Individual differences in variability in child speech: Phonology, personality, or both?

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Variability in adult speech

- Readily captured with formal mechanisms 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 & Pater 2008)

Child speech variability: Qualitatively different

Trevor, age 377 days, attempting 'dog' (Compton & Streeter 1977):

[aʔ] ~ [gʌ] ~ [gæ] ~ [dʌ] ~ [dæ]

Trevor, ages 556-557 days, attempting 'cookie':

[kaka] ~ [kiki] ~ [kʌki] ~ [kaka] ~ [kakə]

K, age 1;5, attempting 'pen' (Ferguson & Farwell 1975:423):

[mãᵊ] ~ [ˠʌ̃] ~ [dɛᵈⁿ] ~ [hɪn] ~ [ᵐbõ] ~ [pʰɪn] ~ [tʰn̩tʰn̩tʰn] ~ [baʰ] ~ [ɖauᴺ] ~ [buã]

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 & Tessier 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.

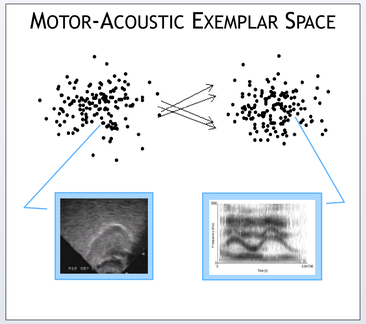
- Extent of variability in a child's speech at one year old is highly predictive of variability at age three (Vihman & Greenlee 1987).
- These two learning styles are typically explained in terms of personality differences—but could there be a grammatical explanation?

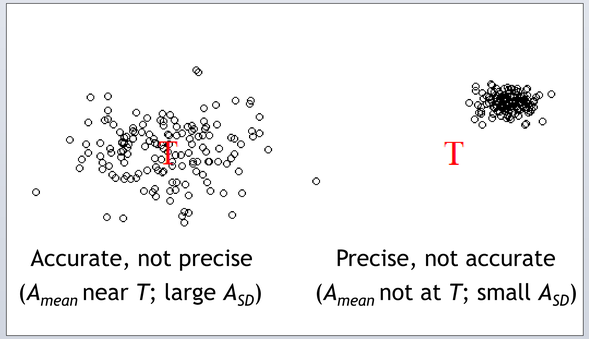
Proposal

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 articulatory 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 A(RTICULATORY)-map
- Schematic A-map entry: $\langle MP_{mean}, A_{mean}, A_{SD} \rangle$
  - MP_{mean} = idealized motor plan (MP), averaged over past traces
  - A_{mean}= weighted average of past acoustic traces for the MP
  - A_{SD} = standard deviation of acoustic traces associated with the MP; measure of reliability of motor-acoustic mapping





Accurate, not precise (A_{mean} near *T*; large A_{SD})

Precise, not accurate (A_{mean} not at *T*; small A_{SD})

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.

ACCURATE: For a candidate with motor plan $MP_{[i]}$, assign a violation in proportion to the distance between $A_{mean[i]}$ and the center of the adult acoustic target *T*.

PRECISE: For a candidate with motor plan $MP_{[i]}$, assign a violation in proportion to the magnitude of $A_{SD[i]}$.

Exploratory/variable: ACCURATE is weighted high

ACCURATE weighted high: Grammar favors candidates which are as close as possible to the adult target, even if likelihood of a performance error is high.

Here, favored candidate features a faithful fricative, even though likelihood of performance error on /s/ is high (as indicated by higher A_{SD} / ACCURATE violation).

	Adult target: [s]	ACCURATE	PRECISE	*H*
		W = 2	W = 1	
☞ a.	*</s/, [s], 2>*	0	-2	-2
b.	*</t/, [t], 1>*	-1	-1	-3

Systematic/stable: PRECISE is weighted high

PRECISE weighted high: Grammar prefers candidates associated with a reliable motor-acoustic mapping, even at the cost of some simplification or substitution affecting the adult target.

Here, favored candidate features substitution of [t] (lower likelihood of a performance error) for /s/ in the adult target.

	Adult target: [s]	PRECISE	ACCURATE	*H*
		W = 2	W = 1	
a.	*</s/, [s], 2>*	-2	0	-4
☞ b.	*</t/, [t], 1>*	-1	-1	-3

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_{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

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