Speek acquisition is multidimensional

- Perceptual-motor: Extract phonetic categories from input; learn mappings from motor plans to perceptual categories.
- Cognitive-linguistic: Learn regularities in sound patterning (possible/impossible combinations, positional restrictions or alternations, etc.)
- Increasingly apparent that these dimensions of learning interact/influence each other.

**Seemingly categorical phonological alternations** may have roots in motor limitations/pressures (Green et al., 2000):
- Positional velar fronting (e.g. Inkelas & Rose, 2007; McAllister Byun, 2012)
- Consonant place conditioned by vowel context (Bates, Watson & Scobbie, 2002)
- Harmony for major consonant place (e.g. Patler 1997, 2002; Becker & Tressler 2011).

**Goal of the A-map model**
- Adapt linguistic formalism to allow for direct representation of sensorimotor influences.
- Our approach: Formal grammar (represented in Harmonic Grammar) interacts with speaker/learner's **INTERNAL MODEL of motor-acoustic mappings** (Wolpert et al., 2001; Tian & Poeppel, 2010; Hickok, 2012; Scott et al., 2013).
  - Learned associations between motor plans and sensory consequences
  - Used to detect errors and predict outcome of planned movements.
  - We implement the internal model as an exemplar space with traces of motor plans, acoustic outcomes, and links between them (cf. the “Linked-Attractor” model, Menn et al., 2009).
  - Competing pressures in motor control:
    - Match a sensory target (e.g. adult acoustic signal)
    - Produce an output that can be attained reliably, whether it matches the target or not.

**Result #1: Elimination of child-specific patterns**
- **PRECISE and ACCURATE** change in weight over time, but they remain part of the grammar; they are not child-specific constraints.
- However: given enough experience, virtually all sounds/sequences can be realized with similarly high reliability (similar values of $A_D$).
- **PRECISE** will cease to have a meaningful impact
  - Grammatical computations will be dominated by ACCURATE and feature-based markedness and faithfulness.
  - Patterns rooted in child-specific motor pressures are eliminated altogether.

**Stage 1: In earliest stages, all motor plans are executed equally**
- ACCURATE thus plays the dominant role in candidate selection.
- Child's outputs will feature a mix of successful executions and performance errors.

**Stage 2: Once a sufficient number of errors builds up, effects of PRECISE will drive a shift to a systematic pattern of substitution.**
- Creates an apparent regression.
- Stage 3: Leveling of motor difficulty dilutes effect of PRECISE, as described above.

**Conclusions**
- Differences between child and adult phonology have historically posed a challenge for the Continuity Hypothesis: One model or two?
- The A-map model offers a mechanism for unification: Differences in motor control, encoded in the A-map, influence grammatical patterns.
- Patterns rooted in child-specific motor limitations disappear over normal maturation.
- ACCURATE continues to exert low-level effects in sociolinguistic accommodation and variation.
- Effects of PRECISE might reemerge in adult speakers who experience a loss of motor control function (compare e.g. Buchwald 2009).