TWO PHONOLOGIES OR ONE?:
SOME IMPLICATIONS OF THE DYG FOR BIOLINGUISTICS

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Phonological Architecture: A Biolinguistic Perspective, by Bridget D. Samuels, Oxford University Press, Oxford, 2011, xii+252pp.

Samuels (2011) develops an evolutionarily adequate theory of phonology, based on Hauser, Chomsky and Fitch (2002). In her theory, phonology is explainable through the domain-general properties in the S-M interface whose precursors are found in other animals, and the apparent uniqueness of these properties emerges from their combination. This is a plausible reply to Pinker and Jackendoff’s (2005) criticism against the Merge-only scenario of FLN by arguing for the apparently species-specific and language-specific nature of phonology.

However, we will claim that this story stands only in I-phonology but that in the spirit of methodological generalism, we must aim at constructing a theory that incorporates both I-phonology and E-phonology in the trilogy model of biolinguistics. We will also show some empirical and conceptual evidence for the DYG, which implies that even such an ‘uneconomical’ phenomenon must have a place in I-phonology as well as E-phonology and that its computation can be offered an account by Turbid Optimality Theory.*

Keywords: Bromberger and Halle (1989), I- and E-phonologies, glossogeny, the Duke-of-York Gambit (DYG), Turbid Optimality Theory

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1. Introduction

In their seminal work “Why Phonology is Different,” Bromberger and Halle (1989) once stated that “[q]uestions about the ordering of transformations and about intermediate representations have all but disappeared from syntax” (p. 51, with underlines by ST) and yet that “derivations based on ordered rules (that is, external ordering) and incorporating intermediate structures are essential to phonology—in other words, they represent an uneliminable aspect of linguistic knowledge” (p. 52, with underlines by ST). Their conclusion was that “facts pertaining to the two domains … are of a very different nature and that there is therefore no reason to assume a priori that they must be covered by formally similar theories” (p. 52).

Now the situation might naturally seem to have changed in the 21st century when the rule-based derivational theory in phonology has been almost entirely replaced by constraint-based Optimality Theory whose basic architecture excludes any intermediate stages induced by ordered rules. However, the dominant trends remain the same in the generative tradition: phonological grammar is still framed separately in Optimality Theory whereas syntactic grammar is framed in the Minimalist Program. This may be because “facts pertaining to the two domains … are of a very different nature.”

In contrast, the author of *Phonological Architecture: A Biolinguistic Perspective*, Bridget Samuels, has a radically different view. The crux of her position is that phonology is the same as syntax, arguing for language design in line with Hale and Reiss (2000, 2008) and with Blaho (2008) on the phonological side and with Hauser, Chomsky and Fitch (2002) on the biolinguistic side. Her general picture concerning the role of phonology in language design is indeed beautiful and at the same time, convincing, precisely because she separates phonology from phonetics, and crucially, from phonological acquisition and phonological change as well. In other words, her success relies not only on her deep insight and extensive knowledge of various fields but also on the fact that she focuses on drawing a clear picture of “substance-free” phonology in the core biolinguistic language design, at the same doing away with “substance-bound” aspects such as acquisition, variation, and historical change in the core frame as well. In short, honestly speaking, the picture is really intriguing because of its broad perspective and the methodology is rather compelling due to its elaborate design.

So the goal and scope of this review article are consequently not to criticize Samuels’s general or specific analysis or to cast doubt on the findings of her work. The analysis and findings of her work are too intriguing
and compelling to do so (section 2.1). Instead, our goal is to prove that the seemingly contradictory claims of Bromberger and Halle (1989) and Samuels (2011) are in fact compatible and can coexist (section 2.2), and to present an alternative view on the general biolinguistic language design that incorporates both “substance-free” and “substance-bound” phonologies as essential units of grammar (section 2.3). If this revised picture turns out to be the case, there will be two separate phonologies whose approaches to computation are entirely different, that is, “substance-bound” phonology in an Optimality-Theoretic way and “substance-free” phonology in a Minimalist-Theoretic way. Thus, phonology is different from syntax in the former sense but the same as syntax in the latter. This is the crux of our position in this review article, and we will show how this is possible.

We will delve into one suggestive case in particular relating to the Duke-of-York Gambit derivation, with the implication that phonologists should re-examine their methodology so as to accommodate this notorious phenomenon. We will show that accommodation is possible in terms of ‘Turbid Optimality Theory,’ a revised version of Optimality Theory that contains ‘turbidity’ in its conception of output representations and constraints (section 3).

2. The Phonological Enterprise in Biolinguistics

2.1. Samuels’s Reply to Pinker and Jackendoff (2005)

Before entering into the main point of the present article, let us briefly sketch out the research program for phonology Samuels (2011) puts forward, which is explicitly stated in chapter 2, ‘A Minimalist Program in Phonology.’ This directly stems from the Strong Minimalist Thesis proposed by Chomsky (2000) in which language is the optimal solution to linking the Sensory-Motor (S-M) and Conceptual-Intension (C-I) systems, so that, as Chomsky (2008: 136) notes, phonology is “an ancillary process ... doing the best it can to satisfy the problem it faces” in the interfaces of FLB (faculty of language in a broad sense). That is, its task is only “to map to the S-M interface syntactic objects generated by computations that are well-designed to satisfy C-I conditions but unsuited to communicative purposes” (p. 2 in chapter 1, p. 9 in chapter 2, pp. 32–33 in chapter 3). This view on phonology might be messy, but there is an advantage: phonology is “much simpler (in the sense of being less domain-specific) than has previously been thought, making use only of abilities that had already found applications in other cognitive domains at the time externalized language emerged”
(p. 10 in chapter 2, p. 33 in chapter 3), and these abilities in FLB include **Search, Copy** and **Delete**. In fact, chapter 3, ‘Phonology in Evolutionary Perspective,’ pursues this line of research in much detail and shows that phonological abilities are present in the animal kingdom: “a wide range of animal species … group objects, extract patterns from sensory input, and perform sequential objects,” and as chapter 5 discusses, they even “perform searches, engage in copying behaviors, and manipulate sets through concatenation” (pp. 58–59 in chapter 3).

These findings have great implications for the well-known biolinguistic debate over the issues of what is domain-specific and what is species-specific. Samuels’s conclusion is that “what underlies human phonology is a unique combination of abilities, but the individual abilities themselves may be found in many other species” (p. 36 in chapter 3) and that “the operations and representations underlying phonology were exapted, or recruited from other cognitive domains for the purpose of externalizing language” (p. 34 in chapter 3). In other words, “the human phonological system is a domain-general solution to a domain-specific problem, namely the externalization of language” (p. 59 in chapter 3). In this view, no part of phonology is unique to language or humans, or for that matter, is part of FLN (faculty of language in a narrow sense), a virtually consistent claim with Hauser, Chomsky and Fitch (2002) and Fitch, Hauser and Chomsky (2005) whose evolutionary scenario is that “FLN is very small, consisting only of some type of recursion (i.e. Merge) and the mappings from syntax to the C-I and S-M interfaces” (p. 10 in chapter 2, p. 59 in chapter 3). This may be a significant reply to Pinker and Jackendoff’s (2005: 212) (and also Jackendoff and Pinker’s (2005)) criticism against the above scenario, claiming that “major characteristics of phonology are specific to language … [and] uniquely human” and that “phonology constitutes a problematic counterexample.” For Samuels, “phonology may be entirely explainable through properties of general cognition and the Sensory-Motor system” (p. 34 in chapter 3), which are the “Third Factor (general principles of biological/physical design)” (p. 9 in chapter 2 and Chomsky (2005)), and the apparent uniqueness of these properties in human phonology can emerge from their combination.

