

## Modular PIC

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### 1. Introduction

Domains of phonological computation, i.e. strings that are computed by phonology in one go, can be identified in two ways: derivationally and representationally. In earlier models of the architecture of grammar, the former is carried out by cyclic derivation (the transformational cycle in Chomsky and Halle's 1968 *Sound Pattern of English*, henceforth SPE) or by levels in Lexical Phonology (Pesetsky 1979, Kiparsky 1982 et seq.); under current theories it is achieved through strata in Stratal Optimality Theory (Kiparsky 2000, Bermúdez-Otero forthcoming) or phases (Chomsky 2000 et seq.). In the representational approach, phonologically relevant chunks are expressed as juncture phonemes in structuralism, as hash marks (#) in SPE, and, since the early 1980s, as prosodic constituency (Prosodic Word etc.) (Selkirk 1981 [1978], 1984, Nespor and Vogel 1986).

Since SPE, both ways of defining chunks have been considered to be compatible, and since the development of Prosodic Phonology in the early 1980s, the division of labor has been roughly defined by word size: cycles determine domains below the word level, while prosodic constituents delineate domains of word size or larger. That is, roughly, Lexical Phonology can handle strings of morphemes but cannot identify larger units because postlexical phonology is non-cyclic (Kiparsky 1982: 131). Strings of words are therefore structured by prosodic constituency. This complementary distribution of competences is made explicit by Hayes (1989 [1984]: 207), among others.<sup>1</sup>

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<sup>1</sup> See Scheer (2011:§423, 2012) for a more detailed study of how cyclic and prosodic chunk definition coexisted

If phase theory is on the right track, this division of labor must be wrong: the very essence of phase theory is to define items that are bigger than the word, and to send them to PF (and LF). Against this backdrop, our first goal is to show that there can only be one chunk-defining device: theory cannot afford to have the same work done twice. We argue that this unification must be in favour of the derivational mechanism: phase theory has independent syntactic motivation, while this is not the case for prosodic constituency on the phonological side.

The second goal of the paper follows on from this idea. As it stands, phase theory is unable to describe all phonologically relevant chunks, as these are too small and too diverse to be delineated in the current working. In order to qualify as the only chunk-defining device in grammar, phase theory needs to be made more flexible: in other words, it needs to be adapted to the demands of phonology.

Both goals are minimalist in kind: parallel and competing grammatical devices are shrunk into one, and a central piece of current syntactic thinking, phase theory, is adapted to interface conditions. In sum, the existence of phase theory triggers a domino chain which first substantially modifies the phonological landscape (prosodic constituency has to go), and then floats back to syntax in order to amend the mechanism itself. This back and forth is expected in an interface-driven environment. It also arbitrates between competing views in one module by bringing the properties of another module to bear (intermodular argumentation, Scheer 2008, 2009).

In order to allow phase theory to describe all phonologically relevant stretches of the linear string, we propose the separation of the Spell-Out operation from the Phase Impenetrability Condition (PIC henceforth). In the current working of phase theory, both necessarily co-occur. In the amended version outlined below, there is a language-specific set

of phase heads, which we call the phase skeleton. When Spell-Out occurs, every individual access point may or may not be associated with a PIC at PF, and the same optional endowment with a PIC also holds for syntax.

As a matter of fact, Spell-Out itself does not leave any trace in phonology or syntax: it is only when it is endowed with a freezing effect that distinguishes "old" (already computed) from "new" (not yet computed) strings that an opacity effect is observed. This role is carried out by the PIC. It follows that the system is bicompositional and in principle allows for Spell-Out to occur vacuously, i.e. without enforcing the PIC. That is, it is possible for Spell-Out not to leave any footprint. It remains true, however, that (phonological and syntactic) opacity effects of cyclic derivation are necessarily caused by a Spell-Out operation. We show in section 3.2 that a great many situations in phonology correspond to this description and that PF-neutral Spell-Out is actually the unmarked case. In section 3.3, we also recall that the absence of any footprint left by Spell-Out in either syntax or phonology is quite a trivial situation encountered also under current assumptions.

We refer to this modified version of phase theory as Modular PIC because it allows for the PIC to produce an effect in one module, but not in another. The module-specificity of the PIC is illustrated by the threefold pattern of the Abruzzese data discussed in section 4: a PIC effect on *Raddoppiamento Fonosintattico* (RF) either occurs in both syntax and phonology (passives), or in neither (actives); or else it is observed in phonology, but not in syntax (unaccusatives). The fourth logical possibility is the pattern mentioned whereby a PIC effect constrains syntax at some access point, but not phonology. An example of this is discussed below in the shape of English t-flapping, which goes into effect across any word boundary, including vP.

The second set of data discussed (in section 5) comes from Bantu. Cheng and Downing (2007, 2009, 2012) use relevant configurations in order to demonstrate that phase theory as it

stands is unable to delineate some phonologically relevant chunks. We agree, but instead of interpreting this as motivation for an extra grammatical device (prosodic constituency), as Cheng and Downing do, we show that our amended version of phase theory is able to cover the patterns observed.

The structure of the article is as follows. Section 2 provides relevant background information, while section 3 outlines Modular PIC, whose workings are introduced in section 4 based on Abruzzese external sandhi. Section 5 presents and reanalyzes Cheng and Downing's data from Bantu, and section 6 provides concluding remarks.

## **2. Background**

### **2.1. Modularity requires translation: representational and derivational incarnations**

Translation, or mapping, is a necessary consequence of modularity, i.e. the idea that the mind and grammar are organised in a number of distinct computational units each of which works with a domain-specific vocabulary (Fodor 1983). In the generative tradition, the modular architecture of grammar manifests itself as the inverted T model (Chomsky 1965: 15ff). On modular assumptions, there is no way in which phonological computation could understand, parse or process morpho-syntactic vocabulary such as, say, "adjunct". This is because every computational system works with a specific vocabulary and hence cannot understand or parse any other. In Cognitive Science, the symbolic nature of computation is called domain specificity (e.g. Gerrans 2002, Fodor 2000: 58ff).

Since the 19<sup>th</sup> century, translation in the modular sense was achieved representationally. Objects were inserted into phonological representations that are non-phonological in nature but carry morpho-syntactic information: structuralist juncture phonemes, SPE-type diacritics (#, +) and finally prosodic constituency (Selkirk 1981 [1978], 1984). Derivational translation

was introduced in Chomsky et al. (1956: 75) and represents a genuinely generative contribution to linguistic thinking. Derivationally defined cycles have been given various names: the transformational cycle in SPE, the phonological cycle in the 1970s (Mascaró 1976), levels in Lexical Phonology (Kiparsky 1982 et seq.), and finally phases today.

On the representational side, the central claim of Prosodic Phonology in the 1980s was Indirect Reference, i.e. the implementation of the modular requirement for translation. That is, computational instructions in phonology (rules or constraints) must not make reference to any morpho-syntactic categories (such as "dative", "third person", "adjunct" etc.). A corollary of Indirect Reference was *non-isomorphism* (Selkirk 1981 [1978]: 138, Nespor and Vogel 1986: 34ff, 124ff): following the idea implemented in SPE's readjustment component, the output of morpho-syntax is sometimes not ready to be used as the input to phonology and therefore needs to be readjusted. The fact that morpho-syntactic and phonological structure may not coincide has been established in the literature since Chomsky and Halle (1968: 371f), where the oft-quoted *cat-rat-cheese* example comes from (see Scheer 2011: §416, Samuels 2011b: 586f).

## 2.2. Prosodic islands, isomorphism and non-isomorphism

As a reaction to syntactic phase theory, Prosodic Phonology has recently developed so-called prosodic islands. The idea is that the procedural and representational means to define chunks converge: the constituents of the Prosodic Hierarchy roughly correspond to syntactically defined phases. Studies following this line of thought include Piggott and Newell (2006), Dobashi (2003), Ishihara (2007) and Kahnemuyipour (2009) (Elordieta 2008 also offers an informed survey).

Kratzer and Selkirk (2007: 106), for example, propose that "the highest phrase within the spellout domain is *spelled out as a prosodic major phrase*" (emphasis in original). They assume that only CP and *v*P are phases, and that CPs and *v*Ps therefore correspond to major phrases on the phonological side: this equivalence should be universal. Language-specific variation in prosodic phrasing is then achieved not by the syntax-phonology mapping as it was previously (see note 3), but purely phonologically by "prosodic markedness constraints, which operate to produce surface prosodic structures that are more nearly phonologically ideal" (Kratzer and Selkirk 2007: 126). This is a significant departure from a Prosodic Phonology essential: mapping becomes universal and phase-driven, while the substantial language-specific variation in prosodic phrasing (i.e. chunk definition) is achieved *in* the phonology by purely phonological mechanisms.

