Universität Tübingen
Seminar für Sprachwissenschaft

Phonetics & Phonology

Articulatory Phonetics

(Hall, Kapitel 1.1 – 1.5; Clark & Yallop, Chapter 2 & 3)

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The articulatory process

reminder:
An egressive pulmonic airstream (⇒ airstream process) passes through the larynx, more precisely the glottis (⇒ phonation)
in the oral tract, the sound receives its final shape (⇒ articulatory process)
The articulatory process

the vocal tract

sagittal section of the vocal tract — from X-ray to schema
The articulatory process

the vocal tract

three resonating cavities

nasal cavity
oral cavity
pharynx

the soft palate (the velum) can be lowered (⇒ airflow through nasal cavity) or raised (⇒ airflow only through oral cavity)
The articulatory process

obstructions in a flow cause turbulences to occur (vgl. Windkanal)

the exact nature of the turbulence is determined by the shape of the obstruction

this is the fundamental principle of the articulatory process: by forming constrictions in the resonating cavities the airstream is modified (turbulences are caused) and the resulting sound is shaped
The articulatory process

The constrictions are formed by the so-called **articulators**

- alveolar ridge/teeth ridge
- teeth (lat. dentes)
- lips (lat. labiae)
- tongue (lat. lingua)
- hard palate (lat. palatum)
- soft palate (lat. velum)
- uvula
- pharynx wall
- glottis
The articulatory process

Articulators

The tongue is further subdivided into regions:

- Tip (lat. apex)
- Blade (lat. lamina)
- Back (lat. dorsum)
- Root (lat. radix)
# The articulatory process

<table>
<thead>
<tr>
<th>German</th>
<th>English</th>
<th>Latin</th>
<th>adjectiv</th>
</tr>
</thead>
<tbody>
<tr>
<td>Zunge</td>
<td>tongue</td>
<td>lingua</td>
<td>lingual</td>
</tr>
<tr>
<td>Zungenspitze</td>
<td>tongue tip</td>
<td>apex</td>
<td>apikal</td>
</tr>
<tr>
<td>Zungenblatt</td>
<td>tongue blade</td>
<td>lamina</td>
<td>laminal</td>
</tr>
<tr>
<td>Zungenrücken</td>
<td>back (of tongue)</td>
<td>dorsum</td>
<td>dorsal</td>
</tr>
<tr>
<td>Zungenwurzel</td>
<td>tongue root</td>
<td>radix</td>
<td>radical</td>
</tr>
<tr>
<td>Lippen</td>
<td>lips</td>
<td>labiae</td>
<td>labial</td>
</tr>
<tr>
<td>Zähne</td>
<td>teeth</td>
<td>dentes</td>
<td>dental</td>
</tr>
<tr>
<td>Zahndamm</td>
<td>teeth/alveolar ridge</td>
<td>palatum</td>
<td>alveolar</td>
</tr>
<tr>
<td>harter Gaumen</td>
<td>hard palate</td>
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<td>palatal</td>
</tr>
<tr>
<td>weicher Gaumen</td>
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<td>uvula</td>
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</tr>
<tr>
<td>Zäpfchen</td>
<td>uvula</td>
<td>uvula</td>
<td>uvular</td>
</tr>
<tr>
<td>Rachen/-wand</td>
<td>pharynx</td>
<td>pharynx</td>
<td>pharyngal</td>
</tr>
<tr>
<td>Stimmritze</td>
<td>glottis</td>
<td>glottis</td>
<td>glottal</td>
</tr>
</tbody>
</table>
The articulatory process

consonants

during the articulation of **consonants** the airstream is obstructed at a supraglottal position

during the articulation of **vowels** the airstream can pass unhindered

**consonants** ⇔ **noise**               **vowels** ⇔ **clear sounds/tones**

consonants are classified according to three dimensions:

(1) the constrictions are formed by approaching/touching one articulator with another. The involved articulators determine the **place of articulation**

(2) the type of constriction determines the **manner of articulation**

(3) furthermore the resulting sound can be voiced or voiceless, which determines its **phonation**
Places of articulation

the constriction is formed by moving an **active articulator** towards a **passive articulator**

**active articulators** are the (more or less) flexible articulators in the lower part of the vocal tract

**passive articulators** are the (more or less) stationary articulators in the upper part of the vocal tract
Places of articulation

A pair of adjectives corresponding to active articulator-passive articulator is used to describe the exact place of articulation.

