The role of articulatory cues in the establishment of perceptual categories

Emily Cibelli
Department of Linguistics, University of California, Berkeley

Background

Research question: How does explicit articulatory training influence the perceptual development of novel phoneme categories?

Past research: In some cases, articulatory learning may aid and even outperform perceptual training [1] of novel contrasts. In cases where prior learning has taken place, however, it may not confer an additional benefit [2]. The reverse link, from perception to production, is often reported to be beneficial [3, 4, 5]. However, the general perception-production link is not always straightforward or facilitatory [6] during learning.

This project addresses the comparative strength of perceptual and articulatory training paradigms with completely novice learners of novel contrasts.

Methods

Stimuli: CV syllables with coronal stop series + 3 vowels (/a/ /i/ /u/) recorded by native Hindi speaker

	unaspirated	aspirated	voiced	breathy
dental	t̪a	t̪ʰa	d̪a	d̪ʱa
retroflex	ʈa	ʈʰa	ɖa	ɖʱa

Study structure: Pre-test, training, post-test
- Pre-test and post-test: AX discrimination task

One of four training types:
- Perception training (AX discrimination with feedback)
- Production training, with repetition task (96 trials)
- Long production training with repetition task (384 trials)
- Guided production training with experimenter feedback and repetition task (96 trials)

Subjects: 60 native English speakers

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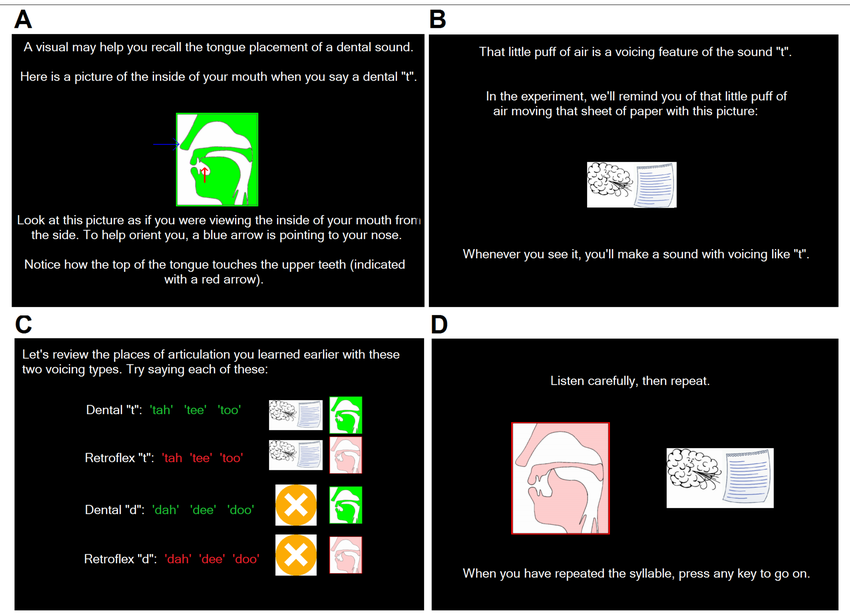
Production training



Production training example slides. (A) Teaching dental place of articulation. (B) Teaching aspiration, with "puff of air" cue. (C) Reinforcing the combination of place and voicing ("puff of air" = aspirated, "no puff of air/**X**" = unaspirated). (D) Example repetition trial, with visual cues.

Modeling

Analysis 1 (d-prime): d-prime ~ session * contrast + (1|subject)

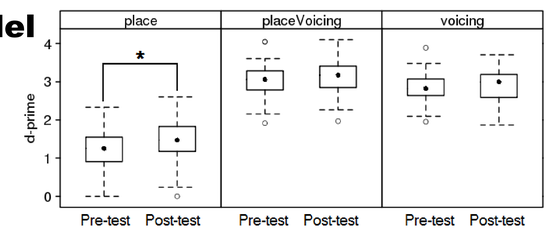
Analysis 2 (logistic regression): correct ~ session * contrast + session * trainingType + vowel + (1 | stimulusA) + (1 | stimulusB) + (1 + session | subject)

Analysis 3 (reaction time): reactionTime ~ session * contrast + session * trainingType + (1 | stimulusA) + (1 | stimulusB) + (1 + session | subject)

Results: Improvement in contrasts

Analysis 1: D-prime model

- Controls for response bias, but limits statistical power
- Improvement from pre-test to post-test restricted to trials which contrast place of articulation (dental vs. retroflex, β = 0.258, *t* = 3.482)



Analysis 2: logistic regression

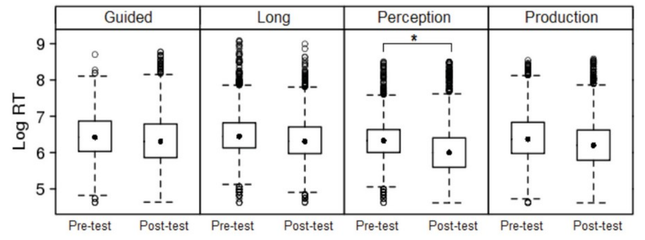
- More statistical power, does not control for response bias
- Improvement detected in all contrasts except aspirated vs. voiced
  - Already highly discriminable (mirrors English /d/-/t/ contrast)

Results: Training type

- Analysis 1: No detectable effect of training type
- Analysis 2: Improvement in all training types except long production training

Analysis 3: reaction time model

- Reduced reaction time on correct trials for perception training only (β = -0.257, *t* = -3.826)



Discussion

- Improvement strongest in trials contrasting on place
  - Most difficult contrast → most room for improvement
- No perception/production training split for accuracy
  - May be equally effective for novice learners
- Long production training: no improvement
  - More repetition trials = more subject productions
  - Imperfect productions may interfere with accurate category development
- Reaction times fastest for perception training
  - May be indication of training effectiveness
  - Or may be task practice effect (AX discrimination for both training and testing)

General conclusion: Both articulatory and perceptual training can contribute to development of perceptual categories for beginning learners.

References

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ecibelli@berkeley.edu