

# REPRESENTATION VS DERIVATION: THE CASE FOR A MODULAR VIEW OF PHONOLOGY<sup>1</sup>

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**Abstract.** Plurilinear representations and constraint-based derivation have been the main tools used in the last 40 years by autosegmental approaches and OT respectively. It is argued here that the border between representation and derivation depends on another key division in phonological theory: in phonology proper, there are no such things as processes involving feature propagation or delinking; only by virtue of morphophonological alternations, that is of phonology/morphosyntax interaction, may an object be said to change into another one. Thus, representational theories better describe core phonology, seen as an autonomous module of grammar, while constraint-based models are necessary to deal with computation associated with phonology's upper interfaces.

**Keywords:** Phonological representation, phonological derivation, morphophonological alternation, modular grammar.

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## 1 THE DUAL LEGACY OF *SPE*

### 1.1 FROM RULES TO CONFIGURATIONS

It is instructive to look back upon the last forty years of research in phonology. The crisis caused by Chomsky & Halle's (1968) book (henceforth *SPE*) came to a provisional end in the mid-seventies, when Goldsmith (1976) introduced a break whose effects are felt to this day and are commonly labeled under the term "autosegmental phonology". It was, according to Encrevé (1988:146), the most "spectacular innovation" in the history of phonological representations since the invention of the alphabet. From then on, it has no longer been possible to view words as mere sequences of letter-like tokens: phonologists have come to the conclusion that a distinction has to be made between the phonemes of a morpheme and the positions they occupy, that the phoneme has an internal structure, and that representations are based on how melodies and positions are synchronized, features behaving much in the same manner as only tones were previously supposed to do.

While the number of possible phonological operations has been drastically reduced to two (spreading and delinking), this milestone naturally made representations much more complex – and possibly more abstract as well: for example, there is nothing more abstract than a pure timing slot. It should be noted that abstraction is not, in itself, a reason for criticism or rejection. A theory should not be dismissed because it is too abstract; it should, however, if it is *arbitrary*. Arbitrariness was precisely the "serious flaw" of their own proposal that Chomsky & Halle emphasized in the last chapter of their book: rules are arbitrary as they are not able to distinguish a commonplace phenomenon from one that is unlikely or even impossible. By contrast, within autosegmental approaches, processes are supposed to be *motivated* if they obey a small number of principles, i.e. well-formedness conditions, imposed to autosegmental configurations (OCP, No Line-crossing, etc.), contrary to other processes which are therefore said to be ungrammatical. Thus, autosegmen-

talism, whose main representative is currently Government phonology, appeared to certain scholars (see, e.g., Encrevé 1988, Kaye *et al.* 1990, Goldsmith 1993) as a project where, thanks to representational devices, the expressive power of *SPE*-type computation could be both restricted and motivated. In particular, the serial nature of early generative phonology was hardly tolerable for many people in the 1980s, and was eventually abandoned in (classic) Optimality theory.

## 1.2 FROM RULES TO CONSTRAINTS

It is also instructive to compare the contribution of autosegmental phonology with the second great break in our field, which dates back to Prince & Smolensky (1993), and is now mainstream: Optimality theory (OT). As is well-known, three main points characterize this approach in relation to the *SPE* original framework:

- (1) a. Violable constraints, which, unlike *SPE* rules, are supposed to be universal, only their ranking (or weight) being language-specific.
- b. Dialectic tension between markedness and faithfulness constraints, the former applying to the surface representations (SR), and the latter to the relation between SRs and underlying representations (UR); in *SPE* faithfulness effects were obtained by default, through the absence (or underapplication) of rules.
- c. Parallel derivation, which replaces *SPE* serialism (at least in the classic version of OT).

