Inducing Epenthesis: Phonetic, Phonological and Morphological Considerations

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This work investigates the question of how phonological systems might arise from phonetic cues, focusing on the contribution of the language learner. Specifically, I present a series of experiments on the learning of morphologically conditioned epenthesis patterns. A theoretical account that situates synchronic phonological systems as the product of natural sound changes (such as Evolutionary Phonology (Blevins 2004)) would attribute the emergence of an epenthetic consonant to the listener's misperception of the natural transition between two adjacent vowels: ratu+ək, pronounced as ratu^{w}ək, re-analyzed as ratuwək. The proposed origins of such a pattern guarantee that such epenthesis would be, at least at first, contextually conditioned (what I will call Type 1). A distinction has been made, however, between such systems and those in which a unique (unmarked) segment is epenthesized regardless of context (Type 2) (see, e.g., Lombardi (2002), de Lacy (2006)). Within a phonetically-based learning model, such a system would require an additional stage of regularization or generalization on the part of the listener.

The experiments described here are aimed at discovering a set of sufficient conditions for the emergence of both of the above types of epenthesis, paying particular attention to the role phonetic, phonological, and morphological information play in how learners induce patterns from their language data. One of the major motivations for adopting an emergentist approach to the question of consonant epenthesis is (ongoing) typological work that suggests that 'impossible' languages may, in fact, be attested, and that 'universals' may not be as widespread as sometimes claimed. For example, the evidence for /g/ epenthesis in Buryat (Poppe 1960) appears to be at least as strong as that for /t/ in Axininca Campa (a frequently cited case (Payne 1981)). At the same time, other natural epenthesis patterns that have been claimed for languages such as Odawa Ojibwa (/t/), Maori (/t/), and Tulatulabal (/ʔ/) seem questionable at best as true instances of productive phonological epenthesis (Piggot (1980); Hale (1973); Voegelin (1935)).

The misperception model allows for systems of all types (natural, unnatural, usual, or unusual) to arise from a combination of phonetically motivated sound changes and fortuitous lexical accidents. A critical factor left unspecified within this model, however, is the link that must be made between natural diachronic processes and natural synchronic languages: the contribution of the learner in transforming lexical sound change into grammatical language change.

The current work seeks to address this gap by investigating some of the characteristics of language learners via a series of experiments of the following kind. Adult participants were run within an artificial grammar learning paradigm (Wilson 2003) in which they were asked to perform a (spoken) production task after a period of auditory training. During training they heard a series of made-up words that occurred in doubles: the singular (e.g., ratu), followed by the plural (e.g., ratuwək). All stems heard in training were vowel final, either ending in o, u, i, or e. The critical items at test were novel consonant-final stems. Participants heard the singular form (e.g. darum), and were asked to produce the plural.

This paper describes the results of three conditions, the Natural, Anti-Natural, and Bi-Modal. In all conditions, the final part of the plural suffix consisted of the sequence -ək. The material that immediately preceded this part of the suffix, and immediately followed the final vowel of the stem, varied by condition. In the Natural condition, participants heard only glides in this position, glides homorganic with the place of the preceding stem-final vowel. When tested, these participants overwhelmingly produced affixed forms which lacked glides (e.g., darum/darumək). In contrast, in the Anti-Natural condition (glide anti-homorganic with the place of the preceding vowel), participants produced the glide at test (e.g., darumwək or darumjək). See Fig.1. This was in spite of the fact that they had never before heard any CC sequences (all training syllables of the form CV), and the glide was completely predictable from phonological context.

The results of the Natural condition are consistent with a generative phonological account which analyzes the homorganic glide as epenthetic (although contextually conditioned), and the underlying plural suffix as -ək. The results from the Anti-Natural condition, however, are at odds with this account. The phonological motivation for epenthesis remains the same as for the Natural condition (onset-less syllables), and the place of glide segment is equally (that is, completely) predictable, yet the results are diametrically opposed. Participants in the Anti-Natural condition might suffer from a general decline in learning due to a more marked status for the dissimilatory glide alternation (e.g., Jusczyk et al. 2002). However, although a difference in performance for vowel-final stems at test between the two conditions indicates that learning was about 25% better in the Natural condition, this alone seems insufficient to account for the quasi-categorical difference between the two conditions on critical consonant-final test items (Fig.1).

The Anti-Natural condition results are, however, consistent with an account in which participants learned two predictable allomorphs for the plural suffix: -wək and - jək. The fact that these suffixes were applied to novel consonant-final stems indicates that implicit phonotactic information regarding preferred syllable shape was not enough to over-ride participants' faithfulness to previously learned morphemes. This analysis can be made consistent with the results of the Natural condition under the following hypothesis: that participants in that condition both perceived and encoded a single plural suffix, attributing all segmental glide material to expected coarticulatory phonetics. This hypothesis was tested in the Bi-Modal condition.

