

# Allophonic Emergence: three ways allophonic rules come to be

Betsy Sneller and Joel C. Wallenberg  
University of Pennsylvania, Newcastle University

May 28, 2015

Formal Ways of Analyzing Variation (FWAV)

Háskóli Íslands

[https://github.com/betsysneller/allophones/blob/  
master/FWAV-CommonGround.pdf](https://github.com/betsysneller/allophones/blob/master/FWAV-CommonGround.pdf)

ooooo  
ooo  
ooooo

oooo  
ooo

# Introduction

In this talk, we'll argue that there are at least three ways that allophonic categories can emerge.

We provide evidence that they have all been attested in recent sound changes, and outline a research program with the goal of supporting or falsifying these hypotheses.

## Introduction

### Three paths to allophony

Mechanical Means

Spontaneous Phonologization

Phonological Specialization

### Testing for the types

Effect of duration

Rate of change

## Conclusions

●○○○○○  
○○○  
○○○○○

○○○○  
○○○

## Introduction

### Three paths to allophony

Mechanical Means

Spontaneous Phonologization

Phonological Specialization

### Testing for the types

Effect of duration

Rate of change

## Conclusions

## Mechanical Means

Traditionally assumed scenario (Ohala, 1981)

- A **mechanical**, non-grammatical effect skews the distribution of outputs perceived by the learner.

## Mechanical Means

Traditionally assumed scenario (Ohala, 1981)

- A **mechanical**, non-grammatical effect skews the distribution of outputs perceived by the learner.
  - Articulatory

## Mechanical Means

Traditionally assumed scenario (Ohala, 1981)

- A **mechanical**, non-grammatical effect skews the distribution of outputs perceived by the learner.
  - Articulatory
  - Perceptual



## Mechanical Means

Traditionally assumed scenario (Ohala, 1981)

- A **mechanical**, non-grammatical effect skews the distribution of outputs perceived by the learner.
  - Articulatory
  - Perceptual
- **Our interpretation:** some generation reanalyzes a phonetic effect as an allophonic rule, introducing a new rule variant into the populations (of utterances within speakers, of speakers in a speech community).



## Mechanical Means

- Some generation reanalyzes a phonetic effect as an allophonic rule, introducing a new rule variant into the populations (utterances, speech community).
- **Preaspiration and coda-devoicing in Icelandic** (Árnason, 1980, 1986):

/hattur/ ('hat') → [hahtyr]  
 /henta/ ('to suit') → [hɛnt̚a]



## Mechanical Means

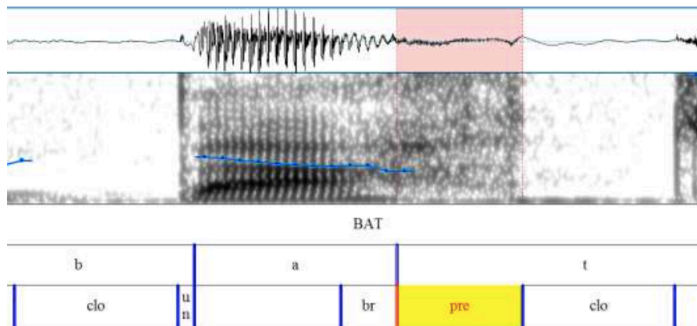
/hattur/ ('hat') → [hahtyr]  
 /henta/ ('to suit') → [hɛnt̪a]

Diachrony (Árnason, 1980, 1986):

1. Icelandic loses contrastive vowel length.
  2. Lengthening Rule: vowels in open syllables lengthen, closed syllables shorten (active rule)
  3. In short syllables, spread glottis gesture is (mis-)timed in the segment preceding voiceless non-continuant codas.
  4. Speakers reanalyze the early-timed gesture as an allophonic rule (our interpretation of Árnason 1986).
- The new rule spreads (and is possibly still spreading in Northern Iceland).

