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CONTENTS

On the Format and Locus of Parameters: The Role of Morphosyntactic Features.

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1. Introduction

The idea that linguistic variability could be reduced to a limited number of parameters introduced a new technical language for comparative formal syntax, and was a decisive factor in the impressive growth of comparative studies over the last thirty five years. The notion of parameter of the early parametric models has undergone significant changes under the pressure of theoretical advances and empirical evidence: the way in which we can conceive of parameters in current minimalist models is clearly different from early formulations in Chomsky's *Lectures on Government and Binding* and in the literature in the early 1980s. Nevertheless, in my opinion there is a fundamental conceptual and formal continuity between early and more recent approaches to language variation; this continuity justifies the use of the same term to refer to the irreducible choice points of the system, and would make a terminological change misleading.

In this article, I will start with a quick survey of the historical development by referring to the two key notions of the format and locus of parameters across different successive models of comparative generative grammar. Then I will address the question of how and where parameters are expressed within current minimalist models. I will make explicit a conception of parameters as morphosyntactic features expressed on functional heads and providing explicit instructions for the triggering of syntactic operations. This will lead to introducing a typology of features, hence of parameters, on the basis of the operations they trigger: there are merge parameters, operating on structure building, movement parameters, triggering different kinds of movement, and spell-out parameters, giving instructions on the syntactic positions that are or are not pronounced.

Under the Borer–Chomsky conjecture on the locus of parameters, the size of the set of parameters is determined by the size of the functional lexicon, hence a parametric system based on these assump-

tions has many parameters. In spite of that, the space of variation is drastically limited by the tight constraints operating on minimalist syntax: only very few operations are possible in syntactic computations. So, the large number of parameters notwithstanding, the system is radically more constrained than approaches to linguistic variation based on an unlimited set of language particular rules, interacting with a much less constrained notion of Universal Grammar, as in pre-parametric models of the Extended Standard Theory.

In the final part of the article I will address the issue of the elements of variation in structural maps emerging from cartographic work. Possible forms of parametrization arising in functional sequences will be illustrated through the case study of the uniqueness or multiplicity of topics in the left periphery of the clause.

2. Some elements of the history of parameters.

The first twenty years of the history of generative grammar mainly focused on linguistic uniformity. This was due in part to a contingent reason: the available data base consisted largely, if not uniquely, of a body of empirical analyses of English, so that little if any formally analyzed evidence was available about language variation. Nevertheless, a crucial assumption was that grammatical fragments of a single language would directly bear on issues of universality through poverty of stimulus arguments: if from the analysis of a single language certain properties emerge which, plausibly, are not inductively determinable from the data available to the language learner, such properties have to be deductively connected to some inner property of the learner. Therefore, these properties tell us something on the structure of the mind and, to the extent to which they are specific to language, on the structure of Universal Grammar (UG). The Standard Theory and the Extended Standard Theory of the 1960s and 1970s of course also assumed devices to express language variation: individual languages were assumed to be generated by particular grammars, consisting of rules specific to the particular language, and respecting general constraints on rule format and application defined by UG. One major problem with this conception came from the insufficiently constrained character of the possible language-particular rules: the search space available

to the language learner remained much too vast to permit a reasonable account of language acquisition. Therefore, reaching the level of "explanatory adequacy" (Chomsky 1964; see Rizzi 2016a for a recent discussion of this notion) remained a distant goal.

Things changed suddenly around the end of the 1970's, with the introduction of the Principles and Parameters model (systematized in Chomsky 1981 on the basis of much research conducted in the previous years). If the possibility of a parametrization of individual principles and rules had been abstractly envisaged before, the first empirical motivation came from the observation that certain island properties, such as the (non-) extractability from indirect questions and from subject noun phrases turned out to manifest a certain level of variability (Rizzi 1978, 1982, ch. II). Poverty of stimulus considerations made it unlikely that the relevant locality principle could be figured out from scratch by the language learner on the basis of the primary data available to him/her; moreover the observed variability clearly appeared restricted to a narrow range of options, so it seemed necessary to maintain the hypothesis that some UG principle was involved. On the other hand, the assumption of a strong universal UG-based component had to be reconciled with the observed variation. So, the idea was explored that the relevant locality principle, Subjacency (first introduced in Chomsky 1973) could contain a parameter, a choice point determining a narrow variation in the operation of the principle: in particular, the choice of the bounding nodes, counting for the computation of locality, could be language-specific to some extent (in the original terminology, either S or S', currently IP or CP, could be the clausal bounding node).

In hindsight, this kind of variability turned out to be rather marginal (with variation within the same language: Grimshaw 1986), and not even naturally amenable to more modern conceptions of parametrization, such as those discussed below. Nevertheless, the S/S' discussion had the merit of offering the first concrete case of a formal device specifically intended to address cross-linguistic variation in a UG-based system, an idea which immediately showed a vast potential for the analysis of language diversity. The idea that language variation could be reduced to the fixation of a finite number of binary parameters introduced a precise theoretical language to address invariance and variation, and this simple innovation immediately showed a great heuristic capacity, and made formal comparative syntax possible, and attractive. In very few years the data base of languages analyzed

through generative tools grew enormously, and for the first time the comparative dimension   got to center stage in generative grammar.

In discussing properties of different conceptions of parametriza- tion it is useful to isolate two questions (here I am developing some lines of the analysis presented in Rizzi 2014):

(1)   What is the *format* of parameters? i.e., what constraints should we expect on possible forms of parametrization?

(2)   What is the ***locus*** of parameters? i.e., where are parameters expressed in the general grammatical architecture?

In the early years of parametric theory, not much attention was devoted to the issue of the format: more or less anything could be a possible parameter, and proposals varied from word- order properties (e.g., OV vs VO), to the licensing of null elements of various kinds (subjects, objects, etc.) to properties of the triggering of movement (V to T, V2, etc.), to the choice in the component in which a given operation took place (e.g., wh-movement in overt syntax or in the syntax of LF in *in situ* languages, affixation in syntax or in the PF component, etc.), to much more global properties of grammatical systems, such as the configurationality of the language (Hale 1983).

