

Intermodular Argumentation and the Word-Spell-Out-Mystery

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1. Intermodular Argumentation and Its Conditions

This contribution calls attention to the intermodular potential of the interactionist architecture that multiple spell-out (Uriagereka 1999) and derivation by phase (Chomsky 2000, 2001 *et seq.*) have introduced. The shipping back and forth of pieces between (morpho-)syntax and the PF/LF interfaces during the derivation of a sentence establishes a pipe between the concatenative and the interpretational devices that did not exist in GB or earlier versions of the inverted T-/Y-architecture. It creates a situation where syntactic theories and analyses may have direct consequences on the phonological side, and vice versa.

I submit that *intermodular argumentation* provides stronger evidence than what can be produced by modular-internal reasoning: it offers the maximal degree of independent assessment that linguists can expect without leaving their discipline. Be it only for that reason, the new interactionist architecture that the minimalist orientation has installed is a good thing to have: after a long period of quasi-silence, syntacticians and phonologists can talk again about things not concerning the weather or job openings. This is one goal of the paper, which will be briefly illustrated by two case studies where syntax can be argued to act as a referee for competing phonological theories (the PIC and the phase edge).

The other goal is to make the conditions of intermodular argumentation explicit: what it can do, want it cannot do, and what it can do only if this or that question is settled beforehand. As far as I can see, much of the intermodular refereeing potential unfortunately hinges on a question that is subject to much ongoing debate: whether morphology is just the lower part of syntax, or whether it is a computational system in its own right that builds hierarchical structure which is distinct from syntactic structure. Depending on this question is the number of spell-out mechanisms that exist in grammar, which, as we will see, is critical for the comparison of phonological and syntactic effects of cyclic spell-out. That is, if it turns out that morphology and syntax are two distinct computational systems, it could be argued with some right that each system comes with its own spell-out mechanism. Note, however, that this is not a necessary conclusion: two distinct structures may as well be 'harvested' by the same mechanism. On the other hand, in case morphology and syntax are found to be emanations of one and the same computational system, there is of course no room for two distinct spell-out mechanisms.

The reason why the number of spell-out mechanisms matters is a massive empirical asymmetry that has been encoded in phonological theories of the interface without, however, having been made explicit as such. I call this phenomenon the *word-spell-out-mystery* which — in a nutshell — is about the absence of phonological effects of the cyclic spell-out of words and larger chunks (against the plethora of phonological traces of the cyclic spell-out of morphemes). There is no good reason for this asymmetry: nobody doubts that spell-out itself is cyclic — whatever the size of the chunks in question. Why, then, should an interpretational system (phonology) be sometimes impacted by the cyclic (wave-)structure of what it receives, but at other times simply ignore it? The null hypothesis is certainly that cyclic chunk-submission will leave traces in whatever (system) is exposed to its piecemeal fire. On this count, sub-word phonology is normal, but word phonology is weird.

We start out with three examples of what intermodular argumentation can look like, before, alas, discovering that this argumentation hinges on a number of conditions that involve a major question of linguistic theory which is unlikely to be settled before some time to come (whether morphology and syntax are one or two computational systems), and precisely the empirical validity of the word-spell-out-mystery mentioned (which might turn out to be no mystery at all). The reader will have to fight through a number of additional issues down a decision tree where every 'yes' opens space

for additional questions (be prepared for three levels in the tree). Unfortunately, indecision will be greater at the end of this chapter than after a couple of pages.¹

2. Intermodular Argumentation

2.1. Interactionism, selective spell-out and the PIC have a phonological ancestor

The minimalist focus on the interface has afforded a radical change in generative interface architecture. Since the 1960s (Chomsky 1965:15ff.), the inverted T-model stands unchallenged (the generative semantics interlude lain aside): a concatenative device (morpho-syntax) feeds two interpretative devices (PF and LF). This architecture was supplemented with a proviso which requires that all concatenation be done before any interpretation. That is, the morpho-syntactic derivation is completed, and the result (S-structure) is then sent to PF and LF in one go.

An alternative view of the communication between morpho-syntax and LF/PF was formulated in phonology in the early 1980s: the backbone of Lexical Phonology (Pesetsky 1979, Kiparsky 1982), so-called *interactionism*, holds that concatenation and interpretation are intertwined. That is, first some pieces are merged, the result is interpreted, then some more pieces are concatenated, the result is again interpreted, and so on.

While GB-syntax of that time hardly produced any echo, generative orthodoxy in phonology reacted on this violation of "all concatenation before all interpretation": Halle & Vergnaud (1987) proposed a non-interactionist version of Lexical Phonology that restores the interface landscape of SPE to a large extent. Halle & Vergnaud (1987) also promote a new idea: selective spell-out. Since cyclic derivation was introduced by Chomsky *et al.* (1956:75) and formalized in Chomsky & Halle (1968:15ff.), interpretation was held to run through the bracketed string (that is inherited from S-structure) from inside out; (roughly²) every morpheme break defined a cycle. Halle & Vergnaud dispense with this definition of what an interpretational unit is: they propose to grant cyclic status only to a subset of morpho-syntactic divisions. That is, some nodes trigger interpretation, others do not.³

The reader will have understood that selective spell-out is exactly what modern (syntactic) Phase Theory is about: in more familiar terminology, nodes may or may not be phase heads, hence their material may or may not be an interpretational unit. As far as I can see, the phonological heritage is left unmentioned in the syntactic literature since derivation by phase was introduced by Uriagereka (1999) and Chomsky (2000, 2001 *et seq.*).

This is also true for interactionism: Uriagereka's multiple spell-out and Chomsky's derivation by phase make the generative interface architecture interactionist, exactly along the lines that Lexical Phonology had laid out: first you do some concatenation, then some interpretation, then some more concatenation etc. For (extra-linguistic) reasons of computational economy regarding the limited availability of active memory, a costly cognitive resource (e.g. Chomsky 2000:101, 2001:15), modern Phase Theory applies the interactionist world view. Here again, the phonological origin of the idea has gone unnoticed as far as I can see (let alone the anti-interactionist reaction of generative orthodoxy in the 1980s).

On the pages below we will also come across a question that is closely related to selective spell-out and interactionism: critical for current syntactic Phase Theory is a device which guarantees that

¹ The present article is a piece of Scheer (forthcoming), and includes (sections 2 and 3) most of the material of two other papers that originate in this book (Scheer, in press a,b).

² In actual fact, SPE holds that all morphemic and syntactic divisions are cycles, except for sequences of morphemes that belong to the same major category, which belong to the same cycle (hence [[[theatr]_N ic + al]_A i + ty]_N, Chomsky & Halle 1968:88f.).

³ An important question is how to decide whether a given node is spelled out or not. The phonological take of Halle & Vergnaud (and all other phonologists who practise selective spell-out) is that this depends on a lexical property of the piece (the affix) that is merged. In Halle & Vergnaud's terminology, there are cyclic (interpretation-triggering) and non-cyclic (interpretation-neutral) affixes. Under the header of phasehood, this is also an important question discussed in current syntactic Phase Theory (more on this in section 3.3). Unlike in phonology where phasehood depends on a lexical property of affixes, the syntactic take is that it depends on the label of nodes (which of course is also a projection of a lexical property, but in a different sense): I call the two options node-driven vs. piece-driven phase (the contrast is further discussed in Scheer, forthcoming, in press b).

previously interpreted strings do not burden further computation — in Chomsky's terms, strings that are returned from interpretation are 'frozen' and 'forgotten' when concatenation resumes. No look-back devices are around in generative theory since Chomsky's (1973) Conditions on Transformations, and their offspring — until its recent revival in the coat of the Phase Impenetrability Condition (PIC) — was essentially phonological (e.g. Mascaró's 1976 and Kiparsky's 1982 Strict Cycle Condition). No look-back devices are designed in order to prevent computation to consider 'old' strings. Depending on their precise formulation, however, they may have very different empirical effects, which correspond to the thing that the analyst wants the computation to be unable to do. We will see in section 3.2.2 that here again, Chomsky's PIC has a phonological precedent: unlike all other no look-back devices that the literature has accumulated since 1973, Kaye's (1992, 1995) mechanism inhibits the modification of previously interpreted strings — which are thus 'frozen'.

2.2. A syntactic referee for phonological theories

In contrast to GB, where the completed morpho-syntactic derivation was merely dumped into PF (and LF) with a "good bye and don't come back", Phase Theory establishes a two-way pipe between the morpho-syntactic and the phonological (and semantic) modules. Actors on both ends are not free anymore to do what they want: their theories and analyses may make predictions on the other end. The intermodular potential of Phase Theory, however, has not received much attention thus far. Syntacticians use Phase Impenetrability for syntax-internal purposes, and Phase Theory evolves at high speed without taking into account what happens when the parcel spends time on the phonological side. On the other hand, phonologists have barely acknowledged the existence of Phase Theory, let alone taken into account the predictions that it makes on the phonological side.

