How does perception interact with production in phonological acquisition?

Pater (1999, 2004): Models of child phonology should accommodate the finding of parallel restrictions across perception and production. *Example: Infants learn to detect words with trochaic foot structure before iambic words (Jusczyk, Houston, & Newsome, 1999).* This parallels truncation in production, which affects the weak syllable in an iambic but not a trochaic foot (e.g. Allen & Hawkins, 1978).

Given these parallels, Pater proposes that both perception and production are governed by the same set of markedness constraints. However, perception and production abilities unfold on distinct time frames (8-9 months versus 18-24 months in the previous example).

To capture this fact, Pater posits two sets of faithfulness constraints:

- **Faithfulness (FS):** Constrains the mapping from lexical to surface forms.
- **Faithfulness (SL):** Constrains the mapping from perceived to lexical forms.

I present case study data documenting parallel constraints on perception and production in a child with phonological delay.

**New observation:** Perception and production errors can diverge in positional bias.

Case Study Subject

Subject B, a 4-year-old boy acquiring American English. Significant phonological delay/disorder.

Of note, B’s output featured positional processes that preferentially neutralize contrast in initial but not final contexts.

- **Positional velar fronting:** /dæk/ → /tæk/, “cake”
- **Positional fricative gliding:** /ʃæk/ → /bas/, “bus”

**Question:** *Can the same positional bias be observed in perception? (Dinsen & Farris-Trimble, 2008)*

Methods

Nonword discrimination task: B responded “same” or “different” to phonetically controlled nonword pairs.

23 identical pairs:

- “I can say woop, I can say woop.”
- 24 pairs differing by a single phoneme in initial or final position:
  - “I can say buv, I can say yuiv,” “I can say wy, I can say yu.”

Three contrasts tested:

- **Coronal versus velar:** Actively neutralized in B’s output at testing.
- **Fricative versus glide:** Initial position only. Keased to undergo neutralization in B’s output roughly one month prior to testing.
- **Coronal versus labial:** Never neutralized in B’s output.

Results were analyzed with a 5-factor logistic model.

**IV:** Session number; **Position in word:** Identity of contrast; **Voice of contrast:** Position of contrast; **Possible harmony context.**

Results

Significant predictors of discrimination accuracy: **Session number** ($p < .001$), **Identity of contrast** ($p < .001$).

Significant post-hoc comparisons:

- Velar-coronal contrast less accurate than fricative-glide or coronal-labial contrast.
- Initial position more accurate than final position.

**Proposal:** **Perceptual-Faith vs. Gestural-Faith**

The perceptual advantage for initial over final contrasts reflects an intrinsic bias of the auditory system (Fujimura, Macchi, & Streeter, 1978).

But neutralization can be driven by articulatory as well as perceptual factors. Articulation has its own positional bias: Neutralization tends to apply preferentially in initial position, where gestures are more forceful (Inkelas & Rose, 2008).

To encode the possibility that positional bias in perception may diverge from positional bias in production, I propose a modified division of faithfulness constraints: **Perceptual-Faith vs. Gestural-Faith**.

**Perceptual-Faith** compares any perceived surface form vs. the lexical representation.

- **Perceived form** could be child’s own production or that of another speaker.
- **When P-Faith has low weight, markedness can induce perceptual simplification.**
- **P-Faith** has a positional constraint: Magnitude of violation is greater in contexts where neutralization is more perceptually salient.

**Gestural-Faith** penalizes any articulatory gesture not specified by the child’s LR.

- **G-Faith** constraints do not apply to perceptual mapping.
- **G-Faith** constraints are not inherently positional. Articulation-driven asymmetries are encoded directly in the magnitude of the markedness violation.

The **Perceptual / Gestural distinction** will make it possible to model B’s divergent patterns in perception and production.

**References**


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**Analysis: Positional Velar Fronting**

**Production mapping**

Fronting is driven by a high-weighted constraint, **K**.

- *K* is a simplified cover for an articulatory-driven constraint detailed elsewhere McAllister, 2009.
- Magnitude of violation of *K* is greater in initial position.

**Table 1:** Violation of *K* outweighs both G-Faith and P-Faith.

**Table 2:** Smaller *K* violation in final position is less than combined violation of P- and G-Faith. Velar target emerges faithfully.

**Perception mapping**

Recall that G-Faith does not apply. In Tables 3-4, *K* violation trumps faithfulness in initial and final position, eliminating the asymmetry.

**Table 3:** An initial velar is perceived fronted.

**Table 4:** A final velar is perceived fronted.

**Discussion**

Dividing faithfulness into perceptual and articulatory components makes it possible to capture speech patterns in cases where the auditory and articulatory systems exert conflicting pressures.

In this system, how will the child learner arrive at a correct LR?

- **Stochastic variation in constraint weight will allow child to perceive the correct target some percentage of the time.**
- **With sufficient exposure, the grammar will converge on an adult-like LR.**
- **Using nonwords presumably influenced extent of neutralization.**