The idea that phases (which did not exist in the 1980s when Prosodic Phonology was developed) and constituents of the Prosodic Hierarchy are *isomorphic* may indeed seem appealing. Both delineate chunks of the linear string that serve as domains for the application of phonological processes: this is what prosodic constituency is all about.

However, the question then arises of why the chunk defining job should be duplicated: if chunks can be defined by phases alone, then what is the purpose of prosodic constituents? It should also be noted that the position of a prosodic islands theory is exactly the reverse of both SPE and regular Prosodic Phonology in claiming that morpho-syntactic chunking (phases) and phonologically relevant domains (prosodic constituency) are isomorphic: as was mentioned, non-isomorphism was a central claim of Prosodic Phonology in the 1980s and 1990s.

### 2.3. Unlike prosodic constituents, phases have independent syntactic motivation

The definition of phases has been subject to some variation over the years: Chomsky characterizes them as propositional (Chomsky 1995), in terms of lexical subarrays (Chomsky 2000), as an escape hatch for movement (Chomsky 2004) or as domains for the valuation of unvalued features (Chomsky 2008). A common ground, though, is the relevance of phases for the cyclicity of movement. The relevance of phases has also recently been discussed in relation to interface conditions, with the specific proposal that phases have independent syntactic motivation because of the requirement to immediately dispose of recently valued, previously unvalued features (Richards 2007, Gallego 2008, Uriagereka 2011).

By contrast, independent motivation does not seem to be attributable to prosodic constituency, whose only purpose and labor is to ship morpho-syntactic information into phonology (Scheer 2011: §400).<sup>2</sup>

Pak (2008, in a Distributed Morphology environment) and Samuels (2011a,b) argue that unlike phases, prosodic constituency has no syntactic import, arguing that if phase structure provides all relevant information, the Prosodic Hierarchy is redundant and needs to be eliminated (see also Seidl 2001): the Prosodic Hierarchy may be reduced to phases, but phases cannot be reduced to the Prosodic Hierarchy.

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<sup>2</sup> In addition to the introduction of morpho-syntactic information into phonology, prosodic constituency is also held to be responsible for eurhythmy and rhythm e.g. by Selkirk (1980: 126ff, 1984: 8ff, 2000) and Ghini (2001). This position is debated, though: there is reason to doubt that rhythm is a linguistic property. For example, Hayes (1984) holds that rhythm is an emanation of metrical poetry and music, rather than of the linguistic system. He writes that "grids are not strictly speaking a linguistic representation at all" (page 65) and concludes on page 69 that rhythm on the one hand and linguistic structure such as stress or the Prosodic Hierarchy on the other belong to separate cognitive domains. Nespor (1988: 228) adds that rhythm "is, in fact, not properly a phenomenon of language, but rather of all temporally organized events." This view was followed by subsequent work including Nespor and Vogel (1986, 1989: 87f) and Selkirk (1986): rhythmic structure materialises as the metrical grid, which is produced by a secondary mapping that takes the Prosodic Hierarchy as an input.

## 2.4. Phase theory needs to be more flexible

Below we aim to show that phase theory can potentially do everything that the Prosodic Hierarchy can do. In other words, phase structure and the prosodic constituency that is currently devised in order to define phonologically relevant chunks are always isomorphic.

Our project will fail if it can be shown that prosodic constituency carries out work in phonology that could not possibly be taken over by phase theory. This is precisely the argument of Cheng and Downing (2007, 2009, 2012) on the grounds of Bantu data, and in contrast to prosodic islands, particularly in their paper "Prosodic domains do not match Spell-Out domains" (Cheng and Downing 2012). They conclude that there are phonologically relevant domains that cannot be described by phase structure as it stands. We agree, but emphasize *as it stands*: in order to be able to take over the chunk-defining function from prosodic constituency, phase theory needs to evolve. That is, phases must be small enough to allow every phonologically relevant stretch of the linear string to be described. Phonologically relevant chunks may be quite diverse across languages, and the variation at hand is classically expressed by language-specific prosodic phrasing.<sup>3</sup>

A brief look at the evolution of phasehood in recent syntactic discussion is encouraging in the sense that it converges with the phonological demand for the definition of relatively small chunks. Chomsky's (2000) original take on phasehood identifies CP and vP, and maybe DP (Chomsky 2005: 17ff), as phase heads. Since then there has been a constant trend towards granting phasehood to smaller and smaller chunks (Den Dikken 2007: 33 and Grohmann 2007 provide an overview; see also Scheer 2011: §773): the idea of a DP phase head is

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<sup>3</sup> There is a large body of literature on this subject; relevant anchor points include Hayes (1989 [1984]: 206ff), Nespor and Vogel (1986: 117ff) and Selkirk (1986).



followed, but DP-internal phases are also argued for (Matushansky 2005). TP is controversial: while Chomsky (e.g. 2000: 106, 2004: 124) explicitly states 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 obvious. TP is indeed assumed to act as a phase head in a growing body of literature, and nodes below TP such as Voice<sup>0</sup> (Baltin 2007, Aelbrecht 2008) and AspP (Hinterhölzl 2006) are also granted phasehood. The vanishing point of the atomization of phasehood is a situation in which all nodes trigger interpretation; or, in other words, where interpretation occurs upon every application of Merge. This radical position – Spell-Out-as-you-Merge – is defended by Samuel Epstein and colleagues (Epstein *et al.* 1998, Epstein and Seely 2002, 2006).

### **3. Modular PIC: Spell-Out may or may not be associated with a PIC**

#### **3.1. Spell-Out only produces effects because of the PIC**

On the phonological side, phase theory eliminates the deeply rooted idea that there are no derivationally defined chunks above the word level, i.e. that postlexical phonology is non-cyclic (Kiparsky 1982). In Chomsky's (2000) initial and most conservative incarnation of phase theory, *v* and C are phase heads which define Spell-Out chunks that are bigger than words. From a modular perspective, it is certainly reasonable to think of a computational system as being shaped by its input conditions. It is not reasonable, therefore, to assume that phonological computation is constantly accessed by chunks of increasing size above the word level without showing any effect of this piecemeal input. Hence if phase theory is on the right track, postlexical phonology can hardly be non-cyclic.<sup>4</sup>

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<sup>4</sup> An anonymous reviewer asks about the input conditions to syntactic computation. To our knowledge, this issue is hardly discussed in the literature, one exception being Uriagereka & Pietroski (2002) and Uriagereka's

Spell-Out, however, does not itself produce any effect. It only leaves a footprint because of the PIC in (1):

- (1) In a phase  $\alpha$  with head H, the domain of H is not accessible to operations outside  $\alpha$ ; only H and its edge are accessible to such operations. (Chomsky 2000: 108)

The PIC identifies the domains that are visible for syntactic computation: the phase head H and its ‘edge’, i.e. the set of its specifiers. It also identifies those items that are invisible to syntactic computation because they have been spelled out: the complement of the phase head (the TP for C, the VP for  $v$ ). According to Chomsky (2012: 5), there is a strict relation between the PIC and *Transfer* (i.e. *Spell-Out*): Transfer ensures that syntactic material is no longer in syntax, and hence that it becomes invisible for syntactic computation.

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(2002) *warping* operation in the Faculty of Language (FL), i.e. the ‘topological’ ability to shift dimensions (for instance, from Euclidean spaces to non-Euclidean ones, or from bidimensional geometries to tridimensional ones), which the FL shares with the arithmetic and geometric systems. Uriagereka proposes that these systems work on a four-dimensional space, which can be obtained by adding a dimension to tri-dimensional space. For syntax, adjunct structures are basic, (‘flat’ in Uriagereka’s terms), and adding hierarchical structure corresponds to creating a new dimension. For semantics, basic predicates are ‘flat’, while  $\theta$ -roles add a further dimension, and so on. Based on this idea, Munakata (2006) proposes that the split CP is a consequence of the necessity to realize the fourth dimension (discourse) in a bi- (or tri-)dimensional syntax.

This whole line of reasoning is mainly based on syntactic and semantic considerations. Phases, in this respect, could be a way of mapping different dimensions into narrow syntax (first bi-dimensional, then tri-dimensional and finally four-dimensional elements), or they could even be marking dimensions (from argument structure,  $v$  to discourse, C). In any case, according to this line, narrow syntax is the reflex of the structure of the FL, hence it is itself shaped by interface conditions.

We leave this argument aside, as we wish to focus on the syntax-PF interface, and more elaboration would be too speculative.