Then, how is this “combination” possible and what are such “properties”? Substantial applications are elaborated in chapter 4, ‘The Syntax-Phonology Interface,’ for the former question and in chapter 5, ‘Representations and Primitive Operations,’ for the latter question.

As for the species-specific combinatory issue, Samuels proposes a theory
of phonological derivation by phase (PDbP) in which phonology proceeds according to a cyclic derivation regulated by the phase system, by combining the conceptions of Lexical Phonology, Distributed Morphology, and Derivation by Phase. This theory is virtually a “direct-reference” approach to the syntax-phonology interface in line with Kaisse (1985), which excludes from the conceptions any such phonologically-unique categories in the prosodic hierarchy as are said to be derived from syntactic categories, a view totally antagonistic to the “indirect-reference” approach adopted by Selkirk (1986) and many other subsequent phonologists. This exclusion is possible because “morpheme-level phases can replace Lexical phonology’s hierarchy of strata and clause-level phases can replace the prosodic hierarchy” (pp. 3–4 in chapter 1, p. 61 in chapter 4). In short, PDbP offers the domains for the cyclic application of phonological rules.

Now one may wonder what phonological rules apply in such domains and how they do. This is directly related to the “properties of general cognition and the S-M system” (p. 34 in chapter 3) in the FLB interfaces, as mentioned at the beginning of section 2.1: they only include the string-based primitive operations **SEARCH, COPY** and **DELETE**, and their applications do not rely upon the internal organizations of segments and suprasegments as the usual Feature-Geometric and Prosodic-Phonological conceptions do. Instead, Samuels shows that these string-based operations, in tandem with PDbP, combine to produce the necessary typology of phonological processes by invoking analyses such as vowel harmony, reduplication, affixation, and tone spreading.

Of course, “no other single species has all the phonological precursors” seen here, “but each of the building blocks of phonology is found somewhere in the animal kingdom” (p. 34 in chapter 3), as we have seen at the beginning of section 2.1. Thus, there seems to be good reason to claim that Samuels’s theory goes “beyond explanatory adequacy” and that it is well qualified as an “evolutionarily adequate” one.

In addition to offering a smart reply to Pinker and Jackendoff’s (2005) criticism, Samuels’s theory also uncovers a missing link between phonology and syntax: “[the Minimalist Program] has not been applied to phonology” (van Oostendorp and van de Weijer (2005: 3)) while “The Minimalist Program, in Chomsky’s original conception, chooses to ignore … all the phenomena of phonology” (Pinker and Jackendoff (2005: 220)). Her conception no doubt satisfies the demands from the both sides and makes them a happy marriage.
2.2. Substance-Free and Substance-Bound Phonologies

As we have seen so far, Samuels’s picture of phonology is beautifully designed to fit the Strong Minimalist Thesis and may have some evolutionary adequacy in that precursors of its primitive operations are found in primates, songbirds, and other animals. This minimal and evolutionarily adequate approach to phonology will be possible only if the object of study is just synchronic phonology and is “Galilean” in character in the sense of Chomsky (2002: 98), who argues that “it is the abstract systems that you are constructing that are really the truth; the array of phenomena is some distortion of the truth because of too many factors, all sorts of things.” It is also “substance-free” in nature in the sense of Hale and Reiss (2008: 258–259), who argue that “the phonetic substance … that leads to the construction of phonological entities … never directly determines how the phonological entities are treated by the computational system” and 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 language change.” Samuels follows these ideas in assuming that “phonologists must stop the practice of ‘substance abuse,’ or misguidedly mixing the study of phonological forms with the properties of phonetic content” (pp. 11–12 in chapter 2).

Samuels in fact clearly expresses her position by saying that “the object of our analysis is I-language (i.e. UG), not E-language” (p. 14 in chapter 1) and that “markedness, naturalness, ease of production, ease of perception, and other functionalist principles should be eliminated from phonology proper; these are ‘E-language’ phenomena outside of the realm of linguistic competence, and thus not demanding of explanation in the synchronic grammar” (p. 2 in chapter 1). She continues to state that “if the goal of synchronic phonological theory is to characterize the properties of phonological systems, the role of diachrony must be factored out: what is diachronically possible must be separated from what is computationally possible, which is still different from what is learnable” (p. 2 in chapter 1, p. 202 in chapter 7).

From this way of circumscribing the domain of study in phonology, it then follows that there are at least two separate phonologies whose ways of computation are entirely different, that is, UG-based, “substance-free” I-phonology in synchronic grammar, and language-particular, “substance-bound” E-phonology in diachronic, variational, and acquisitional grammar.

Now let us turn back to the issue addressed by Bromberger and Halle (1989) at the beginning of section 1. It is no wonder that phonology was
viewed as different from syntax, because the object of their study was E-phonology and their framework required that the rule system should be learned and diachronically changed on a language-particular basis. Needless to say, Chomskian syntax was and is concerned with a grammar of I-language. But for Samuels, phonology is only a matter of I-language, or the “mapping to the S-M interface syntactic objects generated by computations that are well-designed to satisfy C-I conditions but unsuited to communicative purposes” (p. 2 in chapter 1, p. 9 in chapter 2, pp. 32–33 in chapter 3). In this view, phonology is naturally the same as syntax in that the two domains are based on the same computational system. So in Bromberger and Halle’s (1989: 52) remark that “facts pertaining to the two domains … are of a very different nature and that there is therefore no reason to assume a priori that they must be covered by formally similar theories,” we can now recognize that “the two domains” necessarily mean I-phonology and E-phonology, as well as phonology and syntax.

Then what if the computational system of E-phonology were based on Optimality-Theoretic constraints, instead of derivational rules? Even if so, the situation would still be the same as above, because “substance-bound” E-phonology could be computed in an Optimality-Theoretic way and “substance-free” I-phonology in a Minimalist-Theoretic way. Thus, phonology is different from syntax in the former sense but the same as syntax in the latter.