Some sounds make it necessary to introduce further regions:

- **postalveolar** (palato-alveolar): the region right behind the alveolar ridge.
- **sublaminal**: the bottom region of the tongue on the opposite side of the tongue back (i.e., the lamina).
Places of articulation

labial sounds

Labio-labial:
the lower lip approaches the upper
lip and forms a constriction

since both lips are involved those sounds
are rather called bilabial

some bilabial sounds are

\[ m \] as in \langle my \rangle, \langle american \rangle
\[ p \] as in \langle pie \rangle, \langle apple \rangle
\[ b \] as in \langle bee \rangle, \langle able \rangle
Places of articulation

labial sounds

**Labio-dental:**
the lower tip touches the outer and bottom sides of the upper incisors

some labio-dental sounds are

- \[ f \] as in *<fall>, <effect>*
- \[ v \] as in *<village>*
Places of articulation

apical ↔ laminal / dental ↔ alveolar

apico-/lamino-dental:
the tip/blade of the tongue forms a constriction with the edges/inner sides of the upper incisors

some apico-/lamino-dental sounds:
[θ] as in <thick> and <thin>
[ð] as in <then> and <these>

In most languages, the distinction between apical and laminal articulation is irrelevant and hence these sounds are referred to as dental sounds.
Places of articulation

apical ⇔ laminal / dental ⇔ alveolar

**apico-/lamino-alveolar**: the tip/blade of the tongue forms a constriction with the teeth ridge

Some apico-/lamino-alveolar sounds are:

- [t] as in *<tea>* and *<attention>*
- [d] as in *<dye>* and *<adult>*
- [n] as in *<nose>* , *<knee>* and *<manner>*
- [s] as in *<rice>* and *<mess>*
- [z] as in *<rise>* und *<maze>*

Again, if the apical/laminal distinction is of no importance, these sounds are simply called **alveolar** sounds.
Places of articulation

apical ↔ laminal / dental ↔ alveolar

many of the sounds above can be formed in an apical, laminal, dental, oder alveolar way

in the IPA there are diacritical symbols for a precise description of the place of articulation (where the „unmarked“ case is an alveolar sound):

\[
\begin{align*}
[d] & \text{ dental} \\
[d] & \text{ apikal} \\
[d] & \text{ laminal}
\end{align*}
\]

in most languages there are either dental sounds (Russian, Spanish) or alveolar sounds (German) but rarely both

instance of the latter: Malayalam: \[p\ brewingi\] (pig) vs. \[k\ drinkingi\] (first)
Places of articulation

postalveolar

**apico-postalveolar:**
  tongue tip slightly behind the teeth ridge

Some **apico-postalveolar** sounds:
  British English
  [ɨ] as in *<trip>* and *<try>*

**lamino-postalveolar:**
  tongue blade slightly behind the teeth ridge

Some **lamino-postalveolar** sounds:
  [ʃ] as in *<shy>*,* sheep*, *<rash>*
  [ʒ] as in *<measure>*,* vision*
Places of articulation

postalveolar

sublamino-postalveolar: undersurface of the tongue and postalveolar region

sublamino-postalveolar sounds are called retroflex

in some English dialects the 'r' is a retroflex sound: 
\[如期\] as in <read> und <red>.

retroflex sounds as \[ BEEN \] in Hindi and many other Indian languages.
Places of articulation

palatal and velar

**lamino/dorso-palatal:**
blade/back of tongue approaches hard palate

the only true palatal sound of English is 
\[ j \] as in <you>

a palatal sound of German is the
„ich-Laut“
\[ ç \] as in <ich> und <Milch>

in some variants of English, \[ ç \] may also occur, e.g. in <hue>
Places of articulation

palatal and velar

dorso-velar:
back of tongue approaches the soft palate (velum)

velar sounds include
[k] as in <king> and <bake>
[g] as in <game> and <bag>
[n] as in <thing>, <think>

as well as the German „ach-Laut“
[x] as in <Dach> und <Bucht>
Places of articulation

uvular and pharyngal

**Dorso-uvular:**
back of the tongue approaches the uvula

the „standard“ pronunciation of „r“ in German gives an example of an *uvular* sound

\[ R \] wie in <rein>

**radiko-pharyngal:**
the root of the tongue approaches the pharynx wall

*pharyngale* sound such as \[ \text{ʕ} \] occur e.g. in Arabic
Places of articulation

as discussed in the previous session, the glottis is of major importance for phonation.

