24.914
Variation within the individual

Readings and Assignments

- Reading: Ohala (1981)

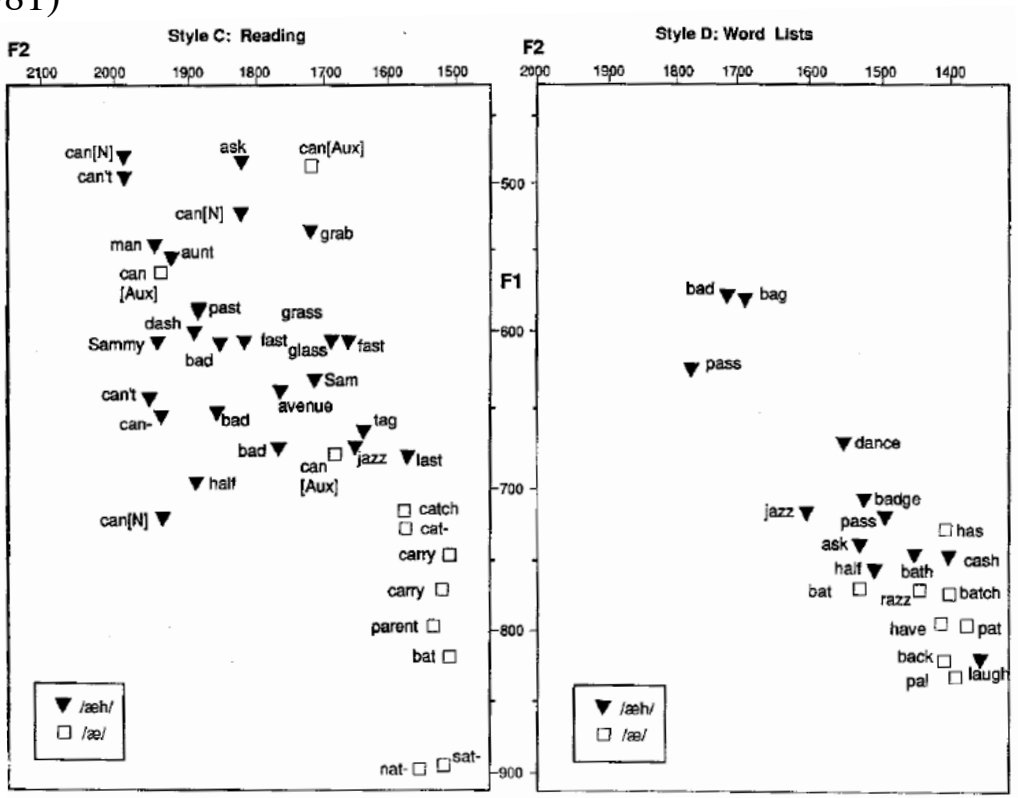
Variation within the individual

- We have seen that change often results in variation between speakers
  - geographical
  - age-based
  - social
- We also find variation within the speech of individuals.
- Variation is often the result of change in progress, but we also find patterns of variation within individuals that are remarkably stable over time.
  - t/d deletion
- How can variation be analyzed phonologically?

Variation within the individual – change in progress

- Sound changes in progress are accompanied by variation within as well as between speakers.
  - Speakers often use both more innovative and more conservative variants
- E.g. /æ/-tensing in NYC (Labov 1981)

- Formant measurements from one speaker's productions of /æ/
- Read connected text (left) vs. word lists (right)
- More raising/fronting of the onset of /æ/ in connected speech.



(b) Locations of nuclei when reading a connected text.
(c) Locations of nuclei when reading word lists

Grade:	0	1	2
right	••	••••	••••
			••
night	••	••	•
white			•
like		••	
sight	•••	•	
quite	•		
striped	••		
swiped		•	
wife	••		
life	••	•••	•
knife	•		•
spider			•
side	••••	•	
	•••		
tide	•••••	•	
applied	•		
characterized	•		
ivory			•
live	•		•
five		•	
I've		•	
by		•	
fly in			•
high	•		
fryin	•		
why		•	
my	••		
try		•	
I'll	•		
piles	•		
while	•••		
mile	•		
violence	•		
shiners	•		
kind	•		
iodine		•	
quinine	•		
time	••		
line		•	
I	•	••••	••••
		•	•
fired	•		••••
tire	•		•
(ay)-75			

