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ASYMMETRY AND THE LANGUAGE FACULTY

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ABSTRACT

In *Syntactic Structures,* Chomsky argues for the autonomy of syntax with respect to semantics on the one hand, and phonology on the other. In this paper, we argue that the autonomy of syntax is further supported by the derivation of sometime unpronounced functional categories. We propose an analysis of the pronunciation/silence of coordinate conjunction and prepositions in additive cardinal numerals and time counting expressions. We provide independent justifications for our analysis as well as we identify extensions to recursive DP coordination and co-compounds. The analysis relies on structural asymmetries derived by the computational procedure of the Language Faculty and is enforced by principles of efficient computation.

Keywords: language faculty, autonomy of syntax, merge, externalization, unpronounced elements, cardinal numerals, time-counting expressions

INTRODUCTION

Chomsky (1957) provides arguments that syntax is a finite system generating infinite structured outputs. This generative system is necessary for a full understanding of language and is independent of other aspects of language, namely semantics and phonology. He convincingly argues that syntax cannot be reduced to semantics or probability. *Colorless green ideas sleep furiously* is derived by the rules of English syntax, but lacks a semantic interpretation. Likewise, *to* and *at, aim* and *name* are morphemes of English, but their morphemic structure is not derived by the rules of English syntax. In this paper, we provide further evidence for the autonomy of syntax with respect to semantics and phonology in the context of recent research in the Minimalist Program (Chomsky 1995 *et seq.*) where syntax is an autonomous computational system, interfacing with semantics and phonology, (1). The infinite structured output generated by Merge and its associated computational procedure in narrow

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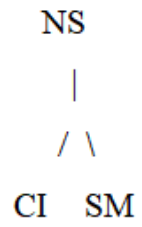
syntax (NS), using Hauser Chomsky and Fitch's (2002) terminology, is interpreted phonetically at the sensorimotor interface (SM) and semantically at the conceptual-intentional interface (CI).

(1)



We focus on interface asymmetries brought about by the derivation of unpronounced syntactic categories. That is, categories that are interpreted at the CI but not at SM. Interface asymmetries support the autonomy of syntax with respect to phonology, as silent categories are not externalized. They also support the autonomy of syntax with respect to semantics, as silent categories may have more than one interpretation or no semantic interpretation altogether.

Chomsky (2005) identifies three factors that contribute to the growth of language in the individual. Merge and its associated computational procedure is the landmark of humans' genetic capacity for language. Language acquisition and languages in contact give rise to variation. Principles of efficient computation, external to the Language Faculty, apply in syntactic derivations, sometimes overriding efficient communication. We argue that the presence of unpronounced categories in syntactic derivations follows from the asymmetry of the computational procedure associated with Merge, and is enforced by principles of efficient computation. We raise the following questions. In what sense is asymmetry part of the computational procedure of the Language Faculty? How does this asymmetry affect the derivation of syntactic structures? In what sense is the presence of unpronounced categories enforced by principles of efficient computation?

We discuss the derivation of interface asymmetries brought about by the sometimes- unpronounced conjunction in cardinal numerals and time counting expressions. The conjunction is apparently "optional" in Italian *cento (e) uno*, as it is the case in English *hundred (and) one*. However, it is obligatorily pronounced in time counting expressions in Italian, such as *le due e trenta* (lit. the two and thirty), and it must be silent in its English counterpart, *two thirty*. Their semantic interpretation is not affected by the pronunciation or silence of the preposition. The fact that the conjunction may, and in some cases must, be pronounced should follow from the theory.

We propose an analysis of the facts based on the assumption that the computational procedure associated with Merge crucially relies on asymmetrical relations and that the pronunciation or silence of a category is enforced by principles external to the Language Faculty (Kayne 2005, 2011; Collins 2007; Di Sciullo 2015, 2017). Our analysis makes correct predictions for the pronunciation/silence of functional elements in syntactic domains, including PP, DP, NumP and NP.

This paper unfolds as follows. We state our assumptions on asymmetry in the Language Faculty and on principles of efficient computation. We provide an analysis of the pronunciation/silence of the functional heads in additive cardinal numerals and time-counting expressions based on our assumptions. We provide independent evidence for our analysis on the basis of the properties of nominal compounds and locative determiners. We extend our analysis to recursive DP coordinations and co-compounds. Unpronounced elements in syntactic structures provide strong evidence for the autonomous syntax and the role of asymmetry in the computations of the language Faculty.

THE LANGUAGE FACULTY AND PRINCIPLES OF EFFICIENT COMPUTATION

We assume the Minimalist Program (Chomsky 1995 *et seq.*), according to which the human capacity for language is located in Narrow Syntax, and the operations of the Language Faculty are reduced to a dyadic recursive operation: Merge. This operation recursively combines two syntactic objects and creates sets[2]. External Merge is an operation that combines two objects that were not previously combined in the derivation. Internal Merge combines previously merged objects, and derives the displacement of linguistic constituents. The displaced constituent and its copy form a discontinuous constituent. The copy of the displaced element is generally not interpreted by the SM system, i.e., it generally remains unpronounced. The CI system however, interprets both the displaced constituent and its copy. Thus, interface asymmetries are derived.

