Full Interpretation of Optimal Labeling

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This article proposes that the label for each syntactic node/set is fully derivable from Agree operating on edge-features of lexical items. It is also proposed that the derivations of labels transparently carve the path for θ-marking at the semantic interface. When tied with the label asymmetry condition at the Sensorimotor-interface and principles of derivational economy, this theory of labeling/Agree derives effects of what is traditionally called the θ-Criterion at the semantic interface. Ramifications for the principle of Full Interpretation are also discussed.

Keywords: Agree; edge-feature; Full Interpretation; label(ing); θ-Criterion

1.   Introduction

Since the advent of the *bare phrase structure* (BPS) theory (Chomsky 1994 *et seq.*), the role that labels play in the computational system of human language faculty (henceforth syntax for short) has been the subject of heated controversy. Since the BPS theory immediately makes it possible for syntax to generate an infinity of syntactic objects (SOs) by recursive application of *Merge* from bottom-up, without making any recourse to non-terminal symbols, projections or labels,[1] sound methodological minimalism naturally starts scrutinizing the notion 'label' itself, raising the following question:

(1)   Does the theory of human language really need to assume labels/labeling to set an empirically adequate account of the known variety of linguistic phenomena?

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[1]   Merge is a symmetric set-formation operation, which maps n SOs $\alpha_1, \ldots, \alpha_n$ to a set of them, $\{\alpha_1, \ldots, \alpha_n\}$.

Although the answers proposed in the past vary (see, e.g., Chomsky 1995, 2000, Collins 2002, Boeckx 2008, Fukui 2006a, 2008, forthcoming, Irurtzun 2007, Hornstein 2009, and Narita 2007, 2008 among many others), many researchers seem to assume that the notion 'label(ing)' is a necessary part of a good linguistic theory of sufficient descriptive/explanatory adequacy.[2] I concur. Indeed, there is evidence that labels yield instructions to both the Conceptual–Intentional system (C–I) and the Sensorimotor system (SM).

As for the C–I side, I would like to first point out the growing body of empirical evidence for the *Predicate-Internal Argument Hypothesis* (PIAH), launched by the advent of the VP-internal subject hypothesis (Koopman & Sportiche 1983, Fukui 1986, Sportiche 1988, Kuroda 1988). The leading assumption of the PIAH is that every predicate-argument structures of a predicate category P is 'saturated' within the projection of P: For example, all nominal arguments of a verbal category are base-generated/externally merged within vP. Here we see a direct mapping from syntax to semantics, which has been shown to be crucially mediated by labels. Thanks to the PIAH, linguists now can entertain the strongest possible hypothesis regarding the relation between syntax and C–I, namely that predicate-argument structure is syntax (Hale & Keyser 1993, 2002, Hinzen 2006). In particular, the PIAH suggests that the following syntax/C–I correspondence holds, which I would like to call the *PIAH-Conjecture*:

(2)   *PIAH-Conjecture*

        If an SO {α, β} is labeled by the label of α, C–I interprets it as α θ-marking β
        (if α is a predicate category).[3]

Note crucially that the predicate-argument relation is asymmetric: A predicate category P *θ-marks* an argument category A, not vice versa. Note further that it is always the predicate category P that projects over its argument A asymmetrically. This correspondence rather strongly suggests to us the possibility of motivating label(ing) from C–I considerations: Labeling is a syntactic operation that codes the predicate–argument asymmetry between Merge-mates that appears subsequently at the point of C–I-interpretation (see Irurtzun 2007).

Interestingly, empirical evidence suggests that labeling feeds asymmetry to SM as well. One of the fundamental phonological operations, feeding SM, is *linearization*. Presumably due to the modality restriction imposed by the SM system, the hierarchical, '2D' structure generated by syntax is 'unpronounceable'. Such an unpronounceable input must be transformed to a corresponding pronounceable output of some form, satisfying SM-interface condition.[4] Linearization refers to the phonological mapping of an input hierarchical SO to a corresponding

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[2]   Collins (2002) replaces 'label' with an alternative notion 'locus', but essentially the same question applies to the latter, too.

[3]   For now, this parenthesized qualification seems necessary, since we know that not all labels have interpretation at C–I: Consider, for example, subject raising to [Spec,TP], which is assumed to let T project, even though T does not θ-mark the moved subject in any obvious sense. But see section 3 below.

[4]   Of course, I do not deny the existence of phonological properties that make recourse to hierarchical syntax in some fashion, for example, prosody. See Samuels (2009a) for related discussion.

sequence of phones readable by SM. I would like to point out that, although past proposals are diverse, they seem to have reached a consensus that the linearization process requires asymmetrically labeled syntactic input. Let us refer to this requirement by linearization as the *Label Asymmetry Condition*.

(3)   *Label Asymmetry Condition*

SM-linearization works properly for a syntactic node/set only if one and only one label is defined for that node/set.

To take a representative example, Kayne's (1994: chap. 3) LCA-based account of linearization resorts to asymmetric labels. Specifically, in order to let a specifier/ adjunct of head H asymmetrically c-command its H′/HP-sister, Kayne's account must rely on May's (1985) category/segment-distinction on syntactic nodes (saying that any specifier/adjunct merger splits the target category into segments), which in turn is made available by asymmetric labels (but see Uriagereka 1999). Indeed, without the category-segment distinction on each node, "specifiers and adjoined phrases appear to have no place" in his theory (Kayne 1994: 16). Chomsky's (1995) modified LCA carefully avoids this problem by assuming that non-minimal, non-maximal projections (X's) are invisible to the LCA and hence they do not c-command their sister Spec in the first place, which clarifies the relevance of labels to the Kaynean antisymmetry program. It is Fukui & Takano (1998) who show that the recourse to c-command is actually eliminable from the Kaynean antisymmetry program, a proposal that further clarifies the crucial relevance of labels to linearization. Their proposal is that linearization uniformly maps headed-nonhead distinction on two Merge-mates to postcedence (if α projects over β, then $\{\alpha, \beta\}$ is mapped to a string where β precedes α), yielding the universal Spec–Compl(ement)–Head word order, with apparent 'head-initial' Spec–Head–Compl order being derived by Head–to–Spec move- ment; see already Takano (1996). Both Kayne and Chomsky's label–and–c- command-based anti-symmetry theory and Fukui & Takano's only–label-based theory share the goal of deriving the effect of head-parameter from invariant UG axioms. In retrospect, Chomsky's (1981) head-parameter, some version of which is adopted by a number of researchers even currently (e.g., Epstein *et al.* 1998, Richards 2004, Fox & Pesetsky 2005), was the first proposal that clearly expressed the crucial relevance of projections/headedness to linearization. All in all, it should be clear that all of the past proposals on linearization processes rely on asymmetric labels, which I take to mean that the role of asymmetric labeling at linearization is indispensable.

    In short, the asymmetry between a predicate and its argument is uniformly traced by asymmetric labels (PIAH-Conjecture). SM also exploits the same sort of asymmetry for linearization purposes. If we are right in seeing syntax as a device generating instructions to C–I and SM, and if both C–I and SM utilize asymmetry *of the same sort*, then it becomes plausible to suppose that labeling as an asym- metry-coding device is a syntax-internal operation (see already Chomsky 1994, 1995; see also Boeckx 2008). It is essentially these empirical considerations that lead me (among others) to reserve a positive answer to the question in (1).

    However, recall that the minimalist program is a research program guided

by the *strong minimalist thesis* (SMT) that human language is an optimal linker of C–I and SM (see Chomsky 2001, 2008, Berwick & Chomsky, to appear, and Narita 2009d for varying definitions thereof). Since minimalism holds the SMT not only as a methodological guideline but also as a substantive empirical hypothesis about biological reality, we also have to ask whether there is any sense in which the notion 'label' is a 'must' for a perfect system like human language, which itself emerged in almost just an 'eye-blink' in evolutionary time. Thus, the question is:

(4)   Does 'label' count as a virtually conceptually necessary part of human language (an optimal C–I/SM-linker, insofar as the SMT holds)?

It is essentially with respect to this substantial minimalism question that Chomsky (2007a: 23) rightly reminds us that "it may be that as understanding progresses, the notion 'label' will remain only as a convenient notational device, like NP, with no theoretical status," and argues that "reference to labels (as in defining c-command beyond minimal search) is a departure from the SMT, hence to be adopted only if forced by empirical evidence, enriching UG." I am also sympathetic to this argument. I will hint in section 2 that there may be no such thing as 'projection' or percolation of features as implicitly assumed by virtually every previous theory of labels, though I will also argue in sections 2–4 that the driving force of labeling, which I will propose to be *Agree* operating on *edge-features* of lexical items (LIs), actually constitutes a part of syntax's optimization to C–I-interpretation. Thus, this article is an attempt to articulate my own moderate "Yes" to question (1) and a moderate "No" to question (4) at the same time.

2.   A Unification of Labeling and Agree

If labels are generated by syntax, a computational system that optimally interfaces with C–I and SM, insofar as the SMT holds, then syntax should be designed in the way that it generates labels in an optimal way. This section provides my own proposal for how syntax meets this task. The core proposal is that labels in syntax can be defined in terms of Agree with respect to edge-features of LIs. I will first set out some of my assumptions about the functioning of Agree in section 2.1. Then I will attempt to unify labeling and Agree in section 2.2, where I will also provide a theoretical characterization of the edge-feature (EF). Discussion on how the proposed system works will follow in section 2.3.

2.1.   *Some Background Characterization of Agree*

Since Merge is just a set-formation operation that combines SOs, it cannot rearrange elements internal to already created SOs. Thus, Merge obeys the *No-Tampering Condition* (NTC):

(5)   *No-Tampering Condition* (NTC)

Merge of X and Y leaves the two SOs unchanged (Chomsky 2008).

However, empirical evidence suggests that something that cannot be expressed by Merge is also at stake in human language: Linguistic expressions exhibit some dependency between two non-sister LIs that cannot be readily captured by Merge. For example, in the *there*-expletive construction in (6) the main verb exhibits singular number agreement with an associate NP. Similarly, the negative particle in the matrix clause can license an NPI within its c-command domain as in (7). To take another example from Japanese (8), the wh-in-situ in the embedded clause is licensed by the question particle *ka* in the matrix clause, and so on.

(6)   There *seems* to be likely to be *a boy* in the garden.

(7)   I *don't* think *anybody* will take French this semester.

(8)   Kimi-wa [John-ga   *nani*-o   katta   to]   omotta-ndesu *ka*?   *Japanese*
       you-TOP   John-NOM what-ACC bought   that   thought-POL   Q
       'What did you think John had bought?'

So syntax must provide a way (or several ways) to code such (potentially long-distance) non-sister relations between two LIs. Chomsky (2000) and many other subsequent works suggest that *Agree* is responsible for capturing (at least some of, optimally all of) such dependencies.

Agree is a dependency established between a pair of LIs by a derivational search operation relative to a given feature F. Some LI P with an uninterpretable feature F acts as a *probe*, and it seeks in a certain search domain a matching F on a *goal* LI G for establishing an Agree-dependency between them. In what follows, I will adopt the term *Search* to refer to the derivational search operation in question and *Agree* to refer to the relation established thereby, respectively, a distinction that is sometimes blurred in the literature but is nevertheless important, as I will claim. If P's Search reaches a matching goal G with respect to F (henceforth, *P Searches$_F$ G*), then Agree-relation with respect to F holds from P to G (henceforth, *P Agrees$_F$ with G* or *Agree$_F$(P, G)*).

Given that the asymmetric probe-goal distinction on the two Agree-mate LIs (P and G) arises derivationally at each application of Search, I claim that the following holds for any Agree-relation.

(9)   *Agree is asymmetric*

Agree$_F$(X, Y) ≠ Agree$_F$(Y, X).

