A typology of sound change: phonetic properties and frequency effects

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Goals

- This paper seeks to contribute to a typology of sound change or phonetic variation based on the causes and mechanisms of change.

Factors to consider

1. The phonetic trajectory of the change
2. Whether the change is phonetically gradual or abrupt
3. Unidirectionality across languages
4. Whether or not novel segments are created
5. Whether or not the conditioning environment lost

Factors to consider

6. The domain of change—words versus larger units
7. The type of lexical diffusion:
   (i) based on word frequency,
   from high frequency to low frequency or
   from low frequency to high frequency, or
   (ii) based on word class
8. Whether the outcome is lexically regular or not

Outline of the paper

1. Lexical diffusion as a diagnostic for the mechanisms of sound change.
2. The most common type of lexical diffusion—from high frequency words to low frequency words—suggests an articulatory mechanism for sound change or phonetic variation, which I identify as the result of neuromotor automation of articulatory routines.

Outline of the paper

3. I propose a model which integrates lexical change with the broader articulatory change that results in lexical regularity.
4. I compare articulatory explanation to proposals for perceptually explanations, such as Ohala's.
5. I demonstrate the predictions of an articulatory model for types of phonetic change and report on preliminary findings of a cross-linguistic survey.

Lexical diffusion

- Even sound changes that end up lexically regular might exhibit patterns of lexical diffusion while they are in progress.
- The pattern of lexical diffusion that is observed while a change is in progress gives us evidence about the mechanism that is driving the change.

Lexical diffusion and phonemic theory

1. Sound change can be phonetically gradual but it must be lexically abrupt.
2. Sound change can be lexically gradual but then it must be phonetically abrupt.

Labov's proposal (1981, 1994)

Two types of change

1. Neogrammarian change

2. Lexical diffusion change

Empirical evidence for lexical diffusion of gradual changes

- The following (among others) demonstrate that sound change can be both lexically and phonetically gradual:

  Hooper 1976, Phillips 1984, 2006, Bybee 1981, 2000, 2001a and b, Oliveira 1991, Khrishnamurti 1998, Khanina and Shluinsky 2010

High frequency words change first

Vowel reduction and deletion

- Pre-stress vowel reduction in English (Fidelholtz 1975) and Dutch (Van Bergem 1995)
- Reduction and deletion of shwa in American English (Hooper 1976, Patterson et al. 2003))
- Vowel reduction in English adjective –*ate* (Phillips 1998)
- Reduction of vowels in hiatus in Spanish (Alba 2003)

High frequency words change first

- **Consonant reduction**
- t/d deletion in American English (Bybee 2000, 2002b, Gregory et al. 1999)
- final [t] deletion in Dutch (Goeman and van Reenan 1985, Phillips 2006)
- deletion of [ð] in Spanish (D'Introno and Sosa 1986, Bybee 2001, 2002a)
- reduction of Spanish [s] to [h] in syllable-initial position (Esther Brown 2004)

High frequency words change first

- reduction of Spanish [s] to [h] to ∅ (Earl Brown 2008)
- fricativization of voiceless stops in English RP (Buizza and Plug 2010)
- flapping in American English (Gregory et al. 1999)
- w-deletion in Danish (Pharao 2010)

High frequency words change first

- **Vowel shifts**
- American English centralization of [æ] (Moonwomon 1992)
- American English fronting of [ɔ] (Moonwomon 1992)
- Diphthongization of Middle English [i:] and [u:] in the *Survey of EnglishDialects* (Ogura 1987)

High frequency words change first

- **Assimilation and retiming or overlap**
- Palatalization of [tj] in American English (Bush 2001)
- English fronting of [u:] around coronals(Ogura 1987, Phillips 2006)
- Vowel changes in hiatus in Spanish (Alba 2003)
- Gestural compression of Brazilian Portuguese [ʃtʃi] to [ʃʃ] (Cristófaro-Silva and Guimaraes 2006)

High frequency words change first

- In all of these studies there is phonetic variation and high frequency words have more of the innovative variants.