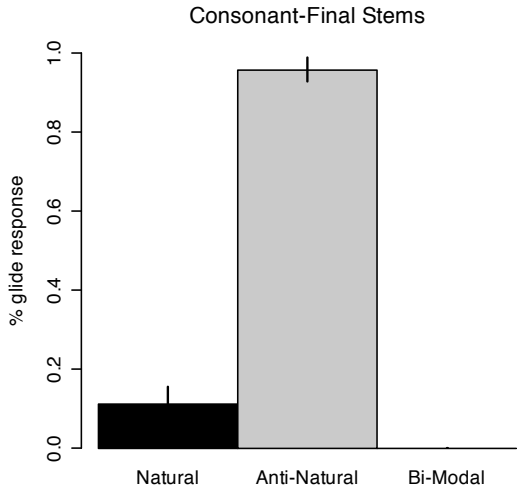

Figure 1

The Bi-Modal condition mixed phonetically natural tokens (identical with Natural condition stimuli) with spliced tokens from which all traces of excrescent glides were removed, resulting in V-V sequences. The reasoning was that the spliced tokens would force a segmental interpretation for the naturally produced tokens, resulting in participants learning three (partially predictable) plural allomorphs: -wək, - jək, and -ək. Figure 1 shows that this was clearly not the case. Interestingly, participants behaved in this condition as they had in the Natural condition – producing only affixed forms lacking glides at test.

This set of results is interpreted to indicate, firstly, a primacy of phonetic naturalness over phonological. While phonotactic information was implicitly available during training, listener response did not always conform to it. This is evident in the Anti-Natural condition, where participants seem to have learned two glide-initial allomorphs for the plural suffix. The phonetic naturalness of the training items, on the other hand, strongly predicted participant response. In both the Natural and the Bi-Modal conditions participants responded largely as though they had learned a single vowel-initial form for the plural, one with phonetic variants (a separate orthographic test supports the interpretation that participants treated glides heard in training as the phonetic product of coarticulation).

The auditorily distinct tokens in the Bi-Modal condition, rather than inducing learners to encode three allomorphs: -wək,- jək, and -ək, produced a phonologically unimodal response distribution. Listeners appear to treat ..Vək and ..VGək plurals as phonetic tokens of the same morpheme class. This is plausible under a model in which listeners have phonetic expectations based on their native language competence (e.g., Beddor & Krakow 1986), as well as a predilection for limiting the surface realizations of semantically identical morphemes. Specifically, the fact that these two acoustically quite distinct phone sequences could be classified identically is attributable to speaker knowledge that carefully articulated vowel-vowel sequences result in an intrusive pause or glottal stop, whereas rapid or colloquial speech often produces phonetic gliding between two vowels. This interpretation accounts for the results of the Natural condition (in which listeners interpret all glides as phonetic). It is also consistent with the Anti-Natural

condition, where even a bias towards a single-morpheme solution would not be enough when faced with two tokens that were impossible phonetic variants of the same target (..ujək and ..iwək).

Taken together, these results have important and interesting implications for how phonological patterns may be learned from phonetic precursors. If generalization based on phonological or morphological information must contend with a large phonetic bias, then certain limits can be placed on the likelihood of particular synchronic epenthesis patterns under the present non-UG constrained learning model. In particular, the likelihood of a Type 2 epenthesis pattern resulting from a Type 1 pattern – requiring, as it does, generalization beyond a phonetically natural conditioning context – is predicted to be low. This is in comparison to the generalization that might result due to a regular pattern that was not phonetically natural (such as paradigms arising from historical consonant deletion which have come to be reinterpreted as synchronic epenthesis (Blevins 2008)). Other factors that could play a role in this process are the relative frequency of the different stem types in the lexicon, leading to frequency differences among the suffix allomorphs, and possible regularization effects (Hudson Kam & Newport 2005). Accidental associations might also arise within an idiosyncratic lexicon, not just at the phonological level, but at other levels as well, such as the semantic. Where such a reliable predictor is discovered, within-domain regularization might result, at the same time that across-domain regularization might be prevented. Further experiments are currently underway to test these and other hypotheses about the inception and evolution of consonant epenthesis systems. It is hoped that this work will provide insights not only into the mechanics of these particular systems, but also into the general processes by which phonological grammars emerge over time.

References

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Experimental Stimuli:

Singular	Plural		
All Conditions	**Natural**	**Anti-Natural**	**Bi-Modal**
ˈratu	ˈratuwək	ˈratujək	ˈratuwək
ˈrilo	ˈrilowək	ˈrilojək	ˈriloək
fraˈbomu	fraˈbomuwək	fraˈbomujək	fraˈbomuwək
tʃoˈræno	tʃoˈrænowək	tʃoˈrænojək	tʃoˈrænoək
kro	ˈkrowək	ˈkrojək	ˈkrowək
vu	ˈvuwək	ˈvujək	ˈvuək
ˈhædi	ˈhædijək	ˈhædiwək	ˈhædijək
ˈskibe	ˈskibejək	ˈskibewək	ˈskibeək
teˈlʌpi	teˈlʌpijək	teˈlʌpiwək	teˈlʌpijək
gluˈdɛbe	gluˈdɛbejək	gluˈdɛbewək	gluˈdɛbeək
fi	ˈfijək	ˈfiwək	ˈfijək
sme	ˈsmejək	ˈsmewək	ˈsmeək

Shaded cells indicate tokens that were created via splicing in order to avoid excrescent glides in the natural coarticulation of adjacent vowels. For example, the token [skibeək] was created by recording a single utterance with a long pause: [skibe ək], then splicing out the pause, as well as the very beginning of the final vowel, to minimize glottalization. Further adjustments (such as shortening the root-final vowel) were made as necessary to make these words sound as natural as possible. Even so, these tokens, exhibiting as they did, a fairly sharp discontinuity, were rather unnatural sounding; at the same time, they were clearly distinguishable from the full glide variants (e.g., [gludebewək]).