ONLINE SUBJECT EVALUATIONS ARE NOW OPEN

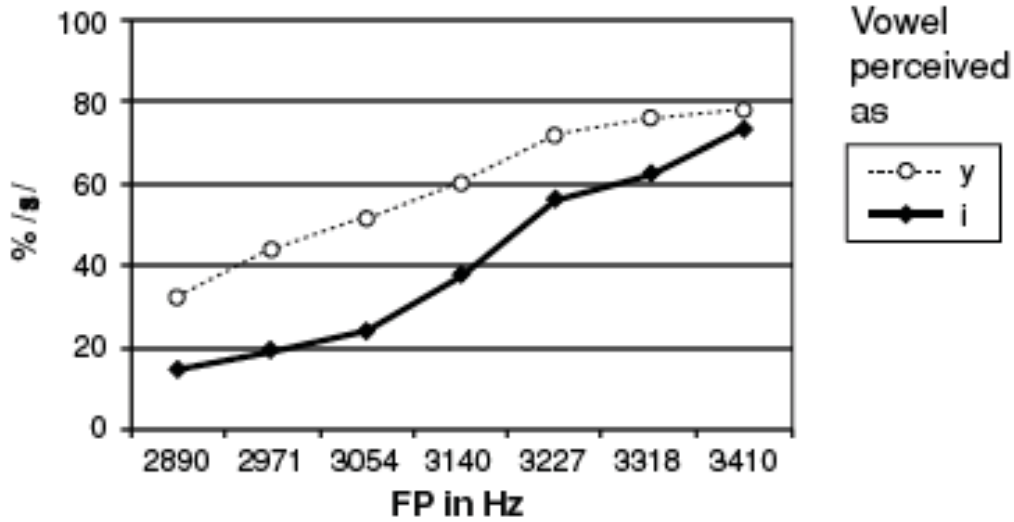
- You have until Monday, December 14 at 9am
- Please evaluate all subjects in your list
- Don’t forget your TAs
- Write comments

Your feedback is read and valued!

24.915/24.963

Linguistic Phonetics

Phonetic Grammar and Lexical Access



Source: Mitterer, Holger. "On the causes of compensation for coarticulation: Evidence for phonological mediation." Attention, Perception, & Psychophysics 68, no. 7 (2006): 1227-1240.

Citing sources in your final projects

- If you make use of any sources in writing your final projects, you need to cite them in the paper.
- Any format is OK as long as you include in-text citations and a full list of bibliographic references.
- A standard format in linguistics:
  - in-text citations are placed in parentheses after the quote, paraphrase or summary, in the format (Author(s) Date)

'Aspiration can enhance this contrast because it is associated with wider glottal opening than in unaspirated stops (Dixit 1987)'

  - The full references are listed at the end of the paper, e.g.

Dixit, Prakash (1987). Mechanisms for voicing and aspiration. *UCLA Working Papers in Phonetics* 67, 49–102.

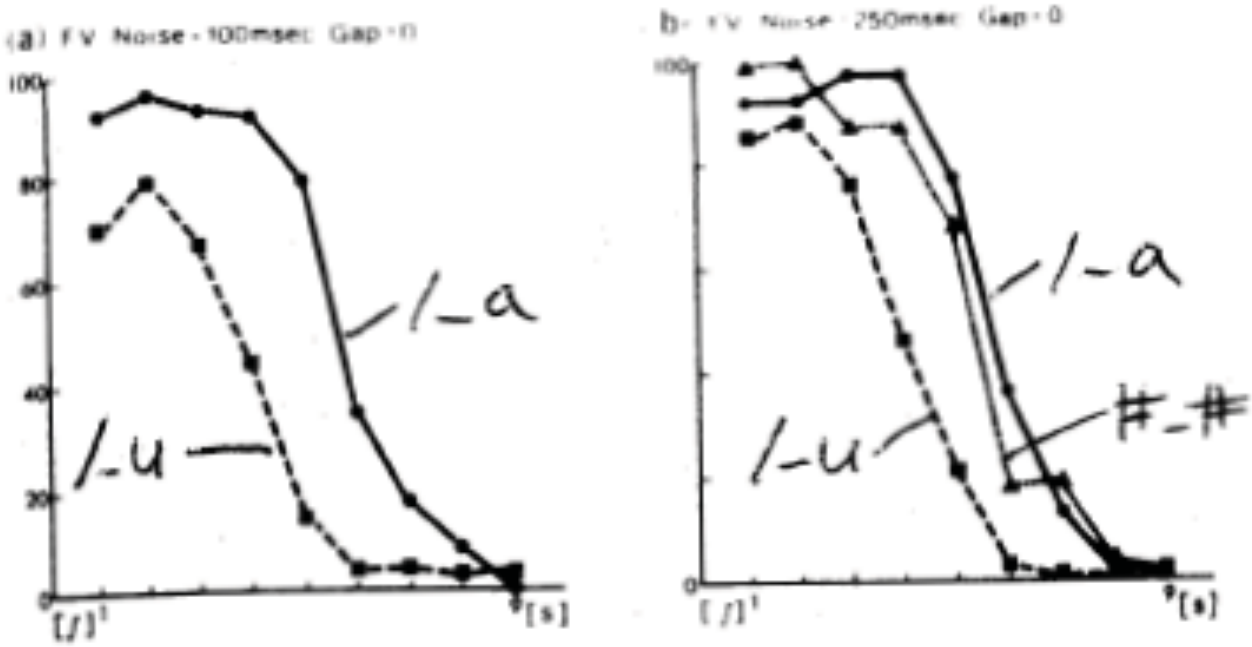
Compensation for coarticulation

- We have seen evidence that knowledge of phonological processes such as assimilation and deletion of word-final segments is used in processing pronunciation variation.
- Knowledge of the grammar that governs the mapping from a sequence of words to a speech signal is useful in inferring the word sequence that gave rise to a particular speech signal.
- The same applies to phonetic grammar: knowledge of 'low-level' contextual effects like coarticulation should also affect interpretation of the signal.
- Such effects are often referred to as 'compensation for coarticulation'.

