Last week...

- Introduction to the architecture of the vocal tract
- Pulmonic egressive airstream mechanism
- Focus on *pulmonic consonants*
  - manner – kind of constriction
    - plosive, fricative, approximant, etc.
  - place – location of the construction
    - bilabial, labiodental, dental, alveolar, etc.
- Mentioned different airstreams
  - pulmonic
  - glottalic
  - velaric
This week

• Finish off airstreams
• Talk about voicing
• Vowels
• Introduction to *phonetic* vs. *phonemic* transcription
Airstream

• Airflow from lungs is just one possibility for consonant production
  – pulmonic ingressive – not used
    • except in 1 constructed ceremonial language Damin
    • stylistic uses (North German etc.: ‘ja’)
  – other airstream mechanisms:

  – glottalic – larynx used as a piston
    • both ingressive and egressive
  – velaric / lingual / oral – tongue creates airflow
    • only ingressive found naturally (clicks)
    • except Damin again!
Glottalic ingressives

• Implosives
  – only plosives

• Larynx lowers
  – acts like plunger in a syringe
  – reduces air pressure above it
  – release closure, air sucked in

• Tend to be voiced – vocal folds vibrate
  – Voiceless implosives are found (Lendu)
Glottalic egressives

- **Ejectives**
  - only obstruents (plosive, fricatives, affricates)

- **larynx raises**
  - works like a piston
  - compresses air above it
  - can’t maintain frication for long

- **only voiceless**
  - vocal folds must be tightly adducted = glottal stop
  - some ejectives stronger than others
  - do occur in English! word-final voiceless plosives
Velaric ingressives

• Clicks
  • utilise sucking mechanism
    – create velar closure (may be uvular too)
    – create second closure (at lips, or with front of tongue)
    – closures are simultaneous
  • retract tongue between the two closures
    – release front closure – air sucked in
    – Damin has velaric egressives (obviously!)
• Common paralinguistically
  – as consonants in southern (and eastern) Africa
Velaric ingressives

low pressure

[kO]
Summary of airstreams

<table>
<thead>
<tr>
<th></th>
<th>ingressive</th>
<th>egressive</th>
</tr>
</thead>
<tbody>
<tr>
<td>pulmonic</td>
<td>(stylistic)</td>
<td>universal</td>
</tr>
<tr>
<td>glottalic</td>
<td>implosive</td>
<td>ejective</td>
</tr>
<tr>
<td>velaric</td>
<td>clicks</td>
<td>(Damin)</td>
</tr>
</tbody>
</table>
Voicing

• The third aspect of defining pulmonic consonants
  – contrast for obstruents (plosives & fricatives)

• Voicing relates to vocal fold vibration
  – typically seen as presence (voiced) vs. absence (voiceless)
    • slightly more complicated (aspiration)…

  – vocal fold vibration is
    • periodic (periodicity)

  – rate of vibration can be measured
    • fundamental frequency (F0)
    • measured in Hertz (Hz) = repetitions per second

  – voice quality
    • vocal fold vibration can have different characteristics
Voice

Aerodynamically driven
Vocal folds driven apart from below

• air pressure opens them
• air rushes through the gap (glottis)
• pressure falls in rushing air (cf. slamming doors on a windy day)
• vocal folds spring back together

Cycle starts again

(image from Stevens 1998)
Voicing

• Typical rates of vibrations
  – adult male = 125 Hz
  – adult female = 200 Hz
  – 3 year old child = 300-400 Hz
    • Flies’ wings vibrate around 170 Hz

• Rate of vibration = F0
  – related to sensation of pitch in voiced sounds
  – one reason why males have lower pitched voices than females
Voicing

Repeated pattern seen in nasal (at left) and following vowel (at right)
Aspiration

- English voiceless fricatives have no vocal fold vibration
- Voiceless plosives also have no vocal fold vibration
  - but there is an additional property
    - voicing does not begin immediately after the release of a voiceless plosive in English
      - there is a delay between release and voice onset
    - during the delay – vocal folds close from wide position
      - airflow through the vocal folds creates turbulence
      - first oral, then glottal
      - called ‘aspiration’
Vowels

• All languages have voiced vowels
  – Vowels differ from consonants
  – Vowels lack aerodynamically significant constrictions
    • they have a single manner (vowel)
    • they do not show a particular constriction location (place)
    • they do not – in most languages – contrast for voicing