Moreover, following Chomsky (2000) and many subsequent works, I assume that there is a structural condition on the possible application of Agree, namely that for any Agree$_F$(P, G), the search domain for a probe P is restricted to P's c-command domain in a given SO. This condition can be stated as in (10).

(10)   *The c-command domain condition on Search*

For any Agree$_F$(P, G), G must be within P's sister/complement.

I further adopt Chomsky's (2001) hypothesis that uninterpretable features that probe are nothing more than features that lack value. Unvalued features that have established appropriate Agree-relations get deleted at the point of *Transfer* (Chomsky 2001, 2004, 2008). Transfer is an operation that stripes off a certain well-defined domain of an already constructed SO to C–I and SM. The domain subjected to Transfer (the Transfer domain for short) becomes inaccessible to further syntactic operations — the *Phase-Impenetrability Condition* (PIC); see Chomsky (2000 *et seq.*).

(11)   *Phase-Impenetrability Condition* (PIC, Chomsky 2000)

In a phase α with head H, the domain of H is not accessible to operations outside α, only H and its edge are accessible to such operations.

Certain unvalued features are designed to probe matching goals (their interpretable valued counterpart) within their search domain, establishing one or more Agree-relations before Transfer. If appropriate Agree-relations are established, unvalued features can get deleted by Transfer, and if not, they will remain 'uninterpretable', leading the derivation to crash. I follow Uriagereka (1999) and many subsequent works in assuming that Transfer can apply multiple times in a given derivation. For concreteness, I specifically assume with Chomsky (2000, 2004, 2008) that a certain class of LIs, called *phase heads*, trigger Transfer of their complement at the completion of their computation.

I will further assume that Agree is a transitive relation.

(12)   *Agree is transitive*

For any feature F and any three LIs X, Y and Z, if Agree$_F$(X, Y) and Agree$_F$(Y, Z) hold, then Agree$_F$(X, Z) holds.

Already many researchers propose some versions of (12) (Frampton & Gutmann 2000, Adger & Ramchand 2001, Legate 2005, Haegeman & Lohndal, in press; see also Hiraiwa 2005). For example, Adger & Ramchand (2001) and Legate (2005) propose that (12) is responsible for the successive cyclic realization of relativizing complementizers in Scottish Gaelic relative clauses. Consider (13).

(13)   An duine [**a**   thuirt   e [**a**/*gun   bhuaileas   e]]   *Scottish Gaelic*
       the man   *C-REL said*   *he* *C-REL/that* *strike-REL*   *he*
       'The man that he said he will hit'

(Adger & Ramchand 2001: 9)

According to Adger & Ramchand (2001), the most deeply embedded clause contains a gap for relativization, whose interpretive Var(iable)-feature triggers the (successive cyclic) complementizer agreement in question. Interestingly, not only the main relative clause but also its subordinate clause exhibits the

relativized complementizer *a*. Adger & Ramchand (2001) and Legate (2005) propose that Agree is essentially a transitive relation (12), and that the cyclic establishment of Agree-relations (each of which is phase-bound) can result in the apparent long distance multiple agreement in question. Their proposal can be schematically shown as in (14).

(14)   *Legate's and Adger & Ramchand's analysis: Agree and transitivity*

the man $[C_1 \ldots [v_1 \ldots [C_2 \ldots [v_2 \ldots pro_{Var} \ldots]]]]$
          Agree$_{Var}$ Agree$_{Var}$ Agree$_{Var}$ Agree$_{Var}$

According to the theory of phases by Chomsky (2000, 2007a, 2008), no probe in a given phase Ph can look into subordinate phase domains, due to the PIC (11). Since finite clauses should constitute phases, Var-feature probing from the highest relative clause complementizer should not be able to reach the deeply embedded gap, crossing multiple phase boundaries. However, if Agree is a transitive relation, then each of the lower phase heads can establish Agree$_{Var}$ to pass up the relevant Agree$_{Var}$-relation to the highest relative complementizer, as depicted in (14). Combined with the phase theory, this set of data constitutes good evidence for the transitivity of Agree (12).[5] See Legate (2005) for further evidence for this proposal.[6]

Summarizing, Agree is asymmetric (9) and transitive (12), subject to the c-command search domain condition (10) and the PIC (11), as I will assume in what follows.

2.2.   *The Agree$_{EF}$-based Label Theory: An Outline*

Now we are ready to articulate the core proposal that *Agree$_{EF}$ can fully derive labeling*, where EF stands for *edge-feature* (Chomsky 2007a, 2008). This sub-section will outline the gist of the Agree$_{EF}$-based label theory.

According to the BPS theory, every syntactic expression is composed by recursive application of Merge in a bottom up fashion. Since all the SOs are composites of a finite number of lexical items (LIs), 'computational atoms' for syntax, these LIs must contain a property that enables them to undergo Merge. Chomsky (2007a, 2008) calls this property the *edge-feature* (EF):

> For an LI to be able to enter into a computation, merging with some SO, it must have some property permitting this operation. A property of an LI is called a *feature*, so an LI has a feature that permits it to be merged. Call this the *edge-feature* (EF) of the LI. […] The fact that Merge iterates without limit

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[5]   This view is corroborated by Adger & Ramchand's (2001) independent argument that the A'-dependency in Scottish Gaelic does not involve null operator movement.

[6]   Many of the 'multiple agreement' phenomena (such as those discussed by Hiraiwa 2005) can be readily accounted for in terms of the transitivity of Agree (12), without recourse to Hiraiwa's powerful mechanism of *Multiple Agree*, a set of simultaneously established Agree-dependencies from a single probe to multiple goals. I will leave the issue of Multiple Agree open in what follows. Note that the transitivity of Agree is anyway necessary to account for the cross-clausal long distance agreement effects as in (13), since finite clauses should constitute phases impenetrable for later operations (due to the PIC; but see Bošković 2007).

is a property at least of LIs — and optimally, only of LIs, as I will assume.
(Chomsky 2008: 139)

According to this proposal, each LI is associated with an undeletable EF. Since my proposal will rely on some specific assumptions on the EF, I will first make them explicit. In the end, I propose that the EF is closely related to the matter of how labels are provided in syntax.

I follow Chomsky in assuming that each LI is associated with an EF.[7] I further assume with him that the presence of an EF signifies Mergeability. Merge applies freely, regardless of whether internally or externally, so long as the Merge-mates are associated with EFs (Chomsky 2007a, 2008). Since each LI will retain its Mergeability throughout the derivation, we are led to assume that the EF is undeletable. Further, since there is no reason to suppose otherwise, I assume that one and the same EF is associated with every LI, and consequently that the EF does not have any value sub-specification. That is, I assume that the EF is unvalued.[8,9]

However, note that the EF is just a feature. We have assumed above that Agree/Search constitutes an indispensable part of syntactic derivations, and that Search is triggered by an unvalued feature (probe). If an EF is a feature that lacks value, then there is no principled reason to exclude the possibility that the EF is also a feature that can act as a probe for Agree. In what follows I will pursue exactly this possibility. I will specifically claim that Agree$_{EF}$ is at the core of labeling in syntax.[10]

Every LI in the human Lexicon is associated with an EF which is unvalued but nevertheless undeletable. I specifically propose that due to this property, the EF can act either as a probe or as a goal for Agree$_{EF}$ repeatedly. A probing feature seeks its matching counterpart, namely a feature of the same sort. Thus an EF can search an EF, which can be found virtually everywhere in the derivational workspace, since every LI has an EF. Moreover, since the goal EF always lacks value by definition, Agree always fails to value the probing EF (and the goal, too). Thus, even after the establishment of Agree, EFs remain active, possibly participating in subsequent Agree with another EF. Some unvalued features need to be valued by the Agree-mate at Transfer in order to receive legitimate interpretation, but not the EF, as I assume.[11] That is, I specifically assume that the EF is a feature that can be deleted or appear at interfaces without getting valued.

Given these background assumptions, my proposal is that labels are fully

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[7]   Maybe with a possible exception of interjections, if they lack EFs (see Chomsky 2008:1 39). I put this matter aside in what follows.

[8]   In fact, Chomsky (2007a: 8) suggests, "[v]ariation among LIs with regard to deletability of EF would be a departure from SMT, so we assume that for all LIs, one or the other property holds." Here I am pointing out that variation among LIs with regard to the value-specification of EF would also be a departure from the SMT.

[9]   See Narita (2009a, b) for further discussion of EFs.

[10]   See already Fukui (2006a, 2008), who proposes that the EF is crucially at stake in the labeling operation in syntax (what he calls *Embed*). I am specifically proposing here that what utilizes the EF for labeling purposes is no different from Agree. See also Narita (2007) and Boeckx (2008) for some relevant discussion.

[11]   Here, I am departing the oft-held assumption that feature-valuation is a necessary part of Agree.

derived by means of Agree$_{EF}$-relations established in syntax. The proposed definition of labels is given in (15).

(15)   *The Definition of Labels*
       For any SO Σ, an LI H is the label of Σ =$_{def}$ H Agrees$_{EF}$ with the rest of the LIs within Σ.[12]

The subsequent discussion will substantiate the proposal.

2.3.   How It Works

This sub-section outlines how the proposed Agree$_{EF}$-based label theory works. Underlying this proposal is the assumption that some interface conditions require that each node/set be unambiguously labeled. As discussed in section 1, the label asymmetry condition, feeding linearization by SM, is one such constraint:
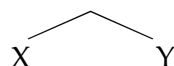
(3)   *Label Asymmetry Condition*
       SM-linearization works properly for a syntactic node/set only if one and only one label is defined for that node/set.

Some C–I conditions are to be explicated in the subsequent discussion.

2.3.1. Head–Compl Cases

To start the illustration of how the proposal works, consider first the simplest case of merger of two LIs, say X and Y.

(16)   External Merge of X and Y → {X, Y}

Here, both X and Y are associated with EFs. The label asymmetry condition (3) forces syntax to generate a label for this symmetric Merge-result, which is just a set, without internal ordering among elements: {X, Y}. Our proposal postulates that this is done by means of Agree$_{EF}$. Suppose that X's EF probes into X's c-command domain, which is just another LI Y in the case in question. Y has an EF, so this probe can establish an asymmetric relation Agree$_{EF}$(X, Y).

(17)   X Searches$_{EF}$ Y → Agree$_{EF}$(X, Y) holds.

The result is that X Agrees$_{EF}$ with the rest of the LIs contained in (16), thus X will qualify as the label for {X, Y} by definition (15). (The label LI will be informally marked by underscores here and below.)

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[12]   See fn. 25 for a slight modification of (15).

In (16), X and Y mutually c-command each other, thus each can probe the other. Thus if, on the other hand, Y Searches$_{EF}$ X at (16), Y will qualify as the label instead. The choice of which Searches$_{EF}$ which here is in principle free, I assume, insofar as the choice yields a right sort of structure interpretable at the C–I- and SM-interfaces. The effects of Agree$_{EF}$ at the C–I-interface will be discussed in section 3 in detail.