We can conclude that both theories can be coexistent and stand side by side without any redundancy in the grammar as a whole, because one focuses on E-phonology, i.e. diachronic, variational, and acquisitional grammar, and the other on I-phonology, i.e. synchronic grammar. Their scopes, functions, and thus ways of computation can be completely different from each other, so there will be no problem in light of Ockham’s Razor reasoning. Importantly, our proposal is that phonologists must aim at accounting for both I-phonology and E-phonology. This position may be called “methodological generalism,” and there seem to be mainly three reasons for adopting this line of methodology if we aim at constructing a theory of biolinguistics, in addition to the more biologically-significant reasons to be argued in section 2.3.

The first reason relates to the concept that “the wider, the better” on the condition that “methodological generalism” can avert the greatest amount of redundancy and superfluity. Samuels also seems to partially agree with this condition, saying that “[l]ike all other scientists, we must eliminate redundancy from our theories and adopt the simplest solution possible, ceteris
Regarding the latter point in particular, i.e. simplicity, it may be difficult to define what is meant by the term “simple” at all: it is utterly true that one theory is simpler than two theories, “ceteris paribus,” but two theories can also be simple if each of them has its own scope, function, and way of computation and there is no redundancy or superfluity between them. Evidently, I-phonology and E-phonology are different in any sense. Thus, “ceteris paribus” does not seem to apply at all in this case.

Instead of methodological generalism, Samuels chooses to adopt “methodological minimalism.” Concerning this tenet, she notes that “[t]he point of linguistic Minimalism is not to make the linguist’s calculations more economical (a methodological minimalism); rather, we’re making a bet that the object of our study is simple (an ontological or metaphysical minimalism) … Nevertheless, ontological minimalism demands methodological minimalism” (p. 8 in chapter 2). However, the opposite may well be the case: methodological minimalism has actually forced her to adopt ontological minimalism because of its focus on I-language. In general, the object of study naturally follows from what methodology to adopt, and ontological minimalism does not exist a priori. Furthermore, methodological minimalism, and the consequent ontological minimalism, may often cause the segregation of linguistics from other neighboring fields in life sciences, cognitive sciences, and neurosciences, as has been proved in the history of biolinguistics. If so, methodological generalism would be a better tenet for phonologists, and in section 2.3, we will argue for a biolinguistic model based on methodological generalism that may fully harmonize linguistics with other neighboring fields.

Secondly, as stated in section 2.1, Samuels’s theory indeed may well go “beyond explanatory adequacy” and be qualified as an “evolutionarily adequate” one. However, one should wonder whether it really satisfies explanatory adequacy if its UG-related I-phonology system entirely parts with acquisition, variation, and historical change. This situation is in sharp contrast with the one in syntax, where the computation in the Minimalist Program is widely extended to acquisitional and diachronic/variational grammar. It is true that diachronic/variational grammar involves external factors and may not have much to do with explanatory adequacy, but acquisitional grammar does have much to do with it: explanatory adequacy is ensured when the theory of UG-related I-phonology explains how a child acquires phonology or how s/he comes to have an internal representation of a system of operations that determines well-formed phonological forms. How-
ever, Samuels’s theory still remains to be tested in this regard. In fact, Samuels’s ontological minimalism seems to skip and ignore acquisitional and diachronic/variational phonology. So like syntacticians, it would be better for phonologists to make the phonological theory the workplace for acquisitional and diachronic/variational grammar in a coherent and consistent way. This practice will be achieved if we allow both I-phonology and E-phonology in the general picture, and explanatory adequacy is measured up on the basis of both internal and external factors.

The third reason for adopting methodological generalism has much to do with a proper treatment of markedness. Samuels herself admits the necessity of markedness, saying that “‘substance-free’ also has its limits. That is to say, human physiology bounds the possible modalities in which language can be expressed” (note 3 on p. 12 in chapter 2). And the possible modalities in which language can be expressed and that are bounded by human physiology are nothing but markedness. However, instead of incorporating markedness in phonology, she does “not attempt here to account for the relative markedness of phonological processes, and introduce Evolutionary Phonology (Blevins (2004)) as a theory of diachronic phonology” (p. 6 in chapter 2). This is because “markedness, naturalness, ease of production, ease of perception, and other functionalist principles should be eliminated from phonology proper; these are ‘E-language’ phenomena outside of the realm of linguistic competence, and thus not demanding of explanation in the synchronic grammar” (p. 2 in chapter 1). This choice is reasonable because there can be so many definitions for markedness and that “no matter which sense of the term one uses, markedness always demands rather than provides explanation” (p. 18 in chapter 2). Nevertheless, Samuels admits that “substance-free” has its limits and markedness requires an account in phonology, so “substance-bound” E-phonology should naturally be incorporated into the picture in some way.

Then, why does she choose to adopt Evolutionary Phonology for a theory of E-phonology, instead of Optimality Theory, which is precisely a framework for “markedness, naturalness, ease of production, ease of perception, and other functionalist principles”? One reason is that Optimality Theory builds markedness into a set of universal constraints that are UG-related I-phonology matters and not E-phonology ones. However, this point can be reconciled if we hypothesize that markedness constraints (and their ranking with respect to faithfulness constraints) are acquired in a particular grammar, while only faithfulness constraints are innate and exist in UG. The function of the latter type of constraints is to primarily monitor some identity
between linguistic input and output forms by way of imitation, and thus their precursors may be found in some species of primates and birds with imitating behaviors, which seem to suggest evidence for the existence of mirror neurons, as Rizzolatti and Fadiga (1999) and Akins and Klein (2002) argue. As for humans, also, brain activity consistent with mirror neurons has been found by Molenberghs, Cunnington and Mattingley (2009), and thus mirror neurons may be related to imitation in human behavior and faithfulness in human language.

Moreover, Evolutionary Phonology may be a promising candidate for a theory of E-phonology, but it has been only applied to diachronic phonology and still remains to be tested extensively in acquisition and variation. In contrast, Optimality Theory has widely proved to be valid in acquisition and disorders (Dinnsen and Gierut (2008), Kager, Pater and Zonneveld (2004), and references therein), learnability (Tesar and Smolensky (2000), Tesar (2013), and references therein) and variation (Anttila and Cho (1998), Spenader, Eriksson and Dahl (2003), and references therein) as well as historical change (Holt (2003) and references therein). Thus, it appears to be more suitable within the framework of E-phonology in the general biolinguistic picture.

From a biolinguistic point of view, Pinker and Jackendoff (2005: 212) make the following suggestive remark related to the above conception: “[p]honologists have long noted that many of [the phonological adjustment rules] act to smooth out articulation or enhance discriminability. Since these two requirements are often at cross-purposes …, a fixed set of rules delineating which adjustments are mandated within a speech community may act in service of the ‘parity’ requirement of language.” Optimality Theory offers such a system of phonology since it regards the grammar of a particular language as an optimal solution to the question of how the ranking of markedness requirements that “smooth out articulation” and faithfulness requirements that “enhance discriminability” is “mandated within a speech community.” Under this view, markedness requirements are domain-general E-phonology matters in FLB along with Hauser, Chomsky and Fitch’s (2002) and Samuels’s (2011) Merge-only scenario in FLN while faithfulness requirements are domain-specific I-phonology matters in FLN along with Pinker and Jackendoff’s (2005) criticism, and the grammar of a particular language emerges in E-phonology through the ranking of these constraints as an externalization of language.