## Preaspiration in Aberystwyth English (Hejná, 2014)

- The same change appears to be in progress in Aberystwyth English, Northwest British English, and possibly other British Englishes.
- As in Icelandic, it effects both vowels preceding voiceless codas and liquids preceding a voiceless consonant in codas (Hejná, p.c.).

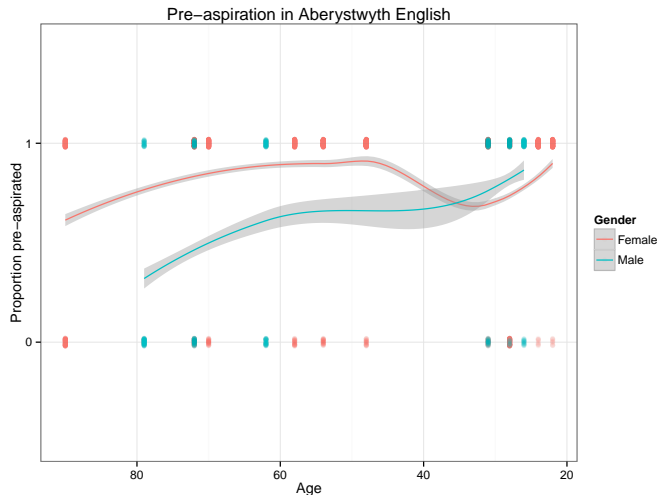


○○○○●  
○○○  
○○○  
○○○○○

○○○○  
○○○

# Preaspiration in Aberystwyth English (Hejná, 2014)

- New allophone is still spreading:



## Introduction

### Three paths to allophony

Mechanical Means

Spontaneous Phonologization

Phonological Specialization

### Testing for the types

Effect of duration

Rate of change

## Conclusions



# Spontaneous Phonologization

Scenario proposed by Janda and Joseph (2003); Fruehwald (2013)

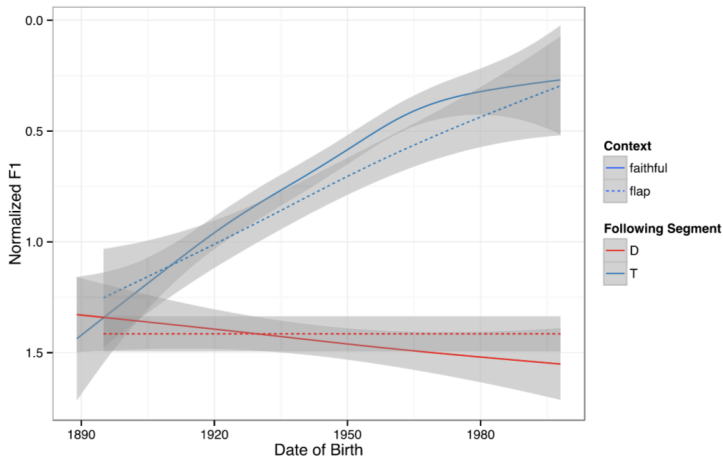
- Speakers **spontaneously** create an allophone without any phonetic motivation.
  - Allophonic categories emerge in individual speakers' grammars before any phonetic motivation.

○○○○○  
 ○●○○○  
 ○○○○○

○○○○  
 ○○○

# Spontaneous Phonologization: PRICE-raising in Philadelphia English (Fruehwald 2013)

(308 speakers)



## Introduction

### Three paths to allophony

Mechanical Means

Spontaneous Phonologization

Phonological Specialization

### Testing for the types

Effect of duration

Rate of change

## Conclusions



○○○○○  
○○○  
○○  
○●○○○

○○○  
○○○  
○○

# Phonological Specialization

Proposed by us:

○○○○○  
○○○  
○●○○○

○○○○  
○○○

# Phonological Specialization

Proposed by us:

- A phonetic change begins, creating variation in phonetic space.

○○○○○  
○○○  
○○○  
○●○○○

○○○○  
○○○

## Phonological Specialization

Proposed by us:

- A phonetic change begins, creating variation in phonetic space.
- This variation is reanalyzed as an allophonic distinction for a generation of speakers.

