Diagnosing phonological categories

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What defines phonology?

Phonology defined by categoricity

Phonology defined by contrast

Contrastive \neq \text{categorical}

Voicing \neq \text{spreading}
Outline

Phonology defined by categoricity

Phonology defined by contrast

Contrastive ≠ categorical

Voicing ≠ spreading
Two aspects of speech

<table>
<thead>
<tr>
<th>Phonology</th>
<th>Phonetics</th>
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<tbody>
<tr>
<td>symbolic representations;</td>
<td>physical representations;</td>
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<tr>
<td>allow idealizations of</td>
<td>continuous in time and space;</td>
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<tr>
<td>temporal chunking (segmentation),</td>
<td>internal temporal structure</td>
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<td>qualitative categorization (labels),</td>
<td>allows overlap;</td>
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<td>timelessness;</td>
<td>quantitative values on multiple independent dimensions;</td>
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<td>rules manipulate</td>
<td>rules</td>
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<td>features and feature values,</td>
<td>interpret feature values in time and space,</td>
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<td>associations;</td>
<td>can be gradient.</td>
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<td>thus phonological rules can</td>
<td></td>
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<tr>
<td>be category changing,</td>
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<tr>
<td>produce static changes over whole segments,</td>
<td></td>
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<td>be lexical/cyclic.</td>
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Keating (1996, 263), based on Keating (1988); Cohn (1990)
Categoricity/gradience distinction

- Idealised model (Pierrehumbert et al., 2000; Myers, 2000; Scobbie, 2005; Cohn, 2007);
- Empirical research (Barry, 1992; Cohn, 1993; Zsiga, 1995; Holst & Nolan, 1995; Nolan et al., 1996; Ellis & Hardcastle, 2002);
- Evidence from acquisition (Maye et al., 2002, 2008; McMurray et al., 2009);
Predictions/consequences

- Phonological categories signalled by areas of stability within continuous phonetic space.
- Phonetic rules are not category-changing (category change = phonological rule).
- Redundancy (phonology duplicating phonetics).
Outline

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Contrastive $\neq$ categorical

Voicing $\neq$ spreading
Toronto school

- Avery et al. (2008); Hall (2006); Dresher (2009)
- Contrastivist Hypothesis:
  The phonological component of a language $L$ operates only on those features which are necessary to distinguish the phonemes of $L$ from one another. (Hall, 2006, 20)
Enhancement

- Stevens et al. (1986); Stevens & Keyser (1989); Keyser & Stevens (2006); Stevens & Keyser (2010)

- Stevens & Keyser (2010):
  - Underlying representations are entirely feature-based and contain only distinctive features.
  - Differences between underlying and surface representations are mainly due to strategies of enhancement and overlap, which introduce, delete or extend gestures, but do not operate on features.
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Ecuadorian Spanish /s/-voicing

- Word-final /s/ becomes voiced before a vowel or a sonorant consonant in the next word.
  
  /gas#akre/ [ga.za.kre] ‘acrid gas’
  /gas#noble/ [gaz.no.βle] ‘noble gas’

- Regressive voice assimilation to voiced and voiceless obstruents
  
  /gas#karə/ [gas.ka.ro] ‘expensive gas’
  /gas#blaNko/ [gaz.βlanj.ko] ‘white gas’
gas acre
gas noble
Individuals’ realisations of /s/-voicing

Data from 7 native speakers of Quito Spanish on /s/ voicing in the prevocalic (gas acre) and pre-sonorant (gas noble) environments. The ellipses represent 95% confidence intervals for /s/ voicing before voiced and voiceless stops.
Two types of speakers

- ‘Central’ speakers: broad range of variation, use the centre of the phonetic space defined by voicing duration and fricative duration;
- ‘Peripheral’ speakers: categorical variation, tend to voice categorically, avoid the centre of the phonetic space.
Modelling voicing duration and voicing ratio in Quito Spanish

Two mixed effects models:
  ▶ of voicing duration in /s/-voicing environments
  ▶ of voicing ratio in /s/-voicing environments

Random effects:
  ▶ Speaker
  ▶ Word

Fixed effects:
  ▶ manner of articulation (sonorant vs. vowel) of the segment following the sibilant;
  ▶ speech rate (normal vs. fast);
  ▶ phonetic strategy of the speaker (central vs. peripheral).
Speech rate effects