Compensation for coarticulation

- E.g. Mann & Repp (1980) – identification of an [ʃ-s] continuum in rounded and unrounded vowel contexts.

%ʃ



Source: Mann, Virginia A., and Bruno H. Repp. "Influence of vocalic context on perception of the [ʃ]-[s] distinction." Attention, Perception, & Psychophysics 28, no. 3 (1980): 213-228.

Compensation for coarticulation

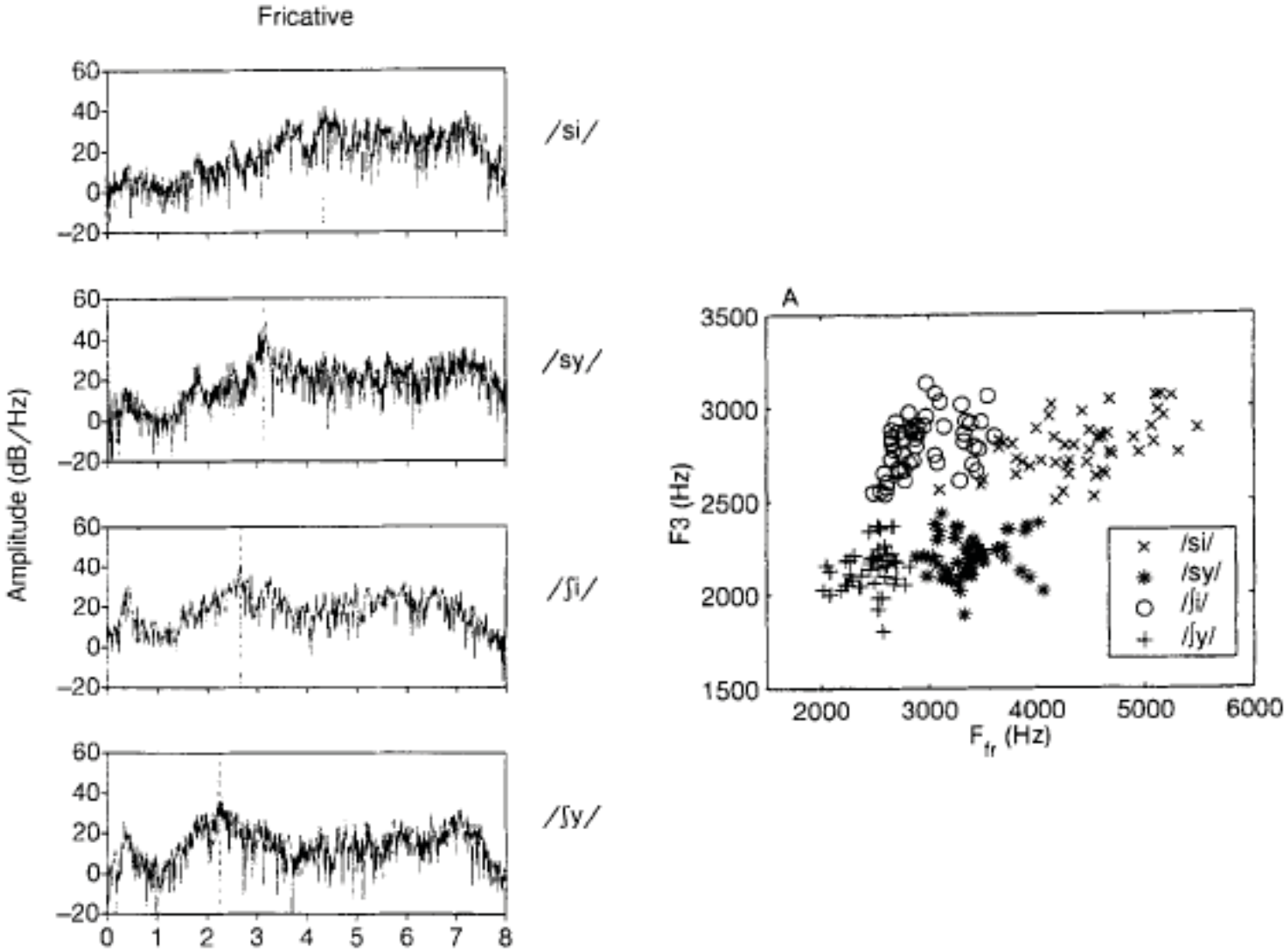
Again there is a competing 'ignorance-based' account of compensation for coarticulation effects: auditory contrast (e.g. Holt 2005, Holt, Lotto & Kluender 2000).

- compensation for coarticulation involves different categorizations of the same acoustic signal depending on context.
- Maybe this is because the auditory representation of the signal is affected by context - i.e. it actually sounds different.
- specifically, 'subsequent to *high-frequency energy*…target syllables are labeled more with *low*-frequency responses' (and vice versa).
  - [u] has lower F2, F3 than /a/ (?)
  - [ʃ] has lower spectral peak than [s]
  - More [s] responses (high) after [u] (low).
- Main evidence: compensatory effects induced by non-speech stimuli.

Mitterer (2006)

- Evidence that compensation for coarticulation can involve knowledge of speech production patterns.
- Lip-rounding coarticulation affects the realization of stridents [s, ʃ] in Dutch (Smits 2001):
  - Anticipatory lip-rounding lowers resonance peak(s) in fricative preceding round vowel [y].
  - Peaks of [s, ʃ] are more similar in [sy, ʃy].