○○○○○  
○○○  
○○○  
●○○○○

○○○○  
○○○

## Phonological Specialization

Proposed by us:

- A phonetic change begins, creating variation in phonetic space.
- This variation is reanalyzed as an allophonic distinction for a generation of speakers.
  - Different from Mechanical Means because the phonologization is **not** the result of generationally compounding perception or production errors.

○○○○○  
○○○  
○○○  
●○○○○

○○○○  
○○○

## Phonological Specialization

Proposed by us:

- A phonetic change begins, creating variation in phonetic space.
- This variation is reanalyzed as an allophonic distinction for a generation of speakers.
  - Different from Mechanical Means because the phonologization is **not** the result of generationally compounding perception or production errors.
  - Different from Spontaneous Phonologization because it **is** a reanalysis of existing phonetic space.

○○○○○  
 ○○○  
 ○○○  
 ○●○○○

○○○○  
 ○○○

## Phonological Specialization

In a categorical dimension (e.g. a consonant changes from  $k > t$ , as in Hawaiian):

- A phoneme changes from A to B, but while A and B are in variation, they become reanalyzed as allophones, specialized for different phonological contexts, and they both survive.

(The case of categorical specialization, as in Kroch 1994, Fruehwald and Wallenberg 2013, In preparation.)

$$/k/ \rightarrow [k] / \text{Context}_1$$

$$/k/ \rightarrow [t] / \text{Context}_2$$

○○○○○  
○○○  
○○○●○○

○○○○  
○○○

## Phonological Specialization

In a continuous dimension (e.g. a vowel fronts), suppose:

○○○○○  
○○○  
○○○●○○

○○○○  
○○○

## Phonological Specialization

In a continuous dimension (e.g. a vowel fronts), suppose:

1. A vowel change in vowel V begins, creating variation in phonetic space.



○○○○○  
 ○○○  
 ○○○●○○

○○○○  
 ○○○

## Phonological Specialization

In a continuous dimension (e.g. a vowel fronts), suppose:

1. A vowel change in vowel V begins, creating variation in phonetic space.
2. Speakers do not control the variance of their vowel production around their phonetic target for V, and assume uniform variance.

○○○○○  
○○○  
○○○●○○

○○○○  
○○○

## Phonological Specialization

In a continuous dimension (e.g. a vowel fronts), suppose:

1. A vowel change in vowel V begins, creating variation in phonetic space.
2. Speakers do not control the variance of their vowel production around their phonetic target for V, and assume uniform variance.
3. They hear larger than expected, asymmetrical variance around V in the last two generations of the speech community.

○○○○○  
○○○  
○○○●○○

○○○○  
○○○

## Phonological Specialization

In a continuous dimension (e.g. a vowel fronts), suppose:

1. A vowel change in vowel V begins, creating variation in phonetic space.
2. Speakers do not control the variance of their vowel production around their phonetic target for V, and assume uniform variance.
3. They hear larger than expected, asymmetrical variance around V in the last two generations of the speech community.
4. Speakers reanalyze half of the variance as allophone A<sub>1</sub> for V, and the other half of the variance as allophone A<sub>2</sub> for V, and assume they are supposed to occur in different phonological contexts.

○○○○○  
○○○  
○○○●○○

○○○○  
○○○

## Phonological Specialization

In a continuous dimension (e.g. a vowel fronts), suppose:

1. A vowel change in vowel V begins, creating variation in phonetic space.
2. Speakers do not control the variance of their vowel production around their phonetic target for V, and assume uniform variance.
3. They hear larger than expected, asymmetrical variance around V in the last two generations of the speech community.
4. Speakers reanalyze half of the variance as allophone A<sub>1</sub> for V, and the other half of the variance as allophone A<sub>2</sub> for V, and assume they are supposed to occur in different phonological contexts.
5. The allophonic rule spreads after the split, spreading at the expense of the old, unitary V system.