Below I first expose three intermodular arguments that I have made elsewhere: in each case, the existence of a device in current syntactic theory is taken to evaluate competing phonological theories according to whether they provide for this device or not. That is, since derivation by phase is based on selective spell-out, the PIC and the phase edge, phonological effects of cyclic spell-out must also feature these devices. Phonological theories that require all nodes to be spelled out, where no look-back devices don't play a role, or which do not spell out the sister of the phase head (cf. the phase edge), do not qualify (Scheer, in press a,b).

Once this is completed, I step back in order look at the conditions that need to be met for intermodular arguments to bite. The baseline is the fact that the chunks which are designated by the spell-out mechanism for interpretation must be the same on the syntactic side and on the PF/LF side. This presupposes that we have the same spell-out mechanism — something that seems to go without saying, but which deserves a second thought. This second thought is induced by the word-spell-out-mystery, which will be introduced.

3. How Syntax Can Referee Phonological Theories

3.1. Morpheme-specific phonologies (two engines) and non-selective spell-out

Let us now look at three cases where phonological theories may be evaluated by syntactic theory. The arguments that are reviewed in this section are originally made in Scheer (in press a,b). All concern phonological theories of affix class-based phenomena. We therefore start by introducing relevant evidence, as well as analyses thereof that the phonological literature has produced over the past 30 years. Both have been extensively discussed in the literature since the 1980s; I therefore only introduce aspects that are critical for the demonstration.

Affix classes are best studied in English (see Booij 2000:297 for a literature overview regarding other languages). Their existence was identified in SPE (Chomsky & Halle 1968:84ff.); since then, the basic diagnostic for class membership is the behaviour of affixes with respect to stress: they may be stress-shifting (class 1) or stress-neutral (class 2). While the former roughly correspond to the Romance stock of lexical material (e.g. *-ity*, *-ic*, *-ion*, *-ary*, *-al_{adj}*), the latter typically are of Germanic origin (e.g. *-ness*, *-less*, *-hood*, *-ship*, *-ful*). Relevant overview literature includes, Giegerich (1999), McMahon (2000), and Bermúdez-Otero (forthcoming).

For example, a root such as *párent* appears with regular penultimate stress when it occurs in

isolation; adding the stress-shifting affix *-al* produces *parént-al*, while the stress-neutral item *-hood* yields *párent-hood*. Another way of looking at these facts is that both *párent* and *parént-al* bear transparent penultimate stress, while *párent-hood* illustrates an opaque non-penultimate pattern where stress behaves as if the suffix were not there. In other words, stress has been reassigned when *-al* was added (stress-shifting), but reassignment was blocked upon the merger of *-hood*. The task for the analyst is thus to organize underapplication of the stress rule, which must somehow be prevented from reapplying to strings that are headed by class 2 affixes.

The table in (1) shows the solution that is proposed by Lexical Phonology.

(1) *párent* - *parént-al* vs. *párent-hood* in Lexical Phonology

		parent	parént-al	párent-hood
lexicon		parent	parent	parent
level 1	concatenation	—	parent-al	—
	stress assignment	párent	parént-al	párent
level 2	concatenation	—	—	párent-hood
	rule application	—	—	—

The spine of Lexical Phonology is its stratal architecture: the lexicon contains underived roots, all class 1 affixes are concatenated at stratum 1 (level 1), while class 2 affixes join in at stratum 2 (level 2). After the concatenation is complete at each stratum, a stratum-specific phonology applies to the string as it stands. Rules are assigned to specific strata: in our example, the stress-assigning rule is a level 1 rule, which means that it is active at level 1, but absent from level 2. Another ground rule is that the derivation is strictly serial: given the order lexicon → level 1 → level 2, strings that are present at some level must run through all subsequent levels on their way to the surface. This means that they experience the computation that these levels.

Under (1), then, /parent/ in isolation receives stress at level 1, where stress assignment is active. This is also true for /parent-al/, since *-al* has been concatenated in time. Stress assignment to /parent-hood/, however, concerns only /parent/ since *-hood* has not yet joined in. After its concatenation at level 2, stress does not move, since the stress rule is absent from this stratum. Note that this is critical: otherwise **parént-hood* would be produced.

Underapplication of stress assignment at level 2 is thus achieved by the split of phonological computation into two morpheme-specific mini-grammars: one that assesses class 1 strings (where the stress rule is present), another that takes care of class 2 strings (where the stress rule is absent). The set of rules that applies at level 1 is thus necessarily distinct from the set of rules that applies at level 2 — both phonologies specifically apply to a certain class of morphemes.

Morpheme-specific phonologies have been carried over from serial Lexical Phonology into the constraint-based environment of OT, where the two-engine approach falls into two varieties — serial and parallel. On the one hand, Stratal OT (Kiparsky 2000, Bermúdez-Otero, forthcoming) and DOT (Rubach 1997 *et seq.*) faithfully continue the stratal architecture of Lexical Phonology: strata are serially ordered, and any string that was present at stratum *n*–1 must run through stratum *n* and all subsequent strata. In OT, differences among mini-grammars (the two engines) are expressed by means of different rankings of the same universal constraint set. Morpheme-specific phonologies therefore incarnate as different constraint rankings. That is, constraints are re-ranked between strata.

The alternative implementation of the two engine-approach is parallel: class 1-strings are assessed by two distinct computational systems X and Y; the former applies to class 1, the latter to class 2-strings. In contrast to the serial solution, however, class 1-strings never meet class 2-computation, and vice versa: nothing is serially ordered, and hence strings that are headed by a class-specific affix do not run through other 'strata' (there are no strata in this approach) on their way to the surface. There are two competing representatives of this solution, co-phonologies (e.g. Inkelas 1998) and indexed constraints (e.g. Pater 2000).

Further details would lead too far afield. It suffices here to bear in mind that all versions of Lexical Phonology, past and present, share two essential properties: (i) phonology is made of two distinct computational systems and (ii) spell-out is non-selective. The latter is a consequence of the former:

interpretation occurs upon every concatenation of an affix, only is the string sent to distinct mini-phonologies according to its morphological properties.⁴

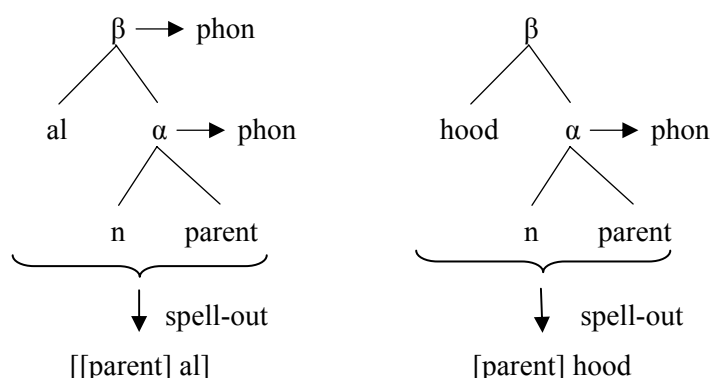
3.2. Selective spell-out and only one computational system (one engine)

3.2.1. Halle & Vergnaud (1987): Selective spell-out

Halle & Vergnaud (1987) have introduced an alternative that works with only one computational system.⁵ The heart of their mechanism is selective spell-out. The idea has already been introduced in section 1: only some nodes of the morpho-syntactic tree trigger spell-out. Whether or not a node dominates an interpretational unit (i.e., is a phase head or not) is decided by its head: affixes are lexically specified for being interpretation-triggering (cyclic affixes in Halle & Vergnaud's terms) or interpretation-neutral (non-cyclic). This property is then inherited by the node that they project, and the spell-out mechanism does or does not send nodes to PF/LF according to this property.

Under (2)a below, β triggers spell-out because it is projected by the class 1 affix *-al*; by contrast under (2)b, the stress-neutral class 2 affix *-hood* does not provoke the interpretation of its node.

- (2) Halle & Vergnaud (1987): analysis of affix class-based stress
 a. *parént-al* b. *párent-hood*



An additional proviso is that all roots are interpretational units by themselves (Halle & Vergnaud 1987:78). This is integrated into (2) by the fact that the root node α is always spelled out. The difference between *parént-al* and *párent-hood*, then, is one of cyclic structure: in addition to the root, the former is subject to interpretation as a whole, while the latter is not. The input that enters phonology is thus */[[parent] al]/* vs. */[parent] hood/*.⁶ Penultimate stress assignment then applies to each cycle: while the derivation ends for the latter item when *[párent]* has received stress (there is no further cycle), it reapplies to *[párent al]*; that is, stress is shifted to the right, and the result is *parént-al* vs. *párent-hood* (*[parent]* in isolation of course comes out as *párent*).

This analysis achieves underapplication by selective spell-out: class 2 affixes do not trigger interpretation, which prevents the stress rule from reappling. Two more ingredients, however, make

⁴ It was mentioned earlier that the classical take of Lexical Phonology is to spell-out only when two successive morphemes belong to different affix classes ("at the end of every stratum"), rather than at every morpheme break. This option is reminiscent of SPE (see note 2) and empirically indistinguishable from a situation where literally every boundary triggers interpretation (which is what some versions of Lexical Phonology actually practise).

