English consonants: Phonemes and Allophones

Effects related to aspiration and ‘devoiced’ voiced sounds and a few other issues

Phonemes

- Strict, detailed definitions of the term phoneme are complex
  - Not part of this course
  - Take phonology courses to fight over the details
- Rough and ready idea is indispensable for practical phonetics
  - Must make a distinction between phonemic and allophonic differences

Rough definition of phoneme

- Phoneme (*Concise Dictionary of Linguistics*, Oxford U. Press 1997)
- "The smallest distinct sound unit in a given language: e.g. /ˈtɪp/ in English realizes the three successive phonemes, represented in spelling by the letters *t*, *i*, and *p*.

Phonemic differences vs. allophonic differences

- Differences in speech sound that can signal differences between two different words are *phonemic differences*
- Other differences in speech sound that are clearly audible are only *allophonic differences*
  - ‘pronunciation variants’ that cannot signal different words.

Representing allophonic differences

- 'Broad' (= coarse-grained) transcription enough for phonemic representation
  - Choose simple symbol for a 'representative' (allo)phone
- 'Narrow' (= fine-grained) transcription often requires diacritics
- Diacritics for stops

  p^h - aspirated p

  $p^{\neg}$ - 'p with inaudible release' ('unreleased p')

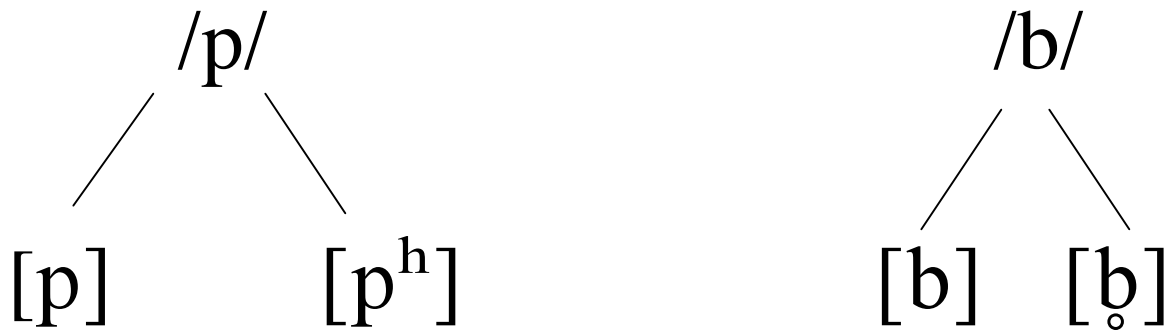
  $b̥$ - '(partially) devoiced b'

Examples: ‘pie, spy, buy’

- ‘pie’ [ˈpʰaj]
- spy [ˈspaj]
- ‘buy’ [ˈb̥aj] or [ˈbaj]
- Which of [b̥] [pʰ] [p] are allophones of the same phoneme?

Answer: ‘pie, spy, buy’

Phonemes in ‘/’ (slash or solidus, pl solidi) marks



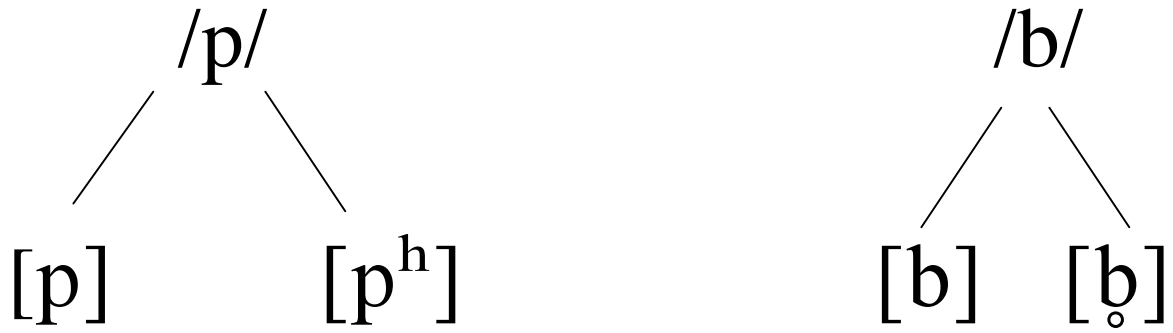
Phones in square brackets

Examples ‘Stop.’, ‘Stop!’, ‘Stop!!’, ‘Stob!’