Smits (2001)



Mitterer (2006), Smits (2001)

- Listeners appear to take this coarticulatory effect into account - accept strident with lower peak as [s] in the context of [_y] compared to [_i].
- Synthesized an [s- ʃ] continuum by varying the frequency of the lowest spectral peak (FP) from 3410 Hz to 2890 Hz in 7 equal steps in Bark.
- Synthesized an [i-y] continuum by varying F3 from 2725 Hz to 2400 Hz in 7 equal steps in Bark.
- Forced choice classification of stimuli as [si, sy, ʃi, ʃy] presented orthographically.

Classification results

- A: vowel classification depends on F3 and FP - higher FP favors [i].
- B: Fricative classification depends on F3 and FP - lower F3 favors [s] (compensation for coarticulation).
- C: same result, plotted by vowel identification - if vowel is heard as [y], fricative is more likely to be identified as [s].

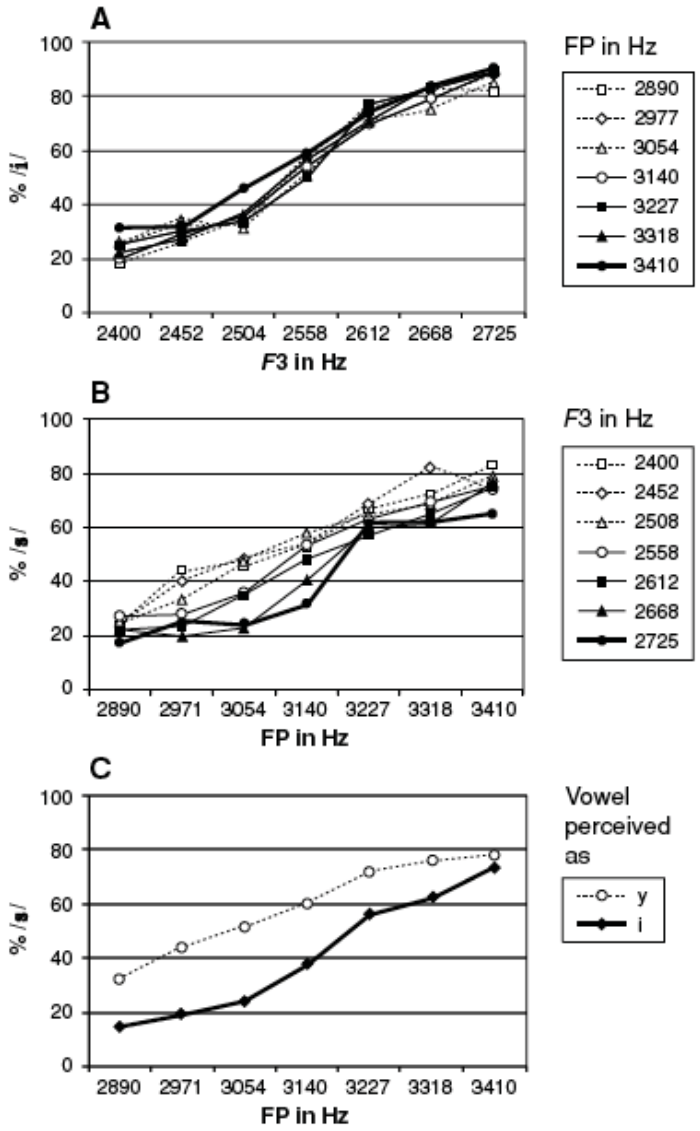


Figure 2. Results from Experiment 1. (A) Percentages of vowels perceived as [i] depending on the *F*3 (abscissa) and fricative pole (FP) of the preceding fricative (different functions). (B) Percentages of fricatives perceived as [ʃ] depending on the FP (abscissa) and *F*3 of the following vowel (different functions). (C) Percentages of fricatives perceived as [ʃ] depending on the FP (abscissa) and perceived vowel identity (different functions).

Auditory contrast effect?