To sum up, the general biolinguistic language design we propose here, based on methodological generalism, incorporates both “substance-free” I-
phonology and “substance-bound” E-phonology as essential units of grammar, and the phonologies have different ways of computation, the former in a Minimalist-Theoretic way and the latter in an Optimality-Theoretic way. This methodological generalism results in ontological generalism, which accommodates a wider array of facts to be accounted for in the general biolinguistic language design. We will delve into this biolinguistic language design in more detail in the following section.

2.3. Two Models for Language Evolution

Samuels’s biolinguistic language design, based on the Strong Minimalist Thesis, seems to be something like the duology model in (1a), while the one we adopt is the trilogy model in (1b), which is proposed in Kirby (2002), Kirby and Hurford (2002), and Fitch (2010).

(1) Two Models for Language Evolution

a. Duology model with two “geny”s

Evolution provides prior learning bias

Phylogeny Ontogeny

Mutation effects election

b. Trilogy model with three “geny”s

Evolution provides prior learning bias

Phylogeny Ontogeny Glossogeny

Emergent universals effects election Learning influences language change

In the duology model with the two “geny”s, the phylogeny-ontogeny relation involves the process of how UG and experience (and the “Third Factor”) form a particular grammar, which is Samuels’s main concern, and the
ontogeny-phylogeny relation shows how mutation with the emergence of Merge has made human-specific language survive in the present state, which is categorized as “macro evolution” in human language.

On the other hand, in the trilogy model with the three “geny”s, “glossogeny” is crucially incorporated into the biolinguistic language design. This term is first coined by Hurford (1990) to mean historical linguistic change, which follows from the core fact that language is culturally transmitted. So glossogeny can also be called “cultural evolution” or “micro evolution.” Of course, to incorporate glossogeny into the model exactly means to regard both E-language, as well as I-language, as essential units of grammar.

Specifically, in the trilogy model, the phylogeny-ontogeny relation concerns the process of how UG and faithfulness constraints form a particular grammar, through the externalization of language involving experience (parameter settings and ranking of constraints) and the “Third Factor” (general principles of biological/physical design and markedness constraints). Under the Optimality-Theoretic view, phylogenetically emergent faithfulness constraints and their promotion are recapitulated in the ontogenetic learning process (Tanaka (2012a, b)), while much evidence in the literature (Gnanadesikan (1995/2004) et seq.) has proved that acquisition is nothing but promotion of faithfulness constraints. Next, in the ontogeny-glossogeny relation, copying errors in one generation eventually lead to language change in the next generation, which means that the failure of faithfulness promotion in the learning process directly brings about faithfulness demotion in historical change (Tanaka (2009)). This relation also gains evidence from the observation in which the order of consonant acquisition is recapitulated in the historical changes that underlie Grimm’s Law (Tanaka (2011a, b)). Finally, the glossogeny-phylogeny relation shows the fact that languages with Merge have survived and those without Merge have become extinct, and other arguments for this relation are fully discussed in Keller (1995), Deacon (1997), Kirby (1999), and Kirby, Smith, and Brighton (2004) from the viewpoints of historical linguistics, anthropology, computational modeling, and cognitive science.

Also, it is notable that Fitch (2010), an evolutionary biologist and cognitive scientist and one of the authors of Hauser, Chomsky and Fitch (2002) and Fitch, Hauser and Chomsky (2005), wisely argues that “Both I-language and E-language (external, shared data) exist. ... I-language, and the capacity to acquire it, are the core systems we seek to understand biologically. I, along with many linguists, biologists, and psychologists, agree that I-language is the proper empirical starting point for this investigation. However,
this is no argument against the study of glossogeny. Language change is a fact, and since the advent of writing we have a rich database documenting language change. These may provide further insights into the nature of the language acquisition system. … Both the study of I-language and of historical change can be of value in understanding the biological underpinnings of the instinct to learn language.” (pp. 33–34).

Now from the discussion so far, it may follow that 1) I-phonology, which is the same as syntax, and E-phonology, which is different from syntax, are both essential units of grammar, and that 2) what is computationally possible is separated from what is diachronically possible and learnable (possible in acquisition), and thus that 3) the former computation is implemented in a Minimalist-Theoretic way while the latter computation in an Optimality-Theoretic way. As a consequence, Samuels’s Minimalist approach to phonology is compatible with Optimality-Theoretic phonology.

However, let us take up one suggestive example for discussion in the following section, the Duke-of-York Gambit (DYG) derivation in phonology. This phenomenon is primarily observed in acquisition and historical change. But if this is the case in synchronic grammar as well, then computation in acquisition and historical change may well be partially the same as computation in synchronic grammar, which leaves some significant implications for what we have elaborated so far in the biolinguistic language design.

3. The DYG as ‘Non-Economical’ Operation

3.1. The DYG in Acquisition, Historical Change, and Other Species

The DYG has linguistically attracted attention since Pullum (1976: 83), who defines it as “a linguistic analysis which determines that certain structures are assigned a derivation of the general form $A \rightarrow B \rightarrow A$” and who named it after a historical figure called “Duke of York” lampooned in the following traditional rhyme:

(2) The Duke-of-York Gambit
The Grand Old Duke of York
He had ten thousand men
He marched them up a great high hill
And he marched them down again.

In addition to the $A \rightarrow B \rightarrow A$ derivation Pullum mentions, the derivations of $\phi \rightarrow A \rightarrow \phi$ and $A \rightarrow \phi \rightarrow A$ may well be categorized as the DYG. In any way, Pullum (1976: 83) notes that “[l]inguists very frequently seem to
give evidence of a tacitly held belief that there is similarly something inept and risible” about such an analysis, and there seem to be no actual examples or analyses in syntax that fully support the DYG in its authentic sense, as we will see in section 3.2.

In fact, the DYG seems to have explicitly been excluded in the generative tradition because of its uneconomical nature violated by evaluation metrics. For example, Chomsky and Halle (1968: 63, underlined by ST) state that “it seems reasonable to suppose that the grammar should be selected in such a way as to minimize the amount of ‘computation’ that is necessary, and that ‘length of derivation’ is one factor in determining ‘complexity of computation.’” Halle and Idsardi (1998: 1, underlined by ST) also note that “[d]erivations ..., which have been dubbed by Pullum (1976) the ‘Duke of York gambit,’ have justly been singled out as unacceptable because of the superfluous steps in them.” So the DYG seems to have rarely been dug out in phonology as well, either as unnatural phenomena or linguistic analyses.