Note also that even after Agree$_{EF}$(X, Y) holds as in (17), both EFs of X and Y will remain unvalued. Since we assumed that an unvalued EF can probe, X and Y seem to be still eligible candidates for establishing 'another' Agree$_{EF}$-relation (Agree$_{EF}$(X, Y) or Agree$_{EF}$(Y, X)) in (17). However, I claim that it is not the case. Consider establishing the 'second' Agree$_{EF}$(X, Y) first. This relation is completely useless: it does not result in any new label, and the Search-operation resulting in such a futile Agree-relation is presumably ruled out by some economy principle (I will return to this matter later in section 3.2.) Consider next another possible Agree-relation in (17), Agree$_{EF}$(Y, X). In (17) X first Searches$_{EF}$ Y, letting X become the label of (17). But both EFs remain unvalued and hence eligible for initiating anther application of Agree, so let us suppose that Y can in principle initiate Agree$_{EF}$(Y, X) at (17). According to (15), this would cause Y to project in addition to X, thus resulting in a structure where *more than one label coexists*, what Citko (2008) calls a 'Project Both' structure: {X̲, Y̲}. I argue that such an ambiguously labeled structure violates the label asymmetry condition (3), and therefore is ruled out at SM. In general, in order to satisfy (3), it must be the case that only one label is generated per each Merge-result set/node. However, if syntax establishes Agree$_{EF}$(Y, X) in addition to Agree$_{EF}$(X, Y) in (17), label asymmetry disappears: both X and Y become the label of the Merge-result by definition (15). Then, the SO would become unpronounceable again, and the SM-linearizability conditions presumably filter out such an 'asymmetry-breaking' Search$_{EF}$-operation, as I propose.[13] Thus, at each external merger of two LIs, one and only one of them probes the other in any convergent derivation, establishing Agree$_{EF}$, which in turn generates a label for the Merge-result by (15), deriving the head-complement configuration.

If the complement is just an LI, as in (16), the labeling convention in (15) is pretty straightforward, since basically it is just a matter of establishing one Agree$_{EF}$-relation between the 'head' LI and its sister LI. But (15) is expected to cover the head-complement cases in general. Suppose another LI, say Z, is merged with (17).
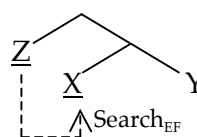
(18)   External Merge of Z. → {Z, {X̲, Y}}
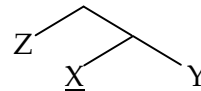
Suppose further that we want Z to become the label of (18). In order for Z to project by our definition of labels (15), Z must undergo Agree$_{EF}$ with all the LIs contained in (18), here X and Y. Suppose that Z undergoes Agree$_{EF}$ with X in (18).

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[13]   Though see fn. 33.

(19)   Z Searches$_{EF}$ X → Agree$_{EF}$(Z, X) holds.

This Agree-relation in effect derives the label Z for (18). The reason lies in the transitivity of Agree discussed above (12), repeated here.

(12)   *Agree is transitive*

   For any feature F and any three LIs X, Y and Z, if Agree$_F$(X, Y) and Agree$_F$(Y, Z) hold, then Agree$_F$(X, Z) holds.

In our case (18), given Agree$_{EF}$(Z, X) and Agree$_{EF}$(X, Y), Agree$_{EF}$(Z, Y) is deduced by the transitivity of Agree (12).

   Notice that X and Y mutually c-command each other, hence they should be equidistant to the probe Z, and Y should be a potential goal for Z's probe at (18). However, even if Z Searches$_{EF}$ Y and establishes Agree$_{EF}$(Z, Y), it does not generate a label for (18): all we have then are Agree$_{EF}$(Z, Y) and Agree$_{EF}$(X, Y), a combination of which does not derive any label by our definition of labels (15). Thus, in order to provide a label for (18), Z needs to enter Agree$_{EF}$(Z, X) anyway, hence Z's Search$_{EF}$ of Y counts as a superfluous operation for the purpose of labeling. Such a futile application of Search presumably violates some computational economy principles governing syntax: A derivation D$_1$ where Z Searches$_{EF}$ Y and then X at the point of (18) is presumably blocked by the presence of a more economical derivation D$_2$ in which Z only Searches$_{EF}$ X, deriving label X by the transitivity of Agree. I will come back to this issue in section 3.2.

2.3.2. Internally Merged Spec

Let us turn to Spec cases. I will first discuss the cases of internally Merged Specs, and then those of externally Merged Specs.
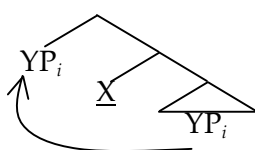
   Suppose that recursive application of Merge constructs an SO (20), which contains a sub-constituent YP. Suppose that X is the label of (20). According to our labeling convention (15), that is, X has established Agree$_{EF}$-relations to all the LIs within its complement.

(20)
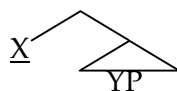
Suppose further that internal Merge dislocates YP to the edge of (20):

(21)

The usual consensus is that dislocation/internal Merge in human language necessarily results in 'uniform chains', in the sense that it does not alter the maximal/minimal status of the label of moved elements (Chomsky's 1995 *Chain Uniformity Condition*; see also Emonds's 1970, 1976 'structure-preserving' hypothesis). That is, the label of the target SO projects in all instances of internal Merge.[14] In the present case, the internal Merge of YP necessarily results in the projection of X. But why should it be the case? The label asymmetry condition (3) requires that the Merge-result (21) be provided with an unambiguous label. The observation amounts to the claim that it is always X that enters $Agree_{EF}$-relations with the LIs in YP. But why? Why can't other LIs, say the label of YP, $Search_{EF}$ X and establish $Agree_{EF}$/labeling?

In fact, our $Agree_{EF}$-based label theory provides a straightforward answer to the question, when combined with the *copy/remerge theory of movement* (Chomsky 1993, 1995, 2004). Note that prior to internal Merge of YP, X was the label of (20). By our definition of labels (15), X $Agrees_{EF}$ with the rest of the LIs within (20), crucially including those contained in YP. Note further that the YP internally merged to the edge of (20) is just a copy of the YP contained in (20), and X has already established $Agree_{EF}$-relations to all the LIs contained in the original occurrence of YP. Internal Merge is just *remerge*, and the remerged YP is just the same SO as the one contained in XP. One generally expects that the syntactic relations which hold from α to β is identical for all the copies of β, if there are any. Thus, for example, we see that the copies of the same DP would share the θ-roles, Case-agreement relations to the checking head, 'indices'/binding-relations, and so on. So should the $Agree_{EF}$-relations between X and the LIs within YP be. Thus a generalization (22) holds, which is just a straightforward consequence of the copy/remerge theory of movement.

(22) *Agree is conservative over internal Merge*

Copies/occurrences of the same SO created by internal Merge share the same set of Agree-relations.

X has already $Agreed_{EF}$ with the LIs within YP at the derivational point of (20). Thus, due to (22), the same $Agree_{EF}$-relations must be conserved for the two copies created by internal Merge. That means, X must $Agree_{EF}$ with the LIs in both of the two copies of YP. *Therefore*, X is the label of (21) by definition. In this way, we derive the Chain-Uniformity effect of internal Merge without adding any independently stipulated constraints to the theory of UG. Let us call this result *Corollary 1*.

(23) *Corollary 1*

If α is internally merged to an SO β labeled by an LI H, leaving its occurrence within β, then the Merge-result is labeled by H.

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[14]   Donati (2006) claims that it is not always the case, raising the *wh*-free relative construction as a possible counterexample. Since alternative analyses are readily available (see, e.g., Caponigro 2002, 2003), I put this matter aside.

This way, the Chain-Uniformity effects are subsumed under the copy/remerge theory of movement.

Note that I am departing from the once-dominant assumption that internal Merge should be triggered by a viral 'EPP-property' of the attracting head. It has been widely assumed in the literature that internal Merge is a 'costly' operation and should be employed only when its application contributes to checking of a viral uninterpretable feature called the 'EPP-feature' (the last resort conception of movement; Chomsky 1986, 1995). However, Chomsky (2004, 2007a, 2008) argues that this was a wrong conception of internal Merge. Rather, without any further stipulation, Merge should be able to take as input either two independent SOs (as in external Merge) or two SOs one of which is part of the other (as in internal Merge). Correspondingly, "I[nternal]M[erge] (= Move, with the 'copy theory') is as free as E[xternal]M[erge]" (Chomsky 2008: 140), unless stipulated otherwise, due to the undeletability of EFs. Thus, every LI can in principle be subject to internal Merge, insofar as an undeletable EF is present. No extraneous and redundant 'EPP-feature-checking' is stipulated to be necessary to drive internal Merge.[15]

2.3.3. Externally Merged Spec

So far we have seen that our Agree$_{EF}$-based label theory correctly captures head-complement cases and internally merged Spec cases. Our next task is to extend our discussion to the cases of Spec-headed external merger. Consider an SO of the form {H̲, XP}, where H, an LI, Agrees$_{EF}$ with all the LIs within XP, thus H qualifies as the label. Suppose that an independently constructed SO, say YP, is externally merged with that SO. For concreteness suppose Y Agrees$_{EF}$ with all the LIs contained in YP, thus Y qualifies as the label of YP.

(24)
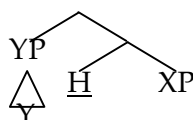
Suppose that we want the result that H projects in (24). Since the existence of externally merged Specs in human language is undeniable (consider, e.g., an external argument DP merging into [Spec,vP]), syntax should have a way to let H project in the configuration like (24). According to our definition of labels (15), this essentially means that H can enter Agree$_{EF}$ with the LIs within YP, in particular Y. However, recall the c-command domain condition on Search, repeated here, which restricts the search domain for a probe to its sister/complement.

---

15   Although internal Merge itself should be as free as external Merge, there may be some language-specific phonological constraints that require some Agree$_F$-relation to have a phonological reflex in terms of dislocation, utilizing the availability of free (internal) Merge: For example, it might be the case that some phonology, say of Hungarian, requires the goals of Agree$_{Q/WH}$ to be pronounced adjacent to the [+WH] C, whereas such requirement is absent in other phonological systems, say of Chinese. We can easily recapture the (only) apparent 'costfulness' of internal Merge in these terms.

(10)   *The c-command domain condition on Search*

   For any Search for $Agree_F(P, G)$, G must be within P's sister / complement.

The Spec of H (YP here) is, however, by definition out of H's c-command domain. What we want is nevertheless the result that H can $Search_{EF}$ into YP here. To ensure this, Search should be able to extend its search domain to its Spec, at least in some environment. Then, the problem is:

(25)   How can a probe H search into its Spec, while still conforming to the c-command domain condition on Search (10)?

I would like to sketch two options in resolving this matter, both of which are compatible with the subsequent discussion.

2.3.3.1. Option A

Option A will seriously entertain some consequence of Chomsky's (2000, 2008) conception of phase. According to Chomsky, Transfer applies cyclically at the completion of each phase, sending off the phase-interior domain (the complement of the phase head) to the C–I- and SM-interfaces. Syntax will then 'forget about' the Transferred domain completely, behaving as if it is not there in the derivational workspace anymore. That is to say, if a phase head H in a configuration {YP, {H, XP}} Transfers XP, then only the phase head H and its 'edge', YP, will remain visible to syntax after Transfer.

   Suppose, then, that after Transferring its first-merged complement (XP), a phase-head H will be able to regard its second-merged phrase (YP) as its 'second complement'. I would like to propose along this line of reasoning that the head H will also become able to extend its search domain to this second complement, too.

   Returning to the problem of externally merged Spec in (24), addressing question (25), suppose that H is a phase head. Suppose further that H subjects its complement XP to Transfer, before or after the external merger of YP, which results in the elimination of XP from the derivational workspace:

(26)   H Transfers the complement XP: {YP, {H, X̶P̶}} → {YP, H}
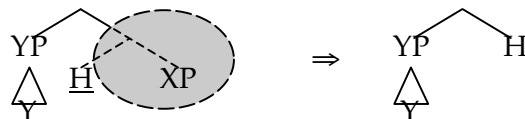
Now YP becomes the 'second complement' of H, and H can search into YP, while still satisfying the c-command domain condition on Search. The label asymmetry condition requires that the structure (26) should be provided with an unambiguous label, so $Agree_{EF}(H, Y)$ is required to set H as the label of (26).

(27)   H Searches$_{EF}$ Y → Agree$_{EF}$(H, Y) holds.
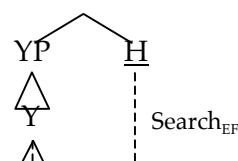
The transitivity of Agree (12) derives Agree$_{EF}$-relations from H to all the LIs within YP (since Y already Agrees$_{EF}$ with them), and H is assigned to (27) as its label by definition (15).