With respect to representations, Prince & Smolensky argued that their model builds on Autosegmental Phonology. Freedom of Analysis, the first of the three principles underlying the theory of GEN, stipulates that “any amount of structure may be posited”: “GEN may supply candidates with syllabic, moraic, or other prosodic structure, with association lines, and with additional segmental material, ranging from empty root nodes through fully specified vowels or consonants.” McCarthy & Prince (1993: §2.3)

The comparison between autosegmental and OT accounts is extremely interesting as it provides two different ways of answering the following question: what should a rule-free phonology be like? So as to get rid of serial rules, the autosegmental approach focuses on the structure of *representations*, OT, by assessing candidate outputs partly against their inputs, explicitly focuses on *derivation*, i.e. on processes whereby an object is changed into another one. The question then arises: should we try to overcome this opposition by unifying the two theories? Assessing the respective roles of representation and computation is, as Anderson (1985) had already sensed, one of the most challenging epistemological problems that emerge from the phonology of these last forty years.

### 1.3 IS UNIFICATION POSSIBLE?

To begin with, is this unification desirable? I think it is, because the two approaches show major and specific drawbacks. Both involve the same flaw: some kind of circularity.

On the representational side, Government phonology is unable to provide a straightforward account of variation.<sup>2</sup> Variability is assumed to follow from parameters associated to the principles mentioned above. Yet, parameter settings through licensing relations look like ad hoc stipulations: consider, for example, the variable behaviour of word-final empty nuclei from language to language according to whether they can or cannot dispense licensing (Charette 1991:132-142). In contrast to this “legalist” approach (Boltanski 1999:153), the same markedness constraints can be said to be differently ordered cross-linguistically in OT according to their ranking vis-à-vis faithfulness constraints; in other words, unlike parameter settings, the ranking of markedness constraints has an *extrinsic* motivation. More generally, recent developments of OT have led to the most interesting

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<sup>2</sup> Most proponents of GP may argue that variation is extra-phonological and therefore should not be accounted for within a theory of phonology. I have a different stance: grammars generally model one arbitrarily chosen variety of a language; since the same speakers always employ more than one variety, at least a certain type of variation should be viewed as an integral part of grammar. At any rate, the line between phonology and variation is not of the same nature as those between phonology and morphology or between phonology and phonetics; there is no sociolinguistic module.

formal accounts of free variation since Labov's times (see e.g. Boersma 1997; Anttila 1997, 2007; Hayes 2000; Hayes & Wilson 2008).

As to OT, markedness constraints can also be said to be ad hoc, as they generally lack formal motivation.<sup>3</sup> For example, why are CV syllables unmarked *vis-à-vis* CVC (with one additional element) and V (with one element less)? ONSET and NOCODA simply record typological and acquisitional evidence; they do not explain anything. By contrast, Strict CV allows a unified account of CVCv and cV markedness, assuming that empty positions (v, c) are marked.

There are several cases of theoretical competition and eventual unification in the history of science. Physics offers at least three different examples. The first and the simplest one is when a new and more global approach annexes an earlier and “narrower” theory, the latter becoming a particular case of the former. This is the case of general relativity and classical mechanics. I do not think that this applies to the phonological frameworks at stake: neither of them can be shown to be more global than the other.

The second example is when two competing theories account for different empirical domains. This is the case of the theory of relativity *versus* quantum theory. Here a real unification should occur (and is still expected), both theories becoming particular cases of a third more global one. This case does not seem more relevant than the former, since the domains of configurational and constraint-based approaches largely overlap.

The third example may be the most appropriate for our purpose. Until the twenties of the last century, certain natural phenomena – light for example – seemed to exhibit a mysterious dualism: some data supported the view that they had a corpuscular nature, and that a particle should therefore be sought; other data pointed towards a wave theory. This

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<sup>3</sup> For most phonologists working in the OT framework, formal motivation might be unnecessary as markedness constraints are supposed to be “phonetically grounded” (see Archangeli & Pulleyblank 1994, Hayes & Steriade 2004, Bermúdez-Otero & Börjars 2006, de Lacy 2006, Kingston 2007). However, not only is this groundedness problematic in many cases, but phonologists are far away from a consensus on the relationship between phonology and phonetic substance (see, e.g., Iosad 2017 and Reiss 2017).

continued until Louis de Broglie succeeded in explaining that light was *simultaneously* a particle and a wave, according to the “perspective”: one is the other’s limit. I have long forgotten what de Broglie’s perspectives are, but I think there might be a similar way to answer the question that arises from the dual nature of phonology: if representation and derivation are both part of our field, *where should we draw the line between them?* Interestingly, the response I will argue for squares with repeated claims for the autonomy of phonology in relation to upper modules (see in particular Scheer 2011).