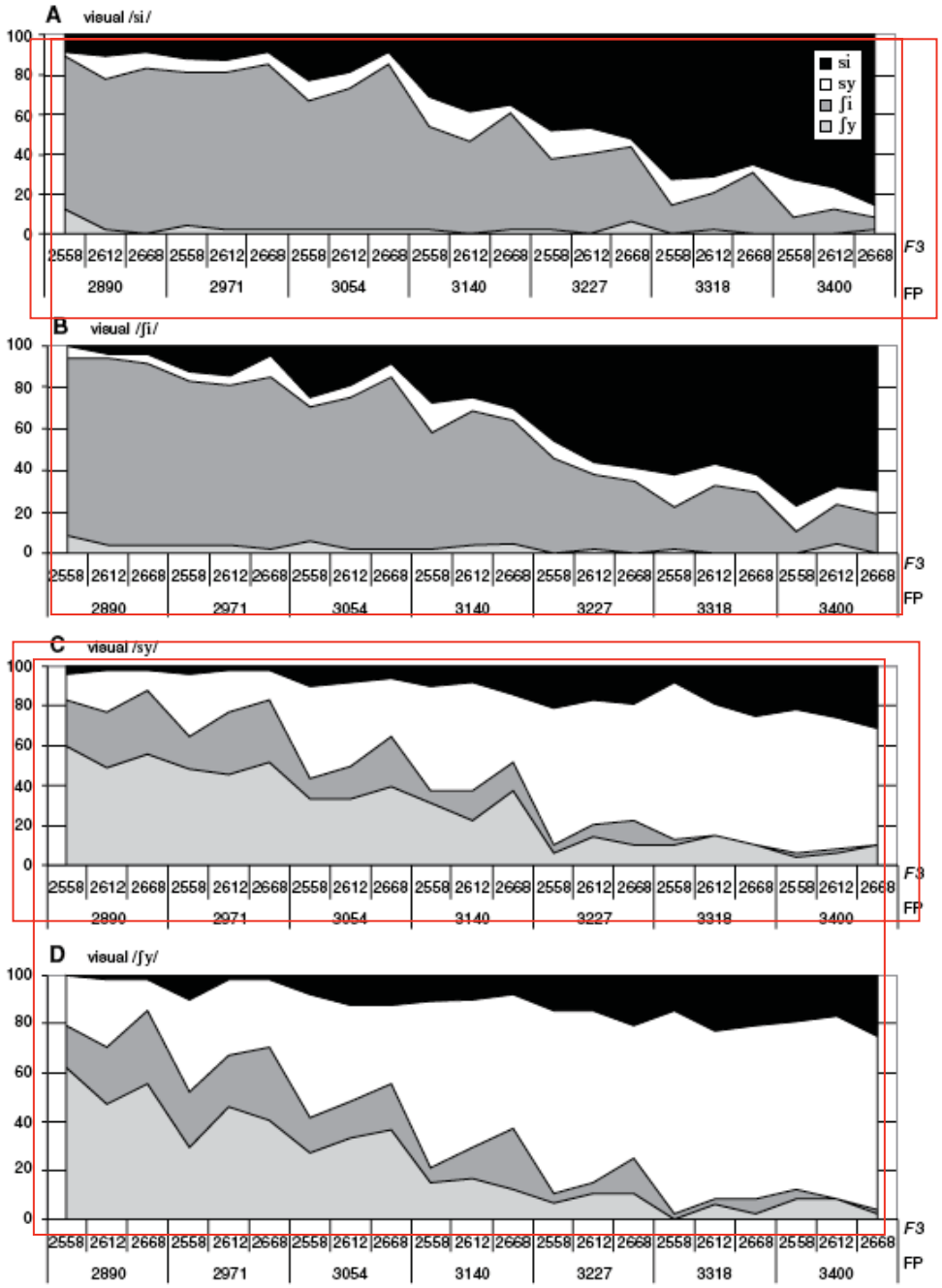
- A sinusoid following the fricative affects fricative identification.
  - varied over range of [i-y] F3.
- Effect is 'assimilatory' not compensatory: higher sinusoid favors [s] identification.

- Further evidence that compensation for coarticulation is based on vowel identification, not auditory contrast.
  - Use visual information to shift vowel percept without altering acoustics (cf. Fowler 2000).
  - Does fricative perception depend on acoustics, or perceived vowel quality?
  - Auditory contrast effect should be independent of visual cues.

Audio-visual compensation for coarticulation

- Lip-rounding is a salient visual cue.
- Combined synthetic fricative-vowel stimuli with video of the face of a speaker pronouncing [si, su, ʃi, ʃy].

- Only 1 subject was influenced by visual fricative.
  - no lip protrusion in Dutch [ʃ]
- Vowel and fricative identifications were affected by visual vowel [i vs. y].
  - ➢More [s] responses with visual lip-rounding.



Source: Mitterer, Holger. "On the causes of compensation for coarticulation: Evidence for phonological mediation." Attention, Perception, & Psychophysics 68, no. 7 (2006): 1227-1240.

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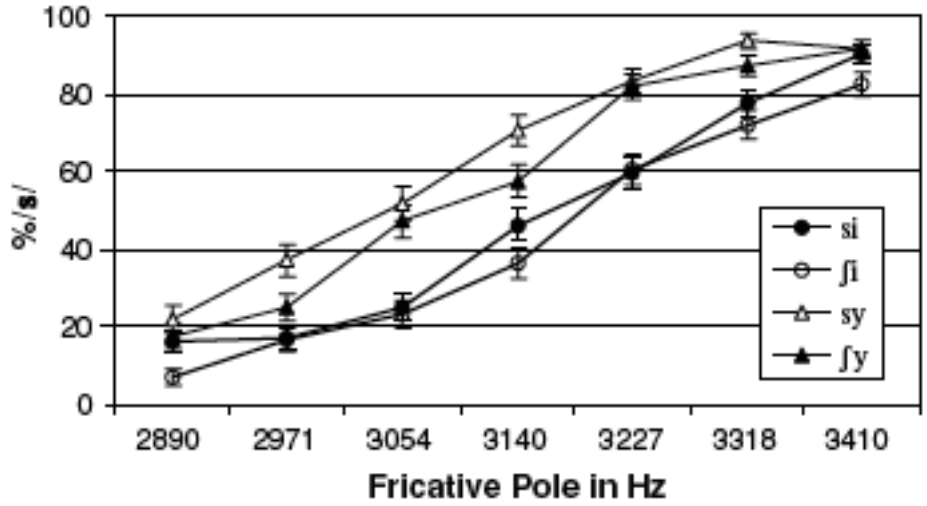


Figure 7. Mean percentages of [s] identifications in Experiment 3 depending on visual syllable (different functions) and fricative pole (FP) frequency (abscissa). Values are collapsed over all *F*3 frequencies.

Source: Mitterer, Holger. "On the causes of compensation for coarticulation: Evidence for phonological mediation." Attention, Perception, & Psychophysics 68, no. 7 (2006): 1227-1240.

- Logistic regression analyses for individual subjects
  - predict categorization probabilities based on F3, FP, visual F, visual V.
- Subjects differed in the weights they attached to F3 and visual V in vowel identification.
- F3/visual V generally only had a significant effect on fricative identification if it had a significant effect on vowel identification for the same subject.
  - I.e. compensation for coarticulation is mediated by vowel identification - it is not a direct effect of vowel acoustics.

