

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. /^htip/ 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

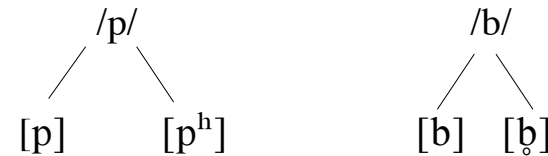
- ‘Broad’ (= coarse-grained) transcription enough for phonemic representation
 - Choose simple symbol for a ‘representative’ (allo)phone
- ‘Narrow’ (= fine-grained) transcription often requires diacritics
- Diacritics for stops
 - p^h - aspirated p
 - p[̚] - ‘p with inaudible release’ (‘unreleased p’)
 - b̚ - ‘(partially) devoiced b’

Examples: ‘pie, spy, buy’

- ‘pie’ [ˈp^haj]
- ‘spy’ [ˈspaj]
- ‘buy’ [ˈb̚aj] or [ˈbaj]
- Which of [b̚] [p^h] [p] are allophones of the same phoneme?

Answer: ‘pie, spy, buy’

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



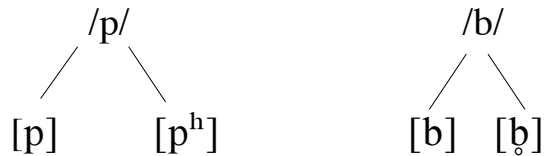
Phones in square brackets

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

- ‘Stop.’ [ˈstap̚]
- ‘Stop!’ [ˈstap]
- ‘Stop!!’ [ˈstap^h]
- ‘Stob!’ [ˈstab] or [ˈstab̚]
- Which of [b] [p^h] [p] are allophones of the same phoneme?

Answer: ‘Stop(!!!) Stob.’

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



Phones in square brackets

Example allophone rule

$$/p/ \rightarrow \begin{cases} [p^h] / \# _ \\ [p^h] / \check{v} _ 'V \\ [p^r] / _ \# \text{ (optionally)} \\ [p] / s _ \\ [p] \text{ elsewhere} \end{cases}$$

= ‘word boundary’

\check{v} = ‘weak stressed’ or ‘unstressed’ or ‘reduced’ vowel’

'V = primary- stressed full vowel

,V = secondary-stressed (full)

Rough notation

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

$$/X/ \rightarrow [y] / [A] _ [B]$$

Allophone in **free variation**

$$/X/ \rightarrow [y] \text{ or } [z] \text{ (optionally)}$$

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^r] 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'

/ 'pit / [p^hit^h], [p^hit^ˀ], [p^hit]

'spit'

/ 'spit / [spit^h], [spit^ˀ], [spit]

/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)
 - vvvvvvvvvv -- 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 a / Negative VOT

Coronal —<ooooooooooooo Voicing starts before <
 Glottal vvvvvvvvvvvvvvvvv (voicing leads opening)

/ t a / Near Zero VOT

Coronal —<ooooooooooooo Voicing starts at <
 Glottal ::=:::vvvvvvvvvvvvvvv (short voicing lag)

/t^h a / Positive VOT

Coronal —<ooooooooooooo Voicing starts after <
 Glottal ::=:::vvvvvvvvv (long voicing lead)

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

[d a] Fully voiced ‘d’

Coronal —<ooooooooooooo Voicing starts **before** <
 Glottal vvvvvvvvvvvvvvvvv (voicing leads opening)

[ɖ a] Devoiced ‘d’

Coronal —<ooooooooooooo Voicing tries to start at or before <
 Glottal xxxvvvvvvvvvvvvvvvv (voicing leads opening)

[t a] Unaspirated ‘t’

Coronal —<ooooooooooooo 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

- /'ba'babʰsə'bab/ -->

[^h'b_əa'^hba_əsə'^hba_ə]

- /'zɑ'zɑzʰsə'zɑz/ -->

[^h'z_əɑ'^hzɑ_əsə'^hzɑ_ə]

[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

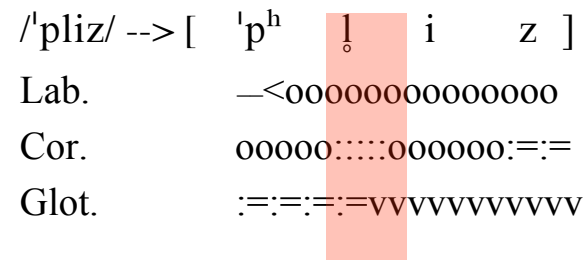
Side effects

- 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

Secondary features of Voiced vs voiceless obstruents

- | | |
|---|--|
| <ul style="list-style-type: none"> • Voiced <ul style="list-style-type: none"> – Lower amplitude of burst or frication <ul style="list-style-type: none"> • (= ‘less loud’) – Constriction duration shorter (VCV) – Preceding vowels longer (VC) | <ul style="list-style-type: none"> • Voiceless <ul style="list-style-type: none"> – Higher amplitude of burst or frication <ul style="list-style-type: none"> • (= ‘louder’) – Constriction duration longer (VCV) – Preceding vowels shorter (VC) |
|---|--|

