Squibs and Discussion

"SUBSTANCE ABUSE" AND
"DYSFUNCTIONALISM":
CURRENT TRENDS IN
PHONOLOGY
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1 Form and Substance in Phonology

A coherent theory of the relationship between form and substance in linguistics has yet to be proposed for either phonology or syntax. In this squib we attempt to contribute to this necessary inquiry in the domain of phonology by first defining *form* and *substance,* then critiquing recent work that implicitly or explicitly touches on the relationship between the two. We will argue that the current trends in phonology are incompatible both with coherent definitions of form and substance and with basic principles of science. Since we are not proposing a complete alternative model of phonology, we invite the reader to reflect on how our proposals could be implemented or on how our assumptions (which we believe are widely shared in principle, if not in practice) should be modified.

We propose that it is useful to conceive of a grammar as a relationship between (a) a set of symbols (entities like features and variables; constituents like syllables, feet, NPs) and (b) a set of computations (operations whose operands are drawn from the set of symbols, such as concatenation and deletion). The issue of substance arises only with respect to the set of symbols, and for the sake of simplicity we restrict ourselves to the set of phonological primitives known as distinctive features and to the representations that can be defined as combinations of distinctive features. *Form* refers to the characteristics of phonological computations: Are they rules and/or constraints? Do they apply serially or in parallel? Are there limits on the number of operands they can refer to?

In this squib we concentrate on the issue of substance in phonology. In brief, the question we are interested in is the following:

(1) Do the phonetic correlates (i.e., the substance) of a particular distinctive feature or feature bundle have any nonarbitrary

bearing on how that feature or feature bundle is treated by the computational system?

It is trivial to show that languages differ in that their computational systems treat specific features or feature bundles differently—for example, Standard German has coda obstruent devoicing and English does not. From this we can conclude that languages *can* treat the same symbols differently. A more challenging problem arises when we find an apparent example of crosslinguistically universal, seemingly nonarbitrary treatment of a feature or feature bundle. In such cases we must ask ourselves the following question:

(2) Is the observed pattern a reflection of substantive constraints on the computational system, or is the pattern due to other causes?

As we will show, other a priori plausible causes include the process of language change, the nature of the language acquisition device, and sampling errors. From the standpoint of grammatical theory, factors such as sampling errors are obviously uninteresting. However, language change and the nature of the learning path are also, strictly speaking, not part of grammatical theory. The modular approach to linguistics, and to science in general, requires that we both model the interactions between related domains and sharply delineate one domain from another. Occam's razor demands that, in doing so, we avoid redundancy and the postulation of unnecessary factors.

Before proceeding to our argument that generalizations that bear on patterns of phonetic substance are not relevant to phonological theory strictly defined, we can suggest that there is potentially much to gain from this approach in that it posits that universal phonology can be studied not just across languages, but also across modalities. What is shared by the phonologies of signed and spoken languages? We believe that there must be a core of formal properties (e.g., organization into syllables and feet, feature-spreading processes) that are modality independent and thus not based on phonetic substance. The goal of phonological theory should be to discover this formal core.[1]

2 Three Examples of ''Substance Abuse''

2.1 Positional Faithfulness in Beckman 1997

Beckman (1997) proposes the constraints in (3a–b) as members of the universal constraint set.

(3) a. *Ident-σ_I(hi)*
   A segment in the root-initial syllable in the output and its correspondent in the input must have identical values for the feature [high].

    b. *IDENT(hi)*

       Correspondent segments in output and input have identical values for the feature [high].

As Beckman explains, this set of constraints allows faithfulness to a feature, like [high], to be maintained in some contexts, but not others, since the context-sensitive constraint (3a) can be ranked above a markedness constraint that is violated by, say, the presence of high vowels, *HIGH, which in turn is ranked above the general constraint in (3b). In other words, the ranking in (4) will allow surface high vowels only in root-initial syllables.

