THEORETICAL CONSIDERATIONS

Importance of theories:
- Representation of abstract knowledge
- Representation and production of input
- Derivation of developmental change
- Guidance and directing of clinical work; offer of a variety of clinical possibilities; different perspectives on the problem to be solved

Theories are based on observations and experiments, but they abstract away from them, attempting to find order and rules.

How Phonology was born
- difficulties of the instrumental analyses:
  - French /u/ = [x], [χ], or [k]
    - rue, dur, secret
- mental level of language: capacity to recognize an abstract reality that unites family of sounds.
- identify those abstract realities – the phonic elements of language (phonemes) – and to classify them according to their function. The new science that would do this = Phonology.

Phonological theory
- Abstract aspect of grammar
- Competence = the speaker’s interpretation system.
- Phonology studies this interpretation system; it investigates the principles governing the sound systems.
- Speech sounds vs. phonemes:
  - Speech sounds = phones, segments, allophones;
  - Phonemes establish meaningful units in a language.

Phoneme: Historics
- Jan Beaudoin de Courtenay in 1870 (Kazan School, St Petersbourg);
  - phoneme = sum of phonetic properties that all together constitute an indivisible unit
  - sound duality = differences between a physiologically concrete sound realization and its mental image.
  - Phoneme = psychological sound unit, the sound “intended” by the speaker and “understood” by listeners.
- Concept popularized by N. Kruszewski in

Phoneme: definitions
- three ways to consider a phoneme.
  1) Psychological (Baudouin de Courtenay, 1870): phoneme is a mental reality, as the intention of the speaker or the impression of the hearer, or both.
Phoneme: definitions

2) Physical (Daniel Jones, 1918): phoneme is a head term of a family of speech sounds.

- **allophones**: phonetic similarity and complementary distribution

  E.g. - /l/: [l̩], [l̩], [l̩]
  leg, pill, play
  - but: /h/ and /ŋ/

  **free variation**:
  E.g. step
  [p] = (un)aspirated, (un)released, or [ʔ]

Functional (Nikolai Trubetzkoy, 1936): phoneme is the sum of the phonologically relevant properties of a sound. A phoneme is a minimal unit that can distinguish meanings.

- contrast between speech sounds (contrastive distribution); commutation test:

  - minimal pairs: ran, man, tan, can, ban, fan
  - near minimal pairs: mission vs. vision

A phoneme is...

- a mental reality, as the intention of the speaker or the impression of the hearer, or both.
- a head term of a family of speech sounds.
- an abstract phonological unit that serves as a reference model for a set of speech sounds related to each other.
- the smallest unit without meaning that can be delimited in speech. Its main function is to distinguish words.
- discrete units that keep lexical items apart.
- a sum of phonetic properties that all together constitute an indivisible unit.
- phoneme is the sum of the phonologically relevant properties of a sound.
- a set of co-occurring features.

Natural classes – patterns in behaviour

- [t], [d] = alveolar stops > flapping (English)
- [p], [t], [k] = voiceless stops > aspiration (English)
- [b], [d], [g] = voiced stops > fricativisation in intervocalic position (Spanish)
- [ɡ], [ŋ], [ɾ] not a natural class

Features: Phonetic Features

- The production of every segment is complex (voicing, place, manner);
- Articulatory components depend on each other.
- Different combinations > different sounds.

  - [t] + voicing = [d]
  - [t] + lower the tongue tip = [s]
  - [ɡ] - nasalization = [k]

Phonetic Features

- Articulatory characteristics can be translated into features:

<table>
<thead>
<tr>
<th>[b]</th>
<th>[d]</th>
<th>[ɡ]</th>
</tr>
</thead>
</table>
  voiced | +   | +   | +   |
  bilabial | +   | -   | -   |
  labiodental | -   | -   | -   |
  dental | -   | -   | -   |
  alveolar | -   | +   | -   |
  palatal | -   | -   | -   |
  velar | -   | +   | -   |
  uvular | -   | -   | -   |
  pharyngeal | -   | -   | -   |