⁵ Halle & Vergnaud (1987) is a book about stress, not about the interface. The interface theory that it contains has only really emerged in subsequent work: Halle *et al.* (1991), Halle & Kenstowicz (1991), and Odden (1993). Modern offspring includes Halle & Matushansky (2006) and Halle & Nevins (forthcoming). I use Halle & Vergnaud (1987) in order to refer to the entire line of thought in recognition of the fact that this book appears to be the first source in print (except a 1986 unpublished manuscript of Halle's which to date I was unable to hunt down).

⁶ Recall that Halle & Vergnaud are anti-interactionist, i.e. need to complete the morpho-syntactic derivation before the full string, augmented with cycle-defining brackets, is sent to PF for interpretation.

crucial contributions to the result: it was already mentioned that roots are always spelled out by themselves — this is nothing that selective spell-out enforces per se. Also, class 1, rather than class 2 affixes, are interpretation-triggering — this choice is not determined by any property of the theory either.

In sum, then, Halle & Vergnaud achieve the same affix class-based effect as Lexical Phonology (and modern incarnations thereof), but without recurring to morpheme-specific phonologies: there is only one computational system that assesses all strings.⁷

3.2.2. *Kaye (1995): A different implementation of selective spell-out*

Kaye (1992, 1995) adopts selective spell-out and, like Halle & Vergnaud, rejects morpheme-specific phonologies. The implementation of selective spell-out, however, is significantly different given the 'secondary' choices that Kaye makes. A comparison appears under (3) below.⁸

(3) differences between Halle & Vergnaud (1987) and Kaye (1995)

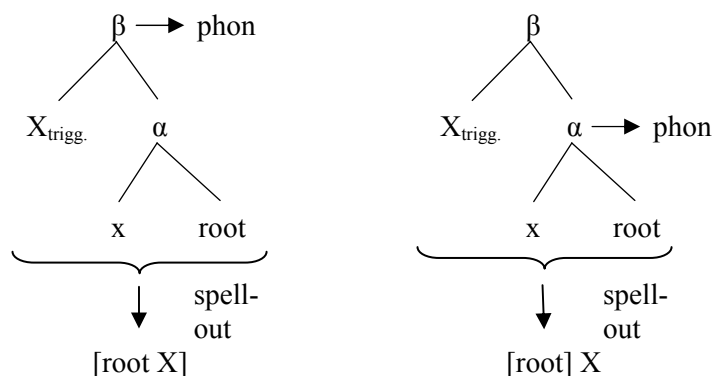
	Halle & Vergnaud	Kaye
a. the root is an interpretational unit	yes	no
b. the word is an interpretational unit	no	yes
c. interpretation-triggering affixes trigger the spell-out of	their own node	their sister
d. type of English affix-classes that triggers interpretation	class 1	class 2
e. underapplication is achieved by	cycles	cycles and no look-back

Unlike in Halle & Vergnaud's approach, the root is not an interpretational unit (i.e. a cycle) per se in Kaye's system. By contrast, the word is always an interpretational unit (while, recall, it is not with Halle & Vergnaud: /[parent] hood/). A third contrast is that in Kaye's system, it is class 2 affixes that are interpretation-triggering, while this privilege was granted to class 1 affixes by Halle & Vergnaud. Finally, the critical difference for the global purpose of this chapter is that the sister of the interpretation-triggering affix, rather than the node that dominates the affix itself, is spelled out in Kaye's system. Table (4) below depicts this difference.

⁷ For the sake of completeness, it needs to be mentioned that the single computational system at hand only refers to the contrast with morpheme-specific multiple phonologies. It disregards chunk-specific phonologies, which apply only to a certain *size* of pieces. Chunk-specific phonologies have been proposed for the word level (SPE's word-level rules, adapted basically in all subsequent theories) and for the contrast between sequences of morphemes and sequences of words (in the familiar vocabulary of Lexical Phonology, the former are lexical, the latter post-lexical rules). Chunk-specific phonologies are a separate issue (see Scheer, forthcoming for further discussion).

⁸ Space restrictions only allow for a digest version of the comparison, and also of the presentation of Kaye's system. Further discussion is provided in Scheer (forthcoming, in press a).

- (4) interpretation-triggering affixes: what exactly is spelled out
- Halle & Vergnaud (1987): cyclic affixes trigger the spell-out of their own constituent β
 - Kaye (1995): cyclic affixes trigger the spell-out of their sister α



Given an interpretation-triggering (i.e. cyclic) affix X and a root, two significantly distinct results are produced: $/[\text{root } X]/$ vs. $/[\text{root}] X/$. Note that this is only the isolated result of the action of the affix, which needs to be supplemented by the computation-independent provisos (3)a,b: the root is always a cycle with Halle & Vergnaud, the word is always an interpretational unit in Kaye's system. This leaves us with identical structures: $/[[\text{root}] X]/$ is produced on both sides.

This does not mean, however, that the two different spell-out strategies return identical results. The contrast is shown under (5) below where strings with interpretation-neutral (Y) affixes are opposed to strings with interpretation-triggering (X) affixes.

(5)		Halle & Vergnaud	Kaye
a.	root- $X_{\text{triggering}}$	$[[\text{root}] X]$	$[[\text{root}] X]$
b.	root- Y_{neutral}	$[\text{root}] Y$	$[\text{root } Y]$

The contrast between Halle & Vergnaud and Kaye thus concerns strings that bear an interpretation-neutral affix, and it is the result of the combined choices under (3)a-c. These are hard-wired in the two systems, i.e. independent of the situation in particular languages. By contrast, the analyst must still identify which are the interpretation-triggering and which are the interpretation-neutral affixes in every language studied — interface theory will not help. It was already mentioned in (3)d that Halle & Vergnaud and Kaye make opposite choices for English. Finally, Kaye's analysis of the *párent* - *parént-al* vs. *párent-hood* pattern crucially relies on an ingredient that is absent from Halle & Vergnaud's system, i.e. a no look-back device — modification-inhibiting no look-back to be precise (see (3)e).

Indeed, Kaye (1995) holds that previously interpreted strings cannot be modified by computation at later cycles. The striking parallel between Kaye's no look-back in phonology and current 'freezing' Phase Impenetrability in syntax is the subject matter of Scheer (in press a), where it is argued that the absence of a PIC device disqualifies phonological theories. In Kaye's system, then, *párent* and *parént-al* identify as $[\text{parent}]$ and $[\text{parent al}]$, respectively, while *párent-hood* comes down to phonology as the complex $[[\text{parent}] \text{hood}]$. Application of penultimate stress to the two former produces the correct result right away. The latter first receives penultimate stress on the inner cycle, i.e. $[\text{párent}]$, but then Kaye's PIC inhibits modification of this string (and hence stress shift) on the outer cycle. The English situation is further discussed in Scheer (in press a), namely, cases where underapplication must be achieved for class 1 strings (level 2 rules in Lexical Phonology, e.g. (*sign*, *sign-ing*₂ vs. *si[g]n-ature*₁) are examined.

For the purpose of the present contribution, however, we have now taken stock of everything we need in order to compare the competing phonological theories that have been developed on the grounds of phonological effects with their cousins that are based on syntactic evidence.

3.3. Making sure that the PIC, the phase edge and selective spell-out are necessary properties of Phase Theory

The logic of the intermodular argument is that some property of spell-out is firmly established on one side of the phasal pipe, and therefore must also be present on the other side. In our case, syntactic Phase Theory evaluates competing phonological theories. The logic of the argument thus requires to make sure that the evaluating syntactic properties are firmly established as an indispensable property of the theory. This is certainly true of the PIC and the phase edge. These are absolutely critical for derivation by phase to work out at all. The PIC is the condition on computation that achieves the goal which motivates derivation by phase in the first place: it unburdens active memory. The phase edge is also a critical ingredient of Phase Theory: derivation by phase, supplemented with the 'freezing' PIC, cannot work in its absence, since it is undisputed that some material of phase heads may continue to be available for further computation. Spelling out the complement of an interpretation-triggering XP is thus a necessary property of the spell-out mechanism.

Finally, establishing selective spell-out as a necessary property of syntactic Phase Theory requires a few more words. Chomsky's original take on phasehood identifies CP and vP, maybe DP (Chomsky 2005:17f.), as phase heads. The DP track has been followed, and also DP-internal phases are argued for (Matushansky 2005). Den Dikken (2007:33) provides an overview and argues that "[t]here is good reason to believe that DP and CP are each other's counterparts in their respective domains (the noun phrase and the clause)."

TP is also under debate: while Chomsky (e.g. 2000:106, 2004:124) is explicit on the fact that TP does not qualify as a phase head (because it is not propositional), den Dikken (2007) points out that according to Chomsky's own criteria, this conclusion is far from being obvious. Indeed, TP is assumed to act as a phase head in a growing body of literature, and nodes below TP such as Voice⁰ (Baltin 2007, Aelbrecht 2008) and AspP (Hinterhölzl 2006) are also granted phasehood.

It does not take a lot to predict the vanishing point of the atomization of phasehood: taken to the extreme, all nodes will trigger interpretation; or, in other words, interpretation occurs upon every application of Merge. As a matter of fact, this view is not utopia, but has actually been proposed in work by Samuel Epstein and colleagues: Epstein *et al.* (1998), Epstein & Seely (2002, 2006) practice Spell-out-as-you-Merge.