however, it can also participate in articulation

one sound produced with the glottis is the glottal stop [ʔ]

to articulate [ʔ] the vocal folds are kept tightly together and then the glottis is opened rapidly ⇒ a click sound can be heard

the glottal stop occurs in German before word-initial vowels (cf. the corresponding English sentence): [ʔ]Anna [ʔ]aß [ʔ]ein [ʔ]Ei.

another glottal sound is [h] as in <have> und <behave>.
Places of articulation

glottal

This fact is responsible for letting German sound so “hard“ in the ear of non-native German speakers

[?] can also be found between two vowels, in particular if the second is stressed

cha[?]ótisch  Ru[?]íne  Be[?]ámter  O[?]áse

A sequence of two glottal stops is characteristic for denial:

[?Δ?Δ]  [?a?a]  [?m?m]
Places of articulation

summary

some combinations of active and passive articulator cannot form constrictions for anatomic reasons, e.g. *apiko-uvular, radiko-dental*

sometimes the description of places of articulation are shortened by using special expressions (e.g. *bilabial* for labio-labial, *retroflex* for sublamino-postalveolar)

sounds can be grouped together by specification of only the passive articulator (e.g. velar, palatal, uvular, pharyngal)

or by specification of the active articulator

- **labial** with lip involvement
- **coronal** with involvement of tongue tip or blade
- **dorsal** with involvement of tongue back, etc.
## Places of articulation

### Summary

<table>
<thead>
<tr>
<th>Place of Articulation</th>
<th>Description</th>
<th>Phonemes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Labial</td>
<td>Lower lip</td>
<td>[p b m]</td>
</tr>
<tr>
<td>Labiodental</td>
<td>Upper lip</td>
<td>[f v]</td>
</tr>
<tr>
<td>coronal</td>
<td>Teeth ridge</td>
<td>[t d n s]</td>
</tr>
<tr>
<td>Postalveolar</td>
<td>Behind teeth ridge</td>
<td>[ʃ ŋ]</td>
</tr>
<tr>
<td>Retroflex</td>
<td>Sublamina</td>
<td>[ɾ r]</td>
</tr>
<tr>
<td>dorsal</td>
<td>Hard palate</td>
<td>[ɾ]</td>
</tr>
<tr>
<td>Palatal</td>
<td>Soft palate</td>
<td>[k g x n]</td>
</tr>
<tr>
<td>Velar</td>
<td>Uvula</td>
<td>[ɾ]</td>
</tr>
<tr>
<td>Uvular</td>
<td>Pharynx wall</td>
<td>[h f]</td>
</tr>
<tr>
<td>Radical</td>
<td>Tongue root</td>
<td>[ʔ h]</td>
</tr>
<tr>
<td>—</td>
<td>Vocal folds</td>
<td>(vocal folds)</td>
</tr>
</tbody>
</table>
the second important parameter for classifying consonant articulation (next to the place of articulation) is the **manner of articulation**

for instance:

[t s] are both alveolar sounds ⇒ **same place of articulation**

[k x] are both velar sounds ⇒ **same place of articulation**

[t k] are articulated by the rapid release of a complete oral closure ⇒ **same manner of articulation**

[s x] are articulated by forming a constriction that causes a turbulence in the flowing air, producing a hissing sound ⇒ **same manner of articulation**
Manner of articulation

stops/plosives

**stops** (with egressive pulmonic airstream: **plosives**) are formed by a total oral closure that is rapidly released. Hereby the velum is raised and the air flows through the oral cavity only.

