A Multiple Interface Approach: Radical Minimalism and the Pragmatic Role of Phonology

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Abstract:

In this paper we will analyze and discuss the architecture of the language faculty assumed in Radical Minimalism and the place the phonological component has in constraining structure generation, given a free, unbounded generative algorithm and contextual requirements. We will focus our attention in the syntax-semantics / pragmatics-phonology interface, acknowledging that none is to be studied in substantive isolation but seeking deep explanation of phenomena in the interaction between those components, each of which has specific properties that have to be taken into account. After an overview of Radical Minimalism in Part I, the pragmatic-communicative value of suprasegmental phonology will be considered from this perspective in Part II, taking as theoretical background not only Radically Minimalist assumptions but also Optimality Theory and Relevance Theory; and drawing on empirical data from Spanish, English and Latin.

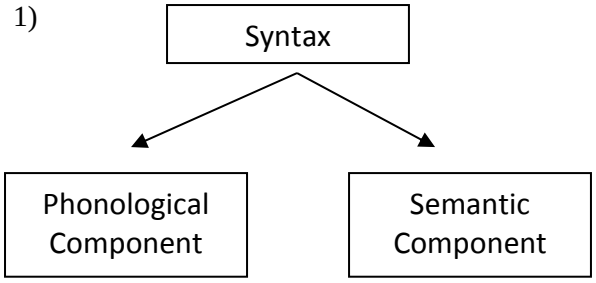
Keywords: Interfaces; phonology; semantics; syntax; pragmatics; Radical Minimalism

Part I: Overwiew

1. Introduction

The present work will depart from a methodological consideration, which also affects the conception we will put forward regarding the architecture of the linguistic system: the phonological exponent of a given node does not provide at all a clear path to understanding its syntax, and even less so, its semantics. Consider the well-known and influential Y-model, traceable to the Standard Theory (see particularly Chomsky, 1965), but used, although many times implicitly, in other theories of functional roots:

1)



Research within generative grammar (and other models, like Systemic Functional Linguistics and, needless to say, Structuralism) has taken the Phonological Component-Syntax path, which means *in*ducing syntax from phonology (e.g., Kayne, 1994; Moro, 2000). Of course, this methodological choice has led to progress within the descriptive field, as Koster (2010) points out, but little progress regarding explanation has been made, because semantic structure has most frequently been wiped under the rug. Moreover, this line of inquiry has the following additional problem: generation is completely divorced from interpretation, in such a way that there is a single active generative component and the interfaces are completely passive. The syntax disposes and the interfaces read, configuring a unidirectional system. Interpretative systems constrain generation by means of legibility conditions on the output of the syntactic generator, but such a system has either been proven inaccurate in its current form (Putnam, 2010) or replaced by such a strong generator that legibility conditions are superfluous (e.g., Pesetsky & Torrego, 2007). This posits a problem, from both a theoretical and an empirical point of view. Theoretically, the architecture of the language faculty has superfluous elements in a strongly constructivist system, namely, the interfaces. Moreover, definitions of central concepts like *recursion* are modeled upon what is functional to this or that theory, giving rise to multiple misunderstandings (see the recent Everett-Pesetsky debate on recursion in Piraha). Throughout the history of Generative Grammar, the *locus* of semantic interpretation has not been clear at all, and its relation to phonology was sometimes close, sometimes completely distant. In the last stages of the Extended Standard Theory, for example, S-Structure was also responsible for semantic interpretation, as phenomena like topic and focus was the result of applying a transformational rule to D-Structure. On the empirical side, a fundamental assumption is needed, which Culicover & Jackendoff (2005) formulate as follows for Mainstream Generative Grammar:

***Interface Uniformity:* (Culicover & Jackendoff's version)**

The syntax-semantics interface is maximally simple, in that meaning maps transparently into syntactic structure; and it is maximally uniform so that the same meaning always maps onto the same syntactic structure. (2005: 6)

A corollary is in order:

Structural Uniformity:

An apparent defective or misordered structure is regular in underlying structure and becomes distorted in the course of the derivation. (2005: 7)

These assumptions require a *polystratal* theory, in which an underlying representation Σ is uniformingly mapped onto Σ' via a set S = $\{r_1, r_2, \ldots r_n\}$ of transformational rules. In minimalism, S is a unary set, containing the rule Move-α. However, substantive triggers for the rule are required (say, EPP features, Edge Features, and so on), so that the situation is not as simple as one would assume *a priori*. This univocal situation of correspondence between a syntactic representation Σ and its counterparts Φ (for phonology) and Λ (for the conceptual system) also leads to mistakes analyzing the data. Some of these assumptions have been shared with non-generative theories (like SFL), on which we will come back below. The main objection is that the theory requires the object to be much more static and monolithic than it is in the phenomenological world.

Three alternative approaches have emerged in recent years: Jackendoff's (2002) *Parallel Structure*, Stroik & Putman's (2009, in press) *Survive Minimalism* and Krivochen's (2011a, b, 2012a, b) *Radical Minimalism*. Without dismissing the potential of the others as alternatives, we will set our focus on the view from Radical Minimalism, occasionally coming back to features of these other alternatives. RM is a newly developed framework that departs from the following basic assumptions:

a) Language is part of the "natural world"; therefore, it is fundamentally a physical system.

b) As a consequence of (a), it shares the basic properties of physical systems and the same principles can be applied, the only difference being the properties of the elements that are manipulated in the relevant system.

c) The operations are taken to be very basic, simple and universal, as well as the constraints upon them, which are determined only by the interaction with other systems.

d) (b) and (c) can be summarized as follows:

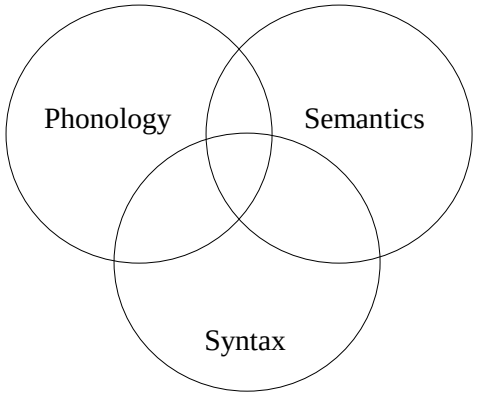
e) **Strong Radically Minimalist Thesis (SRMT):**

All differences between physical systems are "superficial" and rely only on the characteristics of their basic units [i.e., the elements that are manipulated], which require minimal adjustments in the formulation of operations and constraints [that is, only notational issues]. At a principled level, all physical systems are identical, make use of the same operations and respond to the same principles.

From SRMT, the regularities that have been found regarding the structure of each faculty in the context of a massively modular mind follow straightforwardly (Katz & Pesetsky's, 2011 "Identity Thesis" as an example), as well as the parallels existing between subpersonal systems (i.e., mental faculties) and other biological / physical systems (see Uriagereka, 1998 for some examples and references). It seems relevant to insist on the fact that we are not making a reduction of biology (as language is ultimately a biological system, if Chomsky's claim that language is a natural object is accepted) to physics (and that our use of RM in mathematics and physics is not a metaphor), but simply analyzing a biological phenomenon in physical terms, as a physical system (in which there is no contradiction whatsoever) and, as such, applying the tools that have been devised in physics and mathematics in the degree that it is possible, and without confusing the methodological tools with substantive elements. Of course, looking for exact correlates between any two fields would be irrational in the substantive level (i.e, units of analysis, as Poppel & Embick, 2005 correctly point out), but we put forth that the methodological level has much to tell us, as they are all "parcels" of the same Universe that, we tried to show in our previous work and will also argue here, are identical in a principled level of abstraction.