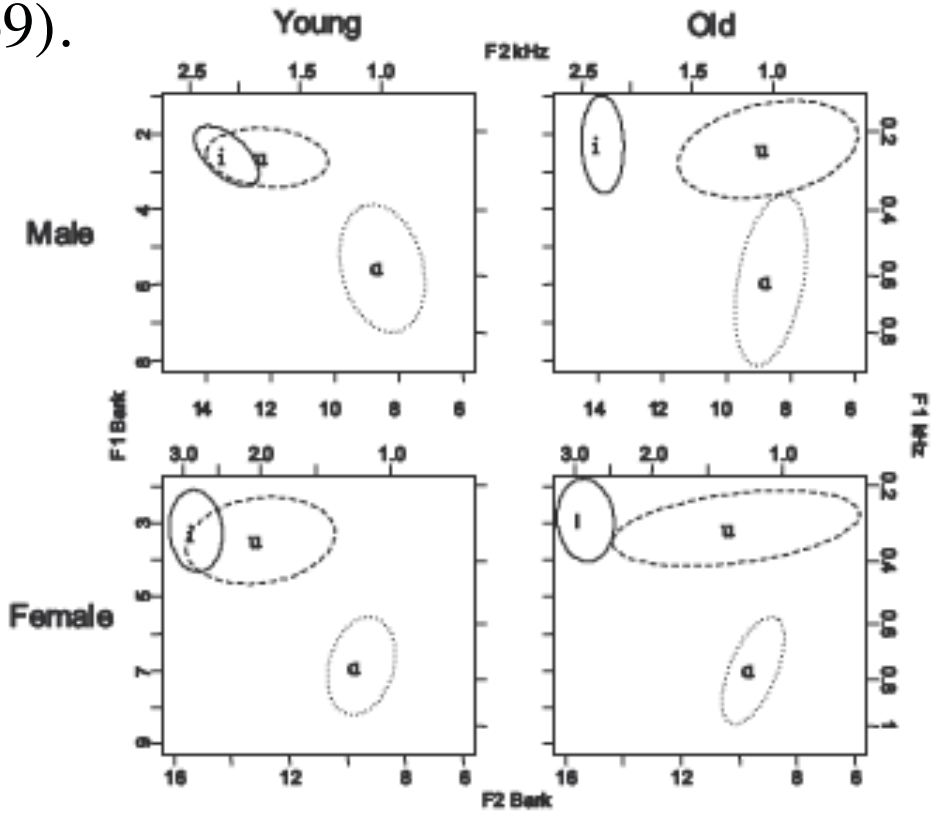
- Summary: at least some compensation for coarticulation effects are due to knowledge of coarticulatory effects in speech production.

Language-specific compensation for coarticulation

- If compensation for coarticulation is an instance of listeners employing knowledge of production patterns in interpreting speech signals, then the effects should vary across languages depending on the specific patterns of coarticulation that obtain in that language.
- Some evidence that this is true: Beddor, Harnsberger & Lindemann 2002.
  - Found different patterns of V-to-V coarticulation in English and Shona.
  - Some evidence for comparable differences in the effects of V-to-V coarticulation on vowel perception.
- Evidence for dialect-specific compensation for coarticulation: Harrington (2008) *JASA* 123.

Harrington (2008) - production and perception of coarticulatory variation in /u/

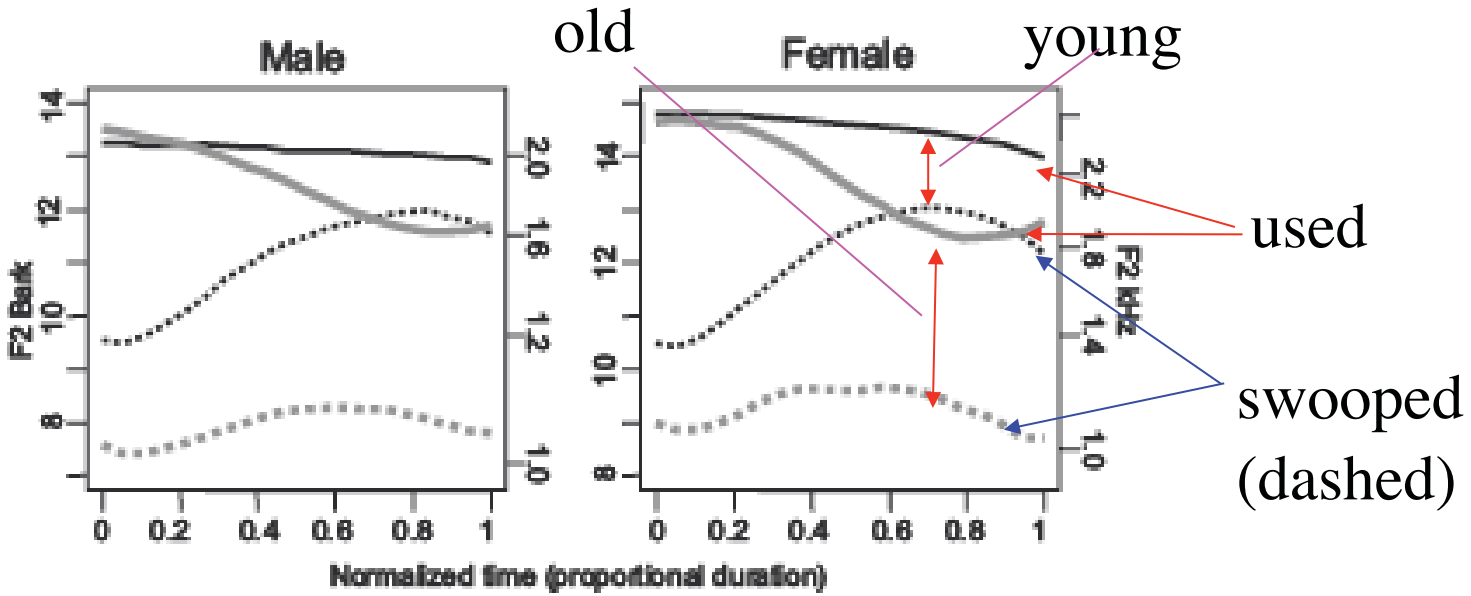
- There has been change in the phonetics/phonology of Standard Southern British English in recent years.
- Young speakers (18-20) have fronter /u/ compared to older speakers (over 50, mean 69).