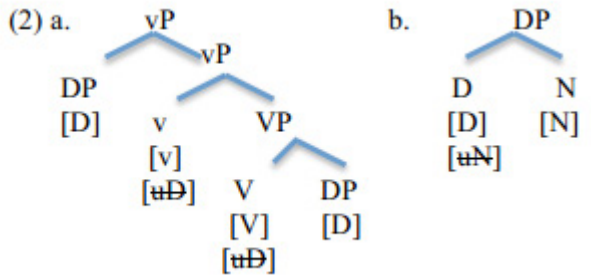
The derivation of linguistic expressions can be represented as hierarchical structures, where structural relations hold. There are two basic structural relations that determine the hierarchical properties of syntactic structures, the precedence and the dominance relations. Both relations are asymmetrical. A relation $\{a, b\}$ is asymmetrical if its terms cannot be inverted. Thus, if a precedes b, b does not precede a; if a dominates b, b does not dominate a; if a asymmetrically c-commands b, b does not asymmetrically c-command a[3]. Asymmetrical relations are derived by Merge and are basic relations in syntactic phenomena such as agreement and displacement.

We argued in Di Sciullo and Isac (2008) that Merge is asymmetrical in the sense that certain aspects of the computational procedure of the Language Faculty are subject to conditions enforcing asymmetrical relations. For example, Select, a sub-procedure of Merge, is asymmetrical in the sense that the bundles of features of the objects undergoing Merge are in a proper subset relation[4].This condition holds for successful derivations. For instance, the parts of a DP must be merged together before the merger of a verb (V) to its DP complement, or in the merger of a VP to its DP subject. Derivations are cancelled if the proper subset condition on Select does not hold.

2 This definition of Merge does not make reference to labels, and is thus a simplified variant of Chomsky's (1995) definition: Target two syntactic objects α and β, form a new object Γ{α, β}, the label LB of Γ(LB(Γ)) = LB(α) or LB(β). We will not discuss label-free derivation or labeling algorithms in this paper. See Chomsky (2013, 2015) for discussion.

3 C-command: X c-commands Y iff X and Y are categories and X excludes Y, and every category that dominates X dominates Y. Asymmetric c-command: X asymmetrically c-commands Y, if X c-commands Y and Y does not c-command X. (Kayne 1994)

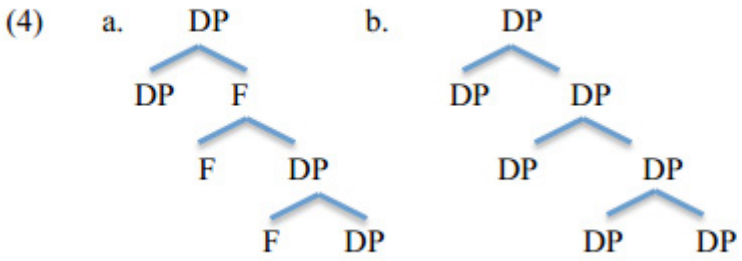
4 The proper subset relation is an asymmetrical relation: if A and B are sets of features, and if A is a proper subset of B, there is at least one feature of B that is not part of A, and not conversely.



Merge is recursively unbounded, as there is theoretically no limit to the length of a sentence. We argued in Di Sciullo (2015) that asymmetry is also part of the computational procedure of the Language Faculty in the sense that recursion is indirect, defined as follows:

(3) Indirect recursion is the recursive merger of X mediated by a functional category F.
(Di Sciullo 2015:31)

For example, in convergent derivations, the merger of two categorically non-distinct objects is mediated by a functional category (F), as illustrated in (4a), as opposed to (4b).



We proposed in Di Sciullo (2015) that the generation of intermediate functional heads between constituents is enforced by a third factor principle of efficient computation. *Minimize Symmetrical Relations* enforces the derivation of structural asymmetry between constituents in syntactic derivations. This principle minimizes sisterhood relations derived at first Merge and in the syntactic derivation by enforcing Internal Merge to apply to one or to the other constituent. This principle is in line with current minimalist syntax (Chomsky 2013), including Moro's (2000) Dynamic antisymmetry model where points of symmetry (sisterhood relations) may arise in the derivations and either one or the other constituent in a sisterhood relation is displaced in the course of the derivation breaking the symmetry and deriving an asymmetrical c-command relation.

According to the Strict Minimalist Thesis (Chomsky 2001), language is the best solution to interface legibility conditions. There is a significant asymmetry between the semantic interface, the system of thought, and the sensorimotor interface externalizing the system of thought, with the first having primacy. For example, the fact that copies of displaced constituents are generally unpronounced follows, according to Chomsky (2011) from *Pronounce the Minimum*, which is part of the third factor principles.

