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# Naturalism, Internalism and Nativism:
## <What> The Legacy of *The Sound Pattern of English* <Should Be>

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# 0.1. Basics of *SPE* Phonology

Phonology is the study of abstract sound patterns in human *language*, as opposed to phonetics, which studies all aspects of *speech*, including articulation and acoustics. We illustrate with a somewhat simplified example. In Québec French, the adjective meaning 'small' shows an alternation between the tense vowel [i] in the open syllable of the masculine form *petit* [pt$^{s}$i] vs. the lax [ɪ] in the corresponding feminine form *petite* [pt$^{s}$ɪt], where the syllable is closed by the consonant [t], reflecting a general phonological pattern: [i] and [ɪ] are in complementary distribution determined by syllable structure. In English, the same phonetic vowels occur, with the same vocal tract configurations and corresponding sound spectra (*modulo* accidental details). However, the English vowels can appear in the same environment, say between a [b] and a [t] in a closed syllable, as in *beet* [bit] vs. *bit* [bɪt]. So, we can say that English and Québec French have the same two vowels **phonetically**, but the **phonological** status of [i] and [ɪ] differs in the two languages.

In *The Sound Pattern of English* [Chomsky and Halle, 1968, henceforth *SPE*] and most phonological models, this difference consists of two factors, a representational difference and a computational difference:

- Québec French has the same vowel stored in the representations of *petit* and *petite*, say /i/, and a mental computation turns /i/ into [ɪ] in a closed syllable. The difference in pronunciation is a result of a specific computation.
- English has different vowels stored in the representations of *beet* and *bit*. The stored representational (featural) distinction persists in pronunciation.

The phonology of each language consists of various computations. In *SPE* the computations are called rules, and the phonology of a language is a complex function resulting from composing the rules in a particular order. The input to the phonology is called an underlying representation, and the output is called a surface representation or, somewhat confusingly, a 'phonetic representation'.

The mapping of an underlying form to a surface form by the computational system is called a derivation. It is the output of the derivation, the 'phonetic' form, that is the input to the mechanisms leading to speech, and this output form should not be confused with the actual articulatory movements and their concomitant acoustic results.

## 0.2. Internalism in Phonology

Our simple example from Québec French allows us to discuss one of the most important notions of *SPE* phonology, and Chomsky's linguistics more generally: radical internalism. The input representations referred to above consist of morphemes, minimal data structures containing (at least) semantic and phonological information. Under the internalist perspective, these morphemes are encoded as (or, just are) information in the minds/brains of speakers. They are not in books, in the air, or anywhere out in the world as properties of speech communities. When we informally refer to speakers of 'Québec French' or 'English' we assume an idealized population that is identical in all ways relevant to the phenomenon under discussion, say having type-identical vowels in type-identical morphemes in their lexicon.[1] So, the internalism that is standard in other aspects of Chomsky's linguistics, and is in fact the most profound consequence of the cognitive revolution of the 1950's and 60's, is equally relevant to Chomsky's phonology.

According to the discussion on p. 3 of *SPE*, language is taken to be a system of knowledge that is fully internal to the human mind: "The person who has acquired knowledge of language has internalized a system of rules that determines sound-meaning connections for indefinitely many sentences". This "for the most part, obviously, unconscious knowledge", which is "realized physically in a finite human brain", is referred to as "the speaker-hearer's 'competence'", and it should be strictly distinguished from "performance", that is, from "what the speaker-hearer actually does" with this knowledge on a particular occasion. The general goal of linguistics "is the construction of a grammar", where grammar refers to "the explicit theory constructed by the linguist and proposed as a description of the speaker's competence". Of course, competence cannot be observed directly. Its properties can only be discovered indirectly, for example by inferring them on the basis of evidence provided by performance. Since performance "is a complex matter that involves many

[1] Crucially, when linguists discuss small scale variation, they make a more fine grained generalization and talk about dialects, even regiolects, with the exact same logic, just a different 'zoom factor'.

factors", this main body of empirical data from which phonological conclusions can be drawn will necessarily include a welter of accidental and irrelevant information. A universal phonological theory provides a principled basis for distinguishing between relevant and irrelevant aspects of empirical data, as in all sciences.