(4) IDENT-σ_1(hi) $\gg$ *HIGH $\gg$ IDENT(hi)

This is assumed to be a welcome result.

> The high ranking of positional faithfulness constraints, relative to both the more general IDENT constraints and markedness constraints, yields the result that features and/or contrasts in *just those positions which are psycholinguistically or perceptually salient* are less susceptible to neutralisation than in other locations which are not protected. (Beckman 1997:8; emphasis in original)

Beckman (p. 5) cites more than ten psycholinguistic studies to support her claim that word-initial material is more salient than medial or final material. It is unclear, however, whether this generalization would hold, say, in a language with noninitial stress. It is also unclear whether Beckman's extension of psycholinguistic findings concerning word-initial syllables to *root*-initial syllables is justified. However, let us assume that Beckman has stated the relevant generalizations correctly. The more important point is that we believe the correct conclusion is the *opposite* of the one Beckman draws.[2] We reject Beckman's decision to encode the findings of psycholinguistic experimentation in the grammar because we think it is possible to derive the same result without positing new mechanisms like positional faithfulness.[3] Consider the following alternative theory.

    We know that children acquire spoken language primarily on the basis of acoustic input from speakers in their environment, with Universal Grammar (UG) providing constraints on the hypothesis space.[4] We also know that phonological contrasts are best distin-

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[2] We wish to stress that we are not singling Beckman out for any reason except that her article appeared recently in a widely read journal and is well written and clear in its arguments and assumptions.

[3] For other arguments against context-sensitive faithfulness see Reiss 1996:315.

[4] It may be a useful idealization to assume that UG does not just constrain the learning path, but completely determines it. We suspect that such a position will prove most fruitful in sketching an explicit theory of acquisition, but justification for this goes beyond the scope of this squib.

guished and recalled when occurring in certain positions. Imagine a child exposed to a language $\mathscr{L}_1$ that allows high vowels in all syllables—initial, medial, and final. Imagine further that $\mathscr{L}_1$ has initial stress and that stress is realized as relatively increased duration and intensity. Given this scenario, it would not be surprising to find that a child constructing $\mathscr{L}_2$ on the basis of output from $\mathscr{L}_1$ consistently fails to acquire a contrast between mid and high vowels in relatively short, quiet syllables (those that are noninitial and thus unstressed), but succeeds in acquiring it in initial syllables, which are stressed and thus longer and louder. This mapping from $\mathscr{L}_1$ to $\mathscr{L}_2$ is an example of ''sound change''—in particular, what is known as a ''conditioned merger'' in traditional historical linguistics.

On the other hand, it is highly implausible that a child would consistently fail to correctly analyze the mid/high contrast in longer, louder (stressed) syllables, yet successfully analyze the contrast in relatively short, quiet syllables.

We see therefore that the existence of positional faithfulness phenomena can be understood as merely reflecting the nature of the learning situation.[5]

(5) If the acoustic cues of a given contrast in the target language are correctly analyzed by the acquirer in a context where they are relatively weak, they will also be analyzed correctly in a context where they are relatively strong.

Note that (5) is essentially definitional, since the strength, or acoustic salience, of a contrast is just a measure of how easy it is to perceive. What is most important to understand is that the theory proposed here is not meant to *replace* a synchronic account of the data. So, the best synchronic analysis must somehow be able to generate vowel neutralization in noninitial syllables. (5) is meant to guide us in choosing a theory of grammar in which to couch that synchronic account, but (5) is not part of the grammar. Whatever theory of phonology one adopts must be able to synchronically generate the type of pattern that Beckman describes, but the predictions generated by the correct theory, qua phonological theory, should not overlap with the predictions derivable from (5).