However, there is a pitfall in the reasoning of evaluation metrics based on economy. Bakovic (2013: 59, underlined by ST) wisely criticizes this approach, saying that “[t]he assumption behind this argument is that derivational step reduction is somehow desirable, but no solid evidence for the putative desirability of shorter derivations is provided; this assumption is thus unsupported by any kind of empirical evidence and is only weakly supported by unsubstantiated claims about the implementation of competence grammar in performance, claims that in fact conflict with generative grammar’s ideological goal of separating competence from performance.” That is to say, the reasoning of derivation step reduction as it stands is unacceptable due to the lack of empirical evidence for it and the methodological flaw of misguidedly mixing competence with performance.

Thus, it is fair to recognize that Pullum’s (1976: 100) remark that follows will take us back to the right track and remind us of the original resolution: “the strategy of avoiding or of adopting the Duke of York gambit will be reasonable precisely when the result is a reasonable analysis, and unreasonable precisely when it is not.” So let us re-examine the DYG both empirically and methodologically, firstly the DYG in performance, i.e. E-phonology, in this section and secondly the DYG in competence, i.e. I-phonology, in section 3.2.

For the former issue, it might at first appear difficult to find empirical evidence for the DYG in performance or E-phonology, because this is precisely in the domain of economy and efficiency. However, superfluity or redundancy is paradoxically found in E-phonology, as is often the case
with fully superfluous and redundant speech performance in violation of the Gricean Maxim of Quantity. Specifically, the DYG is observed in acquisition and historical change, which are the domains in E-phonology fully susceptible to the minimization of articulatory effort and the maximization of perceptive distinction.

For example, in acquisition, it is generally known that infants develop stop consonants in the order of non-velars first and then velars, while Pater (1997) and Pater and Werle (2001) report the phenomenon called velar harmony in English infants around the age of 1 year and 3–9 months, in the assimilation of non-velars to velars in the domain of a word like dog [gɔg], bug [gʌg], coat [kok], cup [kʌk], tickle [ɡɪ:ɡu:], pickle [ɡɪɡʊ], and so on. This logically means that in the development of stop consonants, infants take the step of non-velars → velars → non-velars at the target position of assimilation. Moreover, infants generally develop obstruents in the order of voiced ones first and then voiceless ones, and around the age of 2 and a half years, Smith (1973, 2010) observes word-final devoicing of English infants as in cobweb [kɔbwɛp], bed [bɛt], card [ɡa:t], big [bɪk], egg [ɛk], and so on, a well-known phenomenon in adult grammar of German and Dutch. Again, this clearly shows the DYG of voiced → voiceless → voiced in the development of word-final obstruents in English.

Also, in diachronic grammar, this type of derivation seems to have empirical evidence. For example, Wells (2011) takes up three cases for the DYG, saying that “Take popular London English. If Dickens is to be believed, London working-class speakers in the nineteenth century tended to confuse v and w: beware of widers! (beware of widows). They certainly don’t now. Historically, w → v → w. Another well-known, nay stereotypical, Cockney feature is h-dropping. Remarkably, current London yoof … generally don’t drop h. So, in the appropriate lexical contexts, h → ɸ → h. Londoners have diphthong shift, no? That is, the PRICE vowel has shifted in popular London speech from ʌt to something in the area of ɑɪ, ər? And the FACE vowel has gone from eɪ to ɑɪ, ɛɪ? Not any more. Paul Kerswill, Sue Fox and associates have shown that in inner-London Multicultural London English (blog, 2 July 2010) PRICE has reverted to ɑɪ and FACE to eɪ (or even eː). So we have ɑɪ → ɒɪ → ɑɪ and eɪ → æɹ → eɹ.” (underlines by ST).

Thus, our conclusion is that the DYG is empirically tested in performance-level E-phonology, or in acquisitional and diachronic grammar. Looking back at the trilogy model of the biolinguistic language design in (1b), we must admit that the DYG is attested in ontogeny and glossog-
eny. Furthermore, this seemingly costly, wasteful, and aimless process is also found in the natural world of animals both ontogenetically and phylogenetically. For example, in ontogeny, frogs experience a process of $\phi \rightarrow {\text{tails}} \rightarrow \phi$ in their development of embryos, tadpoles, and adults, while salamanders are subject to a process of $\phi \rightarrow {\text{external gills}} \rightarrow \phi$ in their development of embryos, fetuses, and adults. The appearance and disappearance of tails and external gills are conditioned by the so-called mechanism of apoptosis. Similar processes are also found phylogenetically: snakes may be an example of $\phi \rightarrow {\text{limbs}} \rightarrow \phi$ in the evolution of fish, amphibians, and reptiles, while frogs and salamanders may have experienced a process of $\text{lungs} \rightarrow {\text{air bladders}} \rightarrow \text{lungs}$ in the evolution of dipnoans, fish, and amphibians. Also, for that matter, all obsolete or extinct species that were unique in history may be considered as cases for the DYG $\phi \rightarrow \text{species} \rightarrow \phi$, just like the non-avian dinosaurs found in the Mesozoic era and the weird and bizarre creatures enclosed in the Mid-Cambrian Burgess Shale. All of these ontogenetic and phylogenetic examples show the way the DYG goes in natural history.

3.2. The DYG in Synchronic Phonology

If the DYG is observed as a natural process of ontogeny and phylogeny in life forms and of ontogeny (acquisition) and glossogeny (historical change) in human language, then it may not be so odd that it is observed in the phylogeny of human language as well. For example, what if Pirahã had actually lost Merge in the evolutionary process, as shown in (3)? Here, we consider Merge as recursion, and this language has often been taken up as “a language without Merge?” since Everett (2005, 2012). In fact, as Schuessler (2012) interestingly remarks, “[o]ne of the arguments is that he’s stealing something from the indigenous people to become famous. … In a sense what Dr. Everett has taken from the Pirahã isn’t gold or rare medicinal plants but recursion, a property of language that allows speakers to embed phrases within phrases.”

(3) Merge in the Ontogeny-Glossogeny-Phylogeny Relation

Suppose that humans originally did not have Merge in the ancient times of “primitive language” but that some mutation caused Merge in an indi-
vidual and its descendants in the ontogeny-glossogeny relation, so that there emerged a mixing state of languages with Merge (i.e. ⌋) and those without it (i.e. ⊗). In terms of the struggle of survival, the former languages are evidently more adaptive than the latter ones, because they make possible a higher level of inner thought and mutual communication, and hence only the languages with Merge survived and were selected in the glossogeny-phylogeny relation. This was the advent of “authentic language” which had Merge universally, but Pirahã somehow lost this in later history. Note here that for Pirahã, the whole process exactly means the DYG of φ → Merge → φ.

This is just speculation, and there is of course the possibility that Pirahã originally did not have any intermediate stage of Merge in its evolution. However, it may also be true that Pirahã originally did have it. So if the above speculative story is true, it will be a case for the DYG in the phylogeny of human language. In fact, the DYG seems to be observed in the phylogeny-ontogeny relation, that is, competence-level I-phonology or synchronic grammar, as we will see below. If such evidence is empirically valid, phonologists should necessarily re-examine their methodology.