OR
**Matrices of features:**

<table>
<thead>
<tr>
<th>[b]</th>
<th>[d]</th>
<th>[g]</th>
</tr>
</thead>
<tbody>
<tr>
<td>+voiced</td>
<td>+voiced</td>
<td>+voiced</td>
</tr>
<tr>
<td>+bilabial</td>
<td>-labiodental</td>
<td>-bilabial</td>
</tr>
<tr>
<td>-dental</td>
<td>+alveolar</td>
<td>-alveolar</td>
</tr>
<tr>
<td>-palatal</td>
<td>-velar</td>
<td>+velar</td>
</tr>
<tr>
<td>-uvular</td>
<td>-pharyngeal</td>
<td>+pharyngeal</td>
</tr>
</tbody>
</table>

**Phonetic Features**

- Binarism (+ or -)
- Natural class [b, d, g]:
  - +voiced
  - -labiodental
  - -bilabial
  - -dental
  - +alveolar
  - -alveolar
  - -palatal
  - +velar
  - -velar
  - -uvular
  - +uvular
  - -pharyngeal

- Putative natural class

**A same set of features should be able to account for all and only sounds of human languages**

- Generation of sounds:

<table>
<thead>
<tr>
<th>+bilabial</th>
<th>+bilabial</th>
<th>-bilabial</th>
</tr>
</thead>
<tbody>
<tr>
<td>+labiodental</td>
<td>+labiodental</td>
<td>-labiodental</td>
</tr>
<tr>
<td>+dental</td>
<td>+dental</td>
<td>-dental</td>
</tr>
<tr>
<td>+alveolar</td>
<td>+alveolar</td>
<td>-alveolar</td>
</tr>
<tr>
<td>+palatal</td>
<td>+palatal</td>
<td>-palatal</td>
</tr>
<tr>
<td>+velar</td>
<td>+velar</td>
<td>-velar</td>
</tr>
<tr>
<td>+uvular</td>
<td>+uvular</td>
<td>-uvular</td>
</tr>
<tr>
<td>-pharyngeal</td>
<td>-pharyngeal</td>
<td>-pharyngeal</td>
</tr>
</tbody>
</table>

**Problems with articulatory features:**

- such grammar is too powerful
- it makes wrong predictions
- different features for consonants and vowels

- Need of a more abstract set of features > phonological features.

**Phonological Features**

- Distinctive features = smallest indivisible sound properties that establish phonemes; they demonstrate similarities and dissimilarities between phonemes.

- Roman Jakobson, 1928:
  - a universal system of phonemic representation
  - phoneme is a bundle of distinctive features
  - phonemes are distinguished by their unique feature combination
  - the specification for any phoneme stated through a set of binary values [+/-] for each distinctive feature

- Jakobson, Fant and Halle (1952) ("Preliminaries to Speech Analysis") = an elaborated version of the distinctive feature theory; acoustic features
- Jakobson and Halle (1956) a new distinctive feature system that included articulatory features.
- Chomsky and Halle ("The Sound Pattern of English" (SPE), 1968) are defined primarily according to articulatory features.
  - principle of universality
  - principle of binarity
- **Features that divide segments into major classes:**
  - [+/- syllabic]: vowels vs. consonants and glides
  - [+/- consonantal]: consonants vs. vowels and glides
  - [+/- sonorant]: obstruents (stops, fricatives, affricates) vs. sonorants (nasals, liquids, glides, vowels)

- **Obstruents**
  - [+] +cons
  - [-] -cons
  - [+] +son
  - [-] -son

- **Sonorant Cs**
  - [+] +cons
  - [-] -cons

- **Glides**
  - [+] +son
  - [-] -son

- **Vowels**
  - [+] +syll
  - [-] -syll

- **Features that specify the state of glottis and place of articulation:**
  - [+/- voice]: voiced vs. voiceless
  - [+/- coronal]: segments that are pronounced with the tongue tip or blade vs. with the centre, back or root of the tongue
  - [+/- anterior]: segments that are pronounced within the limits of the lips up to the alveolar ridge

- **Labial**
  - [+] +ant
  - [-] -ant

- **Alveolar/Dental**
  - [+] +cor
  - [-] -cor

- **Palatal**
  - [+] +cor
  - [-] -cor

- **Velar/Uvular**
  - [+] +cor
  - [-] -cor

- **Other features:**
  - [+/- high]: high vowels and [k, g, j] vs. the rest
  - [+/- low]: low vowels and [h, l] vs. the rest
  - [+/- back]: back vowels and [k, g, n] vs. the rest
  - [+/- round]: rounded vowels and [w] vs. the rest
  - [+/- front] or [+/- anterior]: front vowels
  - [+/- tense]: reflects the presence of muscular tension of the body of the tongue. When the feature is there, the sound is longer and more peripheral.

