# Beyond Functional Sequence

## The Cartography of Syntactic Structures, Volume 10

Edited by

Ur Shlonsky

OXFORD STUDIES IN COMPARATIVE SYNTAX

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# Cartography, Criteria, and Labeling

LUIGI RIZZI

## 1 Introduction

In classical X-bar theory, labels of categories were determined by the X-bar schema: A head entering syntax would automatically generate its own projection. In a Merge-based system, the question arises of how the label is assigned to the new node created by Merge; if the system is constrained by the Inclusiveness condition (Chomsky 1995), the label must come from one of the two elements undergoing Merge (and, ultimately, from the lexical items that they consist of). So, a labeling algorithm is needed. Recent research suggests that the algorithm may provide an important new tool to revisit old problems in a principled way, and to generate new analytic paths (Chomsky 2008, 2013; Cecchetto and Donati 2010).

In this paper I will explore the consequences of a labeling algorithm for the system of Criteria (Rizzi 1991, 1997, 2011). In particular, I will adopt the algorithm introduced in Chomsky (2013), propose a particular formalization for it, and use it to capture the freezing effects that are observed when a phrase reaches a position dedicated to a scope-discourse semantic property ("criterial freezing": Rizzi 2006, 2011). The central goal here is to explore the possibility that labeling may provide a comprehensive solution to what may be called "the halting problem" for wh-movement, and in fact for all kinds of phrasal movement: why is it that the element moved successive-cyclically must pass through certain positions without stopping and must stop in certain other positions? Chomsky's analysis provides an answer to the first question; I will try to address the second question, and trace back to labeling the freezing effects observed in criterial positions. This will also require some refinements of the basic properties of Bare Phrase Structure.

In sections 2 and 3, I will illustrate the system of criteria and the criterial freezing effects. Section 4 will be devoted to presenting Chomsky's (2013) approach to labeling, based on the idea that a syntactic object created by Merge is assigned the

label of the closest head; section 5 will suggest a particular formalization of the notion "closeness" and illustrate some of its consequences. In section 6 I will show how the system can derive freezing effects through natural auxiliary assumptions on the way of functioning of phrasal movement. In section 7 I will touch upon some possible additional consequences of the system in connection with the evidence bearing on successive cyclic movement, and in section 8 I will briefly address the status of the subject position with respect to the "halting problem."

## 2 A structural approach to scope-discourse semantics: The Criteria

In A'-constructions, a syntactic element typically occurs in two positions dedicated to two kinds of interpretive properties: properties of argumental semantics (theta roles) and properties of scope-discourse semantics (the scope of operators, topicality, focus, etc.). Uncontroversially, thematic roles are determined by local head-dependent relations: verbs (or perhaps differently flavored v's) and other categories determine the interpretive status of their immediate dependents with respect to such properties as agent, patient, goal, etc. at the interface with meaning. The criterial approach to scope-discourse semantics puts forth the hypothesis that scope-discourse properties also are structurally determined by local head-dependent relations: the initial periphery of the clause is assumed to be populated by a sequence of functional heads such as question and relative markers (Q, R), markers for topicality and focus (Top, Foc), and so forth; so, A'- constructions have the following shape:

(1) a. Which book Q should you read <which book> ?
b. This book TOP you should read <this book> (as soon as possible)
c. THIS BOOK FOC you should read <this book> (not that one)

This structural approach is immediately supported by the observation that in many languages the heads abstractly postulated in (1) are overtly expressed. For example, in Dutch varieties, Q can be overtly expressed as *of*, adjacent to the wh-element *wie* in (2)a, and many languages have overt topic and focus markers such as the particles *yà* and *wè* in the West African language Gungbe, as in (2)b–c:

(2) a Ik weet niet [wie *of* [ Jan ____ gezien heeft ]] (Dutch varieties, Haegeman 1994)
"I know not who Q Jan seen has"
b Un sè [do [dan lo *yà* [Kofi hu ì ]]] (Gungbe, Aboh 2004)
"I heard that snake the TOP Kofi killed It"

c Un sè [do [dan lo *wè* [Kofi hu ____ ]]] (Gungbe, Aboh 2004)
"I heard that snake the FOC Kofi killed"

Under familiar uniformity guidelines, the natural initial hypothesis is that all languages exploit the system overtly illustrated by (2), with structurally determined and dedicated positions for topicality, focus, and so forth, except that the relevant functional heads may be overt or not, a common type of low-level parametrization. In this system, a criterial head $X_{Crit}$ has a dual role:

- In syntax, it attracts a phrase bearing the matching criterial feature (Q, R, Top, Foc, etc.), thus creating a Spec-head configuration of elements agreeing in the criterial featural specification (the criterial configuration)
- At the interfaces with sound and meaning the criterial head carries explicit instructions for properly interpreting its dependents.

So, for instance, a topic head carries the following instruction at the interface with semantics-pragmatics:

(3) [ "Topic" ] Top [ "Comment" ]

That is, "interpret my specifier as a topic, and my complement as a comment"; similarly, a Foc head guides the interpretation of focus-presupposition structures:[1]

(4) [ "Focus" ] Foc [ "Presupposition" ]

[1] N. Chomsky (p.c.) observes that there is no direct relation between a head and what is traditionally called its Spec. Certainly, there is no relation directly determined by Merge, as YP is merged to X' (in traditional notation), not to X. So, on what basis can the criterial head determine interpretive properties of the Spec at the interface, if such interface effects are solely based on fundamental relations established in syntax?

One possibility that comes to mind is that, as a prerequisite for Internal Merge, the criterial head must enter into a Search (or Agree) relation with the phrase to be moved, so one could claim that it is in virtue of this relation, established in the syntax, that the criterial head activates interpretive routines at the interface.

This view would also open the possibility of a partially unified account of movement and *in situ* languages: for instance, wh-movement and wh-*in situ* would have in common the Search operation connecting the Q head and the wh-phrase, an operation followed by Internal Merge in movement languages but not in *in situ* languages, with interface effects determined by the shared Search relation. I will not try to develop this view here, nor address the important question of the role of covert movement in *in situ* structures.