For example, in non-rhotic dialects of English, the derivation of r → φ → r is observed in examples like here [ɪə] and here [ɪər] is, where the coda r is deleted by r-deletion lexically but is recovered by r-insertion in a postlexical intervocalic environment (McCarthy (1993), Halle and Idsardi (1997), McCarthy (1999), etc.). The DYG in synchronic grammar is also reported in Polish (Rubach (2006)) and Lardil (Kavitskaya and Staroverov (2010)), but let us take up here a very clear case of English that is discussed in Tanaka (2013), a derivation that involve CiV-lengthening and i-shortening (see Chomsky and Halle (1968), Halle and Mohanan (1985), and Rubach (1984, 1996) for details of the rules, although they are not discussed with respect to the DYG there).

As is clear from the examples in (4a, b), each of the rules has strong motivation for lengthening and shortening before the environment of CiV, depending on the quality of the vowel concerned.

(4) Motivations for CiV-lengthening, i-shortening, and the DYG

a. V → V: / _CiV
   Iranian / Iranian      colony / colonial      study / studious
b. /ai/ → [i] / _CiV
   crocodile / crocodilian divide / division    vice / vicious
c. /i/ → [ai] → [i] / _CiV
   family / familiar    Darwin / Darwinian      office / official
Therefore, the examples in (4c) necessarily force us to assume an analysis in which they are derived in the process of the DYG, i.e. \([i] \rightarrow [ai] \rightarrow [i]\), as shown in (5).

(5) The DYG

| UR    | /krɔkədail+ɪən/ | /ɪən+ɪən/ | /fæmɪliər/ |
|-------|----------------|-----------|------------|
| CiV-lengthening | - | irɛ̃in̴ɪən | fəmɪlɪər |
| i-shortening  | krɔkədilɪən | - | fəmɪlɪər |
| SR     | krɔkədilɪən | irɛ̃in̴ɪən | fəmɪlɪər |

Suppose a putative analysis in which English grammar did not have \(i\)-shortening but only CiV-lengthening, with the proviso that it somehow did not apply to the cases in (4c). If so, then there would be no DYG in the derivation. However, such a grammar could not account for the shortening in (4b), of course. Another DYG-less analysis would be that the suffixes in (4a) actually contain the string CyV that triggers CyV-lengthening, but the ones in (4b, c) match up to the environment CiV that does not trigger CyV-lengthening but causes \(i\)-shortening before CiV. However, there would be no independent evidence for such a strained distinction between the suffixes in (4a) and the ones in (4b, c).

In any case, as pointed out at the beginning of section 3.1, derivational theory has evaluation metrics that must rule out the DYG as full of superfluity and redundancy, as assumed by Chomsky and Halle (1968) and Halle and Idsardi (1998), but there appears to be compelling evidence for DYG derivations as in (5). In other words, under a global view, the DYG might appear uneconomical; under a local view, however, each of the two processes in the DYG is productive and has its own independent motivation. Thus, derivational theory will necessarily be caught in a dilemma.

This is just a very simple case, and there are more crucial cases for the DYG. McCarthy (2003) carefully and wisely redefines the DYG and claims that Pullum’s (1976) cited original examples are not the authentic ones. For that matter, neither are the examples noted by McCarthy (1993), Rubach (2006), and Kavitskaya and Staroverov (2010) mentioned above. The DYG derivations are actually divided into “vacuous (apparent)” and “feeding (authentic)” cases (McCarthy (2003: 24)), and according to his redefinition in (6), even the apparently convincing examples in (5) will be categorized as (6a).
(6) Refinement of the DYG

a. The Vacuous (Apparent) DYG

UR \[/\overline{CAD}/\]

\[\begin{array}{ll}
*\text{AD} \rightarrow \text{BD} & \text{CB} \text{D} \quad \text{ZBD} \\
*\text{CB} \rightarrow \text{CA} & \text{CAD} \quad - \\
\text{SR} & \text{CAD} \quad \text{ZBD} \quad \text{CAW}
\end{array}\]

b. The Feeding (Authentic) DYG

UR \[/\overline{CAD}/\]

\[\begin{array}{ll}
*\text{AD} \rightarrow \text{BD} & \text{CB} \text{D} \\
*\text{CB} \rightarrow \text{EB} & \text{EBD} \\
*\text{BD} \rightarrow \text{AD} & \text{EAD}
\end{array}\]

The vacuous instances are cases where rules \(*\text{AD} \rightarrow \text{BD}\) and \(*\text{CB} \rightarrow \text{CA}\), which are independently motivated to derive \(\text{ZBD}\) from \(/\overline{ZAD}/\) and \(\text{CAW}\) from \(/\overline{CBW}/\), respectively, simply lead to the change of \(A \rightarrow B\). However, the authentic instances in (6b) are precisely cases where the intermediate \(B\) triggers or feeds another rule \(*\text{CB} \rightarrow \text{EB}\) but is finally lost by a later rule. So on the surface, there is no reason why \(E\) appears out of nothing, exactly because the output \(\text{EAD}\) does not contain any environment for the rule \(*\text{CB} \rightarrow \text{EB}\). Regarding the authentic cases, McCarthy (2003: 25) further remarks that “feeding DY derivations have scarcely ever been reported in the literature, and Pullum cites no actual examples. ... The conclusion I reach is that, in general, feeding DY derivations do not exist. This typological result demands an explanation.”

Tanaka (2013) reports two cases for authentic feeding DYG derivations in English. Let us take up one of them here, which involves \(s\)-voicing at the intermediate stage between \(\text{CiV}\)-lengthening and \(i\)-shortening. Crucial examples are the ones in (7b).

(7) Motivations for \(s\)-voicing and the feeding DYG

a. \(/s/ \rightarrow [z] / \text{V: V}

\text{precise / precision} \quad \text{Caucasian / Caucasia}n \quad \text{fantasy / fantasia}

b. \(/i/ \rightarrow [ai] \rightarrow [i] / \text{CiV}

\text{Paris / Parisan} \quad \text{Tunis / Tunisia} \quad \text{Artemis / Artemisia}

Note here that the examples in (7b) not only need DYG derivations such as the ones in (5) but also the intermediate long vowels in them crucially trigger \(s\)-voicing and then are lost, which are exactly authentic DYG derivations where \(\text{CiV}\)-lengthening feeds \(s\)-voicing. This process is explicitly shown in (8) (for the surface opaque overapplication of \(s\)-voicing in \text{precision} and \text{Parisan}, see below and Tanaka (2013)).
(8) The Feeding DYG

UR  /kɔːkæs+ɪən/ /prɪsæs+ɪən/ /pærɪs+ɪən/
CiV-lengthening  kɔːkæsɪən  →  prɪsæsɪən
s-voicing  kɔːkæzɪən  prɪsæzɪən  pəræzɪən
i-shortening  →  prɪsɪən  pərɪzɪən
SR  kɔːkæzɪən  prɪsɪən  pərɪzɪən

One may wonder if the stressed i in Parisian would be just phonetically long and hence trigger s-voicing; however, the “phonetically long” (but phonologically short) stressed i does not trigger s-voicing, unless it is followed by the CiV string, as is clear from (9a). Only a phonologically long vowel can trigger this.