Consistent with this internalism, we see that, just as in syntax, Chomsky's phonology, as presented in *SPE* itself and many of the papers leading up to the book [Chomsky, 1951, 1957b,a, 1964b, Chomsky et al., 1956, Halle, 1959, 1962, 1964, Chomsky and Halle, 1965], considers the actual object of study to be the cognitive system (phonological competence) that underlies observable behavior (speech production and perception). Observable behavior is just one source of evidence for competence.

Despite the clarity and coherence of *SPE*'s radical cognitivism, much subsequent work in phonology has ignored or rejected internalism to varying degrees. As we'll see, much of the literature fails to engage with the philosophical foundations of the cognitive revolution, and has been preoccupied with describing verbal behavior, rather than the underlying knowledge that makes that behavior possible. These preoccupations have maintained or even gained in popularity from the time of the publication of *SPE* up until the present, as witnessed by the prominence of 'output-driven' models of phonology [e.g., Tesar, 2014] and by the prevalent orientation towards 'the surface' throughout the field.

Of course, most scholars accept that *some* aspects of language are 'in the mind', but the Chomskyan perspective is that language, phonology included, is *all* in the mind. Linguistic mental representations are the constituents of language, and are not understood as "representing" mind-external entities. For example, Chomsky [2009a, p. 27] proposes that for surface phonological ('phonetic') entities "such as the syllable /ba/; every particular act externalizing this mental entity yields a mind-independent entity, but it is idle to seek a mind-independent construct that corresponds to the syllable". This perspective, not only for phonology, but also for syntax and semantics, is endorsed by many scholars, including Jackendoff [1992] who says "Language, as far as I can tell, is *all* construction," meaning "all internal construction".

Aside from internalism, naturalism and nativism are the most important notions of Chomsky's legacy in linguistics. These notions don't just apply to phonology as to syntax; rather it is also the case that Chomsky's consistent and radical versions of these notions can even be justified with phonological examples. As phonologists, we regret that the phonological arguments are not as well known as the syntactic ones. For the purposes of this brief discussion, we focus on the relationship between internalism and nativism.

# 0.3. Anti-internalism and rejection of nativism

*SPE* is explicit in its commitment to nativism:

> The significant linguistic universals are those that must be assumed to be available to the child learning a language as an a priori, innate endowment. That there must be a rich system of a priori properties-of essential linguistic universals is fairly obvious from the following empirical observations. Every normal child acquires an extremely intricate and abstract grammar, the properties of which are much underdetermined by the available data. This takes place with great speed, under conditions that are far from ideal, and there is little significant variation among children who may differ greatly in intelligence and experience. The search for essential linguistic universals is, in effect, the study of the a priori *faculté de langage* that makes language acquisition possible under the given conditions of time and access to data.
>
> It is useful to divide linguistic universals roughly into two categories. There are, first of all, certain "formal universals" that determine the structure of grammars and the form and organization of rules. In addition, there are "substantive universals"[2] that define the sets of elements that may figure in particular grammars. [p. 4]

Despite these clear statements, nativism has fared badly in the phonological literature in recent years, and we'll discuss two influential trends. Optimality Theory (OT) [e.g. Prince and Smolensky, 1993, McCarthy and Prince, 1993] began as a strongly nativist model of phonology, consisting of an innate constraint set, built on an inventory of substantive universals, such as the subsegmental features used in *SPE*. In OT, a universal algorithm determines the output form for a given phonological input based on a language-specific ranking. In OT, then, the only locus of language variation is in the ranking of the universal constraints in a given language $L$ and the set of morphemes that happen to be present in the lexicon of $L$ (although there is some confusion with respect to the latter issue, represented in discussion of the so-called Richness of the Base). For example, an underlying /i/ is able to surface in a

[2]The term 'substantive' here means 'having substantive (phonetic, speech-related) *correlates*', not 'being substance'—an important distinction often misinterpreted in the phonological literature.

closed syllable in English [bit] 'beet', but not in Québec French [pt$^{s}$ɪt], despite the two languages having the same constraints, because the two differ in their constraint ranking.