Reproduced from Harrington, Jonathan, Felicitas Kleber, and Ulrich Reubold. "Compensation for coarticulation,/u/-fronting, and sound change in standard southern British: An acoustic and perceptual study." The Journal of the Acoustical Society of America 123, no. 5 (2008): 2825-2835. 10.1121/1.2897042, with the permission of the Acoustical Society of America.

Coarticulatory variation in /u/ - production

- In addition, young speakers show less coarticulatory variation in F2 of /u/, as assessed by a comparison of pronunciations of *used* [just] and *swooped* [swupt].
  - [j_s] should be a fronting context, raising F2
  - [w_p] should tend to lower F2
  - The difference between the two is much larger for old speakers



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Compensation for coarticulation - perception

- Young subjects show a correspondingly smaller effect of compensation for coarticulation on identification of /i-u/ continua.
  - *yeast-used* and *sweep-swoop* continua.

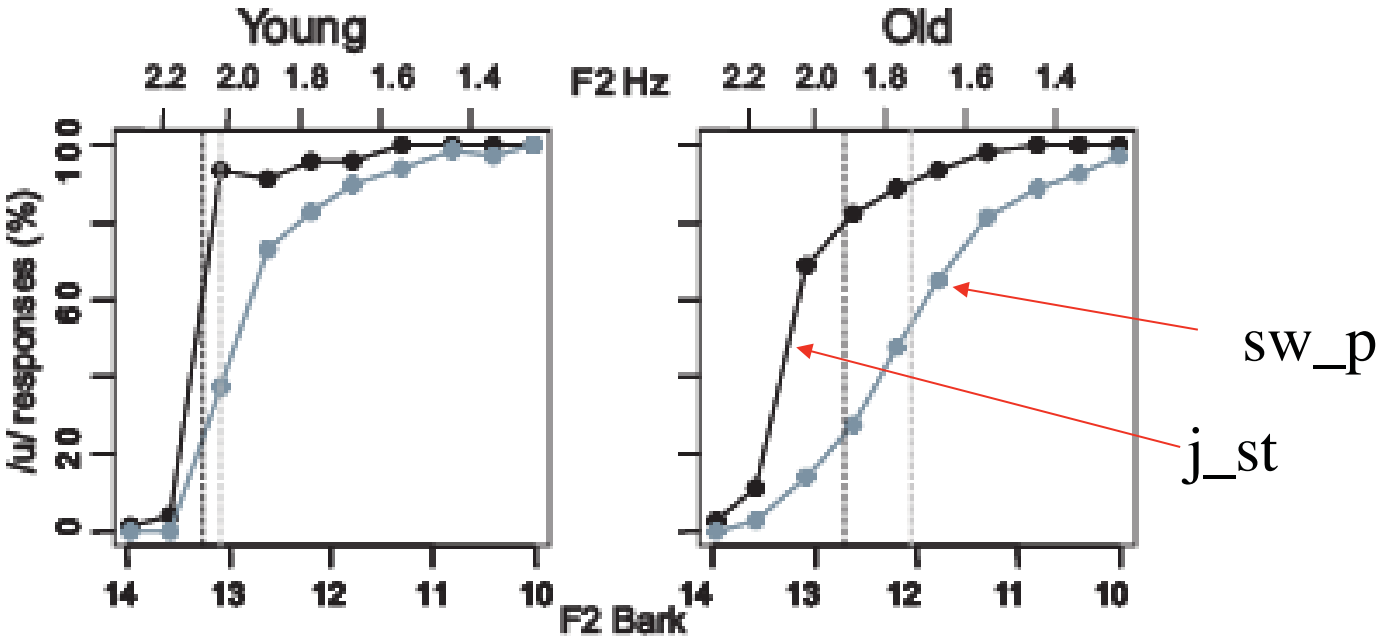
F2 onset

- *yeast-used*: 2450 Hz
- *sweep-swoop*: 600 Hz
- steps are at equal bark intervals on each continuum, but different step sizes used in the two continua

Table removed due to copyright restrictions.
Source: Table 2, Harrington, Kleber & Reubold (2008) "Compensation for coarticulation, /u/-fronting, and sound change in standard southern British: An acoustic and perceptua study" The Journal of the Acoustical Society of America.

Compensation for coarticulation - perception

- Subjects identified each stimulus as *swoop*, *sweep*, *used* or *yeast*.
- Category boundaries (50% i-u) determined for each subject by fitting a sigmoid (probit) function to identification data.
- Shift in category boundary between contexts differs significantly between young and old subjects.
- Subjects compensate for the coarticulation they produce.



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Knowledge of phonetics/phonology is used in speech perception

- Studies of compensation for coarticulation, assimilation and deletion indicate that listeners do exploit their knowledge of production grammar in interpreting speech signals.
  - Contextual variation that is generated in production is taken into account in perception.
- There may also be auditory contrast effects and general perceptual mechanisms at work, but these are not sufficient to account for the observed effects.