(9) Evidence for µ → µµ → µ
   a. No s-voicing before non-CiV
      Lisa [s] elicit [s] Parisian [s] → [z] precision [s] → [z]
   b. No ə-insertion after the short i
      Irian [i] Syria [i] Algeria [iː] → [iːə] serious [iː] → [iːə]

A phonologically long vowel on the surface, in turn, can trigger ə-insertion before r, i.e. ə → ə / ə / ə, like the examples in (9b); however, the stressed i in Irian and Syria, the same vowel in Parisian, never triggers ə-insertion, which means that it must be phonologically short on the surface. It must be the case then that the stressed i in Parisian is phonologically long before the CiV environment at the intermediate stage but is phonologically short in surface form, even though it may be phonetically long.

So far, so good. The DYG in both vacuous and feeding cases seems to have some empirical evidence. Then, what is the methodology that accommodates this? The cases above are no doubt seen in synchronic phonology, but Samuels’s account of I-phonology based on the S-M interfaces does not seem to be effective because of the uneconomical nature of the phenomenon and the limited viability of her proposed operations. Neither does classic Optimality Theory, which excludes any intermediate stage between input and output forms, as can be seen in (10).
(10) Classic Optimality Theory
   a. The Vacuous DYG in the *familiar*-type forms

| Input   | Output       | *I:CiV | *VCiV | Faith-μ |
|---------|--------------|--------|-------|---------|
| /krɔkədiːl+ɪən/ | krɔkədailɪən | ⬤       | ⬤     |         |
|         | krɔkədiliən  |         |       | ⬤ ⬤     |
| /ɪən+ɪən/   | ɪəniən     |         |       | ⬤ ⬤     |
|         | ɪəniən      |         |       | ⬤       |
| /fəmili+ər/ | ʃəmiliər  | ⬤       |       | ⬤       |

b. The Feeding DYG in the *Parisian*-type forms

| Input   | Output      | *V:sV | *I:CiV | *VCiV | Faith-μ | Indent [ voi ] |
|---------|-------------|-------|--------|-------|---------|---------------|
| /kɔːkæziən/ | kɔːkæziən  | ⬤     | ⬤     |       | ⬤       |               |
|          | kɔːkæziən  | ⬤     | ⬤     |       | ⬤       |               |
|          | kɔːkæziən  | ⬤     |       | ⬤     | ⬤       |               |
|          | kɔːkæziən  |       | ⬤     | ⬤     | ⬤       |               |
| /prɪsəziən/ | prɪsəziən | ⬤     | ⬤     |       | ⬤       |               |
|          | prɪsəziən  | ⬤     |       | ⬤     | ⬤       |               |
|          | prɪsəziən  | ⬤     |       | ⬤     | ⬤       |               |
|          | prɪsəziən  |       | ⬤     | ⬤     | ⬤       |               |
| /pərɪz+ɪən/ | ʃərɪziən  | ⬤     |       |       | ⬤       |               |
|          | ʃərɪziən   | ⬤     |       |       | ⬤       |               |
|          | ʃərɪziən   | ⬤     |       |       | ⬤       |               |
|          | ʃərɪziən   |       | ⬤     | ⬤     | ⬤       |               |

It is true that by this account, the correct output form [ʃəmiliər] is assured in the vacuous DYG (10a), but this does not actually constitute a case for the DYG because there is no intermediate stage included in the input-output correspondence. Crucial is the feeding DYG (10b), where the desired output [ʃərɪziən] is harmonically bounded by the unwanted one *[pərɪziən] that would wrongfully become optimal. The same is true for the wanted output [prɪsəziən], which is harmonically bounded by the erroneously optimal *[prɪsəziən], although this is a non-DYG case. But what is common among the two unpredictable cases in classic Optimality Theory is that they concern opacity: both [ʃərɪziən] and [prɪsəziən] involve the overapplication of s-
voicing. Needless to say, opacity can never be accounted for without using “potential intermediate representations,” and it is no exaggeration to say that the history of Optimality Theory to date, in a sense, has been a variety of repeated trials to somehow devise “potential intermediate representations,” in order to account for opacity and break away from its “classic” state.

Among the various strategies proposed in the literature, we will adopt here Turbid Optimality Theory, which is the most appropriate for the DYG and will be discussed in the following section.

3.3. Turbid Optimality Theory

Turbid Optimality Theory, developed by Tanaka (2014a–d), is a general framework for transparent and opaque grammar, whose spirit of output-oriented representations is inherited from Containment Theory by Prince and Smolensky (1993/2004) and Goldrick (2001). What is new about Turbid Optimality Theory is the claim that constraints are categorized into the three types given in (11), based on the sensitivity of the output representations. The three types of sensitivities stand in the entailment relation in (12) by definition.

(11) New Proposal: Turbidity-Sensitive Constraints (cf. Tanaka (2014a–d))

a. X-Sensitive Con = constraints that are sensitive to an element X present in both the input and output (i.e., filled with underlying structure and parsed into surface structure).

b. X̄-Sensitive Con = constraints that are sensitive to an element X and an element X̄ absent in the input but emergent in the output (i.e., not filled with underlying structure).

c. <X>-Sensitive Con = constraints that are sensitive to an element X, an element X̄, and an element <X> present in the input but lost in the output (i.e., not parsed into surface structure).

(12) Entailment Relation for Sensitivity

a. X-Sensitive = sensitive to X only

b. X̄-Sensitive = sensitive to both X and X̄

c. <X>-Sensitive = sensitive to any of X, X̄, and <X>

Given these constraints, opaque cases (underapplication and overapplication) as well as a transparent one are neatly captured by the ranking schemata in (13).
(13) Ranking Schemata for Transparency and Opacity (Tanaka (2014a–d))

a. Transparency
   Both X and $\overline{X}$ work because they are present in the output.
   \[ \rightarrow \text{X-Sensitive Con, } \overline{X}\text{-Sensitive Con} \gg \text{Faith} \]

b. Opacity: underapplication
   X works, but $\overline{X}$ does not even though it is present in the output.
   \[ \rightarrow \text{X-Sensitive Con} \gg \text{Faith} \gg \overline{X}\text{-Sensitive Con} \]

c. Opacity: overapplication
   X works, and so does $<X>$ even though it is not present in the output.
   \[ \rightarrow \text{X-Sensitive Con, } <X>-\text{Sensitive Con} \gg \text{Faith} \]

In each case, the term “to work” means “to trigger a certain process.”
First, in a transparent case, both X-Sensitive and $\overline{X}$-Sensitive Cons are ranked above Faith because “visible” elements, either underlying or derived, must work. Second, underapplication is a phenomenon in which an element $\overline{X}$ emergent in the output behaves as if it were not present there and does not trigger any process even if the environment matches it, so the relevant $\overline{X}$-Sensitive Con is ranked below Faith (see Tanaka (2014c) for specific examples). Conversely, overapplication is a phenomenon where an element $<X>$ lost in the output behaves as if it were present there and does trigger a process if the environment matches it, so the relevant $<X>$-Sensitive Con outranks Faith. Crucial is the ranking schema in (13c) for the explanation of the DYG cases above, since they concern some overapplication.