The initially elegant OT model appeared to offer solutions to some long-standing issues, and introduced a set of different problems—a normal situation in discussion of incommensurable theories in any scientific field. However, it quickly became apparent that the innate component of phonology in OT terms was implausibly rich, requiring an *extensional* characterisation of a large set of constraints as part of innate endowment. More recently, the issue of nativism is just ignored in most OT literature, but has to be understood as tacitly rejected given the specificity of the constraints posited, such as "Assign one violation for each contrast between N and NC in which NC does not have an oral release that belongs to category of 4 or larger along the RELscale" which is an actually proposed constraint in a paper in the journal *Phonology* [Stanton, 2019, p. 674]. In addition, various scholars posit constraints that are not just specific to one language, but to the realization of one morpheme in a particular language, such as the ALIGN-*um*-L markedness constraint that refers to the Tagalog morpheme /um/ [Kager, 1999, p. 122].

Outside of the OT literature, we find anti-nativist titles such as *The emergence of distinctive features* [Mielke, 2008] and 'Phonology without universal grammar' [Archangeli and Pulleyblank, 2015]. How is it possible that Chomsky's stature in phonology is universally recognized by the phonological community, as is his development of the idea of Universal Grammar, and yet, so much current work, even by his former students, is anti-nativist, anti-UG? We think we have the answer, but first let's document (with added boldface) the not uncommon denial of nativism via the denial of the Argument of the Poverty of the Stimulus (APoS) in the phonological literature.

Perhaps it is not surprising that a psychologist like Peter MacNeilage rejects the APoS:

(1) Peter MacNeilage, *The origin of speech* (2008: 41):

> however much **poverty of the stimulus** exists for language in general, **there is none of it** in the domain of the structure of words, the unit of communication I am most concerned with. Infants **hear all the words** they expect to produce. Thus, the main proving ground for **UG does not include phonology**

This anti-nativist perspective is also implicitly anti-internalist since it suggests that words are out there for children to hear, a view at odds with the generative program as understood by, say, a syntactician like Howard Lasnik (2000, p. 3) :

> The list of behaviors of which knowledge of language purportedly consists has to rely on notions like "utterance" and "word." But what is a word? What is an utterance? These notions are already quite abstract. Even more abstract is the notion "sentence." Chomsky has been and continues to be criticized for positing such abstract notions as transformations and structures, but the big leap is what everyone takes for granted. It's widely assumed that the big step is going from sentence to transformation, but this in fact isn't a significant leap. The big step is going from "noise" to "word".

We assume that Lasnik would agree that the abstractness goes even further than words, to the level of segments and phonological features.

MacNeilage's view also has an unfortunate English-centred perspective on words. In an agglutinative language like Turkish, a given root can appear in hundreds or thousands of words, such as the root *ev* 'house' in the noun *evlerimizdekilerinki* meaning 'the one belonging to the ones in our houses' (Hankamer 1989:397). Children clearly do not hear all the words that that they can produce.

Phonologist Jeff Mielke's work arguing against an innate set of phonological features also rejects APoS:

(2) Mielke [2008], *The Emergence of Distinctive Features*

- "Many of the **arguments for UG in other domains do not hold for phonology**. For example, there is little evidence of a learnability problem in phonology" [p. 33]
- [Most of the evidence for] "**UG is not related to phonology**, and phonology has more of a guilt-by-association status with respect to innateness". [p. 34]

Although Mielke dedicates a whole monograph to arguing that features can be learned, he never addresses logical arguments against such a view presented by Fodor [1980] and others, or the clear assertion by Chomsky and Halle [1965] that "one does not 'construct features from scratch for each language' " in a response to the American Structuralist linguist Fred Householder [1965].

