Reconsidering phonologization from an individual-difference perspective

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Part I: Theories of phonologization
Part II: Illustrations
Part III: Phonologization redefined
References

Variation and Change

Table 5.1 Comparative Espiritu Santo (phonemic, PES = Proto-Espiritu Santo)

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(Hale, 2014)
Phonologization as cue weight adjustments

...what begins as an intrinsic byproduct of something, predicted by universal phonetic principles, ends up unpredictable, and hence, extrinsic. (Hyman 1976: 408)

<table>
<thead>
<tr>
<th>Stage I</th>
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<th>Stage III</th>
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<td>‘intrinsic’</td>
<td>‘extrinsic’</td>
<td>‘phonemic’</td>
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Phonologization as cue weight adjustments

■ Why are cues being reweighed in the first place?
  ■ "...in stage II the pitch lowering after [b] has become exaggerated to such an extent that it cannot be entirely predicted on the basis of the universal effect of a preceding voicing consonant. (Hyman 1976: 408).

■ Is there evidence for the different stages?
Phonologization as cue weight adjustments

(Kang, 2014)

(see also Beddor, 2009; Kirby, 2010, 2013; Beddor et al., 2018; Coetzee et al., 2018, etc.)
Listener misperception as a source of sound change

When listeners fail to compensate for context-induced variation in speech properly, such errors in perception may lead to adjustments in perceptual and production norms (Ohala 1981, 1993 etc.).
Misperception in a nutshell

Speaker /an/ ↓ distorted as [ã(n)] → heard as [ã]

Listener /ã/ ↓ interpreted as [ã] → produced as [ã]

turns /ã/
Misperception in a nutshell

Speaker /an/  Listener /ā/  turns /ā/
↓ distorted as ↓ interpreted as ↓ produced as
[ā(n)]  heard as  [ā]
Misperception in a nutshell

Speaker
/an/
↓
distorted as
↓
[ã(n)]
→ heard as
→ [ã]

Listener
/ã/
↑
interpreted as
↑

turns
→

Speaker
/ã/
↓
produced as
↓
[ã]
Variability in listening mode as a source of sound change

- Hyper- and hypo-articulation leads to variation in pronunciation (Lindblom, 1990);
- Sound change occurs when individuals focus on the “how” mode of listening instead of the “what” mode of processing (Lindblom et al., 1995).
Some common assumptions

- There exists normative modes of speech perception and production.
- Sound change is a consequence of the accumulation of deviations from existing norms:
  - Listener misperception à la Ohala
  - Functional/listening mode fluctuation à la Lindblom
- Phonologization occurs at the moment when deviations are accepted as the norm.
Challenges for this deviant-accumulation account of change

- Sound change takes place when deviations from the norm are treated as parts of the norm (Ohala, 1993; Lindblom et al., 1995).

- The actuation puzzle:
  Deviations are usually treated as exceptional and filtered out and ignored by speakers of the same speech community.
Challenges for this deviant-accumulation account of change

- **The transmission puzzle**: How can deviations from the norm take place systematically enough to give rise to stable new variants?
What deviations?

- Intra-speaker variation or inter-speaker variation?
What deviations?

- **Inter-speaker variation** is the key.
Individual differences in speech production and perception

- Individuals may differ in perceptual and/or articulatory targets for the “same” sound category (e.g., Beddor 2009; Baker et al. 2011; Idemaru et al. 2012; Newman 1997; Schertz et al. 2015, 2016; Yu 2013; Yu and Lee 2014; Yu 2016 etc...).
  - Sound change in progress is NOT the target here.
  - Variability exists among individuals within the same dialect group, same gender, and SES etc.
Individual variability relating to contrast distinctness

- Individuals who prefer longer stop VOTs also produce longer VOTs in production (Newman, 1997)
- The distinctness of an individual’s production of a contrast correlates with how well the individual discriminates that contrast:
  - /s/ vs. /ʃ/ (Newman et al., 2001; Perkell et al., 2004b)
  - tense vs. lax vowels (Perkell et al., 2004a)
Tonal contrasts in Cantonese

\[
\begin{array}{c|c}
\text{Tones} & \text{Description} \\
\dot & \text{(high, level)} \\
\ddot & \text{(mid, level)} \\
\dddot & \text{(low-mid, level)} \\
\dddot & \text{(low-mid to low, falling)} \\
\dddd & \text{(low-mid to high, rising)} \\
\dddd & \text{(low-mid to mid, rising)} \\
\end{array}
\]
Tonal realization