Let us go directly into the matter in hands, making some considerations on the following graphic, in which each of the circles is a set S whose characteristics we will formalize below:

2)



So, given this state of affairs, let us define the interactions between these sets:

3) Phon ∋ {± voiced, ±back, ±round…*n*}

   Sem ∋ {cause, location, event…*n*}

   Syn ∋ {∅}

We claim that Syn is an empty set because it is an operation (*not* an object, crucially), a concatenation function defined as follows (Krivochen, 2012a: 5):

4) **Definition 3:** *concatenation* defines a *chain* of coordinates in *n*-dimensional generative workspaces W of the form $\{(x, y, z…n) \supset W_X \ldots (x, y, z…n) \supset W_Y…(x, y, z…n) \supset W_n\}$.

This means that complexity arises as a result of concatenation of elements of different nature in different workspaces, but all manipulated by the same operation. A strong version of this thesis, and the one we will put forth, is that all complexity in the physical Universe is the result of the successive application of *Concatenation*. Let us now define formally the intersections between the sets, and exemplify so that the reader has a clear idea of where we will be standing the rest of the paper:

5) Sem ∩ Phon = interjections

   Sem ∩ Syn = conceptual structures (see Jackendoff, 2002)

Syn ∩ Phon = musical capacity

Syn ∩ Sem ∩ Phon = natural language

This formal definition allows us to have an unambiguous characterization of so-called "natural language" as the intersection between a computational system and systems providing substance to be manipulated, without implying that these systems are not themselves computational. Our focus will be set on the interface between phonology and the other systems, accepting, as the simplest case, that all constraints over representations are interface conditions, and not intra-systemic stipulations. In other words, given the fact that *concatenation* is a free *n*-ary operation, it would be stipulative to restrict its power via computational filters. We thus leave the bargain to legibility conditions, which have to be formulated anyway.

Now, what exactly is the place for pragmatics in this architecture? Given the fact that we adopt a Relevance-theoretic approach to pragmatics, that is, we think of pragmatics from an internalist point of view, we will situate it in the *interface* between the aforementioned components. Not the intersection, as there is no particular feature that can be regarded as "pragmatic feature", but pragmatics will be interpreted as a series of interpretative derivational steps via which inferences are drawn, a context-sensitive mechanism that takes data from different components and combines it syntactically with contextual propositions to draw inferences, that is, new information. Pragmatics is, then, not a component but a set of computational routines or algorithms that involve different kinds of information, particularly contextual propositions.

Before entering the realm of phonology, we will make some general considerations on the nature of Syn, Phon and Sem representations to spell their characteristics out and have thus a crystal-clear introduction to the framework in which our considerations on suprasegmental phonology will develop.

1.1 On the Nature of Syntactic Representations:

This framework allows us to manage symbolic representations in a way in which we can best capture their essential property, *hierarchy*, while accounting for epiphenomena in terms of interface conditions. Let us first review the classic X-bar theory axioms, which characterized phrase structure in the Government and Binding model (Chomsky, 1981 et. seq.) and underlie most current models of phrase structure to different extents:

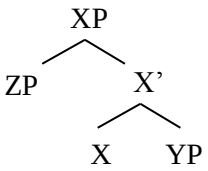
1. Endocentricity: every projection has a head

2. Projection: every head projects a phrase

3. Binary branching: every non-terminal node is binarily-branched

The kind of structures generated by this system is as follows:

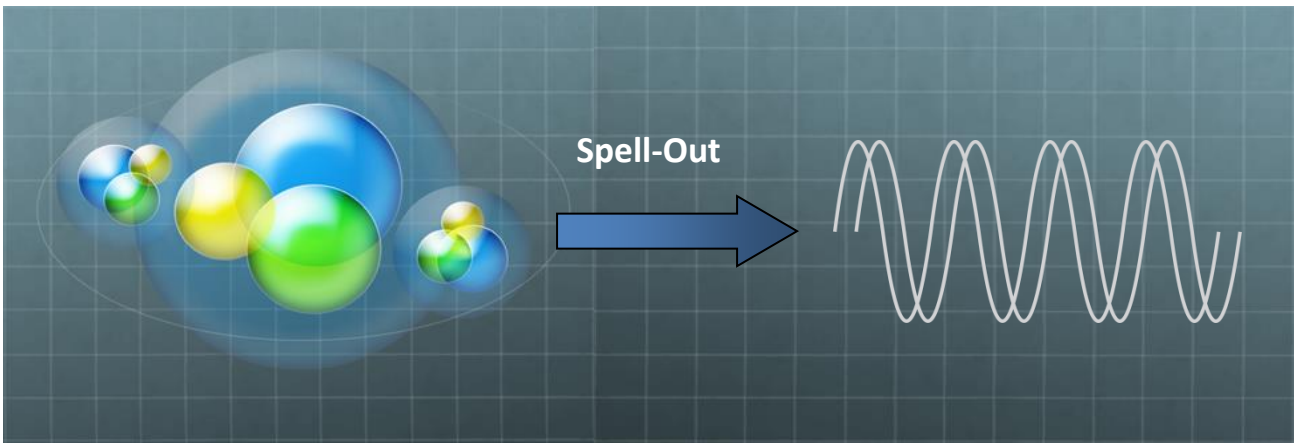
6)



These are bi-dimensional representations within the syntactic workspace, then Spelled-Out. It is commonly assumed that Spell-Out implies a "flattening" of the hierarchical structure onto a linear representation: our claim is that there is no *essential* difference between a tree-like representation and its linearized form. Syntactic derivations have been claimed to be either *bottom-up* (Chomsky, 1995 and other orthodox works) or *top-down* (Zwart, 2009, in a different framework, Uriagereka, 1999), but always maintaining the underlying assumption that the *up-down* opposition is defining for syntactic processes: c-command is *top-down*, whereas m-command is *bottom-up*; Agree is also a *directional* operation (although there is no general agreement with regard to whether it is top-down or bottom-up, see Zeijlstra, 2011 and Putnam, Van Koopen & Dickers, 2011) and, given the fact that syntactic operations in orthodox Minimalist syntax are driven by the need to check features via Agree, directionality is centrally embedded within the theory. Syntactic structures, then, are *bi-dimensional*, only differing from phonological representations in epiphenomenal characteristics, like *headedness* or

binarity which, as we have shown here and in past works, are Conceptual-Intentional (C-I) *interface requirements*. If a true qualitative difference is to be found between syntax and phonological externalized structures, then the nature of syntax must be revisited, as we have done. In our system, there is a difference between *syntax* and *phonology* regarding the dimensions of each domain: syntax is *n-dimensional*, and its conversion to phonology implies flattening the structure to have *two dimensions* (we will analyze phonological representations below). The representations would look as follows:

7)



In figure (7) we show how a syntactic structure -whose more exact representation, in our opinion, is that of an atom, with a *nucleus* (but no *head*) and peripheral elements (so-called *specifiers*, *complements* and *adjuncts*, all derived from the assumption of headedness) - is converted into externalized sound waves, after inserting Vocabulary Items in the syntactic terminals: semantic information has phonological correlates.

To summarize our proposal, we will briefly explicit the features of syntactic representations, this is, symbolic representations built by *Concatenation* in whichever (Hilbert) workspace:

- They are *n*-ary sets (this is, binarity, if existent, is an interface requirement)

- They are *n*-dimensional, depending on the characteristics of the workspace (e.g,, Calabi-Yau forms require *Concatenation* to apply in –at least- a 6-dimensional workspace)
- They are recursive in the following sense: they are the result of an operation applying more than once in the course of a derivation.