- **Phonological Rules**
  - E.g.
    - Bat [bʌt]: [b] = voiced bilabial stop
    - Pat [pa't]: [pʰ] = voiceless aspirated bilabial stop
    - Spat [spat]: [p] = voiceless unaspirated bilabial stop

  - The difference between voiced and voiceless sounds is distinctive, but the phonetic feature of aspirations is a predictable, or redundant feature.

- **Features that specify manner of articulation:**
  - [+/- continuant]: presence vs. absence of the airflow
    - [+ continuant]: fricatives, glides, fricatives, and laterals
    - [- continuant]: stops, nasal stops, and affricates
  - [- continuant]: stops, nasal stops, and affricates
    - [+ continuant]: fricatives, glides, fricatives, and laterals
    - [- continuant]: stops, nasal stops, and affricates
  - [+/- strident]: noisy or hissing airflow. The others are [- strident]:
  - [+/- delayed release]: distinguishes affricates and stops:
  - [+/- nasal]: makes difference between stops and nasal stops

- **all these features are available in the Grammar**
  - not necessarily all of them are needed in a particular grammar
    - E.g. to represent a richer vocalic system one will need more features than for example for a language that has only 3 vowels [i, a, u]
    - Problems: [+ hi, +lo]

- **Problems:**
distinctive features of a phoneme = lexicon (arbitrary knowledge) and form the underlying representation of that phoneme.

predictable features are derived from phonological rules that operate on underlying representations.

result is a phonetic (surface) representation.

complete description going from the UR through the set of phonological rules to the surface representation is called derivation.

Phonological form /p/

phonological rules ...

Phonetic form [p]

Terminology and symbols:

- A: affected segment (/ /)
- B: change ([ ])
- C and D: context (environment)
- \textbf{Æ}: becomes
- \textbf{/}: in the environment

Notes:

- A, B, C, D are distinctive feature matrices.
- A or B but not both may be null.
- B \rightarrow B / C \_\_ D (insert B)
- A \rightarrow B / D \_\_ D ( deletes A)
- C or D or both may be absent.
- A consists of only 1 feature column.
- C and D may contain only the feature \# (word boundary) and + (morpheme boundary).

Analysis of data (phonetic)

- Coming up with the UR.
- Coming up with a (set of) rule(s).
- How to do it?

Phonological rules - transformation rules (or a rewrite rules) - are stated in a formalized notation system:

\[ A \rightarrow B / C \_\_ D \]

Segments, or full or partial matrices of features. If a matrix contains a full specification, it refers to one segment, if it's partially specified, then it stands for a natural class.

By convention the minimal specification possible is given for the affected segment and all and only the features that change are given for the change.

Such transformation rules operating on the underlying forms represent the link between the underlying level (Phonology) and the surface level (Phonetics).

V: vowel ([+syll])

C: consonant ([−syll])

G: glide ([−syll, −cont])

C₀: zero or more consonants

Ø: null

#: word boundary

+: morpheme boundary

$: syllable boundary

( ): optionality

{ }: disjunctive choice (or)

E.g. pass [pæs] pass you [pæjju]
this [ðɪs] this year [ðɪjɪs]
passed
passing
passes

[s] form [ı] or [ı] from [s]?
How to choose the underlying form?

The underlying form should be:
- one of the surface forms
- the simplest form
- has the widest distribution, so that the rule writing be easier
- phonetically natural: 'expected form', found across languages, motivated by the features nature:

1) wider distribution: [s] appears in more contexts than [ʃ]

2) naturalness of the process:
   - [s] is [+cor, +ant];
   - [ʃ] is [+cor, -ant];
   - [ʃ] is [+cor, -ant].

[ʃ] and [ʃ] have features in common, while [s] is not similar to the segments it precedes in the examples above.

