# On the use of *Evolutionary Phonology* for phonological theory

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## 1. Introduction

Theoretical phonology centrally focuses on representing the implicit knowledge that speakers have of the sound patterns in their language, as Blevins (this volume) points out on the first page of her synopsis. Equally important, according to Blevins, is it to provide explanations for the distribution of sound patterns across attested spoken languages. While this has been aimed at in numerous studies in different frameworks, Blevins mentions Generative Phonology and Optimality Theory in this context, the alternatively proposed *Evolutionary Phonology* (henceforth: EP) is claimed to differ from previous work in maintaining a principled distinction between phonological and extra-phonological explanations for sound patterns. For this purpose, EP focuses on diachronic processes and tests the hypothesis that ''regular phonetically based sound change is the common source of recurrent sound patterns'' (p. 2).

In the following I argue that EP is only of limited use for phonological theory. I focus on Blevins' criticism of alternative accounts (§2), EP's supposed simplification of phonological theory by ascribing the occurrence of typological patterns to sound change (§3), and a short description of the grammar model by Boersma (§4), which follows restrictions similar to those posed in EP.

## 2. What *Evolutionary Phonology* is not

EP is not a phonological theory, despite what its name suggests, as it does not provide a formalisation of the implicit knowledge speakers have of

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their language and the relation between this knowledge and the forms produced by speakers. Instead, it is a device that restricts the task of phonology. EP rightly promotes a strict division between phonology and phonetics in the grammar and thus refutes a phonological account of phonetically motivated sound changes. The main objection of EP against Optimality Theory (henceforth: OT) is "its reliance on universal markedness constraints as a means of capturing typological generalizations across phonological systems" (Blevins 2004: 244). This criticism is well motivated, because markedness constraints postulate phonetic restrictions as phonological, innate constraints and therefore duplicate the task of phonetics within phonology. In footnote 5, Blevins mentions possible non-innativist alternatives, namely the "phonetically-based optimality approaches of, e.g. Boersma (2003, 2005) or Hayes and Steriade (2004)". Blevins argues that if these frameworks claim to have constraints that emerge from detailed phonetic knowledge over the lexicon, they have to be motivated over alternatives such as "phonetic exemplar-based lexicons, or positive probabilistic constraints based on generalizations over the lexicon". In the synopsis, however, it is not illustrated (or referred to any work that illustrates) how these alleged alternatives perform generalizations over exemplars or lexical items. Several psycholinguistic studies give evidence for abstraction in the process of speech recognition, see e.g. Eisner and McQueen (2005), Kraljic and Samuel (2005), and McQueen et al. (in press). The inability to account for such abstraction is a general problem with episodic approaches, as discussed by Cutler et al. (2006). Blevins thus dismisses non-innativist OT approaches and one of their main advantages, namely the capability to formalize generalisations and to apply them to new forms, without providing a working alternative. In this respect EP further proves that it is not a phonological theory.

## 3. Does phonetics constrain change, structure or acquisition?

In EP, sound change is restricted by phonetic and other factors and determines typological distributions. This position is termed "change explains structure" by Kiparsky (2004: 1) and differs from the structuralist and generativist approach, where "structure explains change" (Kiparsky ibid.). In the latter, typological patterns of synchronic systems account

for sound change. Whereas the evolutionary approach claims that (phonetic and other) restrictions operate on diachronic processes, synchronic approaches claim that (universal) restrictions operate on the end stages of such processes, namely the language systems. In both approaches the acquisition process is of importance, in EP, e.g., "the learner, as reinventor of the phonological system, is the prime source of regular sound change" (Blevins 2004: 230).[1] Besides these two views, a third position is to assume that phonetic restrictions apply in the acquisition process, and are therefore observable both in sound change *and* in typological data. This approach is called 'acquisitional' in the following, where it will be shown that it does not substantially differ from what has been proposed in EP.