As for the locus of parameters, as the S/S' parameter looked like a specification on a given principle, Subjacency, it seemed natural to generalize this case, and assume that UG principles could be, in general, the place in the global grammatical architecture in which parameters were expressed.

But this conception of the locus of parameters quickly turned out to be dubious. On the one hand, certain UG principles did not show any plausible kind of parametrization (e.g., the Theta Criterion); on the other hand, and more importantly, some properties of variation turned out to be linked to the presence of particular items in the func- tional lexicon, rather than being global properties of certain principles or modules of grammar. So, for instance, long distance anaphora, a much studied element of variation in the functioning of the binding theory (Manzini & Wexler 1987), seemed to depend on the presence of particular items in the functional lexicon, *sig* in Icelandic, *sé* in Italian, etc., rather than being a global property of binding in a given language (i.e., other items, such as *se stesso* in Italian, do not manifest the long distance binding option: Giorgi 1984); the prepositional or

postpositional character of an adposition depended in part on the lexical specifications (arguably even in largely uniform languages like English: *after three weeks, three weeks ago*), etc..

This kind of consideration lent support to a different view on the locus of parameters, often called the Borer–Chomsky conjecture (see Borer 1983):

(3)   Parametric values are expressed in the functional lexicon.

This conception leads to the expectations that parameters are more numerous than in the initial conception of parameters expressed on principles: principles are few in a grammatical architecture such as the Government-Binding framework (and even fewer in a minimalist grammar), whereas the functional lexicon is a rich inventory, all the more so if cartographic studies are on the right track (see below). Under the Borer–Chomsky conjecture, there are many more opportunities for parametrisation and the size of the functional lexicon offers a reasonable basis for an estimate of the numerosity of parameters, which then shifts from the order of tens to the order of hundreds (or more).[1] Correspondingly, in a system with numerous parameters each parameter is expected to be more local and limited in scope than in a system with few parameters. In particular, it is less likely that a single parameter will autonomously control complex typological clusters, because it will interact with many other parameters which will make the deductive connection between a single parameter and large arrays of properties more complex and indirect.

Evidence for such a more local and diffuse effect of individual parameters came from the observation that certain parameters assumed initially as directly and autonomously controlling several properties turned out to interact with other parameters which limit their scope. For instance, the Null Subject Parameter (Rizzi 1982), initially assumed to be directly responsible for so-called "subject inversion" in languages like Italian, interacts with another parametric property, at least partially independent, having to do with the activation of a vP peripheral focus position which hosts postverbal subjects in languages like Italian (Belletti 2004, and, for general considerations on the

[1] For instance, Longobardi et al. (2015) postulate 82 parameters just for the structure of the DP; Cinque & Rizzi (2010), based on Heine and Kuteva's (2002) hundreds of independent grammaticalization targets, estimate that the number of functional heads must be at least of that order of magnitude; each functional head could carry a few parametric properties of the kind to be discussed below.

Null Subject Parameter in a system analyzing subject inversion as focalization, Nicolis 2005: see below). So, some languages licensing null pronominal subjects have clause-final subject focalization, and others do not.

More radically, it was proposed that certain global properties initially assumed to be controlled by large parameters actually dissolved into the operation of smaller parameters. So, freedom in word order is not controlled by a single global "non configurationality" parameter, but rather dissolves into the combination of smaller properties: null subject and null object languages are typically freer in the positioning of the subject and object DP's, respectively, than other languages; scrambling languages are freer than non-scrambling languages; languages permitting the disintegration of nominal structures (possibly as a consequence of properties of the determiner system: Boskovic 2009) are freer than languages keeping DP's intact; etc. so, there are in fact distinct degrees of freedom of word order as a function of the fixation of more local parameters, rather than a unique binary opposition between configurational and non-configurational languages. This is the state of affairs expected under the microparametric view advocated by Kayne 2000, 2005, and directly connected to the Borer–Chomsky conjecture (now largely assumed, but not completely uncontroversial: see Baker 2001, 2008, 2013, and this volume, for discussion).

This conception of parametric theory has sometimes been criticized as involving an undeclared retreat to the idea of language particular rules (Newmeyer 2004, 2005): if there are so many parameters, how is parametric theory different from a theory permitting language-specific rules, as in EST models?

To address this point, the distinction between format and locus of parameters becomes important. A system with parameters expressed in the functional lexicon permits many parametric specifications, but may still define an extremely restrictive framework for linguistic variation: it all depends on the format for parameters that the theory assumes. This leads us to address the format of parameters in current grammatical models.

3. On the format of parameters

What is a possible parameter in a minimalist grammar? I would like to adopt the following definition, adapted from Rizzi (2014):

(4)   A parameter is an instruction for the triggering of a syntactic operations, expressed as a morphosyntactic feature associated to a functional head.

So, when a functional element enters syntax becoming a functional head, it will trigger certain syntactic operations on the structure which is being built, on the basis of the featural instructions associated to it. What kinds of operations can be triggered? The list of possible elementary operations permitted by a minimalist grammar is highly restricted. Keeping the discussion at a rather informal level, we can identify:

(5)   a. Merge

       b. Move

       c. Spell out

Correspondingly, we may envisage merge parameters, controlling properties of structure building, movement parameters, controlling the various movement properties[2], and spell-out parameters, determining the pronunciation of a given head and of its immediate dependents. Each parametric property is strictly local, in that the triggered operation can only affect the immediate structural environment of the relevant head. Given the highly limited nature of the possible syntactic operation and the locality of their structural consequences, the system is radically more restricted than an EST type system based on an unlimited set of possible language specific rules. The search space within which the language learner must determine the specific properties of the language s/he is exposed to is restricted accordingly, so that the learnability problems that an EST type grammar had to face are kept under control.[3]

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[2] See below on the reduction of movement to search and internal merge.

[3] See the discussion in Rizzi (2014), which also addresses experimental evidence bearing on the early fixation of parametric properties. For a general discussion of the current status of parametric comparative syntax see also the other contributions in Picallo, ed., (2014), and Guardiano & Longobardi (2016).