Two things may be said in defense of selective spell-out. For one thing, it needs to be noted that it does not matter how fine- or coarse-grained interpretational units turn out to be — the only claim that selective spell-out makes is that *there are* nodes which are not spelled out. The actual distribution of phasehood over nodes is currently done according to quite distinct principles in syntax and in phonology (node-driven vs. piece-driven phase, see note 3) and therefore represents a separate field of investigation.

The other thing is that there may be principled reasons that prevent the atomizing trend to reach Spell-out-as-you-Merge. Boeckx & Grohmann (2007) indeed argue that the atomization of phasehood is marshaled by the anti-locality of movement (see Grohmann 2003): if phase heads are too fine-grained, escape-hatch movement through the phase edge out of the complement will not be possible anymore since it will be too local.

I thus take it that at least for the time being Spell-out-as-you-Merge is marginal, and perhaps for principled reasons, syntactic spell-out is necessarily selective.

3.4. Phonology must provide for selective spell-out, the phase edge and the PIC

We are now in a position to make the intermodular argument, which appears to be simple at first sight: if selective spell-out, the PIC and the phase edge are necessary properties of Phase Theory, phonological theories of the effects of cyclic spell-out must also have them.

Recall from sections 3.1 and 3.2 that selective spell-out divides phonological theories in two camps, one where all nodes are spelled out (Lexical Phonology) and another where spell-out is indeed selective (Halle & Vergnaud 1987, Kaye 1995). The former can thus be dismissed on intermodular grounds, while the latter qualifies. The PIC further filters phonological theories: Lexical Phonology

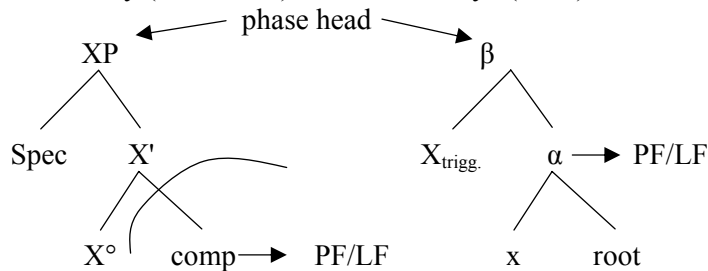
and Halle & Vergnaud (1987) do not use any no look-back device,⁹ while modification inhibiting no look-back is the mechanism that achieves underapplication in Kaye's system. Syntactic theory thus selects Kaye (1995), which is the only theory to pass both filters.

Finally, let us look at the phase edge. Current syntactic Phase Theory holds that in case XP is a phase head, the spell-out of XP only triggers the interpretation of the complement; the head and its specifier — the edge of the phase — are spelled out only at the next higher phase (Chomsky 2000:108 *et seq.*). Kaye's (1995) version of interpretation-triggering affixes and Chomsky's phase edge are contrasted under (6) below.

(6) the phase edge in syntax and phonology: spell out your sister!

a. Chomsky (2000,2001)

b. Kaye (1995)



The parallel is quite striking: in both cases, given a phase head, the sister of its head is spelled out. In syntax, this is the complement (i.e. the sister of the head of the phase head XP); in Kaye's system, this is the sister of the interpretation-triggering affix (whose projection is the phase head).

Now in sections 3.1 and 3.2, we have come across three competing theories of cyclicity-induced phonological effects: one where all nodes are spelled out (Lexical Phonology), one where only the node that dominates interpretation-triggering affixes is spelled out (Halle & Vergnaud 1987), and one where only the sister of interpretation-triggering affixes is sent to interpretation (Kaye 1995, and more recently Ziková & Scheer 2007, Ziková 2008). In the intermodular perspective, then, if the spell-out mechanism spells out the complement of phase heads — their sister —, the latter is selected, while the two former must be dismissed.

4. The Headstone of the Argument: All Effects Are Due to the Same Spell-Out Mechanism

This is where we stand after the first round of intermodular argumentation. There is a second round (alas) because the premises of the argument turn out to be less obvious than they may appear to be at first sight. The headstone of the entire argumentation — which is tacitly assumed above — is that the syntactic and the phonological effects of cyclic spell-out that we are talking about are the two ends of the *same* pipe. That is, they are produced by the *same* spell-out mechanism. Were they not, there would be no reason for 'phonological' spell-out to mimic the properties of 'syntactic' spell-out: the latter could spell out the sister of the phase head, while the former spells out something else; the latter could also be selective and implement the PIC, while the former could ignore these devices.

The existence of just one spell-out mechanism is probably intuitive, and taken for granted by most readers, who will never have thought of an option where the grammatical architecture accommodates more than one parcel-shipping company. We approach this question in two steps: first we have a second thought on the interpretation of the phase edge (in the present section), which will then set us on the track of a massive empirical generalization — the word-spell-out-mystery —, which has always remained unspoken in the phonological literature.

Reconsider (6). Saying that Kaye's way of doing spell-out is the phonological version of the phase edge is imprecise: it is certainly the result of phonological evidence, but it concerns morphology. That is, where Chomsky's mechanism spells out words and larger chunks, Kaye's evidence is based on the

⁹ Of course, (classical versions of) Lexical Phonology feature Kiparsky's (1982) Strict Cycle Condition (SCC), which is a no look-back device. The SCC, however, is devised for derived environment effects — it plays no role in affix class-based phenomena. Further discussion of the history of no look-back devices in general, and of the SCC in particular, can be found in Scheer (forthcoming, in press a).

spell-out of morphemes. What the parallel really is about, then, is syntax and morphology: chunks of whatever size seem to be spelled out by the same mechanism: spell out your sister!

This result thus certainly contributes to the ongoing debate whether morphology and syntax are instances of the same computational system or not. Showing that they are is the goal of Distributed Morphology (see Embick 2007, for example, on this issue), while Lexical Phonology-affiliated morphological approaches ('autonomous' morphology, e.g. Booij *et al.* 2007) and syntactically oriented theories such as Ackema & Neeleman's (2005, 2007) argue for a distinct morphological device. Julien (2007) and Lieber & Scalise (2007) provide a survey of the issues.

But its validity as an intermodular argument (against phonological theories that do not spell out the sister of phase heads) precisely hinges on the debate at hand: if it turns out that morphology and syntax are two distinct computational systems, it could probably be argued that each system comes with its own spell-out mechanism (but note that this is not a necessary conclusion: two distinct structures may as well be 'harvested' by the same mechanism). In this case, the intermodular arguments that were made above do not bite since the phonological evidence for the phase edge concerns the spell-out of morphemes, whereas the syntactic evidence for the same device is based on the spell-out of words and larger pieces. If on the other hand it is found that morphological structure is just the lower part of syntactic structure, there can be only one spell-out mechanism, and the intermodular arguments made go through without further discussion.

We have thus reached a point of indecision: the *prima facie* arguments only hold if we can be sure that there is only one single spell-out mechanism, and this question depends on the ever-lasting debate whether morphology and syntax are one.

In this situation, an obvious thing to do is to try to circumvent this 'technical' difficulty by simply looking at phonological effects of the cyclic spell-out of words (rather than of morphemes). The striking fact is that there are none! This is at least what the phonological literature says — and what I call the word-spell-out mystery. Whatever its nature and eventual solution, it is clear that its existence is somehow related to our indecision problem — it can hardly be accidental that the critical piece of evidence that you need to look at in order to sort out two competing hypotheses does not exist.

5. The Word-Spell-Out Mystery

5.1. The absence of cyclicity-induced external sandhi: a consensual fact that theories build on, but do not talk about

Traditional terminology distinguishes between internal and external sandhi. The former refers to phonological effects of morpheme boundaries, while the latter describes phonological effects of word boundaries. This distinction comes in handy for the purpose of this section, which is about something that the literature does not talk about: the cyclic spell-out of words. While the procedural (i.e. cyclic) management of morphemes has spilled a whole lot of ink (this is essentially what Lexical Phonology is about), I have not come across either a phonological phenomenon that requires, or an analysis that proposes, a procedural treatment of words or bigger chunks — except for intonation, on which more in section 5.4 below.¹⁰

The absence of procedural activity above the word level — or rather: of phonological traces thereof — is admitted as the correct empirical record in the field. The literature therefore offers only representational treatments of syntactically conditioned phonological effects. In practice, this means that all external sandhi phenomena are ascribed to some variation in prosodic constituency.

The exclusive ambition of representational management at and above the word level is rarely made explicit, though. The only cases that I am aware of are Selkirk (1984) and Inkelas (1990). These authors observe that while prosodic constituency can cover the full spectrum of units (morphemes and

¹⁰ Traditionally there are two ways for morpho-syntax to bear on phonology: procedurally (cyclic spell-out, called the transformational cycle in SPE) and representationally (boundaries in SPE, i.e. # and the like, the prosodic hierarchy since the 1980s). The two channels may be easily distinguished, the simplest way being the fact that on the representational side some object — a boundary, a prosodic constituent or whatever item is favoured by the particular interface theory — is inserted into phonology independently of lexical (vocabulary) insertion (classically by mapping rules as in Prosodic Phonology).

words alike), Lexical Phonology is confined to the Lexicon, i.e. to morphemes. Since there is no place for two devices (procedural and representational) that do the same job below the word level, Inkelas (1990) argues, prosodic constituency should be extended to the Lexicon. Lexical Phonology, then, is an empty shell at best.