Note that, insofar as we keep to Option A, the projection of a head H over an externally merged Spec crucially hinges on the (prior or subsequent) Transfer of the first complement by H. Then, under the assumption that all nodes must be labeled, the consequence is (28).

(28)   An LI H can have an externally merged Spec only if H's complement can be subject to Transfer.

(28), a corollary of Option A, has certain virtues: first of all, it can make sense of Chomsky's (2000, 2001, 2008) distinction between the transitive/unergative v*P-phase and the unaccusative/passive vP-phase. Rather than introducing a stipulative distinction between transitive/unergative v* as a strong phase head and unaccusative/passive v as a weak phase head, we can rather say that (28) forces only v in the transitive/unergative construction to Transfer its complement, since it will take an external argument DP/NP as an externally merged Spec. In contrast, v in the unaccusative/passive construction will not have an external argument DP as its Spec, thus it is free from the pressure of Transferring its complement, yielding in its apparent 'weak phase' nature. Moreover, (28) will set an explanation of the claim that only a phase head can have an externally merged Spec. This claim seems supported by a growing body of empirical data: See McGinnis's (2001) argument that introduction of an indirect object requires another (strong) phase head called Appl(icative) (see also Pylkkänen 2008); see also Chomsky's (2007a) and Fukui & Zushi's (2008) claim that only nPs which host determiners in their Spec constitute (strong) phases. These considerations provide indirect but important support for (28), and thus for the proposed reverse-engineering of labels.

2.3.3.2. Option B
Another possible solution to the question in (25) will rely on the possibility of syntactic Head(–to–Spec)-movement, which is independently argued for by Fukui & Takano (1998, 2000), Toyoshima (2000, 2001), and Matushansky (2006). Suppose that H in (24) is further internally merged to (24), resulting in (29):

(29)
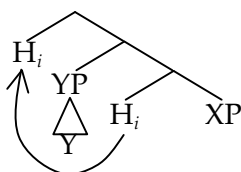
Nothing proposed so far blocks this internal Merge, given the assumption, reached in section 2.3.2, that internal Merge is (as) costless (as external Merge). Now, the higher copy of H takes YP in its c-command search domain. Then, nothing assumed so far prevents this occurrence of H from probing its expanded search domain (see Bošković 2007 for a proposal in the recent framework that moved elements can probe). Then, suppose that H enters Agree$_{EF}$(H, Y):

(30) H Searches$_{EF}$ Y → Agree$_{EF}$(H, Y) holds.
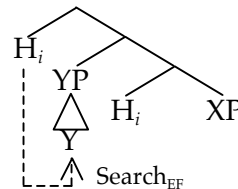
The result is that H becomes the label of (30): Agree$_{EF}$(H, Y) and the transitivity of Agree (12) leads to H Agreeing$_{EF}$ with the rest of the LIs within the entire SO (30), thus projecting by definition (15).

In this way, Option B does not resort to a prior application of Transfer as Option A does, though derivations in line with Option B do not yield (28) in any obvious way.

Note that (30) is a 'Project Both' structure in some sense, i.e. both of the Merge-mates' labels, both H, 'project', which might be problematic for the label asymmetry-based linearization purposes, no matter what linearization mechanism ultimately turns out to be correct. However, note that the two 'heads' are just two occurrences of one and the same LI H, and empirical evidence suggests that usually all but one occurrence of an LI can remain unpronounced at the SM-interface. If either one of the occurrences of H is chosen to be unpronounced, then (30) becomes still linearizable, as I assume (see Narita 2007, 2008 for some relevant discussion). It is not unreasonable to assume that there can be language-specific or construction-specific variation in which copy of H to pronounce in such a configuration.[16,17]

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[16]   Alternatively, if not H itself but an LI that H Agrees$_{EF}$ with, say X, is internally merged to the edge in question and Agrees$_{EF}$ with Y 'on H's behalf', then the transitivity of Agree in combination with Agree$_{EF}$(H, X) still derives Agree$_{EF}$(H, Y), letting H qualify as the label.

(i)   [X$_i$ [[$_{YP}$ ...Y...] [H [$_{XP}$ ... X$_i$...]]]]

This derivation is free from the label ambiguity problem that (30) potentially faces. It is not unreasonable to assume that natural languages may differ, under Option B, in which head (H or X) to move to provide the H-label in such a configuration. In these ways, we may be able to provide some independent motivation of Fukui & Takano's (1998, 2000) V/N-movement parameter.

[17]   I would like to point out that (30) is exactly the structure that Zoerner (1995), Oshima & Kotani (2008), and Narita (2009c) propose for coordinate structures (where H is the coordinating particle like *and*). They propose that coordination involves a structure of the form in (i), where the Co(ordinator)-head iteratively move to the edge and project as many times as there are coordinand XPs.

(i)   {Co$_i$, {AP, {Co$_i$, {BP, ... {Co$_i$, {YP, {Co$_i$, ZP}}}...}}}}

I would like to leave these two options (Option A and Option B) open here, since the following discussion is compatible with either of them. They can provide accounts of the cases of externally merged Specs on a case-by-case basis.

2.4. *No Feature-Percolation Necessary*

The discussion above showed that the proposed system can readily derive labeling facts in both cases of Head–Compl merger and Spec–Headed merger, in accordance with the definition of labels in (15) (repeated here).

(15) *The Definition of Labels*

For any SO Σ, an LI H is the label of Σ $=_{def}$ H Agrees$_{EF}$ with the rest of the LIs within Σ.

Note that label as defined here is nothing more than a convenient well-defined shorthand for the LI prominently Agreeing$_{EF}$ with the rest of LIs for a given SO.

So far, we refrained from assuming any copying operation of some LI as a label-designator, as once assumed by Chomsky (1994, 1995) in his formulation of Merge as creating {γ, {α, β}}, where γ is a copy of either α or β (see also Fukui 2006a, 2008, forthcoming). Nor did we assume any 'feature-percolation' mechanism that "projects" features of LIs to some phrasal node/set. To say the very least, our Agree$_{EF}$-based label theory does not need any such 'feature-percolation' mechanism as a necessary part of the theory of syntax. We can informally say that an LI H (say within α) 'labels' or 'projects' in an SO Σ as nothing more than a shorthand for H Agreeing$_{EF}$ with all the LIs contained in Σ, but the word 'label'/'project(ion)' is potentially misleading, since it strongly implies that some 'feature-percolation' carries up ("projects") the features of the head LI to nodes/sets it labels, an unnecessary stipulation that should be avoided unless thoroughly justified by empirical evidence (see Narita 2009a, b for a concrete proposal that 'feature-percolation' can be eliminated in human language; Samuels 2009a makes a similar argument in the domain of phonology). That said, it becomes questionable whether the notion 'label' itself has any significance in syntax, independent of its ingredient Agree$_{EF}$-relations. I will return to this point in due course.

Iteration of copies of Co is proposed by these researchers to capture, among other things, the availability of (optional) multiple pronunciation of the coordinator particle, as in (ii).

(ii)   a. John will criticize [$_{CoP}$ Mary (and/or) Bill (and/or) Sue and/or Tom].
         b. John will [$_{CoP}$ criticize Mary (and/or) praise Bill (and/or) humiliate Sue and/or admire Tom].

As pointed out by Oshima & Kotani, the topmost occurrence of Co can also surface in some languages, too, as in French (*et* A *et* B), Italian (*e* A *e* B), Russian (*mo* A *mo* B), Serbo-Croatian (*i* A *i* B), Japanese (A–*to* B–(*to*), A–*mo* B–*mo*), Godoberi (A–*la* B–*la*), etc.. These considerations further substantiate the plausibility of the syntax of coordinate structures in (i), which I claim to be an instantiation of Option B. See Narita (2009c) for further discussion on how such 'Project Both' structures can be linearized by means of cyclic Transfer.

3.   θ-Criterion in Optimal Labeling

This section discusses what the proposed Agree$_{EF}$-based label theory can tell us about the nature of semantic interpretation at C–I. The claim to be made is that the proposed theory deduces the effects of what has been called the θ-Criterion (Chomsky 1981).

3.1.   *Theta Principle*

Empirical evidence (Koopman & Sportiche 1983, Fukui 1986, Sportiche 1988, Kuroda 1988, Huang 1993) suggests that the PIAH-Conjecture (2), repeated here, holds for human language.

(2)   *PIAH-Conjecture*

If an SO {α, β} is labeled by the label of α, C–I interprets it as α θ-marking β (if α is a predicate category).

The PIAH is a hypothesis that every argument of a predicate category P is base-generated/externally merged within the projection of P. Thus, an internal argument DP of a verb V is base-generated into the complement of V, an external argument DP into the Spec of *v*, and so forth. We assume that (2) holds at C–I, and that syntax is designed to generate labels to serve for a proper interpretation conforming to (2).

However, it should be pointed out that not all labels enter into θ-theoretic predicate–argument relations. For example, consider subject raising to [Spec,TP]. In a simple clause with a transitive verb, like *John loves Mary*, the subject DP *John* is first base-generated at [Spec,*v*P], entering the external θ-role assignment by *v*, and then attracted by T to its Spec due to Case/agreement reasons (the 'EPP' phenomena, whose characterization has been under much controversy). The standard assumption is that T projects at the internal merge of the subject DP to T'. But this T-projection does not enter into a predicate-argument interpretation in any obvious way. Or in general, the labeling at internal Merge does not serve for thematic interpretation, as observed throughout the history of transformational grammar. What this means is that satisfaction of (2) is a sufficient but not a necessary condition for label-projection. Then, the presence of labels in syntax is considered not to be fully justified by the C–I-interface (in particular θ-theoretic) considerations like the PIAH-Conjecture (2), even though it maximally satisfies the label asymmetry condition by SM (3). If that is the case, then labels seem to be a potential candidate for 'imperfection', from the viewpoint of syntax's optimization for C–I, which is assumed to be prior to the secondary optimization for SM-interface conditions (Chomsky 2007a, 2008).

However, the discussion in section 2.3.2 showed that the labeling in the internal Merge cases is only derivative, and the structure-preserving projection of H is not triggered by Search$_{EF}$ by H but only derived from the conservativity of Agree over (internal) Merge (22), repeated here.

(22)   *Agree is conservative over internal Merge:*

Copies of the same SO created by internal Merge share the same set of Agree-relations.

By contrast, the Agree$_{EF}$ from a predicate category P (say a verb) to its externally merged argument A (say a DP) is always established by a genuine derivational Search-operation triggered by the EF of P as a probe and targeting that of (the head of) A as a goal. This dichotomy rather suggests the possibility of explaining the partial transparency between labels and predicate-argument relations in a non-stipulative way.

I propose that the *Theta Principle* I suggest in (31) holds at the C–I-interface:

(31)   *Theta Principle*

α Searches$_{EF}$ β in syntax. ⇔ α θ-marks β at C–I.

(31) says that only derivational search of EF, Search$_{EF}$ (a sufficient but not a necessary condition for Agree$_{EF}$) feeds θ-theoretic interpretation. I claim that (31) will exclude labeling of internal Merge from feeding any θ-theoretic interpretation, while still setting a general account of PIAH-effects in a non-stipulative way.

Consider a concrete example, an English sentence *Brutus stabbed Caesar*. Cast in a neo-Davidsonian event semantic representation, the interpretation is something like (32).

(32)   a.   Brutus stabbed Caesar.
       b.   ∃*e*: Past(*e*) & Stab(*e*) & Agent(Brutus, *e*) & Theme(Caesar, *e*)
            (There is an event *e* such that it was in the past, it was a stabbing, its agent was Brutus, and its theme was Caesar.)