The view of sound change proposed here suggests that many phonological tendencies, or markedness patterns, are actually emergent properties. ''Positional faithfulness'' is due, not to the nature of phonology, but to the ''sifting effect'' of acquisition on the incidental, arbitrary nature of the phonetic substance associated with phonological symbols. Since effects such as those observed by Beckman already have a coherent extragrammatical account within acquisition theory (and it is necessary, in any event, to have an acquisition theory), building positional faithfulness into a theory of universal phonology is a misuse, or abuse, of phonetic substance in theory construction.

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[5] This idea is discussed more thoroughly in Hale, forthcoming.

2.2 r-*Insertion in McCarthy 1993*

McCarthy's (1993) discussion of intervocalic *r*-insertion in Massachusetts English is fairly well known, so an example should suffice for illustration. In this dialect an underlying sequence like *Wanda arrived* is realized with a ''linking'' [r]: *Wanda*[*r*] *arrived.* As McCarthy himself notes (and as discussed by LaCharité and Paradis (1993) and Halle and Idsardi (1997)), ''r is demonstrably not the default consonant in English'' (p. 189). That is, it is not the maximally unmarked consonant that an Optimality Theory (OT) account predicts would emerge in such a situation. In order to account for the insertion of [r], McCarthy proposes a special *rule* of *r*-insertion: ''a phonologically arbitrary stipulation, one that is outside the system of Optimality'' (p. 190). There are several problems with this proposal, many of which are insightfully discussed by Halle and Idsardi. However, we propose that one of their criticisms requires elaboration. Halle and Idsardi rightly point out that ''reliance on an arbitrary stipulation that is outside the system of Optimality is equivalent to giving up on the enterprise'' (p. 337), but they do not discuss what we consider to be a most important observation: grammars contain arbitrary processes. McCarthy's grammar has an arbitrary component (containing rules like *r*-insertion) and a nonarbitrary component (containing the substantive OT constraints). Such a theory is empirically nondistinct from the theory we propose below, which posits that *all* grammatical computations are arbitrary with respect to phonetic substance. The set of phenomena predicted to exist by our theory (with only arbitrary processes) is identical to the set of phenomena predicted to exist by McCarthy's theory (with both nonarbitrary and arbitrary processes). Since McCarthy must adopt a model that allows arbitrary phenomena (like *r*-insertion), the addition of a special subcomponent to account for alleged ''nonarbitrary'' phenomena violates Occam's razor.

The diachronic source of *r*-insertion is transparent: the relevant dialects also exhibit *r*-deletion in codas, so insertion reflects rule inversion triggered by hypercorrection. Again, the diachronic facts do not make a synchronic account unnecessary, but they show that basically idiosyncratic historical events affect specific grammars—and, in part, how they may do so.

2.3 *Structural Constraints on Nonstructures*

Perhaps one of the most problematic cases of ''substance abuse'' we have come across is McCarthy's (1996) appeal to parameterized constraints to account for opacity effects in Hebrew spirantization. McCarthy invokes a constraint schema with parameters specifying the level at which conditions must hold. He then describes the specific instantiation of the constraint for Hebrew: ''In correspondence terms, the meaning of this constraint is as follows: the constraint is violated if a surface stop β *or its underlying correspondent* is immediately preceded by a vowel'' (p. 224; emphasis in the original). As pointed out in Reiss

1997, this powerful constraint type has two problems. It compromises the OT notion of a universal constraint set by allowing parameterized constraints. It also undermines McCarthy's implicit and explicit appeal to phonetic grounding for well-formedness constraints,[6] since the structures that violate this constraint need not be potential surface structure strings. In fact, they need not exist as strings at any level of representation.