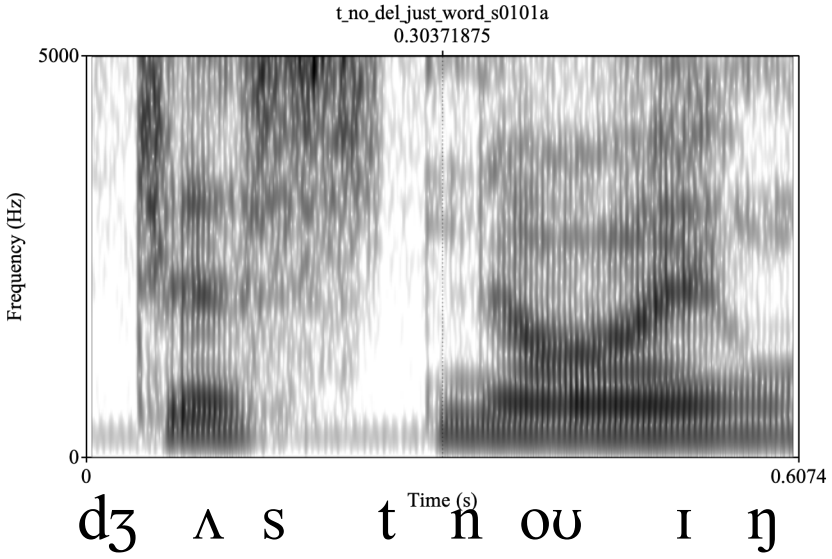
0	1	2	
••••	••	••••	out
•	•		about
•	•		trout
	•		house
••	•		south
•	•••		mouth
•	•		couch
••			now
••			how
••			sound
••••			down
••••			
••			
••••			round
•			hound
•			ground
(aw)-39			

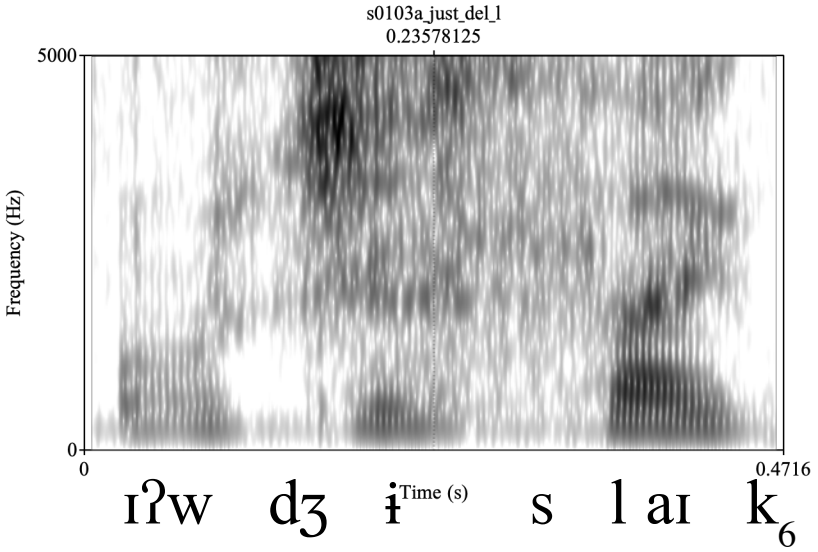
- E.g. 2 Diphthong centralization on Martha's Vineyard (Labov 1963)
- Data on centralization from a single speaker
- Varying degrees of centralization in successive productions of the same word.

Table based on data from Labov 1963: "Phonetic determination of centralization. Centralization chart for North Tisbury fisherman GB."

Variation without (much) change

- We also find patterns of variation within the speech of individuals which do not correspond to changes in progress.
  - variation continues without progressing for long periods.
- The most studied example is final t/d deletion in English
  - *last* [dʒʌst]/[dʒʌs] *hand* [hænd]/[hæn] etc





Final t/d deletion

- The most studied example is final t/d deletion in English
  - *just* [dʒʌst]/[dʒʌs] *hand* [hænd]/[hæn] *told* [t^hoʊld]/[t^hoʊl]
- studied since the 60's with no evidence of directional change
  - final [t], [d] are not being deleted completely
- attested in most varieties of English
- t/d deletion is subject to complex phonological and morphological conditioning.
  - derived in grammar – how is variation derived in phonology?
- we see geographical and social variation in the frequency of t/d deletion
  - we also see a lot of cross-dialectal consistency in which factors favor and disfavor deletion.