In this system, the expression of informationally relevant articulations such as topic-comment and focus-presupposition, and also the articulation operator-scope domain for different kinds of operators, is thus reduced to a uniform syntactic schema Spec-head-complement, with the particular criterial head triggering the appropriate interpretive routines. The reduction of scope-discourse articulations to a uniform syntactic configuration in which specific interpretive properties are determined by the nature of the criterial head is sometimes referred to as the "syntacticization of scope-discourse semantics" (Cinque and Rizzi 2010): the mapping to interpretation for scope-discourse properties is made fully transparent at the interfaces by geometrically uniform syntactic representations combined with a rich inventory of functional atoms in the cartographic style.

Similar considerations hold at the interface with sound systems: the criterial heads and features give explicit instructions to the phonological processes of pitch contour assignment, to yield the special contours that typically make topic-comment and focus-presupposition articulations easily detectable from the phonetic signal (Bocci 2013). In this system, sound and meaning are connected by syntax, of which the system of criterial heads is a core component: no syntax independent connection is required between PF and LF.[2]

## 3 Criterial Freezing

Once a phrase enters into a criterial configuration, it is frozen in place, and becomes unavailable to further movement. For instance, Lasnik and Saito (1992) observed that a wh-phrase satisfying (in our terms) the Q-criterion in an embedded C-system cannot be moved further to the main C-system:

(5) a. Bill wonders [[which book] Q[ ___ was published this year ]]
b. * Which book does Bill wonder [ ___ Q[ ___ was published this year ]]

Examples of this sort suggest the existence of a freezing principle like the following:

(6) An element satisfying a criterion is frozen in place (Rizzi 2006, 2011)

[2] The terms *criterion*, *criterial heads*, and so forth stem from the Wh Criterion of May 1985, Pesetsky 1982, Rizzi 1991 (later called Q Criterion), which was then generalized to a family of criteria (Top, Foc Criteria in Rizzi 1997, Neg Criterion in Haegeman and Zanuttini 1996, etc.). The term was originally intended to draw an analogy with the Theta Criterion of Chomsky 1981: much as there must be a biunique relation between Theta roles (in the lexical representations of assigners) and arguments, the same holds for Q-marked operators and Q-marked heads, etc.

It could be argued that examples like (5)b do not require the postulation of a syntactic freezing principle: the impossibility of the further movement in (5)b could be a consequence of an "inactivation" mechanism (Bošković 2008) by which the checking of the relevant attracting feature in (5)a makes the phrase "inactive," and unavailable for further movement. Moreover, a structure like (5)b could be independently excluded because it may not be properly interpretable at LF: if *which book* is interpreted as a wh-operator both in the main and embedded C-system (i.e., "for which x, x a book, Bill wonders for which x, x a book, x was published this year"), the structure would contain two operators and a variable (a state of affairs ruled out, e.g., by Koopman and Sportiche's 1982 Bijection Principle), and in any event it is not clear what a reasonable paraphrase could be for (5)b.

So, such simple cases of freezing appear to admit alternative analyses making a principle like (6) unnecessary. Nevertheless, there are more complex cases that are harder to analyze by appealing to inactivation, or interpretive problems.

The general form of such cases is the following. Consider a complex phrase α containing two criterial features $F_1$, $F_2$:

(7) $[_{\alpha} \ldots F_1 \ldots F_2 \ldots ]$

One could imagine that α could move to a lower criterial position to satisfy $F_1$, and then continue to move to a higher criterial position satisfying $F_2$. Here inactivation should not be relevant because two distinct features are involved; and no obvious interpretive problem would arise (under the copy theory of traces, all the relevant information for interpretation is expressed at each site). Still, this state of affairs does not seem to be possible: as soon as the complex phrase reaches the closest relevant criterial position, it becomes unavailable to further movement. The abstract configuration in (7) may still lead to a well-formed structure (e.g., by subextracting from α the carrier of feature $F_2$). But further movement of α is excluded.

Consider for instance a concrete case like (8)

(8) Piero non è riuscito a capire [ [quanti libri di Gianni] Q siano stati pubblicati quest'anno]
"Piero didn't manage to understand how many books by Gianni have been published this year"

Suppose that the DP Gianni is relativized, for example, in an appositive relative. That is, we have a complex DP containing two elements bearing criterial features, Q and R (the criterial feature for relatives):

(9) [quanti$_Q$ libri del quale$_R$]
"how many books by whom"

Suppose that we end up with an intermediate representation like the following, in which the complex phrase (9) has been moved to the C system of an indirect question, and then the relative phrase *del quale* is attracted by a higher relative C:

(10) Gianni, R Piero non è riuscito a capire [ [quanti$_{Q}$ libri del quale$_{R}$ ] Q siano stati pubblicati quest'anno ]
"Gianni, Piero didn't manage to understand how many books by whom have been published this year"

From an intermediate representation like (10), subextraction of *del quale* is (somewhat marginally) possible, yielding (11)a, while pied-piping of the whole complex phrase "[quanti libri del quale]," as in (11)b, is impossible:

(11) a. Parlami di questo autore, **del quale** R Piero non è riuscito a capire [[ **quanti libri** ____] Q [ siano stati pubblicati nel 1967], . . .
"Tell me about this author, by whom Piero didn't manage to understand how many books ____ Q have been published in 1967, . . ."
b. *Parlami di questo autore [**quanti libri del quale**] R Piero non è riuscito a capire [ ____ Q [ siano stati pubblicati nel 1967]. . .
"This author, how many books by whom Piero didn't manage to understand [ ____ Q have been published in 1967"

Notice that a heavy pied-piping of this sort (a *picture of whom* pied-piping, in the sense of Cinque 2005) is possible in appositive relatives if the movement takes place from a nonfreezing position:

(12) Parlami di questo autore, molti libri del quale (Piero mi ha detto che) ____ sono stati pubblicati nel 1967
"Tell me about this author, many books by whom (Piero told me that) have been published in 1967"

But pied-piping is not an option from a freezing position, as in (11)b.

Here it is not obvious that there would be an interpretive problem: (11)b should permit the interpretation of (11)a, with "reconstruction" (in fact, use of the lower copy) of *quanti libri* in the embedded C-system. But the structure is excluded. This follows from a principle like (6), which has precisely the effect of blocking pied-piping of such cases of complex phrases with multiple criterial features.