3 Neo-Saussureanism

The conclusion we wish to draw from the above examples and many others like them is that the best way to gain an understanding of the computational system of phonology is to assume that the substance of phonological entities is *never* relevant to how they are treated by the computational system, except in *arbitrary, stipulative* ways. What this means is that many of the so-called *phonological universals* (often discussed under the rubric of markedness) are in fact epiphenomena deriving from the interaction of extragrammatical factors like acoustic salience and the nature of language change. It is not surprising that even among their proponents, markedness ''universals'' are usually stated as ''tendencies.'' If our goal as generative linguists is to define the set of *computationally possible* human grammars, ''universal tendencies'' are irrelevant to that enterprise. We propose extending the Saussurean notion of the arbitrary nature of linguistic signs to the treatment of phonological representations by the phonological computational system. Phonology is not and should not be grounded in phonetics since the facts that phonetic grounding is meant to explain can be derived without reference to *phonology.* Duplication of the principles of acoustics and acquisition inside the grammar violates Occam's razor and thus must be avoided. Only in this way will we be able to correctly characterize the universal aspects of phonological computation.

John Ohala has done the most to demonstrate that many so-called markedness tendencies can be explained on phonetic grounds and thus should not be explained by universal cognitive principles. Examples discussed by Ohala include patterns of assimilation and the contents of phonemic inventories. For an extensive bibliography on this topic see Ohala 1998. We differ from Ohala in our use of the term *phonology* (which for him covers all aspects of the sound systems of human language) but wholeheartedly endorse his approach.

It is obvious that our proposal runs contrary to most of the discussion in chapter 9 of *SPE* (Chomsky and Halle 1968). This chapter starts out with an ''admission'' that the theory developed in the earlier chapters is seriously flawed.

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[6] For example, McCarthy and Prince (1995:88) refer to a constraint *VgV as the ''phonologization of Boyle's Law.''

> The problem is that our approach to features, to rules, and to evaluation has been overly formal. Suppose, for example, that we were systematically to interchange features or to replace [αF] by [−αF] (where α is +, and F is a feature) throughout our description of English structure. There is nothing in our account of linguistic theory to indicate that the result would be the description of a system that violates certain principles governing human languages. To the extent that this is true, we have failed to formulate the principles of linguistic theory, of universal grammar, in a satisfactory manner. In particular, we have not made use of the fact that the features have intrinsic content. (p. 400)

Later in the chapter Chomsky and Halle themselves acknowledge that they are on the wrong track.

> It does not seem likely that an elaboration of the theory along the lines just reviewed will allow us to dispense with phonological processes that change features fairly freely. The second stage of the Velar Softening Rule of English (40) and of the Second Velar Palatalization (34) of Slavic strongly suggests that the phonological component requires wide latitude in the freedom to change features, along the lines of the rules discussed in the body of this book. (p. 428)

We propose that switching the feature coefficients as described in the first quotation might lead to the description of systems that are *diachronically* impossible human languages (ones that could never arise because of the nature of language change), but not to ones that are *computationally* impossible. The goal of phonological theory, as a branch of cognitive science, is to categorize what is a computationally possible phonology, given the computational nature of the phonological component of UG.[7]

4 Explanatory Inadequacy

What are the implications of our view that phonology should be all form and no substance? In particular, does this conclusion about the nature of phonological operands have any positive implications for phonological theory? We think that there is one clear conclusion to be drawn. Since we have argued that languages appear to vary in some arbitrary ways (e.g., inserting [r] and not, say, [t]), it is necessary to develop a theory that allows for such variation. In other words, the child should be equipped with a universal computational system and a set of primitives that can be modified upon exposure to positive evidence. For this reason, we believe that current versions of OT,

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[7] This argument, as well as other ideas in this squib, was anticipated by Hellberg (1980) and Kaye (1989). More recently, Ploch (1997, 1999) argues that the phonology of nasals is grounded in cognitive, not phonetic, principles.

which assume a universal set of substantive constraints (*VOICEDCODA, LAZY, etc.), are not likely to prove enlightening. A set of constraint templates, with principles of modification from which the learner can construct the necessary constraint inventory for the target language, may prove to be more useful. Similarly, a rule-based theory equipped with a set of principles for defining possible rules would also allow for the type of stipulative, crosslinguistic variation we have argued is necessary. Note that, given an explicit theory of acquisition, such a ''nativism-cum-constructivism'' view of phonology is well constrained: UG delimits the set of possible rules or constraints; the data determine which rules or constraints are actually constructed.