Sound change can occur in three different ways in EP. The listener can acquire a prototype (or best exemplar) and/or a phonological form that differ(s) from that of the speaker.[2] This process is called *Choice*, and depends on variation in the input. Without variation in the input the listener still can construct a phonological form that differs from that of the speaker due to its inherent ambiguity. This manner of sound change is called *Chance*. In the third type, called simply *Change*, the listener plainly misperceives the signal. Both *Choice* and *Chance* obviously take place in the acquisition process, and are thus in line with the 'acquisitional' hypothesis. The last process, *Change*, is not described as being restricted to the acquisition process, and this type of diachronic change is therefore assumed to occur any time. This, however, seems unlikely. Speech perception very often takes place in a noisy environment, and listeners are used to correct for misperceptions either on the basis of probabilistic knowledge (they have not or hardly encountered such a form before) or the lexicon (which tells them what they should have perceived). Without these correctives, sound changes caused by misperception should occur all the

[1] This insight stands in contrast with the factors employed in EP to explain the emergence of similar sound patterns across languages termed 'direct inheritance' and 'parallel evolution', which imply that sound structure is inherited, not learnt. Here the problematic nature of comparing the development of phonological structures to evolutionary biology becomes obvious.

[2] It is not clear to me why Blevins includes the construction of a protoype/best exemplar. This implies that abstraction is taking place on the phonological *and* on the phonetic level, which dublicates the task of phonology in phonetics.

time, which is not the case. We can therefore assume that misperceptions only happen in a language system if these correctives are not developed yet, i.e. during the acquisition process.

From this follows that none of the three mechanisms in EP causing sound change illustrate that extra-phonological factors have a restricting influence *outside* the acquisition process. Thus, the pressure to account for typological patterns can be taken from theories on sound change and put on acquisitional models. According to Blevins (2004), *neither* belongs to what she calls 'pure' phonology, which is restricted to the formal relationship between surface patterns and abstract contrasts. However, "a genuine understanding of sound patterns is not possible without detailed phonetic models, historical models, and cognitive models of language acquisition" (2004: 250). The question arises here what we gain by excluding typological, acquisitional, and diachronic accounts from 'pure' phonology if we do not provide complementing models for them? Besides, how can EP's claim be tested that diachronic accounts of typological generalisations are superior to synchronic ones, if no diachronic model is provided? In the following section an alternative approach is presented, which renders not only these questions but EP in general redundant.

## 4. A phonological model that goes beyond EP's requirements

The theory of *bidirectional phonology and phonetics* (Boersma 2005, to appear), henceforth BiPhon, models phonology, phonetics, and their interface.[3] It suffices EP's restriction on keeping phonetics and phonology separate, and, in contrast to EP, is able to derive abstract representations from phonetic input. Furthermore, this theory provides a tool to describe the acquisition of phonetic and phonological knowledge, and diachronic changes thereof.

BiPhon employs four types of representations. Two are abstract and phonological; a surface form, which contains phonological structure such as syllables and moras, and an underlying form devoid of any predictable structure, which is stored in the mental lexicon. The additional two

[3] Recent work by Apoussidou (2006) on the acquisition of lexical stress shows that this model can be extended to include the interface with semantics.

phonetic representations are an auditory and an articulatory form. In the process of speech production, the speaker chooses an underlying form and constructs a surface form from it with correlating articulatory and auditory form. In the reverse process of speech perception, the listener has to construct phonological representations from the auditory input. In both processes, the phonological representations are evaluated together with their phonetic forms, but by different types of constraints. The interface between phonetic and phonological forms is constituted by cue constraints, which map auditory cues (and their cue values) onto abstract phonological categories such as segments and features, e.g. "[200 ms] is /+long/".