In a discussion of Chomsky's legacy, it is most relevant to note the divergent perspectives on such matters of phonologists who have worked in the generative tradition:

(3) Archangeli and Pulleyblank [2015] 'Phonology without universal grammar'

- "See Mielke [2004/8] on why **features cannot be innately defined**, but must be learned"

- "[Children face] the challenge of **isolating specific sounds from the sound stream**"
- "the predictions of [Emergent Grammar] fit the data better than do the predictions of UG."

(4) Blevins [2003, p. 235], *Evolutionary Phonology*

> "**Within the domain of sounds, there is no poverty of the stimulus**. [I offer] general arguments against the 'poverty of stimulus' in phonology, ... [there is no evidence that] regular phonological alternations cannot be acquired on the basis of generalizations **gleaned directly from auditory input**."

These passages clearly locate segments in the 'auditory input', the 'sound stream', and thus reject the radical rationalist-internalist perspective of Chomskyan phonology alluded to above, simply expressed by Hammarberg [1976, 354]: "[I]t should be perfectly obvious by now that segments do not exist outside the human mind." Scholars denying a poverty of the stimulus problem for phonology fail to recognize the well-established difficulty of defining invariant acoustic correlates of segments, a challenge known as the Problem of the Lack of Invariance, which is discussed insightfully by philosopher Irene Appelbaum [1996].

Finally, here is yet another phonologist, author of a popular text and co-editor of a philosophically oriented volume on phonological knowledge [Burton-Roberts et al., 2000] rejecting phonological internalism and nativism in one breath:

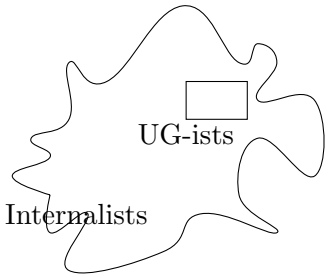
(5) Carr [2006], 'Universal grammar and syntax/phonology parallelisms'
> "Phonological objects and relations are internalisable: **there is no poverty of the stimulus argument in phonology. No phonological knowledge is given by UG**."

Carr's quotation makes clear the logical relationship between internalism and nativism, and helps us to explain the rejection of nativism as a logical consequence of a failure to appreciate internalism: if phonology is internalisable, it need not be innate. A non-Chomskyan linguist or psychologist studies the mind, and so is an internalist, but he or she may very well deny any interesting domain specific innate knowledge—think of your average connectionist. So, internalism definitely does not imply nativism. However, there is a valid implication in the other direction: Universal Grammar is a claim of innate knowledge, so a nativist in cognitive science has to be an internalist. By contraposition we know that if 'nativism implies internalism' is true, then 'NOT-internalism implies NOT-nativism' is also true. And that's the problem: for many phonologists, it is logically impossible that they be nativists, because they are not internalists.

(6) The relationship between internalism and nativism

- Internalism $\not\Rightarrow$ UG
- UG $\Rightarrow$ Internalism

$\therefore$ No-Internalism $\Rightarrow$ No-UG




So, given the rejection of the internalist legacy of *SPE*, the nativist legacy stands no chance. This anti-internalism is clear from claims in phonology, phonological acquisition and speech perception literature that features, segments, alternations, patterns and so on are *in* the signal, to be *found* by the listener / learner. We know however, that just as a Necker cube is not discovered by our visual faculty, but instead is invented by the mind each time it is perceived or imagined [Marr, 1982], in the same way, the mind constructs phonological representations out of a limited set of innately available resources such as features. We even see this happening when we interpret the sounds of a parrot or Hoover the "talking" seal as speech—the words and segments we "hear" are definitely not out in the world.