Here I will adopt the view, central in minimalism, that each operation is triggered by a morphosyntactic feature. So, we may envisage the following general definition of the format for parameters:

(6)   X has F

in which X is an element of the functional lexicon (on which see Rizzi & Cinque 2016), and F is a morphosyntactic feature triggering syntactic operations of merge, move and spell-out. X may have F in one language, and not in another language, a binary choice.

The next question is: what is F, the class of relevant morphosyntacic features, hence of parametric properties? In order to structure the approach, let us now look in some detail at the morphosyntactic features which trigger syntactic operations. I will consider three broad classes of features, hence of parametric properties, along the lines of the typology of operations in (5).

3.1 Merge parameters

They deal with all the properties of structure building which may vary across languages. While properties of semantic selection (s-selection, in the sense of Grimshaw 1979, Pesetsky 1982) may well be invariant (apart from the possibility of interface parameters, as advocated in Chierchia 1998), properties of categorial selection (c-selection) not directly deducible from s-selection may vary. In the terminology and classification adopted here, they are merge parameters (or, more precisely, external merge parameters, if we understand movement as involving internal merge, see below) . One familiar example may be the selection of a reduced clausal complement by certain verb classes, e.g., epistemic verbs. *Believe*-type verbs in English select a reduced clausal complement, permitting exceptional case marking and inconsistent with control; in Romance they select a full clausal control infinitive introduced by a complementizer system (with an overt prepositional complementizer in Italian and a null C in French):

(7)   a.   John believes [Bill to be a nice guy]
         b. *John believes [PRO to be a nice guy]

(8) a. *Gianni crede [Piero essere una brava persona]
     b. Gianni crede [di [PRO essere una brava persona]]

(9) a. *Jean croit [Pierre être un type bien]
     b. Jean croit [[PRO être un type bien]]

The fact that these properties appear to affect verb classes, rather than individual verbs, is consistent with the idea that the parametrization is linked to elements of the functional lexicon, in this case an appropriately flavored instance of v, along the lines of Harley (2011), Ramchand (2008) and related work.

   Analogously, with perception verbs, Italian and French permit pseudo-relatives (Cinque 1990a, Guasti 1988, Casalicchio 2013) while English does not, and French and English permit participial-gerundival complement clauses, while Italian does not ((11)b is fine in Italian, but with the gerundival clause functioning as a clausal adjunct controlled by the subject "…while I was coming back home", not as a complement of the perception verb with *Gianni* as subject):

(10) a. *I saw John that was coming back home
      b. I saw John coming back home

(11) a. Ho visto Gianni che tornava a casa
      b. *Ho visto Gianni tornando a casa

(12) a. J'ai vu Jean qui rentrait à la maison
      b. J'ai vu Jean rentrant à la maison

Examples of this sort could easily multiply. Merge parameters also include certain elements of variation in functional sequences, such as the number and type of topic positions permitted in the left periphery of a given language, the position of negation and agreement markers in the functional sequence of IP etc. We will address such cartographic parameters in a separate section.

3.2 Move parameters

   In order to illustrate this kind of parametrization, certain assumptions on movement must be made explicit. Following current guidelines, I will assume the following:

(13) a. Move is a complex operation (Chomsky 2000) involving
      I.   the establishment of a probe-goal search relation fol-
          lowed by
      II. (internal) merge of the goal.

    b. Movement may involve a head or a phrase.

If movement is a complex operation, then both components, search and internal merge, are a priori parametrizable; and if head movement exists as a distinct operation from phrasal movement (assumption (13)b), we need a way to differentiate the two, and express the fact that they both admit parametrization. In Rizzi (2015b, 2016b) I proposed to modify Bare Phrase Structure by using the feature *lex*, distinguishing heads from phrases, a device which I will assume here (the system is expressed in terms of the labeling algorithm introduced in Chomsky (2013, 2015).

Let us start then from head movement parameters. Consider the difference between English and French in terms of head movement. Both English and French have verbs agreeing with subjects, but in French lexical verbs are attracted by the functional head bearing Phi features (indicated as Phi in (14), the kind of position designated by the label AgrS in previous work[4]), while in English lexical verbs do not move, as is shown by the respective ordering with adverbials (Emonds 1978, Pollock 1989):

(14) a. John   Phi   often   sees Mary

    b. Jean   voit+Phi souvent ____   Marie

So, the head indicated as Phi acts as a probe and launches a search operation in both languages, looking for a verbal head with matching Phi features, the goal. Once the probe-goal relation is established, the features on the goal are valued, and this determines the agreeing morphology on the verb. At this point, the goal may be internally merged with the probe in French-type languages, yielding the order in (14)b, or remains *in situ* in English-type languages.

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[4] In standard minimalist approaches, the position is identified with T carrying Phi features; in other approaches Phi identifies an independent position. The point is not of crucial important for our discussion, so we will just refer to the position as "Phi".

Other languages, e.g., creole languages such as Jamaican (Durrleman 2008), do not show any kind of morphological manifestation of agreement on the verb; they may involve a Phi-like head attracting the subject and determining its (abstract) case, but they may not involve any search from the Phi head for a particular verbal form, as V remains invariant. So, search may or may not be triggered from Phi to V (or, actually, v, as is stated more accurately below); if it is, V may or may not be moved to (internally merged with) Phi. In short, we have the following parametrization for Phi involving its syntactic (head – head) relation with V:

(15)
$$\text{Search for V?}$$

Yes   No (Creole)

Internal merge of V?

Yes (French)   No (English)
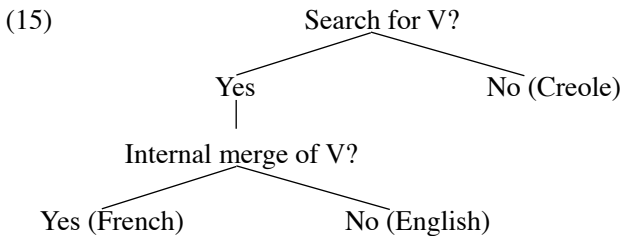
Here I assume, as in Chomsky (2000), that search is a prerequisite for internal merge, and that this holds for head-movement as well. If a search relation is established, the language may trigger internal merge of the goal, or not. Therefore we have, in association with individual functional heads:

(16) a. Search parameters: is a probe-goal search activated or not wrt a particular feature set?

b. Internal merge parameters: once a probe-goal relation is established, is internal merge of the goal with the probe activated or not?