Final t/d deletion – phonological conditioning

- t/d deletion is phonologically conditioned - more likely in some contexts than others
- Deletion generally applies to word-final t/d preceded by another consonant.
- Rate of deletion depends on the preceding consonant
  - In the Buckeye Corpus of Ohio English (Coetzee & Kawahara 2013)
    - st 60% *last, past, just*
    - nt 50% *went, different, count*
    - Tt 33% *act, kept, respect*
    - (Although they count /nt/ → [ɾ̃] as t-deletion)
  - similar patterns in other accents

Final t/d deletion – phonological conditioning

- Rate of deletion depends on the following context
  - In the Buckeye Corpus of Ohio English
    - Ct#C 61% *last night*
    - Ct#V 51% *last eight*
    - Ct## 39% *last*.
- The rate of deletion is always highest before consonants, but there is variation between dialects whether deletion is more frequent before vowels or pause:

	Pre-V ***west end***	**Pre-Pause** ***west***	***Pre-C*** ***west side***
AAVE (Washington, DC)	29	73	76
Chicano English	45	37	62
Jamaican English	63	71	85
Trinidadian English	21	31	81
Tejano English	25	46	62

(Data from a table in Coetzee & Pater 2011)

Final t/d deletion – morphological conditioning

- [t,d] are less often deleted when they are in the past-tense /-d/ than when they are part of a morpheme-final cluster
  - *mist* > *missed*
- Rate of deletion is intermediate when the past tense is also marked by a vowel change
  - *kept, told* > *missed*
- This pattern is observed across dialects, with variation in overall rates of deletion:

	Regular past (missed)	***Semi-weak past (kept)***	***Monomorpheme (mist)***
Philadelphia English (Guy 1991b)	17%	34%	38%
Chicano English (Santa Ana 1992)	26%	41%	58%
Tejano English (Bayley 1997)	24%	34%	56%

(Data from a table in Coetzee & Pater 2011)

Analysis of optional phonological processes

- The basic mechanism for deriving variation in Optimality Theoretic phonology is variation in constraint-ranking
  - Two constraints can be unranked in a grammar
  - Unranked constraints may be ranked in either order in each derivation
- Example: analysis of t/d deletion (after Coetzee & Pater 2011)
  - *CT – no coronal-final word-final clusters
  - MAX C – every consonant in the input must appear in the output.
  - unranked: *CT, MAX C

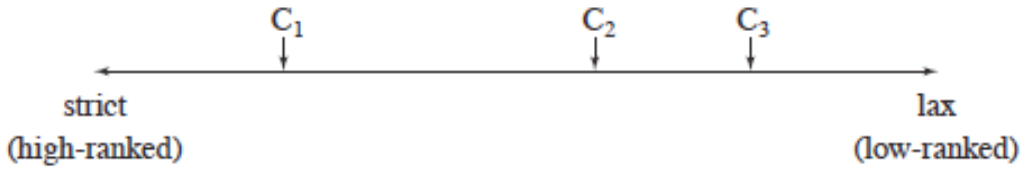
	/læst/	*CT	MAXC
a.	☞ læst	*	
b.	☞ læs		*

Stochastic OT

- How do we derive a particular frequency of deletion?

One model: Stochastic OT (Boersma 1998, Boersma & Hayes 2001)

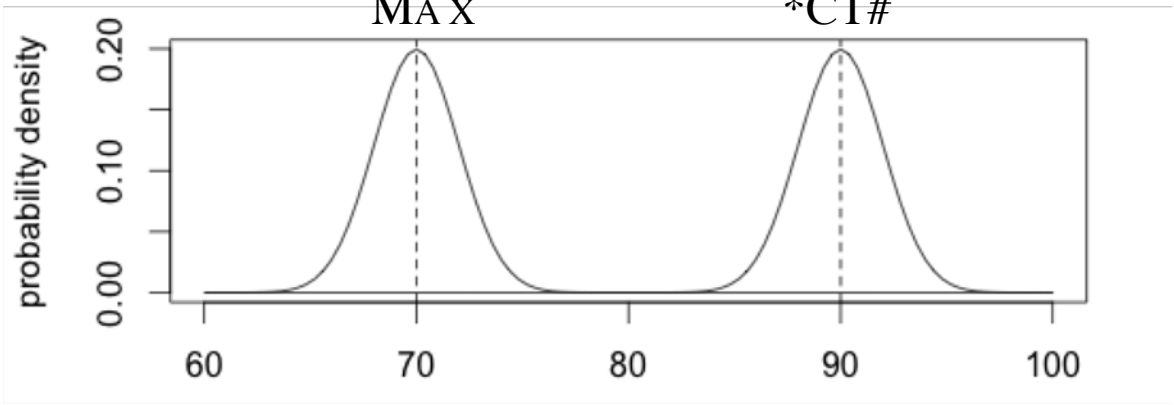
- Constraints are assigned values on a ranking scale