- (2) “PIC is guaranteed by Transfer to the interfaces of all information that would allow the interior to be modified by G. This principle must be defined with care -more care than in my own publications on the topic-to ensure that the interior, while not further modified, can nevertheless be interpreted in other positions (see Obata 2010).” Chomsky (2012: 5)

We take this remark as our starting point, and propose that Transfer is not the only way to ensure a PIC: there can be a PIC associated with a phase head that does not result in the disappearance of the relevant material from the module, in our case PF.

Note that the PIC is only the latest incarnation of what may be called no look-back devices: since Chomsky (1973), there has been a tradition of instruments that restrict the access of current computation to already computed strings. Relevant references on the phonological side include Mascaró (1976) and Kean (1974, the phonological cycle), Kiparsky (1982, the strict cycle condition), Mohanan (1986, levels and bracket erasure) and Kaye (1995, analytic vs. non-analytic domains). In each case, relevant domains are defined cyclically, but phonological effects are only the result of PIC-type restrictions on computation (see Scheer 2011: §287).

Finally, observe that the formulation of a Modular PIC is quite similar to the formulation of a ‘weak phase’ in Chomsky (2001). According to Chomsky (2001), passives and unaccusatives exhibit a weak  $v$  phase head, i.e. a head that is a phase only from a propositional point of view, but that does not trigger the Spell-Out of its complement. This idea was developed in order to extend the  $v$  to all verbs (in the DM “verbalizer” tradition) while keeping the contrast between a transitive, Burzio generalization-encoding head, and a “defective” head, which cannot license an external argument nor assign accusative to its complement. Crucially, for Chomsky the PIC and Spell-Out are coincident, which means that

a weak phase head does not have Spell-Out, as well as not having a PIC effect. We wish to propose that Spell-Out and PIC-induced opacity effects are separate, and hence that Spell-Out does take place, even if opacity effects are not visible.

This might help solve the issues pointed out by Richards (2011) and raised by the concept of weak phase. According to Richards, “weak” *v* behave exactly like transitive ones, for instance by providing a reconstruction site which is identical to those which are found for intermediate movement with transitive verbs, or for linearization purposes. In Richards' view, the main problem with weak phases is that weak phase heads appear to behave exactly like strong phase heads in terms of cyclicity, while being defective for case assignment and argument licensing. Our model captures this difference, by proposing that Spell-Out does take place at every phase (for a given language), while opacity can vary. In this sense, we always have a site for reconstruction because there has always been Spell-Out. What we do not always see is the reflex of this Spell-Out at PF (and sometimes at syntax itself, like in the case of long distance agreement or case assignment which are discussed in section 3.3).

### 3.2. Selective footprints in phonology

Modular PIC separates the Spell-Out operation from the PIC: a PIC may or may not hook on a phase. The effect is that phases endowed with a PIC at PF will leave a phonological trace (will be visible in phonology), while bare phases with a PIC only at syntax will not. This is parallel to what we know from the interaction of morphology and phonology: some morphological boundaries are visible to the phonology (e.g. class two affixes in English: *párent-hood* where stress is computed only over the root), while others are invisible (e.g. class one affixes: *parént-al* where stress is computed over the entire word, which behaves just as if it were monomorphemic, see section 3.4 below).

That there are phases which are not associated with a PIC at PF is empirically supported. If every Spell-Out operation were associated with a PIC at PF as currently assumed, a cyclic effect would be expected at all phase boundaries: material contained in the lower spell-out domain should be frozen, and hence phonological processes applying across such domain boundaries should be blocked. However, external sandhi across phase boundaries is a cross-linguistically trivial situation. One case in point is the *vP* in English. In this language, t-flapping is reported to operate across *all* word boundaries regardless of the syntactic relationship between the words (provided the /t/ is word-final and intervocalic). Some examples from descriptions of relevant American varieties (Kahn 1976, Kiparsky 1979, Kaisse 1985: 25ff, Nespor and Vogel 1986: 46f, 224ff) are *at issue*, *a white owl*, *invite Olivia*, *at eleven*, *just the other night a racoon was spotted in our neighbourhood*. Jensen (2000: 208) specifically mentions a case where flapping applies across a *vP* boundary: *a very dangerous wild cat escaped from the zoo*.<sup>5</sup>

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<sup>5</sup> A point that needs to be made in this context can only be briefly mentioned in this footnote: in addition of being module- and phase head-specific, the PIC is also process-specific. This is a trivial and well-known fact about sandhi phonology (but which often goes unmentioned). In (relevant varieties of) English for example, t-flapping is unbounded by morpho-syntactic divisions, but other phenomena such as word stress assignment apply only within words. Hence the visibility of the word boundary is process-specific. This is more generally true for all boundaries and all processes in all languages. Classically in Lexical Phonology (and OTed versions thereof), the process-specificity of boundary impact is dealt with by the assumption of distinct computational systems: in the English case, the rule assigning word stress is present in the Lexicon (which assesses strings of morphemes), but absent from postlexical phonology (where strings of words are computed). By contrast, t-flapping is present in both rule systems. What is at stake and would need to be discussed is thus the opportunity of splitting phonological computation into several independent computational systems according to the size (lexical vs. postlexical) and/or the nature (lexical strata) of the pieces involved. This touches upon the debated question whether morphology and syntax are run by the same or different computational systems (see the DM position discussed in section 3.4). Relevant discussion goes beyond the scope and space restrictions of the

On the other hand, several scholars have discussed the matter of a PIC associated with  $\nu$  at syntax, especially for successive cyclic movement or for some sort of ‘structural rhythm’, in Uriagereka’s (2011: 256) terms. Richards (2007), for instance, shows that the PIC associated with  $\nu$  is a necessary condition imposed by the Strong Minimalist Thesis, in order for the derivation to be able to proceed (see Gallego 2008 and Uriagereka 2011 for PIC associated with  $\nu$ ).

Cross-linguistically, phases that do not leave any footprint in phonology are perfectly unremarkable and are in fact probably more common than those that do produce external sandhi phenomena. It should also be noted that the evolution of phase theory described in section 2.4 significantly increases the number of phases that do not have any phonological effect.

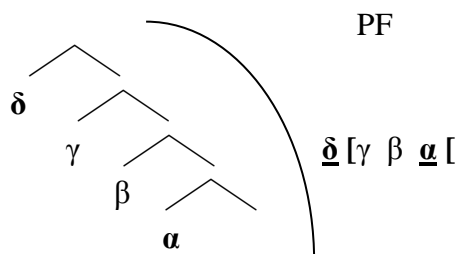
Even though Chomsky’s original idea was that phases and the PIC are indissociable, phenomena such as English t-flapping leave us with only two logical solutions: either there is no phase/PIC at  $\nu$ P, or there is a phase at  $\nu$ P, but it is not associated with a PIC on the phonological end. It is the latter option that we wish to explore: the phase skeleton (i.e. the set of phase heads) is invariable for a given language, and a decision is made for each phase head with regard to whether or not it is endowed with a PIC at PF. Whether or not a particular phase head is associated with a PIC is part of its lexical properties. Two languages may thus have the same phase skeleton, i.e. identical sets of phase heads, but differ with respect to which access point is associated with a PIC at PF. This is shown in (3) below.

(3) Modular PIC: languages choose which access points are endowed with a PIC

language A:

phase heads  $\alpha$  and  $\delta$  have a PIC at PF

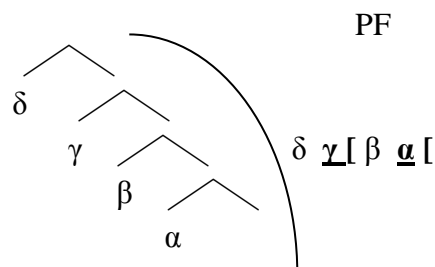
phase heads  $\beta$  and  $\gamma$  do not



language B:

phase heads  $\alpha$  and  $\gamma$  have a PIC at PF

phase heads  $\beta$  and  $\delta$  do not



There is reason to believe that the phasehood of a functional head is language-specific (Gallego 2010). This means that every language selects its own set (possibly marshalled by some imposed and some impossible choices), which then constitutes what we call the phase skeleton. For each language, a head can thus be specified as being a phase head or not, as well as inducing a PIC at PF or not. The phasehood of heads is thus a parametric choice made by languages. This is line with the so-called *Borer-Chomsky conjecture*, as Baker (2008) calls it, according to which “[a]ll parameters of variation are attributable to differences in the features of particular items (e.g., the functional heads) in the lexicon”. Variation is encoded on functional heads, and it is specified in the lexicon. Phasehood is one of the specifications on a functional head.