In order to appreciate the fact that positing the type of substantive constraint found in the OT literature adds nothing to the explanatory power of phonological theory, consider the situation in which learners find themselves. Equipped with an OT-type UG, a child born into a Standard German–speaking environment ''knows'' that voiced coda obstruents are ''marked.'' However, this child never needs to call upon this knowledge to evaluate voiced coda obstruents, since there are none in the ambient target language. In any case, by making use of positive evidence the child successfully acquires a language like German. Born into an English-speaking environment, the child again knows that voiced coda obstruents are marked. However, the ambient language provides ample positive evidence that such sounds are present, and the child must override the supposed innate bias against voiced coda obstruents in order to learn English. So, this purported UG-given gift of knowledge is either irrelevant or misleading for what needs to be learned. Our substance-free theory of phonology shares with OT-type theories a reliance on positive evidence. The two theories have the same empirical coverage, since we also assume that both English and German are acquired. The difference is that we leave out of the genetic inheritance ''hints'' that are irrelevant or misleading. We find our solution to be more elegant. Once again, note that this argument is equally applicable to markedness theories of all types, not just those couched within OT. Since markedness cannot have any bearing on learnability, it is probably irrelevant to any explanatorily adequate theory of grammar. We thus propose banishing markedness from consideration in future linguistic theorizing.[8]

[8] In fact, there are two distinct types of markedness in the phonological literature. This squib is concerned with substantive markedness. Simplicity or evaluation metrics of the *SPE* symbol-counting type can be seen as measuring ''formal'' markedness. We believe that the best approach to such formal requirements is to build them into the language acquisition device (LAD). Under this view learners never compare extensionally equivalent grammars for simplicity or economy; they simply construct the one that is determined by the LAD. There is, then, no reason to introduce the terms *simplicity* and *economy* into the theory since they are contentless labels for arbitrary (i.e., not derivable) aspects of the LAD. For a concrete example of how we think the characterization of the LAD should be approached, see Hale and Reiss, forthcoming.

5 Discussion

The ''substance abuse'' approach has been criticized for cognitive science in general by Pylyshyn (1984:205ff.). Pylyshyn describes a box emitting certain recurrent patterns of signals. He then asks what we can conclude about the nature of the computational mechanism inside the box, given the observed pattern of output. The answer is that we can conclude nothing, since the observed patterns may reflect the nature of what is being computed (in his example, the output is a Morse code rendering of English text, and the observed regularity is the ''*i* before *e,* except after *c*'' rule), not the nature of the computer. In Pylyshyn's words, ''[*T*]*he observed constraint on* [the system's] *behavior is due not to its intrinsic capability but to what its states represent*'' (p. 207; emphasis in the original). If we are interested in studying the phonology ''computer,'' then we need to distinguish a possible phonological computation from an impossible one. The set of attested phonological patterns and their distribution may be somewhat skewed by the sifting effect of language change. Real explanation of the nature of phonological computation requires us to see beyond such epiphenomena as ''markedness tendencies.''

We believe that the current impregnation of the architecture of the phonological ''virtual machine'' with phonetic substance represents a step backward for phonological theory. Phonologists should now call upon their impressive success in amassing descriptions of individual phonological ''programs'' and aim for a more abstract, but deeper, understanding of phonological computation.