In fact the possibility of subextraction in (11)a suggests that what is frozen is not the whole phrase, but rather the element that enters into the criterial satisfaction (the criterial goal in the terminology of Rizzi 2011, i.e., *quanti* in (11)a). So, (6) should be revised as follows:

(13) Criterial Freezing II: In a criterial configuration, the criterial goal is frozen in place.

The same kind of contrast can be observed in other kinds of criterial constructions, such as topicalization (14), Contrastive Focus movement (15), and clefting (16) (Belletti 2009, ch. 10, 2013):

(14) a. **Di questo autore**, Top Piero non è riuscito a capire [ [ **quanti libri** ___ ] Q [siano stati pubblicati nel 1967]
"By this author, Piero didn't manage to understand how many books ___ Q have been published in 1967"
b. *[**Quanti libri di questo autore**], Top Piero non è riuscito a capire [ ___ Q [siano stati pubblicati nel 1967]
"How many books by this author, Piero didn't manage to understand ___ Q have been published in 1967"

(15) a. **DI QUESTO AUTORE** Foc Piero non è riuscito a capire [[ **quanti libri** ___] Q [siano stati pubblicati nel 1967], non di quell'altro
"By THIS AUTHOR Piero didn't manage to understand how many books ___ have been published in 1967, not by that other one"
b. *[ **Quanti libri DI QUESTO AUTORE**] Foc Piero non è riuscito a capire [ ___ Q [ siano stati pubblicati nel 1967], non di quell'altro.
"How many books BY THIS AUTHOR Piero didn't manage to understand ___ have been published in 1967, not by that other one"

(16) a. E' **di questo autore** $Foc_{cleft}$ che Piero non è riuscito a capire [ **quanti libri** ___ ] Q [siano stati pubblicati nel 1967]
"It is by this author that Piero didn't manage to understand how many books ___ Q have been published in 1967"
b. *E' [**quanti libri di questo autore**] $Foc_{cleft}$ che Piero non è riuscito a capire [ ___ Q siano stati pubblicati nel 1967.
"It is how many books by this author that Piero didn't manage to understand ___ have been published in 1967"

In all these cases subextraction is fine, as in the a examples (the extractee and the remnant in bold), while pied-piping of the whole phrase (in bold) is excluded, as in the b examples. In conclusion, there is evidence for the freezing effect captured by principle (13). Questions of "further explanation" immediately arise at this point. This is an important issue that is receiving more and more attention in connection with cartographic studies: can properties of the detailed structural maps uncovered in cartographic work be traced back to more fundamental principles of linguistic computation (Cinque and Rizzi 2010; Abels 2012; Haegeman 2012; Rizzi 2013)? The issue clearly arises in connection with freezing effects: do they require the stipulation of a specific formal principle like (13)? Or can they be derived from fundamental computational principles? At this point, considerations of labeling become relevant.

## 4 Chomsky (2013) on labeling

Chomsky (2013) proposes a new algorithm for labeling structures created by Merge. The new approach builds on previous labeling proposals (Chomsky 2008), and explicitly aims at addressing properties of movement; in this respect, it integrates elements of dynamic antisymmetry (Moro 2000, building on Kayne 1994), which provides reasons for starting or continuing movement, with elements of the criterial approach, which expresses the configurational conditions in which movement stops.

Two main ideas characterize the new approach:

(17) Labeling algorithm: The category created by Merge receives the label of the closest head.
(18) Labeling must be complete at the interfaces.

Assumption (17) reduces the locality conditions on labeling to minimal search, or relativized minimality: the closest element with the right characteristics (here, the closest head that the element to be labeled contains) wins the competition.

Assumption (18) is different from previous assumptions on the timing of labeling, in which the possession of a label was considered a prerequisite for further applications of Merge. Under the new view, Merge can also apply to unlabeled structures, and the necessity of labeling only arises at the interface with meaning. That interpretive systems may need labels clearly makes sense: interpreting a DP, or a VP, or a CP is quite a distinct matter, with the formal label of a syntactic object plausibly triggering different interpretive routines.[3] One important consequence of assumption (18) is that labeling can be deferred until when the structure is passed on to the interpretive systems, at the end of the phase in a phase-based architecture. The system crucially capitalizes on this limited possibility of delaying labeling in computing a structure.

Chomsky (2013) considers the different subcases of Merge in the context of the labeling algorithm (I will go through the particular cases in section 5 in connection with a specific formal definition of "closeness"). A problematic case is the merger of two phrases, XP-YP merge, yielding a representation like the following:

(19) $[_{\alpha}$ XP YP $]$

Here two distinct heads, the head of XP and the head of YP, are equally close to the syntactic object α created by merging XP and YP, so the labeling algorithm

[3] Complete labeling at the interface may be thought of as a subcase of "Full Interpretation." Anyway, if the requirement of a complete labeling can be made to follow from the needs of the interpretive systems, no stipulation is needed. If not, a stipulation (labeling must be complete at the interface) replaces another stipulation (labeling is needed for further applications of Merge), with no loss of explanatory power.

cannot choose and no label is assigned. This does not prevent the element from undergoing further applications of Merge, but under (18) α must be labeled before being transferred to the interpretive system. Chomsky indicated two possible ways to obtain proper labeling in this configuration:

A. One of the two phrases is moved further before the end of the phase, so that we get an intermediate representation like the following:

(20) . . . XP . . . [$_{\alpha}$ <XP> YP]

At this point "The intuitive idea is that the lower XP copy is invisible to LA [Labeling Algorithm], since it is part of a discontinuous element, so therefore . . . [the syntactic object] will receive the label of YP" (Chomsky, 2013, 44). Chomsky notices that this has the effect of forcing the continuation of successive cyclic movement in a derivation like the following:

(21) a. [ C [Bill read [which$_{Q}$ book]]]
b. * You think [$_{\alpha}$ [which$_{Q}$ book] [ C [Bill read ____] ] ]
c. [$_{\beta}$ [which$_{Q}$ book] [ Q [you think [$_{\alpha}$ <[which book]> [C [ Bill read ____ ] ] ] ] ]