BiPhon does not use markedness constraints, in line with criticism on the notion of markedness (see Haspelmath 2006) and its formalisation as markedness constraints (see Blevins this volume). Markedness effects result from the interaction of restrictions on the articulatory form (formalised as articulatory constraints), the restrictions on the correlation of articulatory and auditory from (sensorimotor constraints), and the restrictions on the correlation of auditory and surface from (cue constraints). From this follows that typologically common sound patterns are not directly accounted for by the interaction of universal markedness and faithfulness constraints in factorial typology, as is usually the case within the framework of OT. A further difference from other OT approaches is that none of the constraints used in BiPhon are innate; they are acquired on the basis of positive evidence.

Language acquisition, where the learner has to construct surface and underlying forms from the auditory input, is performed in two stages in BiPhon. In the first stage, the learner constructs language-specific phonetic categories based on the statistical distribution of forms in the input. In the second stage, the learner replaces these phonetic categories by more abstract, phonological categories (guided by the lexicon), and constructs correlations between these phonological categories and their auditory forms in the shape of cue constraints (for both stages, see Boersma, Escudero and Hayes 2003).

Diachronic changes can arise in several ways during this acquisition process. The learner can construct different phonetic categories than the previous generation due to variation in the input, resulting in different cues and/or different phonological categories. If there is no variation in

the input, the learner can nevertheless construct different categories and associate the (same or different) cues. All of these possibilities result in cue constraints (and perception grammars) that differ from those of the previous generation. For an illustration, see Hamann's (2006) study on the diachronic development of retroflex segments, which models Ohala's (1974 et seq.) notion of misperception as a source of sound change in BiPhon.

Sound change cannot only occur during the acquisition process in BiPhon. The parallel evaluation of phonetic and phonological forms allows an ongoing, gradual change in the phonetic correlates of phonological forms for single speakers. Thus, slightly different articulatory and acoustic forms for underlying forms can emerge. A good example for such a shift is the change in vowel space of Great Britain's Queen Elizabeth over the time span of 50 years (Harrington et al. 2000), which seems not to be accompanied by a change of phonological vowel representations. Though EP includes variation as a *cause* for sound change, it only refers to variation dependent on speech rate and style, and does not provide a model of how a single speaker can gradually change the phonetic realisations of abstract forms over a period of time.

Furthermore, BiPhon allows an element of teleology in sound change, a principle that Blevins (2004: 278ff.) rejects. The autonomy of phonetic and phonological forms enables the learner to choose a slightly less complex articulation for a phonological form as long as its perceptual distinctiveness from other forms is not at stake. At the same time, learners can choose a more complex articulation than the previous generation to enhance the perceptual distance between contrasting segments. This so-called dispersion effect has been observed by Liljencrants and Lindblom (1972) and formulated within OT by Flemming (1995) and Padgett (2001) as Dispersion constraints. Boersma and Hamann (2006) show with their simulations of the acquisition of sibilant inventories that such dispersion effects arise automatically in BiPhon without Dispersion constraints. The sibilant system [s $s^j$ ʃ], for instance, emerges as the more dispersed [s ɕ ʂ] after a number of generations, mirroring the diachronic development of Polish sibilants (see Padgett and Zygis 2003). This exemplifies that sound changes are changes of whole systems, with the urge to prevent a merger of contrasting segments (as long as the functional load of the contrasts is high enough, see Labov 1994). EP has no mechanism to deal with such changes.

## 5. Conclusion

Blevins (this volume) convincingly argues that phonology should not include phonetic explanations for typological patterns, especially not in the form of innate markedness constraints (as is common practice in OT). In this respect, EP can be understood as a restrictive device on phonological theory. However, its claim that phonetic restrictions apply in sound change is not well founded. No formal model of diachronic change is given, which is necessary to illustrate its superiority to possible alternatives such as phonetic constraints operating on language acquisition or synchronic grammars. This illustrates that a restriction on what Blevins calls 'pure' phonology does not improve phonological theory. What we need instead is a grammar model that can formalise the interaction of phonology with other modules, one that can account for language acquisition, language change, and the occurrence of typological common and uncommon sound patterns. In the light of the fact that the theory of BiPhon by Boersma (2005, to appear) provides such a grammar theory, EP seems to be dispensable.

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