1.2 On the Nature of Conceptual Representations:

In this section we will define some features of conceptual representations. First of all, we will make it clear that we will discuss the properties of *conceptual* and not *semantic* representations, since we have a definition of *concept* (following proposals like Jackendoff's 2002; Talmy, 2000, among others), whereas the definition, scope and object of *semantics* remain unclear. Conceptual representations are mental representations of our apprehension of the world via sensorial stimuli, which are organized syntactically in order to have a structured perception of the physical world. As the raw material for conceptual representations comes from different faculties, those in closer relation to the physical universe (e.g., the visual faculty, the auditory systems, etc.), the requirements that the corresponding module must be underspecified enough to deal with different kinds of data. Conceptual representations, *a priori*, are *n*-dimensional, with the possibility of *computing* 1-D, 2-D and 3-D stimuli (i.e., points, lines / planes and solids in Euclid's terms), but, as far as modern neuropsychology tells us, there is no way to *perceive* the 4^{th} dimension unless converted to 3-D representations (e.g., drawings of *hypercubes*). However, we can perfectly *conceive* a 4^{th} dimension, even if there is no way to access it empirically. A possible explanation for this is that 4-D stimuli do not form part of the input we receive, and thus considerations of brain maturation with basis on sensitive data would come into play against a mature brain having the capacity to perceive 4-D objects, but not to dismiss it as a theoretical possibility. Conceptual representations are fundamentally *locative*, and built syntactically between the *temporal* lobes (*Figure*) and the *parietal* lobe (*Ground*), once the prefrontal cortex is activated, originating Ws whose objects are later assembled in a third W, as we have claimed above. Any *n*-dimensional W needs some operation like Merge to organize the material into hierarchical

representations, so we are dealing with a very complex system, possibly analogous to Fodor's *Central Processor*, a system that is interpretative and generative. This suggests that the mind-brain is dynamic enough to have systems that can be both generative *and* interpretative as required by the input. This conception of the mind-brain follows the line of the *Quantum Human Computer Hypothesis* (Salmani Nodoushan, 2008; Krivochen, 2011b, forthcoming): systems are dynamic, and an element comprises all of its possible outcomes (i.e., the interpretation it receives at some point in the derivation) until *Transferred*. An essential point to make is that the weight of concepts and phonology in language is not symmetrical: this is, there could be no "language" without concepts, as they provide the objects that are manipulated by Merge, but phonology is by no means a necessary requirement. Generic concepts are instantiated in *roots*, which are semantically underspecified and thus have to be Merged to procedural elements to be interpreted. For example, a root like √TABLE (we use English words, but roots are universal and thus language-neutral) denotes a generic entity (which is not a Universal Quantification interpretation: in a UQ interpretation, we have a set and the extension of a predicate is the whole set. In genericity as we are manipulating the concept here, we are dealing with the abstract idea of "table", which is pre-categorial). Generic entities, either eventive or sortal, cannot be read by the semantic interface C-I, and so Determiner (for sortal entities) and Time (for eventive entities) must come into play. This gives rise to a *conceptual-procedural* derivational dynamics that is interface-driven, and therefore *principled*, non-stipulative. If our derivational model generates a Procedural-Conceptual (P-C) dynamics such that there is a periodic alternance of Conceptual elements – argumental in nature- being under the logical scope of Procedural functors (as has been made explicit in previous works, mainly Krivochen, 2012b), it is not because there is a stipulation, but because our syntax is blind and unbounded, and constraints are third-factor principles. As there has been no clarification regarding the nature of these principles in Generative Grammar, we think a biologically-(third-factor) based, computationally explicit version of Relevance Theory (RT) can provide significant insight into the operations that take place at C-I, and the three factors model is a very powerful tool even if RM explicitly rejects the existence of FL in the Chomskyan sense. We can thus improve the explanatory adequacy of Relevance Theory by enriching it with Radically Minimalist assumptions and get as a result a comprehensive model of the interaction between the syntactic

workspace and the interfaces, whatever they are (since, as the reader must have noticed, there is no substantive claim regarding units or levels of representation in Relevance Theory). In such a model, the optimal scenario, and the one we have in mind, is that *all operations are interface-driven, and, thus, ruled by formalized, biologically-oriented version of Relevance Principles*:

- *Human cognition tends to be geared to the maximization of relevance* (possibly, by biological adaptation, Manuel Leonetti, p.c.)
- *Every ostensive stimulus carries the presumption of optimal relevance*

We believe there is a close relation between third-factor requirements, architectural constraints that affect the very basis of the systems, and the principles of relevance, which would strengthen the hypothesis that Relevance Theory is an *internist* theory which works at a *subpersonal* level to provide *principled explanations* of the functioning of the inferential module. The so-called "third factor principles", to which we think Relevance Principles belong, are the following (Chomsky, 2005: 6):

a) Principles of external data analysis (Cf. RT's *second Principle*)
b) Principles of computational efficiency, and architectural constraints related to development of systems.(Cf. RT's *first Principle*)

Let us exemplify our position with the derivation of *explicatures* and *implicatures* in a Relevance-Theoretic approach.

Inferences within RT are classified in two types:

- Explicatures: fully-fledged propositions, result from an enrichment of the Logical Form that reaches the interpretative semantic component. These LFs are incomplete propositional forms, which contain unfilled referential variables (either eventive or sortal), to be completed with procedural information (from T or D respectively). Explicatures are the representation of the *explicit* content, not to be confused with the *encoded* content: the former is conveyed by procedural and conceptual elements combined and is inferential in nature, whereas the latter is

the result of decoding the information conveyed by each of the elements separately, without necessary association. In turn, explicatures are usually divided in two:

- *Propositional explicatures*: those related with decoding, referent assignment, disambiguation and semantic enrichment processes.
- *Higher-level explicatures*: those related to the illocutionary properties of the utterance, functors of propositional explicatures.

Implicatures: the result of a context-sensitive inferential process applied to propositional explicatures, so that a propositional explicature is computed in a "context" formed by other propositions, either immediately recoverable from the phenomenological environment or part of the more general knowledge of the world of the subject.

However, this scenario would be incomplete if we do not take into account a third variable: phonology-phonetics. The availability of vocabulary items to be inserted in terminal nodes will be proved essential for generating drastic interface effects at C-I: implicatures and explicatures.

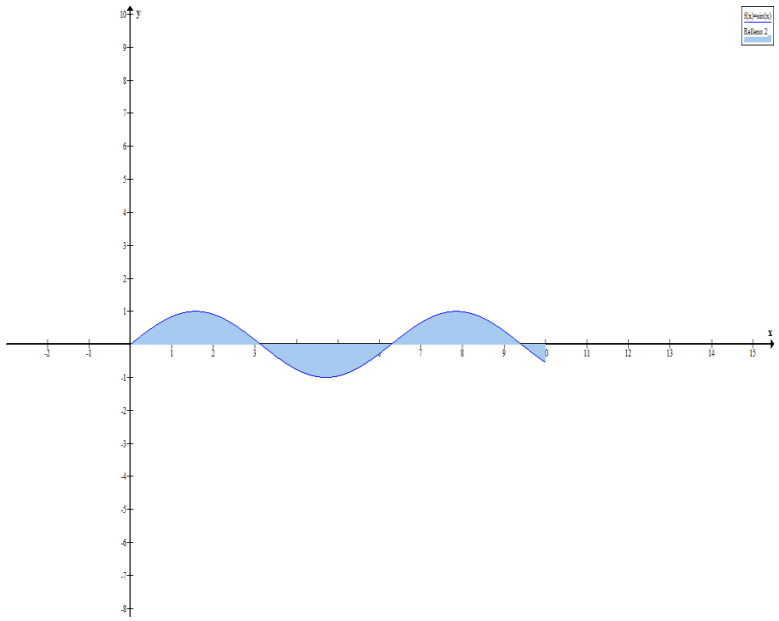
This path leads to a highly desirable conclusion: a dynamic, interface-driven derivation with biological plausibility instead of feature-driven operations whose justification lies only within the theory.