- ‘Stop.’ [ˈstɑpˀ]
- ‘Stop!’ [ˈstɑp]
- ‘Stop!!’ [ˈstɑpʰ]
- ‘Stob!’ [ˈstab] or [ˈstɑb̚]
- Which of [b] [pʰ] [p] are allophones of the same phoneme?

Answer: ‘Stop(!!!) Stob.’

Phonemes in ‘/’ (slash or solidus, pl solidi) marks



Phones in square brackets

Rough notation

Conditioned allophone: The phoneme /X/ is realized as phone [y] in environment between A and B

/X/ --> [y] / [A] _ [B]

Allophone in **free variation**

/X/ --> [y] or [z] (optionally)

Example allophone rule

/p/ --> { [p^h] / #__
{ [p^h] / ˘v__ˈV
{ [$p^{\neg}$] / __# (optionally)
{ [p] / s__
{ [p] elsewhere

= ‘word boundary’

˘v = ‘weak stressed’ or ‘unstressed’ or ‘reduced’ vowel’

ˈV = primary- stressed full vowel

ˌV = secondary-stressed (full)

Translation

- The phoneme /p/ is realized as an aspirated p (the phone [p^h]) at the beginning of a word or between a weak vowel and a stressed vowel.
- It is realized optionally as an unreleased (inaudibly released) p (the phone [$p^{\urcorner}$] word finally
- It is realized as an ordinary voiceless (un- or weakly- aspirated) stop after /s/ and elsewhere.

Allophone rule sheet to follow

- We will examine some important allophones in English Cs and Vs
  - Then I'll handout rule summary (and post on web)
- For details see Chapter 3 of Rogers and Appendix F (p 292 - 298)
  - Our rules will be much shorter

Allophones of Consonants

- Many important details in English ‘narrow phonetics’ related to voiced/voiceless distinction in obstruents

Allophones of stops: Aspiration and release

- Consider the following words
- ‘tip’, ‘pit’, ‘spit’, ‘plum’, ‘queen’, ‘apt’
- Broad and Narrow transcriptions
- ‘Line drawings’ showing relative timings of constrictions at articulators
  - (See Rogers p 25-27 for overview)

Aspiration etc. ‘pit, spit’

‘pit’

/ ˈpɪt / [ˈpʰɪtʰ], [ˈpʰɪt˺], [ˈpʰɪt]

‘spit’

/ ˈspɪt / [ˈspɪtʰ], [ˈspɪt˺], [ˈspɪt]

/p, t, k/ **always** aspirated at beginnings of words in stressed syllables (always)

Never aspirated after /s/.

Variable word finally, often with inaudible release (‘unreleased’)

Timing of articulator movement

- Many details of English consonant allophones can be illustrated with diagrams
- Very rough sketches of
  - Relative degrees of constriction of supra laryngeal articulators
  - Characterization of lottal activity
  - Relative timing of constrictions of different articulators and of changes in glottal activity

Simple example

- Consider:
  - Voiced, voiceless and voiceless aspirated stops
  - E.g. [d] [t] and [t^{h}]
- All involve very similar activity of the supra glottal articulators
- What differs is timing relations to glottal events
- Line diagrams can make this idea clear

Timing diagram Rogers p 51

Graphic
unavailable
(see Figure 3.3
of Rogers
2000)

SLVT articulators in Rogers' line drawings

- Rough cut of major articulatory regions
  - Supralaryngeal articulators
    - Labial - bilabial or labiodental
    - Coronal - tongue tip or blade
    - Dorsal - body of tongue
    - Velic - velo-pharyngeal port
  - Glottal activity (e.g voicing state)

For supra glottal articulators

- Separation of lines relates to degree of constriction at that articulatory region
- Closed : —— stops
- Slightly open: ═══ fricatives
- More open: ——
—— approximants
- Most open : ——
—— vowels

More articulators (assignment 2)
Rogers p 35 Figure 2.5

- Graphic unavailable

My timing drawings: glottal states

- Voiceless states of **glottis**

  =:=:=:=: Slightly open (as in aspiration or [h])