The syntactic derivation of this sentence will generate the structure in (33).

(33)
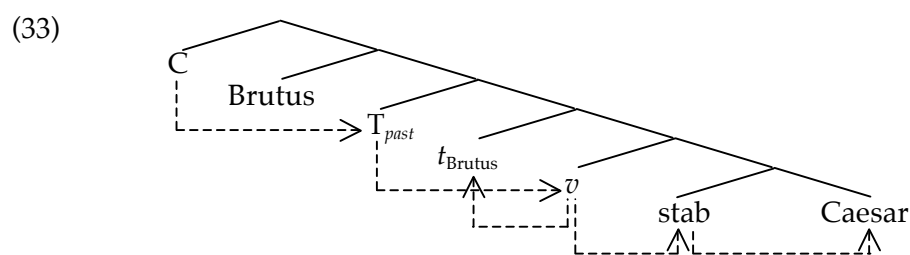
Derivational Search$_{EF}$-operations involved in this example are probings of EFs from *stab* to *Caesar*, from *v* to *stab*, from *v* to *t*$_{Brutus}$, from T to *v*, and from C to T, indicated as arrows in (33). Readers can easily notice that they are all what we need for θ-theoretic relations among LIs: *stab* assigns an internal Theme θ-role to the object *Caesar*, *v* assigns an caused-sub-event status to V (and/or, *v* 'verbalizes' the root *stab*, in terms of Distributed Morphology; see Halle & Marantz 1993, 1994 among others), and it also assigns an external Agent θ-role to (an occurrence of) *Brutus*, the past tense (T) is predicated of *v*, and C (finiteness, assertion of 'truth',

etc., which result in existential closure of an event variable) of T. These Search$_{EF}$-operations inductively result in the Agree$_{EF}$-relations necessary for appropriate labeling, but note that labels have no θ-theoretic effects at C–I in themselves, according to the Theta Principle (31). In general, the PIAH-Conjecture becomes a corollary of the Theta Principle. Call this Corollary 2:

(34) *Corollary 2*

    If the label of α θ-marks the label of β in the configuration {α, β}, the label of α necessarily projects (Chomsky 1995, 2000).

The Theta Principle (31) states that the label of α θ-marks the label of β at the C–I-interface only if it Searches$_{EF}$, and hence Agrees$_{EF}$ with, the label of β in syntax. As we have seen, the transitivity of Agree leads to the projection of the former by definition (15).

    Chomsky (1995, 2008) among many others observes that for the most part θ-theoretic relations (or the 'Conceptual' aspects of interpretation) are determined by instances of external Merge (cf. *the duality of semantics* in the sense of Chomsky 2004, 2008). This observation is in fact a predicted consequence of the theory presented above. External Merge is a merger of two SOs that have been independent of each other, hence there is no Agree$_{EF}$-dependency between the two Merge-mates. The resultant structure is thus *prima facie* 'labelless', which is problematic from the viewpoint of (at least) the label asymmetry condition by SM (3). Thus at each application of external Merge, some Search$_{EF}$ must be involved in order to provide a label to the Merge-result. This is why external Merge always feeds some θ-theoretic interpretation. By contrast, for internal Merge the label is determined by an already established Agree$_{EF}$-relation, whose (perhaps only) function is to provide asymmetric labels for SM-linearization. Thus, if there is really a one-to-one correspondence between Search$_{EF}$ and θ-marking as stated in (31), the primacy of external Merge for θ-theoretic interpretation is in fact a natural consequence of the inner workings of the proposed Agree-mechanisms.

    Thus, if we assume that the label asymmetry condition (3) requires each node/set within a given SO be unambiguously labeled, what we obtain from (31) is the following set of corollaries:

(35) *Corollary 3*

    External Merge always feeds θ-role assignment.[18]

(36) *Corollary 4* (to be strengthened)

    Internal Merge of α to β, leaving the original occurrence of α within β, *need not* feed any θ-role assignment by (the label of) β to α.

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18 External merger of expletives like *there* in English seems to be an apparent counter-example to Corollary 3, since it does not feed any obvious θ-theoretic interpretation at C–I. However, the problem is not so much lack of θ-theoretic interpretation as lack of *any* interpretation of expletives themselves. I propose that what is special about expletives is not that external merger fails to assign a θ-role to them but that their 'zero' lexical semantics consequently nullifies θ-roles assigned to them, hence they are still not counterexamples to Corollary 4.

The primacy of external Merge for θ-theoretic interpretation can be seen as a consequence of these corollaries, a welcome result of the proposed system of labeling (cf. the duality of semantics).

3.2. Economy and θ-Theory

In the preceding discussion, I outlined how the proposed theory can be connected to considerations on C–I-interpretation. Taking the PIAH-facts as a clue, I proposed that Search of EFs from α to β is in one-to-one correspondence with the predicate-argument asymmetry between α and β at C–I. So far, I have largely refrained from discussing the potential overgeneralization possibly resulting from the proposed system. For example, if EFs are ubiquitous, appearing on all LIs, and $Search_{EF}$ alone can trigger θ-role assignment at C–I, then what prevents an LI X from assigning identical θ-roles to more than one element? Or what prevents an LI Y from receiving more than one θ-role? What prevents a θ-role of an LI X from being assigned to an LI Y which is located far from X, while the locality of θ-role assignment is typically restricted to X's 'governing domain'? (See Chomsky 1981, Marantz 1984.) Or what restricts the θ-domain even more locally, excluding, for example, the possibility of 'exceptional θ-marking' comparable to exceptional Case-marking (ECM)? Potential worries are abundant.

My answer to these questions is a minimalist one: It is principles of computational efficiency that crucially restrict modes of $Search_{EF}$ in syntax, and thus of θ-role assignment at C–I. Let me articulate this view.

Minimalist inquiry is guided by the core intuition that human language is the simplest possible computational system whose function is to generate an infinite range of linguistic expressions subject to interpretation by performance systems. Computations by such a system are expected to be optimal, each applying as small a number of operations as possible, and excluding anything unnecessary. Then, we expect that computations in syntax obey an economy constraint like (37):

(37) *Principle of Derivational Economy*

If syntax can generate two convergent derivations D_1 and D_2 for the same interface interpretation from one and the same lexical array, and if D_1 consists of all the derivational steps (operations) contained in D_2 plus some more steps, then the more economical derivation D_2 will block D_1.

Whether (37) requires some global computation (as in Chomsky 1995; see also Fukui 1996) or its effect is restricted to some well-defined computational sub-domains of a given derivation (such as phases; see Chomsky 2000, 2001; see also Collins 1997) is under controversy, an issue that will not concern us here. What is important to the present discussion is that any version of (37) will ensure that (38) holds (either globally or locally within each phase).[19]

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[19] It is proposed by van Riemsdijk (2008) that a third-factor principle that tends to avoid a consecutive sequence of identical elements, what he calls *Identity Avoidance*, is also at work in human language (Swiss relative clauses, OCP effects in SM, etc.; see also N. Richards

(38)   *Corollary of No Redundant Search*

   If $Agree_F(X, Y)$ is established, X can no longer $Search_F$ Y redundantly.

Redundant application of Search between the same probe and goal does not gain any new Agree-relation, and is totally futile from a computational point of view, thus excluded by (37).

   Now I demonstrate that (37) and (38) derive a number of further favorable consequences, answering the questions raised at the beginning of this sub-section.

   First, (38) will let us strengthen Corollary 4 in (36) as:

(39)   *Corollary 4* (strengthened)

   Internal Merge of α to β, leaving the original occurrence of α within β, *cannot* feed any θ-role assignment by (the label of) β to α.

As we have already concluded in (36), any element G moving to the edge of P has already entered $Agree_{EF}(P, G)$, thus no further $Search_{EF}$ is required at internal Merge, at least for asymmetric labeling purposes. Moreover, an already established $Agree_{EF}(P, G)$ precludes P from $Searching_{EF}$ G redundantly, due to (38). Consequently, θ-role assignment from P to G at C–I, which is in one-to-one correspondence with P's $Search_{EF}$ of G, is also precluded.

   Moreover, another corollary of (38) is that θ-marking is always to the head/label of the complement SO, which can be stated as in (40):

(40)   *Corollary 5*

   If an LI H is externally merged with an SO Σ and act as a probe for $Search_{EF}$, H always $Searches_{EF}$ (and hence θ-marks/'s-selects') the label of Σ.[20]

Consider the derivation of (19) again, summarized here as (41).

(41)   a.   Merge(X, Y) → {X, Y}.
       b.   X $Searches_{EF}$ Y. → $Agree_{EF}(X, Y)$ holds, leading to the projection of X.
       c.   Merge(Z, {X, Y}) → {Z, {X, Y}}.
       d.   Z $Searches_{EF}$ X. → $Agree_{EF}(Z, X)$ holds. Given $Agree_{EF}(Z, X)$ and $Agree_{EF}(X, Y)$, the transitivity of Agree (12) derives $Agree_{EF}(Z, Y)$, leading to the projection of Z.
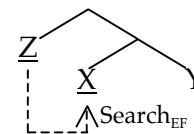
2007, Boeckx 2008: sect. 3.5).

   (i)   *Identity Avoidance* (van Riemsdijk 2008)
         *XX

   (38) can also be seen as another manifestation of Identity Avoidance.
[20]   Note that, according to Option A in section 2.3.3.1, in the case of externally merged Specs as in (27), [Spec,YP] becomes a 'second complement' for the purpose of Agree after Transfer of P's complement XP.

If the derivation reaches the point (41d), Z cannot Search$_{EF}$ Y anymore due to the already established Agree$_{EF}$(Z, Y) and the Corollary of No Redundant Search (38). Moreover, Z cannot Search$_{EF}$ Y at the point of (41c), either. Suppose Z Searches$_{EF}$ Y instead of X at the point of (41c) as in (42d) below:

(42) a. Merge(X, Y) → {X, Y}. (=(41a))
      b. X Searches$_{EF}$ Y. → Agree$_{EF}$(X, Y) holds,
          leading to the projection of X. (=(41b))
      c. Merge(Z, {X, Y}) → {Z, {X, Y}}. (=(41c))
      d. Z Searches$_{EF}$ Y. → Agree$_{EF}$(Z, Y) holds.
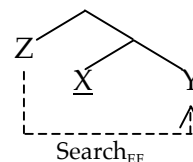
Note that Z still cannot project, given the absence of Agree$_{EF}$(Z, X). Thus, due to the label asymmetry requirement that all SOs be labeled, Z is required anyway to Search$_{EF}$ X in addition. However, this derivation, comprising Z's Search$_{EF}$ of both X and Y is less economical than the one in (41) where Z Searches$_{EF}$ only X but not Y. Thus, the principle of derivational economy (37) ensures that the more economical derivation in (41) wins, blocking the less economical one in (42).

This illustration shows that at any external merger of a projecting LI X and a phrase YP labeled by an LI Y, it is always the most economical for X to Search$_{EF}$ Y for the purpose of labeling the Merge-result. Principles of derivational economy rule out any other, less economical derivations. Therefore, any externally merged LI is forced to Search the EF of the label/head of its sister/complement. Hence Corollary 5 holds.

Once Corollary 5 is established, we can further derive (without any further stipulation) Corollary 6 (43), a canonical observation that at least goes back to Chomsky (1986).

(43) *Corollary 6*

      There is no 'exceptional θ-marking'. (An LI H cannot Search$_{EF}$/θ-mark into the Spec of its complement.)

Furthermore, insofar as we keep away from the possibility of sideward movement (Nunes 2001, 2004; see fn. 21), we also achieve Corollary 7.

(44) *Corollary 7*

      No LI can be θ-marked by two distinct LIs.