## 2 BACK TO BASICS

### 2.1 THE DUAL NATURE OF RULES

Let us remember the scope of *SPE* rules. They are a legacy of structural phonology, and, as such, they are dependent on its two main historical trends: Prague School and American structuralism. Due to the former source, rules should affect phonemes that are strictly defined through distributional analysis. For example, as shown in (2a), Spanish has three nasal phonemes – a labial /m/, a coronal /n/ and a palatal /ɲ/ – that contrast in onset position, while, as shown in (2b), only an underspecified nasal can occur in coda position – an “archiphoneme”, whose place feature is imposed by the following onset, if any.

(2) Trubetzkoy's "(archi)phonemes"

a. Spanish /m/ ~ /n/ ~ /ɲ/

['kama] “bed”	['kana] “rattan, stick”	['kaɲa] “reed”
[so'mar] “to sum”	[so'nar] “to sound”	[so'ɲar] “to dream”

b. Spanish /N/ = {nasal}

['kampo] “countryside”	['kanto] “I sing”	['baŋko] “bank”
['aɲfo] “large”	['pan/ŋ] “bread”	['bjen/ŋ] “well, asset”

It follows that Spanish will be said to have the “allophonic rule” in (3).

- (3) a. Sp. /N/ → [m, n, ɲ, ŋ] / \_LAB, COR, PAL, VEL  
 b. Sp. /N/ → [n/ŋ] (according to the variety) / \_#

However, in accordance with a tradition that dates back to Bloomfield (1933), the input of *SPE* rules is not only based on distribution; it can also follow from morphophonological alternations. Consider the data from Somali in (4). Distributional evidence would have led to posit /la:N, siN, da:N, sa:N/ in the singular and definite forms for the same reasons as in Spanish: no place contrast is allowed in coda. Yet, as this would make the plural form unpredictable, the /m/ ~ /n/ contrast is assumed to exist in all positions underlyingly.

- (4) (Neo-)Bloomfieldian "morpho-phonemes"

	<i>singular</i>	<i>definite</i>	<i>plural</i>	
a. Somali /m/	[la:n] [sin]	[la:nta] [sinta]	[la:mo] [simo]	“branch” “hip”
b. Somali /n/	[da:n] [sa:n]	[da:nta] [sa:nta]	[da:no] [sa:no]	“shore” “hiding place”

Thus, the allophonic rule yielding homorganicity no longer affects one archiphoneme as in (3), but two specified nasal phonemes, in particular /m/ which, as shown in (5), undergoes a real change by losing its labial feature before coronals and word-finally.<sup>4</sup>

- (5) Som. /m/ → [n] / \_COR, #

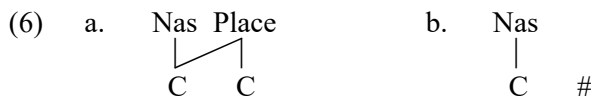
The rules in (3) and (5) differ considerably due to the motivation of their inputs. As said above, (3a,b) are dictated by distributional analysis, while (5) is supposed to account

<sup>4</sup> Conversely, /n/, putatively unmarked as to place, is supposed to acquire [Labial] before labials (although I could not find examples from the scarce literature on Somali phonology).

for the *morphological* knowledge of speakers: the plural of [la:n] is [la:mo], not \*[la:no]; therefore, its [n] is not a “real” /n/ but an /m/ that changes into [n]. Despite that difference, due to Chomsky & Halle's denial of an intermediate phonemic level, (3) and (5) have long been assumed to be formally identical instances of phonological derivation, whereby an object is converted into another one. Does this hypothesis hold? It might be the case that the difference between (3) and (5) dispenses with the need for derivation in one of the two examples. We should thus ask if derivation is necessary in both cases.