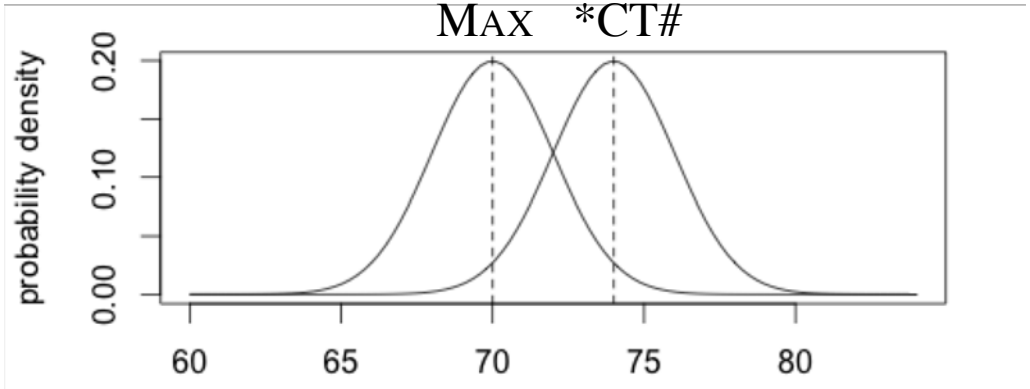
  - Ranking in the usual sense can be read of this scale: a constraint with a higher number ranks a constraint with a lower number
- Randomness is introduced by positing that the position of a constraint on the ranking scale is specified by a probability distribution
  - each constraint has a mean ranking value
  - but each time a form is evaluated, a random adjustment is added to that mean ('evaluation noise')
  - constraint ranking is determined by ordering after these perturbations
  - evaluation proceeds as in standard OT
- Variation occurs if noise sometimes reverses the ranking of two constraints

Stochastic OT

- Noise perturbations are assumed to be drawn from a normal distribution with mean = 0 and standard deviation = 2.
- If two constraints are ranked far apart on the ranking scale, their ranking is effectively fixed
  - Probability that MAXC >> *CT is 1 (probability of reversal 7.7e-13)



  - Probability MAXC >> *CT is 0.92, probability of deletion is 0.08



Analysis of T/D deletion

- Constraints (after Coetzee & Pater 2011)
  - *CT – no coronal-final word-final clusters
  - MAXC/_V - no deletion of prevocalic consonants
  - MAXC-FIN - no deletion of prepausal consonants
  - MAXC - no deletion of consonants
- Probability of deletion in each context depends on the distance between *CT and the relevant Correspondence constraint.

	*CT	MAXC/_V	MAXC-FIN	MAXC/_C	Ct#V	Ct#	Ct#C
AAVE (Wash. DC)	101.0	102.3	96.8	99.0	0.29	0.73	0.76
Chicano	100.4	99.7	100.6	99.6	0.45	0.37	0.62
Jamaican	101.4	100.0	99.2	98.6	0.63	0.71	0.85
Trinidad	101.2	103.4	102.5	98.8	0.21	0.31	0.81
Tejano	100.4	101.9	99.6	99.6	0.25	0.46	0.62

Stochastic OT

- How might we analyze the morphological conditioning of t/d deletion?

- Stochastic OT (and other similar models) allow us to model gradual changes in the frequencies of variants as gradual changes in the ranking numbers of constraints.
- A serious limitation of these models is that they treat all within-speaker variation as completely random
  - much variation is plausibly related to the context of speaking (formal vs. informal, interlocutors etc).

24.914

Language Variation and Change

Modeling Sound Change

Properties of Sound Change

- By surveying patterns of variation (sound correspondences) and their basis in language change, we have identified the following properties of sound change:
  - Sound change construed broadly – e.g. includes isolated changes in word pronunciation as well as regular sound changes.
- Sound change happens all the time.
  - But not everything changes all of the time
- Sound change can be regular – applies to all words in which the relevant phonetic configuration appears.
- Sound change can also be irregular
  - Words change one at a time, or at different rates (not dependent on phonetic conditioning).
- Sound changes are phonetically conditioned
- Individuals generally do not participate fully in sound changes in progress during their lifetimes.
  - Hence change in apparent time
- Sound changes may be restricted to certain social groups even in the absence of geographical isolation.

Properties of Sound Change

- Sound changes can be connected in ‘chain shifts’
  - More broadly: sound changes are not independent.
  - e.g. Northern Cities Shift: ɑ > æ > ɪɛ etc
- Similar sound changes recur across languages and across time.
- Any theory of sound change should account for these properties.

Sound changes recur

- velar palatalization, k, g > tʃ, dʒ /_ [i, j] (or [-back])
  - Sometimes after front vowels [i, e]
  - sometimes the result is some other coronal affricate or fricative (ts, s, ʒ, z), perhaps via subsequent changes.