<table>
<thead>
<tr>
<th></th>
<th>voiceless</th>
<th>voiced</th>
</tr>
</thead>
<tbody>
<tr>
<td>bilabial</td>
<td>[p]</td>
<td>[b]</td>
</tr>
<tr>
<td>alveolar</td>
<td>[t]</td>
<td>[d]</td>
</tr>
<tr>
<td>retroflex</td>
<td>[ʈ]</td>
<td>[ɖ]</td>
</tr>
<tr>
<td>palatal</td>
<td>[c]</td>
<td>[ɟ]</td>
</tr>
<tr>
<td>velar</td>
<td>[k]</td>
<td>[ɡ]</td>
</tr>
<tr>
<td>uvular</td>
<td>[q]</td>
<td>[ɢ]</td>
</tr>
<tr>
<td>glottal</td>
<td>[ʔ]</td>
<td></td>
</tr>
</tbody>
</table>

- Hindi
- Hungarian
- Tlingit
- German
### Manner of articulation

**fricatives**

Both articulators form a constriction such that causes a turbulence in the flowing air, producing a hissing sound.

<table>
<thead>
<tr>
<th>Articulation</th>
<th>Voiceless</th>
<th>Voiced</th>
<th>Language</th>
</tr>
</thead>
<tbody>
<tr>
<td>bilabial</td>
<td>[ɸ]</td>
<td>[β]</td>
<td>Ewe</td>
</tr>
<tr>
<td>labiodental</td>
<td>[f]</td>
<td>[v]</td>
<td></td>
</tr>
<tr>
<td>dental</td>
<td>[θ]</td>
<td>[ð]</td>
<td></td>
</tr>
<tr>
<td>alveolar</td>
<td>[s]</td>
<td>[z]</td>
<td>Mandarin-Chinesisch</td>
</tr>
<tr>
<td>postalveolar</td>
<td>[ʃ]</td>
<td>[ʒ]</td>
<td>German / Margi</td>
</tr>
<tr>
<td>retroflex</td>
<td>[ʂ]</td>
<td>[ʐ]</td>
<td>German / Greenlandic</td>
</tr>
<tr>
<td>palatal</td>
<td>[ɕ]</td>
<td>[ɭ]</td>
<td>German / Greenlandic</td>
</tr>
<tr>
<td>velar</td>
<td>[x]</td>
<td>[ɣ]</td>
<td></td>
</tr>
<tr>
<td>uvular</td>
<td>[χ]</td>
<td>[ʁ]</td>
<td></td>
</tr>
<tr>
<td>pharyngal</td>
<td>[h]</td>
<td>[ɦ]</td>
<td>Arabic</td>
</tr>
<tr>
<td>glottal</td>
<td>[h]</td>
<td>[ɦ]</td>
<td>German / Czech</td>
</tr>
</tbody>
</table>
Manner of articulation

affricates

affricates are simple sequences of a plosive followed by a homorganic fricative

homorganic means being produced by the same active articulator

it makes sense to regard affricates (as e.g. [tʃ] in <change>) as one single segment and not as a sequence of two sounds [tʃ] (as we will see later)

to mark their special status, an arch symbol ː is used in the IPA to span the sequence of plosive and fricative
Manner of articulation

affricates

examples:

\[
\begin{align*}
\text{[tʃ]} & \quad \text{in } \langle \text{cheer} \rangle & \quad \text{coronal alveolar} & \quad \text{coronal postalveolar} \\
\text{[dʒ]} & \quad \text{in } \langle \text{Job} \rangle & \quad \text{coronal alveolar} & \quad \text{coronal postalveolar}
\end{align*}
\]

examples from German are

\[
\begin{align*}
\text{[ts]} & \quad \text{in } \langle \text{Zeit} \rangle & \quad \text{coronal alveolar} & \quad \text{coronal alveolar} \\
\text{[pf]} & \quad \text{in } \langle \text{Pfeife} \rangle & \quad \text{labio - labial} & \quad \text{labio - dental}
\end{align*}
\]

example from Swiss German

\[
\begin{align*}
\text{[kʃ]} & \quad \text{in } \langle \text{Kind} \rangle & \quad \text{dorsal velar} & \quad \text{dorsal velar}
\end{align*}
\]

no affricates are

\[
\begin{align*}
\text{[ks]} & \quad \text{in } \langle \text{Hexe} \rangle & \quad \text{dorsal velar} & \quad \text{coronal alveolar} \\
\text{[ps]} & \quad \text{in } \langle \text{Psalm} \rangle & \quad \text{labio - labial} & \quad \text{coronal alveolar}
\end{align*}
\]
Manner of articulation

nasal

**nasal**

a complete oral closure is built, but the velum is lowered such that air can flow through the nasal cavity