Consider now phrasal movement. Here I will continue to assume that internal merge presupposes the establishment of a probe-goal relation, followed by internal merge of the goal. As we are in the phrasal domain, the goal, a phrase, could not be internally merged with the probe, a head: heads may be complex, but they can only contain other heads, not phrases, a kind of extended structure preserving constraint called Lexical Uniformity in Rizzi (2016b). So,

phrasal movement can only involve internal merge to the projection of the probe, rather than to the probe itself, which would violate Lexical Uniformity.

As in the case of head movement, once a search relation is established, the probe may or may not attract the goal to be internally merged with its projection. So, for instance, in wh-movement languages the probe, a Q complementizer, attracts the phrasal goal to internally merge with its projection, whereas in wh-*in situ* languages internal merge does not take place (or at least, not overtly). Both options are available in French main questions, so the following are both possible:[5]

(17) a. Q Tu as vu <u>qui</u>?
          'You have seen who?'

      b. <u>Qui Q</u> tu as vu __ ?
          'Who have you seen ?

Analogously, in SVO languages we have a search from a Phi-type head to the closest nominal expression in its domain (again, the successful search is annotated by underscoring the probe and the goal in what follows), followed by internal merge of the goal to the projection of the probe Phi (whether or not Phi has also attracted V), whereas in VSO languages the search relation between Phi and S is established, so that agreement in Phi features is checked, but not followed by internal merge of the goal:

(18) SVO:

Phi S V O   → Search
<u>Phi</u> <u>S</u> V O   → Internal merge
<u>S</u>   <u>Phi</u> __ V O

(19) VSO:
Phi S V O   → Search
<u>Phi</u> <u>S</u> V O

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[5] The underscored elements have been connected by search and are in a probe-goal relation; I do not address here the question of whether <u>qui</u> undergoes covert movement in (17a), and of what kind of mechanism is involved in covert movement.

(the correct ordering is derived in (19) once the probe Phi attracts the verbal goal; alternatively, Phi may host an auxiliary verb, in which case the order will be Aux S V O; the postverbal subject in VSO presumably has been moved from its first merge position in the vP, as is shown by the ordering V S Adv O, possibly for labeling reasons (Rizzi 2015b, Shlonsky 2014), but does not move as far as the Spec of Phi in this analysis of VSO).

In conclusion, a functional head acting as a trigger of movement may have two distinct pairs of features, responsible, respectively, for phrasal movement and head movement:
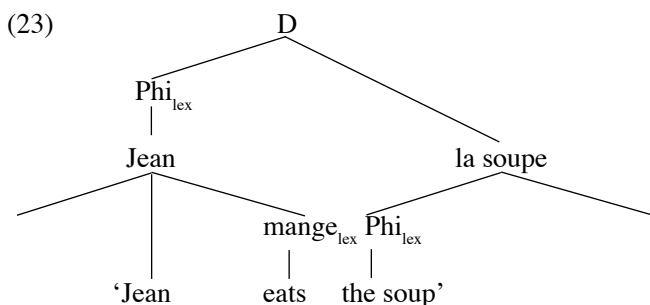
(20) For phrasal movement:
      a. A search feature at the phrasal level.
      b. The corresponding internal merge feature at the phrasal level (IM), what is traditionally called an EPP feature.

(21) For head movement:
      a. A search feature at the lex level (Search$_{lex}$ Feature)
      b. The corresponding internal merge feature, again at the lex level (IM$_{lex}$ Feature)

So, the head carrying Phi in the clausal IP structure in a language like French carries all four features. First of all, a search feature for a noun phrase (of category D) carrying matching Phi features, and the corresponding internal merge feature (what is traditionally referred to as an EPP feature) triggering internal merge of the goal (the subject DP) with the projection of the probe, hence determining movement of the subject DP from its thematic position to the subject position in the higher zone of the IP.[6] Then, there is a search feature for a lex verbal element (a verb with matching phi features), and the corresponding internal merge feature triggering internal merge of the verbal goal with the probe and yielding a complex head, a verb endowed with agreement features. So, we have a lexical representation like (22) for Phi in French:

[6] The subject DP is not merged with the probe itself, the Phi head (because we are here at the phrasal level), and a phrase cannot be internally merged with a head because of Lexical Uniformity. So the DP is merged with the projection of the probe, a phrasal (non-lex) category.

(22) Phi head: Search Feature: Phi, D
                        IM Feature   :   Phi, D goal

                        Search$_{lex}$ Feature: Phi, v_{lex}
                        IM$_{lex}$ Feature   : Phi, v_{lex} goal

The head is endowed with a search feature at the phrasal level establishing a search relation with a DP endowed with Phi features, and of the corresponding internal merge feature, instructing the system to internally merge the goal DP with the structure headed by Phi; the functional head Phi is also endowed with a search feature at the head level (Search$_{lex}$Feature) establishing a search relation with a verbal head carrying Phi features, and of the corresponding internal merge feature (IM$_{lex}$Feature), instructing the system to internally merge the goal v_{lex} with the probe Phi: here the goal can be merged with the probe head, under Lexical Uniformity, as both are heads (lex elements). This yields the following representation (omitting many details):

(23)   D

            Phi$_{lex}$
               |
            Jean   la soupe

                                  mange$_{lex}$ Phi$_{lex}$
                                        | |
            'Jean   eats   the soup'

Phi in English would have the same specification, except that it would lack the IM$_{lex}$ Feature, thus no verb movement would be triggered.[7] At least for a first approximation, a VSO language would presumably involve Phi with the same specification as French, except that the IM Feature, triggering movement of the subject DP, would not be specified.