At the semantic interface however, both the displaced constituent and its copy are interpreted. Other constituents than copies of displaced constituents may be unpronounced, including Complements (null objects) Specifiers (null subjects) as well as Heads (Chomsky 1981, Kayne 2005, Liao 2013).

Assuming derivation-by-phase (Chomsky 2001, 2008)[5], where the edge of a phase includes both the Head and the Specifier, we proposed in Di Sciullo (2005a) that either the Specifier or the Head of a morphological phase must be legible at the SM interface. This condition intervenes in the linearization of morphological constituents and is sensitive to whether one or the other edge positions in a morphological phase has phonetic features. Also assuming the derivation-by-phase model, Collins (2007) proposes that the non-pronunciation of "at" and "to" in English *here* and *there* follows from a more general version of the Doubly-Filled Comp Filter (Koopman and Szabolcsi 2000), restated in terms of the Spell-Out condition in (5). This condition derives the fact that the locative/directional preposition which is assumed to be part of the syntactic derivation of *here* and *there* (Katz and Postal 1964, Van Reimsdijk 1978, Kayne 2005) is silent in languages such as English.

(5) Spell, Out Condition:

a. Edge(X) must be phonetically overt.

b. The condition in (a) applies in a minimal way so that either the Spec or the head of a phase can be pronounced but not both. (Collins 2007)

While structural asymmetry between syntactic constituents is enforced by *Minimize Symmetrical Relations*, we proposed in Di Sciullo (2015) that *Minimize Externalization* enforces the non-pronunciation of certain constituents. *Minimize Externalization* is in line with Chomsky's (2011) *Pronounce the Minimum,* and other principles on the generation of unpronounced constituents can be thought of as principles minimizing externalization.

In this section, we identified our assumptions on the computational procedure of the Language Faculty and on the external principles of efficient computation. In the next section, we provide an analysis of complex numerals and time-counting expressions based on these assumptions.

CARDINAL NUMERALS AND TIME COUNTING EXPRESSIONS

We argued elsewhere (Di Sciullo 2012, 2015) that complex numerals, as expressed in natural language, are derived by Merge and its associated computational procedure[6]. We proposed a feature-based derivation of complex numerals in Di Sciullo (2012). According to this analysis, simplex numerals are associated with valued and unvalued numeral features [*u*Num]. Feature valuation is done via

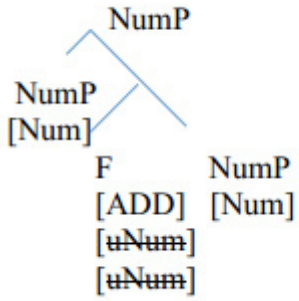
5 In the theory of cyclic spell-out (Chomsky 2001, 2008), the edge of a strong phrase (the Head and the Specifier) is spelled-out at a later point in the derivation than the complement. This implies that for strong phrases there can be no interaction at the time of spell-out between the members of the edge and the complement.
(i) The Edge(X) of a phase includes both X (the Head) and the Specifier of X [Spec [H [Compl]]]
Only the edge of a phrase is accessible from outside. (Chomsky2001)

6 See also Hurford (1975), Ionin and Matushansky. (2006), Stavrou and Terzi. (2008) among other works, on the derivation of complex numerals.

agreement, which is asymmetrical in the sense that there must be a proper subset relation between the set of features of the agreeing objects, as discussed above and detailed in Di Sciullo (2005a) and Di Sciullo & Isac (2008).

We thus proposed a Minimalist analysis of the derivation of cardinal numerals, (Di Sciullo 2012, 2015). According to this analysis, cardinal numerals (NUM) merge with a functional head (F) associated with formal unvalued features [uNUM] and semantic valued features, including the addition feature [ADD]. The representation in (6) illustrates the result of feature valuing under asymmetric agreement in additive cardinal numerals. Unvalued features are eliminated under the independently motivated proper inclusion relation[7]. The bundle of features of the F head consists of a valued feature, including the addition feature [ADD], and other valued features such as the subtraction feature [SUB]. The F Head in additive cardinal numerals is pronounced as a coordination conjunction, for example in French *vingt-et-un* (Lit. twenty and one) "twenty one" as well as in additive time counting expressions, in Italian *le due e cinque* (Lit. the two and five) "two o five". In Italian time counting expressions, subtractive F head is pronounced as *meno* "minus", e.g. *le due meno cinque* (Lit. the two minus five) "five to two".

(6)



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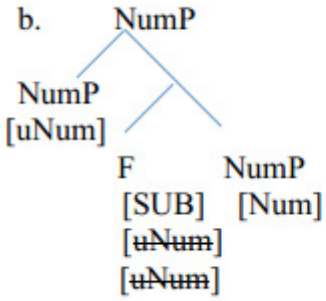


We observe that there is micro-variation in the pronunciation/silence of the intermediate functional element in additive cardinal numerals as well as in time counting expressions. The following examples from Italian, English and French illustrate this point.