# 0.4. What is innate?

*SPE* phonology explicitly adopts strict and consistent naturalism, internalism and nativism. We have indicated that much recent work rejects without justification the nativism of *SPE*. However, another rampant problem in the literature is an over-eager implausible nativism, deriving, we believe, from a misreading of *SPE*. This work, based on the vague notion of markedness, is portrayed as a development of a passage in *SPE* itself:

> 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 [$\alpha$F] by [-$\alpha$F] (where $\alpha$ 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]

Unfortunately, the literature on markedness ignores a later passage where Chomsky and Halle acknowledge that a formal model of phonological computation should probably not make reference to 'intrinsic content' of features:

> 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 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]

So, Chomsky and Halle conclude that the computational system which makes up the phonological module cannot be understood by reference to functional considerations of naturalness or restrictions on surface forms. This conclusion is echoed elsewhere: "Where properties of language can be explained on such 'functional' grounds, they provide no revealing insight into the nature of mind. Precisely because the explanations proposed here are 'formal explanations,' precisely because the proposed principles are not essential or even natural properties of any imaginable language, they provide a revealing mirror of the mind (if correct)" [Chomsky, 1971, p. 44].

If we agree with Chomsky [2007] that "the less attributed to genetic information (in our case, the topic of UG) for determining the development of an organism, the more feasible the study of its evolution," then not only the highly specific constraints mentioned above, for particular morphemes in particular languages, but pretty much every putative expression of ill-formedness or markedness, needs to be banished from theorizing about UG.

Our own interpretation of the legacy of *SPE* includes the following components:

i) We assume that phonological UG contains innate features, and that this assumption is in line with what was referred to in *SPE* as "universal phonetics", including a set of substantive features that are "independent of any particular language" and which determine "a certain infinite class of possible phonetic representations from which the phonetic forms of sentences of any human language are drawn" (*SPE*, p. 8). Despite the disrepute into which the universal phonetics view has fallen, we believe that the arguments given in *SPE* and Chomsky and Halle [1965], remain convincing.

ii) Possibly some other representational primitives or structure-building algorithms to account for syllables, feet, stress, and other phenomena which we assume are also part of phonological UG.

iii) Some basic logical operations that define the mappings among the representations. This part of the model can be called a theory of structural changes

for the rules in a derivation. In our own recent work [e.g., Leduc et al., Forthcoming, Bale and Reiss, 2018], we have deconstructed the traditional *SPE* arrow '→' and replaced it with set subtraction and unification for a wide range of processes.

iv) A theory of environments that determines the conditions under which one part of a representation can 'trigger' a non-vacuous mapping to another representation in a derivation. For example, there appear to be rules in which a consonantal change in a syllable onset is triggered by a consonant in the immediately preceding onset. Could a rule be triggered by any preceding onset at any distance? Many scholars have worked on such questions about locality in phonology. Our own prejudice is that actual segmental adjacency, which is the most typical condition in rules is just a special case of long-distance interaction.

v) Closely linked to the innateness of features as components of a universal representational code, is the notion, accepted in *SPE*, of a *universal phonetic interpretation* of features (and other representational primitives). In addition to participating in phonological representation and computation, features also serve as the basis for phonetic interpretation at the interface between linguistic competence and the sensory-motor system: "the distinctive features provide a representation of an utterance which can be interpreted as a set of instructions to the physical articulatory system, or as a refined level of perceptual representation" (p. 65).[3] This no longer falls under the purview of phonology, and so *SPE* provides only cursory remarks about the interpretation of features in speech production or perception, suggesting that it is governed by "universal interpretative conventions" (p. 403). In other words, the output of the grammar, the surface or 'phonetic' representation, is transduced to speech output in an invariant manner, not specific to any particular language. This position is either ignored or presented as patently false by much recent work, but a full defense is not possible here (see Volenec and Reiss [2018] for details).