  - Old English: cild [k] > child [tʃ], ceosan [k] > choose [tʃ]
  - Latin > Italian: kɛntum > tʃɛnto 'hundred' gɛnte > dʒɛnte 'nation'
  - PIE > Old Church Slavonic: *kel- > tʃelo 'forehead'
  - Middle Chinese > Mandarin: kiai > tɕi 'to continue'
- vowel nasalization: VN > Ṽ
  - Latin > French: bon(um) > bɔ̃
  - Portuguese, Hindi, Bengali, Old Church Slavonic etc

Phonetics and Sound Change

- Phonetic considerations have long been hypothesized to play a central role in accounting for the nature of sound change.
- The Neogrammarian hypothesis: sound change is exceptionless and purely phonetically conditioned.
  - 'sounds change not words'.
  - Suggests that the mechanisms of sound change involve phonetics, i.e. properties of speech production and perception.
- Recurrence of similar sound changes across languages and across time.
  - The properties of speech production and perception are basically the same for all speakers at all times.

Paul (1880)

- One of the Neogrammarians, Hermann Paul, proposed an account of the mechanisms of sound change that is remarkably modern in many respects and gives a central role to phonetics
  - speech production, perception and acquisition thereof.

Paul's (1880) theory of sound change

- Proposes that speech production is based on stored 'memory-pictures left behind by the sensation of the movements carried out before' (p.3)
  - Consists of 'motory sensation' and 'sound picture'
  - 'the memory-picture of the sensation may have power to reproduce the movement associated therewith as its reflection; and if the sensation called up thereby corresponds with the memory-picture, then we may also rest assured that we have carried out the same movement as formerly.' (p.6)
  - 'motory sensation' - representation in terms of patterns of proprioceptive feedback?
  - associated with 'sound pictures' - auditory representations.
- Speech production is variable

  '…uniformity…can never become absolute. Less important vacillations in the pronunciation of the same word in the same place in the sentence are inevitable' (p.8)
  - variation is unnoticed, does not result in mismatch with memory-picture.
  - References to translation of *Prinzipien der Sprachgeschichte* by H.A. Strong, excerpt reprinted in Baldi & Werth *Readings in Historical Phonology*.

Paul's (1880) theory of sound change

- Stored representations are constantly updated based on experience
  - 'this sensation is the product of all the earlier impressions received in the course of carrying out movement in question…the motory sensation must be somewhat modified with each new impression' (p.8)
- More recent experiences are given greater weight in this representation
  - 'the later impressions always have stronger after-influences than the earlier'
  - stored representations are a weighted average of previous productions, with greater weight given to recent experiences?

Paul's (1880) theory of sound change

- The variability of speech production together with this method of updating stored representations makes change in pronunciation possible.
  - If deviations from the stored target are predominately in one direction, the stored representation will shift in this direction.
  - Subsequent deviations start from this new reference point.
  - If deviations continue to be biased in a particular direction through iterations of this process, then 'imperceptible' deviations from the motory-sensation target can add up to a significant change.
  - 'There thus gradually arises, by adding together all the displacements (which we can hardly imagine small enough), a notable difference – whether it be that the movement progresses steadily in a special direction, or that the advance is regularly interrupted by relapses, if only the latter are less frequent and smaller than the first' (p.9)
- What would bias deviations in this way?
  - Random noise would be unlikely to produce much change.

Paul (1880) – the role of the community

- Moreover any such bias must overcome the conservative influence of the speech community.
- 'Sound-pictures' are based on 'all that we hear from those with whom we enter into communication' (p.12)
- The results of executing motory-sensations are compared to the sound-picture.
  - significant deviations are regarded as errors: 'it belongs to the very essence of language as a means of communication, that the single individual should always find himself in agreement with the companions with whom he communicates.' (p.12)
  - 'the demand for such agreement remains…unconscious' (p.12)
- So a sound change can only develop if it is shared by the majority of a speech community
  - So biases driving sound change must be shared by the community.
- Attributes a special role to transmission between generations.
  - The mechanism for this is not clear to me.

Paul (1880) – sources of bias

- Minimization of effort
  - 'There are a great number of cases in which…this sound-group is simply more convenient than that' (p.10)
  - homorganic clusters are 'more convenient' than heterorganic clusters

Old Italian	Italian	
okto	otto	'eight'
nokte	notte	'night'
lakte	latte	'milk'

  - Expresses reservations about the generality of effort considerations.
- Sound change is phonetically conditioned because biases like effort minimization are dependent on phonetic context.

Paul (1880) – sources of bias

- Speech errors
  - Observes that non-local metathesis looks similar to attested speech errors (pp.16-17)
    - Latin *marmor* > OHG *marmul*
    - Latin *martyrium* > MHG *martel~marter*
  - Also dissimilation between similar sounds/clusters
    - Greek *drúphaktos* 'wooden barrier' from *phrássō*
    - cf. tongue twisters: 'If Peter Piper picked a peck of pickled pepper…'
- If speech errors are common enough they could give rise to change.
  - The bias would arise from the nature of speech production favoring certain kinds of errors.