Speaker adaptation

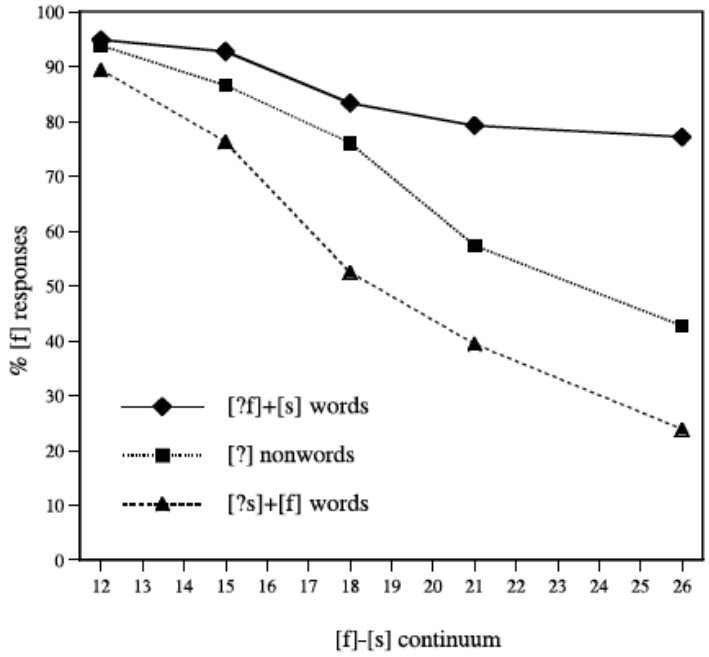
- What happens when the ‘young’ SSBE speakers talk to ‘old’ SSBE speakers? Does confusion ensue?
- In many cases, listeners can quickly adapt to patterns of speech that differ from their own.
- This process of adaptation can be analyzed as involving inferences concerning the speaker’s grammar.
- Ideally, we should use the grammar of our interlocutor in interpreting speech. If we don’t know it, we have to try to learn it as we listen.

Norris, McQueen & Cutler (2003)

- Lexical decision task in Dutch.
- Some words contain a final sound [?] that is ambiguous between [f] and [s], created by averaging [f] and [s] waveforms.
  - pretest to ensure ambiguity.
- Three conditions:
  1. Words are meaningful if [?] is interpreted as [s].
     - E.g [witlo?] - *witlof* 'chicory', *witlos* is not a word.
  2. Words are meaningful if [?] is interpreted as [f].
     - E.g [na:ldbo?] - *naaldbos* 'pine forest', *naaldbof* is not a word.
  3. Non-word if [?] is interpreted as either [f] or [s].
- Subjects in each condition hear 20 target words + the other 10 targets unedited + fillers.
- Subjects in (1) and (2) accepted edited words as corresponding word.

Norris, McQueen & Cutler (2003)

- After lexical decision task, subjects categorized stimuli from an [εf−εs] continuum (same speaker).
  - created by adding different proportions of [f] and [s].
- Boundary differed depending on condition in part 1:
  1. [?] = [s], more stimuli categorized as [s].
  2. [?] = [f], more stimuli categorized as [f].
  3. Non-word group did not differ from (1) or (2).



Norris, McQueen & Cutler (2003)

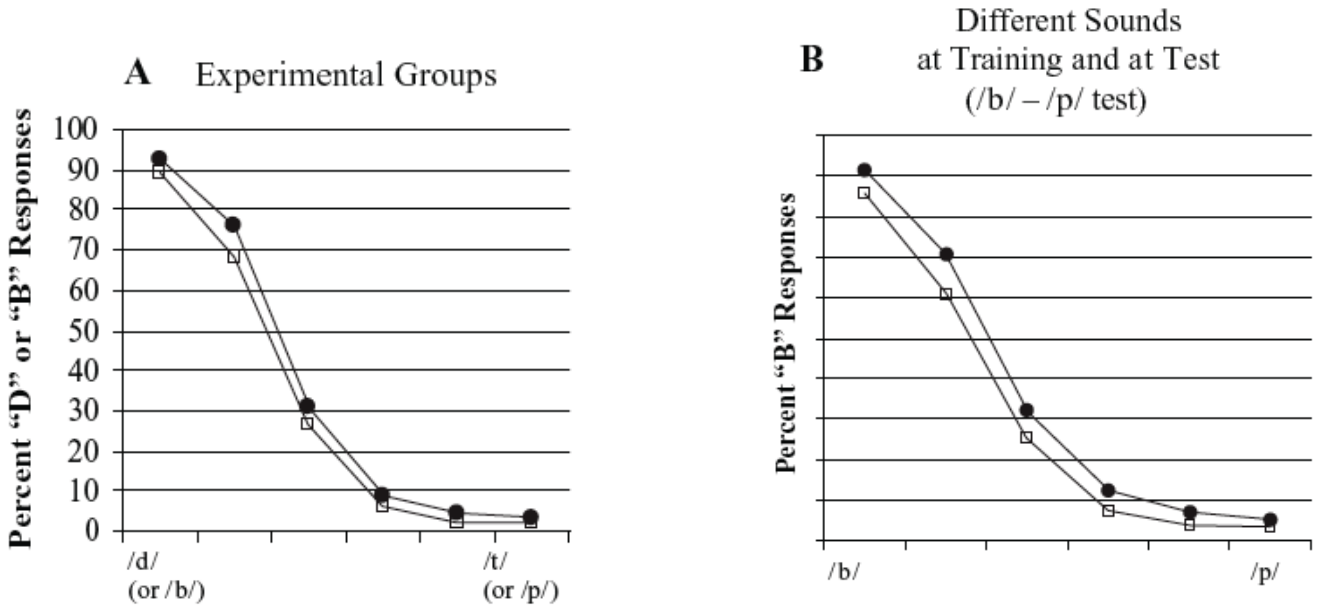
- Interpretation: subjects have learned that speaker has an unusual /s/ or /f/ on the basis of hearing this rendition in 20 words.
  - they have learned about the speaker's grammar
- This knowledge affects the perceptual boundary between /f/ and /s/ for that speaker.
  - i.e. subjects use the inferred grammar in lexical access.
- A follow-up study (Cutler et al 2005) followed the training phase with a cross-modal priming task (visual lexical decision following an auditory prime).
  - Priming effect of modified words depended upon the interpretation of [?] learned in the training phase.
  - Crucial words had not been heard in the training phase - consistent with grammar learning rather than word learning.

