# *Phonology 2: Natural classes and phonological rules*

Ling400

# *Natural class*

- **Natural class**: A class of phonemes characterized by the sharing of a given feature or features; for example
  - **Vowels**
  - **Consonants**
  - **Voiced sounds**
  - **Voiceless sounds**
  - **Nasal sounds**
  - **Stops**

# Finding Allophones

1. Use feature charts to recognize phones and their distinctive features.

# Distinguishing Allophones

❷ Assume that the necessary data is furnished to know, for example, if in a given language there are minimal pairs to contrast two phonemes.

# Data

| | | | | | |
|---|---|---|---|---|---|
| Pat | [ $p^h$æt ] | pill | [ $p^h$ɪl ] | tack | [ $t^h$æk ] |
| spat | [ spæt ] | spill | [ spɪl ] | pack | [ $p^h$æk ] |
| bat | [ bæt ] | bill | [ bɪl ] | cap | [ $k^h$æp ] |
| | | | | gap | [ gæp ] |

| | | | |
|---|---|---|---|
| cab | [ $k^h$æb ] | kill | [ $k^h$ɪl ] |
| scab | [ skæb ] | skill | [ skɪl ] |
| gab | [ gæb ] | gill | [ gɪl ] |

# Data

| | | |
|---|---|---|
| Pat [ $p^h$æt ] | pill [ $p^h$ɪl ] | tack [ $t^h$æk ] |
| spat [ spæt ] | spill [ spɪl ] | pack [ $p^h$æk ] |
| bat [ bæt ] | bill [ bɪl ] | cap [ $k^h$æp ] |
| | | gap [ gæp ] |

| | |
|---|---|
| cab [ $k^h$æb ] | kill [ $k^h$ɪl ] |
| scab [ skæb ] | skill [ skɪl ] |
| gab [ gæb ] | gill [ gɪl ] |

# Distinguishing Allophones

3. Decide if the data shows that two or more phones in question occur in minimal pairs; if yes, they represent separate phonemes in that language.
   Check in all environments for added support.

# *Minimal pairs*

| | |
|---|---|
| pat [ $p^h$æt ] | bat [ bæt ] |
| pill [ $p^h$ɪl ] | bill [ bɪl ] |
| cab [ $k^h$æb ] | gab [ gæb ] |
| kill [ $k^h$ɪl ] | gill [ gɪl ] |
| cap [ $k^h$æp ] | gap [ gæp ] |

Therefore, / p /, / b / and / k /, / g / are phonemes.

# Distinguishing Allophones

4. If the answer to #3 is no, decide if the two phones are in complementary distribution and if they are phonetically similar. Describe the environment (what precedes and what follows) for each phone.

# p *and* $p^h$

| | | |
|---|---|---|
| Pat [ $p^h$æt ] | pill [ $p^h$ɪl ] | pack [ $p^h$æk ] |
| spat [ spæt ] | spill [ spɪl ] | cap [ $k^h$æp ] |
| | | gap [ gæp ] |

a) Is there evidence for minimal pairs? No.
   Conclusion: p and $p^h$ are in complementary distribution.
b) Are there many shared features?
c) Is there a systematic environment?

# p *and* $p^h$

| | | |
|---|---|---|
| Pat [ $p^h$æt ] | pill [ $p^h$ɪl ] | pack [ $p^h$æk ] |
| spat [ spæt ] | spill [ spɪl ] | cap [ $k^h$æp ] |
| | | gap [ gæp ] |

b) Are there many shared features?
c) Is there a systematic environment?

Yes. Yes. Looks like **allophones**

# Distinguishing Allophones

5. Decide which is the more “basic” allophone (not predictable or conditioned by environment — the “elsewhere one”).

# *Environment*

| | | |
|---|---|---|
| Pat [ $p^h$æt ] | pill [ $p^h$ɪl ] | pack [ $p^h$æk ] |
| spat [ spæt ] | spill [ spɪl ] | cap [ $k^h$æp ] |
| | | gap [ gæp ] |

[k] and [p] occur initially medially finally

$[k^h]$ and $[p^h]$ occur initially medially finally

Note: The same is true of $[t^h]$ and [t].

# Distinguishing Allophones

6. This is the basic phoneme (underlying form).
   Describe the systematic relationship between/among the allophones, writing a rule to derive them from the basic phoneme.

# *Generalizations*

- /p/ has (at least) two allphones: [p] [$p^h$]. [$p^h$] occurs at the beginning of a word and [p] occurs elsewhere.
- /t/ has (at least) two allphones: [t] [$t^h$]. [$t^h$] occurs at the beginning of a word and …
- /k/ has (at least) two allphones: [k] [$k^h$]. [$k^h$] occurs at the beginning of a word and …

# *Phonological rules*

- Phonological rules
- Phonological processes
  - apply when some conditions are satisfied (usually specified in terms of environment)
  - phonetically natural processes in most cases (often sensitive to natural classes)

# *Formalization*

- Formula:
- X can be rewritten Y in the environment of this position (____), i.e. after A, before B.

- X ➔ Y / A ____ B

# *Common processes*

- **Assimilation**: changing a feature of a phoneme when it is near another one so that the two share a feature.
- **Dissimilation**: changing a feature of a phoneme when it is near another identical phoneme to make it more "distinct" from its twin.

# *Common processes*

- Metathesis (also in children's speech)
- Insertion
- Deletion
- Strengthening
- Aspiration
- Flapping

# Distinguishing Allophones

**Rule:**

In the present case voiceless stops aspirate in initial position.

**Here's how to write the rule:**

A stop is aspirated at the beginning of a word.

Formally:

$$\begin{bmatrix} + \text{ stop} \\ - \text{ voiced} \end{bmatrix} \rightarrow [+ \text{ aspir}] \quad / \quad \# \_\_\_$$

# *Nasalized Vowels in English*

bee [bi]  bead [bid] lay [leɪ]  bean [bĩn]

lace [leɪs]  lame [lẽĭm] bad [bæd] bang [bæ̃ŋ]

Vowels are nasalized before a nasal consonant.

$$[+\text{vowel}] \rightarrow [+\text{nasal}] \,/\, \_\_ \begin{bmatrix} +\text{cons} \\ +\text{nasal} \end{bmatrix}$$

# *Why does nasalization occur?*

- It is an assimilation process.
- Vowels are nasalized in anticipation of the following nasal consonant.
- The velum is lowered slightly earlier than required for the nasal consonant, thereby nasalizing the preceding vowel.

# *Nasal(ized) vowels in Akan*

- [ka] ‘bite’,  [kã] ‘speak’
- [fi] ‘come from’, [fĩ] ‘dirty’
- [tu] ‘pull’, [tũ] ‘hole/den’
- [nsa] ‘hand’, [nsã] ‘liquor’
- [tʃij] ‘hate’, [tʃij̃] ‘squeeze’
- [pam] ‘sew’, [pãm] ‘confederate’

# *Separate Phonemes?*

- Yes. We can find minimal pairs involving “regular” vowels and nasal vowels in Akan.
- [a] and [ã] belong to separate phonemes in Akan. Similarly for [i] and [ĩ], [u] and [ũ] , and [ij] and [ĩj̃].