<table>
<thead>
<tr>
<th>Manner</th>
<th>Sound</th>
<th>Example</th>
</tr>
</thead>
<tbody>
<tr>
<td>bilabial</td>
<td>[m]</td>
<td></td>
</tr>
<tr>
<td>labiodental</td>
<td>[ɲ]</td>
<td>Teke</td>
</tr>
<tr>
<td>alveolar</td>
<td>[n]</td>
<td></td>
</tr>
<tr>
<td>retroflex</td>
<td>[ɳ]</td>
<td>Hindi</td>
</tr>
<tr>
<td>palatal</td>
<td>[ɲ]</td>
<td>Spanish &lt;=n&gt;</td>
</tr>
<tr>
<td>velar</td>
<td>[ŋ]</td>
<td></td>
</tr>
<tr>
<td>uvular</td>
<td>[N]</td>
<td>Japanese</td>
</tr>
</tbody>
</table>
Manner of articulation

approximants

approximants

similar to a fricative a constriction is formed which is, however, not narrow enough to cause turbulences in the air flow and hence the air can pass relatively unhindered.

approximants can be further classified by the type of constriction.

in the case of lateral approximants (short: laterals) the passes at the sides of the tongue which forms a central closure.

in the case of central approximant the air passes in the center while there are constrictions at the sides of the oral cavity.
Manner of articulation

approximants — laterals

the following sounds are lateral approximants (short: laterals)

<table>
<thead>
<tr>
<th>Approximant</th>
<th>Symbol</th>
<th>Example</th>
</tr>
</thead>
<tbody>
<tr>
<td>alveolar</td>
<td>[l]</td>
<td></td>
</tr>
<tr>
<td>retroflex</td>
<td>[l]</td>
<td>Toda</td>
</tr>
<tr>
<td>palatal</td>
<td>[ʎ]</td>
<td>Italian &lt;gli&gt; [ʎi]</td>
</tr>
<tr>
<td>velar</td>
<td>[ʟ]</td>
<td>middle Waghi</td>
</tr>
</tbody>
</table>

Note that there are also lateral fricatives, e.g. in some north- and south american languages

<table>
<thead>
<tr>
<th>Manner</th>
<th>Voiceless</th>
<th>Voiced</th>
</tr>
</thead>
<tbody>
<tr>
<td>alveolar</td>
<td>[ɬ]</td>
<td>[ɮ]</td>
</tr>
</tbody>
</table>
Manner of articulation

approximants – central

the following sounds are central approximants:

<table>
<thead>
<tr>
<th>Manner of Articulation</th>
<th>Symbol</th>
<th>Example</th>
</tr>
</thead>
<tbody>
<tr>
<td>labiodental</td>
<td>[ʋ]</td>
<td>Dutch &lt;water&gt; [ˈvʌtər]</td>
</tr>
<tr>
<td>alveolar</td>
<td>[ɹ]</td>
<td>Engl. &lt;try&gt; [trɪə]</td>
</tr>
<tr>
<td>retroflex</td>
<td>[ɻ]</td>
<td>Engl. &lt;red&gt; [rɛd]</td>
</tr>
<tr>
<td>velar</td>
<td>[ɯ]</td>
<td>Aranda</td>
</tr>
</tbody>
</table>

the following two central approximants are also called semi-vowels or glides

<table>
<thead>
<tr>
<th>Manner of Articulation</th>
<th>Symbol</th>
<th>Example</th>
</tr>
</thead>
<tbody>
<tr>
<td>'labio-velar'</td>
<td>[w]</td>
<td>Engl. &lt;wed&gt; [wɛd]</td>
</tr>
<tr>
<td>palatal</td>
<td>[j]</td>
<td>Engl. &lt;you&gt;</td>
</tr>
</tbody>
</table>
Manner of articulation

trills

trills

are produce by a vibration of the two articulators, caused by the current of air

labial  [B]  „make the horse stop“-sound
alveolar  [r]  süddt. „gerolltes“ 'r'
uvular  [R]  German „standard“ „R“-sound
Manner of articulation

taps & flaps

taps & flaps
are produced by a single contraction of the muscles of the tongue tip such that one articulator is thrown against another as in a rapid stop gesture

alveolar [ɾ]
retroflex [ɾ̃]

in some dialects of English (American English) for <t>:<sitting> [sɪtɪŋ]

in Spanischen the tap contrasts with [r]:<pero> (but) <perro> (dog)
[peɾo] [pero]
Manner of articulation