The issue arises when putatively identical featural representations (using pretty much any current model of phonological primes) are said to have different pronunciations in different languages. To make this concrete, recall our discussion of the vowels [i] and [ɪ] in English and Québec French. In fact, the [i] of *petit* and the [i] of *beet* are somewhat different. The universal phonetics perspective of *SPE* requires that the two vowels in fact be phonologically different, encoded differently in long-term memory. The rejected alternative (adopted by most other work) is that the two can be (type)-identical but

[3]Passages like this understandably lead Rey [2003] to the contention that linguists, including Chomsky, actually are intentionalist when they are not being philosophical.

realized differently by post-phonological language-specific rules of phonetic implementation.

## 0.5. Naturalism in phonology

The rightful legacy of *SPE* includes the naturalism, internalism and nativism found also in Chomsky's syntactic work.[4] By naturalism, we refer to the idea that language, including phonology, can fruitfully be studied as a natural object [see especially Chomsky, 2000]. Chomsky has labeled the resistance to naturalistic inquiry of language among certain philosophers "methodological dualism". As James McGilvray sums up the idea in the introduction to Chomsky [2009b], certain philosophers "might have anything from a reasonably clear to a very good [. . . ] idea of what naturalistic scientific methodology is, but they clearly refuse to hold that language and concepts could be investigated using this methodology" (p. 22) and "when it comes to crucial features of the mind, the empiricists abandon not just internalism and nativism, but the methods of the natural sciences" (p. 21).

We detect a related methodological problem within contemporary phonology which also seems tied to neglect and/or ignorance of foundational arguments concerning internalism and nativism. Phonology has seen a number of widely adopted innovations in recent decades, such as the use of more complex graph-theoretic representations for both segment-feature relations [e.g., Sagey, 1986] and higher-order units like syllables [e.g., Zec, 2007], that are consistent with a trend towards increased rigor and explicitness expected in science. However, phonology has a long way to go before it can be considered a mature science in practice. The rejection of radical internalism has lead to the biggest problem that characterizes much of phonological reasoning since *SPE*, the notion of markedness, which results in forms of teleological reasoning that, we hold, have no place in modern scientific inquiry. Markedness-based empiricist phonological theories are trying to be theories about too many things at the same time——not only phonological competence, but also typological trends concerning the distribution of patterns in the languages of the world; verbal behavior factors related to speech rate; inter- and intra-speaker variation related to dialect and register differences; and even the intelligibility of the speech of young children.[5] In trying to do too much, such work fails to adopt the normal

[4] We discuss many of the themes covered here in greater detail elsewhere[Hale and Reiss, 2008, Bale and Reiss, 2018, Volenec and Reiss, 2018, 2019, Reiss, 2017].

[5] In our view, this field of "child phonology" has nothing to do with competence grammars, and everything to do with children's immature performance systems [Chomsky, 1964a, Smith,

strategies of natural sciences like isolation, idealization and simplification.

Probably a majority of working phonologists believe that "Many if not most phonological phenomena [are] characterizable in terms of output restrictions" [Tesar, 2014], or else that phonological grammars manifest "conspiracies" for "reoccurrence of a common output factor" as Kager's (1999, p. 56) OT discussion summarizes Kisseberth's (1970) early post-*SPE* work. McCarthy's (2011, p. 2) discussion of Kisseberth asserts that a conspiracy involving two rules ensures that "[f]inal vowel deletion cannot create bad syllables in surface forms, and epenthesis exists to eliminate" bad syllables. In some work, the purpose is expressed in terms of pathologies: phonological computation has to "cure" a "condition" Yip [1988]. Phonology is said to contain "principles of well-formedness (the 'laws') that drive it" [Prince and Smolensky, 1993, p. 216], taking input representations and making them somehow better, more harmonic or optimal. Such passages, demonstrate that phonology has not, in general, achieved the rigor of a natural science—naturalism is not explicitly rejected, but such teleological rhetoric makes it clear that it hasn't been universally embraced either.