Let us now illustrate the system at the CP level. A functional head may have none of these features, in which case it is inert for movement,

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[7] A finer distinction would be needed here to distinguish lexical from functional verbs, as the latter do raise to Phi in English; we will omit this refinement.

e.g., the complementizer *that* of an embedded declarative clause; or it can have just one feature, e.g., the Q complementizer of a wh-*in situ* language, triggering a search relation with an *in situ* wh-element; or two such features, e.g. a search feature for a wh-element and an internal merge feature triggering merge of the goal with the projection of the probe, as in a wh-movement language without inversion (Hebrew and other Semitic languages, Brazilian Portuguese, various creole languages, for instance); or three or all four features. The last case, a language with a complementizer head attracting both a wh-phrase and a head of the IP system, may be illustrated by the Q complementizer in English main clauses, with lexical representation (24), and yielding a structural configuration like (25) (I assume that in inversion structures the relevant complementizer Q attracts an occurrence of T endowed with Q, expressed here as $T\text{-}Q_{lex}$):

(24) Q head: Search Feature: Q
              IM Feature: Q goal

              $Search_{lex}$ Feature: $T\text{-}Q_{lex}$
              IM_{lex} Feature: $T\text{-}Q_{lex}$ goal

(25)   DP

              Q

        Which book   you read

                        did   Q
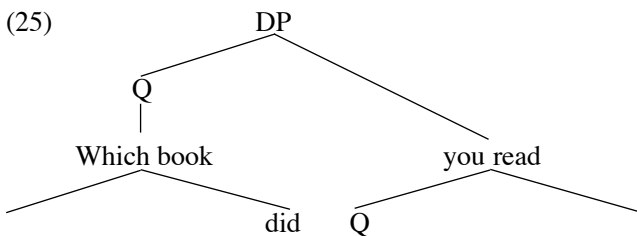
In conclusion, move parameters involve two pairs of featural instructions, one involving search and internal merge for a phrase, and the other involving search and internal merge for a head (a lex element, in the formalism adopted here); phrasal (non-lex) internal merge involves merge of the goal phrase with the projection of the probe, while head (lex) internal merge involves merge of the goal head with the probe, in accordance with Lexical Uniformity. This mechanism handles all major cases of phrasal (A and A') movement and head movement as cases of triggered movement. If untriggered movement exists, i.e. a set of movement operations not depending on a previously established probe-goal relation, or even, more broadly,

there are kinds of movement not depending on specifications of morphosyntactic features, extra options should be added, and it is not clear how possible parametrisations could be expressed in a way consistent with the Chomsky – Borer conjecture. I will not go into the many ramifications implied by such options, and, for the sake of this discussion, I will simply assume that untriggered movement does not exist.[8]

Notice that in my illustration of movement to Phi and to Q I have kept the traditional assumption that the same head Phi attracts the inflected verb and the subject DP, as in the French case, and that in the C system, the same head, Q, attracts the T bearing element and the wh phrase. A conceivable alternative is that each individual functional head is endowed at most with a single pair of features triggering movement, so that an individual head is a trigger for either head movement or phrasal movement, but not for both simultaneously. If so, the relevant cases would have to be reanalyzed as involving two distinct heads, the lower one triggering head movement and the higher one triggering phrasal movement. The possible interpolation of various kinds of adjuncts in French between the subject and the inflected verb suggests that distinguishing two separate heads as triggers of the two types of movement is at least an option. The higher head attracting the subject could be the Subj head, on which see Cardinaletti (2004), Rizzi (2006), Rizzi & Shlonsky 2007):

(26) Jean, à mon avis, trouvera la solution
      'Jean, in my opinion, will find the solution'

Similarly, a construction like complex inversion in French (Rizzi & Roberts 1989), with the lexical subject occurring between the wh-element and the tensed verb (which in turn precedes the subject clitic, suggesting that it has moved to the C-system) supports the splitting hypothesis for the C-system:

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[8] I will also not address here the possibility that head movement may be phrasal movement "in disguise", i.e., involving previous extraction of the dependents out of the phrase followed by remnant movement of the phrase containing only the head. Notice that this analytic path would require a way to differentiate full-fledged phrasal movement and phrasal movement *qua* head movement in disguise, as the two clearly are not interchangeable. Imaginable featural mechanisms differentiating the two kinds of phrasal movement may be akin to what we proposed in the text assuming the traditional distinction between head and phrasal movement.

(27) Où Jean est-il allé?
      'Where Jean did he go?'

So, the possibility of expressing attracting features for head and phrasal movement on separate heads clearly is an option. I will leave open whether this splitting is just an option, or the splitting is what happens in general in cases of double phrase- and head- attraction in the same zone of the syntactic tree.

3.3 Spell-out parameters

Much early work on parametric theory revolved around the Null Subject Parameter: some languages license a phonetically null subject pronoun, and this apparently low-level property connects with other structural properties of the language. This parameter then is, for historical reasons, an important representative of spell-out parameters, having to do with variation in the obligatory, optional or impossible pronunciation of certain heads and of their immediate dependents.

In the original work, a single parametric property was intended to capture a cluster of properties which clearly differentiate non-null subject languages like French and English from null subject languages of the Romance family, such as Italian and Romanian (Rizzi 1982, ch. IV). Italian and Romanian allow null pronominal subjects with referential and non-referential interpretation (as in (28a'-b'), (29) a-b, respectively); they also allow subject inversion, with the overt subject in clause-final position, as in (30a'-b'), alternating with the clause initial position; and free violations of *that*-trace effects, as in (31a-b). English and French do not allow any of these properties (as in the c-d, c'-d' examples).

(28) a. Io parlo italiano   a' ___ parlo italiano
      b. Eu vorbesc italiana   b' ___vorbesc italiana
      c. Je parle l'italien   c'* ___ parle l'italien
      d. I speak Italian   d'* ___ speak Italian

(29) a. ___ piove
      b ___ plouă.
      c. Il   pleut
      d. It is raining

(30) a. Gianni ha telefonato   a' ___ ha telefonato Gianni
      b. Ion a telefonat   b' ___ a telefonat Ion
      c. Jean a téléphoné   c'* ___ a téléphoné Jean
      d. John telephoned   d'* ___ telephoned John

(31) a.   Chi credi che ___ verrà?
      b.   Cine crezi că ___ va veni?
      c.* Qui crois-tu que ___ viendra?
      d.* Who do you think that ___ will come ?