6 The Mirage of Enhancement

A particularly illustrative combination of functionalism and what we consider to be the misuse of substantive considerations can be found in the literature on phonetic enhancement and the maximization of contrast (e.g., Stevens, Keyser, and Kawasaki 1986). For example, the tendency of three-vowel systems to contain the maximally distinct set /i, u, a/ is taken as a reflection of a phonological principle demanding the ''best'' use of the available acoustic space. Like other claims concerning markedness and UG, this pattern is no more than a tendency. However, we can show that the view of markedness as an emergent property, outlined above, can give insight into this statistical pattern. Imagine a language $\mathscr{L}_1$ that had the four vowels /i, u, e, a/. Now we know that merger of acoustically similar vowels (like /i/ and /e/) is a common diachronic process. It would not be surprising if a learner constructing $\mathscr{L}_2$ on the basis of data from speakers of $\mathscr{L}_1$ were to fail to acquire a slight distinction and end up with a three-vowel system containing /i, u, a/. However, it is much less likely that the learner would fail to acquire an acoustically more robust distinction like /u/ versus /a/ and end up with an inventory containing, say, /i, u, e/.[9] So,

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[9] Note that ''phonetic substance'' may itself indicate how weak the rea-

vowels that are close together in the acoustic space are likely to merge diachronically. Vowels that are acoustically distant are not likely to merge diachronically. The observed pattern of maximal contrast is thus not built into the phonology, but is an emergent property of the set of observed phonological systems due to the nature of diachronic sound change.

7 Functionalism and ''Dysfunctionalism''

The rise of OT has been accompanied by a revival of functionalism in phonology. In fact, there is no necessary connection between OT as a theory of computation and functionalist reasoning, and an OT proponent might invoke what we call the ''NRA defense'' (''Guns don't kill people; people kill people''): Computational theories aren't inherently functionalist; people are functionalist. However, the ease with which functionalist ideas can be implemented in OT has clearly invited this ''functionalist'' explosion and may bear on the question of whether or not the theory is sufficiently constrained or even constrainable. Note also that the ''logic'' of functionalism (namely, that *all* phenomena are explicable by reference to competition between universal, but violable, principles) is identical to the logic of OT. In this section we briefly show that the ''substance'' orientation of functionalism can be turned on its head to yield a theory that we will dub ''*dysfunctionalism.*''

Many functionalist theories of grammar can be summarized in almost Manichean terms as consisting of a struggle between the ''competing forces'' of ease of articulation (what is presumed to be ''good for'' the speaker) and avoidance of ambiguity (what is presumed to be ''good for'' the hearer). As an example of the former, consider Kirchner's (1997) constraint ''LAZY—Minimize articulatory effort'' (p. 104). For avoidance of ambiguity, consider Flemming's (forthcoming) MAINTAIN CONTRAST constraints, which are violated by surface merger of underlying contrasts.

The interplay of what is ''good for'' the speaker and what is ''good for'' the hearer supposedly gives rise to the patterns we see in language: sometimes mergers occur and the speaker's output is ''simplified,'' potentially creating a difficulty for the hearer; sometimes the speaker maintains distinctions, perhaps producing a more ''complex'' output, thus avoiding ambiguity for the hearer.[10]

soning is in this case: English [i], as well as the other front vowels, is significantly lower than Danish [i]. Why is the ''maximization of contrast'' not active at the phonetic level—precisely the level that provides the alleged ''substance'' (perceptual distinctness, in this case) for the functionalist claim?

[10] Further evidence for the incoherence of the functionalist position is the fact that ''careless'' speech often can lead to supposedly complex outputs such as the stop cluster in [pt]*ato* for *potato*. Onset stop clusters are not found in careful speech, so it is surprising, from a functionalist perspective, that they should be found precisely when the speaker is not putting forth greater articulatory effort.

The problem with this theory is that functionalist principles can be replaced by their opposites, which we will call ''dysfunctionalist'' principles, with no significant change in the set of grammars predicted to exist. Consider the following principles, proposed by a linguist with a different view of human nature than the functionalists have:

(6) *Principles of ''dysfunctionalism''*
   OBFUSCATE: Merge contrasts, use a small inventory of distinctive sounds, and so on.
   NO PAIN–NO GAIN: Maintain contrasts, use a large inventory, generate allomorphy, and so on.

