Instead, they occur in **complementary environments**. Complementary means that they do not occur in the same environment. They complete one another. Take allophones of / p / for example:

- [p^h] occurs at the beginning of a word.
- [p] occurs elsewhere.

Predictability

Allophones of a phoneme are predictable based on the environment. In other words, native speakers of a language know (subconsciously) the circumstances each allophone is used. These circumstances are called **conditioning environments**.

For example: As for the allophones of /p/. A native speaker knows that [ph] only at the beginning of the word. Therefore, the conditioning environment for [ph] is word initial position.

English again

Believe it or not, English has a third [p] like sound. It is the unreleased version of [p] and it is represented as [p̚]. Take a look at the data below and identify the allophones of / p / and state their distributions.

[p^hɪk̚] [spɪk̚] [t^hɪp̚]
 [p^hɪt̚] [spɪt̚] [stɑp̚]

Another example from English

Take a look at the data below and identify the allophones of /l/ and state their distributions. [ɫ] is devoiced.

[blu]	[p̥le]
[glim]	[kl̥ir]
[lif]	[pl̥aw]
[slɪp]	[kl̥æp]
[flɒg]	

Now take a look at the following data about [r] and [ɹ]. What is going on?

[bru]	[p̥rɔw]
[grin]	[t̥rɪp]
[drip]	[c̥rɪp]
[frɔŋ]	[p̥re]
[ʃrɪmp]	

English vowels

Consider the following data from English. English has some long vowels and short vowels. The colon [:] after a vowel indicates that the vowel is long. Determine whether long and short vowels are allophones of distinct phonemes or allophones of the same phoneme. In either case, justify your response and give a rule if possible.

[ɡɪft]	<i>gift</i>	[hʌ:g]	<i>hug</i>
[rɑ:bd]	<i>robbed</i>	[nɒt]	<i>note</i>
[lʌk]	<i>luck</i>	[ɡɪ:v]	<i>give</i>
[mo:wd]	<i>mowed</i>	[sli:z]	<i>sleaze</i>
[slæpt]	<i>slapped</i>	[pət]	<i>pot</i>
[mes]	<i>mace</i>	[kræ:b]	<i>crab</i>

Korean – [s] vs. [ʃ]

Consider the following data from Korean. Determine whether [s] and [ʃ] are allophones of distinct phonemes or allophones of the same phoneme.

[ʃi]	<i>pee</i>	[sal]	<i>flesh</i>
[miʃin]	<i>superstition</i>	[kasu]	<i>singer</i>
[ʃinmun]	<i>newspaper</i>	[sanmun]	<i>prose</i>
[kaʃi]	<i>thorn</i>	[miso]	<i>smile</i>
[paŋʃik]	<i>method</i>	[susek]	<i>search</i>
[ofip]	<i>fifty</i>	[so]	<i>cow</i>

Korean – [l] vs. [r]

Consider the following data from Korean. Compare [l] and [r]. Determine whether they are allophones of distinct phonemes or allophones of the same phoneme. In either case, justify your response and give a rule if possible.

[ʌ] represents a high central rounded vowel.

[kal]	<i>dog</i>	[onelppam]	<i>tonight</i>
[kenel]	<i>shade</i>	[silkwa]	<i>fruit</i>
[irumi]	<i>name</i>	[mul]	<i>water</i>
[kiri]	<i>road</i>	[seul]	<i>Seoul</i>
[juɰutʃʌm]	<i>receipt</i>	[kəriro]	<i>to the street</i>
[pəl]	<i>leg</i>	[saram]	<i>person</i>
[ilkop]	<i>seven</i>	[tatʌl]	<i>all of them</i>
[ipalsa]	<i>barber</i>	[vərʌm]	<i>summer</i>
[uri]	<i>we</i>		

Polish

Consider the following data from Polish. Give a rule that captures the alternation in the data.

[klup]	<i>club</i>	[klubi]	<i>clubs</i>
[trup]	<i>corpse</i>	[trupi]	<i>corpses</i>
[trut]	<i>labor</i>	[trudi]	<i>labors</i>
[kot]	<i>cat</i>	[koti]	<i>cats</i>
[wuk]	<i>lye</i>	[wugi]	<i>lyes</i>
[sok]	<i>juice</i>	[soti]	<i>juices</i>

Tamil

Determine the distribution of the voiceless ([p], [t], [k]) and voiced non-nasal ([b], [d], [g]) stops in Tamil. Give a rule that captures the distribution of ([p], [t], [k]) and ([b], [d], [g]).

[kambi]	<i>wire</i>	[pagəl]	<i>morning</i>	[taŋgu]	<i>stay</i>
[kajdi]	<i>prisoner</i>	[sa:bō]	<i>curse</i>	[natpu]	<i>friendship</i>
[vandi]	<i>vehicle</i>	[pajgə]	<i>bags</i>	[paŋgu]	<i>share</i>
[va:ɖu]	<i>wither</i>	[pattu]	<i>ten</i>	[ajmbəɖu]	<i>fifty</i>

Give the underlying forms of the following: [pajg], [vandi]?

4 Phonological Processes

Words are stored in our minds in their phonemic form. When they are produced, phonemes might change some of their features, get completely deleted, or we might even end up with new sounds that are not originally in the word. All of these changes are phonological processes. There are different types of phonological processes.