An initial representation like (21)a requires wh-movement (English is not a *wh-in situ* language, but see footnote 4). If the clause α ends up being embedded under a main V like *think,* intermediate wh-movement will yield an XP-YP configuration that will disallow labeling of α in cases like (21)b: XP is headed by a Q element, YP by a declarative complementizer (given the selectional properties of *think*), no coherent labeling of α is possible, and a representation like (21)b cannot surface as such.[4]

[4] Chomsky (p.c.) observes that English permits *in situ* questions in "quiz show" sentences like "JFK was assassinated in which Texas city?" In these cases, too, the wh-phrase cannot stop in an intermediate C-system: "*Do you think in which Texas city JFK was assassinated?" Stopping in the intermediate landing site is excluded by labeling, much as in the case of (21)b. A similar pattern is observed in a language like French, fully admitting *wh-in situ*, and in in multiple questions in English:

(i) a. Who thinks [ C [ Mary saw whom ]]
b. * Who thinks [whom C [ Mary saw ____ ]]

As before, the embedded CP hosting the wh-phrase *whom* in its Spec could not be properly labeled.

Aoun, Hornstein, and Sportiche (1981) observed the following generalization: overt wh-movement must proceed to the final scope position of the wh-phrase, or not take place at all; stopping in an intermediate site is excluded. The explanation of this generalization in Rizzi (1996) through the application of the Q-criterion at S-structure can now be dispensed with, as labeling takes care of this class of cases.

Further movement of *which book* salvages the structure, as the declarative complementizer remains the only candidate for the labeling of α (this is clearly connected to Moro's 2000, 2011 approach, which also considers movement a way to resolve a conflicting situation for Dynamic Antisymmetry).

B. At some point movement is allowed to stop, for example, in the main C-system in (21)c, or in the embedded C-system under a verb selecting an indirect question:

(22) John wonders [$_{\alpha}$ [which$_{Q}$ book] [ Q [Bill read ____ ] ] ]

(21)c, (22), illustrate a criterial configuration, in the sense summarized in 2. Chomsky (2013, 45) observes that in the criterial configuration both XP and YP are headed by Q, hence both heads provide the same labeling information, there is no conflict, and α can be correctly labeled as Q, a (main or indirect) question. The labeling algorithm thus correctly captures the environments in which movement must continue, and those in which it stops.

As the references summarized in section 3 show, the conclusion about (22) must be strengthened. The halting of the wh-element in the criterial configuration is not only possible, but also necessary: there is a freezing effect. So, the next natural step is to try to derive the freezing effect from labeling: in that case, the labeling algorithm would provide a comprehensive solution to what we have called "the halting problem" for wh-movement: why should the movement computation continue in some cases, and stop in others? In order to explore this, let me first suggest a possible formal implementation of the critical notion of "closeness."

## 5 Formalizing "closest head"

Clearly, "closeness" must be computed in hierarchical terms. Here is a possible approach in terms of c-command and minimality:

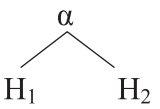
(23) $H_1$ is the closest head to α iff
I. α contains $H_1$, and
II. there is no $H_2$ such that i. α contains $H_2$, and
ii. $H_2$ c-commands $H_1$.

Definition (23) is nonoptimal in the obvious sense that it has Relativized Minimality (RM)/minimal search (Rizzi 1990; Chomsky 2000) built into it. Clearly, there is a redundancy, as the locality principle should be stated once and for all, and appealed to in the computation of local relations, rather than being built into each local relation. Nevertheless, for the sake of this discussion I will continue

to use the redundant definition (23) in order to make the consequences of the system fully transparent.[5]

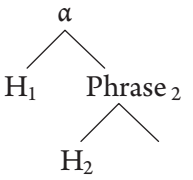
There are three main cases to consider, corresponding to the three subcases of Merge determined by the nature of the two merged elements:

I. Head-Head Merge (X-Y Merge). Here the two elements are both drawn from the lexicon, and Merge yields the following:

(24)



This configuration is already problematic: in terms of definition (23), each head would prevent the other from being the closest head to α, as the configuration is one of mutual c-command. Chomsky 2013, 47, suggests that H - H merge may be possible in only one case: merger of an unlabeled lexical root with a functional head expressing a categorial property (v, n, a, etc.) (Marantz 2013, and much related work). In this case, the only category that can project is the one of the functional head because the root has no categorial label to project: [$_n$ book + n], [$_v$ book + v], and so forth. Notice that, in order to make labeling possible here, "head" in (23) must be understood as "head with a label," so that the unlabeled root will not prevent v (or n, a, etc.) from projecting.

II. Head-Phrase Merge (X-YP Merge). This is the core recursive case of Merge: a phrase already formed by previous applications of the procedure is merged with a head drawn from the lexicon:

(25)



[5] A more satisfactory statement, which I can only sketch out here, would involve excorporating locality from the definition, and stating it as a general definition of Minimal Configuration that different local processes refer to (as in Rizzi 2004):

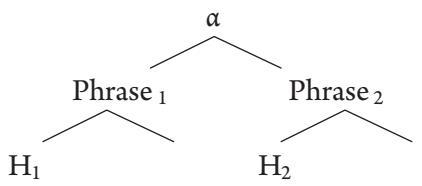
(i) α receives the label of a head H such that
I. α contains H and
II. H is in a Minimal Configuration with α.
(ii) Minimal Configuration (MC): Y is in a MC with X iff there is no Z such that Z is of the same type as Y, and Z intervenes between X and Y.
(iii) Z intervenes between X and Y iff Z c-commands Y and Z does not c-command X.

The typology of positions is computed on the basis of the particular structural property searched for, as in the tradition of the RM approach. As (i) searches the structure for a head without further qualification, any intervening head blocks the local relation.

Here things are straightforward: $H_1$ is closer to α than $H_2$ (or any other lower head) hence α gets the label of $H_1$. So, for instance, we have $[_V$V DP], $[_T$ T VP], $[_C$ C TP], etc.[6]

III. Phrase – Phrase Merge (XP-YP Merge). This is the case of merger of two phrases already formed by previous applications of Merge:

(26)

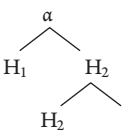



In case of Phrase-Phrase Merge, the situation is problematic, as we saw before. In terms of the notion of closeness in (23), both $H_1$ and $H_2$ qualify as the closest head to the new node created by Merge ($H_2$ does not intervene between $H_1$ and α because $H_2$ does not c-command $H_1$; and vice-versa), so the algorithm gives inconsistent indications in (26), and α remains unlabeled.