Paul (1880) – regularity of sound change

- Proposes that the regularity (uniformity) of sound change follows from the fact that motory sensations are sounds (or sound sequences?)
  - 'A motory sensation does not form itself specially for every word, but in every case where the same elements recur in language their production is guided by the same sensation
  - 'Should, then, the motory sensation suffer displacement by reason of the pronunciation of an element in any word, then this displacement is also a precedent for the same element in another word'
- I.e. the unit of sound change is the motory sensation, and words are specified in terms of motory sensations.
  - So gradual change in the pronunciation of sounds must be regular.
  - Changes in the units used to a represent a given word ('underlying representation') could occur on a word-by-word basis.
- Not clear exactly how context-dependent change works.
  - Are motory sensation context-specific segments?

Paul (1880)

- Can Paul's model account for age-related variation accompanying sound change in progress?

The role of the speaker in sound change

- 'Ease of articulation' has commonly been regarded as the basis for sound changes such as lenitions and assimilations.

Old Italian	Italian	
okto	otto	'eight'
nokte	notte	'night'
lakte	latte	'milk'

Latin	Portuguese	French	
bon(um)	bõ	bɔ̃	'good'
un(um)	ũ	œ̃	'one'

The role of the listener in sound change

- However there are many sound changes that cannot easily be understood in terms of reduction of effort, e.g. fortition.

Latin	French	
jumentum	[ʒ]ument	‘draft animal’
jocus	[ʒ]eu	‘game’
junius	[ʒ]uin	‘June’

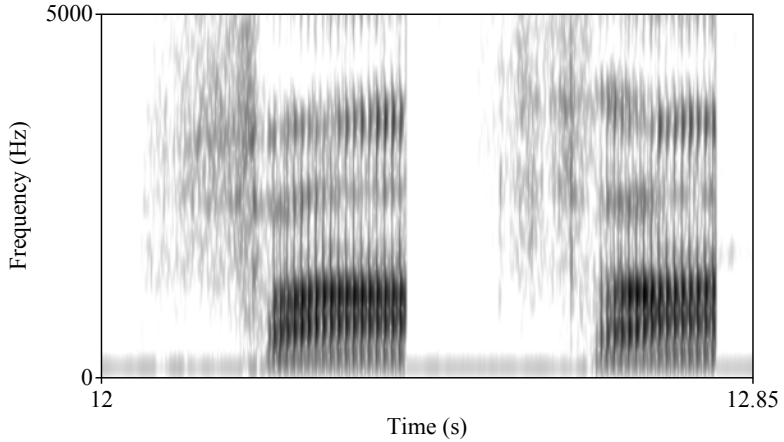
- Ohala (1981) proposes an account of the origins of sound changes that gives a central role to the listener

Changes between perceptually similar sounds

- Regardless of the precise mechanism involved, the relevance of speech perception is indicated by frequent changes involving articulatorily dissimilar, but perceptually similar sounds.
  - Suggests biases pertaining to speech perception
- f > θ

RP English	Cockney	
θɹu	fɹu	'through'
θɪn	fɪn	'thin'