(7) a. cento (e) uno (It.)
b. hundred (and) one

(8) a. vingt *(et) un (Fr.)
b. twenty (*and) one

7 Independent motivation for feature valuation under the proper subset relation, basically asymmetrical agreement, is provided in Di Sciullo (2005) for morphological derivations.

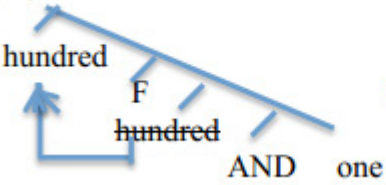
(9) a. Sono le due *(e) trenta. (It.)
is-PLUR the two and thirty
"It is two thirty."
b. It is two (*and) thirty.

The examples in (7) show that the conjunction may, but needs not, be pronounced in some cases in both Italian and English. The examples in (8) and (9) illustrate micro-variation between English and French. The conjunction is silent in English (8a)-(9a); whereas it is pronounced in French, (8a). How are these facts derived? Why must the conjunction be silent in some structures and be pronounced in others? Why is there apparent "optionality" in the pronunciation of the preposition in some languages? We argue that these facts follow from the asymmetry of the computational procedure associated with Merge in conjunction with third factor principles *Minimizing Symmetry* as well as *Minimize Externalization*.

Whether they are pronounced or not, the intermediate functional heads F are legible at the interface with the Conceptual Intentional system. The proposed analysis however, did not account for the apparent "optionality" of the conjunction in some cases and its obligatory pronunciation or its silence in other cases.

We assume the derivation of additive cardinal numerals represented in (6) above and propose that the pronunciation/silence of the conjunction in additive cardinal numerals follows from the theory. Given derivation by phase (Chomsky 2001, 2008 *et seq*.), and Collins' (2007) Spell-Out Condition, it follows that the functional head F, here a coordinating conjunction, must be pronounced when the Specifier of F is not filled[8]. For example, in the derivation of *hundred and one*, feature valuing is done both via Internal Merge and External Merge. As we illustrate in (10a), Internal Merge applies to *hundred,* displacing it from the Specifier of the lower F head to the Specifier of the upper F head. The Specifier position of the lower F Head is no longer filled, and the lower F head is pronounced (AND), as illustrated in (10a). In contrast, in the derivation of *hundred one* in (10b), feature valuing is done only via External Merge, giving rise to the silence of the conjunction (<AND>).

(10) a.



b.

(11) a. [hundred {[F], [Num]} F [~~hundred~~ {[F], [{ADD], [~~uNum~~], [uNUM]} [AND {[F], [ADD], [~~uNum~~]} one {[F], [Num]}]]]

and

b. [hundred {[F], [Num]} [<AND {[F], [ADD], [~~uNum~~], [~~uNUM~~]}> one {[F], [Num]}]]

Evidence that Internal Merge applies in the derivation of cardinal numbers comes from the diachrony of numerical systems. In Latin numerical system, inverse ordering of the base with respect to the digit

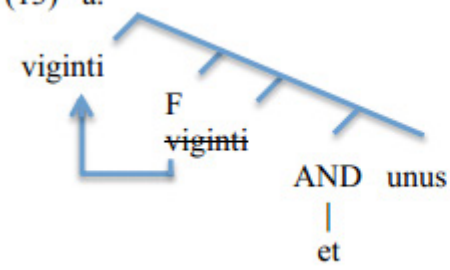
8 According to Zwart (2005), coordinations are always outputs of previous auxiliary derivations. The conjunction is a left edge marker of the second member. Te Velde (2006) also argues for a derivation of coordinate structures that occurs by phases. CP and vP are full phases, and all other projections are sub arrays of phases.

is observed in additive cardinal structures near the tens, along with differences in the pronunciation/ silence of the conjunction, as the examples in (12) illustrate[9].

(12) a.viginti (et) unus (Lat)
twenty and one
"twenty one"
b.unus et viginti
one and twenty
"twenty one"

The difference in the ordering of the digit with respect to the base as well as the differences in the pronunciation/silence of the conjunction follow from our analysis, more specifically, it follows from whether feature valuation is done via Internal Merge or External Merge.

(13) a.



b.

As mentioned in the preceding section, a preposition must be pronounced in Latin subtractive cardinal numeral. Thus, in addition to the coordinate conjunction structure in (12b), we also find related prepositional structures, (14), where the prepositional head *de* (from) must be pronounced. According to our analysis, the obligatory presence of the preposition in (14) follows from the displacement of a constituent from the lower functional domain to a higher functional domain, and is enforced by the third factor principle minimizing symmetrical relations.

(14) a. unus *(de) viginti
one from twenty
"nineteen"
b. duo *(de) viginti
two from twenty
"eighteen"

In *Syntactic Structures*, Chomsky argues not only that syntax is autonomous from semantics but also that syntax can provide a foundation for understanding questions relating to semantics.