○○○○○  
○○○  
○○○●○○

○○○○  
○○○

## Phonological Specialization

In a continuous dimension (e.g. a vowel fronts), suppose:

1. A vowel change in vowel V begins, creating variation in phonetic space.
2. Speakers do not control the variance of their vowel production around their phonetic target for V, and assume uniform variance.
3. They hear larger than expected, asymmetrical variance around V in the last two generations of the speech community.
4. Speakers reanalyze half of the variance as allophone A<sub>1</sub> for V, and the other half of the variance as allophone A<sub>2</sub> for V, and assume they are supposed to occur in different phonological contexts.
5. The allophonic rule spreads after the split, spreading at the expense of the old, unitary V system.

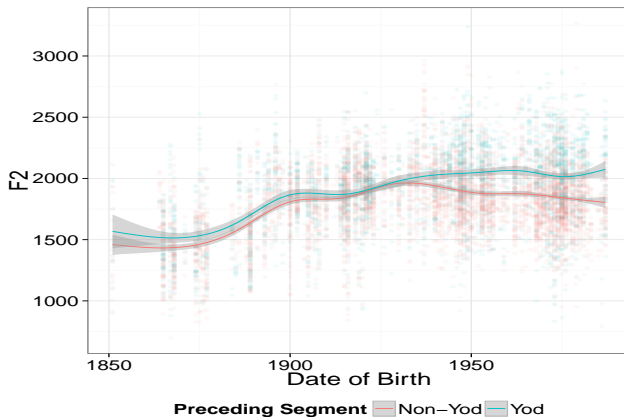


○○○○○  
○○○  
○○○  
○○○○●

○○○○  
○○○

## Phonological Specialization:

GOOSE-NEW split in New Zealand English (Seyfarth and Sneller 2014)



## Introduction

### Three paths to allophony

Mechanical Means

Spontaneous Phonologization

Phonological Specialization

### Testing for the types

Effect of duration

Rate of change

## Conclusions



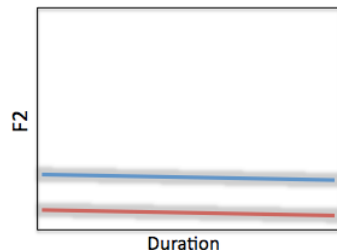
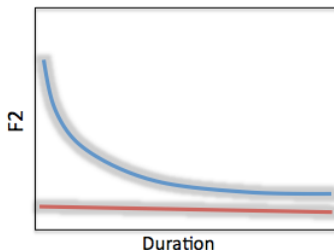
Does a surface distinction map to one underlying category or two?

○○○○○  
○○○  
○○○  
○○○○○

○○●○  
○○○

## Effect of duration

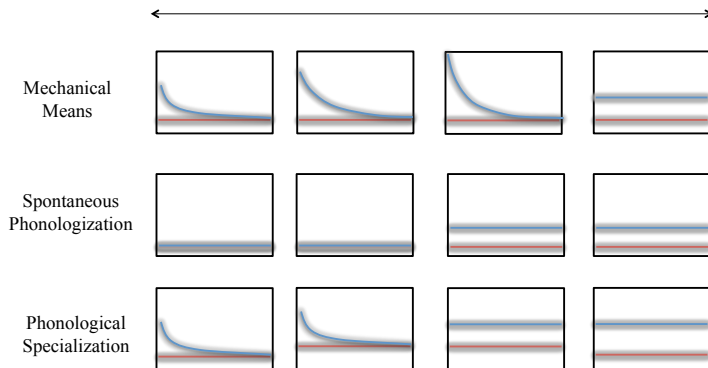
- If a difference in acoustic output is caused by coarticulation, it will increase for short tokens (?).
- If the difference is caused by allophony, it will be present in the long tokens too.



