PERCEPTUALLY MOTIVATED EPENTHESIS ASYMMETRIES IN THE ACQUISITION OF CLUSTERS

Adam Albright (MIT), Giorgio Magri (CNRS, University of Paris 8)

A growing body of evidence supports the view that children's phonological patterns are shaped not only by child-specific performance pressures (Kiparsky and Menn 1977; McAllister Byun 2011), but also by the universal forces that define adult grammars (Fikkert 1994; Gnanadesikan 2004). For many processes of child phonology, both explanations are plausible. For example, epenthesis into consonant clusters (/CCV/ → [C**V**CV]) may be motivated by a strong articulatory preference in children for mandibular oscillation, favoring CV sequences (MacNeilage 1998), or it may be motivated by the same phonological constraints that derive epenthesis in adult phonologies. In this talk, we provide evidence that epenthesis in child English is not merely a result of articulatory pressures, but is shaped by the same set of perceptually motivated constraints that govern epenthesis in adult phonologies. In adult systems, converging evidence from reduplication, infixation, loanword adaptation, alliteration, and puns shows that epenthesis is preferred in stop+liquid clusters (/pra/ → [p**V**ra]), relative to s+stop clusters (/sta/ → [s**V**ta]) (§1). Fleischhacker (2001, 2005) attributes this to the greater perceptual similarity of [pra] ∼ [p**V**ra], and the lesser similarity of [sta] ∼ [s**V**ta]. Based on data from over 550 children in the *Iowa-Nebraska Articulation Norms Project* (INANP) database (Smit *et al.* 1990), we show that children are subject to the very same set of asymmetries (§2). This finding supports the strong *continuity hypothesis* that children possess the same set of representations and constraints as adults. Furthermore, it leads to a new solution for the long-standing puzzle posed by children that produce s+stop before stop+sonorant clusters (Barlow 2001), despite the fact that the latter cluster type is generally thought to be less-marked due to its rising sonority (§3).

§**1 - Asymmetries in adult epenthesis.** The splittability of a cluster through vowel epenthesis or infixation depends on the cluster type: s+stop clusters are least splittable while stop+sonorant clusters are most splittable, with a whole continuum in between, schematized in (1).

(1) s+stop < s+nasals < s+liquids < s+glide; stop+r < stop+l < stop+glide

For instance, Broselow (1987, 1992, 1992) and Fleischhacker (2001, 2005) look at cluster simplification in loans and L2 errors, and report that a vowel is preferably epenthesized *into* a stop+sonorant cluster (*anaptyxis*: CCV → C**V**.CV) but *before* an s+stop cluster (*prothesis*: CCV → **V**C. CV), with s+sonorant clusters displaying variation both across and within languages. Another source of evidence comes from corpus frequencies: Zuraw (2007) collects a corpus of cluster initial loans from English and Spanish into Tagalog, and notes that infixation splits the onset cluster more frequently in the case of stop+glide than stop+liquid clusters. Furthermore, Zuraw reports that in a production task, the frequency of infixation by Tagalog speakers into the cluster is smallest for s+stop clusters, larger for s+liquid clusters and largest for s+glide clusters. Similar asymmetries are found in word games: Pierrehumbert and Nair (1995) report that English speakers infix more often into stop+l than stop+r clusters, and Fleischhacker (2001) reports similar results from puns. Fleischhacker shows that this asymmetry is rooted in perceptual similarity: epenthesis in rising sonority clusters (/pr/) is less salient than in shallow sonority clusters (/st/), and is therefore hypothesized to be less severely penalized by faithfulness constraints, under Steriade's (2001) *P-Map* hypothesis.

§**2 - Analogous asymmetries in child epenthesis.** This talk provides evidence that the asymmetries in adult epenthesis in (1) carry over from adult to child phonology. We have looked at onset consonant cluster simplification in 555 children from the INANP database. The database provides transcribed elicited child productions for all singleton codas and onsets, as well as for the most common bi- (25 targets) and tri- (5 targets) consonantal clusters. **¶2.1** The **relative frequencies** reported in (2a) show that epenthesis into s+stop clusters is clearly dispreferred relative to stop+sonorant clusters. Within fricative+C clusters and within stop+sonorant clusters, observed frequencies (2b) and (2c) of child epenthesis into the cluster closely match the adult hierarchy (1), with the exception of C+glide clusters. For adults, epenthesis into C+glide clusters is reported to be preferred over epenthesis into C+liquid clusters, both when C is a sibilant and a stop. The frequencies in (2b) and (2c) instead drop for C+glide clusters.