The role of word frequency

- Change that diffuses from **high frequency** words/phrases to lower frequency ones is indicative of processes that occur in highly practiced behavior, i.e. the automation of neuromotor routines.
- In 1976 I compared this pattern to one in which **low frequency** words are affected first, notably changes of an analogical nature: analogical leveling affects low frequency words before high frequency words.

Two distinct mechanisms

1. The domain-general process by automation of repeated behaviors progresses more rapidly with more repetition.
2. Repeated use makes high frequency words more them accessible and less likely to change on the basis of more productive patterns.

Exemplar models

- The existence of changes that are both phonetically gradual and lexically gradual has been taken to be a strong argument against theories in which only abstract phonemes exist in memory and all detail about how they are realized in context is lost.
- That is, it has been taken to be an argument for exemplar models (Bybee 2000, 2001, Pierrehumbert 2001).

Exemplar models

- Exemplar models provide a natural way to represent change that occurs more rapidly in high frequency words.
- A word that has undergone reduction in production will have an impact on memory representation, adding or strengthening a reduced exemplar.

An articulatory basis for sound change

Characterization of casual speech processes

As ‘due to two gradient modifications to gestural structure during the act of talking—

(a) increase in overlap and

(b) decrease in magnitude of gestures’ (Browman and Goldstein 1992: 173)

Characterization of sound change

- Substantive Reduction (reduction in the magnitude of gestures) or
- Temporal Reduction (by which gestures are compressed temporally and therefore overlap).
- Both of these proposals cover the two most common types of sound change—assimilation and lenition.

Automation of neuromotor routines

1. Domain-general
2. Not sloppy speech
3. Uniformity across speakers of the same dialect
4. Lindblom 1990

Exemplar model

- Production routines for individual words interact with more general production routines.
- In regular sound change, the general routine eventually comes to be changed.

Comparison with perceptually-motivated change

Ohala (1981, 1989, 1993, 2003) proposes

(i) hypo-correction, which accounts for an (assimilatory) change becoming emancipated from its conditioning environment

(ii) hyper-correction, which accounts for dissimilation and

(iii) perceptual confusion.

Hypo-correction

- Hypo-correction creates a sound change when a listener fails to normalize variation thus not attributing it to the environment.
- My view: phonetic change is a sound change from the beginning; allophonic variation from coarticulation and reduction is introduced into a language and becomes conventionalized.

Facts that are unexplained in the hypo-correction scenario

1. Hypo-correction creates new segments.
2. Hypo-correction does not seem applicable to lenition.

Facts that are unexplained in the hypo-correction scenario

3. Hypo-correction does not explain why high frequency words change first.
4. 4. It does not explain why words and phrases of extreme high frequency undergo extreme reduction.
5. No account of spread to other words and other speakers.

Hyper-correction accounts for dissimilation

- Examples from Latin to Spanish:

  robur > *roble* ‘oak’

  carcere > *cárcel* ‘jail’

  marmore > *marmol* ‘marble’

  arbore > *árbol* ‘tree’

But: *taratrum* > *taladro* ‘drill’

  OSp *cerebro* > OSp *celebro* ‘cerebrum’

(examples from Menéndez-Pidal 1968:182-3).

Hyper-correction accounts for dissimilation

1. Such changes are usually described as sporadic

2. It is also significant that no new segments are created in such changes.

Perceptual confusion

1. Problem: normal children acquire the phonetics of the dialect to which they are exposed with rather exquisite detail. (Foulkes and Docherty 2006)
2. Perceptual confusion should go either way (Pensado 1996), yet in many of the examples Ohala attributes to perceptual confusion, there is clear directionality.

Perceptual confusion

3. Many of the sound changes cited in Ohala's work have plausible explanations in articulation.

To distinguish articulatory causes from perceptual, we can use lexical diffusion as a diagnostic.