- Speech rate manipulation as a test of categoricity/gradience (Solé, 1995, 2007).
- Varying degrees of voicing duration across speech rates $\rightarrow$ categorical.
- Varying degrees of voicing ratio across speech rates $\rightarrow$ gradient.
Speech rate effects

Interaction between speaker type and speech rate on voicing duration (left) and voicing ratio (right).
/s/-voicing and overlap

- [z] is not a phoneme in Quito Spanish
  - voicing contrast lost in Spanish sibilants around 16c. (Robinson 1979, and references therein)
- If phonological output cannot contain features which are not distinctive, /s/-voicing must be phonetic (gestural overlap).
- Consequences:
  - Quito inter-speaker variation not predicted.
  - Theory does not distinguish between central and peripheral types of speakers
  - Categorical behaviour as accidental (contra evidence from language change and acquisition).
Contrastive [voice] could spread to sibilants from a laryngeally contrastive segment.

Hall (2006): [SV] ([Sonorant Voice]) can be used in a feature hierarchy to distinguish sonorants from voiced obstruents.

Supported by disparate laryngeal behaviour of sonorant subclasses.

/s/-voicing and the Contrastivist Hypothesis
Contrastive [voice] could spread to sibilants from a laryngeally contrastive segment.

But there is no voicing contrast in sonorants.
Contrastive [voice] could spread to sibilants from a laryngeally contrastive segment.

But there is no voicing contrast in sonorants.

Hall (2006): [SV] ([Sonorant Voice]) can be used in a feature hierarchy to distinguish sonorants from voiced obstruents.

- supported by disparate laryngeal behaviour of sonorant subclasses
- /v/ in Russian and Czech does not trigger RVA, but undergoes it.
- /ɾ/ in Czech does not trigger RVA, but undergoes both progressive and regressive devoicing.
Some problems with [Sonorant Voicing]

- Contrastive specification determined based on phonological activity.
- Crucially assumes that pre-sonorant voicing consists in spreading.
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Pre-sonorant voicing in West-Flemish

- Word-final fricatives undergo voicing before a vowel/sonorant consonant in the next word.
  /zɛs jaːr/  \[zɛz. jaːr\] ‘six years’
- Word-final stops surface as voiceless before a vowel/sonorant consonant in the next word.
  /ɑxt jaːr/  \[ɑxt jaːr\] ‘eight years’
- Stops and fricatives are laryngeally contrastive (in onsets), sonorants are not.
- Both, stops and fricatives, undergo voicing before voiced stops.
Voicing tail

Instances of gradient voicing in West-Flemish invariably involve voicing in the initial part of the segment.
Spreading from sonorants?

- Word-final fricatives tend undergo categorical, but optional voicing word-finally before a sonorant/vowel.
- Word-final stops before a sonorant/vowel surface either as voiced, or with limited gradient voicing.
- No increased phonetic voicing in West-Flemish pre-sonorant stops ($p=0.73$ compared to voicing before voiceless stops) → sonorant voicing not phonologically active.
- Passive voicing always in the initial part of the closure.
Fricative voicing as perceptual reanalysis

Model based on Ohala (1981)
No re-interpretation in stops
Influences on perception

- Coda fricatives show
  - a reduced oral gesture;
  - a lower oral pressure build-up;
  - lower velocity of air through the oral constriction;
  - a less intense frication (Solé, 2010).

- Shorter and less intense frication are cues to voicing in fricatives (Stevens et al., 1992; Ladefoged & Maddieson, 1996).

- Word-final pre-sonorant fricatives may be perceived as voiced by listeners.

- Stops less likely to undergo the change.
Predictions

The diachronic perceptual reinterpretation hypothesis:
- captures the stop/fricative asymmetry;
- involves categorical voicing which is not spreading;
- is difficult to reconcile with the Contrastivist Hypothesis.
Summary

- Top-down approaches to the phonetics-phonology division do not converge with a bottom-up distinction based on categoricity and gradience.
- Empirical problems:
  - Enhancement and overlap cannot capture the distinction between categorical and gradient allophony.
  - The Contrastivist Hypothesis cannot accommodate feature insertion which is not spreading.
- Misguided use of Ockham’s Razor.
- Phonetic evidence is crucial to establishing what counts as a phonological category.
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