1.3 On the nature of Phonological Representations:

We will now turn to the other relevant interface: the so-called Sensory-Motor (S-M) system, responsible for sound perception and articulation of the vocal organs. Phonological representations define a 2-D system, which implies a necessary *dimensional impoverishment*, from $n > 2$ to 2. It may seem that the linearity of the *signifié* (à la Saussure) would define a 1-D system, but sound externalization systems require at least and, optimally, maximum, 2 dimensions: wave *frequency* and *longitude*. We can thus describe any string of sounds (e.g., an utterance) as a set of coordinates S =

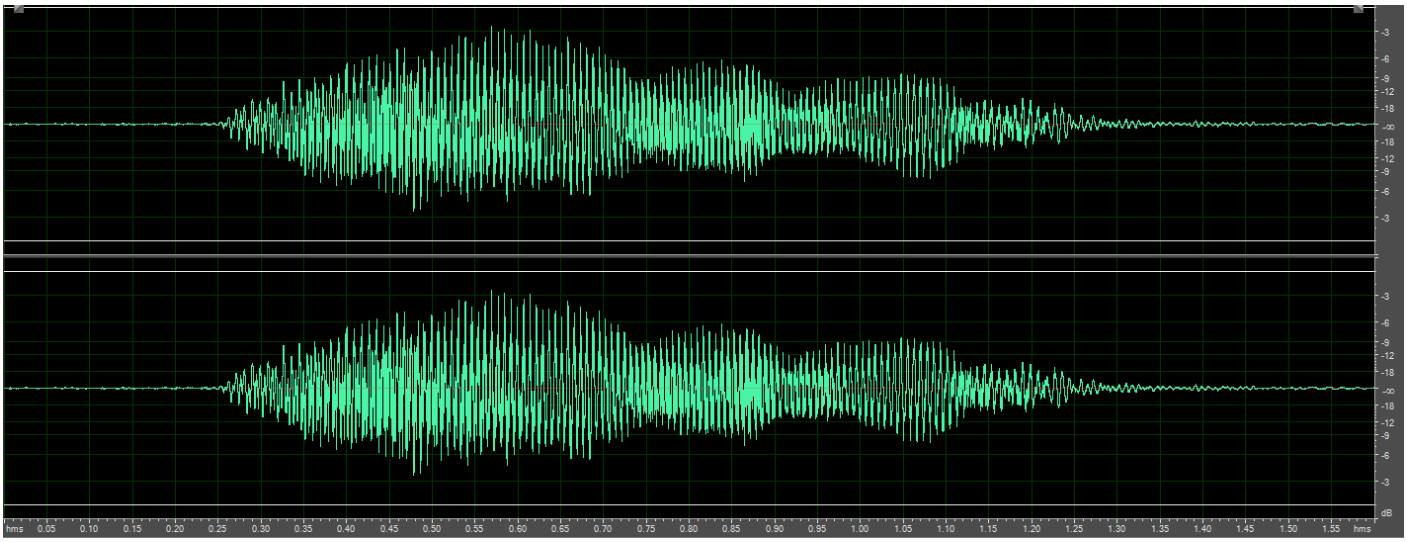
$\{(X_1, Y_1), (X_2, Y_2) \ldots (X_n, Y_n)\}$, where the X axis is longitude and the Y axis is frequency. This allows us to define the factors that affect the sound continuum in a formal way. Let us assume that a sound wave is mathematically representable by a function $f(x) = \sin(x)$, which results in the following graph:

8)



If the Y axis corresponds to dB and X to time, then, for example, sound intensity in a given time interval (t_1, t_2) can be described as the integral $\int (t_1\ t_2)$ of the function sin(x); *pitch level*, as the relation between peaks and sines in an interval (t_1, t_2) such that the more peaks, the higher the pitch. Pitch *movement*, as the reader may assume, is the result of applying *concatenation* to pitch levels at different t_n, consequently, it is not a primitive notion in the theory. The graph above is a simplified version of what we normally get in a recording, something more like (9)

9)



Essentially, (8) is formally equivalent to (9), and the definitions we have proposed above are thus equally valid. The reader can take (8) to be the mathematical representation of the function underlying (9). From now on, we will use the type of (9), but theiretically prefer the graphs of the type of (8), as they make it easier to make generalizations and test predictions. Moreover, they simplify the mathematical explanations, whose unambiguity is essential in our framework.

The phonological interface does not admit an element in a multiplicity of states, therefore, it is *not quantum* (Krivochen, 2011b), it can only be *interpretative*: Merge does not apply in any form. This non-quantum character of PF is related to its essentially linear character, if there is only one direction / sense in which the sound wave can go, a single wave cannot be in multiple states until observation. However, this interface constraints the grouping of primitives in terminal nodes since it is a characteristic of languages that they do not group dimensions in a single node if there is no single Vocabulary Item to spell that node out. This feature is a key to understanding language typology: Anglo-Saxon and Germanic roots cannot express both *motion* and *direction*, so direction is materialized in a satellital position:

10) *John went*$_{[MOTION]}$ *into*$_{[DIRECTION]}$ *the room*[1]

On the other hand, Romance languages cannot Spell-Out *motion* and *manner* in the same way Germanic languages can, in the form of a *Path-of-Motion* construction:

11) a. *John ran into the kitchen*

b. **Juan corrió dentro de la cocina* (impossible with the POM reading, possible if the whole event of running took place *inside* the kitchen)

John run$_{3pS\text{-}PAST\text{-}PERF}$ inside of the kitchen

'John ran inside the kitchen'

c. *Juan entró a la cocina corriendo* (*manner* is Spelled-Out in a satellite position)

John enter$_{3pS\text{-}PAST\text{-}PERF}$ to the kitchen running

'John entered the kitchen running'

In past works we have used a *descriptive* generalization to account for this situation, the *Morpheme Formation Constraint*:

12) ***Morpheme formation constraint***:

Dimensions cannot be grouped in a terminal node (i.e., a morpheme) if there is no Vocabulary Item specified enough to materialize that node.

The fundamental operation is Vocabulary Insertion, also known as Spell-Out, in which the sensory-motor S-M system "grabs" a part of the derivation in W that has been *analyzed* and determined to be fully interpretable and provides means for externalization. This operation, as we have seen, implies *dimensional impoverishment*. The *syntax-phonology interface* has been represented graphically in (7), so that the reader can have a mental image of what *dimensional impoverishment* is.

[1] Of course, the possibility of using "enter" exists, but that is a Latin borrowing (derived from "in" + "eo"), not a pure English root.

Part II: Phonetics and Phonology

In this section we will narrow our focus to the S-M system, once we have outlined the theoretical framework we will assume. This part of the paper will be divided in two main subsections, segmental and suprasegmental phonology, with the attention set on English and Spanish, but also including data from other languages so that the universality of the principles we propose can be empirically supported, beyond logical consistency. Our goal is outline a theory of the syntax-semantics-phonology interactions within Radical Minimalism, which is an area that we have not studied in previous works since our main interest was the interaction between Conceptual Semantics and syntactic structure.

The road to PF (Phonetic Form) has been considered anomalous in Minimalism since Chomsky (1995). There, it is said that, by adding elements to the representation, PF violated the *Inclusiveness Condition*, which explicitly banns the inclusion of elements absent from the NUM (a numeration, a subset of lexical items drawn from a Lexicon). In this sense, Inclusiveness is a *faithfulness constraint* in terms of Optimality Theory (OT), since it pleas for identity in the symbols that enter a derivation and those that are evaluated at the interface levels (or the EVAL function, in OT proposals). Here, we will present a different view on phonology and its role in the linguistic capacity: parasitic though it is, since it provides only a means of externalization and is by no means a *sine qua non* condition for language (though it is for communication), phonology is an interface system and, as such, its legibility conditions affect the disposition of the abstract symbols in the syntactic workspace. Moreover, contrarily to Chomsky, we will propose that conditions upon phonological representations can be formulated as *third-factor principles*, this is, general principles of economy that do not depend on a specific faculty. Such an approach, we will see, has its theoretical and empirical advantages over current mainstream conceptions of the role of phonology and the SM system. Our inquiry will begin with the factors that, according to Mascaró (2002), affect the SM system, and revisit them under RM's light. Mascaró distinguishes two kinds of factors:

- Articulatory

- Efficient Communication

Under the first label, we will include phenomena of *assimilation* (either place or voice), *addition* (epenthesis) and *elision*, with their corresponding subtypes (e.g., nasalization as a subtype of assimilation). These constraints affect articulation in a segmental level, and have a *local* scope: a phoneme can influence its immediate surroundings, but nothing beyond. Under the second label, we have *suprasegmental features*, and therefore we will widen our scope, going to the clausal level and analyzing the relation that tends to hold between certain syntactic configurations, designed to convey a certain meaning (this is, by DFI, free unbounded *concatenation* is both triggered and constrained by the CI system) and the possibilities a certain language licenses to Spell-Out that configuration, that is, inserting phonological matrices in syntactic terminals.