Lexical diffusion from low to high frequency words

- Middle English mid front rounded vowels became unrounded.
  - *seon* > *see*
  - *deop* > *deep*
  - *beon* > *be*
- Phillips 1984 reports that in the *Ormulum* low frequency words are written with *e* or *ee* more than high frequency words.

Summary

Sound changes that affect low frequency words first

- As low frequency words have weaker cognitive representations and may be more difficult to access, they more likely to be replaced by forms representing more productive patterns.
- Phonotactics: productive patterns replace low (type) frequency patterns.


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Sound changes that affect low frequency words first

- Tensing of final [ɔ] in French (Morin et al. 1990)
  - began with a grammatically conditioned alternation which tensed final vowels in nouns and adjectives.
  - generalized to all nouns and adjectives, and eventually to adverbs.
  - The last word to be affected was the high frequency adverb *trop* ‘too much, too many’.

R > r in Brazilian Portuguese

- /R/ occurs word-initially and after C's such as /l/: *guelra* 'grill'
- /r/ intervocalically and after glides such as [w]: *europa* 'Europe'
- /l/ is vocalized in some dialects: *sal* [sau] 'salt'; *salto* [sauto] 'jump'

R > r in Brazilian Portuguese

- After /l/ vocalization [R] follows [w]:
  - *gue[wRa]* ‘grill’

- [R] in these contexts tend to become [r]
- Cristofaro-Silva and Oliveira argue that this is due to the higher type frequency of [wr] clusters over [wR]: 1800 : 101

R > r in Brazilian Portuguese

- Note that where other consonants vocalize or disappear, [R] remains:

  – *honra* ‘honor’ [õʀa]
  – *enredo* ‘plot’ [iʀedu]

Sound changes that affect low frequency words first: metathesis?

Hume 2004 argues for two factors that can provide the conditions for metathesis:

1. phonetic features that can spread over consecutive segments, thus producing a parsing problem;
2. and a higher type frequency of certain orders of segments over others.

High type frequency patterns replace low frequency patterns

- If two patterns (phonotactic or otherwise) are very similar and there is a big difference in type frequency, the one with higher type frequency could be accessed more readily and therefore replace the one with lower type frequency.

A typology of sound change and other phonological change

Table 1: A typology of sound change based on eight factors.

	Sound change	**Phonological change**
Phonetic path	Reduction & retiming	Not restricted
Gradual or abrupt	Gradual	Abrupt
Lexical diffusion	From Hi to Lo	From Lo to Hi
Lexical regularity	Lexically regular	Lexical exceptions possible
Directionality across languages	Unidirectional	Differs across languages
Domain of change	Words and phrases	Words
Resulting segments	Novel segments possible	Existing segments only
Conditioning environment	Can be lost	Maintained

Predictions made by articulatory theory

- Lenition
- Assimilation
  - Anticipatory assimilation should be more common than carry-over
  - Carry-over assimilation should involve more sluggish articulators

Anticipatory vs. carry-over assimilation

	Anticipatory	Carry-over	Bidirectional
Total for 23 languages	**78 (63%)**	**34 (28%)**	**11 (9%)**

Table 3: Articulators involved in carry-over retiming

Tongue body	46% (17)
Lips	38% (14)
Velum	22% (8)
Glottis	11% (4)
Tongue blade	0
Tongue tip	0

Table 4: Articulators involved in anticipatory retiming.

Tongue body	40% (28)
Glottis	31.4% (22)
Lips	18.6% (13)
Velum	5.7% (4)
Tongue blade	2.8% (2)
Tongue tip	1.4% (1)

Conclusions

- I have presented arguments for the hypothesis that many sound changes are motivated by, and have their origins in, the automation of production.
- I have also proposed a typology based on a number of factors that can help us determine the causes and the mechanisms of changes in sounds.

Conclusions

- I have emphasized lexical diffusion patterns because their diagnostic value has been under-appreciated in past discussions.