But this can only be a temporary state of affairs: under the assumption that nodes need labels at the interface, α must receive a label before being passed on to the interpretive system, at the latest before (or at) the end of the relevant phase.

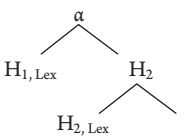
[6] It should be noticed here that such representations as (25), (26), use an informal notation distinguishing heads and phrases, as in traditional X-bar theory. If one adopts a strict version of bare phrase structure, which has no device to express bar levels, (25) would look like the following:

(i)




Hence the system would not immediately make the needed distinctions with (24) and (26). So, the system must have the capacity to locally distinguish heads and projections. I will not address this problem in any detailed manner here, but, just to fix ideas, one could assume that elements drawn from the lexicon are accompanied by a feature Lex, defining heads, which may or may not be passed on to the immediately dominating node (the possibility of passing the feature on would permit the option of forming complex heads, e.g., by head movement), so that (i) really should look like the following:

(ii)




Where $H_2$ (sister of $H_{1, Lex}$) is a projection, and therefore it does not affect the capacity of $H_{1, Lex}$ to label α. In the text I will continue to use the informal notation used in (25)–(26), but one should bear in mind that the problem of distinguishing heads and projections exists, and is crucial for labeling.

Let us now consider again the two ways in which the deadlock represented by (26) can be resolved according to Chomsky (2013) and see how the two devices fare with respect to definition (23).

In case $\text{Phrase}_1$ moves out from (26) we get

(27) $\text{Phrase}_1 \ldots [_{\alpha} <\text{Phrase}_1> \text{Phrase}_2 ]$

Formulation (23) of "closest head" yields the desired result of making labeling of α possible. (23) requires that the heads to be taken into account should be "contained" in α: we understand this as meaning that "all the occurrences of the relevant H are contained in α"; when $\text{Phrase}_1$ is moved out from (26), $H_1$, head of $\text{Phrase}_1$, is both internal and external to α (it has internal and external occurrences), hence it is disregarded, and α receives the label of $H_2$, as desired.[7]

So, for instance, the thematic subject of a transitive structure is merged with vP, which yields a [Phrase Phrase] structure:

(28) $[_{\alpha}$ DP vP]

At this point the subject must vacate the position and raise, in order to allow proper labeling of the structure α as vP: after subject movement, DP and D are invisible (they are both internal and external to α), hence the closest head to the new node is v, unambiguously.[8]

At some point movement must stop. This happens when it reaches a criterial position. Criteria are defined as configurations in which Spec and head share a major interpretable feature (section 2), for example, Q in questions:

(29) $[_{\alpha}$ [which $_{Q}$ book] [did $_{Q}$ you read ____ ] ]

Both heads in XP-YP share the Q feature agreeing in the criterial configuration, so search of both XP and YP provides a nonambiguous indication, Q, which can label the whole structure:

(30) $[_{Q}$ [which$_{Q}$ book] [did $_{Q}$ you read ____ ] ]

[7] This interpretation of the functioning of locality appears to be needed elsewhere. Krapova and Cinque (2008) discuss an interpretation of RM in which the intervener Z in the configuration . . . X . . . Z . . . Y . . . triggers the effect when "all the occurrences" of Z intervene. This interpretation allows the authors to explain the ordering of wh-elements in multiple wh-questions in Bulgarian.

[8] What happens if the phrase which moves out of (28) is vP, rather than DP? Adriana Belletti suggests that this may correspond to the "smuggling" analysis of passive *à la* Collins (2005), in which it is the verbal chunk, not the subject DP, which moves out of the verbal nucleus. Analogously, the VOS order found, for example, in Malagasy may be derived through movement of the vP. I leave the exploration of these analytic options for further work.

So, what characterizes a criterial configuration is that it receives the label of the criterial feature (and we get, in traditional X-bar notation, QP for questions, TopP for topic-comment articulations, FocP, RelP, etc.).

## 6 Deriving Criterial Freezing from Labeling

Consider now the complement of a verb selecting an indirect question, in criterial terms a clause headed by Q:

(31) a. John wonders [ Q [Bill read [which$_Q$ book]]]
b. John wonders [$_\alpha$ [which$_Q$ book] [ Q [Bill read ____] ] ]
c. * [$_\beta$ [which$_Q$ book] [ Q [ John wonders [$_\alpha$ ____ Q [ Bill read ____ ] ] ]

The wh-phrase moves to the embedded C-system, as in (31)b, where a criterial configuration is created, and α can be properly labeled as Q.

Why is (31)c excluded? This is a violation of Criterial Freezing (section 3). Can the effect be related to Chomsky's labeling algorithm? I think there is a natural possibility to consider.

Phrasal movement can only involve maximal projections: i.e., given the traditional X-bar schema, XP can be moved, but the nonmaximal projection X' is inert for movement: there is DP movement, VP movement, CP movement, but no D', V', C' movement.

(32) Phrasal movement can only involve maximal projections.

The impossibility of moving nonmaximal projections may be generalized in the form of a principle:

(33) Maximality: only maximal objects with a given label can be moved.

So, movement of intermediate projections is systematically banned under Maximality.[9]

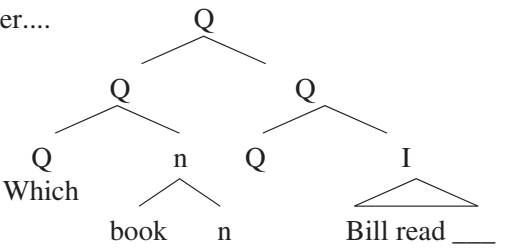
[9] Notice that (33) would also ban head movement, at least in versions of bare phrase structure in which the label of heads is inherently indistinguishable from the label of projections. If head movement exists, the system must thus have a way to distinguish heads and projections. In fact, as mentioned in footnote 6, this is needed anyway for the labeling algorithm to work properly. If the notational solution introduced in footnote 6 is adopted, head movement, for example, verb movement, would be possible in accordance to maximality, as movement of the maximal object with label v, Lex, and similarly for other cases of head movement. The maximality requirement would be relevant here too, as it would capture the familiar ban against "excorporation," extraction of a part of a complex head.