Suppose an LI A (say the label of AP) receives a θ-role from P. Then, it follows from the Theta Principle (31) that P Searches$_{EF}$ A at some point of the derivation. Given Corollary 5 (40) that Search$_{EF}$/θ-marking is always to the head/label of the complement, it must be the case that P takes AP as its complement (that is, P is externally merged with AP). In order for a distinct LI Q to assign its θ-role to A, then AP must also be in Q's complement, too, but this is impossible: internal Merge of A(P) to the edge of some SO Σ must yield a set, namely {A(P), Σ}. A(P)'s sister will be always a phrase Σ, which can never be Q, an LI. Thus, there can be no LI Q distinct from P that can take AP as its complement, Searching$_{EF}$/θ-

marking A.[21]

Consequently, we now have an explanation for the observation that θ-role assignment is indeed an interpretive phenomenon tied to external Merge. Another important consequence is that there is no 'movement into θ-position' (and hence control cannot be reduced to movement; see Brody 1999, 2002, Culicover & Jackendoff 2001, Landau 2003 for the latter point).[22] If there is really any instance of θ-role assignment by a predicate category P to a moved category G (or its head) which P already Agrees$_{EF}$ with, as sometimes claimed to be possible by not a small number of researchers (Bošković & Takahashi 1998, Hornstein 1998, 1999, 2001, Boeckx & Hornstein 2003, 2004), then my proposal fails, and it becomes a curious question why in these cases such a 'redundant' Search$_{EF}$ is allowed to be applied, violating otherwise natural principles of computational efficiency (37)/(38). Crucially, note that in our theory 'movement into θ-position' is banned (Corollary 4 (39)) exactly for the same reason why the 'exceptional θ-marking' is absent (Corollary 6 (43)), why θ-marking/s-selection is always to the complement head (Corollary 5 (40)), why external Merge but not internal Merge always feeds some predicate-argument structure (Corollary 3 (35)), and why the effects of duality of semantics hold at all. Therefore, any advocates for 'movement into θ-position' who wish to deny Corollary 4 (39) or Corollary 7 (44) must carry a heavy burden of proof for their selective disapproval of the proposed system.

What we can conclude from the discussion is that principles of computational economy severely constrains the possible mode of Search$_{EF}$, and hence that of θ-marking.[23] The theory, when tied with the Theta Principle (31), makes a number of strong (and apparently correct) predictions about the possible range of θ-theoretic interpretations at C–I, which as a whole constitute the effects of what has been called the *θ-Criterion*. We find it of particular significance that our theory essentially deduces the θ-Criterion as a corollary of principles of computational efficiency, maximally conforming to the SMT. Several important ramifications of the proposal are to be discussed in the next section.

4.   Reverse-Engineering Interfaces

The minimalist program is a pursuit of *principled explanation* of language, which attributes the properties of syntax to computational optimization principles and interface conditions that language must meet to be usable at all (see Chomsky 2008; see also Narita 2009d). What we discussed in the previous discussion was a

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[21]   As noted above, this discussion leaves open the possibility of an LI Q Searching$_{EF}$/θ-marking the label of its complement AP that is introduced there by sideward movement (Nunes 2001, 2004), if such an instance of Merge is allowed in syntax.

[22]   Again with a possible exception of sideward movement cases. See fn. 21.

[23]   As Juan Uriagereka (p.c.) points out, it is as if syntax can calculate all the possible paths for Agree/Search in a given derivation and choose the path contains the least derivational steps, a situation quite reminiscent of Hamilton's Principle in physics, according to which nature (light, motion, etc.) chooses the path which requires the least effort. See Fukui (1996) for a nice summary of minimization principles in various sciences potentially relevant to biolinguistics.

hypothesis as to how syntax satisfies the constraints it obeys via Agree$_{EF}$. Now we would expect that this study would let us know more about the nature of some such constraints.

4.1. Full Interpretation of Syntactic Derivations

The Theta Principle (31) says that C–I interprets Search$_{EF}$, the essential trigger for the labeling effects, as the one-to-one instruction for θ-marking.

(31)   *Theta Principle*

α Searches$_{EF}$ β in syntax. ⇔ α θ-marks β at C–I.

It is "as if syntax carved the path interpretation must blindly follow" (Uriagereka 1999: 275, 2002: 64, Hinzen 2006: 250, Chomsky 2007a: 15).

     Note that according to the current proposal, Search$_{EF}$, the θ-marking indicator, is itself a strictly derivational operation, hence *not part of linguistic representations* in any sense. There is evidence supporting this important consequence of our theory: Uriagereka & Pietroski (2002) observe that no known languages have formatives that exactly corresponds to neo-Davidsonian θ-predicates like Theme, Agent, and so on. They write:

> We find it significant that no language we know of has lexical items synonymous with the (meta-language) expressions 'Theme', 'Agent', 'Benefactive', and so on. One can say that there was a boiling *of* the water *by* John; but 'of' and 'by' do not *mean* what 'Theme' and 'Agent' mean. This is of interest. Languages have words for tense, force indicators, all sorts of arcane quantifications and many others. Yet they do not lexically represent what seems to be a central part of their vocabulary. […] We think this sort of fact reveals a simple truth. *θ-roles are not part of the object-language*.
>
> <div align="right">(Uriagereka & Pietroski 2002: 278)</div>

Our Theta Principle can make perfectly good sense of their important observation, thus render it as its supporting evidence: θ-marking emerges solely as a result of Search$_{EF}$, a purely syntax-internal, strictly derivational operation, not a representation, hence there are no representational counterparts of θ-roles in the humanly possible Lexicon.

     The hypothesis that the C–I-interface can actually 'see' the purely syntax-internal derivations, such as Search$_{EF}$, is a non-trivial claim. This hypothesis is quite congenial to Epstein & Seely's (2002) proposal (extended to some degree) that syntax interfaces with C–I and SM at each and every application of rules in syntax, or it is as if Transfer (the interfacing operation) is 'buried in' syntactic rules themselves.[24]

     It is important in this context to note that Pietroski (2005, 2007, 2008, to appear) makes a very interesting hypothesis on the syntax/C–I-interface, what he calls *Predicate Conjunctivism*. Briefly put, its claims can be summarized as follows

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[24]   Epstein & Seely's (2002) original claim was only that Spell-Out, a 'SM-branch' of the Transfer which stripes off SOs to the SM-interface, is buried in each application of Search/Agree.

(45)   *Predicate Conjunctivism* (Pietroski 2005, 2007, 2008, to appear)
   a.   Each LI is an atomic *monadic predicate*.
   b.   Merge signifies *conjunction* of predicates ('&') at C–I.
   c.   Each SO of the form {α, β} is a monadic predicate of a complex sort, whose meaning is determined by conjoining the monadic predications α and β.

According to this view, each LI is a monadic predicate that constitutes an instruction for the C–I system to fetch a corresponding atomic concept. For example, *red* fetches an atomic concept RED and *ball* fetches an atomic concept BALL, each of which can be used as a monadic predicate, being predicated of something. Similarly, a phrasal Merge-composite *red ball* just means a composite concept that can be used as a monadic predicate satisfiable by something both red and ball. Here, Merge signifies conjunction ('&') of two monadic predicates (RED and BALL).

   Returning to our previous example *Brutus stabbed Caesar* (32), repeated here as (46) with its structure and interpretation, we see how nicely the target event-semantic interpretation can be derived by recursive application of predicate conjunction *á la* Merge and θ-marking *á la* Search$_{EF}$.

(46)   a.   Brutus stabbed Caesar.
       b.   ∃e: Past(e) & Stab(e) & Agent(Brutus, e) & Theme(Caesar, e)
             (There is an event e such that it was in the past, it was a stabbing, its agent was Brutus, and its theme was Caesar.)
       c.
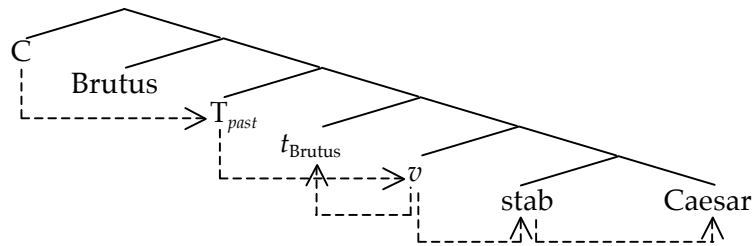
Indeed, if syntax utilizes Merge as the sole structure building operation, it is natural to expect that this single operation corresponds to the sole semantic interpretation rule, given that syntax is optimized for C–I insofar as the SMT holds. As Merge is symmetric, this semantic rule is expected to be a symmetric one, too, thus predicate conjunction as proposed by Pietroski is really a good (arguably the best) candidate. Further, θ-marking, an asymmetric relation which is now claimed to have a one-to-one correspondent in syntax (Search$_{EF}$), can alter the argument nPs to monadic predicates that can then be conjoined with the higher event predicates by predicate conjunction. Further addition of adjuncts, concatenated with SOs without involving θ-marking (see Chametzky 2000, Hornstein & Nunes 2008) will just signify simplistic conjunction, as predicted by Predicate Conjunctivism.[25]

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[25]   A common assumption is that adjuncts are SOs that do not receive any θ-roles. If such a standard view is on the right track, then our Theta Principle (31) predicts that no Search$_{EF}$ is

(47) a.   Brutus stabbed Caesar **quickly**.
      b.   ∃*e*: Past(*e*) & Stab(*e*) & Agent(Brutus, *e*) & Theme(Caesar, *e*) &
             Quick(*e*)
             (There is an event *e* such that it was in the past, it was a stabbing, its
             agent was Brutus, its theme was Caesar, and it was quick.)

(48) a.   Brutus stabbed Caesar quickly **with a knife**.
      b.   ∃*e*: Past(*e*) & Stab(*e*) & Agent(Brutus, *e*) & Theme(Caesar, *e*) &
             Quick(*e*) & **With-a-Knife**(e).[26]
             (There is an event *e* such that it was in the past, it was a stabbing, its
             agent was Brutus, its theme was Caesar, it was quick, and it was with
             a knife.)

These observations point to the conclusion that Merge transparently carves the
path for predicate conjunction at C–I, with the help of θ-marking, carved by
Search$_{EF}$. Combined with the Theta Principle, now we have the following two
fundamental C–I-interpretation rules, each of which strictly corresponds to one
of the fundamental operations in syntax, Merge and Search$_{EF}$.

(49) a.   Merge(α, β) in syntax. ⇔ α(*e*) & β(*e*) at C–I.
      b.   X Searches$_{EF}$ Y in syntax. ⇔ Y(*e*) → θ_X(Y, *e*) at C–I.

It is as if each application of these syntactic operations interfaces with C–I. Or, even
more radically put, it may be that these syntactic operations themselves *are* C–I-
interpretation operations (Merge *is* '&', Search$_{EF}$ *is* θ-marking, etc.).

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involved in cases of adjunct merger. As a consequence, adjoined structures should be
labelless. (See already Hornstein & Nunes 2008, Boeckx 2008 for such a view.) But this con-
sequence seems problematic for our hypothesis that SM (in particular linearization) requires
asymmetric labels (3). If adjoined structures are labelless, SM cannot assign to them linear
ordering based on label asymmetry, thus they would be 'too symmetric' to linearize.
However, if we assume with Chomsky (2004) that adjuncts are introduced by a distingu-
ished *pair-Merge* operation, creating ordered pairs of the form ⟨α, β⟩ (cf. Saito & Fukui 1998).
(In order to distinguish it from pair-Merge/adjunction, Chomsky sometimes uses the term
set-Merge to refer to the ordinary Merge, creating a simple unordered set {α, β}.) Ordered
pairs are intrinsically asymmetric, and pair-Merge straightforwardly weaves the headed/
adjunct asymmetry in the resultant ordered pair. Then, even if adjoined structures might
lack label asymmetry, they still exhibit *pair-Merge* asymmetry. Then, it is not implausible to
assume that phonological operations can utilize this asymmetry, avoiding the linearization
problem raised by the lack of labels. Consequently, it is necessary to slightly revise our ori-
ginal definition of labels (15) as follows:

   (i)   *The Definition of Labels*
          For any SO Σ, an LI H is the label of Σ =$_{def.}$ H Agrees$_{EF}$ with the rest of the LIs *set-
          Merged into* Σ.