(2) a.

ST:	0.78%
TL DL TR DR TW:	2.96%

b.

ST:	0.78%
SN:	1.56%
FR:	3.24%
FL:	3.78%
SW:	2.34%

c.

TR:	1.5%
DR:	2.79%
TL:	3.24%
DL:	5.94%
TW:	2.7%

<u>**Legend**</u>: **ST** = /sp sk st/; **SN** = /sm sn sn/; **FR** = /θr fr/; **FL** = /fl sl/; **SW** = /sw/; **TR** = /kr tr pr/; **DR** = /gr dr br br/; **TL** = /kl kl pl/; **DL** = /gl bl/; **TW** = /tw kw/.

Finally, the relative splittability of stop+sonorant clusters in (2c) depends not only on the sonorant (l, r, glide) but also on voicing of the stop. Although this asymmetry has not been investigated in adult phonology, it is plausibly consistent with Fleischhacker's perceptual approach, since voiceless stops devoice a following sonorant, so epenthesis would yield an additional voicing difference on the liquid. **¶2.1** Further evidence for the role of the hierarchy (1) in the child INANP database comes from the **conditional probabilities** in (3). To illustrate, here is how the entry 40% has been computed for row cluster type s+stop (ST) and column cluster type stop+liquid (TR, TL, DR, DL) in (3a). For each s+stop cluster x and each stop+liquid cluster y, we have computed the ratio between the number of children who perform epenthesis in both x and y divided by the number of children who perform epenthesis in x. This ratio thus represents the empirical conditional probability that a child performing epenthesis into cluster x also performs epenthesis into cluster y: the closest the ratio is to 1, the strongest is the conditioning effect. By averaging over all s+stop and stop+liquid clusters, we get 0.4, i.e. 40%.

(3) a.

	ST	TR TL DR DR
ST	**46**	40
TR TL DR DR	11	**25**

b.

	ST	SN	SL	FR
ST	**46**	59	70	38
SN	30	**33**	56	34
SL	20	28	**36**	32
FR	12	12	26	**18**

c.

	TR	TL	DR	DL	TW
TR	**31**	21	30	29	17
TL	15	**41**	21	43	17
DR	20	24	**24**	31	20
DL	10	24	15	**39**	9
TW	23	29	28	28	36

Thus, (3) quantifies the strength with which epenthesis in the row cluster type conditions epenthesis in the column cluster type. Crucially, the entry above the diagonal is always larger than the corresponding entry below the diagonal, matching the order in (1). For instance, the difference 40% vs 11% in (3a) shows that epenthesis into ST clusters conditions epenthesis into stop+liquid clusters, not vice versa. Again, stop+glide clusters in (3c) behave exceptionally.

§3 - Implications. The findings reported in §2 have two theoretical implications. **¶3.1** Fleischhacker and Zuraw develop an account of the epenthesis hierarchy (1) based on *perceptual similarity*. They provide experimental evidence that speakers judge the pair /CC/ → [CVC] most dissimilar when CC is an s+stop cluster and least dissimilar when it is a stop+sonorant cluster, with a whole range in between. They propose that adult phonology encodes this perceptual similarity through Steriade's (2001) *P-Map*, whereby DEP[V]/S_T is ranked higher than DEP[V]/T_R. Under this interpretation, our findings provide evidence that child phonology has access to P-Map motivated rankings among faithfulness constraints. **¶3.2** Children that acquire s+stop clusters before other cluster types (Barlow 2001, Fikkert 1994) pose a long standing problem: s+stop clusters are marked and are thus expected to be acquired later. Approaches that posit a special status for the initial /s/ are unable to account for children that acquire s+stop clusters before other sC clusters. Our findings pave the way for a new approach. As recalled in §1, epenthesis into s+stop clusters is heavily dispreferred in adult phonology. Also deletion has been reported to be dispreferred in the case of s+stop clusters (Fleischhacker 2005). Our findings in §2 show that (at least some of) these dis-preferences for certain repair strategies for certain cluster types carry over to child phonology. This suggests the following approach to the precocious acquisition of s+stop clusters in certain developmental paths: they are acquired early despite their marked status because they are "harder to simplify", i.e. epenthesis and deletion incur a higher cost (say, a violation of a higher ranked faithfulness constraint).