○○○○○  
○○○  
○○○○○

○○○●  
○○○

## Effect of duration: Predictions



## Introduction

### Three paths to allophony

Mechanical Means

Spontaneous Phonologization

Phonological Specialization

### Testing for the types

Effect of duration

Rate of change

## Conclusions

○○○○○  
○○○  
○○○  
○○○○○

○○○○  
○●○

## Rate of change: coarticulation

- A phonological rule operates on a single phonological category (Fruehwald, 2013).

○○○○○  
○○○  
○○○  
○○○○○

○○○○  
○●○

## Rate of change: coarticulation

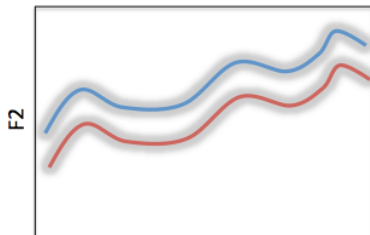
- A phonological rule operates on a single phonological category (Fruehwald, 2013).
- If two variables have different rates of change, it means there are two rules at work (Fruehwald 2013's application of the Constant Rate Effect, Kroch 1989).

○○○○○  
○○○  
○○○  
○○○○○

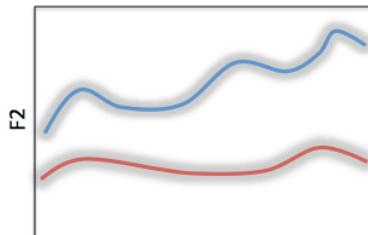
○○○○  
○●○

## Rate of change: coarticulation

- A phonological rule operates on a single phonological category (Fruehwald, 2013).
- If two variables have different rates of change, it means there are two rules at work (Fruehwald 2013's application of the Constant Rate Effect, Kroch 1989).



Date of Birth



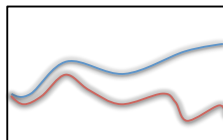
Date of Birth

oooooo  
ooo  
oooooo

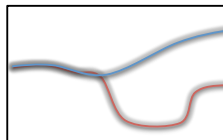
oooo  
oo●

## Rate of change: Predictions

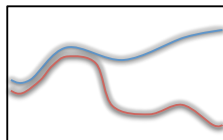
Mechanical  
Means



Spontaneous  
Phonologization



Phonological  
Specialization





ooooo  
ooo  
ooooo

ooo  
ooo

## Conclusions: 3 types of allophonic splits

### Mechanical means

- Effect of duration for the whole change until reanalysis.
- Gradual split in rate of change.

ooooo  
ooo  
ooooo

oooo  
ooo

## Conclusions: 3 types of allophonic splits

### Mechanical means

- Effect of duration for the whole change until reanalysis.
- Gradual split in rate of change.

### Spontaneous phonologization

- No effect of duration (pre-split don't have a distinction and post-split don't coarticulate).
- Immediate split in rate of change.

ooooo  
ooo  
ooo  
ooooo

oooo  
ooo

## Conclusions: 3 types of allophonic splits

### Mechanical means

- Effect of duration for the whole change until reanalysis.
- Gradual split in rate of change.

### Spontaneous phonologization

- No effect of duration (pre-split don't have a distinction and post-split don't coarticulate).
- Immediate split in rate of change.

### Phonological specialization

- Effect of duration until reanalysis.
- Immediate split in rate of change.

ooooo  
ooo  
ooooo

oooo  
ooo

## Final thoughts and questions

- To use these metrics, we need **lots** of data from lots of people.

ooooo  
ooo  
ooo  
ooooo

ooo  
ooo

## Final thoughts and questions

- To use these metrics, we need **lots** of data from lots of people.
  - We need data on changes before they happen, or close to actuation (possible with corpora).

ooooo  
ooo  
ooooo

ooo  
ooo

## Final thoughts and questions

- To use these metrics, we need **lots** of data from lots of people.
  - We need data on changes before they happen, or close to actuation (possible with corpora).
- DARLA, FAVE.