The fact that prepositional structures are part of cardinal numerals and time counting expressions

9 Languages vary in the order of the digit with respect to the base. Italian inverts the order of the digit and the base near the tens, from 17 to 20, e.g. tredici vs. diciotto. Greek inverts the order of the digit and the base from 13 to 20.

provides a syntactic basis to the semantics of these expressions. Cardinal numerals (used for counting) can be semantically understood as being points in the abstract space of natural numbers (Cantor 1914). We argued in Di Sciullo (2017) that the prepositional structure in cardinal numerals brings about a spatial orientation. The pronunciation of a directional preposition in Latin subtractive cardinal numerals externalizes part of this structure, which could be represented in the extended projection of prepositions (Cinque and Rizzi 2009). The fact that feature valuation can be done via Internal Merge or External Merge in the derivation of cardinal numerals could provide a syntactic basis for cardinal numerals potentially being expressed in natural language from different points of view.

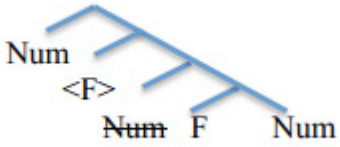
In this perspective, we derive Latin *duo de viginti* "eighteen" by the displacement of *duo* from the lower Specifier position to the Specifier of Relative View (RelViewP), a category independently needed in the extended projection of prepositions in Cinque and Rizzi (2010). The derivation represented in (15) indicates that both *duo* and *viginti* are Externally Merged to the lower F Head. *Duo* is internally merged to the Specifier of the immediately superior F head on the lower RelViewP for feature valuing of the intermediate F head. Since the Specifier of the lower F Head is pronounced (*viginti*), the lower F-head is silent. *Duo* is further Internally Merged to the Specifier of the highest RelViewP for feature valuing. Given the Spell-Out condition in (5), only the intermediate F-head is pronounced. The Spell-out of this F-head is the preposition *de* (from) in Latin. This is also the case for time-counting expressions, as discussed below.

(15) $[_{\text{RelViewP}}$ duo F $[_{\text{RelViewP}}$[~~duo~~] F $[_{\text{Place}}$ viginti F ~~duo~~]]]
<[DOWN]> [FROM]
|
de

According to our analysis, the hierarchical structure of additive and subtractive cardinal numerals is derived as follows. A numeral is first merged with a functional head, a coordinate conjunction in the case of additive cardinal numerals. The resulting syntactic object is then externally merged to another cardinal numeral in the second step of the derivation, see (16). In the third step of the derivation a functional category is Externally merged to the previous output and a cardinal numeral can be either externally or internally merged to the previous output, see (17). Collins' (2007) Spell Out condition minimizes the externalization of the edge constituents. Consequently, the functional head is not pronounced in (16); whereas it is pronounced in (17). We extend the analysis we proposed for complex cardinal numerals to time-counting expressions.

(16)
Num
<F> Num

(17)



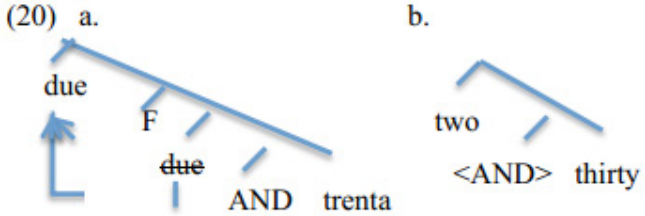
In addition to unpronounced nouns, such as HOUR and O'CLOCK (Kayne 2003, 2006, 2015), time-counting expressions include the additive and the subtractive heads found in cardinal numerals (Di Sciullo 2016; Di Sciullo and Echevarria, in press). Furthermore, micro-variation in the pronunciation of the functional head is also observed in these structures, as the examples in (18) illustrate. In additive time counting expressions, the intermediate functional head must be pronounced in Italian, whereas it must be silent in English. In subtractive time counting expressions, such as the ones in (19), the intermediate functional head is pronounced as the preposition *meno* "minus" in Italian and *to* in English. Furthermore, the order of the constituents is inversed. The hours precede the minutes in Italian; whereas they follow the minutes in English.

(18) a. le due *(e) trenta (It.)
the two and thirty
"two thirty"
b. two thirty

(19) a. le due *(meno) cinque (It.)
the two minus five
"five to two"
b. five to two

The derivation proposed above for additive cardinal numerals extends to additive time counting expressions. Furthermore, the variation in the pronunciation/silence of the functional Head follows from whether feature valuation is done via External and Internal Merge, as it is the case for Italian, see (20a, 21b), or only by External Merge, as it is the case for English, see (21a, 21b).

(20) a. b.



(21) a. [due {[F], [Num]} F [~~due~~ {[F], [Num]} [F {[F], [ADD], [~~uNum~~] [~~uNum~~]} trenta {[F], [Num]}]]] (It.)

e

b. [two {[F], [Num]} [<F {[F], [ADD], [~~uNum~~] [~~uNum~~]}> thirty {[F], [Num]}]] (En.)