## 2.2 DERIVATION IS A MORPHOSYNTACTIC EFFECT

Is the derivation in (3a) necessary? I contend that it is not. The concept /N/ follows from the classic view of phonemic representations where features do not overlap (hence /N+p/). However, strict linearity at the underlying level – causing place spreading at the phonetic level (hence [mp]) – results from unidimensionality. The autosegmental approach does not require feature spreading or delinking in such cases: Spanish homorganic NC clusters should simply be viewed as underlying geminates, in which linearity (i.e. the sequence Nasal+place features) is expressed *in the melodic tier*, as shown in (6a). No one has ever claimed that lexical geminates or long vowels result from spreading.<sup>5</sup>



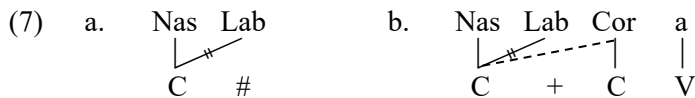
As to (3b), this rule involves no phonological change either, as no feature is added nor deleted: [n] (or [ŋ]) is the unmarked realization of the archiphoneme /N/ in (6b). Derivation only occurs by virtue of morpheme adjunction in Spanish, where cross-morpheme NCs behave like their Somali cognates, with the underspecified coda receiving the place

<sup>5</sup> The same holds, say, for languages where front vowels palatalize consonants beyond what is expected universally (i.e. at Bermúdez-Otero & Trousdale's (2012) “phonologisation” level): the I-element is underlyingly associated with two positions as well. Likewise, vowel harmony simply requires many-to-one association, as in (6a); only affixation allows us to refer to derivation, as in Turkish /ip-uun/ → [ipin] ‘rope-gen.’, /ip-lar/ → [ipler] ‘rope-pl.’



feature of the following onset: *Jua*[n] but *Jua*[ŋ] *Carlos*, *do*[n] *Antonio* but *do*[m] *Pedro*.

Let us now consider the case of Somali. Like Spanish, it has homorganic NC clusters, with the nasal coda lacking a place feature of its own, including intramorphemic ones from which no alternation can be subsumed: see Gabbard (2010: 33). However, unlike Spanish, Somali *has* the rule in (5). This is because (i) as in Sp. *Jua*[ŋ] *Carlos*, *morphemic information* (the suffix /-ta/ but also the boundary #) is introduced; (ii) the two languages have the same (nasal) phonology *but different lexicons*: Somali, unlike Spanish, has radicals ending with /m/, hence the derivation in (7a) for [(la:)n], where the feature [Labial] is deleted, and the one in (7b) for [(la:)nta], where [Labial] is replaced with [Coronal].



Spanish may be said to have roots ending with any nasal consonant (e.g. *cam-a* 'bed', *man-o* 'hand', *cañ-a* 'rod'), but these consonants, except [n], are never found word-finally because the Spanish lexicon stores stems with theme vowels, not roots with inflectional class features (Bermúdez-Otero 2013). As a result, there are no m-n alternations parallel to Somali [(la:mo)-[(la:n)]. The only exceptions come from a ridiculously small number of loanwords like *álbum* or *islam*. These might be pronounced with a final [n] in low varieties. However, even the existence of a couple of alternations like [(islámiko)-[(islán)] or [(álbumes)-[(álbun)] supporting an underlying /m/ in such styles is highly dubious given the erudite nature of the adjective and the rarity of the plural form.<sup>6</sup>

In sum, the facts discussed above suggest the following answer to the question asked in §1.3 about the border between representation and derivation:

<sup>6</sup> In any case, if the reader wants an example of a language where these alternations are totally absent, I suggest Japanese, which has homorganic NC clusters, but whose nasal coda never alternates with [m] before morpheme-initial vowel.