ooooo  
ooo  
ooooo

ooo  
ooo

## Final thoughts and questions

- To use these metrics, we need **lots** of data from lots of people.
  - We need data on changes before they happen, or close to actuation (possible with corpora).
- DARLA, FAVE.
- What about suprasegmentals?
  - Duration and ROC are good metrics for vocalic and consonantal change.

ooooo  
ooo  
ooooo

oooo  
ooo

## Final thoughts and questions

- To use these metrics, we need **lots** of data from lots of people.
  - We need data on changes before they happen, or close to actuation (possible with corpora).
- DARLA, FAVE.
- What about suprasegmentals?
  - Duration and ROC are good metrics for vocalic and consonantal change.
  - Cho (2015) Development of pitch contrast in Korean prosody.



ooooo  
ooo  
ooo  
ooooo

oooo  
ooo

## Final thoughts and questions

- To use these metrics, we need **lots** of data from lots of people.
  - We need data on changes before they happen, or close to actuation (possible with corpora).
- DARLA, FAVE.
- What about suprasegmentals?
  - Duration and ROC are good metrics for vocalic and consonantal change.
  - Cho (2015) Development of pitch contrast in Korean prosody.
- Questions going further: how does allophone emergence relate to phoneme emergence?
- What's the role of learned phonetic targets (pre-phonological) in allophonic split, or gradient phonological rules in Bermúdez-Otero's work?

## References I

Árnason, Kristján. 1980. *Quantity in Historical Phonology: Icelandic and Related Cases*. Cambridge: Cambridge University Press.

Árnason, Kristján. 1986. The segmental and suprasegmental status of preaspiration in modern icelandic. *Nordic Journal of Linguistics* 9:1–23.

Cho, Sunghye. 2015. Development of pitch contrast in korean prosody.

Fruehwald, Josef. 2013. Phonological involvement in phonetic change. Doctoral Dissertation, University of Pennsylvania.

## References II

- Fruehwald, Josef, and Joel C. Wallenberg. 2013. Optionality is Stable Variation is Competing Grammars. *Presented at 25th Scandinavian Conference of Linguistics, Formal Ways of Analyzing Variation (FWAV) Workshop* .
- Fruehwald, Josef, and Joel C. Wallenberg. In preparation. Optionality is Stable Variation is Competing Grammars.
- Hejná, Michaela. 2014. Pre-aspiration and glottalization in Aberystwyth English. To be submitted.
- Janda, Richard D, and Brian D Joseph. 2003. Reconsidering the canons of sound-change: Towards a "big bang" theory. In *Historical Linguistics 2001. Selected Papers from the 15th International Conference on Historical Linguistics*, ed. Barry Blake and Kate Burridge, 205–219. Melbourne: John Benjamins.

## References III

- Kroch, Anthony S. 1989. Reflexes of grammar in patterns of language change. *Language Variation and Change* 1:199–244.
- Kroch, Anthony S. 1994. Morphosyntactic variation. In *Papers from the 30th Regional Meeting of the Chicago Linguistics Society: Parasession on Variation and Linguistic Theory*, ed. K. Beals et al.
- Ohala, John. 1981. The listener as a source of language change. In *Papers from the parasession on language and behavior*, ed. C S Masek, R A Hendrick, and M F Miller. Chicago Linguistics Society.

ooooo  
ooo  
ooooo

oooo  
ooo

Thank you!

## Effect of duration: Mechanical means

### Mechanical means

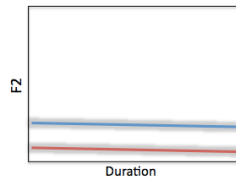
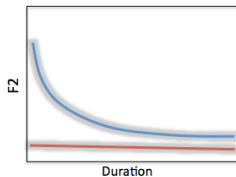
- Because the allophonic split is the result of accruing phonetic effects, we should see an effect of duration for most speakers, until a reanalysis has been made.
- After the reanalysis, as the new allophone spreads, the earlier effect of duration should decrease over time.