- 26 native Cantonese speakers from Hong Kong (15 females)
  - “From Speech to Spelling: Improving Chinese Proficiency of Non-Chinese Speaking Students through Cantonese Speech Learning”.
  - Funded by the Standing Committee on Language Education and Research (SCOLAR).
  - Collaboration with Prof. Peggy Mok at the Chinese University of Hong Kong.
Methods

- Language Background Questionnaire
- Production task: Picture naming task
- Perception task: AX discrimination task
Tonal discrimination accuracy

![Graph showing tonal discrimination accuracy]
Tonal discrimination reaction time

![Tonal discrimination reaction time graph]

- Case study 1: Individual differences in tonal realization
- Case study 2: Individual variation in “coarticulation”
Production Results: Tonal contrasts
Decomposing tonal dynamics

Discrete Cosine Transform
- coefficients describe properties of the signal
  - $k_0$: mean
  - $k_1$: degree of the slope (or not)
  - $k_2$: curviness
Tonal distance

![Diagram](image-url)
Tonal distinctness in perception and production

![Graph showing relationship between perceptual distance and tonal distance in production.](image-url)
Discussion

- Individuals who produce more distinct tones are also “better” at discriminating tones.
  - Are those who do not discriminate tones well also those who are more likely to exhibit tonal mergers?
Tonal mergers in Cantonese

(Mok et al., 2013)
Individual differences in context-dependent phonetic variation

- vowel nasalization in VNC contexts (Beddor, 2009);
- u-fronting between coronals (Harrington et al., 2008; Kataoka, 2011);
- s-retraction in English and other rhotic-related allophony (Baker et al., 2011; Mielke et al., 2016);
- vowel-to-vowel coarticulation (Grosvald, 2009; Grosvald and Corina, 2012; Yu et al., 2015);
The Cantonese sibilant (Yu, 2016)

This sibilant has been variably transcribed as

- /ɕ/ (Chao, 1947)
- /ʃ/ (Wang, 1937)
- /s/ (Jones and Woo, 1912)
- /s/ ~ /ʃ/ (Cheung, 1986; Bauer and Benedict, 1997)
  - /s/ → [ʃ] / ___ ___ [+round]
  - /s/ → [s] / elsewhere
Sibilant-vowel interaction: a quick illustration
What type of /s/ is the Cantonese /s/? (Lee and Zee, 2010)
Vocalic influence on Cantonese /s/ realization

Methods

- /si55, sy55, sa55, .../
- 30 tokens (5 vowels x 2 x 3 repetitions) in a carrier phrase.
- 111 subjects (60 females), age ranges from 18-26.
Vocalic influence on Cantonese /s/ realization
Spectra of Cantonese /s/ before ±round vowels
Gender-based variability in coarticulation

- Females exhibit more vocalic influences than males.
### Variation among males

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[Diagram showing variation among males with marked examples.]

**Case study 1: Individual differences in tonal realization**

**Case study 2: Individual variation in “coarticulation”**
Variation among males

![Graph showing variation among males with spectral mean (Hz) and vowel sounds (a, e, i, o, y).]
Reimagining phonologization

...what begins as an intrinsic byproduct of something, predicted by universal phonetic principles, ends up unpredictable, and hence, extrinsic. (Hyman 1976: 408).

- The same cues are utilized differently by different individuals. Depending on how the cues are learned (inherited)…
Reimagining phonologization

...what begins as an intrinsic byproduct of something, predicted by universal phonetic principles, ends up unpredictable, and hence, extrinsic. (Hyman 1976: 408).

- Some might utilize cues (contextual or otherwise) more multi-dimensionally than others.
Reimagining phonologization

...what begins as an intrinsic byproduct of something, predicted by universal phonetic principles, ends up unpredictable, and hence, extrinsic. (Hyman 1976: 408).

