

Evaluating the inevitability of phonological change: /æ/ in Philadelphia

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After a history of being at the nexus of a number of debates in phonology and sound change, (Labov, 1981; Kirparsky, 1993), the classic Philadelphia Short-a System (PHL) is being rapidly replaced by the nasal system (NAS) (Labov et al, 2015). One reasonable hypothesis is that the shift from the complex PHL to the simple NAS was inevitable, since learners would either innovate or prefer the simpler grammar. However, on the basis of recent work on productivity and grammar competition by Yang (2002, 2005), **we will argue that the “simpler” NAS would not be a tenable grammar given PHL input data.** PHL is defined in (1) (tense before tautosyllabic anterior [nasals or voiceless fricatives]), and NAS in (2) (tense before nasals).

$$(1) \text{æ} \rightarrow \text{tense} / ___ \{m, n, f, \theta, s\}_\sigma]_{\text{stem}} \quad (2) \text{æ} \rightarrow \text{tense} / ___ \{m, n, \eta\}$$

There are multiple tense and lax lexical exceptions to (1) and it is not a surface-true generalization, since it applies at the stem level. NAS, on the other hand, has tense /æ/ before all nasals regardless of syllabicity, making (2) a surface-true generalization.

To evaluate the viability of (2) given input data from (1), we carried out both a productivity analysis, based on the Tolerance Principle from Yang (2005), which states that a rule can tolerate $T = N \ln(N)$ lexical exceptions before it is more efficient to memorize all lexical items, and a grammar competition analysis based on Yang (2002), which states that if G_2 can parse more data from G_1 than vice-versa, G_2 will replace G_1 .

We coded $N=2,255$ word types from the CHILDES database (MacWhinney, 2000) for whether they would be tense or lax under PHL. Given this input data, we evaluated whether a learner could plausibly hypothesize an underlying NAS grammar with listed lexical exceptions producing the PHL distribution. This would be a potential explanation for the actuation of the shift to NAS. Given PHL input data, a NAS grammar would have to list 426 exceptions, which exceeds $T=292$. **NAS is not a tenable grammar given PHL data**, thus reanalysis of PHL directly to NAS is not a plausible pathway of actuation.

Extending Yang’s (2002) model of grammar competition to phonology is not straightforward, since the unambiguous contexts for G_{NAS} and G_{PHL} are perfectly overlapping. In order to carry out this analysis, we trained two Noisy-HGs (Boersma & Pater, 2007) on NAS and PHL data, then evaluated the accuracy of these Noisy-HGs when parsing data from the other grammar. PHL was more accurate parsing NAS data than vice versa (81.9% vs 79.8%). The difference is small, but according to Yang (2002) **this means PHL ought to win in grammar competition with NAS.**

We conclude from these analyses that NAS was not destined to replace PHL due to its formal simplicity. The fact remains, however, that NAS *is* replacing PHL, which should be anomalous given these results. We therefore tested whether one of two intermediate forms of PHL could have been tenable given Yang (2002, 2005). The first intermediate form tested was PHL without the tautosyllabic constraint, since some previous work suggests that the tautosyllabic constraint has weakened to some extent (Brody, 2009). The second possible intermediate form tested was PHL without the tense fricative conditioning, since pre-fricative contexts produce the least phonetically tense variants (Kroch 1996), possibly leading to misperception of tense [æ] in these contexts as lax.

In the productivity analysis, PHL without the tautosyllabic constraint would require too many listed exceptions to hypothesize NAS ($362 > T$), but PHL without fricative conditioning passes the tolerance threshold ($265 < T$). It would be possible for NAS to be actuated by a misanalysis of PHL-minus-fricatives, however, in an analysis of 94 Speakers from the IHELP corpus, there was no evidence that any speaker only lacked fricative conditioning while conforming to the remaining constraints. In the grammar competition analysis, PHL-minus-fricatives grammar parsing NAS data was roughly evenly matched with NAS parsing PHL-minus-fricatives data (84.7% vs 84.2%). Similarly, the PHL-minus-tautosyllabic grammar parsing NAS was also evenly matched with its counterpart (90.7% vs 90.2%).

In conclusion, the replacement of PHL by NAS was neither inevitable on the grounds that NAS is formally simpler, nor on grounds that it is dialectally more common. Rather, some additional change had to occur to PHL *first*, whether it was the misperception of tense [æ] in pre-fricative contexts, or the loss of the tautosyllabic constraint. These results echo the results of Fisher, Prichard & Sneller (2014), who found in case studies of families that there was never a direct transition between generations from PHL to NAS, but always an intermediate PHL system first.

References

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