2. Suprasegmental phonology:

The study of suprasegmental phonology is the center of the present study, to which we will devote more space and closer inspection. Thus, we will revise some architectural claims regarding the place legibility conditions on the SM side and how they affect the syntactic derivation, if at all. Moreover, we will claim that the syntactic representation is a function of the intersection between the requirements of these two components. Coming back to our characterization of pragmatics in Part I, it is to be expected that an interface-driven mechanism is very closely related to pragmatics since the drastic effects the application of an operation have at an interpretative interface can very well be characterized as "pragmatic" effects. We will come back to this below.

In the specific realm of phonological representations, our view greatly differs in this respect with that of Kayne (1994) and Uriagereka (1999), who assume that the PF 2-D linearized representation is a function of binary-branched syntactic structure, modeled upon the notion of c-command. Let us briefly review Kayne's Linear Correspondence Axiom (LCA), the founding stone of this approach:

13) **Linear Correspondence Axiom**

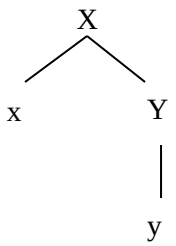
d(A) is a linear ordering of T

Where d(X) is the set S of terminals (i.e., non branching nodes) that X dominates, and A is the maximal set of nonterminals such that the first asymmetrically c-commands the second and T is the set of terminals. In plain words,

14) "*Let X, Y be nonterminals and x, y terminals such that X dominates x and Y dominates y. Then, if X asymmetrically c-commands Y, x precedes y*" (1994: 33)

This creates, as we said before, a relation of function between syntax and phonology, such that there is a univocal relation between a phrase marker and its Spell-Out: for each phrase marker, there is one and only one Spell-Out possibility. For example:

15)



In this case, according to Kayne's LCA, *x* precedes *y* by means of c-command: the first branching node that dominates *x* also dominates *y* and there is no dominance between them. Given this scenario, it seems clear that *x* will precede *y*. Kayne's framework establishes a simple mapping algorithm between syntax and phonology, but this apparent simplicity has its cost: in order to accept Kayne's LCA, further assumptions must also be made:

- The theory needs a difference between terminal and non-terminal nodes, for which binary-branching tree-like representations are the only choice. We have already argued against 2-D syntax, and consequently will not expand on this argument.
- The notion of c-command is essential, which also follows only from a 2-D syntax. Moreover, additional characteristics must be assumed, like its transitive and antisymmetric character.
- In order not to predict wrong strings, a stipulation must be added: the LCA does not apply to traces, or, in more recent times, copies are not pronounced. Nunes (2004) and Krivochen & Kosta (2013) are two alternative approaches to copy-realization.

- Inter-linguistic variation regarding word order must be accounted for via a movement rule that positions the relevant elements in convenient positions c-commanding the rest of the structure. This movement rule is not only stipulative but unclear: does it apply on-line or after Transfer? In any case, what is its trigger?
- Related to the consideration above, the LCA theory requires a fixed clausal skeleton, which establishes a polystratal theory as a *sine qua non* requirement for variation.

These characteristics and requirements do not collocate well within a Radically Minimalist framework, since they are mostly stipulations over the syntactic component, to which much substantive bargain is put. In our case, since the syntactic component is nothing more than *concatenate*, we have to account for linearization properties from an interface point of view. This is the purpose of the rest of the paper.

2.1 Prolegomena to a Multiple Interface approach to suprasegmental phonology:

In this section we will propose a model of analysis that includes syntax, phonetics / phonology and semantics / pragmatics, as we firmly believe that no linguistic phenomenon can be fully understood in substantive isolation but only from an interface perspective, taking into account the interaction between the free generative component and the way free generation via *concatenation* is constrained by the interpretative modules, C-I and S-M. In our view, each and every utterance is the optimal solution of a fundamental tension in natural language: infinite means for generation, a certain intention (embodied in conceptual structures of the kind of Fodor or Jackendoff, abstract and Universal) and the means of externalization available in a certain natural Language. On the interpretative side, Relevance Principles constrain the type and number of computations used to build inferential propositions, be them explicatures or implicatures. Considerations of optimal design lead us to think that on-line production of language is the best possible solution to this tension at every point, being the measure at hand Optimal Relevance.

To begin our inquiry on suprasegmental phonology, we must explicit the theoretical assumptions we will make:

- Syntactic / conceptual structure is free and *n*-dimensional, binary branching and headedness being interface readings of atomic-like structure.
- PF representations are not a direct function of fixed syntactic structure.

We will focus on this second point as essential claims on the cognitive architecture. In our terms, the phonological representation to externalize a syntactic structure depends on two types of constraints: *local* and *global*.

2.1.1 Local Constraints:

Local constraints over externalization of syntactic structure depend on the availability of Vocabulary Items –VI- (i.e., phonological matrices) to Spell-Out syntactic terminals. We will assume an array of VI as in Distributed Morphology (DM), in which phonological exponents convey both purely phonological information and distributional information, determining the contexts on which it can be inserted, that is, the information it can Spell-Out. Therefore, the phonological entry for the English plural would be as follows (Embick & Noyer, 2007):

16) /z/ $\longrightarrow$ [Pl]

Of course, English plural also has the exponents -Ø (as in *mice*, with internal inflection) and –en (as in *oxen*). According to Embick & Noyer, this depends on the involved root. Whatever turns out to be the case, it seems logical to think that there is little of systematic here, since the –en plural form was "regular" in earlier stages of the history of English. Now, what does "regular" mean? In our terms, near to DM, we define "regular" as "distributionally underspecified", so that the contexts on which the relevant VI can appear are wider. If this is so, then all that is needed is explicit the distributional properties of the more restricted items, the "regular" forms following from an *elsewhere principle*: "insert X in contexts Y_Z and W otherwise". A revised version of the explicitation of the plural VI would be as follows:

17) [Pl] $\longrightarrow$ -en/{√OX, √BROTHER, ...}

[Pl] $\longrightarrow$ -Ø/{√MOOSE, √MOUSE,...}

[Pl] ⟶ -s/ {*elsewhere*}

This account is far from satisfactory since it needs practically a rule for each root, without providing explanatory criteria, and therefore these constraints are purely descriptive. However, to the best of our knowledge, this is the best we can expect since patterns in both a local and a global level depend on historical issues that go far beyond the system, as Coseriu (1960) would put it. The relevant constraint here is, then, that ruling the *competition* between phonological exponents to be inserted in a terminal node so that the most specified exponent wins, the rest being sub-optimal candidates. The situation can be modeled as follows:

18) GEN ⟶ {√, {3P, Sg, Pres, Ind, Act}}

B-List ⟶ [-s] {3P, Sg, Pres, Ind, Act}☞

⟶ [Ø] {Sg, Pres, Ind, Act}*

⟶ [-ed] {Sg, Past, Ind, Act} *!