5.2. How (phonological) interface theories behave: Claims for and against cyclic spell-out of words, for and against its cyclic interpretation

5.2.1. The baseline position of SPE: everything is cyclic

Given this empirical situation and its reception in the literature, let us briefly review the spectrum of positions have been taken by phonological interface theories. Two things need to be carefully distinguished: the submission of pieces to interpretational modules, which may or may not be cyclic on the one hand; and the phonological (or semantic) interpretation thereof (i.e. of whatever is submitted), which may also be cyclic or not. The former is a matter of the spell-out mechanism, while it is reasonable *a priori* to think that the latter is a decision of the phonological computational system: phonology either ignores that it receives a string in pieces and acts only at the end of the submission process, or assesses pieces as they are submitted.

The baseline position is represented by Chomsky *et al.* (1956) and SPE, where cyclic derivation was introduced: both the spell-out and the phonological interpretation of word sequences is cyclic, as shown by the following quote: "The principle of the transformational cycle [...] appl[ies] to all surface structure whether internal or external to the word" (Chomsky & Halle 1968:27).

5.2.2. Lexical Phonology: The interpretation of word sequences is not cyclic

Lexical Phonology has a different take. Following an insight from the Prague school (Booij 1997:264, note 3), all versions of this theory implement what I call Praguian segregation, i.e. the distinction between word- and sentence-phonology. This means that phonology subdivides into two distinct chunk-specific computational systems which compute sequences of morphemes (lexical phonology) and sequences of words (post-lexical phonology), respectively.¹¹

The term 'cyclic rule' (which is still used today in phonological quarters in a kind of *lingua franca*-understanding) is indicative of the front line that is set in Lexical Phonology: early versions of the theory assumed that all phonological rules which contribute to word-formation are cyclic (i.e. rules which apply to sequences of morphemes), while all post-lexical rules are non-cyclic (i.e. those rules that apply to sequences of words). The cyclic condition on lexical rules has been called into question later on (Rubach & Booij 1984 introduced lexical post-cyclic — i.e. non-cyclic — rules), but the necessarily non-cyclic character of post-lexical rules stands unchallenged in all Lexical Phonology quarters up to the present day. This is the only thing that is of interest for the present discussion.

5.2.3. Lexical Phonology makes no claim about spell-out and installs non-cyclic interpretation of word sequences without argument

On the other hand, as far as I can see, Lexical Phonology makes no claim regarding the cyclic character of spell-out. The only thing that is central for this theory is the contrast between the cyclic *interpretation* of morpheme sequences (lexical phonology), against the non-cyclic *interpretation* of word sequences (post-lexical phonology).

The reasons for this fundamental distinction, however, are not made explicit as far as I can see.

¹¹ The two chunk-specific phonologies, lexical and post-lexical, add to the distinct morpheme-specific phonologies that we have come across in section 3.1. That is, the Lexicon (where words are constructed) accommodates lexical phonology (word phonology), which itself falls into distinct morpheme-specific phonologies. Lexical phonology as a whole is then opposed to post-lexical phonology (sentence phonology), and syntax applies in the midst, i.e. on the result of word-, but before sentence-phonology. The total of distinct computational systems in Lexical Phonology is thus three: two in the Lexicon (or actually more, depending on the language and the particular brand of Lexical Phonology), one after syntax (post-lexical).

One may suppose that post-lexical phonology is declared non-cyclic on the grounds of the observation that cyclicity-induced external sandhi is absent from the record. This, however, is no more than a supposition: Kiparsky (1982) simply decrees that there is no cyclic interpretation of words without argument.

"The former, the rules of *lexical phonology*, are intrinsically cyclic because they reapply after each step of word-formation at their morphological level. The latter, the rules of *postlexical phonology*, are intrinsically noncyclic." Kiparsky (1982:131f., emphasis in original)

5.2.4. Halle & Vergnaud and Kaye: restoration of SPE — everything is cyclic

Let us now turn to Halle & Vergnaud (1987), who are committed to the SPE heritage, but also to Lexical Phonology and the lexicalist environment of the 1980s, of which Praguian segregation is an expression. The result is a system where both morphemes and words are subject to cyclic spell-out; the concatenative process, however, takes place in two rounds, one where words are created, another where sentences are built (word-internal vs. word-sequence strata in Halle *et al.* 1991). Following SPE, word- and sentence-construction is separated by a specific word-level phonology.¹²

This much for spell-out. Within this architecture, then, all phonological interpretation is cyclic, no matter whether the input are morphemes or words. This follows Halle & Vergnaud's general orientation, which is to restore SPE: (i) there are no morpheme-specific phonologies, (ii) there is no distinction between a phonology of morphemes and a phonology of words: both chunk-sizes are interpreted by the same computational system; (iii) all phonological interpretation is cyclic.

Kaye's (1995) position is the same as Halle & Vergnaud's as far as I can see: Kaye rejects morpheme-specific phonologies, but has morpheme- and word-sequences interpreted by the same computational system, which carries out cyclic interpretation across the board.

5.2.5. Distributed Morphology is entirely agnostic in phonological matters

Finally, Distributed Morphology is entirely agnostic in regard to the issue at hand as far as I can see — simply because it is not concerned with, and does not make any claim about, phonological interpretation. From the vantage point of DM, morpho-syntax cannot accommodate multiple computational systems, but PF may or may not accommodate morpheme-specific and/or chunk-specific mini-phonologies, whose interpretational action also may or may not be cyclic.

5.3. What a "trace of cyclic spell-out" is: PIC à la carte? Chunk-specific PIC?

5.3.1. Cyclic spell-out of words but no phonological traces?

From a global perspective, the situation seems paradoxical: cyclic spell-out of words and larger chunks — derivation by phase in modern terminology — is a central piece of current syntactic thinking, but it looks like it has no phonological consequences. By contrast, the cyclic spell-out of morphemes is just as undisputed, but — as expected — leaves ample traces in phonology.

Having distinct chunk-specific phonologies that distinguish word- and sentence-phonology as proposed by Lexical Phonology does not solve the problem: it merely records the contrast between the area which produces phonological effects (internal sandhi) and that which does not (external sandhi). What it does not, however, is to correlate the phonological non-effect for chunks at and above the word level with the other end of the interactionist pipe: we want to know how it could be that the same input to (an) interpretational system(s) — the piecemeal submission of a string hacked into pieces of growing size — in one case produces (opacity) effects, but in another leaves no trace at all.

¹² In order to avoid confusion, below I do not mention Halle & Vergnaud's specific word-level phonology anymore, which is irrelevant for the discussion.

5.3.2. *Wrong data or an on/off switch for Phase Impenetrability*

There are only two ways in which I can make sense of this mystery: either the empirical generalization is just wrong (phonologists have not worked hard enough, if they have a closer look, they will find cyclicity-induced external sandhi) or interpretational systems are able to ignore their input conditions. The latter option means that a phonological system (or a semantic system for that matter) has a switch that decides whether 'old' strings, i.e. those that have already undergone previous computation, are subject to a special treatment or not. Or rather, as will be suggested below, the switch at hand is borne by the spell-out-mechanism (not by the phonological computational system).

In other words, word phonology would feature a no look-back device, while sentence phonology has no Phase Impenetrability Condition and hence treats all strings in the same way, old and new alike.

A third option that is logically possible is certainly not a serious candidate and may be left unexplored: spell-out of words and larger chunks could be non-cyclic (while morphemes are submitted piecemeal to interpretation). This would mean that cyclic derivation in general and interactionist derivation by phase in particular are flat out wrong.

5.3.3. *Phase Impenetrability requires a memory-keeper*

Let us pursue the option according to which interpretational systems are parameterized for subjecting or not subjecting 'old' strings to a special treatment. An interesting question is what "special treatment" actually means, and by whom it is organized. As far as I can see, the literature on no look-back devices in general, and on Phase Impenetrability in particular, does not really address this question: no look-back is declared to be a property of the system, but what it actually takes for the system to implement the desired effect remains vague.

It was already mentioned that the (Chomsky's) whole motivation for cutting sentences into pieces and sending them to PF/LF piecemeal is to be able to achieve computational economy regarding active memory by imposing the Phase Impenetrability Condition on 'old' pieces. The economy effect is achieved by allowing further computation to 'forget' these 'old' pieces and their internal structure.

Chomsky is also explicit on the fact that the economy of active memory concerns phonological as much as syntactic computation ("the phonological component too can 'forget' earlier stages of derivation", Chomsky 2001:12f.). Which means that Chomsky takes Phase Impenetrability to be a general condition on computational systems (at least in grammar); the alternative that we are currently pursuing has the opposite take: every computational system 'chooses' to benefit from computational economy or not.