‘Spill-over’ effects of aspiration



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

Flapping (tapping)

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

Flapping more examples

- Example from child's speech
 - Baby: 'Daddy' [ˈdæ₁di]
 - Toddler: 'Daddy' [ˈdæ₁ɾi]
 - 5-year old (extra polite): 'Daddy' [ˈdæ₁t^hi]
- More examples
 - 'buddy' /'bʌ di/ --> [ˈbʌ ɾ i]
 - 'butter' /'bʌ dət/ --> [ˈbʌ ɾ ə]
 - 'sitter' /'sɪtə/ --> [ˈsɪɾ ə]
 - 'city' /'sɪti/ --> [ˈsɪɾ i]

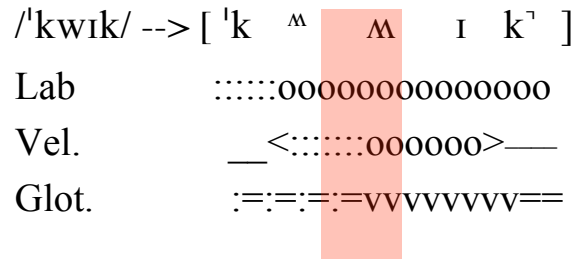
Place assimilation and coarticulation

- Small changes in place of articulation in some consonants
 - Alveolar consonants become dental before θ ð
 - 'tenth' /'tenθ/ --> [ˈtɛnθ]
 - 'width' and 'stealth' may show similar changes in /d/ and /l/
- Stops
 - Labialized before rounded vowels [w] and [ɹ]
 - 'dwell' [ˈd^wwɛɪ]; 'Gwen' [ˈg^wwɛn], 'twin': [ˈt^whɪn] or (?) [ˈt^ʷɪn],

Complex coarticulation in /stop+r/

- /t/ and /d/ retroflexed, rounded (and possibly affricated) before /ɹ/
 - 'train'
 - [ˈt^hɹ̥ɛjn] or [ˈt^ʃɹ̥ɛjn] or maybe even [ˈt^ʃɹ̥ɛjn]
 - Kids sometimes spell 'train' as 'chrain'
 - 'drain'
 - [ˈd^ɹɹ̥ɛjn] or [ˈd^{ɹ̥}ɹ̥ɛjn]

‘Spill-over’ effects aspiration and rounding coarticulation.



Broad transcription /kʷɪk/. Open glottis (aspiration) extends through much of /w/, yielding [w_o] or [ʷ]

AK shows mainly pharyngeal constr. in [ʔ] 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>

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’ [ɫ]
 - Often described as ‘velarized’ but may more often be pharyngealized
 - Dark [ɫ] often shows up as a ‘syllabic’ l
 - We will not systematically distinguish it from schwa+dark l
- Examples
 - ‘pal’ [p^hæɫ] v. ‘lap’ [læp]
 - ‘little’ [lɪɾɫ] or [lɪɾ]

Syllabic nasals and glottal stop

- ‘Mountain’, ‘sutton’, ‘sudden’
 - Broad transcription /mawntən/ /bʌ tən/, /sʌ dən/
 - Narrow transcription (casual pronunciation)
- ‘Mountain’ [mawɳ̩] or [mawɳ̩ʔ]
- ‘Button’ [bʌ ɳ̩] or maybe [bʌ ʔɳ̩]
 - See Rogers p 55 “RP Glottalization”
 - Something much like this may happen frequently in NA English
- ‘Sudden’ [sʌ ɳ̩], ‘red den’ [ɹɛɳ̩]

Inaudible releases

- Unreleased (inaudible release) stops often occur in stop clusters
 - ‘apt’, ‘act’, ‘abdicate’
 - [ˈæp̚tʰ] [ˈæk̚tʰ] [ˈæb̚dɪk̚hɛjtʰ]
- Unreleased stops often occur prepausally (e.g. utterance final)
 - Even possible for word like [ˈæk̚tʰ] making final stop very difficult to hear.
- Many languages do not allow inaudible releases of stops
 - Require aspiration or brief vocalic release
 - Compare: [ˈæk̚tʰ] [ˈæk̚h̥tʰ] [ˈæk̚ʔtʰ]

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 /ɪ/ is pretty strongly rounded
 - Rogers p 60.
 - *Could** be transcribed most accurately [ɪ^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’ [ˈɹɑd^{n̩}ni]
 - ‘kindness’ [ˈkɪ^{h̩}n̩d^{n̩}n̩s]
- Similarly, ‘d’ before ‘l’ may lead to ‘lateral release’ or ‘lateral plosion’
 - Can be transcribed as d + raised l
 - ‘sadly’ [ˈsæd^{l̩}li]
- What about ‘butler’???
[ˈbʌ ʔt^{l̩}l̩əɹ] emphatic [ˈbʌ t^{l̩}l̩əɹ]