Another possible way out is to reanalyze the apparent adjunct-like elements as either a head
or a Spec of some functional category (*the Cartography hypothesis* by Cinque 1999, 2002, Rizzi
2004). In fact, any of the modifier categories can be syntactically analyzed either as a true
adjunct, or a Spec or a head of some abstract functional category. The decision among these
options should be made by biolinguists on a case-by-case basis, I believe.

[26]   More accurately, this conjunct should be regarded as a shorthand for something like
       With(Knife, *e*) or ∃*x*: Knife(*x*) &With(*x*, *e*). See Pietroski (2005) for details.

Once we find that *some* syntactic operations transparently instruct corresponding C–I-interpretations, minimalists want to ask *to what extent* such a transparent syntax/C–I mapping holds. Evidently, the strongest answer would be: "maximally" or "to the fullest extent." This desideratum can be rephrased in terms of an extended version of the principle of Full Interpretation (Chomsky 1986), which can be called *Derivational Full Interpretation* (DFI).

(50)   *Derivational Full Interpretation* (DFI, the strongest version)

Every syntactic operation correlates with a corresponding interpretation at C–I.

This is, arguably, the strongest possible hypothesis regarding the transparency between syntax and C–I. (Can we make any stronger sense of C–I optimization than this? Perhaps not.) Then, we are interested in how close the actual syntax satisfies this desideratum.[27]

Potential counterexamples are abundant. Interestingly, most of them come from various 'virus-checking' proposed in the vast literature. The clearest example is Search with respect to φ-features: It is predominantly assumed that the functional categories v^* (or V) and T (or C) are associated with 'viral' unvalued φ-features that are forced to $Search_φ$ their matching goal D(P)s within their c-command search domain.[28] In general, φ-feature-checking do not feed any obvious C–I-interpretation, and are hence potential counterexamples to our desideratum (50). The same holds for many other virus checking Search-operations proposed in the past literature.

However, it should be noted in this context that, without stipulation, there is no obvious conceptual necessity for a perfect 'sound'-'meaning' linking system like human language (insofar as the SMT holds) to employ anything like 'viral' uninterpretable features such as φ-features and corresponding valuation operations that check them off. Thus, the existence of viruses is an apparent 'imperfection' of human language, hence a potential SMT-killer. This worry in fact goes back to at least as early as Fukui & Speas (1986), who first expressed the hypothesis that viruses on functional categories can be parametrically absent in some I-languages, suggesting Japanese as one of the clearest instantiations of "no virus"-type languages. See especially Fukui's subsequent works (1986, 1988, 2006a, 2008, and papers collected in 2006b) for the apparently plausible and "rarely challenged"[29] hypothesis that Japanese lacks any viruses in its Lexicon (see also Kuroda 1988, 1992, Hoji 2003). Just consider numerous facts attested in this language, such as the lack of morphological subject-verb agreement, the lack of determiners, the lack of singular/plural morphological distinction on nominal inflection and hence the generic 'mass'-like characters of nouns, the lack of real

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[27]   It would also be a desired ingredient of Uriagereka's (2008) *co-linearity thesis*. See also Narita (2009d) for discussion.

[28]   It does not matter whether the viral φ-features of T are inherited from C or those of v^* are inherited by V, as proposed by Chomsky (2007a: 2008).

[29]   "Rarely challenged," not really because there exist a number of serious counterargument against it, but rather because it is quite descriptively convenient to postulate such viruses. See Narita (in press) for discussion.

pronouns and anaphors, the lack of expletives, the possibility of multiple Specs (the lack of the 'one-Spec-per-one-head' constraint), the lack of WH-movement (WH-in-situ), the existence of optional scrambling, multiple nominatives, multiple genitives, all of which point to the need of reconsidering the universalist conception of viral features ($u\varphi$, uWH, etc.), which is now seen as both conceptually and empirically unfavorable. See Narita (in press) for discussion.[30]

Chomsky (1995: chap. 4) once tried to explain the existence of viruses in syntax by stipulating that such viruses are there to be used as the actual triggers of dislocation operations (Move, Attract, internal Merge) ubiquitous in natural languages. This proposal has numerous followers in the field. However, once we emancipate ourselves from such a stipulation and instead assume with Chomsky (2008: 140) that undeletable EFs of LIs allow internal Merge to apply (as) freely (as external Merge), we cannot blame dislocation for the source of viruses anymore.

Thus, if 'virus checking' (such as φ-feature agreement) is really a syntactic operation, as standardly assumed, then our strongest possible conception of Full Interpretation (50) immediately fails, yielding an apparent departure from the SMT. Logically speaking, then, we should drop either (i) the assumption that (50) is a viable hypothesis, *or* (ii) the assumption that virus checking is a syntactic operation.

As for the first possibility, Indeed, DFI (50) is very easy to withdraw (only the SMT favors (50)), but minimalists want to keep to it as close as possible, keeping the departure from the SMT minimal. Recall the hypothesis that syntax is (secondarily) optimized for SM-purposes, too (see section 4.2). Then, it might be that such virus checking operations, although semantically uninterpretable, actually serves for SM-optimization in some sense. Recall further that virtually all the virus checking operations proposed in the literature are provided with some manifestation of morphological agreement as their evidence. Then, such valuations apparently have some morpho-phonological consequences. Then, we might be able to keep a weaker version of DFI, allowing syntax to serve not only for C–I-interpretations but also for some SM interpretations, too.

(51) *Derivational Full Interpretation* (DFI, a weaker version)

Every syntactic operation correlates with a corresponding interpretation either at C–I or at SM.

There is still a strong sense in which (51) conforms to the SMT, given that language must satisfy both SM and C–I usability conditions. As is to be discussed at length below in section 4.2, externalization at SM might be quite a complex task, which may require a lot of 'computational tricks'. Then it is reasonable enough to suppose that there can be some syntactic operations which are responsible mainly for SM-purposes, such as realization of agreement morphology: for example, Agree$_\varphi$. Then a revised, second best hypothesis of DFI (51) might still be a tenable constituent of optimal syntax, while allowing virus valuation to be syntactic operations.

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[30]   See also Chandra (2007) and Hornstein (2009).

What is more interesting is to pursue the second possibility, namely to keep the strongest DFI in (50) as such and rather abandon the assumption that morphological agreement/valuation (such as what is called Agree$_\varphi$/Search$_\varphi$) itself is an independent syntactic operation. For example, we might want to entertain the hypothesis that morphological virus-checking is in fact a post-syntactic, morpho-phonological manipulation. See, for example, Bobaljik (2008) for a quite relevant argument for the view that morphological φ-feature valuation is a post-syntactic morpho-phonological operation. Or, Chomsky's (2007a, 2008) recent proposal that Agree/Search is derivationally simultaneous with Transfer might be quite relevant (see also Hiraiwa 2005 and Boeckx, to appear). According to this hypothesis, all the virus valuation operations take place at the phase level, with a designated phase head LI constituting the sole computational locus of them. Among these synchronized operations is the interfacing operation Transfer, sending off the phase-interior domain (the complement of the phase head) to the C–I- and SM-interfaces. The phase head manipulates the phasal syntactic representation as much as needed (maybe by inheriting its viruses to the next lower non-phase head LI; see Chomsky 2007a, M. Richards 2007) in order to attain successful valuations for viruses at Transfer. In this hypothesis, then, in a certain sense, virus valuation really is *just a part of the Transferring operation*: Transfer assigns whatever value is available to the unvalued features within the phase-interior domain, maybe in accordance with some heuristic locality constraints like relativized minimality, without invoking valuations as *operations* independent of Transfer itself. Interfacing (for which Transfer is claimed to be responsible) is virtually conceptually necessary (that's the whole function of syntax to begin with), thus if valuation to unvalued features can be reduced to this kind of 'repair strategy' at Transfer, then it might still be possible to keep the strongest possible formulation of DFI (50) as such, maximally conforming to the SMT.[31] Note that even in this line of approach, Search$_{EF}$/θ-marking should be necessarily a syntactic operation. Then, the second hypothesis sketched here amounts to the reformulation of syntactic Search-operations as primarily responsible for carving C–I-interpretations (such as θ-marking), while removing most of its alleged responsibility for virus checking.

It is customary to assume that it is the principle of Full Interpretation in the rather traditional, representational form (Chomsky 1986 et seq.; M. Richards 2007) that categorically resists uninterpretable/unvalued features remaining at the C–I (and SM) interface, and thus necessitates virus-checking (deletion of uninterpretable features) as syntax-internal operations. The representational version of Full Interpretation can be stated as (52):

(52) *Representational Full Interpretation* (RFI; cf. Chomsky 1995: 194)

SOs that are subjected to interpretation must be constituted entirely of interface-legitimate objects (which crucially excludes unvalued/uninterpretable features).

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[31] See Boeckx (to appear) for an intriguing suggestion essentially pointing to the effect of this proposal.

Then, in a sense, there is a certain tension between the derivationally revamped Full Interpretation (DFI) in its strongest form (50) and RFI (52), as long as we grant the existence of uninterpretable features (for want of a better explanation of their origins; see Narita (in press) for further discussion). The former does not want any syntactic operation to be responsible for virus-checking, while the latter does. We have seen that we can find a point of compromise by (i) weakening DFI to (51), letting it speak to interpretive effects at SM, or (ii) eliminating virus-checking as an independent syntactic operation.

Only further empirical inquiry can advise us to decide which version of Full Interpretation is on the right track (both DFI (50)/(51) and RFI (52), or just one or the other, or none).[32] Before leaving this discussion, I would like to point out that the rather pervasive *duality of semantics* (Chomsky 2001, 2004, 2008, 2007a) lends further empirical support to DFI (either (50) or (51)). Recall that we adopted Pietroski's Predicate Conjunctivism and claimed that Merge corresponds to conjunction ('&') (see (45)). Given that the principle of derivational economy (37) excludes any superfluous steps in syntactic derivations, we naturally expect that any application of internal Merge is tied to some interpretation beyond conjunction, since the first application of Merge, i.e. external Merge, is enough to instruct that much. Moreover, recall the corollary of our system that internal Merge (in contrast to external Merge) *cannot* feed any θ-marking. If DFI holds and every syntactic operation should correlate with non-trivial interpretation at C–I (or SM), then, the prediction is:

(53)   *Corollary 8*

Internal Merge correlates with interpretation beyond conjunction and θ-marking.

(53) is allied to Chomsky's hypothesis on the duality of semantics, which postulates that the dichotomy of external versus internal Merge correlates with that of 'conceptual'/'deep' versus 'intentional'/'surface' semantics. Chomsky (2001: 34ff.) specifically proposes, building on the insight from Fox (2000) and Reinhart (1997, 2006), that any application of internal Merge (other than those necessary for convergence, e.g., virus-checking) is required to yield 'surface interpretation' *INT*. INT is supposed to include intentional and discoursal effects like scope, topic-comment, old/new information, definiteness and specificity, context-confinement, force, so on so forth, which seems to be characterizable only as 'anything but θ-theoretic interpretation'. Consider further Reinhart's (1997, 2006) and Fox's (2000: 75) argument that (optional) application of QR must result in scope shifting of quantificational expressions. Given that QR is an instance of

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[32]   One might argue that scrambling of the Japanese sort constitutes counterevidence to the stronger DFI (50) (though not to the weaker one (51)), given that this operation is often claimed to be 'semantically vacuous' (though phonologically not) in many cases (see Saito 1989 among others; see also Fukui & Kasai 2004). However, see Kuno (2003) for a view that scrambling in Japanese, though free from any ancillary feature-checking, nevertheless feeds an interpretation (sometimes hard to detect as such) where the root clausal constituent is interpreted as being 'predicated of' (or being 'about') the scrambled constituent (presumably due to the interface economy of the Fox-Reinhart sort, as Kuno argues; see below).

internal Merge that has no phonetic effect, either version of DFI, (50) or (51), predicts that QR must have a non-vacuous interpretive consequence at C–I, along the line with Corollary 8. These results can be readily recaptured as another consequences of the far-reaching derivational syntax-semantics transparency, namely DFI, thus we don't have to postulate an independent condition specific to optional movement anymore, a further simplification of UG.