  ====== Closed tight as in [ʔ]

  ——————— Unknown (either === or :=:=:)

- Voiced state of **glottis** (typing)

  vvvvvvvvv -- voicing (folds buzzing)

- Voice-ready (typing)

  xxxxxx -- vocal folds about ready to voice but not buzzing

My timing drawings: articulators

- Rogers' "velic" = my "VPPort"

- Typing:

  ———————— Closed articulator (as in stops)

  < Opening articulator (<<<< longer opening)

  > Closing articulator

  =:=:=: Slightly open (as in fricatives)

  :::::::::::: Pretty open articulator (as in approximants)

  ooooooo Quite open articulators (as in vowels)

Timing diagrams See Rogers p. 51 fig 3.3

/d ɑ / *Negative VOT*

Coronal ——<oooooooooooooo *Voicing starts before <*

Glottal vvvvvvvvvvvvvvvvv (voicing leads opening)

/ t ɑ / Near *Zero VOT*

Coronal ——<oooooooooooooo *Voicing starts at <*

Glottal =:=:=:vvvvvvvvvvvvvv (short voicing lag)

/t^h ɑ / Positive VOT

Coronal ——<oooooooooooooo Voicing starts after <

Glottal :=:=:=:=:=:vvvvvvvvv (long voicing lead)

English ‘partly voiced’ stops (see Rogers’ p 47.)

[d ɑ] Fully voiced ‘d’

Coronal ——<oooooooooooooo *Voicing starts **before** <*

Glottal vvvvvvvvvvvvvvvvv (voicing leads opening)

[d̥ ɑ] *Devoiced* ‘d’

Coronal ——<oooooooooooooo *Voicing tries to start at or before <*

Glottal xxxvvvvvvvvvvvvvvvv (voicing leads opening)

[t ɑ] Unaspirated ‘t’

Coronal ——<oooooooooooooo Voicing starts **shortly after <**

Glottal :=:=:=:vvvvvvvvvvvvvvv

Devoiced ‘d’ and unaspirated ‘t’ may often be perceptually equivalent

Obstruents weakly voiced in English

- Many languages work hard to keep voicing going during obstruents
  - E.g. French, Russian
- English does not
  - Phonemically voiced stops, fricatives and affricates only likely to show true voicing during constriction when they are between voiced sonorants (approximants and vowels)

Examples

- /ˈbɑˈbɑbsəˈbɑb/ -->

  [ˈb̥ɑˈbɑb̥səˈbɑb̥]

- /ˈzɑˈzɑzsəˈzɑz/ -->

  [ˈz̥ɑˈzɑz̥səˈzɑz̥]

[d̥] vs. [t] ? Any real difference

- 'Devoiced' obstruents can be very similar to voiceless unaspirated sounds with respect to 'actual' voicing
- Small differences may remain in 'excitation' from larynx
  - Other 'secondary features' of 'devoiced voiced' sounds resemble ordinary voiced sounds
    - so they may **sometimes** be perceptually separable

Secondary features of Voiced vs voiceless obstruents

- **Voiced**
  - Lower amplitude of burst or frication
    - (= '*less loud*')
  - Constriction duration **shorter** (VCV)
  - **Preceding** vowels **longer** (VC)
- **Voiceless**
  - Higher amplitude of burst or frication
    - (= *'louder'*)
  - Constriction duration **longer** (VCV)
  - **Preceding** vowels **shorter** (VC)

Side effects

- So far we've looked mainly at allophones of voiced and voiceless obstruents themselves
  - Some special things happen to things next to obstruents
    - e.g. vowels are shorter before voiceless obstruents
- Next: Effects on approximants next to aspirated obstruents

‘Spill-over’ effects of aspiration

/ˈpliz/ --> [ˈpʰ l̥ i z]

Lab. —<ooooooooooooo

Cor. ooooo:::::oooooo:=:=

Glot. :=:=:=:=vvvvvvvvvv

Open glottis (aspiration) extends through much of /l/

Flapping (tapping)