Merger (as well as the oft-proclaimed diachronic principle ''Change is simplification''), well attested in the languages of the world, will be accounted for by the (dys)functional requirement that one should OBFUSCATE. The failure of merger (and the generally ignored diachronic process of ''complexification''), equally widely attested, will be attributed to the effects of NO PAIN–NO GAIN. The competition of these two ''dysfunctionalist'' principles will thus lead to the same results as the usually cited functionalist principles. Although the ultimate question of whether human beings are fundamentally lazy, but helpful, or something seemingly more perverse is intriguing, it hardly seems that investigation into such matters should form the foundation of a theory of phonological computation.[11] We propose, therefore, that functionalism provides no insight into the nature of grammar. Again, we propose leaching all substance out of phonology in order to better observe the abstract computational system.

The alternative—which seems to be the focus of many current developments in phonological theory—seems clear. Given a sufficiently rich and explicit theory of the human personality (giving us principles such as ''Be lazy'' and ''Be helpful to the listener'') and the human articulatory and perceptual systems (''phonetic'' substance), phonology itself will turn out to be epiphenomenal. Although this seems considerably less promising to us, it has clear implications for the research strategy that phonologists should adopt. Phonologists, under such a view, should focus their energies in two domains: phonetics and the empirical explication of fundamental features of the human personality (''laziness,'' ''helpfulness,'' etc.).

8 Conclusions

We are advocating that phonologists, qua phonologists, attempt to explain less, but in a deeper way. As we hope to have indicated, empirical results provided by phoneticians and psycholinguists contribute to the development of a substance-free phonology, and we look forward to important cooperation with scholars in these fields. We

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[11] We would be happy to provide examples—drawn from the history of linguistic theory—of the evolutionary advantages of self-interested effort (NO PAIN–NO GAIN) and OBFUSCATE. We refrain for reasons of space, fully confident that readers will have no difficulty generating ample evidence on their own.

recognize that only they can provide explanation for many (E-language) generalizations that are striking in their statistical regularity.[12] Since we believe that the focus of phonological theory should be on the cognitive architecture of the computational system, we also believe that the nonsubstantive aspects of OT have been tremendously important for the development of the field. The best of the OT literature is far more explicit about the nature of the assumed computational system than its predecessors often were. The mere existence of such a well-developed alternative to rule-based phonology is valuable, regardless of specific formal problems (e.g., synchronic ''chainshifts'') or the ''substance abuse'' found in any particular implementation.

References

Beckman, Jill N. 1997. Positional faithfulness, positional neutralisation and Shona vowel harmony. *Phonology* 14:1–46.

Chomsky, Noam, and Morris Halle. 1968. *The sound pattern of English.* New York: Harper and Row.

Engstrand, Olle. 1997a. Areal biases in stop paradigms. In *Reports from the Department of Phonetics, Umeå University (PHONUM) 4,* 187–190. (Papers from Fonetik 97, The Ninth Swedish Phonetics Conference, held in Umeå, May 28–30, 1997.) Department of Phonetics, Umeå University.

Engstrand, Olle. 1997b. Why are clicks so exclusive? In *Reports from the Department of Phonetics, Umeå University (PHONUM) 4,* 191–194. (Papers from Fonetik 97, The Ninth Swedish Phonetics Conference, held in Umeå, May 28–30, 1997.) Department of Phonetics, Umeå University.

Flemming, Edward. Forthcoming. Phonetic detail in phonology: Toward a unified account of assimilation and coarticulation. *Coyote Papers, Proceedings of the Arizona Phonology Conference 5, Features in Optimality Theory.* Department of Linguistics, University of Arizona, Tucson.

Hale, Mark. Forthcoming. *Theory and method in historical linguistics.* Oxford: Blackwell.

Hale, Mark, and Charles Reiss. Forthcoming. Grammar optimization. *Language Acquisition.*

Halle, Morris, and William J. Idsardi. 1997. *r,* hypercorrection and the Elsewhere Condition. In *Derivations and constraints in phonology,* ed. Iggy Roca, 331–348. Oxford: Clarendon Press.