Italian and English also differ in the subtractive expressions. In Italian, the derivation of subtractive time counting expressions, (22a), is parallel to the derivation of additive time counting expressions, (21a). The derivations differ in the valued features of the lower F head, which is [ADD] in additive time-counting expressions and [SUB] in subtractive time counting expressions. The derivation of subtractive time counting expressions in English relies on the extended prepositional structure, which it externalized only in part, (22b). We proposed in Di Sciullo (2016) that the preposition *to* in subtractive time counting expression in English is part of the lower Relative View phrase in the extended projection of P. The higher RelView phrase is headed by the preposition UP, which is unpronounced, since its Specifier is filled by the Internally merged constituent [five <MINUTES>]. The pronunciation of TO follows from the fact that its Specifier has been vacated by the displacement of [five <MINUTES>] to the Specifier of the highest phase.

(22) a. [due {[F], [Num]} F [~~due~~ {[F], [Num]} [F {[F], [SUB], [~~uNum~~] [~~uNum~~]} cinque {[F], [Num]}]]] (It)

meno

b. [Relview five F {[F], [UP]} [RelView ~~five~~ F {[F], [TO]} [Place/Goal two F {[F], [SUB], ~~five~~ {[F], [Num]}]]] (En.)

to

Furthermore, Di Sciullo and Ecchevarria (in press) derive the semantic difference between Italian and Valencian Catalan partitive time counting expressions, illustrated in (23). They argue that the difference relies on the choice of the valued features associated with the functional heads in the RelView projections.

(23) a. un quarto alle cinque (It.)
a quarter to the five
"a quarter to five"

a. tres	quarts	per	les	cinc	(Valencian Catalan)
three	quarters	for	the	five	

"a quarter to five"

(24) a. [Relview ~~a quarter~~ F {[F], [UP}[RelView ~~a quarter~~ F {[F], [TO], [~~uNum~~] [~~uNum~~]}[Place/Goal [the five] F ~~a quarter~~]]]] (It.)

to

b.[Relview tres quarter [RelView ~~tres quarter~~ F {[F], [DOWN]}[[RelView ~~tres quarter~~ F {[F], [FROM], [~~uNum~~] [~~uNum~~]}[Place/Goal the five F ~~un quarter~~]]].(V.C)

per

Here again the difference in the pronunciation/silence of the functional heads follows from our analysis. The analysis of additive cardinal numerals and time counting supports the hypothesis that the pronunciation of functional heads in complex cardinal numerals and in timecounting expressions follows from the asymmetry of the computational procedure of the Language Faculty which relies on asymmetrical relations, and is enforced by third factor principles of efficient computation.

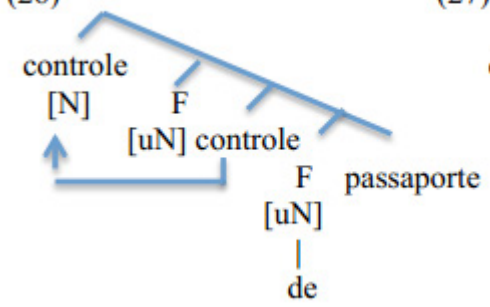
INDEPENDENT MOTIVATION

The proposed analysis is independently motivated, as discussed in what follows.

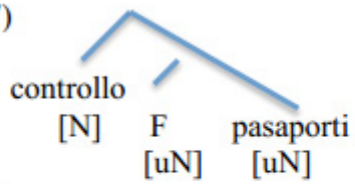
Empirical support for indirect recursion comes from the fact that the intermediate functional projection is pronounced in nominal compounds in some languages, as discussed in Di Sciullo (2015). This is the case for the preposition *de* "of" in Brazilian Portuguese as well as in European Spanish, e.g. *controle de passaporte* (BP), (lit. control of passports) "passport control", as well recursive nominal compounds, e.g. *ponto de controle de passaporte* (BP) (lit. point of control of passports) "passport control point". This follows from the asymmetry of the computational procedure of the Language Faculty and is enforced by *Minimize symmetrical relations*. In Brazillian Portuguese nominal compounds, feature-valuation is done both by External Merge and Internal Merge. Given the Spell Out condition in (5), the prepositional head is pronounced, see (26).

(25) a. controle: {[N]}
b. passaporte: {[N]}
c. de: {[P], [uN]}

(26)



(27)



As it is the case with cardinal numerals and time counting expressions, there is variation in the pronunciation/silence of the functional head. While a preposition is pronounced in Brazilian Portuguese as well as in European Spanish and in French, it can be silent in Italian nominal compounds. This follows from the computational procedure of the language faculty and Third Factor Principles minimizing symmetry and externalization. In Italian nominal compounds, feature-valuation is done by External Merge, see (27). Given the Spell Out condition in (5), the prepositional head is not pronounced.