In current practice, phase heads, and hence phase structure, are determined on the basis of morpho-syntactic evidence alone. Under the perspective of a unified interface theory in which the same mechanism defines syntactically and phonologically relevant chunks, phonological evidence for phases needs to be taken just as seriously as syntactic evidence. As mentioned previously, a situation in which a computational system is insensitive to its input

conditions, i.e. never marks the boundaries of its input string, appears to be implausible. Hence if phases transport chunks between morpho-syntax and phonology, it is to be expected that they leave footprints in the latter.

That syntactic phases should be informed by phonology in fact follows from the Strong Minimalist Thesis (SMT) as formulated in Chomsky (2000: 97):

- (4) Language is an optimal solution to legibility conditions.

The SMT outlines a methodological procedure for the definition of language, which we can understand here as the core computational system of syntax. In order for an expression  $\pi$  to meet legibility conditions, i.e. for it to be legible at the interfaces, it must satisfy the conditions of Full Interpretation (FI). The question is how this Full Interpretation can be granted. We propose that the answer is that PF instructs syntax on FI conditions for any expression  $\pi$  that syntax will produce. Therefore, phonologically relevant chunks can and must be reflected in syntax.

### 3.3. PIC-footprints are selective in syntax as well

The Abruzzese data discussed in section 4 below show that the reverse configuration also exists: there are cases where Spell-Out produces a phonological but no syntactic effect. Hence in terms of Modular PIC, the phase head in question is endowed with a PIC at PF, but not in syntax.

As we will see, Abruzzese also illustrates the three other logical possibilities of Spell-Out-PIC (mis)match. The overall situation is given in (5) below.



## (5) logical possibilities of (mis)match between Spell-Out and PIC

PIC at syntax	PIC at PF	illustration	phonological phenomenon
+	+	Abruzzese: transitive active $v$	RF
–	+	Abruzzese: unaccusative $v$	RF
–	–	Abruzzese: passive $v$	RF
+	–	Abruzzese: C	RF
		English: $vP$	t-flapping

Heuristically, then, in an environment where Spell-Out may be vacuous, two things must be identified in the study of a language: 1) the phase skeleton and 2) the association of a PIC to a given phase head in syntax and phonology.<sup>6</sup> Evidence for 2) may be found in the footprints that are left: the presence or absence of a PIC for a given phase needs to be worked out independently for each module, and based on evidence from that module alone. Evidence for 1) comes from the combined effects of 2): whenever there is a syntactic or a phonological footprint, there must be a phase boundary (endowed with a PIC). The reverse, however, is not true: there can be phases that are vacuous.

Finally, note that vacuous Spell-Out, i.e. one that leaves no trace in either syntax or phonology, is not an innovation introduced by Modular PIC: it occurs trivially on many occasions also in the current model when no opacity effect is encountered in either module. One example is long-distance Case/agreement assignment in restructuring infinitive (RI) constructions in Japanese and German, analysed by Bobaljik and Wurmbrand (2005). The authors note that the case properties of the embedded complement depend in on the nature of the matrix predicate. Specifically, when the matrix verb is transitive active, the object of the

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<sup>6</sup> Following the logic of the system, Spell-Out should also be able to be vacuous at LF, but this is pure speculation at this point.

embedded clause will be marked as Accusative; when the matrix verb is passive or unaccusative, it will be marked as Nominative. Consider for example the Japanese sentences in (6) and (7). In (6), we see that the verb *eat* is not able to assign Nominative to its object (it assigns Accusative). In the restructuring context in (7), however, the object gets Nominative case. On the assumption that we are dealing with a biclausal structure, Bobaljik and Wurmbrand conclude that it is the matrix verb which assigns Nominative to the object. For our purposes, this means that *v* has not blocked assignment of Case from the matrix verb into the embedded clause, hence that there has not been a PIC effect induced by a transitive *v*.

- (6) *Emi-ga ringo-o /\*ringo-ga tabe-ta*  
 Emi-NOM apple-ACC /\*apple-NOM eat-PAST  
 Emi ate apples
- (7) *Emi-ga ringo-ga tabe-rare-ta.*  
 Emi-NOM apple-NOM eat-can-PAST  
 Emi was able to eat apples

Bobaljik and Wurmbrand (2005: 817)

According to Bobaljik and Wurmbrand, the same reasoning holds for German *long passive* constructions of the sort illustrated in (8), where the object *die Traktoren* receives Nominative from the matrix verb which is marked as passive, while the embedded predicate, which is not marked as passive, could not possibly have assigned Nominative to the object.

- (8) *weil die Traktoren zu reparieren versucht wurden*  
 since the tractors (NOM) to repair tried were.PL  
 since they tried to repair the tractors

It goes without saying that transitive  $v$  in main clause contexts does show PIC effects both in German and Japanese, as argued by Bobaljik and Wurmbrand in the same paper. Their data thus show that in specific syntactic configurations no opacity effects are associated to a phase head.

Other long distance contexts in which  $v$  does not induce opacity effects are quirky subject constructions in Icelandic (Zaenen, Maling and Thrainsson 1985, Taraldsen 1995, Sigurðsson 1996 and many others), or long distance agreement in Hindi/Urdu, exemplified in (9).

- (9) Vivek-ne [kitaab pa,rh-nii] chaah-ii  
 Vivek-Erg book.F read-Inf.F want-Pfv.FSg  
 Vivek wanted to read the book

Bhatt (2005: 760)

In (9), the matrix verb *want* long-distance agrees with the object of the complement clause. Once again, neither the matrix  $v$  nor the embedded  $v$  have created any opacity effects.

### 3.4. Modular PIC below the word level

While the present study is concerned with strings of pieces of word size or larger, we would briefly like to show in which way Modular PIC may also contribute to the understanding of

cyclic structure below the word level. There is a long tradition in phonology to study this area, especially in Lexical Phonology (Kiparsky 1982 et seq.). We pick a basic and well-known phenomenon, affix class-based effects in English, in order to illustrate that Modular PIC has potential to unify the analysis of strings of morphemes and strings of words.

The idea that morphology and syntax are run by the same computational system, rather than by two distinct modules, is a corner stone of Distributed Morphology (single engine approach, Marantz 1997). In DM, all category-modifying heads are phase heads (e.g. Marantz 2007, Embick and Marantz 2008: 6). This proposal is at odds with regular cyclic structure inside the word. Affix class-based phenomena prompt [parent al] (class 1 suffix) vs. [[parent] hood] (class 2 suffix): the former receives transparent penultimate stress (*paréntal*), while the latter is stressed opaquely as if there were no suffix (*párenthood*). Kaye (1995) takes opacity as a diagnostic for phasehood: class 2 affixes project phase heads, while class 1 affixes do not (this is parallel to the phase edge mechanism in syntax, see Scheer 2008). Therefore [parent al] is one single interpretational domain (to which stress assignment regularly applies), while [[parent] hood] affords two domains: [parent] is first computed on its own and receives regular penultimate stress, which is then "frozen" by the PIC and hence cannot be further modified when passing through the outer cycle. Hence, contrary to the DM take, class 1 *-al* does not appear to be a phase head, since it does not introduce opacity.

The DM take on phasehood imposes much stronger freezing effects below the word level than above: every xP is a phase head and associated to a PIC. In this environment, there should therefore be no stress shift such as in *óorigin* - *orígin-al*<sub>1</sub> - *origin-ál*<sub>1</sub>-*ity*<sub>1</sub> either because the PIC ought to freeze stress on the root-initial vowel. Again, class 1 suffixes do not behave like phase heads. Marvin (2002: 56ff) therefore concludes that (primary) stress is an exception to Phase Impenetrability, which does not apply to this particular phenomenon.

This is but a different wording of Modular PIC, though, except that Marvin rests on a local and unsystematic "exception". Modular PIC may thus reconcile the DM take on cyclic structure below the word level (every xP is a phase head) with basic affix class-based phenomena: rather than by phasehood (as Kaye 1995 has it), class 1 and class 2 affixes are opposed by inducing (class 2) or not inducing (class 1) a PIC. Both trigger Spell-Out.

### 3.5. Active memory economy in syntactic and phonological computation

Phases are the result of converging concepts, developed in the past decades. According to Chomsky (2012), phases reconcile *locality* requirements (which stem from Minimal Computation) with *cyclicity* (which is defined as “the intuition that properties of larger linguistic units depend on properties of their parts”, Chomsky 2012: 1). Cyclicity serves the task of impeding infinite computation of the same element, by rendering the element itself invisible at some point. Still following Chomsky, phases have the task to distinguish between copies of an element from repetitions of that element. Ideally, all syntactic operations should take place within a phase in order to be able to distinguish copies from repetitions (the information on copies is available locally within a phase).