4.2.   *On the Label Asymmetry Condition*

Given the discussion above, we may want to conclude that the notion 'label' itself is of relatively small significance to the theory of syntax. It is just a well-defined shorthand for an LI prominently Agreeing$_{EF}$ with other LIs (definition (15) is repeated here).

(15)   *The Definition of Labels*

For any SO Σ, an LI H is the label of Σ $=_{def}$ H Agrees$_{EF}$ with the rest of the LIs within Σ.

Labels themselves have no obvious interpretation at C–I, though they might derivatively constitute convenient instructions to SM-linearization. Only Search$_{EF}$ is proposed to feed interpretation at C–I.

My proposal was partially based on the assumption that the label asymmetry condition at the SM-interface (possibly among others) requires that each node/set within a legitimately interpretable SO be unambiguously labeled in order to be linearizable at all, (3) repeated here.

(3)   *Label Asymmetry Condition*

SM-linearization works properly for a syntactic node/set only if one and only one label is defined for that node/set.

And I worked out how syntax computes derivations conforming to this constraint, crucially excluding labelless structures and ambiguously labeled (Project Both) structures. Readers can readily interpret this hypothesis in *teleological/functional* terms: the SM-interface for some yet poorly understood reason came to have such constraints as (3) largely independently of syntax, and syntax is essentially made to serve to provide only expressions conforming to them. In this view, the properties of syntax are explained essentially as a *function of interface constraints*. Note that the very reason why human SM happened to adopt such linguistic particulars as the label asymmetry condition (3) remains unaccounted for. For further inquiry, if it is ever possible, much evidence seems to be required to be drawn from what we call comparative ethology (Hauser *et al.* 2002, Fitch *et al.* 2005).

I am happy to leave the possibility of this sort of reasoning, as it might actually turn out to be correct. But in addition to this, I would like to add that another non-teleological/non-functional explanation of the label asymmetry requirement is readily available, too. Let me briefly sketch this alternative below.

Chomsky (2007b: 17) suggests that "language evolved, and is designed, primarily as an instrument of thought, with externalization [satisfying SM conditions] a secondary process." Assume that much is on the right track. Then, it is not unreasonable to assume that, insofar as there is no need to externalize them, syntax can freely feed linguistic expressions to the C–I system, without bothering to serve for SM conditions, the label asymmetry condition being among them. Then, such 'language of thought' will entertain an infinite range of symbolic thoughts, some of which might be unexternalizable and hence usable only when confined to the C–I domain, for example, symbolic expressions that leads to ambiguously labeled structures[33] or labelless structures. Derivations of such expressions that would 'sound crazy' if sent to SM may contain LIs being multiply θ-marked, LIs θ-marking multiple LIs, LIs θ-marking each other, LIs θ-marking themselves, Ds θ-marking Vs, Ps θ-marking Ts, Ns without morphological case, Ps specified as first person singular masculine, so on so forth.

In such a view, syntax is really unbounded, infinitely generating structures, whose expressive potentials may well be in many ways far beyond the confinement by SM externalizability conditions. Rather, the phonological system is only "doing the best it can to satisfy the problem it faces: to map to the SM-interface SOs generated by computations that are "well-designed" to satisfy C–I conditions" (Chomsky 2008: 136). Externalization is quite a complex task, required to satisfy a number of modality dependent restrictions such as particulars of vocal tracts, features of auditory and/or visual receptors, the range of motion of gestural muscles, the temporally bounded nature of motion/perception, and so on, which must be largely shared by members of the linguistic community each individual belongs to, for the purpose of more or less successful communication for which there must have been some advantage for SM to be adapted. Among such constraints must be the linearization requirement, namely that structures, generated by syntax in full service of C–I optimization, be mapped to temporal sequences of phones/signs from which the target C–I-interpretations are more or less recoverable. The phonological system does the best it can to meet this, presumably devising various "computational tricks"[34] (Chomsky 1995: 162). The successful phonological system would achieve this task by making use of whatever is readily available in syntactic derivations, a rather likely candidate for which is the set of Agree$_{EF}$-relations, which is generated primarily as a byproduct of Search$_{EF}$ that carves θ-marking at the C–I-interface. Asymmetric labels are correspondingly devisable relatively easily with such

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[33]   Narita (2008) suggests that QR actually creates instances of such primarily unpronounceable ambiguously labeled structures, since a raised QP θ-marks its sister (nuclear scope) as its second argument and hence projects (see Pietroski 2003, 2005 for a neo-Davidsonian analysis of QR semantics; see also Hornstein & Uriagereka 1999, 2002). According to Narita, sentences involving QR are still pronounceable by SM with some tricks, either by pronouncing the lower copy of QP (as in English) or by systematically forgetting one of the ambiguously projected labels (as in Hungarian). If he is right, then some such phonologically problematic structures are still usable in human language, barely satisfying SM-conditions, suggesting the primacy of C–I optimization over SM satisfaction.

[34]   That is, the "features that enable [human language, though designed for elegance, not for use] to be used sufficiently for the purposes of normal life" (Chomsky 1991: 49). See also Fukui (1996) and Ishii (1997) for intriguing discussion in relation to 'discrete optimization problems studied in the field of discrete mathematics/theoretical computer science.

computational tricks as the binary branching constraint on Merge and transitive extension of Agree. So might some label asymmetry-based linearization mechanism(s) be.[35] To the extent that the syntax/C–I mapping is trivial (as the Theta Principle (31) and DFI (50)/(51) suggest), it is conceivable that these are computational tricks primarily in service of SM-optimization matters for the working of externalizable syntax, too.

Thus, there are two pictures presented here as to the relation between syntax and the SM-interface. One sees syntax and its computation as a function of the satisfaction of SM-interface constraints such as the label asymmetry condition (in addition to the C–I constraints). The other sees the relation the other way round, suggesting that the computational properties of syntax in its full service of C–I optimization actually pose a severe constraint on what the 'possible SM-strategies' might be, allowing label asymmetry and others as viable options. The two hypotheses differ in their predictions as to the explanatory burden that syntax can carry. Again, only empirical considerations can eventually advise us on which track is the right one to take. See also Narita (2009d) for some relevant discussion.

5. Concluding Remarks

The current proposal essentially draws a picture that the EF is a key innovation in the evolution of human language. It is this feature which defines the 'computational atoms' for syntax, namely LIs. It is also the EF which allows LIs to be subject to Merge. Further, it can be used as a basis for Search/Agree, which the performance systems can make use of in various ways: C–I utilizes $Search_{EF}$ as the instruction for θ-marking (the Theta Principle (31)), and SM utilizes $Agree_{EF}$ as a necessary component for defining unambiguous labels for each node, feeding phonological linearization. To the extent that this picture has some truth to it, the study of EFs will constitute a major source of insight for future research in the field of comparative ethology (Hauser *et al.* 2002, Fitch *et al.* 2005), addressing the question of what in natural language is distinctively human.

Let us return to the two questions raised at the beginning of this article, (1) and (4). (1) was essentially a methodological, Ockham's razor question:

(1)   Does the theory of human language really need to assume labels/labeling to set an empirically adequate account of the known variety of linguistic phenomena?

We started the whole discussion of the $Agree_{EF}$-based label theory by assuming a moderate *Yes* to (1). In particular, the lack of any empirically successful label-free linearization mechanism in the past led us to make an assumption that phono-

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[35]   This point holds for whatever the correct linearization mechanism might ultimately turn out to be. Note that it is not unreasonable to suppose that all the linearization mechanisms proposed in the past literature (LCA, Kayne 1994), Symmetry Principle (Fukui & Takano 1998), X-bar schema with head-parameter, etc.) might just be one of the several options that human phonological systems can come up with.

logical linearization operations requires asymmetry coded by labels. This investigation reached the definition of labels in (15).

(15) *The Definition of Labels*

For any SO Σ, an LI H is the label of Σ $=_{def}$ H Agrees$_{EF}$ with the rest of the LIs within Σ.

The notion of 'label' here is reduced to just a well-defined shorthand for an LI prominently Agreeing$_{EF}$ with the rest of the LIs in a given SO, nothing more. Since now Agree$_{EF}$-relations generated in syntax can fully derive the effects of labeling, whether the syntax-internal computations really have to refer to labels (instead of Agree$_{EF}$-relations) becomes questionable. It was even hinted that the phonological linearization at the SM-interface might be the sole mechanism in faculty of language ("in the broad sense"; Hauser *et al.* 2002, Fitch *et al.* 2005) that has to refer to labels.[36]

If we can reduce the empirical burden of the notion 'label' along this line of approach, then it constitutes an indirect support for my moderate *No* to the substantial minimalism question in (4).

(4)   Does 'label' count as a virtually conceptually necessary part of human language (an optimal C–I-SM linker, insofar as the SMT holds)?

My *No* was, however, only moderate, since I entertained the possibility that the driving force of labeling, namely Search$_{EF}$, is optimally feeding interpretation (θ-marking) at C–I (the Theta Principle).

(31) *Theta Principle*

α Searches$_{EF}$ β in syntax. ⇔ α θ-marks β at C–I.

I construed the Search$_{EF}$-θ-marking transparency as one instantiation of a more far-reaching principle of (Derivational) Full Interpretation.

(54) *Derivational Full Interpretation* (DFI)

Every syntactic operation correlates with a corresponding interpretation at C–I (or at SM).

To the extent that (54) holds, there is a strong sense in which syntax itself is just a generator of 'language of thought', freely computing symbolic thoughts. Optimality of syntax for C–I would become almost trivial, insofar as syntactic operations *are* C–I-interpretations, and C–I is proposed to be much more interpretive, blindly following the path syntax has carved out (Uriagereka 1999: 275,

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[36] Contra Pinker & Jackendoff's (2005: 212) claim that "major characteristics of phonology are specific to language (or to language and music), [and] uniquely human," Samuels (2009a, 2009b) claims that the formal properties of phonology in human language are entirely explainable in terms of the third factor in language design, principles and properties that are not specific to human language.

2002: 64, Hinzen 2006: 250, Chomsky 2007a: 15; see also Narita 2009d for further discussion on 'naturalization of meaning'). It is only when syntax is used to generate 'pronounceable' objects that the SM externalizability conditions such as linearizability would matter, in which case the calculation of asymmetric labels by means of Agree$_{EF}$-relations might be one of the best available (hence close to optimal) "computational tricks" that the syntax-SM mapping can come up with. Thus, although the notion 'label' itself might not count as a virtually conceptually necessary part of syntax, its availability at the close-to-optimal SM externalization mechanism might be not so mysterious, either. Or, it may eventually turn out to be the case that some 'third factor' principles (Chomsky 2005) actually strongly constrain the optimal C–I-SM linking system to utilize 'label', a readily available *definiendum* of Agree$_{EF}$, for externalization purposes, in which case we may be entitled to withdraw our previous *No* to the question (4).

Much work has to be done, and I hope this article will constitute a modest step toward the minimalist goal of understanding how syntax could be shown to satisfy the SMT.

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