Further independent evidence for our analysis comes from micro-parametric variation in the pronunciation/silence of the preposition AT/TO in *here* and *there* in certain languages. We observed micro-variation in the pronunciation/silent of the preposition in locative determiners in Fallese, a dialect of Italian spoken in the Abruzzi, e.g. *(a)ecche* (here*)/(a)locche (there).* As discussed in Di Sicullo (2017), the preposition AT/TO may remain silent when the locative determiner is in Complement position, whereas it must be pronounced in Adjunct position e.g. *Maria* è rimaste (a) ecche (Lit. Maria is stayed at here) "Maria stayed here." vs. *Maria* è iute a lu paese *(a)locche (Lit. Maria is went at the town at there) "Maria went to the town there."

(28) Complement of locative/directional verb:
a. È rimaste (a)ecche. (Fa.) (*ecche*/*aecche, locche/alloche* are normally used
is stayed (at) here vs. Italian *qui* "here" /*li* "there")
"He stayed there."
b. È iute (a)locche.
is went (at) there
"He went there."

(29) Adjunct position: Unaccusative verb
a. È ariviete aecche. (Fa.) (Normally used with the preposition pronounced)
"He stayed here."
b. È partite alocche. (Fa.) "He left there."

(30) Unergative verb
a. Ha durmite alocche. (Fa.) (Normally used with the preposition pronounced)
"He slept there"
a. Ha camminiete alocche.
"He walked there."

(31) Transitive verb
a. Ha 'ncuntrate Anne alocche. (Fa.)
has met Anne there
"He/She met Anne there."
b. Ha viste Anne alocche. has seen Anne there
"He/She saw Anne there."

These facts illustrate that while the preposition is silent in Italian *qui/li* (It) and English *here/there*, it is pronounced in some cases in Fallese, *(a)ecche/(a)locche*.

We provided a feature-based analysis of the facts, which offers a structural account of the apparent optionality of the preposition in given syntactic structures and its obligatory presence in others. We proposed that both *Minimize Symmetry* and *Minimize Externalization* apply in the derivation of locative determiners. *Minimize Symmetry* enforces the generation of a preposition AT/TO, in the syntactic derivation of locative determiners. This preposition is associated with valued and unvalued features, as in (32). The apparent optionality of the pronunciation of the proposition follows from the fact that feature valuation can be done by External Merge, as in (33 a), or by Internal Merge, as in (33b). The silence of the preposition, (<A>), is enforced by *Minimized Externalization* in (33b).

(32) a. a: {[P], [uD], {LOC]}

a. ecche : {{D], [LOC], [PROX]}

(33) a. [P A {[P], [~~uD~~], {LOC]} ecche {{D], [LOC]}]

b. [PP ecche {[D], [LOC] [P <A> {[P], [~~uD~~], [LOC]} ~~ecche~~ ~~{[D], [LOC]}~~]]

⇑_____|

A unified analysis of the apparent optionality of the prepositional head in these expressions and in deverbal compounds in some languages brings further support to the Strong Minimalist thesis as well as it provides an explanation for interface asymmetries. Furthermore, it provides further support to the independence of syntax with respect to semantics and phonology. In effect, the preposition *at/to* is associated with locative/directional semantic features in locative determiners; whereas the preposition *of* in deverbal compounds has no associated semantic features.

EXTENSIONS

In the following paragraphs, we identify two extensions of the proposed analysis, recursive coordinate structures and co-compounds.

Our analysis can be extended to recursive phrasal coordinate structures, e.g. *Mary, Lucy and Julie* vs. **Mary and Lucy, Julie,* discussed in Kayne (1994) in the antisymmetry framework. These examples illustrate that the conjunction is pronounced before the last conjunct. This is also the case in Italian, as well as in the other Romance languages. We observe that while a conjunction must be pronounced in (34), it must precede the last conjunct in recursive conjunction structures (35).

(34) a. Lucy e Julie sono arrivate. (It.)
Lucy and Julie are arrived
"Lucy and Julie arrived."
b. *Lucy Julie sono arrivate.
Lucy Julie are arrived
"Lucy and Julie arrived."

(35) a. Mary, Lucy e Julie sono arrivate. (It.)
Mary, Lucy and Julie are arrived
"Mary, Lucy, and Julie arrived."
b. *Mary e Lucy, Julie sono arrivate.
Mary and Lucy, Julie are arrived
"Mary and Lucy, Julie arrived."

According to our analysis, in convergent derivations, two DPs cannot merge directly. One or the other is first Merged with a Functional element. This is a consequence of the asymmetry of the computational procedure associated to Merge, enforced by *Minimize Symmetrical Relations*. Thus, a DP is first Merged with a functional element (36a). A second DP is Externally Merged to the preceding output (36b). At the third step of the derivation a functional element F is externally merged to the preceding output, (36c). In the last step of the derivation, a DP is Internally merged to the Specifier of the superior F Head, (36d). Given *Minimize Externalization*, the lower functional head is pronounced, since its Specifier is left without phonetic content.

