Variability in adult speech

- Readily captured with formal methods such as partially ordered constraints (e.g. Kiparsky 1993, Anttila 1997) or noise in evaluation of constraint weights/rankings (e.g. Boersma & Hayes 2001, Boersma & Peter 2008)

Child speech variability: Qualitatively different
Trevor, age 377 days, attempting ‘dog’ (Compton & Streeper 1977):

\[
\begin{align*}
[\text{a}] & \rightarrow [\text{g}] \rightarrow [\text{gæ}] \rightarrow [\text{d}] \rightarrow [\text{dae}] \\
\end{align*}
\]
Trevor, ages 556-557 days, attempting ‘cookie’:

\[
\begin{align*}
[\text{kaka}] & \rightarrow [\text{kiki}] \rightarrow [\text{kaki}] \rightarrow [\text{kaka}] \rightarrow [\text{kaka}] \\
\end{align*}
\]
K, age 1.5, attempting ‘pen’ (Ferguson & Farwell 1975-423):

\[
\begin{align*}
[\text{ma}] & \rightarrow [\text{m}] \rightarrow [\text{da}] \rightarrow [\text{hn}] \rightarrow [\text{mb}] \rightarrow [\text{pmt}] \\
\end{align*}
\]
- An extragrammatical explanation?

- Children use an adult-like grammar but exhibit sporadic breakdowns due to poor motor control (Hale & Reiss 2008)
- Children probabilistically revert to stored forms from earlier grammars instead of generating a form via the current grammar (Becker & Tesser 2011)

The variability of variability

- Differences in the extent of variability across children have led to proposal of two learning styles.

Systematic/stable: Child mainly attempts forms within his/her capacity for correct production

Exploratory/variable: Child attempts more complex forms, with inconsistent results.

- Extent of variability in a child’s speech at one year old is highly predictive of variability at age three (Wihman & Greenlee 1987).
- These two learning styles are typically explained in terms of personality differences—could there be a grammatical explanation?

Proposal

Differences in “tolerance for variability” among child speakers reflect differences in ranking/weight of a grammatical constraint, Precise, which favors forms with a history of reliable articularatory execution.

The A-map model

- Multidimensional exemplar space stores motor-acoustic traces (copy of the motor plan executed and associated acoustic consequences)
- Distributional properties of the exemplar space are indexed in a grammatical module, the ARTICULATORY-mapping map
- Schematic A-map entry: \( <MP_{\text{mean}}, A_{\text{mean}}, A_{\text{SD}}> \)
  - \( MP_{\text{mean}} \): Idealized motor plan (MP), averaged over past traces
  - \( A_{\text{mean}} \): Weighted average of past acoustic traces for the MP
  - \( A_{\text{SD}} \): Standard deviation of acoustic traces associated with the MP
- Measure of reliability of motor-acoustic mapping

There is a potential tradeoff between accuracy (pressure to match the acoustics of the adult target) and precision (pressure to produce a form that can be realized reliably).

We propose that it is grammatically mediated.

ACURATE: For a candidate with motor plan \( MP_{\text{mean}} \), assign a violation in proportion to the distance between \( A_{\text{mean}} \) and the center of the adult acoustic target \( T \).

PRECISE: For a candidate with motor plan \( MP_{\text{mean}} \), assign a violation in proportion to the magnitude of \( A_{\text{SD}} \).

### Status of Precise in adult grammar

- **Precise** is demoted over time, but it is not a child-specific constraint.
- However, for a mature adult speaker, virtually all sounds/sequences can be realized with similarly high reliability (similar values of \( A_{\text{SD}} \)).
- **Precise** will cease to have a meaningful impact on grammatical computations; feature-based markedness and faithfulness will dominate.
- Child-like phonological patterns might reemerge in adult speakers who experience a loss of motor control function (compare e.g. Buchwald 2009).

### Conclusion and implications

- The A-map model suggests that variability in child speech, including individual differences in the extent of variation, need not be construed as extragrammatical.
- Our model joins other recent literature (e.g. Yu 2010) in suggesting that the dividing line between grammar and personality traits may be less distinct than previously thought.

### Selected references