Locality, on the other hand, can be seen as identifying domains of computation, i.e. domains within which syntactic operations can take place, and syntactic relations hold.

Phase theory is also motivated by the minimalist concern for (computational) economy, previously invoked in Uriagereka's (1999) multiple Spell-Out model. Chomsky (2000: 101) holds that the faculty of language has optimal design properties and operates with economy principles. This means, among other things, that computational complexity is unwarranted.

- (10) "There is mounting evidence that the design of FL [faculty of language] reduces computational complexity. That is no a priori requirement, but (if true) an empirical discovery, interesting and unexpected. One indication that it may be true is that principles that introduce computational complexity have repeatedly been shown to be empirically false." Chomsky (2001: 15)

In the interface-driven minimalist environment, then, Chomsky argues that the bias against computational complexity has extra-linguistic causes (i.e. a third factor explanation): computation uses active memory (work bench memory), a very limited cognitive resource. In a linguistic derivation, a whole sentence is too big and too demanding in computational terms to be processed in one go. If sentences are built step by step, the burden imposed on active memory by the computation of successive pieces is reduced. Chomsky is explicit that this also holds for phonological computation.<sup>7</sup>

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<sup>7</sup> It needs to be noted that Chomsky's claim that an entire CP is computationally too complex in order to be processed by active memory in one go is by and large speculative. No measure is available today that assesses the computational complexity of a CP (in absolute numbers), and the capacity of the human active memory is also far from being computable (in absolute numbers: see for instance Mathy and Feldman 2012). The situation in phonology is much the same. In OT, computational complexity has always been an issue. The theory is known to be quite expensive on this side (and sometimes claimed to be uncomputable, see Idsardi 2006), but there is no overall calculus available either that would produce absolute numbers (due among other things to the GEN function, which in classical OT is supposed to create an infinite candidate set, see Frank and Satta 1998).

- (11) "The computational burden is further reduced if the phonological component too can 'forget' earlier stages of derivation." Chomsky (2001:12f)

"If such ideas prove correct, we have a further sharpening of the choices made by FL [faculty of language] within the range of design optimization: the selected conditions reduce computational burden for narrow syntax and phonology." Chomsky (2001:15)

" $\Phi$  [the phonological component] is greatly simplified if it can 'forget about' what has been transferred to it at earlier phases; otherwise, the advantages of cyclic computation are lost. Although the assumption may be somewhat too strong, let us assume it to be basically true " (Chomsky 2004:107f)

The idea is thus that successive chunks of a sentence are computed, and that the output of each computation is stored (and thereby "frozen in place", Chomsky 2001: 6, or "forgotten", Chomsky 2001: 12), so that active memory is vacated for a new computational round. When all pieces of a sentence are computed, they are concatenated and pronounced.

The critical instrument for the reduction of computational complexity and the saving of active memory is the PIC: it is only when the ready-computed string can no longer participate in further computation that these goals are achieved. In the original conception whereby a PIC is associated to every phase, it does not matter whether the phase itself or the PIC is actually responsible for active memory economy. It does matter in a system with Modular PIC, since the bare occurrence of Spell-Out does not guarantee any economy: it may be vacuous. That is, in the absence of a PIC the chunk that is spelled out will be able to be further modified when the next higher phase is computed.

This is precisely the definition of "phonologically relevant chunk": chunks are defined that are relevant for phonological computation, and these may or may not coincide with chunks that are relevant for syntactic computation. Recall from section 2.1 that this is the insight of SPE's readjustment component.

While identifying domains for reducing syntactic computation is a worthwhile enterprise, there are no available studies attesting the exact computational load for different parts of structures (see note 7). Defining a phase as a domain of syntactic computation without knowing what exactly this computation amounts to leaves us with an important issue begging the question.

This issue is addressed in Chomsky (2008), where a definition is put forward that does not follow from active memory of computational economy, but instead builds on the content of syntactic computation. On the assumption that computation is driven by the need of eliminating features from syntax which would be uninterpretable at the interface with LF and PF (Chomsky 2008 and following), phase heads can be defined as the *loci* where uninterpretable features are first-merged. They are, as such, the core of computation, i.e. the *locus* from where everything departs. Uninterpretable features are merged on phase heads and then inherited by other functional projections (like T, for instance), according to a feature inheritance mechanism described by Chomsky (2008). Following this line of thought, we will assume here that phase heads are defined, in syntax, as the *locus* of merge of uninterpretable features. In addition to this, phase heads may also be identified by PF mapping, as we will see below.



### 3.6. (A)symmetric Spell-Out

A basic (if often tacit) assumption of phase theory is that LF and PF phases are always concomitant: when a given node is spelled out, its content is sent to, and interpreted at, both LF and PF. Phase theory would be significantly weakened if it turned out that a given node could be independently spelled out at LF and PF. Chomsky (2004) is explicit in this regard.

- (12) “Assume that all three components are cyclic. [...] In the worst case, the three cycles are independent; the best case is that there is a single cycle only. Assume that to be true. Then  $\Phi$  [the phonological component] and  $\Sigma$  [the semantic component] apply to units constructed by NS [narrow syntax], and the three components of the derivation of  $\langle \text{PHON}, \text{SEM} \rangle$  proceed cyclically in parallel. L [language] contains operations that transfer each unit to  $\Phi$  and  $\Sigma$ . In the best case, these apply at the same stage of the cycle. [...] In this conception there is no LF: rather, the computation maps LA [lexical array] to  $\langle \text{PHON}, \text{SEM} \rangle$  piece-by-piece cyclically.”

Chomsky (2004: 107)

Responding to empirical pressure from various sides, though, independent access of LF and PF is proposed or considered by, among others, Marušič (2005), Marušič and Žaucer (2006), Felser (2004), Matushansky (2005), den Dikken (2007), Megerdooonian (2003) and Caha and Scheer (2008).

Modular PIC allows us to maintain strictly symmetric Spell-Out, while being able to generate the effects that the asymmetric Spell-Out literature tries to account for: the interpretation of material that is shipped to PF and LF may be vacuous. That is, the phase structure of a sentence is uniquely defined at the morpho-syntactic level. Every time a phase

head is hit upon Spell-Out, its complement is sent to both LF and PF. Every phase is thus processed by both interpretational modules, but this does not mean that an effect is systematically encountered: there are some vacuous correspondences. In other words, all phases are treated in the same way by the Spell-Out mechanism, but not necessarily at PF and LF (or in syntax for that matter).

#### **4. Abruzzese *Raddoppiamento Fonosintattico***

##### *4.1. Raddoppiamento Fonosintattico*

*Raddoppiamento Fonosintattico* (RF) is an external sandhi phenomenon that is found in most central and southern Italian varieties as well as in Standard Italian whereby the initial consonant of a word geminates, depending on the properties of the preceding word and/or the syntactic relationship between them. There is a significant body of literature, both descriptive and analytical, that addresses RF, most notably Rohlfs (1966), Nespor (1978, 1993), Vogel (1978), Fanciullo (1997), and Loporcaro (1997a,b) among many others. The phenomenon is best known in its Tuscan version (Nespor and Vogel 1979, 1986, Chierchia 1986), where stress is an important conditioning factor: RF is triggered when the preceding word ends in a stressed vowel, but does not occur after unstressed vowels. This is shown under (13)a below.

##### (13) stress-conditioning of RF

###### a. Tuscan

*la città nnuova*

the city new

‘the new city’

*la casa nuova*

the house new

‘the new house’

b. Abruzzese<sup>8</sup>*la città novə*

the city new

‘the new city’

*la casa novə*

the house new

‘the new house’

In other, most notably southern varieties such as Abruzzese (spoken in Abruzzo, a central region of Italy), RF is not stress-conditioned (see (13)b): here oxytones never trigger the gemination of the following word-initial consonant (Leone 1984, Lepschy and Lepschy 1988: 67-69, Nespor 1993, Borrelli 2002, Loporcaro 1997a and many others).

While stress may or may not trigger RF across dialects, all varieties have lexical triggers. That is, RF is observed after a lexically defined set of words. Membership in this set is arbitrary and varies from system to system in unpredictable ways: monosyllabic function words are typically involved. For example, *tre* "three", *come* "like" and *a* "to (prep.)" are lexical triggers in Tuscan: *tre ccase* "three houses", *come mme* "like me", *a mme* "to me" and so on. Loporcaro (1997a,b) and Passino (2013) provide an overview of the variation across dialects with respect to the lexical set of RF triggers. Hastings (2001) offers a list of lexical triggers for Tollo (11 km from Arielli, from where we draw our data). In Abruzzese, the set includes *gne* 'like, with', *pi* 'for', *gna* 'how', *nghi* 'with', *a* 'at', *llà* 'there' (minimal pair with the fem. sg. determiner *la*, which does not trigger RF), *qua* 'here', *(a)ccuscì* 'so', *si* 'if', *ni* (negation).