oooooo  
ooo  
oooooo

oooo  
ooo

## Effect of duration: Mechanical means

### Mechanical means



## Effect of duration: Spontaneous phonologization

### Spontaneous phonologization

- Because there is no phonetic effect that precedes the phonological effect, we should see no effect of duration at any time



# Effect of duration: Spontaneous phonologization

## Spontaneous phonologization

- Because there is no phonetic effect that precedes the phonological effect, we should see no effect of duration at any time
  1. Speakers with one category show no coarticulation (no difference to be found)

## Effect of duration: Spontaneous phonologization

### Spontaneous phonologization

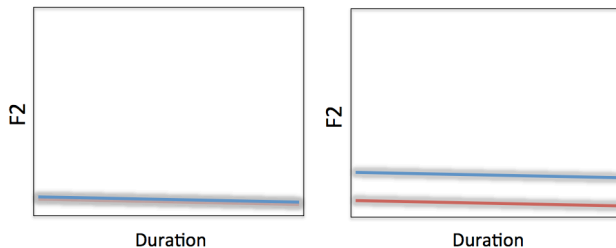
- Because there is no phonetic effect that precedes the phonological effect, we should see no effect of duration at any time
  1. Speakers with one category show no coarticulation (no difference to be found)
  2. Speakers with two categories show two phonological categories (no effect of duration)

oooooo  
ooo  
oooooo

oooo  
ooo

# Effect of duration: Spontaneous phonologization

## Spontaneous phonologization



## Effect of duration: Phonological specialization

### Phonological specialization

- Because the phonologization is the result of reanalyzed coarticulation, we should see older speakers showing an effect of duration (shorter tokens more distinct)

## Effect of duration: Phonological specialization

### Phonological specialization

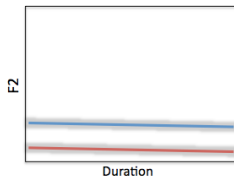
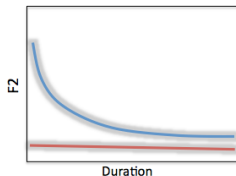
- Because the phonologization is the result of reanalyzed coarticulation, we should see older speakers showing an effect of duration (shorter tokens more distinct)
- and younger speakers with two distinct categories for tokens of all duration

oooooo  
ooo  
oooooo

oooo  
ooo

# Effect of duration: Phonological specialization

## Phonological specialization

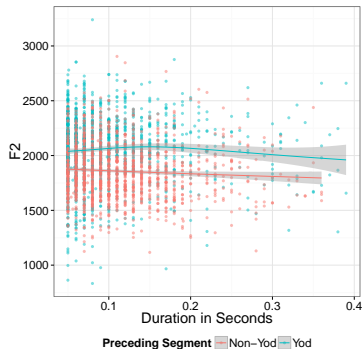
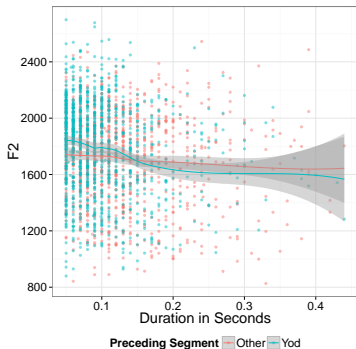


○○○○○  
○○○  
○○○○○

○○○○  
○○○

# Effect of duration: Phonological specialization

## Phonological specialization in New Zealand English



○○○○○  
○○○  
○○○○○

○○○○  
○○○

## Rate of change: Mechanical means

### Mechanical means

- Because the allophonic split is the result of accruing phonetic effects, we should see a gradual drift in the two variables