- (8) a. There is no derivation in morpheme-internal phonology: the phonological processes of a language do not apply to items belonging to the same morpheme.
- b. Only when it comes to morphophonological alternations – due to affix concatenation or to sandhi – may derivation emerge, lexicon permitting.<sup>7</sup>

### 3 WHAT IS MEANT HERE

Before concluding, four points are worth noting to make clear what my proposal is and what it is not. First, as the reader may have understood, the divide I suggest between morpheme-internal phonology and its interfaces does not parallel the one between the so-called “lexical” and “post-lexical” levels posited by Lexical phonology and its heirs, nor can one object that the same work is done twice, once by phonology, a second time by phonology’s upper interfaces since Spanish and Somali share the same (nasal) phonology. What is at stake here is not a matter of levels but of perspectives (cf. §1.3). The rules (3) and (5) can be viewed as different instances of the same phenomenon seen from different angles: both imply underspecified nasal codas; unlike (5), however, (3) is not a derivational process insofar as it neither adds nor deletes any phonological feature, low level phenomena remaining outside phonology, like all morpheme-internal processes.

Secondly, the assumed difference between (3) and (5) does not fit in with the eternal debate regarding the trade-off between the lexicon and computation in phonology – see thereon the recent discussion by Vaux & Samuels (2018): is it preferable to have a more complicated lexicon or a more complicated computation? My purpose is not to play down the importance of computation as a matter of principle. I simply aim to suggest a reason

<sup>7</sup> Note that non-derivational alternatives to alternation-based rules have long been proposed: e.g. the “via-rules” of Natural Generative Phonology (Hooper 1976), whereby (5) could be replaced with a correspondence between /m/ and the archiphoneme /N/. For my part, I think that both views are potential options: /la:m/ (and the resulting derivation) should entail word-final [m] before vowel *even in sandhi contexts*, while /la:N/, with a lexicalized archiphoneme (= (6a)), precludes [m] in sandhi – as in Somali (Barillot, p. c.). As an example of the latter case, Korean *lenis* /p, t.../, aspirated /p<sup>h</sup>, t<sup>h</sup>.../ and *fortis* /p\*, t\*.../ consonants merge word-finally into voiceless plosives ([p<sup>ʔ</sup>, t<sup>ʔ</sup>...]) that undergo the same voicing process in sandhi before word-initial vowels as the word-internal unmarked *lenis* between vowels. Despite regular allomorphic alternations with marked phonemes, these final plosives can thus be argued to be underlyingly archiphonemes that have lost all connection with their historical sources.

for the division of labour between the two facets of phonology, and I contend that the unique trigger of phonological computation is morpheme concatenation; hence, computation operates in the phonology-morphosyntax interface, since phonology, on its own, does not concatenate such items. Nonetheless, the claim “same phonology but different lexicon” departs from OT, where there are no lexical differences, and everything is put into the grammar to a point that the examples above would be explained in a quite paradoxical manner. It is the simplest case, Spanish, the one with place neutralization in coda position and no morphophonological alternations, that would require the most complex treatment, where the principles of Richness of the Base and Lexicon Optimization must be considered for banning specified /m, n/ inputs in coda position. I have argued instead for a strong version of Consistency of Exponence in the morpheme-internal situation, and only in this case, where “no changes in the exponence of a phonologically-specified morpheme are permitted” (McCarthy & Prince 1993: §2.3) simply because the output is fully faithful to the input in the lexicon.

Thirdly, the proposed division between morpheme-internal phonology and its interfaces does not coincide with the distinction between non-derived and derived environments (Kiparsky 1993) either, for two reasons. On the one hand, derived environments may be due to morphology (affix adjunction), as in my approach, but also to phonology, with new material being the result of another phonological process (which is typically the case with opacity effects).<sup>8</sup> On the other hand, in Non-derived Environment Blocking, rules apply in one case and do not in the other, hence producing different and (apparently) contradictory outputs. However, there is no such conflict in our Somali example: both environments attest homorganicity, which is lexical in one case, and derived in the other.

