Experimental Evidence for Diachronic Change

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Evidence for sound change

- The importance of synchronic patterns in informing reconstruction has a long history (e.g. Sweet 1974, Paul 1886), and is implicit in most historical linguistics, even if it is not made explicit.

- Connections between synchronic and diachronic data can be attributed to shared biases in perception and production, which moreover can be tested experimentally.

- I compared a sample typology of diachronic developments with patterns of errors from experimentally elicited misperception and natural errors in perception and production.
Variability

- Studies on production as a source of sound change generally look at existing gradient variability in production.
- Natural patterns of variation in production can demonstrate biases resulting from motor planning, gestural mechanics, and aerodynamics (Garrett and Johnson 2013).
- Existing work has demonstrated parallels in production and sound changes, e.g. tonogenesis conditioned by voicing (Hombert et al. 1979).
Speech errors

- Categorical mispronunciations provide a different source of evidence for biases in production that may play a role in sound change.
- Such errors have been interpreted as evidence for phonological categorization and motor planning (Garrett and Johnson 2013).
- The intended sound and produced sound are usually phonologically similar.
Speech error collections

- Collections of such errors include e.g. Meringer and Mayer 1895, van den Broecke and Goldstein 1980
- Mowrey and MacKay (1990) elicited similar errors using tongue twisters
(Mis)perception as a source of change

- Acoustic similarity facilitates misperception and subsequently change, e.g. if listeners fail to account for contextual influences on phonetic realization (Ohala 1993, a.o.)
- Various works have demonstrated perceptual parallels of attested changes, e.g. palatalization (Chang et al. 2001)
Misperception in natural speech

- Perception errors in natural speech can also provide evidence for phonological processing, lexical retrieval, and salience of different acoustic cues (Browman 1980)
- While lexical influences often make these errors more complicated, Tang (2015) provides a tabulated collection of single-phoneme replacement errors
Misperception in experimental settings

- How close a parallel can misperception studies (e.g. Miller and Nicely 1955) provide for historical developments?
- They are usually unnatural in some ways: masking noise, limited phonological environments, constrained response set (structurally and/or segmentally), lack of semantic content
Diachronic typology

- There are few systematic typologies of sound changes; those which exist are limited to a few language families (e.g. Kümmel 2007)
- Moreover, a reliable typology might not even be possible for cross-linguistically uncommon sounds
- If a correlation between synchronic patterns and known sound changes can be established, similar synchronic patterns could be used as a line of evidence in evaluating less clear reconstructions
To test the relationship between sound changes and synchronic patterns in perception and production, I made a collection of consonant developments (989 observations):

- From a range of unrelated but relatively well-described language families: Indo-European, Semitic, Sino-Tibetan, Uto-Aztecan, Uralic, Mayan, Austronesian, and Otomanguean.
- Using inputs of segments that are present in most of these proto-languages (p t k b d g s z s m n l r j w h); the outputs also include tʃ dʒ z v f.
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This collection of diachronic developments is correlated with the perceptual confusions from Miller and Nicely 1955 (English nonce words in white noise and with filters)

The correlation is highly significant: $r(174) = 0.93$, $p < 0.001$, though largely due to cells for unchanged segments and accurately identified segments

Including *only* unchanged and accurately identified segments, reflecting the relative stability of segments, $r(9) = 0.69$, $p = 0.0033$
Correlations with misperception (laboratory)

Figure: Diachronic Developments by Perceptual Confusions
Correlations with misperception (laboratory)

Figure: Diachronic Developments by Perceptual Confusions

- Omitting unchanged and accurately identified segments, the correlation is still significant: $r(163) = 0.17$, $p = 0.027$
Correlations with misperception (laboratory)

Correlations with confusions from other misperception experiments with different adverse listening conditions are similar or even higher. Omitting unchanged and accurately identified segments:

- Identifications in speech shaped noise in Broersma and Scharenborg 2010, $r(334) = 0.35$, $p < 0.001$

- Identifications including stimuli in unfamiliar languages in Singh and Black 1966, $r(278) = 0.37$, $p < 0.001$
Correlations with misperception (natural)

- Perception errors in natural speech from Tang’s (2015) compilation across English dialects
- The correlation with the collection of diachronic developments is highly significant: $r(382) = 0.94$, $p < 0.001$
Correlations with misperception (natural)

**Figure:** Diachronic Developments by Perceptual Confusions
Correlations with misperception (natural)

- Omitting cells of unchanged and correctly identified segments, $r(366) = 0.49$, $p < 0.001$
- This is the only comparison made with misperception data from natural speech, which is likely why it provides the best parallel

Figure: Diachronic Developments by Perceptual Confusions
Diachronic developments were also correlated with production errors from van den Broecke and Goldstein 1980 (collections from English, German, and Dutch)

This collection doesn’t provide comparisons with the number of correctly produced segments

The correlation is highly significant: $r(270) = 0.33$, $p < 0.001$
Correlations with speech errors (natural)

Figure: Diachronic Developments by Production Errors
Patterns of diachronic developments are strongly correlated with synchronic patterns of perception and production

- In perceptual confusions observed in natural speech
- In the perceptual confusion patterns in highly constrained experimental settings
- In categorical production errors observed in natural speech
Applications

- The correlations demonstrate that synchronic data can be used as a line of evidence in reconstructing sound changes.
- Experimental methods can complement traditional comparative reconstruction, particularly for developments without established diachronic parallels.
- Due to methods of elicitation and reporting, they provide the strongest parallel for diachronic mergers or shifts within an inventory.
Explanatory value

- These connections shed some light on possible factors facilitating sound change.
- Differences in correlations under different conditions and for different segments may further help identify the mechanisms of particular diachronic changes.