Notice that, under bare phrase structure, being a "maximal projection" is not a rigid inherent property of a node, like being marked "XP" in standard X-bar notation, but is a **dynamic** notion in the following obvious sense:

(34) α is a maximal projection iff α is labeled, and the node immediately dominating α does not have the same label.

Then in the criterial configuration [$_{\alpha}$ XP YP], once α receives the label from both XP and YP, neither constituent node of α is maximal, in the sense just defined: only the whole category [XP YP] is maximal, under dynamic definition (34):

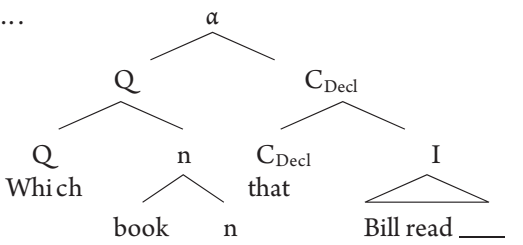
(35) wonder....




So, further movement of *which book* from (35) is excluded by the ban on movement of a nonmaximal objects (33), and the freezing effect illustrated by (31)b is explained (on cases of complex pied-piping see footnote 11).

By contrast, in cases in which the structure is embedded under a verb selecting a declarative we get the following:

(36) think....




At this stage α cannot be labeled because XP and YP would give conflicting indications. *Which book* must move out to permit the labeling of α as a declarative. It is allowed to move out because, under dynamic definition (34) it is the maximal phrase labeled Q, as the maximality principle (33) requires. Hence *which book* can move (because maximality is satisfied), and must move (to permit proper labeling of α). So, both the necessary continuation of movement in intermediate C-systems ((21)b), and the halting in the criterial configuration ((31)c) can be made to follow from labeling, under natural auxiliary assumptions.

Going back to (35), we can observe that here, under our dynamic definition, the whole criterial configuration is maximal, while its components are not. So, we

expect the whole configuration to be allowed to move further. In fact, the indirect question can be moved as a whole, for example, can be clefted or topicalized in Italian:

(37) a E' [[ quale libro Q Gianni abbia letto ____ ] che [Piero non ha capito ____ ]
"It is which book Gianni read that Piero did not understand"

b [Quale libro Q Gianni abbia letto], non so proprio ____
"Which book Gianni read, I really don't know"

This appears to be true in general: criterial configurations cannot be undone, but they can move as a whole. This follows from labeling, the dynamic definition of maximal projection and the maximality principle: only the whole criterial configuration is the maximal object with the relevant label, hence it is allowed to move under maximality, while its components are not.[10]

Notice that this approach also accounts for the complex cases reviewed in section 3, in which two distinct criterial features are involved, that is, Q and R (the criterial feature for relatives). As we observed in section 3, the relative PP *del quale* can be subextracted, as in (38)a, but the whole phrase *quanti libri del quale* cannot be pied-piped to the relative C, as in (38)b:

(38) a. Parlami di questo autore, **del quale** R Piero non è riuscito a capire
[[ **quanti libri** ____] Q [ siano stati pubblicati nel 1967] . . .
"Tell me about this author, by whom Piero didn't manage to understand how many books ____ Q have been published in 1967, . . ."

b. * Parlami di questo autore [**quanti libri del quale**] R Piero non è riuscito a capire [ ____ Q [ siano stati pubblicati nel 1967] . . .
"Tell me about this author, how many books by whom Piero didn't manage to understand [ ____ Q have been published in 1967"

[10] An anonymous reviewer raises the following question: if intermediate movement giving rise to configurations like (36) is feature triggered, the embedded C must have the Q feature; then, why wouldn't this give rise to a configuration analogous to (35), hence triggering a freezing effect? One possible answer is that intermediate movement is not feature triggered, but motivated solely by other considerations, as in Moro (2000); another possible answer is that intermediate movement is feature triggered, but the relevant features are noncriterial, not interpretable (otherwise, an interpretable Q feature in the embedded C in (36) would clash with the selectional properties of the main verb *think*). Hence, if uninterpretable features are deleted once checked (Chomsky 1995), or somehow made invisible to syntactic computations, the uninterpretable Q feature under C would not be seen by the labeling algorithm, and α would remain unlabeled at the stage of the derivation reflected by (36). Therefore, *which book* would be allowed to move under maximality, and then α would be correctly labeled as declarative.

In (38)b *[ quanti$_Q$ libri del quale$_R$ ]* is extracted from the criterial configuration determined by the embedded Q head:

(39) [$_\alpha$ [ **quanti$_Q$ libri del quale$_R$**] Q [ siano stati pubblicati nel 1967]
"How many books by whom have been published in 1967"

Given the labeling algorithm, α is now labeled Q (we may assume that labeling takes place as soon as the conditions are met, as per Pesetsky's Earliness Principle (see Pesetsky and Torrego 2001: 400), hence *[ quanti$_Q$ libri del quale$_R$ ]* is nonmaximal, in terms of dynamic definition (34), and therefore it cannot be extracted from (39) under Maximality. The PP *del quale* obviously is maximal; hence it can be subextracted and moved to the relative complementizer.[11]

In conclusion, the whole range of freezing effects appears to be amenable to Chomsky's labeling approach, under plausible auxiliary assumptions on the *modus operandi* of labeling and on the maximality requirement on phrasal movement.[12]

## 7 Successive cyclicity, "dangling preposition," floating quantifiers

Postal (1972) gave the following argument against Chomsky's (1973) theory of successive cyclic wh-movement: if wh-movement goes through the intermediate C-system, why can't it strand a preposition there (the "dangling preposition" argument)?