Now this computational economy does not come for free: it needs to be organized. Somebody must keep track of which portion of the string has already been subject to interpretation, and which portion is new. Everything that we know about how modules work suggests that the modular computation itself is perfectly unable to do this labour. Indeed, modular computation is known to have the following properties (e.g., Fodor 1983, Pylyshyn 1989, Smith 2002): it is automatic, mandatory and 'blind' (also domain-specific, i.e. content-based, autonomous, stimulus-driven and insensitive to central cognitive goals); that is, modules are input-output devices that perform a calculus on an input and return an output. Given this description, they are perfectly unable to distinguish between portions of a string submitted which are in need of computation, and other portions which are not: modules do not make decisions.

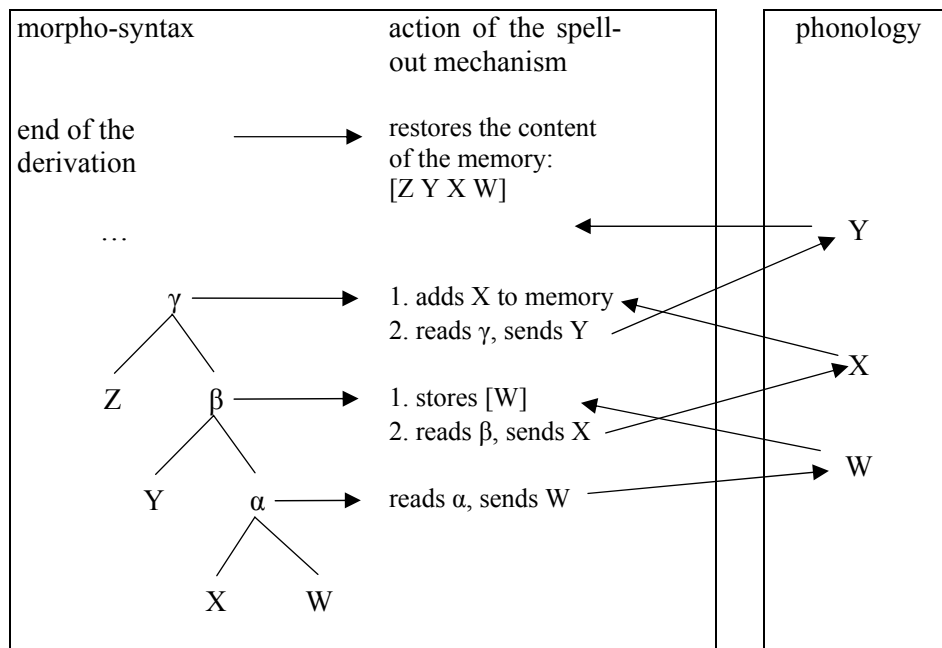
5.3.4. *Phase Impenetrability is a property of the spell-out mechanism, not of concatenative or interpretational systems*

This means is that Phase Impenetrability is not a property of computational systems such as morpho-syntax, phonology (or semantics for that matter). What is it then a property of? As far as I can see, the spell-out mechanism is the only candidate for the management of Phase Impenetrability that is left. This means that the system which is supposed by Phase Theory has three, rather than two individuable units (as far as the derivation of sound is concerned): a concatenative system (morpho-syntax), a spell-out system and an interpretational system.

While the former and the latter are modules, the status of the spell-out mechanism is unclear (to me at least): it is reminiscent of mapping rules in Prosodic Phonology and Jackendoff's (1997) correspondence rules (more recently called 'interface processors'; see Jackendoff 2002), but does not share the basic property of these, i.e. the ability to understand the vocabulary and the structure of the sending as much as of the receiving module. Rather, the spell-out mechanism reads the result of morpho-syntax and manages chunk-submission to phonology, which includes the distinction of 'old' and 'new' portions of the string.

Figure (7) below tries to depict what this system could look like on an example where all nodes are phase heads, where (following regular assumptions regarding the phase edge) only the complement of the head of a phase head is actually sent to interpretation, and where the highest node is a CP, i.e. the end of the syntactic derivation.

(7) no look-back managed by the spell-out mechanism



When spell-out occurs at α , W is sent to phonology, where it is computed and sent back to morpho-syntax. It is then excluded ('forgotten') from further morpho-syntactic computation, but needs to be stored in order to be restituted at the end of the derivation. When spell-out treats β , only X is sent to phonology since, just like for morpho-syntactic computation, previously interpreted strings are excluded from phonological computation. This procedure works through the string until the end of the derivation, where the memory-keeper, that is the spell-out mechanism, restores its memory, which is the linear sequence of all interpreted pieces.

This of course is only a rough schematic picture that does not come any close to what is actually going on. For one thing, the labour that the spell-out mechanism is supposed to do under (7) of course describes only a vanishingly small portion of its real action (unpublished work by Michal Starke studies the properties of the spell-out mechanism in detail). Also, it is probably obvious for every phonologist that phonological computation needs to be able to see previously interpreted strings, even if it cannot modify them. These questions must be left pending.

From a global minimalist perspective, the obligation for the spell-out mechanism (or some other device which is not on my radar) to act as a memory-keeper raises the question whether the trade-off between this extra burden for active memory and the economy that is realized by morpho-syntax and LF/PF is all that positive.

5.4. Intonation requires cyclic spell-out of words for sure — but this does not appear to impact phonological computation

5.4.1. Intonation is governed by syntactic structure

Let us now examine intonation, the only case that I am aware of where the cyclic spell-out of words leaves phonological traces.¹³ The reader must be warned beforehand that the excursion into empirical fields will be quite lengthy — it is the price to pay if the empirical validity of the word-spell-out-mystery is to be seriously addressed. For intonation is a typical concern of syntacticians, who will call the existence of the word-spell-out-mystery into question on the grounds of the obvious cyclic conditioning of intonational phenomena.

At least since Bresnan (1971), it has been established that intonation (also called sentence or phrasal stress) directly depends on syntactic structure. The topic is covered by a rich syntactic literature, including Berman & Szamosi (1972), Cinque (1993), Kahnemuyipour (2004) and Adger (2006). A classical example appears under (8) below (words in small caps bear prominent sentence stress).

- (8) syntax-sensitive intonation
- a. Helen left DIRECTIONS for George to follow.
 - b. Helen left directions for George to FOLLOW.

(8)a means that Helen has left some directions that George should follow, while (8)b is an invitation for George to follow Helen. Since both sentences are phonologically identical but have contrasting syntactic structure, the different intonation must be a consequence of the latter: under (8)a *follow* is transitive and belongs to a relative clause whose head is *directions*, while under (8)b it is intransitive and complements *directions*. The causal relationship between syntax and phonology has also been thought of in the opposite direction: Szendrői (2001,2003,2004) argues that syntactic properties such as focus and climbing can be controlled by intonation.

In sum, there can be no doubt that cyclic spell-out of words and larger units impacts the calculus of intonation. In order for this fact to qualify as a prove that the cyclic spell-out of words may bear on phonology, however, it needs to be shown that the calculus of intonation is the result of phonological computation. Against the intuition that intonation is a phonological phenomenon, I argue below that there is good reason to believe that this is not the case.

Another relevant issue is that intonation is the only phonological phenomenon which has been argued to be recursive (or rather: to require recursive structure, which as we will see is not quite the same thing). A pervasive and largely undisputed empirical generalization, however, is that recursion is the privilege morpho-syntax, the only concatenative device(s) in grammar (Chomsky *et al.* 2002, Neeleman & van de Koot 2006). This is reason enough to doubt that intonation, should it require recursive structure, is any phonological at all.

Whether or not intonation requires recursive structure will not be decided. In case it does, however, it is shown that the bare existence of recursive structure in phonology does not mean that phonology itself is recursive as long as the structure in question has been built by mechanisms that are foreign to phonological computation. We will see that this is precisely the case for all recursive prosodic structure that has been argued for in the literature. We begin by considering this question.

5.4.2. Prosodic structure may be recursive...

¹³ I am aware of one other isolated case where the cyclic spell-out of words is argued to produce a segmental effect. According to Kaye's (1995) analysis, French vowel nasalization goes into effect in *mon ami* [mɔ̃n ami] 'my friend', but not in *bon ami* [bɔn ami] 'good friend' because *mon*, but not *bon*, is a cycle in its own right: the relevant structures are [[mon] ami] vs. [bon ami]. Space restrictions preclude further discussion, which may be found in a Scheer (forthcoming).

Beyond the syntactic literature, intonation has been studied in the perspective of Janet Pierrehumbert where it is phonologically represented as tones (e.g., Pierrehumbert 1980, 2000, Beckman & Pierrehumbert 1986, 1988, and Ladd 2000 provide overviews). Also, this approach puts to use the tools of Prosodic Phonology (among many others, Liberman 1975, Ladd 1986, 1997, Gussenhoven 1992, 2004, Selkirk & Kratzer 2007).

As far as I can see, Ladd (1986) was the first to argue that intonation is recursive, in the sense that it requires recursive prosodic structure. Formally speaking, recursion is a structure where a node is dominated by another node of the same kind. Ladd works with two prosodic constituents, the Major Phrase (MP) and the Tone Group (TG). He aims at showing that intonation cannot be adequately described unless an MP may dominate other MPs, and a TG other TGs.