- Assimilation
- Dissimilation
- Deletion
- Epenthesis
- Metathesis

Assimilation

When assimilation occurs, a sound becomes more similar to the sounds in its environment.

For example:

The plural morpheme / z / becomes [s] when it follows a voiceless stop. This is a case of assimilation as a voiced sound becomes voiceless because of another voiceless stop in its environment.

cats / kæt z / [kæts]
 dogs / dɔgz / [dɔgz]

In some cases, it is hard to decide whether a process is assimilation or not. Here is the way to determine whether a process is assimilation or not.

Consider your IPA chart. The leftmost part is the front of the mouth (bilabial), the rightmost part is the back of the mouth (glottal). In a phonological process, if the output [allophone] becomes closer to the environment than the input /phoneme/, then this is assimilation. The same for the vertical axis of the IPA chart.

More concretely, if the phoneme is / b / and the allophone is [t] and the environment is ___[k], then this is assimilation. In this case / b / (bilabial) moves closer to [k] (velar) and becomes [t].

Similarly, if the phoneme is / b / and it becomes [v] when around [j], then this is assimilation too, because it moved closer to [j].

Dissimilation

Dissimilation is just the opposite of assimilation. When the input becomes less similar to the sounds around, this is dissimilation.

For example:

If /s/ becomes /p/ around [s], this is dissimilation.

Deletion

In some cases, sounds are deleted in certain environments. This is called deletion.

For example:

In Tamil, consonants at the end of the word are deleted.

‘dawn’ / pagəl / → [pagɛ]

‘he’ / avən / → [avɛ̃]

Epenthesis

In some cases, sounds are inserted in certain environments. This is called epenthesis.

For example:

In Turkish, word initial consonant clusters are bad. Therefore, Turkish inserts a vowel between consonants at the beginning of some borrowed words.

English	Turkish
sport	[suɾpor]
train	[tiren]

Similar epenthesis phenomena occur in Persian [ɛspik] *speak* or in Spanish [ɛspaniʃ].

Metathesis

In some cases, certain ordering of sounds is not good. Therefore, the order of two sounds changes. This is called metathesis.

For Example:

In Mandarin, [sk] order is not good at the end of the word in. So, some Mandarin speakers say [æks] instead of [æsk].

5 Rule ordering

As we discussed before, phonology consists of a bunch of rules that apply when the conditions are met. In other words, if a specific sound is in a specific environment, the rule applies.

Some phonological rules need be ordered with respect to each other. While some others are free to apply in any order.

Remember the Tamil example. We said that Tamil has a rule that deletes the consonant at the end of the word.

‘dawn’ / pagəl / → [pagɛ]

‘he’ / avən / → [avɛ̃]

Representation of the rule would be:

Deletion

$C \rightarrow \emptyset / \text{_____} \#$

Tamil has another rule about vowels. When a vowel precedes a nasal consonant, the vowel becomes nasalized. [~] indicates that a vowel is nasalized.

stick /kambu/ → [kām̃bu]

spoon /karəndi/ → [karə̃ndi]

This is an example of assimilation. We call this rule nasalization.

Nasalization

$V \rightarrow [\text{nasal}] / \text{_____}[\text{nasal}]$

Now consider the following examples from Tamil. Which order of the rules consonant deletion and vowel nasalization would yield the desired surface forms.

Underlying form (input) → / paɣəl / / avən /

Rule _____

Rule _____

Surface form (output) → [paɣə] [aṽə]

Phonology Practice

English

Consider the following data from English. Focus on the sounds [t], [d], and [r].

Is the flap [r] a phoneme or is it an allophone of some other sound(s). Can we predict its distribution?

[rajt]	<i>write</i>	[rajrər]	<i>writer</i>
[dara]	<i>data</i>	[det]	<i>date</i>
[mæd]	<i>mad</i>	[mæt]	<i>mat</i>
[bətroð]	<i>betroth</i>	[lærər]	<i>ladder</i>
[lærər]	<i>latter</i>	[dɪstəns]	<i>distance</i>
[rajrər]	<i>rider</i>	[rajd]	<i>ride</i>
[derɪŋ]	<i>dating</i>	[bɛdsajd]	<i>bedside</i>
[mʌrər]	<i>mutter</i>	[turər]	<i>tutor</i>
[mæərər]	<i>madder</i>	[mædnɪs]	<i>madness</i>

Greek

Consider the following data from Greek. Focus on the sounds [k] [x] [c] [ç].

- [x] voiceless velar fricative
- [k] voiceless velar stop
- [c] voiceless palatal stop
- [ç] voiceless palatal fricative

What are the phonemes and what are the allophones? Can we write a rule that gives us the distribution of the four sounds listed above?

[kano]	<i>do</i>	[çeri]	<i>hand</i>
[xano]	<i>lose</i>	[kori]	<i>daughter</i>
[çino]	<i>pour</i>	[xori]	<i>dances</i>
[cino]	<i>move</i>	[xrima]	<i>money</i>
[kali]	<i>charms</i>	[krima]	<i>shame</i>
[xali]	<i>plight</i>	[xufta]	<i>handful</i>
[çeli]	<i>eel</i>	[kufeta]	<i>bonbons</i>
[ceri]	<i>candle</i>	[oçi]	<i>no</i>