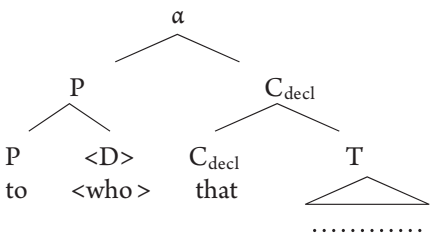
(40) a. Who do you think [$_\alpha$ t C [ we should talk [to t]]]?
b. *Who do you think [$_\alpha$ [to t] C [ we should talk t ]]?
c. To whom do you think [$_\alpha$ t C [ we should talk t ]]

[11] We have not addressed here the mechanism of pied-piping. Let us simply notice that, for *del quale* to satisfy the relative criterion in its final landing site in (38)a, and permit the labeling of the structure as R, the feature R should be transmitted from *quale* to the highest head of the phrase, here the preposition. This may happen through percolation, or through an Agree relation between the preposition and *quale*. Notice that some such mechanism is generally needed for pied-piping of the type *picture of whom*, but not for pied-piping of the type *whose picture*, in which the relevant criterial feature already appears on the highest head of the phrase (here I am using Cinque's 2005 terminology: the necessity of an additional operation may be responsible for the more marked character of the type *picture of whom*).

[12] Cecchetto and Donati (2010) propose a labeling algorithm according to which the head acting as "probe" projects. The freezing effects can be derived much as under the algorithm based on minimal search: in (35) the probe Q would project, *which book* would not be a maximal projection and further movement would be blocked by maximality. By contrast, the necessary continuation of movement in (36) does not immediately follow from a probe-based algorithm. Andreas Blümel informs me that his forthcoming dissertation at the University of Frankfurt independently develops the idea that freezing may be derived from labeling *à la* Chomsky (2013) and the impossibility of moving nonmaximal projections.

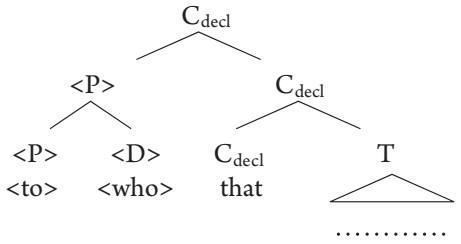
The impossibility of (40)b can now be made to follow from labeling: *to* is visible to the algorithm here because it is internal to the embedded clause (all of its occurrences are internal to α), so it competes with declarative C for labeling (neither one c-commands the other, so they both qualify as "closest" to α), hence the embedded clause α cannot be labeled, and the structure is ill-formed:

(41)




When the preposition is not stranded in the embedded C-system, as in (40)a or c, no problem arises, as the trace is not visible (it has internal and external occurrences) and C (presumably, Decl Force) wins the competition for labeling.

(42)




The literature reports a grammatical case that is quite similar to Postal's impossible structure. McCloskey (2000) argues that in certain varieties of Irish English a floating quantifier is compatible with a wh-element (and interpreted as requiring an exhaustive answer); it can be pied-piped, as in (43)a, or stranded, not only in the position of the variable (as in (43)c), but apparently also in the intermediate C-system (as in (43)b), thus providing straightforward evidence for successive cyclic wh-movement, McCloskey observes:

(43) a. What *all* did he say (that) he wanted?
b. What did he say *all* (that) he wanted?
c. What did he say (that) he wanted *all*? (West Ulster English, McCloskey 2000)

This seems to be in direct contradiction with (our interpretation of) Postal's argument. If *all* is stranded in Spec C in (43)b, the structure should incur the same labeling problem as (40)b, under Sportiche's (1988) analysis of Q-float.

But perhaps floated quantifiers never remain in the position in which they are stranded, and move further to an adverbial position in the low IP space. So *all* could move to such a position in (43)b, thus vacating Spec C entirely. In this case, no labeling problem would arise.

The same conclusion holds, in fact, for the classical case of Q-float from subjects:

(44) My friends have all eaten

*All* could not be stranded in Spec v in (44) because otherwise a competition would arise for labeling the vP, which would give rise to ill-formedness:

(45) [ all t ] [ v VP ]

So, *all* presumably moves out from the stranding position to an adverbial position, thus vacating the Spec v position completely, and permitting proper labeling of vP.

This is independently shown by the fact that, for example, in a French example like (46), *tous* is higher than the manner adverbial *bien*, which suggests that *tous* cannot remain in Spec vP, and must move further, as the labeling approach would predict.

(46) Les amis ont tous (bien) mangé
"The friends have all well eaten"

In fact, floated quantifiers typically occupy identifiable positions in the hierarchy of adverbial positions (Cinque 1999 and, for a recent discussion, Tescari Neto 2013), as would be expected if they always moved from the stranding position to dedicated positions in the functional hierarchy.[13]

## 8 The status of subjects

The canonical subject position is a fundamental halting point of movement, the final landing site of core cases of A-movement (unaccusatives, passive, raising, and in fact any sentence under the vP-internal subject hypothesis). What does this imply for the labeling approach under consideration?

The natural conclusion seems to be that there is a subject criterion. Otherwise (and unless other options are assumed) the subject position would not be a possible halting point for phrasal movement: in order to label [$\text{Phrase}_1$ $\text{Phrase}_2$] in which $\text{Phrase}_1$ is the subject, we must be in a criterial configuration, otherwise labeling would fail.

[13] Koopman (2010) reaches a similar conclusion on the surface position of the floated quantifier in her comparative analysis of West Ulster English and Dutch.

A subject criterion is made independently plausible by certain interpretive properties that go with the subject position (Rizzi 2006). The subject is the argument "about which" the event is presented. So, an active and a passive sentence (also in "all new" contexts) differ in "aboutness": the "hitting event" is presented as being about the truck in (47)a, and about the bus in (47)b:

(47) a Un camion ha tamponato un autobus
"A truck hit a bus"
b Un autobus è stato tamponato da un camion
"A bus was hit by a truck"

This has clear consequences for the overall interpretation and discourse articulation. In a null subject language like Italian, the *pro* subject in discourse must pick out the previously established "aboutness" subject (as observed in Calabrese (1986)):

(48) Poi, *pro* è ripartito
"Then, *pro* left"

That is, if (48) is uttered immediately after (47)a, *pro* is interpreted as referring to the truck; if it is uttered immediately after (47)b, *pro* is understood as referring to the bus (see also Bianchi and Chesi 2012 on island properties of criterial subjects).