Let us examine first the vacuous DYG in the familiar-type forms from the viewpoint of Turbid Optimality Theory. Note in (14) that the optimal output exhibits the mora structure of $<\mu>$, which represents the DYG derivation of $\phi \rightarrow \mu \rightarrow \phi$.

(14) The Vacuous DYG in the familiar-type forms

| Input          | Output         | *I: CiV | *VCiV | Faith-µ   |
|----------------|----------------|---------|-------|-----------|
| /fəməli+ər/    | fəməliər Vµ<µ> | *!      | ✓     | **        |
|                | fəmaɪlər Vµ[µ] | *!      | ✓     |           |
|                | fəmaɪlər Vµ[µ] | *!      | ✓     |           |

A crucial fact is that the optimal [fəməliər] with the mora structure of $Vµ<µ>$, which apparently contains only a short vowel in the output, does not violate the *VCiV constraint. This is because *VCiV is a $<X>$-Sensi-
tive Con and \(<\mu>\) is visible to it. On the other hand, this \(<\mu>\) is invisible to \(*I:CiV\), which is a transparent \(X\)-Sensitive Con, and that is why this constraint only bans \([\text{fəməlɪər}]\) with the mora structure of \(V\mu\mu\).

Incidentally, the ranking of \(*VCIv >> \text{Faith}\) should cause an effect of overapplication, as defined in (13c), but the \(\text{familiar}\)-type forms might at first appear to show a case for underapplication of \(CiV\)-lengthening, as compared with the \(\text{Iranian}\) type in (4a). However, this mystery stems from the complex and illusory nature of the DYG, and logically, (13c) is true. It is clear that the vowel of \([\text{fəməlɪər}]\) with the mora structure of \(V\mu<\mu>\) is treated as long by the constraint \(*VCIv\), although the short \(i\) usually does not undergo \(CiV\)-lengthening. So the above example actually exhibits a case for overapplication of \(CiV\)-lengthening. In fact, the overapplication effect in (13c) is clearer in the case of \(s\)-voicing below, where the invisible mora \(<\mu>\) triggers it.

In either way, Turbid Optimality Theory accommodates the DYG derivations where \(<A>\) and \(<\bar{A}>\) represent \(\phi \rightarrow A \rightarrow \phi\) and \(A \rightarrow \phi \rightarrow A\), respectively. The former also serves to account for the feeding DYG in the \(\text{Parisian}\)-type forms, as well as for the \(\text{precision}\)-type forms. Both types show overapplication of \(s\)-voicing, and of \(CiV\)-lengthening in the sense we just mentioned above.

(15) The Feeding DYG in the \(\text{Parisian}\)-type forms

| Input   | Output   | *s-Voice | *I:CiV | *VCIv | Faith-\(\mu\) | Fill |
|---------|----------|----------|--------|--------|---------------|------|
| /prɪsɪəzɪən/ | prɪsɪəzɪən  \(V\mu\mu\) | *!       | *!     |        |               |      |
|         | prɪsaɪzɪən  \(V\mu\mu\) | *!       |        | *     |               |      |
|         | prɪsɪəzɪən  \(V\mu<\mu>\) | *!       |        |        |               |      |
|         | prɪsɪəzɪən  \(V\mu<\mu>\) | √         | √     | * | *     |      |
| /pərɪsɪəzɪən/ | pərɪsɪəzɪən  \(V\mu\mu\) |        |        | *!     |               |      |
|         | pərɪsɪəzɪən  \(V\mu<\mu>\) | √         | √     | * | ** | *     |
|         | pərɪsɪəzɪən  \(V\mu\mu\) | *!       | *!     |        |               |      |
|         | pərɪsɪəzɪən  \(V\mu\mu\) | *!       |        | *     |               |      |

What is crucial here is that \(s\)-Voice is a \(<X>\)-Sensitive Con and the mora structures of \(<\mu>\) and \(<\mu>\) are visible to it; hence, this constraint demands \(s\)-voicing before any of \(V\mu\mu\), \(V\mu<\mu>\), and \(V\mu<\mu>\), and even before \(V\mu<\mu>\), making \([\text{prɪsɪəzɪən}]\) and \([\text{pərɪzɪəzɪən}]\) optimal, even though their surface vowels might appear to be short. This is how overapplication emerges and the authentic DYG holds true.
To sum up, our discussion so far will leave some significant implications for the theory of biolinguistics. First, if the DYG has empirical evidence in acquisitional and diachronic grammar just like ontogeny and phylogeny in the natural world as seen in section 3.1, then it follows as expected that the computation in phonology may be different from that in syntax and in what Samuels’s theory covers about phonology. This is quite natural because the former concerns “substance-bound” E-phonology and the latter “substance-free” I-phonology. Second, if the DYG has empirical evidence in synchronic grammar as well, which was discussed in section 3.2, then it follows that the computation in acquisitional and diachronic phonology may be partially the same as that in synchronic phonology and that phonologists should re-examine their methodology so as to accommodate this notorious phenomenon. And finally, if such an apparently uneconomical process as the DYG is methodologically incompatible with Samuels’s theory and with classic Optimality Theory, then at present it would better be approached in Turbid Optimality Theory.

Considering the ambitious and exciting nature of the phonological enterprise in biolinguistics, it is now clear that we should respect and adopt “methodological generalism” in section 2, which claims that both I-phonology and E-phonology must be essential units of grammar in the trilogy model. And if the phonological enterprise in biolinguistics is ambitious and exciting at all, then “methodological generalism” should also accommodate such apparently uneconomical processes as the DYG that can stand empirical examination and testing. This article has shown that one such method is Turbid Optimality Theory.

4. Conclusion

To put aside the methodology of how the DYG is accounted for, if the DYG may have empirical evidence in acquisitional, diachronic, and synchronic grammar, then we are inclined to go back again to the question of “Why Phonology is Different” raised by Bromberger and Halle (1989), in a somewhat different sense from the question we discussed concerning I-phonology and E-phonology. Bromberger and Halle’s critical point of departure was the presence of “ordered processes” and “intermediate stages” in phonology, as emphasized with the underlines. And the DYG, which must involve “ordered processes” and “intermediate stages,” is the last derivational residue in the framework of Optimality Theory that does not assume either. So the evidence for the DYG invites us again to question
the issue, and this important question of Bromberger and Halle’s will repeat its appearance and disappearance in linguistic theory as ever, just like such ‘uneconomical’ processes as the DYG. So is the conception of Optimality Theory: the original containment-based theory that was replaced by correspondence, only to return again to the original state with turbidity.

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