Loporcaro (1997a,b) argues that the origin of RF is the loss of Latin word-final consonants. He postulates a period of regressive assimilation of the final consonant of the first word by the initial consonant of the second word. That is, DAT PANE(M) is pronounced

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<sup>8</sup> Unless otherwise stated, the examples from Abruzzese belong to the variety spoken in Arielli (CH), Abruzzo, classified as an Eastern upper-southern Italian dialect.

*dappane*. When final consonants disappeared almost completely in late Latin-Proto Romance, the sequence with regressive assimilation was reanalyzed as a sequence of a truncated word (bearing stress) and a word with an initial geminate: *da ppane* (see also Vincent 1988 and Passino 2013).

Regarding the representational analysis of RF, we follow the classical autosegmental approach (Chierchia 1986, Loporcaro 1988, 1997a,b): lexical triggers are lexically endowed with extra syllabic space at their right edge, on which the initial consonant of the following word geminates. Nothing in the development below hinges on specific assumptions regarding representations or the kind of computation (by rules or constraints). We therefore keep our analysis as theory-neutral as possible in these two respects. On the representational side, we use minimal syllabic vocabulary that should be consensual in an autosegmental frame: x-slots without further syllabic specifications are enough to express all relevant information. The (only) difference between a lexical item that triggers RF (under (14)a) and one that does not (under (14)b), then, is that the former possesses an x-slot to the right of the last vowel, while the latter does not. In dialects where final stressed vowels trigger RF, the extra x-slot is the exponent of stress (i.e. stress materializes as syllabic space: Chierchia 1986, Ségéral and Scheer 2008).

(14) lexical items that trigger vs. do not trigger RF

a	RF trigger	RF triggered on the following #C
	x   x <b>x</b>	x   x <b>x</b> x   x   x   x   x   x
		←
	ll   a	ll   a   v   i   tʃ   i   n   ə
	llà	llà vvicinə
	"there"	"around there"

b.	no RF trigger		no RF triggered on the following #C						
	x	x	x	x	x	x	x	x	
	l	a	l	a	v	i	tʃ	i	n
	la		la vicina						
	"DET fem"		"the neighbor"						

Certain varieties have also been described as imposing syntactic conditions on RF: see for example Napoli and Nespore (1979), Nespore and Vogel (1986) and Kaisse (1985). The empirical validity of the descriptions at hand, however, has been called into question by, among others, Agostiniani (1992) and Loporcaro (1997a,b).

#### 4.2. Syntactic conditions on RF in Abruzzese: actives vs. passives

In light of the discussion above, the baseline situation in Abruzzese is the presence of a lexically defined set of words that trigger RF, with stress playing no role. Below, an additional syntactic filter is described: RF only occurs with lexical triggers when these are in a specific syntactic relationship with the following word.

The pattern under discussion here was first described by Biberauer and D'Alessandro (2006) for the village of Arielli where voice alternations are conveyed by means of RF. While active periphrastic forms do not exhibit RF between the auxiliary and the past participle, passive forms do, as exemplified in (15) and (16).

- |      |    |                      |    |                       |           |
|------|----|----------------------|----|-----------------------|-----------|
| (15) | a. | <i>So vistə</i>      | b. | <i>So vvistə</i>      | [Arielli] |
|      |    | am seen              |    | am seen               |           |
|      |    | ‚I have seen’        |    | ‚I am seen’           |           |
|      |    |                      |    |                       |           |
| (16) | a. | <i>Si rəspəttatə</i> | b. | <i>Si rrəspəttatə</i> |           |
|      |    | are respected        |    | are respected         |           |
|      |    | ‘You have respected’ |    | ‘You are respected’   |           |

Most varieties of Abruzzese exhibit person-driven auxiliary selection, whereby the auxiliary selected to form the present perfect depends on the subject person specification. While 1st and 2nd person select BE, 3rd person invariably selects HAVE, independently of verb class (D'Alessandro and Roberts 2010). The auxiliary selected for the passive is BE. This means that the 1st and 2nd person present perfect and passive have underlyingly the same form, BE+ participle. The voice alternation, however, is still present, as it is encoded by (the sole) means of RF: while active voice does not feature RF, passive does.

The monosyllabic exponents of the auxiliary BE are RF triggers in Abruzzese: 1st, 2nd and 3rd person singular, as well as 3rd person plural. An example of 3rd singular/plural passive appears in (17).

- (17) *Jè vvistə* [Arielli]  
 is seen  
 ‘He is seen/they are seen’

HAVE, on the other hand, is not a lexical trigger for RF, even when it appears in a monosyllabic form. (18)a and (18)b offer the full paradigm for active and passive voice of the verb *warda* ‘(to look)’.

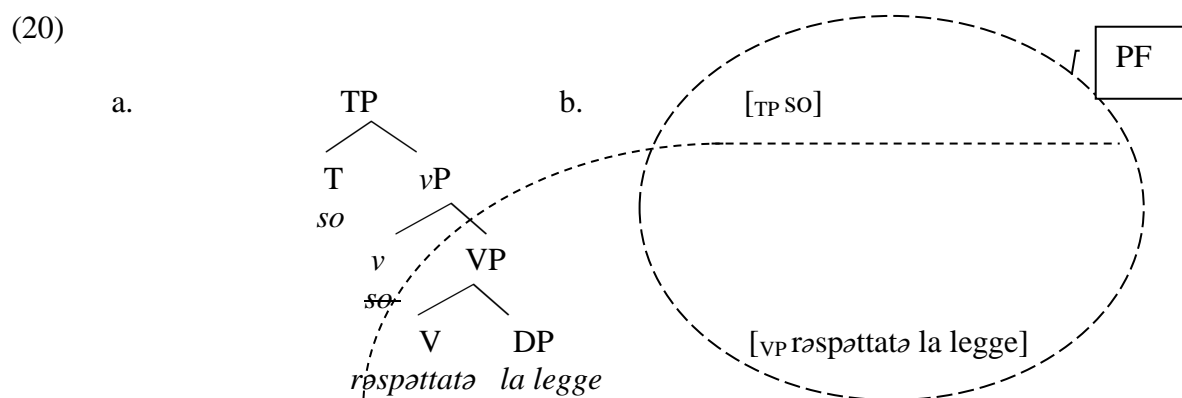
(18) a. ACTIVE	b. PASSIVE	[Arielli]
<i>so wardatə</i> (‘I have watched’)	<i>so wwardatə</i> (‘I am watched’)	
<i>si wardatə</i> (‘you have watched’)	<i>si wwardatə</i> (‘you are watched’)	
<i>a wardatə</i> ...	<i>jè wwardatə</i> ...	
<i>semə warditə</i>	<i>semə warditə</i>	
<i>setə warditə</i>	<i>setə warditə</i>	
<i>a warditə</i>	<i>jè wwarditə</i>	

Biberauer and D’Alessandro (2006) provide a number of arguments in support of the claim that the active and passive auxiliary are the same lexical item, i.e. that the voice alternation at hand is entirely determined in the syntax. This means that in the presence of a lexical trigger, specific syntactic conditions need to apply for RF to take place.

For the analysis of passives we follow the standard minimalist view according to which they present a defective *v* (Chomsky 2000, 2001). The relation between actives and passives has lost its transformational flavor in the Minimalist Program: there is no way to derive one voice from the other in the syntax. Hence *v* is specified as fully encoding Burzio’s generalization in the case of active transitives, and as defective in the case of passives, and in any case not derivable in the syntax (cf. a syntactic approach to passives in Baker, Johnson and Roberts 1989). Following Richards (2007), Gallego (2008), Uriagereka (2011) and, more recently, Chomsky (2012: 4f), we assume that phases are defined as domains in which structural case and unvalued features are valued (see section 3.5). Hence, transitive *v* and C

are phase heads, while unaccusative and passive  $v$  are defective. This means that  $v$  (or Voice, if we wish to follow Collins 2005) needs to be specified as a defective head in the lexicon prior to Merge. Biberauer and D'Alessandro (2006) propose that deficiency is equivalent to the lack of PIC: a non-defective transitive active  $v$  will be endowed with a PIC, i.e. its complement will be spelled out when the next phase head up (C) is merged. On these assumptions, the derivation for an active sentence such as (19) is as in (20).