• How do we describe vowels?
The vowel quadrilateral

Front  Central  Back

Close  \( \text{i} \bullet \text{y} \)  \( \text{i} \bullet \text{u} \)  \( \text{u} \bullet \text{u} \)

Close-mid  \( \text{e} \bullet \phi \)  \( \text{e} \bullet \theta \)  \( \gamma \bullet \text{o} \)

Open-mid  \( \varepsilon \bullet \rho \)  \( \varepsilon \bullet \theta \)  \( \lambda \bullet \text{a} \)

Open  \( \text{a} \bullet \rho \)  \( \rho \bullet \rho \)  \( \alpha \bullet \text{a} \)

Where symbols appear in pairs, the one to the right represents a rounded vowel.
The vowel quadrilateral

- Semi-articulatory, semi-auditory
  - Vowel height defines two extremes
    • close/high vs. open/low
  - Vowel fronting defines two extremes
    • front vs. back
  - Lip-rounding
    • rounded vs. unrounded (spread vs. neutral)

- Points between these extremes are auditory
  • impression that points are equidistant
Transcription

• Spelling is unreliable
  – see vs. sea vs. C
  – rough vs. cough vs. though vs. plough vs. through

• Digraphs
  – English <th>
    • voiceless in ‘thin’
    • voiced in ‘then’
      – Not actually two sounds
        » pothole vs. other

• Different languages
  – English <sh> = German <sch>, French <ch>, Hungarian <s>,
    Welsh <si>, Norwegian <sj>, Turkish <ṣ>, Russian <ɯ>, Arabic
    <ش> etc., <
Transcription

• IPA symbols give us a set of agreed symbols
• based on known human speech production capabilities
• Convert speech into a series of segmental symbols

• Important
  – speech is not static, it is dynamic
  – languages do not manage transitions in the same way
  – some aspects of movement linguistically significant
Plosive

- Complete constriction

- Plosive = oral stop
  - complete oral constriction
  - velum raised
  - no airflow
  - oral pressure increases
  - released explosively

(Images from Ashby & Maidment 2005)
Plosive
Phonetics vs. phonology

• How many sounds does a language have?
  – Depends what we mean by sound…

  – Phonetically distinct sounds (*phones*)?
    • glottal vs. alveolar plosive in ‘cat’
    • laminal fricative in ‘sheep’ vs. apical fricative in ‘shark’
    • oral vowel in ‘bid’ vs. nasal vowel in ‘bin’
    • central vowel in ‘cud’ vs. retracted vowel in ‘cull’

  – Lexically contrastive sounds (*phonemes*)?
    • fan vs. pan
    • ram vs. lamb
    • sin vs. shin
    • ten vs. tan
Phonetics vs. phonology

• Phonetics is about physics – actual sounds
  – articulatory differences
  – acoustic differences

• Phonology is about function – patterns of sounds
  – contrastive differences
  – systematic contextual variants
  – alternations

• We use brackets to indicate whether IPA symbols are used phonetically or phonologically
Phonetics vs. phonology

• Use /slash brackets/ for phonemic transcription
  – symbolising phonemes
  – also called broad transcription
  – the ideal alphabetical writing system
    • only represent lexical contrasts

• Use [square brackets] for phonetic transcription
  – symbolising phones
  – also called narrow transcription
  – a very imperfect writing system!
    • represent any tiny detail
Phonemes & allophones

• Phonetically distinct sounds (*phones*)
  – glottal vs. alveolar plosive in ‘cat’
  – laminal fricative in ‘sheep’ vs. apical fricative in ‘shark’
  – oral vowel in ‘bid’ vs. nasal vowel in ‘bin’
  – central vowel in ‘cud’ vs. retracted vowel in ‘cull’

• These are all contextual variants
  – they occur systematically in different contexts
  – complementary distribution – *never contrastive* in English

• These are allophones of different phonemes
  – allophone = variant
Next week...

• More on phonemes & allophones
• English allophonic processes
• Crosslinguistic differences
Reading

  – chapters 2, 5 & 9

  – chapter 5

  – section 4.3, chapters 5 & 6

Questions? Email Mark: markjjones@cantab.net