Nested prosodic structure was ruled out by the original version of Selkirk's Strict Layer Hypothesis, and this is what Ladd stands up against. Under this pressure (among others), Selkirk (1996) abandons the ban on recursive prosodic structure: in the new constraint-based formulation, the non-recursion of prosodic structure is demoted to a violable constraint. Languages and analysts are thus free to use nested prosodic structure. Since then, numerous analyses have taken advantage of this option (among many others, Booij 1996, Peperkamp 1997, and Truckenbrodt 1999).

5.4.3. ...but phonology is not

This state of affairs faces the fact that no-one has ever heard of recursive phenomena elsewhere in phonology. Recursive structure in syntax and morphology exists because sentences and morphemes may be embedded. Regular phenomena that lead to this description are shown under (9) below.

- (9) recursion in syntax and morphology
 - a. Peter thinks [that John says [that Amy believes [that...]]]
 - b. Czech iterative -áv
 - dělat 'to do'
 - děl-áv-at 'to do repeatedly/often'
 - děl-áv-áv-at 'to do even more often'
 - děl-áv-áv-áv-...-at 'to do really really often'

Recursive structure in natural language has the property of producing grammatically unbounded embedding: grammar happily generates and tolerates an infinite number of embedded clauses, and in the case of recursive morphology, an infinite number of embedded morphemes. The limits on recursive structure in actual production are imposed by performance (factors such as memory), not by competence. That is, speakers will get confused upon the third or fourth level of embedding.

As far as I can see, no equivalent phonological phenomenon has ever been reported (on recursion in general and its absence in phonology in particular, see Pinker & Jackendoff 2005a,b and Neeleman & van de Koot 2006). This empirical situation is the reason why the absence of recursion is widely held to be a major property that sets phonology (and semantics) apart from morpho-syntax. Using the same criteria as for the establishment of recursive structure in morpho-syntax, the empirical situation in phonology thus appears to be in overt conflict with the alleged existence of recursive prosodic structure — which has been admitted only fairly recently under the pressure of data from intonation.

But even if it turns out to be true that intonation is based on recursive structure, the trouble is that there is no reason why recursion should be confined to just this particular area of phonology: beyond intonation, phenomena analogous to those under (9) would be expected to produce, say, syllabic or segmental effects of the same kind.

5.4.4. What it means to say that "phonology is recursive": Alien-inserted structure vs. phonological computation

All worries mentioned turn out to be spurious when a distinction is made between the existence of prosodic structure and the computational system that it was created by. According to the classical conception (Nespor & Vogel 1986),¹⁴ prosodic structure ends up being part of phonology, where it may be referred to by phonological computation. However, it has not been created by phonology or anything phonological: prosodic structure is the output of mapping, which is done by a mapping device that is necessarily located outside of the phonology in modular no man's land. Mapping is an exclusively top-down operation that transforms relevant morpho-syntactic structure into phonologically legible items (and eventually introduces distortions that are not motivated by the morpho-syntactic input, so-called non-isomorphism).

The classical architecture that is required for the management of the prosodic hierarchy thus leaves us with a situation where recursive prosodic structure may well exist in phonology, but with phonological computation being perfectly non-recursive. This is because the recursive structure at hand has not been created by phonological computation — it has been inserted by somebody else, the mapping system.

The meaning of the statement "phonology is recursive" therefore needs to be clarified: if somebody wants to refer to the existence of recursive structure in phonology, this statement is certainly true — at least for those who consider it an advantage to have recursive structure in phonology. If on the other hand the intended meaning is that phonological computation is recursive, the statement is wrong: no evidence to this end has been reported, and intonation does not provide any.

The contrast between intonation on the one hand and all the rest of phonology on the other, then, is not contradictory at all: there are no equivalent recursive phenomena on the segmental or on the syllabic side because these areas are the result of non-recursive phonological computation, not of (possibly) recursive mapping, which is managed beyond phonology.

5.4.5. *PF and LF only interpret: Merge must be absent, hence the result of phonological computation is flat*

The absence of recursion in phonological (and semantic) computation is also central for the generative architecture of grammar. The inverted T-model embodies the insight that there is only one concatenative system in grammar, morpho-syntax. Phonology and semantics are interpretational systems (modules) which do not glue any pieces together: they merely interpret a string whose size, composition and linearity has been decided elsewhere.

The fact that phonology and semantics do not concatenate anything is also a headstone of Chomsky *et al.*'s (2002) argumentation, who hold that ultimately only recursion (Merge) and the ability to talk to other modules in a specific way (Phase) make human language unique and different from animal communication.

If phonology and semantics only interpret strings but are unable to build them, it follows that they must not have access to the building device, that is Merge in current syntactic theory. This is pointed out by Neeleman & van de Koot (2006), who provide detailed argumentation to the end that allowing for Merge (and hence for trees) in phonology and semantics wrongly predicts the existence of recursive structure, and hence of recursive phenomena in these modules. This is a strong argument against Jackendoff's (1997 *et seq.*) parallel approach to modular structure where all modules are granted access to the concatenative device.

Now the distinction between structure that is present in phonology but has not been created by phonological computation on the one hand and phonological computation itself on the other leaves an escape-hatch for the existence of recursive structure in phonology. Neeleman & van de Koot's (2006) argument bites only for phonological structure that is also the output of phonological computation. Structure such as prosodic constituency may be recursive because it has been inserted by extra-

¹⁴ Though not in OT, where — in violation of modularity — prosodic structure is created by ALIGN and WRAP constraints *in the phonology*, i.e. the constraints at hand being interspersed with purely phonological constraints in the same constraint hierarchy. Mapping between morpho-syntax and phonology, which is what ALIGN and WRAP do, is a process that needs to be able to interpret morpho-syntactic structure — something that is impossible on modular grounds when sitting in phonology. More on the problematic relationship of OT with modularity in Scheer (forthcoming).

phonological computation, i.e. mapping. It is perfectly compatible with the non-recursive nature of phonology — to be precise: of phonological computation — and does not predict the existence of recursive phenomena all over the place in phonology.¹⁵

5.4.6. *Is intonation a phonological phenomenon at all?*

Let us now return to the initial question which, recall, was about the absence of phonological effects of the cyclic spell-out of words. We have seen that cyclic spell-out is a factor that influences intonation for sure. Whether through the mediation of the prosodic hierarchy or otherwise, intonation seems to militate against the generalisation that cyclic spell-out of words leaves no phonological traces. This, however, is only true if intonation is a phonological phenomenon in the first place.

Wagner's (2005) work shows that intonation is much more syntactically bound than the phonological literature may suggest. In actual fact, it raises the question whether intonation is phonological at all: it may as well be syntax and nothing else.

This direction is counter-intuitive because intonation is somehow 'made of sound', and hence should be treated in the phonology. This may be true — but we have seen that it does not mean that phonology builds the structure that ultimately gets to the surface in the coat of intonation. Phonology may well be responsible of nothing at all in the process that decides where intonation falls: like everywhere else, its action is purely interpretative; in the case of intonation, the action of phonology could well reduce to making a particular portion of the string phonologically prominent, whereby the portion itself has been designated by extra-phonological devices.

A strong argument in favour of this perspective is the following fact: it appears that intonation may be calculated in complete absence of phonological material, that is possibly before lexical (vocabulary) insertion and hence before phonological computation has a chance to do anything at all. Féry & Ishihara (in press) make this generalisation: the only thing that is needed in order to know where intonation falls is the syntactic structure of the sentence — the particular words and their phonological properties that will ultimately incarnate this structure are entirely irrelevant. Intonation, then, is the result of an exclusively top-down computation that depends on syntactic properties, information structure and eventually mapping decisions.

If it is true that intonation may be calculated in complete absence of phonological material, the logical conclusion is that no phonological structure participates in the entire process: the prominence of this or that item is calculated in syntax alone; phonology only provides a specific pronunciation for the portion that has been designated.

5.5. *Conclusion*

5.5.1. *Either the generalization is wrong, or we need Praguian segregation plus an additional device*

At the end of this inquiry, we are left with a lot of open questions, and some vague indications. While the cyclic spell-out of both morphemes and words is undisputed, why is it that the literature abounds in phonological effects of the former, but does not seem to have met any phonological trace of the latter?

One solution is that phonological effects of the cyclic spell-out of words have simply been overlooked: the generalization is just wrong. Intonation, which appears to be a massive counter-example at first sight, turns out not to harm the word-spell-out-mystery — on the contrary, it rather adds grist to the mill of the mystery since it relies on recursive structure that phonology has no handle on.

¹⁵ Finally, it is worth mentioning that the research programme of Government Phonology in general (Kaye *et al.* 1990), and of so-called CVCV in particular (Lowenstamm 1996, Scheer 2004), roots in the claim that syllable structure is better understood in terms of lateral relations among segments than by using traditional arboreal structure. This is where the title of Scheer (2004) comes from: a lateral theory of phonology. The lateral perspective, whose motivation is purely phonology-internal, thus allows for a non-contradictory implementation of the architectural requirement that phonology has no access to Merge, and that trees must not be the output of phonological computation: phonology-created structure is flat and lateral (see Scheer 2004:xlix ff.).