We have presented VI competition in an OT-like manner (without tableaux, however, since it is merely a notational fancy, just like our own notation), and there is a reason for that: a VI can be inserted in a terminal node if its distributional properties are a proper subset of those of the terminal node (as in the first and second case), but not if there is a feature present in the VI and absent in the terminal node, as in the third case. Between the two possible candidates, once the third is ruled out, the competition reduces to finding the most specified VI. The optimal candidate is that which Spells Out all of the features of a terminal node, nothing more, nothing different (as in the third case), and nothing less (as in the second). To this, we will propose a formalized version of what Searle (1969, Chapter 1) called the "*expressability principle*":

19) $\forall(x), x = \{\lambda \in \text{Sem}\}, \exists(y), y = \{\varphi \in \text{Phon}\} \mid y \cong x$

That is: for every semantic content there is an expression that exactly corresponds to that content. Notice that there is no distinction between intentions, explicatures, implicatures, entailments, etc. There is just conceptual-semantic content, which, in an RT approach, have *pragmatic* nature. This leads us to an interesting claim, namely, that for every proposition you want the listener/reader to

build, there are finite possibilities to convey such propositional content while aiming at Optimal Relevance in a context C: optimally, there is only one. Such would be a perfect solution to the tension between *generation* and *interpretation* we introduced above, is nothing more than a theoretical desideratum, depicting an ideal scenario from which actual communication departs in ways that are theoretically and empirically interesting. This expressability principle is what will lead us in the second part of this inquiry, now fully devoted to the "meaning" of intonation in a global level.

2.1.2 Global Constraints:

Now that we have outlined the framework, we will devote ourselves to the study of an intonation feature and its relation to syntax and semantics: we will focus on *prominence* for two main reasons. The first one is that prominence is easily visible in graphic representations like those we will use. The second is that while there is some consent with respect to what making something prominent could convey, the "meaning" of pitch movement (i.e., tones) is more problematic, and the mainstream theories (like Brazil's 1985) have no clear-cut principles that can lead us to a greater insight to the functioning of language as a mental system. If "system exploitation" can lead to a situation in which any tone can convey any meaning, something Brazil's theory cannot prevent, then the scientific interest of such a theory is undermined: its predictive and explanatory power decrease drastically. To begin with our inquiry, we will take (19) to be valid, as a deep generalization about natural language. Notice that we claim nothing about synthetic or analytic ways of Spelling-Out something, which is close to DM's notion of *fission*, but applied in a macro level. We will also assume that every language has what we call *Spell-Out patterns*, that is, "preferred ways" of Spelling-Out certain syntactic structures. These patterns have arisen historically, and constitute a subset of the total set of possibilities licensed by the system. Of course, positing a 1-to-1 relation between content and sound would too strict to be true, and notice that our formalization of the expresability principle includes an existential quantifier without limiting the implicature on the upper limit: there is *at least* an *y* such that *y* corresponds to *x*. This leaves the door open for the possibility that there are more than one candidate that corresponds to *x*. How can it be? If language is really driven by economy, how come more than one possibility is licensed? The answer we propose is that two phonological matrices may correspond

to a single *explicature* (i.e., a fully-fledged propositional form of the explicit content, not to be confused with the codified content), but they will necessarily differ on the positive cognitive effects they generate, that is, they will differ at the *implicature* level. Following Relevance Theory (Sperber & Wilson, 1995, et. seq.), once a string of sounds is recognized as a significative sentence, a propositional form is abstracted and computed in a propositional context so that, by means of a context-sensitive logic, other propositions are obtained, called "positive cognitive effects" or, simply, *implicatures*. Given this background, our proposal is as follows:

20) *If there is more than one π pattern that can correspond to λ, choose according to Optimal Relevance*.

Where Optimal Relevance, in its strongest possible version, is defined as follows:

21) *α is Optimally Relevant iff it generates positive cognitive effects at no cost*

Needless to say, no proposition is optimally relevant in this sense, for computational cost must be taken into account. However, it is very important to have this definition, as we can define Relevance as follows:

22) *Relevance is a relation between computational cost and positive cognitive effects*. *Ceteris paribus, more cost and less effects, less relevance*; *less cost and more effects, more relevance*.

As the reader may have noticed, the First Principle of Relevance, formulated as:

23) *Human cognition tends to the optimization of relevance*

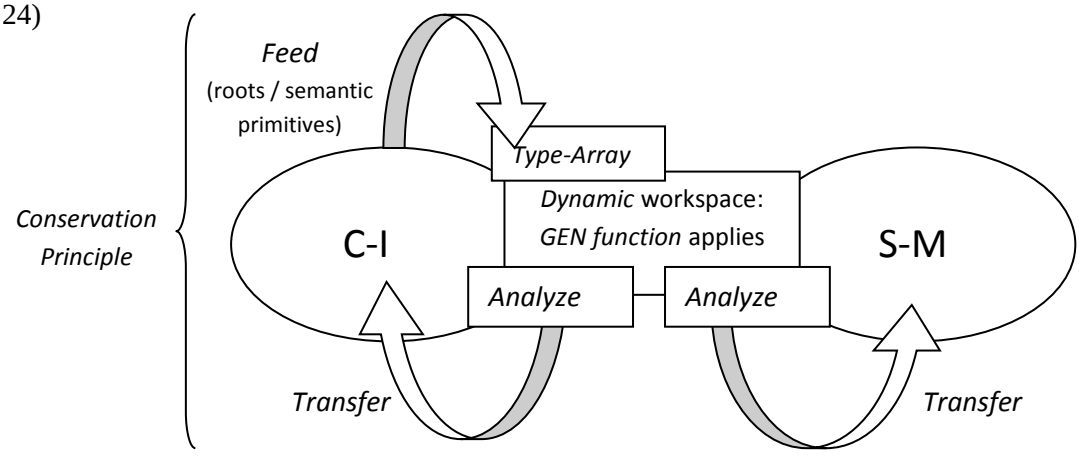
Is the statement of the asymptotically tendency towards strong optimal relevance, whereas in fact the best result we can aspire to is the relativized version Sperber & Wilson (among many others) have used throughout the years. Once this has been said, let us expand on (38) with the following quotation from Carston (1998):

"a) Set up all the possibilities, compare them and choose the best one(s) (according to some criterion/a).

b) Select an initial hypothesis, test it to see if it meets some criterion/a; if it does, accept it and stop there; if it doesn't, select the next hypothesis and see if it meets the criterion, and so on."
Carston (1998: 8)

These items make the process of selection explicit, accepting that the GEN function (i.e., *concatenate*) generates more than one candidate. We will adapt this conception to our version of *crash-proof syntax*, inspired in Putnam (2010) and already explicated in previous works. DFI is this theoretical leap forward that allows us to have a crash-proof system without appealing to, for example, *Agree* to constrain Merge (Cf. Pesetsky & Torrego, 2007). Having a free generative operation, only externally constrained (by means of DFI), we are not constrained by a fixed clausal skeleton, so that our possibilities for generation are much richer. Moreover, we have already defined natural language as an intersection of three sets, and thus our inquiry has a clear object of study. Let us remind the reader of the architecture of language we have proposed in previous works:

24)



Our point of departure is a conceptual structure, built according to the speaker's *intentions*, therefore covering the "intentional" part of C-I. That conceptual structure (for references to which the reader