In the early days of the parametric approach, a systematic attempt
was made to establish deductive connections between these proper-
ties, tracing them back to a single irreducible difference, the fixation
of the Null Subject Parameter interacting with the general structure
of Universal Grammar. The adopted formulation of the parameter
was along the following lines:

(32) *pro* is licensed by the verbal inflection {yes, no}

Relevant UG principles interacting with the parameter were the
EPP, expressing the obligatoriness of the subject position of clauses,
irrespective of the thematic properties of the verb, and the ECP,
banning traces from non-properly governed positions, such as the
subject position.

So, in English and French, (28c'-d"), (30c'-d') would be excluded
because there was no appropriate null filler for the obligatory subject
position (under the EPP), and (31c-d) would be excluded as an ECP
violation. In Italian and Romanian (28a-b) and (29a-b) would be fine,
with the legitimate null pronominal with a referential or expletive
interpretation; and the preverbal subject position could be filled by
the expletive *pro* in (30)a-b and (31)a-b, thus permitting more free-
dom in the positioning of the thematic subject; in particular, subject
extraction would be possible in (31)a-b because extraction could
take place from a lower properly governed position.

In the following thirty years or so, much theoretical and empirical
work led to a rather different global picture. Belletti (2004, 2009)
showed that the inversion operative in (30) does not involve an
optional movement process, but is in fact a device for focalizing
the subject in the low vP periphery, an option which is governed

by an independent parameter. So, some null subject languages, like Italian and Romanian take this independent option, while other null subject languages, like the Bantu language Lingala (Salulessa 2004) do not. The null subject parameter thus interacts with at least another parameter in determining the pattern in (28)-(31). Another important line of research was devoted to the comparative study of partial null subject languages (Hebrew, Brazilian Portuguese, Finnish,…) which permit expletive null subjects but show important limitations in per- mitting null pronominals with referential interpretation (Biberauer, Holmberg, Roberts, Sheehan 2010). On the theoretical dimension, the possibility was explored that the licensing of the null subject may in fact be the result of a deletion operation (Biberauer et al. 2010), and that the impossibility of extracting the subject may be a consequence of a general freezing principle, rather than of the ECP (Rizzi & Shlonsky 2007). So, a substantive body of theoretical and empirical work was devoted to the topic, ideas and analytic tools were refined and changed, and much progress was made. Nevertheless, it seems to me that the core of the original approach has remained intact: a complex cross-linguistic pattern can be deductively connected to a parameter on the licensing of a null pronominal, interacting with UG principles and other parameters. The numerosity of the parameters, under the Borer-Chomsky conjecture, makes it unlikely that a single parameter may govern a complex pattern in isolation from other parametric choices, in this and many other cases: there are just too many parameters, so that interactions will inevitably arise. And indeed we have seen that more than a single parameter determines patterns like (28)-(31). But the important point is that the deductive depth of the system remains intact: so, the conclusion remains valid that null subject languages typically are insensitive to that-trace effects because the availability of the null expletive offers a well-formed filler for the freezing subject position, thus allowing the thematic subject to circumvent the freezing effect and remain extractable (Rizzi & Shlonsky 2007). Interactions are more complex in a system with many parameters, but the deductive depth of the system is unaffected; in fact, if anything, deductive chains tracing back empirically observed patterns to principles and parameters become even more intricate, and interesting (see also Nicolis 2005 on the correlation between the availability of a null expletive and the lack of that-trace effects).

As pointed out at the outset, the null subject parameter is histori-cally the main representative of the class of spell-out parameters, but the class goes well beyond this case. Other spell-out parameters may involve null pronominals in other positions: null objects (Rizzi 1986 and much subsequent work) and other kinds of complements, and null topics and other unpronounced left peripheral elements. All these cases have in common the fact that the relevant head licenses a null specifier. Another class of spell-out parameters may involve the very fact that heads may often be null: languages may permit null copulas, null determiners, null topic and focus markers.[9] If ellipsis phenomena are triggered by special functional heads, as in Merchant (2001), and there is variation across languages, we have another class of spell-out parameters expressible in the format advocated here.

4. Word order properties

A very salient form of cross-linguistic variation involves word order: how does one express the parametrization distinguishing VO and OV, prepositional and postpositional languages, etc? The traditional approach involved a head - complement ordering param-eter expressed in X-bar theory, an approach also consistent with a merge-based structure building device. But how can headedness be expressed in a way consistent with the Borer-Chomsky conjecture, and with our assumptions on the locus and format of parameters? If we think of lexical categories such as V, N, A, etc., as resulting from the merger of unlabeled roots and functional elements like v, n, a, (Marantz 2013, Borer 2005), and providing labels to the complex head root+v, root+n, etc., we may think that ordering statements are encoded in the lexical representation of such functional elements, so that v encodes the property "precedes the complement" in English and "follows the complement" in Japanese, etc.. This approach has been criticized in much recent work. In particular, it has been observed that there are asymmetries between VO and OV languages which would not be expected under a fully symmetric approach based on the headedness parameter (Kayne 1994, Cinque 2013).

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[9] Kayne (2015) makes the radical proposal that all functional heads are null; if that approach is correct, the whole spell-out parametrization would involve the pronunciation of specifiers.

An alternative developed in Kayne (1994) and much related work inspired by his antisymmetric approach proposes that all word order variation is derived by movement: hence, if VO is the universal basic word order, OV can be derived by moving the object to a higher specifier position. Along these lines, all word order variation would be caused, in our terminology, by movement parameters modifying a universal underlying order, where both underlying and surface orders are determined by Kayne's Linear Correspondence Axiom, determining linear order on the basis of hierarchical c-command relations. Again, the relevant parametric property (here a movement property) would be encoded in the categorizing functional heads v, n, etc., and in other heads of the functional system.

A partially different proposal, developed in Berwick and Chomsky (2011), (2016), is to assume that core syntactic representations are purely hierarchical and unordered, a consequence of the assumption that merge is a set-theoretic operation not encoding order. If this is so, linearization is an extra-syntactic process, taking place when syntactic representations are transferred to the sound system. In this view, the relevant parametric properties would involve, in our terminology, spell-out parameters, which could also be associated to the functional entries of v, n, etc..