If the generalization turns out to be correct, just jumping into Praguian segregation will not do: the existence of distinct chunk-specific phonologies, one for morpheme-, another for word-sequences, is necessary, but not enough to explain what is going on. What we need on top of that is a means to make post-lexical phonology ignore cyclic structure. For the zero hypothesis is certainly that if an interpretational system is exposed to piecemeal chunk submission, traces of this fact will appear in its output.

It is certainly empirically adequate to decree that lexical phonology is, but post-lexical phonology is not cyclic — this is the reaction of Lexical Phonology. This does not tell us, however, how come and what it means that interpretational systems can 'decide' to react on cyclic structure, or to ignore it.

5.5.2. *The additional device may be the chunk-specific parameterisation of the PIC*

One way to go about this question has been explored in section 5.3.2: "taking into account cyclic structure" can mean two things for interpretational systems. For one, the Lexical Phonology solution are morpheme-specific mini-phonologies. That is, the cyclic structure that (cyclic) lexical phonology encounters is interpreted by two distinct mini-phonologies according to the morpho-syntactic makeup of the string in question (level 1 vs. level 2, see section 3.1). By contrast, the cyclic structure that (non-cyclic) post-lexical phonology encounters is interpreted by just one single phonology.

Another way of encoding the same contrast is through the parameterisation of no look-back (i.e. Phase Impenetrability). On the account of Kaye (1995), the phonological effect of the cyclic spell-out of morphemes is due to modification-inhibiting no look-back (see section 3.2.2).

If thus the phonological effect of the cyclic spell-out of morphemes is due to Phase Impenetrability, and if this effect is absent when it comes to the cyclic spell-out of words, the conclusion is that the PIC constrains the computation below, but not at and above the word level (section 5.3.2). The next question, then, is what Phase Impenetrability is a property of. It appears that the PIC is unlikely to be managed by concatenative/interpretational systems; rather, it is a property of the spell-out mechanism, which in addition to organising chunk-submission, also decides to make 'old' strings subject to a specific treatment or not (section 5.3.4).

In any event, about all that was said is more or less speculative. This is worth what it's worth: the thing is that the whole issue — the word-spell-out-mystery — appears to be entirely unreflected in the literature. One reason is certainly the fact that the absence of cyclic impact on external sandhi is set in stone since Lexical Phonology and the correlating idea of a completely regular ('automatic') post-lexical phonology.

The study of a larger body of empirical material will have to show whether the current state of affairs is due to this theoretical bias (which, recall, was installed without argument), or whether natural language has really different ways of treating morphemes and words. Which is but another occasion to be thrown back to the question whether morphology and syntax are one: back to where we started.

6. Conclusion

The reader who has made it until the present conclusion was courageous enough to go through a nested structure of topics, which are *a priori* unrelated but are pieces of the same puzzle, as I hope to have shown: the track could be something like

[[[intermodular argumentation] [_{wso-mystery} [chunk-specific PIC or wrong data] [intonation]]]]

where the distribution of topic and comment is classical — the subject introduces the problem, which is clear and appears to allow for a conclusive treatment at first. Just as the reader may think that the issue is settled and the article can be closed, however, doubt creeps in and the comment starts: do we really compare things that are comparable (please stress *comparable*)? Can we take for granted that the spell-out mechanism which sends word sequences to PF is really the same as the shipping mechanism which submits morpheme sequences to phonological computation? The intuitive answer is yes — but if it turns out that morphological and syntactic structure are distinct and not just the lower

and upper part of the same tree, a negative answer may be construed: two different structures may (but do not have to) come each with its private spell-out mechanism, which means that there is no guarantee for the settings being the same regarding the PIC (present/absent), selective spell-out (yes/no) and spell out your sister (yes/spell out something else). Which is what the clean intermodular arguments depend upon.

This is how we discovered that — unfortunately — there is a hurdle to take for those who want to make intermodular arguments, which suppose that:

- (10) The spell-out mechanism that handles the pieces on which morpho-syntactic analyses/theories are built is the same as the one that is responsible for the shipping of pieces that ground phonological analyses/theories.

The king's road to this question is to make sure that there is only one spell-out mechanism in grammar. In this case no further discussion is needed, the intermodular arguments go through and we can sleep well. Unfortunately though, as was mentioned, the only way to make sure that there is only one spell-out mechanism is to be sure that morphology is just the lower part of syntax. Alas nobody can take this for granted as morphologists and syntacticians continue to quarrel about this question, and probably still will in 20 or 50 years. So please, if you could decide one way or the other before that, you'd do a great favour to intermodular argumentation.

For the time being, we must thus live with the eventuality that there are two independent spell-out mechanisms, one handling words, the other morphemes.¹⁶ This is where the comment-part of the topic-comment structure resumes, and eventually starts meandering seriously. For there seems to be a simple way to get around (10), which is to look at 'syntactic' pieces, rather than at their 'morphological' cousins. This strategy, however, fails miserably because there is nothing to look at: we hit the word-spell-out-mystery. This leaves us with another choice, empirical this time: either the mystery is real and language really makes a hard-wired difference between morphemes and words in that it takes into account the cyclic structure of the former, but not of the latter upon interpretation. Or there is no mystery at all, that is the mystery is a fact about a specific theory, rather than about language: if phonologists look hard enough, they will find phonological traces of the cyclic spell-out of words.

This track looks promising because it is suspicious that the non-cyclic interpretation of words was set in stone by Kiparsky (1982) without the slightest mention of an argument, which is certainly the reason why virtually nobody has looked at word-level data through the cyclic prism, all external sandhi being dumped into representational treatments. This is even true for those who — against Kiparsky's stone-set rule — continue to subscribe to the original position of SPE that interpretation of pieces of whatever size is cyclic: as far as I can see, Halle & Vergnaud (1987) have not produced any relevant data or analysis. Only Kaye (1995) presents a good candidate, the case of French vowel nasalization that was mentioned in note 13, but which could not be presented in detail.

The chapter has made one contribution to this empirical debate, against its own goal, as it were: intermodular argumentation would be on the safe side if it could be shown that the word-spell-out-mystery is theory-, rather than language-created. A massive counter-example that especially syntacticians are familiar with is intonation. Intonation, however, is shown not to unsettle the mystery: it is certainly impacted by the cyclic spell-out of words — but it is not a phonological phenomenon in the first place. Its recursive character does not allow it to enter phonology, which is definitely non-recursive, and the designation of the intonationally prominent item can be done on purely syntactic grounds, that is before lexical insertion and hence in complete absence of phonological material. Once intonation-placement is decided, then, all that phonology does is to highlight the designated item.

We thus move forth in our decision tree: if there are two distinct spell-out mechanisms for morpheme- and word-sequences, there may also be two distinct interpretational systems, one for each

¹⁶ Note that 'word' is just a cover term for a chunk size that is larger than a morpheme. What this actually comes down to is a different question that does not impact the demonstration: clitics may or may not count in, and a few other decisions may also have to be taken. The only thing that is needed for the argument is the existence of a front line that separates 'small' and 'big' chunks. But anyway, defenders of the view that morphology is but the lower part of syntax actually use the impossibility to define such a red line as an argument. This all lies beyond the scope of the present chapter.

chunk size. Whether morpheme interpretation is cyclic, while word interpretation is not, depends on the empirical question regarding the word-spell-out-mystery: if the mystery is real, Praguian segregation is true and linguists will have to live with this fact. If it turns out to be an artefact of Lexical Phonology, phonologists may continue to claim that cyclic interpretation is a property of phonological interpretation as such, whatever the chunk size (phonologists, would you please find out about that).

The deepest embedded level of our decision tree is when both previous questions have got a yes: yes, there is a specific spell-out system for morphemes, yes the word-spell-out-mystery is real, which means that phonological interpretation may (morpheme sequences) or may not (word sequences) be cyclic. In this case, Praguian segregation needs to be somehow organized: it is hardly enough to transcribe the observation into prose, as Lexical Phonology does: we want to know (i) who decides that phonological interpretation will be cyclic or not and (ii) how cyclic interpretation is implemented. I have tried to answer both questions: interpretation is cyclic iff it the relevant computation is subjected to the PIC (section 5.3.2), and whether or not the PIC is switched on for a given computation is decided by the spell-out mechanism (rather than by the computation itself, which as a module is unable to make decisions at all, see section 5.3.4).

This, in turn, raises inelegant questions about what kind of animal the spell-out mechanism actually is (a module? something else?), and how the PIC actually works (it is in need of a memory-keeper).

At the end of the venture, we are thus left with a situation where definitely more questions are raised than are answered, and where a clean situation that offers a nice perspective for intermodular argumentation has fallen prey to a whole series of conditions, embodied in a nightmare-like decision tree.

So please, morphologists and syntacticians, find out that morphology and syntax is one; and please, phonologists, find out that there is cyclicity-induced external sandhi. You will make a good deal of the trouble vanish, and you will render a service to fellow (future) readers, which will be able to go home after a couple of pages, and to forget about the already spelled-out decision-meander.

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