Feature-based generalization?

- Do speakers make feature-based generalizations?
- E.g. if subjects are trained to hear an alveolar stop with ambiguous VOT as /t/ or /d/, would they generalize a shift in VOT boundary to /p/-/b/ and /k/-/g/?
- Tested by Kraljic & Samuel (2006). Two phases:
  - Auditory lexical decision with ambiguous [t/d] in a non-initial syllable (*han<u>d</u>y, king<u>d</u>om, fron<u>t</u>ier, magne<u>t</u>ism*)
    - manipulated closure voicing, VOT.
    - 3 conditions [t/d]=/t/, [t/d] = /d/, non-words.
  - Categorize /VtV-VdV/ and /VpV-VbV/ continua.
    - Averaging /t/-/d/ bursts (and closures?) in different proportions
    - Varying closure duration, VOT by editing/cross-splicing.

Kraljic & Samuel (2006)

- Small but significant effect on categorization of both trained and new voicing continua.
- [voice] is only shown to be generalized between stops.



Source: Kraljic, Tanya, and Arthur G. Samuel. "Generalization in perceptual learning for speech." Psychonomic bulletin & review 13, no. 2 (2006): 262-268.

Kraljic & Samuel (2006)

Again, this type of generalization is consistent with the idea that listeners are making inferences in terms of grammar

- assuming VOTs at all places of articulation are derived by the same constraints (e.g. constraints on the distinctiveness of the VOT difference between stops contrasting in voicing).
- short VOT in [t]/ long VOT in [d] provide evidence concerning the speaker's weighting of those constraints.
- This inference leads to expectations concerning VOT at all places of articulation.

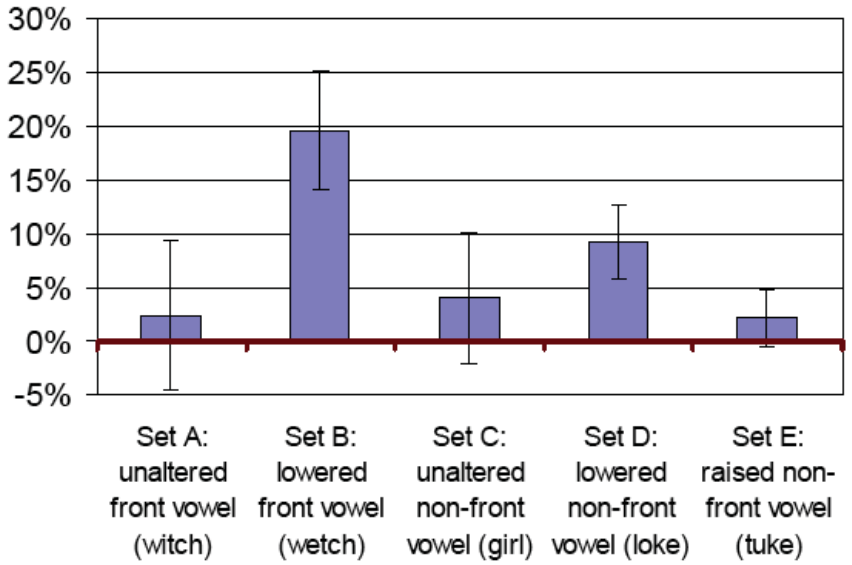
Maye et al (2004): The Weckud Wetch

- Maye, Aslin & Tanenhaus (2004) studied generalization of 'novel' vowel pronunciations.
- Method:
  - Day 1: Listen to a 20 min. section of the Wizard of Oz read by a text-to-speech synthesizer (Mac)
  - Lexical decision task.
  - Day 2: Listen to a 20 min. section of the Wizard of Oz with modified vowels
    - ɪ > ɛ, ɛ > æ, æ > ɑ (neutralizing with /ɑ/)
  - Lexical decision task.
- Subjects more likely to accept stimuli as words if they would be words in the vowel shifted accent.
  - Includes new words.
  - Also accept 'standard' pronunciation.

Maye et al (2004): The Weckud Wetch

- Some indication of generalization to lowered back vowels (not significant)
  - u > ʊ, ʊ > oʊ, oʊ > ɔ

Figure 1: Experiment 1, % Change in "Word" Responses. Error bars represent one standard error.



Source: Maye, Jessica, Richard N. Aslin, and Michael K. Tanenhaus. "The weckud wetch of the wast: Lexical adaptation to a novel accent." Cognitive Science 32, no. 3 (2008): 543-562.

Summary

- There is evidence that phonological/phonetic grammars are used in speech perception to:
- process contextual modifications in pronunciation due to phonological/phonetic processes such as assimilation, deletion, coarticulation.
- adapt to variation between individual speakers.
- So the study of phonological/phonetic grammar is relevant to work on these areas of psycholinguistics and experiments on these processes can shed light on the nature of grammars.

24.915 / 24.963 Linguistic Phonetics

Fall 2015