Patterns of co-variation in child phonological acquisition

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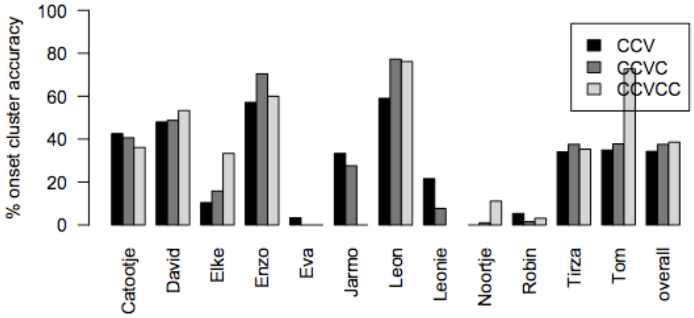
Overview: Children's phonological productions are characterized by variability throughout the course of acquisition. This paper examines the properties of this variation within words that contain multiple sources of syllable-structure markedness, and finds that accurate realization of one marked structure increases the probability that marked structures elsewhere in the syllable will also be accurately realized by the child. These patterns of co-variation are unexpected within standard constraint-based models of phonological grammar, and provide a novel argument for applying scaling factors to the weights of Faithfulness constraints (Coetzee & Kawahara 2013).

Data: The current study examined longitudinal data from the twelve Dutch-acquiring children in the CLPF database (Fikkert 1994, Levelt 1994). All target stressed syllables containing either a complex onset – CCV, CCVC, and CCVCC – or no onset – V, VC, and VCC – were extracted from the database using Phon (Rose & Hedlund 2009) and coded for accuracy. Target onset clusters were realized as clusters in 36% of cases (1503 of 4205 tokens), while target onsetlessness was accurately realized in 87% of cases (5685 of 6519 tokens). As Figure 1 shows, the probability of accurate onset cluster realization increased as the complexity of the coda increased. Mixed model logistic regression with child and by-subjects effect of age as random factors confirmed that target onset clusters were more likely to be realized as clusters in syllables realized with a coda than in syllables realized without a coda ($p < .001$), and in syllables realized with a coda cluster than in syllables realized without a coda ($p = .09$). The same pattern of co-variation held for onsetless syllables (Figure 2), with the probability of accurate onsetlessness increasing as the complexity of the coda increased ($p < .001$ and $p = .02$). These effects were not attributable to age, which was entered as a fixed factor in the model.

Analysis: I model these patterns of co-variation within a modified version of Noisy Harmonic Grammar (Boersma & Pater 2008, *cf.* Boersma 1998, Boersma & Hayes 2001) where the values of Faithfulness constraints are subject to scaling based on extralinguistic factors (see Coetzee & Kawahara 2013 for a application of this approach to issues in adult phonological variation). Constraint-based phonology generally posits distinct onset and coda markedness constraints – i.e., ONSET and *COMPLEXONSET vs. NOCODA and *COMPLEXCODA – that interact only in very restricted ways. Violations of *COMPLEXONSET, NOCODA and *COMPLEXCODA can all be resolved through either consonant deletion (violating MAX-C) or vowel epenthesis (violating DEP-V). Because of this overlap in available repairs, standard Noisy HG predicts a limited degree of co-variation in the onset cluster case. Figure 3a illustrates this, showing that when all constraints have the same weight, the probability of an onset cluster mapping faithfully is relatively higher when the coda cluster is realized faithfully. This approach is inadequate, however, in the face of the onsetlessness data, where the repairs required in onset are distinct from those relevant in coda, as Figure 3b shows. Scaling of Faithfulness weights allows both patterns to be effectively captured. When the weights of Faithfulness constraints are scaled up through skewing of the noise distribution toward higher values, the probability of accuracy increases for both onset and coda structures, regardless of the specific repairs selected.

Implications: This approach effectively captures the attested patterns, while still allowing for distinct accuracy rates across structures. In addition, it suggests a principled means by which extralinguistic factors such as attention and lexical familiarity can interact with the child's developing grammar. Future work will examine additional structures to determine whether co-variation extends to interactions among segmental and syllable-based sources of markedness.

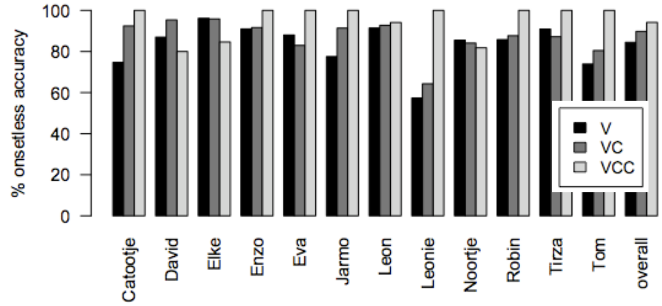
Figure 1 – Accuracy of target onset clusters based on degree of coda complexity



Fixed effects estimates, with probability of onset cluster accuracy as the dependent variable

	Estimate	Std.Error	*z* value	Pr(>|*z*|)
(Intercept)	-8.234	2.267	-3.633	< 0.001
age in days	0.009	0.003	2.835	0.005
simple coda (vs. no coda)	0.265	0.083	3.189	0.001
complex coda (vs. no coda)	0.350	0.206	1.700	0.089

Figure 2 – Accuracy of target onsetlessness based on degree of coda complexity



Fixed effects estimates, with probability of onsetlessness accuracy as the dependent variable

	Estimate	Std.Error	*z* value	Pr(>|*z*|)
(Intercept)	1.960	0.976	2.008	0.045
age	-0.0001	0.001	-0.114	0.909
simple coda (vs. no coda)	0.410	0.079	5.181	< 0.001
complex coda (vs. no coda)	1.043	0.428	2.438	0.015

Figure 3a

	Probability of mapping given tied constraints in Noisy HG without scaling
/CCVCC/→CCVCC	.333
/CCVCC/→CCVC	.167
/CCVCC/→CVCC	.167
/CCVCC/→CVC	.333

Figure 3b

	Probability of mapping given tied constraints in Noisy HG without scaling
/VCC/→VCC	.25
/VCC/→VC	.25
/VCC/→CVCC	.25
/VCC/→CVC	.25

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