Further classification

sibilants are those fricatives (and affricates), that have more acoustic energy at a higher pitch than other fricatives, i.e. \[s z ʒ ʂ ʐ\] (note: this is an auditive characterisation)

obstruents is the collection of plosives, fricatives and affricates

sonorants are all other non-obstruent sounds

sonorants are usually voiced and are more tone-like, obstruents are rather noise-like

rhotics are the 'R' sounds and comprise central approximants \[ɹ ɾ\], trills wie \[r R\] and taps such as \[ɾ\]

liquids is a cover term for rhotics and 'l' sounds (i.e. lateral approximants)
Manner of articulation

Further classification

Manner of articulation

- **Consonants**
  - **Obstruents**
    - **Plosives** [p d k]
    - **Affricates** [ts pf]
    - **Fricatives** [f v ʃ]
  - **Sonorants**
    - **Liquids**
      - **Rhotics** [ɾ ɹ]
      - **Laterals** [l]
    - **Nasals** [m ɲ]
Phonation

**phonation** is the third important parameter in the classification of consonant articulation.

The vocal folds may — depending on the exact state of the glottis (see last session) — vibrate and cause the sound to be **voiced**, or otherwise **voiceless**.

Obstruents are found in both variants, sonorants (like e.g. nasal sounds, laterals, etc.) are usually **voiced**.

In some languages, voiceless sonorants are found, e.g. voiceless nasal sounds in Burmese (Myanmar)

\[ [ mâ ] \ (healthy) \ vs. \ [ mə̀ ] \ (order) \]

A voiceless sound is marked by the diakritic in the IPA.
The IPA table

Consonants

<table>
<thead>
<tr>
<th>CONSONANTS (PULMONIC)</th>
<th>Bilabial</th>
<th>Labiodental</th>
<th>Dental</th>
<th>Alveolar</th>
<th>Postalveolar</th>
<th>Retroflex</th>
<th>Palatal</th>
<th>Velar</th>
<th>Uvular</th>
<th>Pharyngeal</th>
<th>Glottal</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Plosive</strong></td>
<td>p b</td>
<td>t d</td>
<td>t d</td>
<td>c j</td>
<td>k g</td>
<td>q g</td>
<td></td>
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<td>?</td>
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<tr>
<td><strong>Nasal</strong></td>
<td>m m̃</td>
<td>n</td>
<td>η n</td>
<td>η η</td>
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<tr>
<td><strong>Trill</strong></td>
<td>B</td>
<td>r</td>
<td>r</td>
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<td></td>
<td>R</td>
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<tr>
<td><strong>Tap or Flap</strong></td>
<td>ɾ ɾ̃</td>
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<tr>
<td><strong>Fricative</strong></td>
<td>ʋ ʋ̃</td>
<td>f v</td>
<td>θ ð</td>
<td>s z</td>
<td>ʃ ʒ</td>
<td>ç ʝ</td>
<td>x y</td>
<td>χ ʁ</td>
<td>h f h h h</td>
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</tr>
<tr>
<td><strong>Lateral fricative</strong></td>
<td>ɭ ɭ̃</td>
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<tr>
<td><strong>Approximant</strong></td>
<td>u j</td>
<td>r</td>
<td>l j</td>
<td>w l</td>
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<tr>
<td><strong>Lateral approximant</strong></td>
<td>l</td>
<td></td>
<td>l</td>
<td>ʎ ʎ̃</td>
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</table>

Where symbols appear in pairs, the one to the right represents a voiced consonant. Shaded areas denote articulations judged impossible.
Exercise

(1) Go to the Interactive IPA Chart on the web site http://web.uvic.ca/ling/resources/ipa/ipa-lab.htm and listen to the various consonant sounds

(2) Note the IPA-Symbol for the following sounds:
   (a) alveolar trill       (c) voiced uvular fricative
   (b) palatal lateral     (d) palatal glide

(3) Give an exact description of the following sounds:
   (a) \[n\]       (b) \[pf\]       (c) \[t\]       (d) \[ɾ\]

(4) Why is there no voiced counterpart for the voiceless glottal plosive \[ʔ\]?