- (19) *So rəspəttatə la leggə* [Arielli]  
 am-1.sg respected.sg the law.sg  
 'I have respected the law'



The auxiliary and the participle are in different Spell-Out domains and therefore belong to two different chunks at PF. Since transitive active  $v$  is endowed with a PIC at PF, RF will be blocked between the auxiliary and the participle (Biberauer and D'Alessandro 2006). If however  $v$  is defective, as it is in passives, it is not a phase head. This means that, vacuously, no PIC can be associated with it, and that the whole complement of C will be spelled out in one single chunk. Consequently, the auxiliary and the participle belong to the same PF domain and RF will be able to operate. The derivation of the relevant passive sentence in (21) is shown in (22).

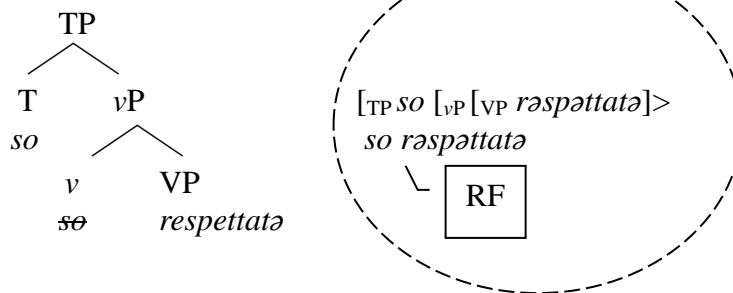


(21) *So rrəspəttatə (da tuttə quində)* [Arielli]

am-1.sg      respected.sg    by all

‘I am respected by everyone’

(22)



The active-passive distinction can be straightforwardly analysed as shown, i.e. with a minimal inventory of phase heads and full concomitance of Spell-Out and PIC. However, there is reason to believe that this tool box is insufficient.

#### 4.3. Abruzzese unaccusatives

The nature and existence of *v* for unaccusative verbs is a widely debated topic. According to Chomsky (1995: 315f), unaccusatives do not feature a *v*. Many studies have investigated the accuracy of this statement, and have also examined the question of whether the nature of *v* in unaccusatives, if it is present, is different from the nature of *v* in unergatives/active transitives. The volume by Alexiadou, Anagnostopoulou and Everaert (2004) is almost completely devoted to this topic, while Borer (1994, 1996), Travis (2000), Kratzer (1996), van Hout (1996), Marantz (1997), Ramchand (1997), Ritter and Rosen (1998), Harley and Noyer (2000) and Legate (2003) all discuss the nature of the functional head(s) above the VP. Most authors agree that *v* is defective in unaccusatives; this assumption is sustained by theta-

and argument structure related considerations as well as by feature-related aspects. For instance, Nominative case is not assigned by  $v$  to its internal argument in unaccusatives, hence there is no valuation of unvalued features within the  $vP$  (see Chomsky 2005, 2012, Gallego 2008).<sup>9</sup> Under the assumption that Spell-Out and the PIC are concomitant, this means that we expect unaccusatives to go along with passives as far as RF is concerned: being defective, unaccusative  $v$  is not a phase head. Spell-Out thus occurs only at C, which means that the entire TP ought to be transparent for syntactic and phonological computation.

However, contrary to expectation, RF in Abruzzese is blocked with unaccusatives, as shown in (23).

- (23) *So rəmastə* [Arielli]  
 am-1st.sg stayed-sg  
 ‘I have stayed’

Unaccusatives differ from passives not only in not triggering RF, but also in auxiliary selection. In the third person, unaccusatives pattern with transitives in selecting the auxiliary HAVE, while passives select the auxiliary BE. Observe the contrast between (24), where the verb is unaccusative (3rd person), and (25), where the verb is transitive passive (3rd person)

<sup>9</sup> By contrast, Legate (2003) argues for a fully phasal nature of what she calls the VP, meaning some sort of vP associated with unaccusatives and passives.



Passives and unaccusatives are syntactically different, not only because the former do not induce a PIC effect at PF while the latter do but also, as was shown in (24)-(25), as they have different auxiliary selection. While unaccusatives follow the transitive pattern by selecting the auxiliary according to the subject person specification, passives always select the auxiliary BE. This suggests that the key factor in syntax, corresponding to the PIC effect at PF, is voice rather than transitivity (Biberauer & D'Alessandro 2006 arrive at the same conclusion). We take this to mean that PIC at PF is linked to an active value for the *voice* feature on *v*. This feature value seems to be the syntactic correlate to the PIC effect at PF.<sup>11</sup>

#### 4.4. The fourth pattern: PIC in syntax, but no footprint at PF

We have so far illustrated the first three lines of table (5). Abruzzese also offers an example of the fourth logical combination, i.e. a PIC associated with Spell-Out at syntax, but not at PF. This is the cross-linguistically trivial case in which a syntactically motivated phase does not leave any footprint in phonology (as in English t-flapping). Consider the example in (27).

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<sup>11</sup> Recall, however, that it is not always possible to find a featural syntactic correlate for a PIC effect at PF.

To account for the same data, Biberauer and D'Alessandro (2006) propose the existence of a Voice head which, when active, is a phase and has an impact on PF. Under this view, unaccusatives are expected to pattern with transitive actives and not with passives. On the basis of participial agreement and of the distribution of auxiliaries, however, D'Alessandro and Roberts (2010) and D'Alessandro and Ledgeway (2010) show that the Voice head (or the higher *v* as they call it) is not a phase head. We therefore follow the argumental view in which passives and unaccusatives share an internal argument and it is simply the value specification of the *voice* feature on *v* what correlates with the PIC at PF.

- (27) *Jè mmeje chə vve* [Arielli]

Is better that comes

‘It’s better that (s)he comes’

- (28) *Jè mmeje chi nni vve*

Is better that not comes

‘It’s better that (s)he doesn’t come’

Assuming that *chi* sits in C<sup>12</sup> and that C is a phase head in syntax (Chomsky 2000), we see that RF is free to operate between the complementizer *chi* and the finite verb in T (21), as well as between *chi* and negation (28). Note that in the presence of a different complementizer, *ca*, which is not an RF trigger, the finite verb does not exhibit RF.

- (29) *Penzə ca ve* [Arielli]

think that comes

‘I think that (s)he comes’

Negation also does not geminate after *ca*.

- (30) *Penze ca ni vve* [Arielli]

think that not comes

‘I think that (s)he doesn’t come’

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<sup>12</sup> Abruzzese has three complementizers (Rohlf, 1969: 190, 1983; Ledgeway 2009: §4.3; D’Alessandro and Ledgeway 2010): the declarative *ca*, the irrealis *chə* and the jussive *ocche*. *Chə* is an irrealis complementizer introducing unselected clauses. We will not pursue a fine-structural analysis of the left periphery of the clause, and simply assume that both *chi* and *ca* sit in C (or in a C-head).

Further evidence for this perspective comes from relative clauses. In (31), RF applies between the relative pronoun *chi* and the subject in Spec,TP. Assuming that *chi* is in the specifier of C, we have to conclude that the phonological material corresponding to C is still visible to phonological computation.

- (31) *Lu waglionə chi ttu si vistə* [Arielli]  
       the boy       whom   you are seen  
       ‘The boy you saw’

## 5. Bantu: phonological domains identified by tone spreading

### 5.1. Cheng and Downing's data and analysis

In a number of recent papers, Cheng and Downing (2007, 2009, 2012) and Downing (2010, 2011) outline arguments in favor of Non-Isomorphism, i.e. the absence of one-to-one correspondence between prosodic constituents and syntactic Spell-Out domains (see sections 2.1. and 2.2).

Generally in Bantu, the right edge of phonologically relevant domains is marked by penultimate vowel lengthening (Kanerva 1990). This is the case for example in Zulu and Chichewa, studied by Cheng and Downing (2012): the second but last vowel of a domain is long (and there are no other long vowels). Hence the presence of a long vowel is indicative of a domain boundary that occurs to the right of the following vowel. Its absence on the other hand assures the absence of a domain boundary. Applying this diagnostic, (32)a shows that the verb always belongs to the same domain as its objects: there is only one long vowel in the sentence (in penultimate position). (32)b demonstrates that subjects are isolated, and appear in a domain on their own when they receive a topic interpretation: in addition to the

penultimate long vowel of the string, another long vowel identifies the domain of the subject. The control under (32)c where the subject is not interpreted as a topic shows that topichood is really responsible for the subject-isolation in (32)b: the subject remains unmarked and there is only one long vowel in the entire string.