- Flapping (tapping)
  - /t/ and /d/ often realized as [ɾ] / ˈV__ ˘v
  - Voiced alveolar flap (or tap) between stressed and 'weak' vowel
    - This is 'opposite' of one good aspiration environment ˘v__ˈV
      - Roughly speaking
        - » aspriation makes stops 'more devoiced and less sonorant'
        - » flapping makes /t,d/ 'more voiced and more sonornant'
- **Example**:
  '*attack*' [əˈtʰæk] vs. '*attic*' [ˈæɾɪk]

Flapping more examples

- Example from child's speech
  - Baby: '*Daddy*' [ˈdæˌdi]
  - Toddler: '*Daddy*' [ˈdæɾɨ]
  - 5-year old (extra polite): '*Daddy*' [ˈdæˌtʰi]
- More examples

'*buddy*' /ˈbʌ dɨ/ --> [ˈb̥ʌ ɾ ɨ]

'*butter*' /ˈbʌ dəɹ/ --> [ˈb̥ʌ ɾ ɚ˞]

'*sitter*' /ˈsɪtəɹ/ --> [ˈsɪɾɚ˞]

'*city*' /ˈsɪtɨ/ --> [ˈsɪɾɨ]

Place assimilation and coarticulation

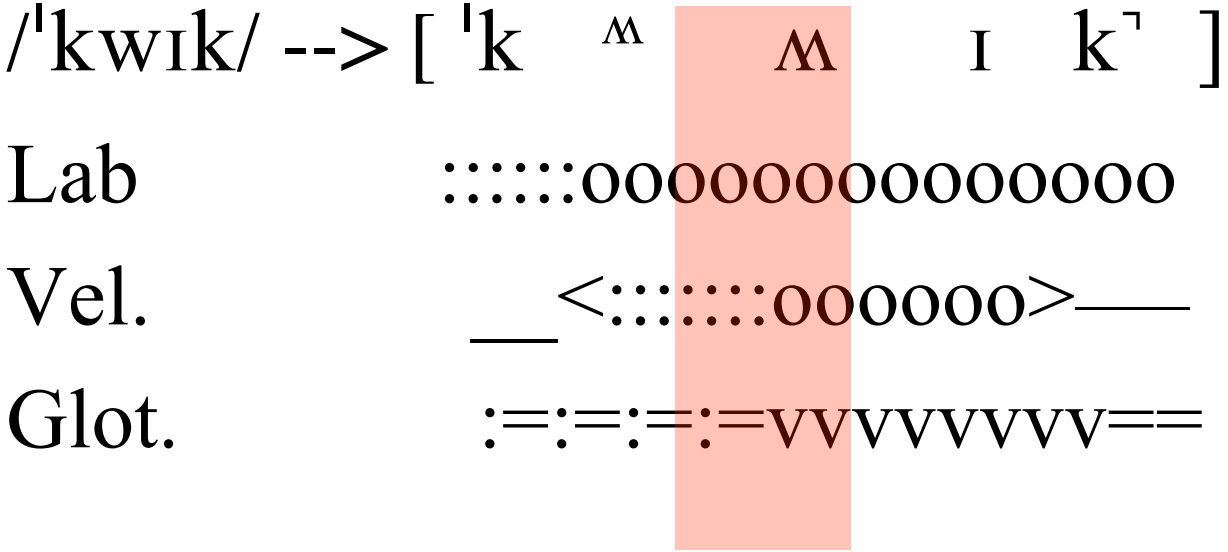
- Small changes in place of articulation in some consonants
  - Alveolar consonants become dental before θ ð

    ‘*tenth*’ /ˈtɛnθ/ --> [ˈtɛn̪θ]
    - ‘width’ and ‘stealth’ may show similar changes in /d/ and /l/
- Stops
  - Labialized before rounded vowels [w] and [ɹ]
    - ‘dwell’ [ˈdʷwɛɬ] ; ‘Gwen’ [ˈgʷwɛ̃n], ‘twin’; [ˈtʷʰw̥ĩn] or (?) [ˈtᵚʍĩn],

Complex coarticulation in /stop+r/

- /t/ and /d/ retroflexed, rounded (and possibly affricated) before /ɹ/
  - ‘train’
    [ˈtʰ̟ɹ̟ẽjn] or [ˈʈsʷ̟ɹ̟ẽjn] or maybe even [ˈʈsʍ̟ɹ̟ẽjn]
    - Kids sometimes spell ‘train’ as ‘chrain’
  - ‘drain’
    [ˈɖɹẽjn] or [ˈɖʊʷɹẽjn]

‘Spill-over’ effects aspiration and rounding coarticulatic.