“Phonologization” happens at the moment of learning at the individual level.
Reimagining phonologization

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- Synchronic variability across individuals ≠ “precursors” to sound change.
Reimagining phonologization

...what begins as an intrinsic byproduct of something, predicted by universal phonetic principles, ends up unpredictable, and hence, extrinsic. (Hyman 1976: 408).

- Synchronic variability across individuals = sound change (the origin of innovation).
A “phonetic path” to sound change (cf. Yu, 2013; Stevens and Harrington, 2014)

- There must be a link between the initiation of sound change in an individuals’ cognitive grammar and widespread change at the group level.
- The spread is dependent on variation between individuals that make up the speech communities.
- An ongoing challenge is to identify the factors responsible for variability within groups of individuals who interact on a daily basis.
### Variation and Change

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(Hale, 2014)
Nature of Change

(Hale, 2007)
What are the relevant questions from this perspective of sound change?

- What is the nature of individual variation in speech production and perception?
- How do individuals who exhibit unique perceptual and production strategies serve as innovators (or early adopters) and sustain the introduction of stable new variants in the community?
  - What accounts for this variation?
    - physiological/biomechanical
    - input-driven
    - intake-driven
What are in-take biases?

- genetic predisposition (e.g., Dediu and Ladd, 2007; Wong et al., 2012; Dediu and Moisik, 2019)
- executive functions
  - inhibitory skills (Lev-Ari and Peperkamp, 2013, 2014);
  - working memory (Mattys and Wiget, 2011; Mattys et al., 2013)
- cognitive processing style differences ((e.g., as indexed by autistic-like traits; Stewart and Ota, 2008; Yu, 2010; Yu et al., 2011; Bishop et al., 2015; Jun and Bishop, 2015);
- theory of mind (Turnbull, 2015);
- ...

...
**Autism Spectrum Quotient** (Baron-Cohen et al., 2001)

- Assess certain social, communicative, and imaginative traits in neuro-(a)typical individuals.

- Questions on:
  - social skills;
  - attention switching;
  - attention to detail;
  - communication;
  - imagination
Speech and language processing and autistic-like traits

- lexical mediation in speech processing (Stewart and Ota, 2008)
- perceptual compensation for coarticulation (Yu, 2010)
- phonotactic influence in speech perception (Yu et al., 2011)
- vowel reduction in production (Turnbull, 2015)
- phonetic imitation (Yu et al., 2013)
- scalar inference in language (Nieuwland et al., 2010)
- pragmatic inference in NPI licensing (Xiang et al., 2013)
- prosody processing (Bishop, 2012, 2013; Jun and Bishop, 2015)
Vowel-dependent sibilant variation and autistic-like traits
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Sound change propagation

Male, AQ = 127

Male AQ = 96

Male AQ = 130

Male AQ = 97
Individual variation in tonal realization

- Individuals who produce more distinct tones are also “better” at discriminating tones.
- Differences in general neural mechanism might underly sensory/perceptual computation, subserving the formation ofisperceptual representations (Ou and Law, 2016, 2018).
Early auditory encoding

- There are significant individual variation in early auditory encoding (e.g., J. Hornickel and Kraus 2013).
Early auditory encoding

- Frequency-following responses (FFRs): an electrophysiological response which reproduces the frequencies present in the evoking sound and reflect early auditory processing in the brainstem and cortex

(Wong et al., 2007)
Early auditory encoding

- Individuals who show more distinctness in producing a contrast (context-dependent or otherwise) might have better at early auditory encoding of the signal.
Differences in cue integration strategies

- Some listeners might be utilizing a buffered strategy such that a category is activated only after all information is heard.
- An examination of individual variability in the time course of cue integration might reveal differences that help explain individual variability in speech perception and production.
Sound change propagation from an individual-difference perspective

- Where individuals are in the semiotic space?
- Why do they situate themselves in this manner?
Sound change propagation from an individual-difference perspective

- Individuals may also have different ...
  - tendencies to attach social meaning to linguistic differences (Garrett and Johnson, 2013),
  - levels of sociolinguistic monitor (Labov et al., 2011; Wagner and Hesson, 2014; Levon and Buchstaller, 2015),
  - likelihoods to adopt new variants (Lewandowski et al., 2007; Yu et al., 2013).