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[12] But see Engstrand 1997a,b for arguments that the statistics may be misleading. For example, the purported markedness of /p/, as evidenced by its relative rarity in voiced stop inventories, vis-à-vis /t/ and /k/, is probably illusory. The overwhelming majority of the languages in a database like UPSID (Maddieson 1984, Maddieson and Precoda 1989) lacking a /p/ are found in Africa. Similarly, the languages of Africa do not ''avoid'' voiced velar stops, which are also commonly assumed to be marked (see footnote 6). ''Thus, it cannot be concluded that velars and bilabials constitute universally underrepresented members of the respective voiced and voiceless stop series. Although this pattern is to be expected from proposed production and perception constraints, it is largely overridden by areal biases'' (Engstrand 1997a:187).

Hellberg, Staffan. 1980. Apparent naturalness in Faroese phonology. *Nordic Journal of Linguistics* 3:1–24.

Kaye, Jonathan. 1989. *Phonology: A cognitive view*. Hillsdale, N.J.: Lawrence Erlbaum.

Kirchner, Robert. 1997. Contrastiveness and faithfulness. *Phonology* 14:83–111.

LaCharité, Darlene, and Carole Paradis. 1993. Introduction: The emergence of constraints in generative phonology and a comparison of three current constraint-based models. *Canadian Journal of Linguistics* 38:127–151.

Maddieson, Ian. 1984. *Patterns of sounds*. Cambridge: Cambridge University Press.

Maddieson, Ian, and Kristin Precoda. 1989. Updating UPSID. *Journal of the Acoustical Society of America,* Supp. 1, Vol. 86, S19.

McCarthy, John J. 1993. A case of surface rule inversion. *Canadian Journal of Linguistics* 38:169–195.

McCarthy, John J. 1996. Remarks on phonological opacity in Optimality Theory. In *Studies in Afroasiatic grammar: Papers from the Second Conference on Afroasiatic Languages Sophia Antipolis, 1994,* ed. Jacqueline Lecarme, Jean Lowenstamm, and Ur Shlonsky, 215–243. The Hague: Holland Academic Graphics.

McCarthy, John, and Alan Prince. 1995. Faithfulness and reduplicative identity. Rutgers Optimality Archive ROA-60, http://ruccs.rutgers.edu/roa.html. [Also in *University of Massachusetts occasional papers 18: Papers in Optimality Theory,* 249–384. GLSA, University of Massachusetts, Amherst.]

Ohala, John. 1998. A bibliography of the phonetics of sound change. Ms., Department of Linguistics, University of California, Berkeley.

Ploch, Stefan. 1997. The nasal fallacy. In *SOAS working papers in linguistics and phonetics 7*, 221–273. Department of Linguistics, School of Oriental and African Studies, University of London.

Ploch, Stefan. 1999. Nasals on my mind: The phonetic and the cognitive approach to the phonology of nasality. Doctoral dissertation, University of London.

Pylyshyn, Zenon W. 1984. *Computation and cognition: Toward a foundation for cognitive science.* Cambridge, Mass.: MIT Press.

Reiss, Charles. 1996. Deriving an implicational universal in a constrained OT grammar. In *NELS 26,* 303–317. GLSA, University of Massachusetts, Amherst.

Reiss, Charles. 1997. Unifying the interpretation of structural descriptions. In *Proceedings of the Fifteenth West Coast Conference on Formal Linguistics,* 413–427. Stanford, Calif.: CSLI Publications. [Distributed by Cambridge University Press.]

Stevens, Kenneth N., Samuel Jay Keyser, and Haruko Kawasaki. 1986. Toward a phonetic and phonological theory of redundant features. In *Invariance and variability of speech processes,* ed. Joseph S. Perkell and Dennis H. Klatt, 426–449. Hillsdale, N.J.: Erlbaum.