- This change is acoustically gradual, but articulatorily abrupt



Changes between perceptually similar sounds

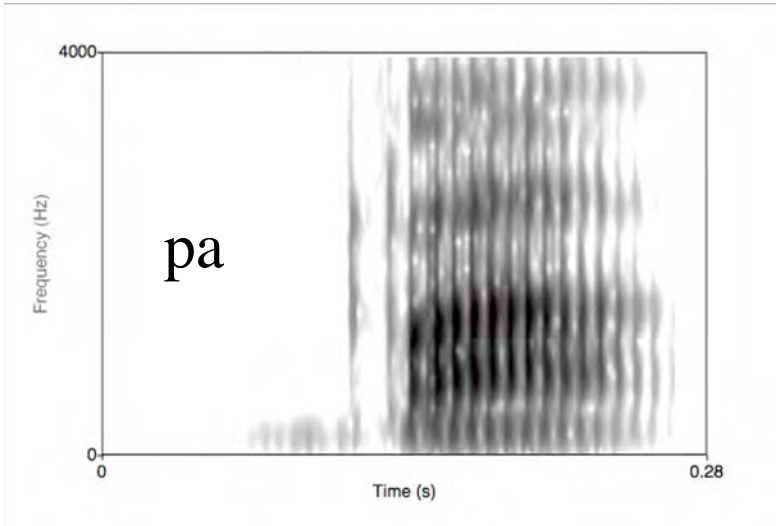
- Labialized stops > labials

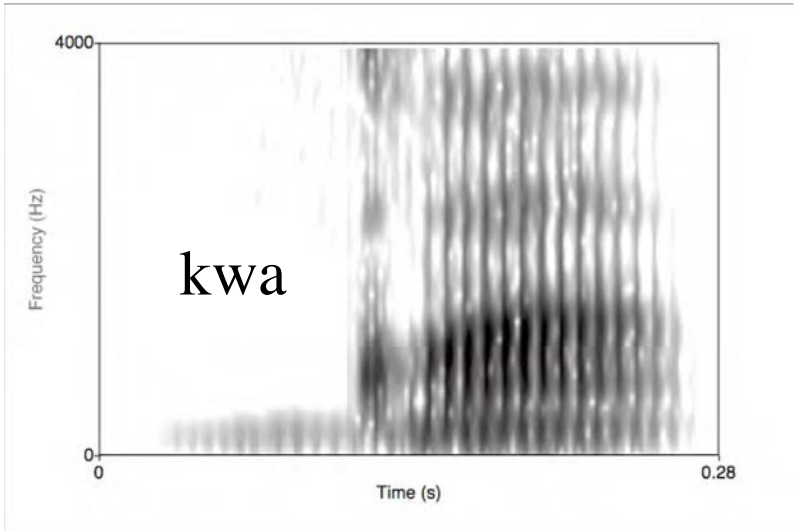
Early Latin	Classical Latin	
dwellom	bellum	‘war’
dwonos	bonus	‘good’
dwis	bis	‘twice’

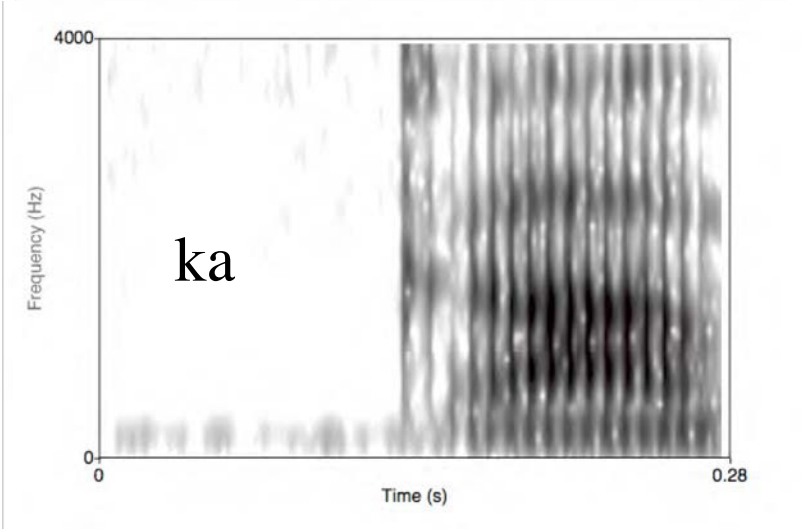
Classical Latin	Romanian	
akwa	apa	‘water’
liŋgwa	limba	‘tongue’
ekwa	iapə	‘mare’