It should be noticed that, whatever option is ultimately adopted to express word order parametrization, it should be able to capture certain cross linguistic generalizations, including those emerging from much comparative work generated by Greenberg (1964), to the extent to which they are grammatical in nature (see Newmeyer 2005, Holmberg & Roberts 2005, 2013 for different points of view). A good candidate for a grammatical analysis is Biberauer et al.'s (2008) Final Over Final Constraint, capturing the fact that a V-final VP can be embedded under an Aux initial projection (yielding the order S Aux O V), but there are no convincing cases of a V initial VP embedded under an Aux final functional projection (S V O Aux). Similarly, impossible orderings excluded by Greenberg's Universal 20 can be ruled out by the derivational mechanism postulated by Cinque (2005) (for an extension to the more complex ordering patterns at the clausal level, see Cinque, this volume).

5. Parametrisations in structural maps:
uniqueness or reiteration of topic structures

Over the last two decades, much attention has been devoted to the study of the functional structures associated to lexical projections and defining the global configurations of sentences and phrases. Cartographic research has focused on the fine properties of such functional structures, bringing to light their complexity and richness (Cinque & Rizzi 2010, Rizzi & Cinque 2016, Shlonsky 2010). The comparative analysis has underscored a robust cross-linguistic uniformity in functional sequences, and also the necessity of postulating certain parameters of variation. Cinque (1999) showed that many cases of language-particular orderings of adverbials not conforming to his general hierarchy are amenable to movements of verbal chunks in the clausal spine: so, language particular reorderings are a function of movement parameters. In this section I will discuss some elements of parametrization emerging from cartographic research on the left periphery of the clause, with special reference to topic structures.

The left periphery of the clause is the privileged place for the expression of scope-discourse properties: the scope of operators of various kinds, the discourse-related configurations of topicality and focus. The criterial approach to scope-discourse semantics, a cornerstone of the cartographic research on the left periphery (Rizzi 1997; see Rizzi & Bocci (2016) for a recent assessment), assumes that the left periphery is populated by a sequence of "criterial" functional heads such as Top and Foc; criterial heads attract to the left periphery phrases endowed with matching features, and guide the interface systems to interpret the configuration in the appropriate way (e.g., as Topic – Comment), and to assign the special intonational properties that go with these configurations. E.g., in a Clitic left dislocation construction in Italian (Cinque 1990), the initial constituent is interpreted as the topic, and the rest of the clause as the comment expressed about the topic:

(32)   Il tuo libro **Top** Gianni lo darà   a Maria domani
       Your book   Gianni will give it to Maria tomorrow'
        TOPIC   COMMENT

Under the criterial approach, a functional Top head attracts a phrase with matching topic features, and guides interface systems to

assign the topic – comment interpretation, and the special prosodic properties associated with this structure (Bocci 2013).

Straightforward evidence for the view that scope-discourse properties are structurally encoded in this way (what is sometimes called the "syntacticization of scope-discourse semantics") is offered by the languages in which the criterial heads are actually pronounced. For instance, the West African language Gungbe, which has been studied in great detail in a cartographic perspective in Aboh (2004) marks both topics and foci with overt particles (*yà* and *wè* respectively) occurring in the left periphery:

(33) … dò Kòfi *yà* gànkpá mè *wè* kpònòn   lé sú -ì   dó
       … that Kofi Top PRISON IN Foc policemen Pl shut him there
                                                    (Gungbe: Aboh 2004)

Under familiar uniformity guidelines, it has been assumed that all languages involve a system of left peripheral criterial heads for the expression of scope-discourse property, except that heads of this system may be pronounced or not in different languages, a case of low level spell-out parametrisation which we mentioned in the previous section.

There are also less trivial cross-linguistic differences, though. In Italian, and in other Romance languages, topics can be indefinitely iterated. For instance all three arguments in a ditransitive sentence can be topics in the Clitic Left Dislocation construction (both the direct and indirect object are resumed by a clitic, while the subject is resumed by the familiar null pronominal subject):

(34) Gianni, il tuo libro, a Maria, glielo darà domani
       'Gianni, your book, to Maria, (he) to him it will give tomorrow'

This is not a universal property of topic configurations: many languages specify a single topic position in the left periphery. For instance in Gungbe, the topic position cannot be reiterated, as in (35):
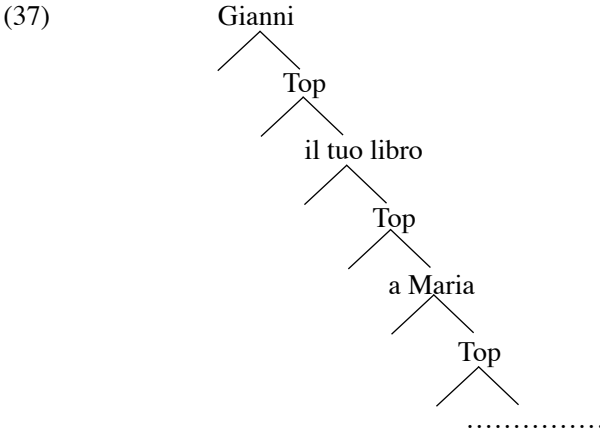
(35) *… dò Kòfi *yà* gànkpá   mè *yà* kpònòn lé sú - ì   dó
       '…that Kofi Top in prison Top   policemen Pl shut him there'
                                                    (Gungbe: Aboh 2004)

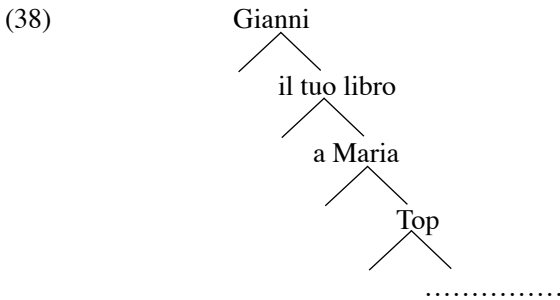Whereas the corresponding Italian structure is fully acceptable:

(36) Kofi, in prigione, i poliziotti ce lo sbatteranno senz'altro
       'Kofi, in prison, the policemen will shut him there for sure'

Uniformity guidelines would lead us to assume a minimal differ-
ence between the two cases, i.e., the same general system of criteria,
uniform in syntax and at the interfaces, except that some property
may be recursive in one kind of language but not in the other.