Broad transcription /kwik/. Open glottis (aspiration) extends through much of /w/, yielding [w̥] or [ʍ]

Clear and dark ‘l’ in NA Eng.

- At beginning of syllables in N.A. English, /l/ is relatively ‘clear’ [l]
- At end of syllables, it is relatively ‘dark’ [ɬ]
  - Often described as ‘velarized’ but may more often be pharyngealized
  - Dark [ɬ] often shows up as a ‘syllabic’ l
    - We will not systematically distinguish it from schwa+dark l
- Examples
  - ‘pal’ [ˈpʰæɬ] v. ‘lap’ [ˈlæp]
  - ‘little’ [ˈlɪɾəɬ] or [ˈlɪɾɬ̩]

AK shows mainly pharyngeal constr. in [ɬ]

Articulation of some laterals (sagittal MRI tracings)

- Graphic unavailable. See web link below

Laterals from MRI http://www.icsl.ucla.edu/~spapl/projects/mripix/figg3.html

Syllabic nasals and glottal stop

- ‘Mountain’ , ’sutton’, ‘sudden’
  - Broad transcription /ˈmawntən/ /ˈbʌ tən/, /ˈsʌ də n/,
  - Narrow transcription (casual pronunciation)
- ‘Mountain’ [ˈmawnʔn̩] or [ˈmawnʔtn̩]
- ‘Button’ [ˈbʌ ʔn̩] or maybe [ˈbʌ ʔtn̩]
  - See Rogers p 55 “RP Glottalization”
    - Something much like this may happen frequently in NA English
- ‘Sudden’ [ˈsʌ ɾn̩], ‘redden’ [ˈɹɛɾn̩]

Inaudible releases

- Unreleased (inaudible release) stops often occur in stop clusters
  - ‘apt’, ‘act’, ‘abdicate’
  - [ˈæp˺tʰ] [ˈæk˺tʰ] [ˈæb˺dɪˌkʰejt˺]
- Unreleased stops often occur prepausally (e.g. utterance final)
  - Even possible for word like [ˈæk˺t˺] making final stop very difficult to hear.
- Many languages do not allow inaudible releases of stops
  - Require aspiration or brief vocalic release
    - Compare: [ˈæk˺tʰ] [ˈækʰtʰ] [ˈækətʰ]

Some additional details

- Most of the things so far might show up on a quiz for ‘moderately narrow’ transcription

- Some additional details will **not** show up in any live **transcription** quiz ever
  - Some facts discussed might be addressed in multiple choice or short answer questions

‘Inherent’ rounding in some Cs

- N.A. English /ɹ/ is pretty strongly rounded
  - Rogers p 60.
  - *Could** be transcribed most accurately [ɻ^{w}]
- /ʃ, ʒ, tʃ , dʒ/ are also somewhat rounded
  (compared to /s, z/)
  - These *could** be transcribed / ʃ^{w}, ʒ^{w}, tʃ^{w} , dʒ^{w} /

*But we won’t bother in ‘moderately narrow transcription’

??? What would we do with ‘Schreck’, ‘Schwepps’ vs. ‘she’

Special releases (plosions)
Nasal and lateral releases

- Stops before homorganic nasals (mainly d+n) often result in a 'nasal release' or 'nasal plosion' (Rogers p 57)
  - Can be transcribed with d + raised n
    - 'Rodney' [ˈɹɑdⁿni]
    - 'kindness' [ˈkʰajndⁿnəs]
- Similarly, 'd' before 'l' may lead to 'lateral release' or 'lateral plosion'
  - Can be transcribed as d + raised l
  - 'sadly' [ˈsædˡli]
- What about 'butler'???

  [ˈbʌ ʔtˡləɹ] emphatic [ˈbʌ tˡ◦əɹ]