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<sup>8</sup> Morpheme-internal opacity effects pose an interesting challenge to the claim defended in this paper. However, as it is part of the general problem caused by opacity (and by the issue of whether derivation requires a serial approach), this topic will be left for further discussion.

Lastly, it should be emphasized that even though the terms “computation” and “derivation” have been employed here as synonyms, the former may be assigned a much broader meaning than the latter. I have used computation/derivation in a particular sense, referring to processes that convert a phonological string into a different one, by manipulating (i.e. adding or deleting) equally phonological objects like features. However, morpheme-internal homorganic NC sequences do not come out of the blue. On the one hand, representations are subject to well-formedness principles (No Line-crossing, OCP, etc.) and implicational markedness scales. On the other hand, languages can make different choices: German, for example, has lexical *non*-homorganic NC clusters, as in *Hemd* “shirt”. At this level, thus, homorganic and non-homorganic NC sequences can be said to compete against each other in the lexicon, which requires some kind of computation, since the same phonetic string, say [nt], can result either from /mt/ or from a (6a)-like underlying geminate depending on the language.<sup>9</sup> Nonetheless, such computation is not derivation; it is a lexicalization process whereby “L1 learners or adults transform the acoustic signal into a stored representation” (Scheer forth.), that is a cognitive category. Interestingly, computation, albeit non-derivational, appears once again to be associated with another interface, in this case between phonetics and phonology.

## CONCLUSION

I hope that the idea expressed in this article may contribute to the ongoing discussions about the work sharing between representational and computational approaches to our field. If I am right, the dual legacy of *SPE* should not be seen as contradictory: representations and derivation actually do partly complementary jobs. Representational approaches account for the internal workings of the phonological module, and might help

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<sup>9</sup> That is from entirely different representations, /mt/ implying an empty nucleus in between the consonants (see Carvalho 2017).

to motivate the markedness constraints required by phonological computation. Constraint-based approaches are required by the latter, that is by derivation which emerges when phonology interacts with other modules such as morphology, syntax, and the lexicon. Thereby, the respective roles of representation and derivation strongly support modularist theories of grammar, and the autonomy of the phonological module.

## REFERENCES

- Anderson, Stephen R. (1985) *Phonology in the twentieth century: theories of rules and theories of representations*. Chicago: University of Chicago Press.
- Anttila, Arto (1997) *Variation in Finnish phonology and morphology*. Ph.D. diss., Stanford University.
- Anttila, Arto (2007) ‘Variation and optimality’, in P. de Lacy (ed.), *The Cambridge Handbook of Phonology*. Cambridge: CUP, pp. 519-536.
- Archangeli, Diana & Pulleyblank, Douglas (1994) *Grounded phonology*. Cambridge, MA: The MIT Press.
- Bermúdez-Otero, Ricardo (2013) ‘The Spanish lexicon stores stems with theme vowels, not roots with inflectional class features’, *Probus*, 25, pp. 3–103.
- Bermúdez-Otero, Ricardo & Börjars, Kersti (2006) ‘Markedness in phonology and in syntax: the problem of grounding’, in P. Honeybone & R. Bermúdez-Otero (eds), *Linguistic knowledge: perspectives from phonology and from syntax*. *Lingua*, 116 (4), pp. 710–756.
- Bermúdez-Otero, Ricardo & Trousdale, Graeme (2012) ‘Cycles and continua: On unidirectionality and gradualness in language change’, in T. Nevalainen & E. C. Traugott (eds), *The Oxford handbook of the history of English*. New York: OUP, pp. 691–720.
- Bloomfield, Leonard (1933) *Language*. New York: Henry Holt.
- Boersma, Paul (1997) ‘How we learn variation, optionality, and probability’, in *Proceedings of the Institute of Phonetic Sciences of the Univ. of Amsterdam*, 21, pp. 43–58.