Example of clinical application:

- soap [təwp]
- kiss [kɪt]
- zoo [du]
- nose [naʊd]

/s/ > [ʃ] and /z/ > [d] at the beginning and end of words

Rule ordering:

Can't [kɪt]: a deletion rule is needed to delete the nasal consonant, and nasalization rule is needed to account for the nasalized vowel:

| Rule of deletion: | [+nas] > Ø / [+voc] ___ [+cons] |
| Rule of nasalization: | [+voc] > [+nas] / ___ [+cons, +nas](C1)$ |
| UR /kærnt/ | UR /kærnt/ |
| Nasalization | +i Deletion | Ø |
| Deletion | Ø | Nasalization |
| Phonetic form | [kɪt] | Phonetic form | [kɪt] |

/s/ > [ʃ] / #___, ___#
/z/ > [d] / #___, ___#

[+cons, +cor, +ant, +cont, +stri, -voi] > [-cont, -strid] / ___#, # ___
[+cons, +cor, +ant, +cont, +stri, +voi] > [-cont, -strid] / ___#, # ___
[+cons, +cor, +ant, +cont, +stri] > [-cont, -strid] / ___#, # ___
- Vacuous rule application (no change)
  - E.g. German umlaut (a vowel becomes front before a front high vowel):
    \[ /\text{gast} + /l/ \rightarrow /\text{gæsli}/ \]
  - \( V \rightarrow [\cdot \text{bck}] / \text{___} [V, +\text{hi}, -\text{bck}] \) (immediately followed)
  - \( V \rightarrow [\cdot \text{bck}] / \text{___} C [V, +\text{hi}, -\text{bck}] \) (in another syllable)

Collapses to:
- \( V \rightarrow [\cdot \text{bck}] / \text{___} (C [V, +\text{hi}, -\text{bck}] \)
- Note that by letting this rule apply to segments which are already \([-\text{bck}]\) (vacuous rule application) a feature is saved as otherwise it would be necessary to specify the input to the rule as \([V, +\text{bck}]\).

- E.g. In Korean \([r]\) an \([n]\) are in complementary distribution: \([r]\) only occurs when preceded by a vowel:
  - \( r \rightarrow n / \text{#} \)
  - \( r \rightarrow n / C \)
    - or \( r \rightarrow n / (\#, C) \)
    - or \( n \rightarrow r / \text{___} V \n      n / \text{elsewhere} \)

Conclusion
- Generative phonologies expanded the analysis to include underlying forms. The underlying form (or representation, UR) is a purely theoretical concept that is thought to represent a mental reality behind the way people use language. UR represents the person's language competency and serves as points of orientation to describe regularities of speech.
- System of binary features involves a big effort for the analysis and abstraction, because we need to
  - manipulate matrices of features instead of phonetic symbols,
  - find natural classes and
  - formulate phonological rules that apply to them;
  - deduct underlying forms
  - apply rules in good order

What does this all give us?
- **Economy**: instead of stocking all possible variants of pronunciation of a segment or a word we give one underlying form and one rule.
- **Productivity**: if we learn a new word, we can apply an already known rule.
  - E.g. French: divine \(\rightarrow\) divin
    - 'schtoumphine' \(\rightarrow\) 'schtoumphin'
- **Variation**: allows to account for geographic and social variation (changing the order of rules application).
  - E.g.:

<table>
<thead>
<tr>
<th>Southern French</th>
<th>Standard French</th>
</tr>
</thead>
<tbody>
<tr>
<td>/anne/</td>
<td>/anne/</td>
</tr>
<tr>
<td>Rule1: CiCi &gt; Ci</td>
<td>/ane/</td>
</tr>
<tr>
<td>Rule2: Nasalization</td>
<td>/ane/</td>
</tr>
<tr>
<td>Rule3: Vowel lowering</td>
<td>/ane/</td>
</tr>
<tr>
<td>Phonetic form</td>
<td>[ane]</td>
</tr>
</tbody>
</table>

- Generative phonology is an attempt to understand and explain the sound patterns of languages.
- Although not originally intended to serve such purpose, phonological rules can also be used to describe the sound patterns of children with disordered phonological systems.