In previous work (Rizzi 2006; Rizzi and Shlonsky 2007, building on Cardinaletti 2004), the criterial head was identified as "Subj," a functional head expressed in the high IP space, and possibly overtly realized as a subject clitic in the Northern Italian Dialects; it was assumed that Subj attracts the closest nominal expression (+N) to its Spec, and then triggers the "aboutness" interpretive routine at the interface. This formalization had the property of singling out the subject criterion as the only one in which the criterial head and the attracting feature are not fully identified, an identity that holds for the other criteria (e.g., the topic criterion involves a Top head and a +Top feature, the focus criterion a Foc head and a +Foc feature).

The dissociation is now particularly problematic, in view of the current assumptions on labeling: the attracted element and the criterial head should share a feature that may also function as a plausible label of the whole configuration (and +N does not seem to be appropriate to label what, in informal notation, we may continue to refer to as "the IP").

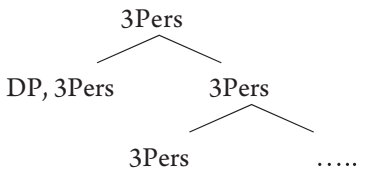
But perhaps a full assimilation of the subject criterion to other criteria is possible. Shlonsky (2013) proposes that the attracting feature really is Person. If this is so, SubjP may, in fact, be rethought of as PersonP. Then, a Person head in the high

functional structure of the clause attracts a DP endowed with person features, thus creating a criterial configuration that allows movement to stop in that position. The "aboutness Subject-Predicate" interpretive routine is then triggered.[14]

(49) [ Un camion 3pers] [3Person [ha [ t tamponato un autobus] ] ]
["aboutness" subject] [predicate] ]

Movement can stop here because the whole clause can be labeled as "person," the criterial feature in common between XP and YP. So we get a subtree like the following.[15]

(50)




In fact, Subject movement must stop in (50): neither XP (DP, 3Pers) nor YP (3Pers. . . . ) are maximal, in the intended sense, so the subject cannot move further, under (33). This gives a strong version of the "Fixed Subject Constraint" (Bresnan 1976). *That*-trace effects are thus derived from Criterial Freezing (Rizzi 2006; Rizzi and Shlonsky 2007), and now, ultimately, from labeling:

(51) * Who do you think [ that [ t 3Person [ will come ]]]

[14] The Person head is obviously reminiscent of AgrS in previous approaches to the structure of the IP. The problem raised by Chomsky (1995) for AgrS (uninterpretable features cannot form an independent head) may be resolved if Person expressed in the clausal structure is indeed an interpretable feature (see Mancini et al. 2011 for developing this hypothesis, building on Sigurdsson 2004; Bianchi 2006, and providing experimental evidence in support).

[15] An anonymous reviewer raises the question of why the categorial D feature on the subject DP in (50) does not suffice to make the subject a maximal node. One possibility is that the person head (akin to AgrS in previous approaches) also bears the D feature, an assumption particularly plausible in the Northern Italian dialects in which the relevant node has the shape of a subject clitic often homophonous with the determiner (Poletto 2000; Manzini and Savoia 2006). In general, the proposed approach requires a full-fledged discussion of which features have "categorial status," hence enter into labeling and freezing effects, and which features do not, a topic that we cannot address here.

The reviewer also observes that if in a language the object moves out of vP to a dedicated position with criterial properties, we would predict its unavailability to further movement. A case in point may be the unmovability of (certain) objects in impersonal passives in Swedish and some varieties of Norwegian (see the discussion in Rizzi 2014, based on Christensen and Taraldsen 1988).

*Who* satisfies the Subject (Person) Criterion in the embedded clause, and then it is frozen there because neither XP nor YP are maximal in the criterial configuration thus created:

(52) . . . that [$_{3Pers}$ [who 3Pers ] [ 3Person [ will [ t come t ]]]]

Languages may then use "strategies of subject extraction" (Rizzi and Shlonsky 2007) to circumvent the freezing effect and allow wh-extraction of a subject.[16]

## Conclusion

According to the criterial approach, scope-discourse semantic properties are structurally expressed by dedicated left-peripheral heads that cause movement and guide interpretation at the interfaces. There are criterial-freezing effects: an expression moved to a criterial position (or at least the criterial goal, the carrier of the criterial feature) cannot undergo further movement. The freezing effects raise the issue of "further explanation": can they be amenable to more fundamental principles and properties of linguistic computations? In this paper I have explored the possibility that Chomsky's (2013) labeling algorithm may provide such a further explanation. According to Chomsky, labeling is ruled by standard locality: the syntactic object created by Merge receives the label of the closest head, a case of minimal search, or RM. Criterial configurations are a permissible "halting sites" for movement because they permit proper labeling of the criterial configuration by the criterial feature. If this is so, the moved phrase ceases to be a maximal projection (in terms of bare phrase structure, the maximal element with a given label); hence its further movement is excluded by the maximality

[16] For instance, Italian (and other Null Subject Languages) permit a "skipping strategy" consisting of the use of expletive *pro* to formally satisfy the Subject Criterion, which allows the thematic subject to skip the freezing position, so that it remains available for further movement (much as in the original ECP-based analysis in Rizzi 1982).

(i) Chi credi [ che [$_{3Pers}$ [*pro 3Pers*] [3Pers [ t verrà t ]]]]
"Who do you think that pro will come?"

Rules like French *que* > *qui* are a somewhat different device used by non-NSLs: see Rizzi and Shlonsky 2007 for discussion. In English and other languages (Swedish, Danish, etc.) the freezing effect can be alleviated by dropping the C-system entirely:

(ii) Who do you think [ t will come ]

Perhaps the strategy used here consists in omitting the whole complex C+PersonP, so that freezing is not triggered. Shlonsky (2013) proposes that the omission strategy is what determines "anti-agreement" effects in Berber, Somali, and other languages: in subject A' dependencies, the verb is in a participial form that does not specify the person morphology.

principle, restricting phrasal movement to maximal objects. Freezing is thus explained. The approach also naturally extends to a characterization of the subject position as a possible landing site for movement, and permits new analyses of classical problems raised by successive cyclic movement. As the system provides principled accounts for cases in which movement must continue and cases in which it must stop, the algorithm offers a comprehensive solution for what we have called "the halting problem" for movement.

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