What property? A priori, the parametrization could be expressed
in at least two ways. It could be that the Top head is recursive in the
left periphery of Italian, so that each topic is attracted by its own
Top head, hence we have

(37)   Gianni
                         /\
                           Top
                           /\
                             il tuo libro
                             /\
                               Top
                               /\
                                 a Maria
                                 /\
                                   Top
                                   /\
                                     ……………

Or, in an approach to structure building permitting multiple speci-
fiers, it could be that both languages admit a single Top head, but
the Italian varieties admits recursive creation of multiple specifiers,
while the Gungbe variety does not. In this case, the structure of (34)
would look like the following:

(38)
               Gianni
                    il tuo libro
                        a Maria
                             Top
                                ……………

Italian does not seem to offer direct evidence to choose between
(37) and (38) because, among other things, Italian differs from Gungbe
in not pronouncing the Top head, hence it does not offer immediate
evidence for or against the possibility of reiterating the head.

But relevant evidence comes from an enlarged comparative per-
spective. The West African language Abidji involves an overt Top
head, like Gungbe, and allows a multiplicity of topics, like Italian.
As Hager – Mboua (2014) points out, in case of topic reiteration each
topic can be accompanied by its own Top particle ɛ́kɛ́:

(39) a. kòfí è   pìpjé   òkókò ɛ́
           Kofi MA peel.RES banana Def.
           « Kofi peeled the banana. »

      b.   òkókò ɛ́$_i$ ɛ́kɛ́ kòfí è pìpjé   nì`$_i$
            banana Def. Top° Kofi MA peel.RES   p.a.$_i$
            « The banana, Kofi peeled it. »

      c.   kòfí$_i$ ɛ́kɛ́ òkókò$_j$ ɛ́ ɛ́kɛ́ t$_i$ è pìpjé   nì`$_j$
            Kofi$_i$ Top° banana$_j$ Def. Top° t$_i$ MA peel.RES   p.a.$_j$
            « Kofi, the banana, he peeled it. »

      d.   òkókò$_i$ ɛ́ ɛ́kɛ́ kòfí$_j$ ɛ́kɛ́ t$_j$ è pìpjé   nì`$_i$
            banana$_i$ Def. Top° Kofi$_j$ Top° t$_j$ MA peel.RES   p.a.$_i$
            « The banana, Kofi, he peeled it. »

So, (39c-d) provide straightforward evidence for the conclusion that
Top recursion of the kind illustrated in (37) is a possible UG option.
What about (38)? At the moment we do not have direct comparative
evidence in favor or against this possibility. Nevertheless, restrictive

approaches to phrase structure, such as Kayne (1994) rule out such representations with multiple specifiers associated to a single head. So, we may tentatively conclude, on grounds of restrictiveness, that multiple topics always occur in a structural representation like (37) in Italian, a representation directly supported by comparative evidence.

The assumption that multiple occurrences of topics always involve topic recursion of the kind illustrated in (37) may well be a simplification. Frascarelli & Hinterhoelzl (2007), Bianchi & Frascarelli (2010) have shown that different occurrences of topics may bear detectably different interpretive properties (they identify, in particular, aboutness shift, contrastive and familiarity topics). So it could be that no recursion is involved in (34), but simply the co-occurrence of different types of topics.

Nevertheless, even if the possibility of distinct topic positions is taken into account, the postulation of some recursion mechanism is inevitable. The generalization about languages of the Italian type is that topics are not restricted to two or three per clause: any number of topicalizable arguments and adjuncts can be topicalized. Here is an example with six topic (-like) elements

(40)   Gianni, a Piero, la sua residenza, a Parigi, da Londra,
         'Gianni, to Piero, his residence, to Paris, from London,
         l'anno prossimo, gliela farà spostare senz'altro
         next year, he will make him move it for sure'

As topics can be added indefinitely, at least one kind of topic position must be recursive.

6. Conclusion

Ever since the Borer-Chomsky conjecture, a widely held assumption is that the locus in which syntactic parameters are expressed in the grammatical architecture is the functional lexicon. As for the format of parameters in a minimalist grammar, under the assumption that syntactic operations are feature triggered, we may think that parameters simply consist in associating to functional heads morphosyntactic features which trigger operations of structure building (external merge), movement (search and internal merge) and spell-out. So, the size of the set of parameters may well be

large: cartographic studies suggest that the functional lexicon is very rich, hence if the parametrization is associated to this component the system will specify many parameters. Nevertheless, what is critical for the restrictiveness of the system is the format, not the locus of parameters: and the format is extremely restrictive, as the elementary operations that can be performed in minimalist syntax are very few. The space of variation that the system leaves open for the language learner is thus severely limited, so that no learnability problem arises even if parameters are very numerous: the situation is therefore very different from an approach to variation based on a potentially unlimited set of language-particular rules, as in pre-parametric models. The numerosity of parameters has an impact on the likelihood that a single parameter may govern a complex cross-linguistic pattern. There are just too many parameters to expect that any of them will be able to operate in isolation: each parameter will inevitably interact in complex ways with many other parameters to determine cross-linguistic variation. The case of the Null Subject Parameter straightforwardly illustrates this point. Nevertheless, it is not true that a system with many parameters will have a shallow deductive structure. Quite the contrary is true: the system of natural language syntax is so tight that complex deductive paths connect individual parameters and observable empirical patterns, involving rich deductive interactions with other parameters and UG principles. A central goal of comparative syntax is to reconstruct and elucidate such complex paths.

In the last decades, cartographic studies have offered a powerful tool to comparative syntax, providing structural maps which can be immediately compared across languages, thus offering direct evidence for invariance and variation. Cartographic results thus have nourished the parametric approach to syntactic variation by offering novel types of evidence for the formal tools that a theory of variation must assume.

Acknowledgement

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