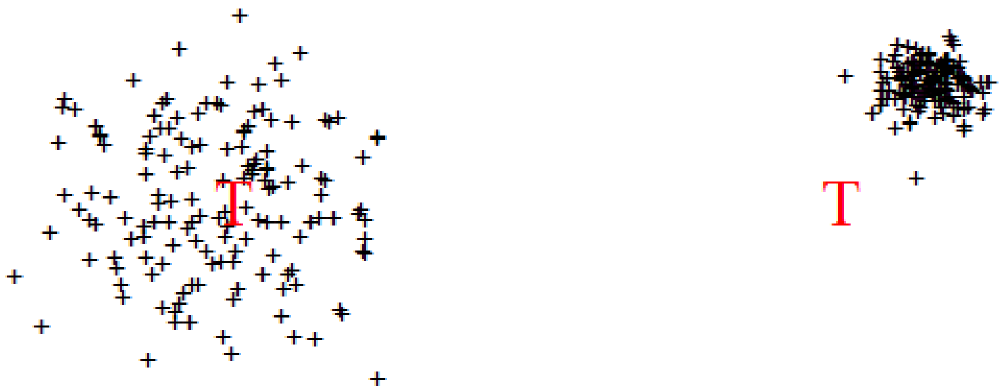
Individual differences in variability in child speech: Phonology, personality, or both?

Modern phonology has no trouble accounting for variability in the output of a speaker's grammar across utterances, invoking solutions such as partially ordered constraints (e.g. Kiparsky, 1993) or noise in the evaluation of constraint rankings or weights (e.g. Boersma & Hayes, 2001; Boersma & Pater, 2008). However, variability in child grammar is qualitatively distinct from that found in adult speech, to the point where an extragrammatical explanation for variability in child speech has been treated as a theoretical desideratum (Becker & Tessier, 2011; Hale & Reiss, 2008). One of the most striking features of child speech is the extent to which individual speakers differ in the degree of variability in their outputs (Ferguson, 1979). In a longitudinal study, Vihman & Greenlee (1987) reported that children varied widely in the consistency of their application of phonological processes, and the extent of variability in a child's speech at one year of age was highly predictive of variability at age three. Vihman & Greenlee thus proposed that children can be classified according to two learning styles: *systematic/stable* or *exploratory/variable*. These differences in "tolerance for variability" are often characterized as a reflection of personality traits rather than grammatical factors. However, the dividing line between grammar and personality may be less distinct than previously thought (e.g. Yu, 2010). Here we propose that the systematic versus exploratory distinction among child speakers has its origin within the grammar—specifically, with the ranking or weight assigned to a constraint that penalizes candidates with a history of varied, unreliable phonetic implementation.

In the proposed model, a multidimensional exemplar space keeps track of all of a speaker's inputs perceived and outputs produced, with the latter encompassing both the motor plan executed and the associated acoustic consequences. Distributional properties of the exemplar space are indexed in a grammatical module, the A(RTICULATORY)-MAP, which is then referenced by two specialized constraints. ACCURATE, a faithfulness constraint, favors a candidate whose cloud of associated acoustic traces is centered as close as possible to the center of the adult acoustic target, labeled **T** in Figure 1. This preference for candidates that match the adult input is shared by most models of phonology. Our model's novel contribution lies in the proposal the grammar is also sensitive to the *precision* of the mapping from motor plans to acoustic space. We posit a markedness constraint, PRECISE, which favors a candidate whose associated motor plan maps reliably to a narrowly defined region of acoustic space. When a child speaker attempts a motorically complex target such as a sibilant, he/she may experience frequent performance errors, resulting in a widely scattered cloud of acoustic outputs. In these circumstances, PRECISE would favor a candidate featuring some substitution such as a stop in place of the sibilant: although the stop is acoustically not a match for the target, its lower motoric complexity means that it can be executed reliably (Figure 1b). PRECISE is not a child-specific constraint, but its effects are particularly pronounced in children because immature speakers experience substantial differences in the reliability of execution of targets that are motorically simple versus complex.

We hypothesize that the systematic/stable versus exploratory/variable distinction reflects differences across children in the weight of PRECISE. If it has a high weight relative to ACCURATE, the grammar will select only candidates associated with a reliable motor-acoustic mapping, and outputs will reflect consistent simplification of the adult target. By contrast, a child in whom ACCURATE carries a high weight relative to PRECISE will attempt to produce the adult target even if he/she is not motorically capable of attaining that target every time. Outputs in this case are predicted to be highly variable, including some correct productions as well as various error forms. The A-MAP model suggests that variability in child speech, including individual differences in the extent of variation, need not be construed as extragrammatical.

Figure 1. Mappings favored by ACCURATE versus PRECISE



a. Accurate but not precise; favored by ACCURATE

b. Precise but not accurate; favored by PRECISE

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