(36) a. [$F_{\{[Conj],[uD],\ \sout{[uD]},[AND]\}}$ $Julie_{\{[D]\}}$]
b. [$Lucy_{\{[D]\}}$ [$F_{\{[Conj],[\sout{uD}],\ \sout{[uD]},[AND]\}}$ $Julie_{\{[D]\}}$]]
c. [$F_{[uD],\ \sout{[uD]}\}}$ [$Lucy_{\{[D]\}}$ [$F_{\{[Conj],[uD],\ \sout{[uD]},[AND]\}}$ $Julie_{\{[D]\}}$]]]
d. [$Lucy_{\{[D]\}}$ [$F_{\{[Conj],[\sout{uD}],\ \sout{[uD]},[AND]\}}$ [$\sout{Lucy}_{\sout{\{[D]\}}}$ [$F_{\{[Conj],[uD],\ \sout{[uD]},[AND]\}}$ $Julie_{\{[D]\}}$]]]]
⇑ and

The fact that only the lowest conjunction must be pronounced in recursive DP conjunctions is derived in a similar way, as we illustrate in (37). In the last step of the derivation, (37e), the third DP is Externally merged to the previously derived constituent. Here again, given *Minimize Externalization*, the lower functional head is pronounced, since its Specifier is left without phonetic content.

The facts however do not follow from the derivation in (38), where the two DPs are first merged together, and one of the two DPs is subsequently Internally Merged to the Specifier of a higher F head conjunction. Given the Spell Out Condition in (5) above, the conjunction is not pronounced, (38c). At the next step of the derivation, two DPs cannot be merged together since the remerged DP is in the Specifier of the F Head, see (38d).

(38) a. [Lucy$_{\{[D]\}}$ Julie$_{\{[D]\}}$]
b. [F$_{\{[Conj],[\sout{uD}],[\sout{uD}],[AND]\}}$ [Lucy$_{\{[D]\}}$ Julie$_{\{[D]\}}$]]
c. [Lucy$_{\{[D]\}}$ [F$_{\{[Conj],[\sout{uD}],[\sout{uD}],[AND]\}}$ [~~Lucy~~$_{\{[D]\}}$ Julie$_{\{[D]\}}$]]]
d. [Mary$_{\{[D]\}}$ [Lucy$_{\{[D]\}}$ [F$_{\{[Conj],[\sout{uD}],[\sout{uD}],[AND]\}}$ [~~Lucy~~ Julie]]]]

Our analysis can also be extended to co-compounds, such as *student worker*, *actor producer*, *bed and breakfast* and *truth or dare*, discussed in previous works (Di Sciullo 2005b, 2011, 2013). We expect that the silence of the conjunction in these structures to follow from feature valuation by External Merge, and its pronunciation from feature valuation by External Merge and Internal Merge, on a par with the derivation of additive cardinal numerals and time counting expressions discussed above. We also expect variation to be observed in certain languages with respect to the externalization the conjunction in co-compounds. We leave the investigation of these pronunciation asymmetries for further research.

CONCLUDING REMARKS

The ability for the human mind to compute complex numerals and time counting expressions is a consequence of the great leap from finite and continuous systems, such as the gesture system, to systems of discrete infinity, such as language, mathematics and music. Unpronounced elements are part of the abstract properties of human language. Their presence in cardinal numerals and in time counting expressions brings further support to the autonomy of syntax with respect to the other aspects of language. In turn, as foreseen by Chomsky (1957), their syntactic structure can provide a foundation for understanding their semantics.

The proposed analysis further supports the autonomy of syntax with respect to phonology, as in some cases the functional head is not pronounced, while it is interpreted at the semantic interface. It also provides evidence for the autonomy of syntax with respect to semantics, since the same syntactic form can be associated with more than one interpretation or lack of semantic interpretation altogether.

We provided a unified analysis of the pronunciation/silence of the functional elements, conjunctions and prepositions, in additive cardinal numerals and time counting expressions, leading to interface asymmetries. The analysis is independently motivated, and can be extended to coordinate DPs structures. We argued that the apparent optionality of the functional heads followed from a minimal choice in the derivation of these expressions.

The facts follow from the asymmetry of the computational procedure of the Language Faculty, enforced by principles of efficient computation, minimizing symmetry and externalization. Results from neurosciences reveal that different, but notwithstanding connected, areas of the brain compute language and mathematics. Even though different areas of the brain are at play (Friedrich and Friederici 2009, 2012) there are reasons to think that mathematics and music emerged with the Language Faculty.

Chomsky's *Syntactic Structure* remains a fertile terrain of investigation. The recursive generation of hierarchical structure, whose constituents may, and in some case must, remain unpronounced, brings strong evidence for the autonomous syntax and the role of asymmetry in the computations of the language Faculty.

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