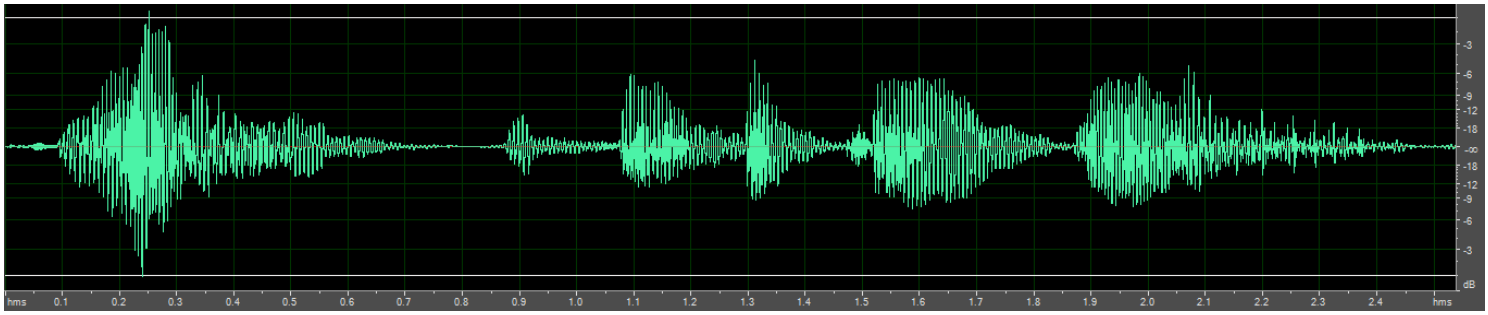
can see Jackendoff, 2002; Mateu, 2000, among others) *can*, but not necessarily *must*, be expressed through language, that is, even if built by syntactic methods (i.e., *concatenate* applying to generic concepts in C-I), conceptual structures are *not linguistic*. What we propose is that, ***given a certain conceptual structure to be externalized, the speaker will look for the most relevant way to materialize it trying to minimize entropy***. This quest for optimal relevance, as we said, is nothing more than an asymptotical tendency, but it is what, in our opinion, drives lexical selection and materialization patterns. Let us see an example:

25) a) *To me, it seems that John is lying*.

b) *It seems to me that John is lying*

The corresponding graphics for (25 a) is the following:

26)



/$_{R}$ tʰəmɪ:/ /$_{P}$ ət sɪmz ðəʧ dʒɒnz laɪɪŋ/

(underlining represents prominence, tones are indicated as subscripts at the beginning of the tone unit)

In traditional Minimalist terms, the prepositional phrase [to me] has been moved to a position in the "Left Periphery" (Rizzi, 1997), namely, Spec-TopP. The (somewhat simplified) structure is the following:

27) [$_{TopP}$ [$_{PP}$ To me] [Top] [$_{TP}$ it [[$_{T}$ seems] [$_{VP}$ [$_{V}$ seems] [$_{CP}$ [$_{C}$ that] [$_{TP}$ John is lying]]]]]

In previous works, we argued that such a position is related to a *contrastive interpretation* at the semantic interface, based on the overt realization of experiencers with raising verbs. TopP can be associated with a contrastive value and thus generate implicatures, for example:

28) *A mí (no a Pedro), Juan$_i$ me parece [t$_i$ un buen muchacho]* (Spanish)

To me (not to Peter), John CL seems a good guy

'To me (not to Peter), John seems to be a good guy'

29) *To me, not to Peter, it seems that John is lying.*

By contrast, Spec-TP only entails "themehood", in informational-structure terms:

30) ?! *Juan$_i$ (no Pedro) me parece [t$_i$ ser un buen muchacho]*

John (not Peter) CL seems to-be a good guy

'John (not Peter) seems to me to be a good guy'

Of course, the contrastive value can be achieved if we make [Juan] phonologically prominent, but in that case, the contrastive value would be carried by the phonology, and not by the syntactic position. There is a hint here about what will be our proposal regarding the interaction between the semantic effects we want to generate and the possibilities *free unbounded Merge* allows, only constrained by DFI.

The question that we must ask ourselves now is what happens when we have doubling but not raising. That is, how do we account for sentences like (31)?

31) *A mí$_i$ me$_i$ parece [que…]*

To me CL seems that…

'To me, it seems that…'

In that case, [a mí] can perfectly be said to carry contrastive value, as (32) is perfect:

32) *A mí$_i$, no a Pedro, me$_i$ parece [que…]*

To me, not to Peter, CL seems that…

'To me, not to Peter, it seems that…'

Then, we cannot claim that the PP is in other position than Spec-TopP (or elsewhere in the left periphery, possibly a form of ModP, since there is an epistemic value in most of these cases).

With respect to (25 b), 25 native speakers (of Australian and British English) claim that they would not make [to me] prominent in that position. However, as Leston Buell (p.c.) very well points out, the following example with a reduced pronoun sounds very awkward:

33) ?*It seems to m' that John is lying*

Therefore, we must maintain the full form /mɪ:/, maybe reducing the length of the vowel to neutralization (i.e., /mi/), but that would prevent prominence, and US and British native speakers of English have agreed in considering that the pronoun must be made prominent, otherwise, there is no point in realizing it lexically as the overt structure is also possible:

34) *It seems that John is lying*

In the aforementioned examples, there is a close bound between phonology and semantics: it is not possible to topicalize some constituent without making it prominent. Furthermore, and following to some extent Brazil's (1985) framework, prominence is a hint for the listener as to how to construct the explicature taking into account the inferences generated by the prominent constituents. What we will add is that *there is nothing at the interfaces that is not present in some form in the syntactic structure, as it is constrained by interface requirements*. Therefore, the relation Top-prominence stops being a purely externalist pragmatic issue to become part of the field of syntax-semantics interface. We will formulate this as a generalization, but first, let us call inferences and other interface-triggered phenomena *drastic interface effects*, following Grohmann (2003). Once this is said, the generalization we propose is the following:

Multiple Interface Generalization (with respect to prominence)

α will be prominent iff:

a. *α is within the syntactic domain of a Top-like procedural node*

b. *There is no β structurally closer to α than Top such that β is a procedural node that can generate a drastic interface effect on α*[2].

Notice the wide scope of our generalization: we have include syntax (since dependencies and domains are created via *concatenate*, even though read off at the interfaces), semantics (since Top is primarily a semantic notion, moreover, the procedural / conceptual character of a node is relevant at C-I) and, of course, phonology.

Our free Merge model, triggered by DFI, allows us to overcome a limitation of Rizzi's conception: in traditional approaches to the left periphery, the nodes Force, Focus, Topic and Finiteness obligatorily dominate TP, that is, they are outside the *dictum* proper and always have scope over *the whole sentence*. In our case, if the interfaces require so in order not to violate DFI and the Conservation Principle, we can have a Top-like node in any position in the clause. This allows us to provide a syntactic explanation of the presence of prominent elements in lower domains. Consider the following contrast (presented by Uriagereka, 1998):