- Boltanski, Jean-Elie (1999) *Nouvelles directions en phonologie*. Paris: Presses Universitaires de France.
- Carvalho, Joaquim Brandão de (2017) 'Deriving sonority from the structure, not the other way round: A Strict CV approach to consonant clusters', *The Linguistic Review*, 34, pp. 589-614.
- Charette, Monik (1991) *Conditions on phonological government*. Cambridge: CUP.
- Chomsky, Noam & Halle, Morris (1968) *The sound pattern of English*. New York: Harper & Row.
- de Lacy, Paul (2006) *Markedness: Reduction and preservation in phonology*. Cambridge: CUP.
- Encrevé, Pierre (1988) *La liaison avec et sans enchaînement: phonologie tridimensionnelle et usages du français*. Paris: Seuil.
- Gabbard, Kevin M. (2010) *A phonological analysis of Somali and the guttural consonants*. BA Linguistics Honors Thesis, The Ohio State University.
- Goldsmith, John A. (1976) 'An overview of autosegmental phonology', *Linguistic analysis*, 2, pp. 23–68.
- Goldsmith, John A. (ed.) (1993) *The last phonological rule: reflections on constraints and derivations*. Chicago: University of Chicago Press.
- Hayes, Bruce (2000) 'Gradient well-formedness in optimality theory', in J. Dekkers, F. van der Leeuw & J. van de Weijer (eds), *Optimality Theory: Phonology, Syntax, and Acquisition*. Oxford: OUP, pp. 88–120.
- Hayes, Bruce & Steriade, Donca (2004) 'The phonetic bases of phonological markedness', in B. Hayes, R. Kirchner & D. Steriade (eds), *Phonetically Based Phonology*. Cambridge: CUP, pp. 1–33.
- Hayes, Bruce & Wilson, Colin (2008) 'A maximum entropy model of phonotactics and phonotactic learning', *Linguistic Inquiry*, 39, pp. 379–440.

- Hooper, Joan B. (1976) *An introduction to natural generative phonology*. New York: Academic Press.
- Iosad, Pavel (2017) *A substance-free framework for phonology: An analysis of the Breton dialect of Bothoa*. Edinburgh: EUP.
- Kaye, Jonathan, Lowenstamm, Jean & Vergnaud, Jean-Roger (1990) 'Constituent structure and government in phonology', *Phonology*, 7, 193–231.
- Kingston, John (2007) 'The phonetics-phonology interface', in P. de Lacy (ed.), *The Cambridge handbook of phonology*. Cambridge: CUP, pp. 401–434.
- Kiparsky, Paul (1993) 'Blocking in Non-derived environments', in S. Hargus & E. Kaisse (eds), *Phonetics and Phonology 4: Studies in Lexical Phonology*. San Diego: Academic Press, pp. 277–313.
- McCarthy, John J. & Prince, Alan (2001 [1993]) 'Prosodic morphology: Constraint Interaction and Satisfaction'. *Linguistics Department Faculty Publication Series*, 14.
- Prince, Alan & Smolensky, Paul (2004 [1993]) *Optimality Theory: Constraint interaction in generative grammar*. Malden, MA, and Oxford, UK: Blackwell.
- Reiss, Charles (2017) 'Substance-free phonology', in S. J. Hannahs & A. R. K. Bosch (eds), *The Routledge handbook of phonological theory*. Oxford: Routledge, pp. 425–452.
- Scheer, Tobias (2011) *A guide to morphosyntax-phonology interface theories: How extra-phonological information is treated in phonology since Trubetzkoy's Grenzsignale*. Berlin: Mouton de Gruyter.
- Scheer, Tobias (forth.) '3xPhonology', unpublished ms.
- Vaux, Bert & Samuels, Bridget (2018) 'Abstract Underlying Representations in Prosodic Structure', in D. Brentari & J. Lee (eds), *Shaping phonology*. Chicago: University of Chicago Press, pp. 146–181.