Markedness and other expressions of 'surface-orientation' in phonology are reminiscent of Appelbaum's (1996) critique of the protean reference to 'gesture' in the motor theory of speech perception [e.g. Liberman and Mattingly, 1985] and Articulatory Phonology [Browman and Goldstein, 1989]: "By leaving the referent of 'phonetic gestures' ambiguous between an articulatory interpretation and a neural one, proponents of the motor theory try to exploit the theoretical benefit of each interpretation, without incurring the theoretical burden of either." In a similar vein, surface-oriented, output-driven phonology oscillates between actual phonetics (sound and articulation) and the output of the grammar (surface 'phonetic' representations). For example, McCarthy and Prince (1995, 88) refer to an OT constraint as the "phonologization of Boyle's Law."[6] There is no way that Boyle's law, or the Bernoulli effect or details about tongue and lip position of actual articulation can '*motivate*' the computation between input and output *of the grammar*. Yet this is exactly what the copious work in OT, Natural Phonology, and various repair-based models of phonology proposes. If grammar is internal, then external facts like the behavior of gases under pressure or the properties of the muscles controlling the lips, are *not directly available to the grammar* (although they may play some role in

2010, Hale and Reiss, 1998, 2008].

[6]McCarthy and Prince [1995, 88] "claim that the operative constraint here is a requirement that posterior stops (i.e., velars) be voiceless—to be referred to as POSTVCLS. This constraint phonologizes the familiar articulatory effect of Boyle's Law: it is difficult to maintain voicing when the supraglottal cavity is small."

filtering the kinds of data that learners can have access to).

For a particularly egregious abuse of 'phonetic' motivation, consider the parameterized constraints of McCarthy [1996, p. 223], e.g. "the meaning of this constraint is this: the constraint is violated if a surface stop, or its underlying correspondent is immediately preceded by a vowel." In other words, phonetic (articulatory or acoustic) motivation is supposed to explain bans on *potential* sequences of segments across levels of representation: a stop consonant should not appear in a surface representation if its correspondent in the underlying representation is preceded by a vowel. In contrast to this approach referring to marked or banned potential structures, *SPE* handles such phenomena by treating a language's phonology as a function composed of multiple rules. As in mathematics and logic, the order of composition matters. There are no teleological conspiracies to repair, cure or optimize representations; no attempts by the grammar to facilitate articulation or comprehension according to vague claims about the 'communicative function' of language [see papers in Hayes et al., 2004, for examples of this view]. In the *SPE* tradition, grammar models "dumb", mechanical computation—that's a good thing, since *grammars* don't have goals and desires, even if *people* do. The *SPE* arguments given *against* building markedness into the formal theory are consistent with the idea of phonology as naturalistic inquiry, and these convincing arguments are only reinforced by the inconsistencies in markedness-based approaches.

# 0.6. Conclusion

Zenon Pylyshyn [1984, p. xix] suggests that "the kinds of theories cognitive scientists entertain are intimately related to the set of tacit assumptions they make about the very foundations of the field of cognitive science. In cognitive science the gap between metatheory and practice is extremely narrow." As elsewhere, Chomsky's work revolutionized the foundations of phonology, yet the implications of *SPE* and related work have been neglected, to the detriment of the field. This is consistent with the failure of phonologists to accord enough weight to clear, accessible arguments made by scholars like Fodor, Jackendoff, and even Kant, relating to leading ideas of Chomsky's general philosophical outlook. Beyond phonology, philosophers and psychologists, as well syntacticians and semanticists interested in 'big picture' issues like naturalism, internalism and nativism, would be well served by paying more attention to the achievements of *SPE*. Working in the field, we remain enthusiastic about discovering not only how these leading ideas apply in phonology, but also how new phonological arguments can bolster Chomsky's often radical, broad philosophical stands.

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