- (32) a. (bá-níké ú-Síphó íí-maali) Zulu  
 2SUBJ-give CL1-Sipho CL9-money  
 ‘They gave Sipho money.’
- b. (ín-kósíkaazi) (í-théngel’ ábá-fán’ ízím-baatho)  
 CL9-woman 9SUBJ-buy.for CL2-boy CL10-clothes  
 ‘The woman is buying clothes for the boys.’
- c. (ú-Síph’ ú-phékél’ ú-Thánd’ in-kúukhu)  
 CL1-Sipho 1SUBJ-cooked.for CL1-Thandi CL9-chicken  
 ‘Sipho cooked chicken for Thandi.’

Cheng and Downing (2012:6)

Cheng and Downing provide examples of similar patterns in Kinyambo, where the cue for the dection of domains is High Tone Deletion, and in Luganda, where the cue is High Tone Anticipation. The patterns are essentially identical, and they all show the same thing: that domain boundaries do not occur where phase theory predicts they do. One relevant data set in this respect are relative clauses.

- (33) We invited [<sub>DP</sub> the [<sub>CP</sub> **students** [<sub>C</sub> **that** [<sub>TP</sub> *Tracy taught to ski*]]]] to visit the Alps.

Cheng & Downing (2012: 10)

Given the restrictive relative clause structure in (33), current phase theory predicts that the head and specifier of the CP (in bold) are spelled out separately from the TP (in italics). Hence under an isomorphic mapping system, phonological material representing TP on the one hand and C as well as Spec,C on the other should fall within separate phonological domains. This prediction, however, falls foul of the workings of Chichewa, as shown in (34).

- (34) (ma-kóló a-na-pátsíra [DP [CP mwaná a-méné á-ná-wa-chezéera]]) [Chichewa]  
 CL6-parent 6SUBJ-PST1-give CL1.child 1-REL 1SUBJ-PST2-6OBJ-visit

( [DP ndalámá zá mú-longo wáake]] )

CL10.money 10.of CL1-sister 1.her

‘The parents gave [the child who visited them] money for her sister.’

Cheng and Downing (2012:10)

As before, phonologically relevant chunks are identified by penultimate vowel lengthening, which marks right domain edges. This identifies two domains (ending in *chezéera* and *wáake*, respectively). The fact that no other vowel lengthens to the left of *chezéera* establishes that the domain runs all the way to the beginning of the matrix sentence. Cheng and Downing conclude that phonologically relevant domains in Luganda cannot be identified by phase structure. They therefore argue in favor of the classical Prosodic Phonology architecture whereby the output of Spell-Out needs to be mapped (or readjusted in terms of SPE) by a specific mechanism that creates extra structure, i.e. prosodic constituency. In the current OT-based environment, the mapping mechanism manifests itself as ALIGN constraints, which in Cheng and Downing's analysis can be expressed as under (35) for Luganda.



## (35) a. ALIGNR (IP/TP, IntPh)

Every syntactic IP/TP is right aligned with a prosodic Intonation Phrase

## b. ALIGNT (IntPh, IP/TP)

Every prosodic Intonation Phrase is right aligned with a syntactic IP/TP.

The same holds for the simple clause. In Bantu, the finite verb moves to T, while whenever an argument leaves the VP, a clitic appears on the verb. This makes the identification of the first-merge or landing sites of arguments quite straightforward. In a simple ditransitive sentence, if the verb has moved to T while the direct and indirect object remained *in situ*, we would expect the verb in T (in bold in (36)) on the one hand and the direct/indirect objects (in VP, in italics) on the other to belong to different Spell-Out domains. In current isomorphic phase theory, this then also means that they must belong to two distinct phonological domains.

(36) [CP [TP **subject verb** [<sub>VP</sub> [<sub>VP</sub> *IO DO*]]]]

Cheng and Downing (2012: 8)

We have already seen in (32)a that contrary to the isomorphism-based prediction, the verb in Zulu belongs to the same phonological domain as IO and DO. As before, Cheng and Downing conclude that phonologically relevant chunks may be larger than what is predicted by phase structure, and therefore need to be defined independently from Spell-Out domains.

## 5.2. Phonologically vacuous Spell-Out

Spell-Out and phonologically relevant domains do not coincide in Cheng and Downing's analysis only if it is assumed that every Spell-Out necessarily leaves a trace in phonology, i.e. is associated with a PIC. On the assumptions of Modular PIC, this is not the case. Therefore there is no need to postulate any mapping or transformation of syntactic Spell-Out domains into extra structure (prosodic constituency). In the case of both relative clauses and simple ditransitives, there is no PIC associated with the phase heads *C* and *v* respectively at PF. That is, phonology does receive two distinct chunks, but these are computed together. In the case of (32)a, for instance, we have a Spell-Out at syntax, meaning that both the IO and DO become invisible for further syntactic computation and can no longer move out of the *vP*, but at PF they are still visible to the verb and the subject. Therefore there is no additional long vowel identifying the Spell-Out domain that Cheng and Downing expect to find.

Note that the Modular PIC analysis may be falsified language-internally. If a particular phenomenon suggests that a phase head, say *v*, lacks or is endowed with a PIC at PF, the PIC is expected to be lacking (or to be present) in all constructions involving the head and that phenomenon in this particular language. This means that in Bantu we expect *v* never to produce domain-identifying long vowels, while in Abruzzese we expect active *v* always to block RF when expressing voice. This prediction seems to be borne out.

## 6. Conclusions

Modular PIC is a means of advancing phase theory in the sense of the Strong Minimalist Thesis: it is adapted to the needs of an interface, PF. Its benefits are also minimalist in kind: a unified interface theory emerges in which the number of devices required to run grammar is

cut down. Rather than having two chunk-defining devices, there is only one – phases – for both syntax and phonology, which means that the same labor is not carried out twice. The same is true for the corresponding structure: instead of phase structure and parallel prosodic constituency, only the former is operational.

Modular PIC makes phase theory more flexible, which allows us to gain ground on the minimalist side while maintaining the empirical insight that syntactically and phonologically relevant chunks may not coincide (non-isomorphism, which goes back to SPE and the 1980s). We have shown that each configuration of the four-way parametric space that is opened by Modular PIC (see (5)) has an empirical echo: phase heads are always spelled out (there is a unique phase skeleton for every language), but any given phase head may or may not be associated with a PIC in syntax, and may or may not be associated with a PIC in phonology.

Another effect that is certainly welcome in a minimalist environment is that phonological evidence now contributes to the discovery of phase heads too: while only syntactic evidence is currently used in order to identify which nodes are phase heads, any time a footprint is left in phonology, we gain information about the makeup of the phase skeleton of the language. Note that this bimodular control of phase structure also opens the way for intermodular argumentation: competing theories in one module may be refereed by evidence from another module (Scheer 2008, 2009).

Looked at from below, i.e. from phonology, Modular PIC shifts the perspective to an angle where the interface is conceived in terms of visibility: just like in morphology where boundaries may or may not be visible to the phonology, a choice is made by the language as to whether to flag or not flag a given phase boundary on the (PF-)surface.

Modular PIC also supports the Chomsky-Borer Conjecture (e.g. Biberauer 2008, Baker 2008, Roberts and Holmberg 2010). Whether or not cyclic derivation leaves a footprint in

either syntax or phonology depends only on lexical information: whether or not a given item is a phase head, and whether or not a given phase head is endowed with a PIC (at syntax and/or at phonology). Note that the current means of expressing non-isomorphism (the noncoincidence of syntactic and phonological domains) is computational, rather than lexical: an extra mapping mechanism (ALIGN constraints in OT) defines which syntactic information is transformed into prosodic constituency.

Finally, consequences for phonological theory are significant: besides the fact that postlexical phonology (i.e. phonology across word boundaries) may make reference to cyclic structure (while it has been thought to be non-cyclic since Kiparsky 1982), the entire Prosodic Hierarchy is superfluous and has to go. Its function is taken over by a version of phase theory made more flexible. A side-effect of this move provides another wider benefit, though one that may produce multiple shockwaves in the architecture of OT: ALIGN constraints are a major source of modularity violations (Scheer 2011: §523). Unlike in the original architecture of Prosodic Phonology, they put mapping, i.e. the translation of morpho-syntactic into phonological structure, *into* the phonology. ALIGN constraints make regular and necessary reference to morpho-syntactic categories, but are a piece of phonological computation (they are interspersed with other phonological constraints in the same constraint hierarchy). Hence they violate Indirect Reference, which is the incarnation of the modular requirement of domain specificity (see section 2.1). Modular PIC eliminates prosodic constituency and the extra computation by which it is created, i.e. ALIGN constraints in OT. ALIGN being a central device in OT – in historical terms too (e.g. Itô and Mester 1999, McCarthy and Prince 2001: vii) – its elimination offers an opportunity to reposition the theory in a modular perspective, but certainly represents a challenge: what would OT look like without ALIGN?

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