Cross-linguistic trends in the perception of place of articulation in stop consonants

Comparison between Hungarian and French

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Plan

- Cross-linguistic differences in speech perception: models
- Models for the acquisition of language-specific place perception
- Cross-linguistic differences in the perception of stop place of articulation: languages with 3 vs. 4 place categories
- Perceptual results with both French & Hungarian listeners
- Implications for phonological systems
Cross-linguistic differences in speech perception: models

- universal boundaries (Werker & Tees, 1984): same in French & Hungarian
- language-specific boundaries (Kuhl, 1994): different in French & Hungarian
- language-specific boundaries from couplings between universal boundaries (Serniclaes et al., 2004): different in French & Hungarian but universal boundaries remain discriminable
voicing & aspiration distinctions (Lisker & Abramson)

Negative VOT

Positive VOT
coupling between phonetic features for voicing
(Serniclaes et al., 1987; 2004)

Prelinguistic voicing boundaries

| b | p | p^h |

English voicing boundary

| p | p^h |

French voicing boundary

| b | p^{(h)} |

negative VOT 0 ms positive VOT
VOT boundary in French, coronal stop+ neutral vocoïd
Bogliotti (2005, PhD U. Paris 7)
Discrimination peaks, infants, 4 vs. 8 months French or languages with voicing-like surroundings Hoonhorst (2004, mémoire de Logopédie, UCL-ULB)
How can findings on cross-linguistic differences in voicing perception be extended to place of articulation?
Distinctive Region Model (DRM) Carré (2004)

Fig. 11. The eight DRM regions and the vocal tract. R1 corresponds to the larynx cavity, R3, R4, R5, R6 to the tongue, R7 to the teeth and R8 to the lips.

Fig. 12. The eight DRM regions and the vowel and consonant places of articulation.
F2 & F3 transition distinctions (DRM, Carré)

Onset F3 transition

Onset F2 transition
DRM with cross-linguistic labels

Onset F2 transition

Onset F3 transition

low high

low high

b g j
Congruent with burst distinctions (Preliminaries …)  
Jakobson, Fant & Halle, 1952)
Hypotheses on place perception in 3 & 4 category languages

- 4-category language (e.g. Hungarian):
  Share-out of the F2-F3 transition space in 4 equal parts

- 3-category language (e.g. French):
  Share-out of the F2-F3 transition space in 3 equal parts
How to implement these hypotheses in perceptual paradigms?
Interest of the neutral vowel context context for comparing consonant distinctions between languages

Perception of place in French fricative+ vowel syllables (Serniclaes & Carré, 2002)

Labelling boundaries in the F2 onset –F2 offset plane

Boundaries converge to flat transitions for neutral vowel settings

(F2 = 1500; F3 = 2500 Hz)
Place perception:
   based on natural boundary in the neutral vocoïd context
   becomes increasingly complex with the expansion of the vocalic space

Also true for voicing

Methodological interest of the neutral context:
   simple landmarks for tracing universal boundaries
Mean acoustic measurements of VOT in voiced and voiceless stops as well as the mean perceptual boundaries along a synthetic VOT continuum are given in two phonetic contexts, i.e. /labial stop + a/ (/ba-pa/) and velar /stop + i/ (/gi-ki/). The contextual shift in perception (29 ms VOT) is about half-way between those in production. Perceptual boundaries follow the productive variations, resulting in a fairly stable relationship across contexts.
Stimuli: «phonetic» continuum (rectangle: with directions normal to flat boundaries) & «phonological» continuum (triangle: with directions normal to alleged 3-category phonological boundaries)
Cross-linguistic differences in speech perception: models

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Experimental set-up
(Bogliotti, 2005; Geng et al., 2005)

- Stimuli: phonetic & phonological continua in the F2-F3 transition space
  - with or without burst
  - Labelling & AX discrimination data
without burst

with burst
Hungarian

without burst

with burst
Hungarian vs. French without burst

French

Hungarian

% réponses

stimuli
Hungarian vs. French with burst
labelling boundaries

French               Hungarian
discrimination of universal boundaries: stimuli without burst

French

Hungarian
discrimination of universal boundaries: stimuli with burst

French

Hungarian
Conclusions

DISCRIMINATION DATA
Natural boundaries no less perceptible in French vs. Hungarian

LABELLING DATA
French /d/ category covers Hungarian /d/ & /ʒ/ categories
Perceptual boundaries for shared distinctions are fairly similar in both languages
Future studies

- Languages with 4 place categories cannot simply make it by combining 2 binary features – in line with what happens with voicing distinctions.
- A further feature is also required.
- Place feature?
- Manner feature (double articulation, affrication)?