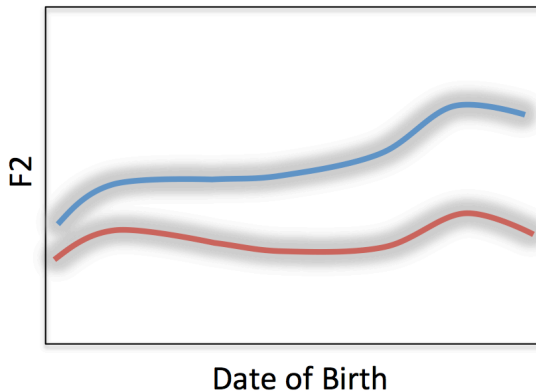


ooooo  
ooo  
ooooo

oooo  
ooo

## Rate of change: Mechanical means

### Mechanical means



## Rate of change: Spontaneous phonologization

### Spontaneous phonologization

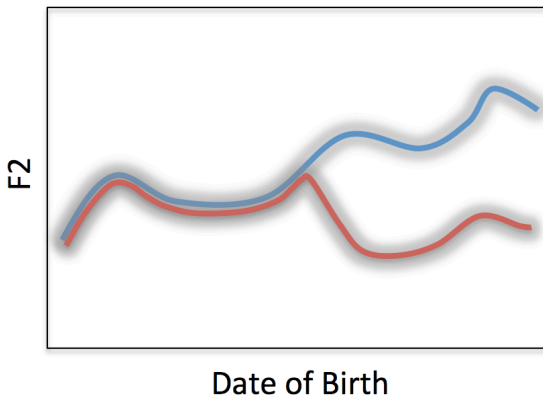
- Because the allophonic split occurs suddenly, we should see both variables in lock step until the community spontaneously creates a new category

oooooo  
ooo  
oooooo

oooo  
ooo

## Rate of change: Spontaneous phonologization

### Spontaneous phonologization



## Rate of change: Phonological specialization

### Phonological specialization

- Because the allophonic split occurs suddenly, we should see both variables in lock step until the community spontaneously creates a new category

# Rate of change: Phonological specialization

## Phonological specialization

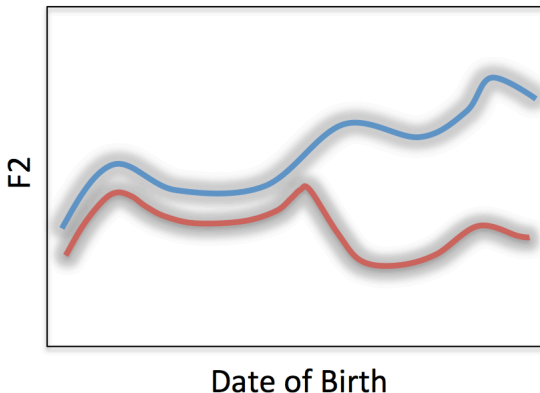
- Because the allophonic split occurs suddenly, we should see both variables in lock step until the community spontaneously creates a new category
- However, we may still see an effect of coarticulation for the early speakers

oooooo  
ooo  
oooooo

oooo  
ooo

# Rate of change: Phonological specialization

## Phonological specialization

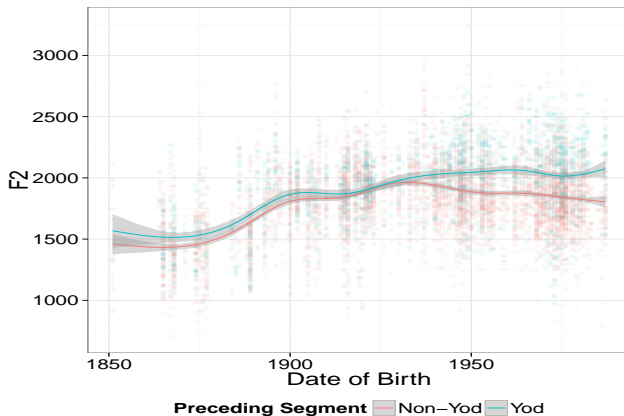


oooooo  
ooo  
ooo  
oooooo

oooo  
ooo

# Rate of change: Phonological specialization

## Phonological specialization in New Zealand English /u/-fronting



○○○○○○  
○○○  
○○○  
○○○○○○

○○○○  
○○○

# Rate of change: Phonological specialization

## Phonological specialization in New Zealand English /u/-fronting