Changes between perceptually similar sounds

- Labialized stops > labials





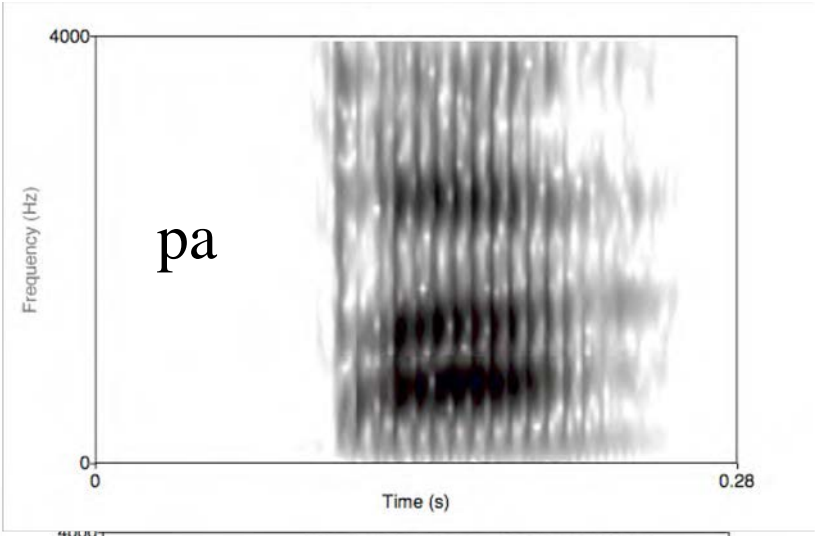


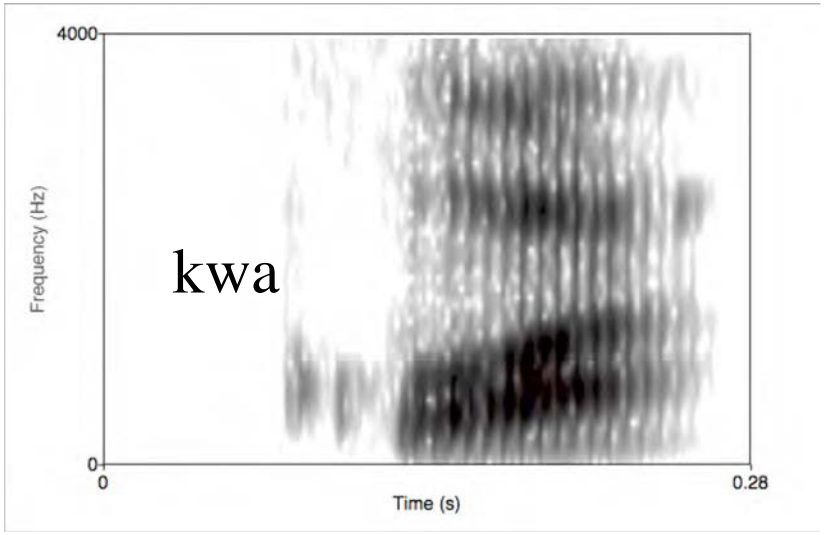
Spectrograms of Korean C(G)V sequences (Suh 2009)

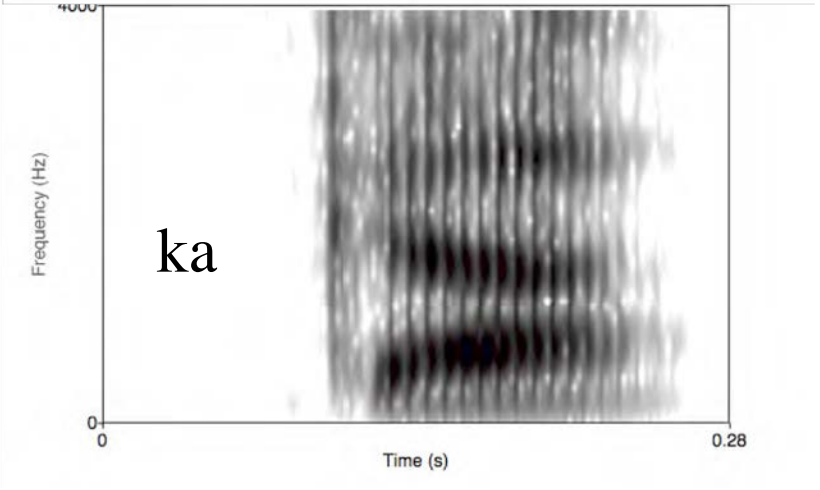
- tense stops

Changes between perceptually similar sounds

- NB similarity between labialized stops and labials depends on exactly how [Cw/C^{w}] are realized







Spectrograms of Spanish C(G)V sequences (Suh 2009)

- [w] is longer, consistently low F2.

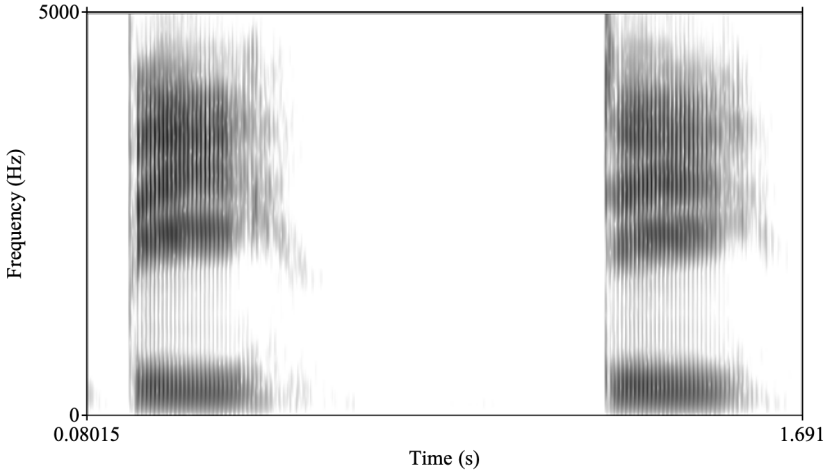
Changes between perceptually similar sounds

- Palatalized labials > Coronals

Old Czech	Litomyšl Czech	
pʲeknʲe	teknʲe	“nicely”
bʲeʒeti	deʒet	“run”
mʲesto	nesto	“town”

  - Palatalization was lost in all contexts, but without change in primary place of other palatalized consonants.

[bi] [di]



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