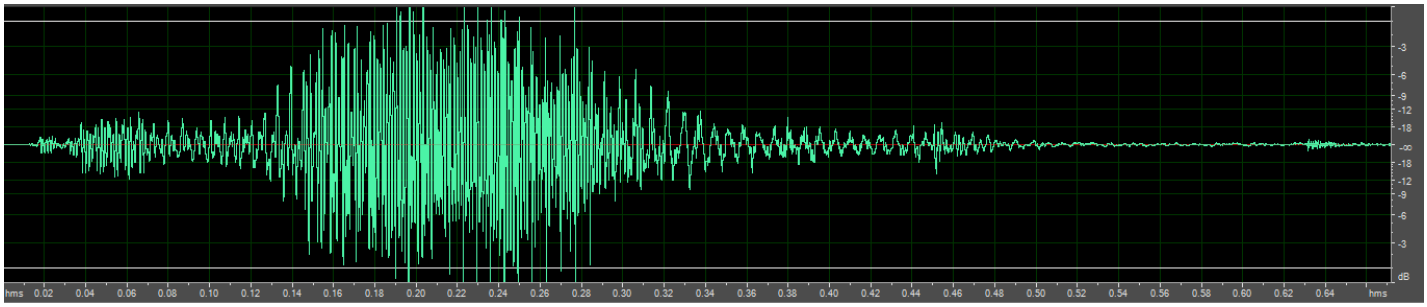
35) a) /aɪ laɪk ɪt/

b) /ə laɪk (ə)t/

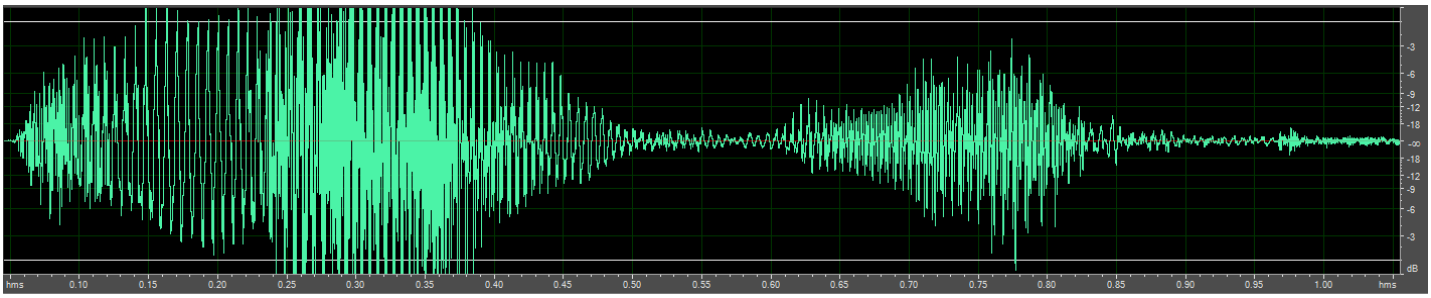
c) /ə laɪk ɪt/

(35 a) is the citation form, the one that transcribes the dictionary pronunciation of each of the words. (b) and (c), on the other hand, are very likely to appear in everyday speech, but in different contexts: (b) does not generate any particular implicature, whereas (c) does. Let us analyze the graphs:

[2] This clause in the generalization is closely related to our Radically Minimalist Minimality principle, but we will not go into general locality conditions here as the topic has been covered in other works. See Krivochen (2012a).



/ᵖ ə laık ət/



/ᵖ ə laık ɪt/

Presented with this contrast, Uriagereka (1998: 316-318) proposes that in the case of (35 c) there is an F projection dominating the pronoun, which impedes cliticization to V_0 since it makes the pronoun prominent (and, incidentally, creates a phrase marker that is compatible with the LCA). This F projection, which makes stress in [it] possible, is in our terms a Top projection, given the fact that it generates a contrastive interpretation:

36) *I like IT* (and not THAT)

We see that Uriagereka's proposal is perfectly compatible with our own framework, and we include his proposal within a wider frame, in which there is a generalization on prominence relating syntax, semantics and phonology without the need to resort to Kayne's LCA.

Unlike Labastía (2005), we reject the differentiation between syntactic and prosodic means of treating informative structure. As we have seen, everything that we find at the interfaces is also found in the syntactic structure, precisely because syntactic structure is a function of interface requirements (ConsP and DFI). This leads us to relativize the concepts of *configurational* and *non configurational*

languages: so-called "free word order" is not so free when we consider that the speaker looks for the optimally relevant way to externalize the information in the conceptual structure in a context C. Let us analyze an example from Latin, a language traditionally considered *non-configurational*:

37) *Tu ne quaesieris, scire nefas, quem mihi quem tibi*
finem di dederint, Leuconoe, nec Babilonios
temptaris numeros.

Horace, Od. I, 11. Vv 1-3.

You shall not ask (it is against natural order to know) what end the gods have granted to me or you, Leuconoe. Do not tempt [consult] Babylonian numbers [astrology] either. (our translation)

The metric Horace has used in this poem is called "asclepiadeus maior" (although he uses a modified version with cesures that do not exist in the original Greek asclepiadeus), and implies a division of the verse in three tonal units following this configuration (taken from Altavista, 2005)

38) /_ _ / _ ˘ ˘ _ // _ ˘ ˘ _ // _ ˘ ˘ _ / ˘ a

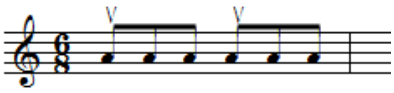
where "a" stands for *anceps*, the last syllable that can be either long or short. Such a metric model results in the following prominence pattern:

39) Tu ne quaesieris,// scire nefas//, quem mihi quem tibi
finem di dederint,// Leuconoe,// nec Babilonios
temptaris numeros//...

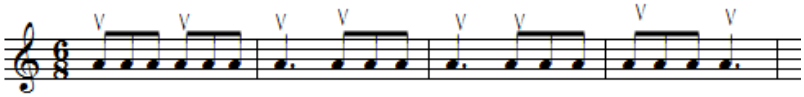
If our hypothesis is correct, then given a certain conceptual structure and a finite set of phonological matrices and, moreover, a finite set of metric patterns, the author will have chosen the *optimal* in that it allows the listener to draw more positive cognitive effects (i.e., implicatures) with less cognitive effort, since the syntax and the metric are in function of generating those effects. This assumption is grounded on the First Principle of Relevance, whereas the listener's side is covered by the Second

Principle, which we have integrated within our framework. Let us analyze briefly the fragment from Horace's Ode.

In musical terms, the notation used by Horace is 6/8, that is[3]:

40) 

The musical representation of the metrics for the first line would be as follows:

41) 

Each eighth note is a short syllable, whereas the quarter with augmentation dot stands for long syllables. We now see more clearly the rhythmic cadence that Horace chose, and how that choice was done in function of the pragmatic ends he was pursuing as the accents fall on words whose contribution to the explicature is essential. This means that any attempt to formulate fixed rules, for example, for accentuation in speech will fall short, since there are many variables to take into account.

Notice, incidentally, that in this case prosody also helps avoiding redundancies: for example, the negative polarity item [ne] in v. 1 receives no prominence, but since the [nec] in v. 2 presupposes a higher polarity item (just like English [nor] semantically presupposes a [neither] earlier in discourse) and is in fact prominent, there is a deep sense of economy in the distribution of prominence among overt elements, particularly *procedural elements*, whose function is to indicate the post-syntactic semantic parser how to interpret the relation between conceptual representations. In this case, [nec] relates two clausal elements, namely [temptare Babilonios numeros] and [quaesire quem finem di dederint tibi et mihi][4]. Regarding *conceptual elements*, the most salient example is that of /Leuconoe/. The name of this woman, to whom Horace is speaking, is a compound word, derived from λευκός

[3] For an excellent reference on language and music, see Jackendoff & Lerdahl, 2004.

[4] The word order has been changed for clarity purposes.

[leukós], "white, light" and νόος [nóos], "mind", meaning approximately "empty-minded". Interestingly enough, prominence is marking the original Greek root (a *conceptual* element) but also the Vocative case desinence, which is arguably a *procedural* element. Syntax, semantics and morphophonology interact in this example to produce the emphatic reading on "empty-minded", which in turn reinforces the whole argument.

3. Conclusion:

A multiple interface approach, in our opinion, is the most promising way to address the interaction between phonology, syntax, and semantics, respecting the specificities of each field but also aiming at maximum integration within a larger model for linguistic inquiry. We agree with Labastía (2005) in that it would be a mistake to treat prosody and its effects on information structure and reduce it to its grammaticalized aspect, but it is also a mistake to treat it independently. Instead of a *parallel structure* (Jackendoff, 2002), we argue in favor of a multiple interface approach, in which representations are functions of interface requirements of interpretative systems. We have simplified the GEN function to a single algorithm (thus dispensing with the Merge-Move tension) and its freedom is only limited by ConsP and DFI, principles that arise independently for other faculties apart from language.

It seems to us that prosody is a *procedural* tool, even though not encoded in a particular category (and therefore its uniqueness). We hope to have shown that in the course of the article. This approach, which is based on the traditional Relevance Theory concept of non-verbal ostensive stimulus, could help in bringing together the grammatical currents in RT and its more interpersonal-oriented ones, with the only aim of productive integration.

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