

Derivational Economy in Syntax and Semantics

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Summary

Economy considerations have always played an important role in the generative theory of grammar. They are particularly prominent in the most recent instantiation of this approach, the Minimalist Program, which explores the possibility that Universal Grammar is an optimal way of satisfying requirements that are imposed on the language faculty by the external systems that interface with the language faculty which is also characterized by optimal, computationally efficient design. In this respect, the operations of the computational system that produce linguistic expressions must be optimal in that they must satisfy general considerations of simplicity and efficient design. Simply put, the guiding principles here are do something only if you need to; and if you do need to, do it in the most economical/efficient way. These considerations ban superfluous steps in derivations and superfluous symbols in representations. Under economy guidelines, movement takes place only when there is a need for it (with both syntactic and semantic considerations playing a role here), and when it does take place, it takes place in the most economical way: it is as short as possible and carries as little material as possible. Furthermore, economy is evaluated locally, on the basis of immediately available structure. The locality of syntactic dependencies is also enforced by minimal search and by limiting the number of syntactic objects and the amount of structure that are accessible in the derivation. This is achieved by transferring parts of syntactic structure to the interfaces during the derivation, the transferred parts not being accessible for further syntactic operations.

1. General economy considerations

Economy considerations have always played an important role in the generative theory of grammar. Early on, they took the form of an evaluation metric for selecting grammars from the format permitted for rule systems. The role of economy has changed in the most recent instantiation of this approach, the Minimalist Program (MP), where there is no need for such an evaluation metric due to the restrictiveness of the theory. Still, there has been no decrease in the importance of Economy Principles. In fact, they play a central role in the foundational works of MP (see the chapters of Chomsky 1995).

MP explores the possibility that Universal Grammar, a genetic endowment which helps children acquire language, is an optimal way of satisfying requirements that are imposed on the language faculty by the external systems the language faculty interfaces with and is also characterized by optimal, computationally efficient design. Language consists of a lexicon and a computational system, which is embedded in two performance systems: articulatory-perceptual and conceptual-intentional, with Phonological Form (PF) and Logical Form (LF) interfacing with the performance systems. A derivation converges at the interface levels if it contains only legitimate PF and LF objects. However, defining linguistic expressions simply as pairs (P, L) formed by a convergent derivation and satisfying interface conditions does not suffice; the operations of the computational system that produce linguistic expressions must be optimal in that they must satisfy some general considerations of simplicity and efficient design. These considerations ban superfluous steps in derivations and superfluous symbols in representations, favor short movements over long movements, etc. Simply put, the guiding principles here are do something only if you need to; and if you do need to, do it in the most economical/efficient way.

2. Derivational economy in syntax

Consider first the former, as it applies to movement. It has led to the last resort nature of movement: In line with the leading idea of economy, movement must happen for a reason. One such driving force may be provided by Case. Consider (1).

- (1) Jane is likely *t* to leave

Since the subject position of raising infinitives is not a Case-licensing position, *Jane* cannot be Case-licensed in the position of *t*. Raising to matrix SpecIP, a nominative-licensing position, rectifies its Case inadequacy. Once *Jane* has been Case-licensed, it can no longer undergo A-movement, to a Case or a non-Case position. This follows from Last Resort, if A-movement is driven by Case considerations. *Jane* being Case-licensed in the position of *t* in (2), Last Resort blocks its movement in (2a-b).

- (2) a. *Jane is likely *t* will leave
b. *the belief Jane to be likely *t* will leave

The efforts to identify the precise reason for each movement have led to raising the more general theoretical issue of where the formal inadequacy driving movement lies, in the target (Attract) or the moving element (Greed). Greed was the earliest approach (Chomsky 1993, revived in Bošković 2007 based on considerations of successive-cyclic movement). Under Greed, X can move only if X has a formal inadequacy, and if the movement will help rectify the inadequacy. Under Attract, the target head always triggers movement (Chomsky 1995), which means it always has a formal inadequacy that is rectified by the movement (see also Lasnik 1995 for a combination of these two approaches to Last Resort). Under this approach, movement of *Jane* in (1) is driven by I, which has a property (the EPP) that is satisfied by a DP—this property triggers movement of *Jane*. (*Jane*'s Case-licensing is merely a beneficial side effect of the satisfaction of the target's requirement.) Returning to (2), while the Greed approach easily handles (2), such examples require additional assumptions in the target-driven system. Thus, Chomsky (2000) posits the Activation Condition, where X can move only if X has an uninterpretable feature, i.e. a formal inadequacy (the need to license its Case feature in the case of A-movement). This essentially reintroduces Greed into a system where movement is supposed to be target-driven. However, the target-driven approach has a conceptual advantage in that under this approach the driving force for movement can be satisfied as soon as the relevant element enters the structure, rather than indefinitely later in the derivation, as in the moving-element driven approach. As discussed in Bošković (2011), there are, however, cases of movement that are driven by the properties of moving elements, like quantifier raising (which does not occur because the target of quantifier raising would require an adjoined quantifier, see also section 2) or multiple movements to the same position such as multiple wh-fronting in languages like Bulgarian, where all wh-phrases must move to SpecCP (see below). This in itself suggests that there is something wrong with wh-phrases that do not undergo movement.

Another natural principle of efficient computation that has the same flavor as Last Resort, namely, do nothing if you don't have to, is the Inclusiveness Condition (Chomsky 1995), which confines the power of syntax to (re)arrangements of lexical items, banning syntax from creating new objects. The condition is very appealing conceptually due to its restrictive nature. It has led to elimination of a number of mechanisms from the Government and Binding theory, like traces, indices, and bar-levels, which in turn has led to a new conception of phrase structure (Bare Phrase structure) and the copy theory of movement.

One question regarding Last Resort is whether lexical insertion, i.e. pure Merge, should be subject to Last Resort. Chomsky (1995) suggests it shouldn't be, the reasoning being that if cost were assigned to it, no lexical insertion would ever take place. On the other hand, Chomsky (2000) suggests that pure Merge is subject to Last Resort, with pure merge being driven by selectional requirements. This, however, led to a considerable enrichment of selectional requirements. Bošković (1997) takes a position in between Chomsky (1995) and (2000). A number of authors have proposed economy-of-representation principles intended to ban unnecessary projections (e.g. Law 1991, Safir 1993, Speas 1994, Chomsky 1995, Bošković 1997, Grimshaw 1997). Noticing such principles typically ban only unnecessary functional structure, Bošković (1997) suggest tying them to Last Resort. The suggestion is that only lexical (as opposed to functional) items are present in the numeration, which is defined as an array of lexical items that is mapped by the computational system into a linguistic expression (Chomsky 1995). Assuming that derivations that do not exhaust numerations do not converge, inserting an element from a numeration into the structure is a step toward a well-formed derivation, hence in accordance with Last Resort. Lexicon is then accessed during the derivation only when a certain functional category becomes necessary in structure building (e.g., feature-checking of a feature of a lexical category may require presence of a particular functional category), again in accordance with Last Resort. This makes lexical insertion uniformly subject to Last Resort.¹

Returning to movement, the conception of movement as a last resort operation brings up the question of optionality. Truly optional movements do not fit well with a framework where movement takes place for a reason: in such a framework either there is a reason for a movement to take place, in which case it must take place, or there isn't, in which case it in fact cannot take place, given Last Resort. Everything else being equal we then would not expect to find truly optional movements. In a case like French (3), where wh-movement appears to be optional it must then be the case that everything else is not equal. Consider then the broader French wh-movement/wh-in-situ paradigm in (3)-(5), which can be used to illustrate several issues regarding the minimalist guideline that language is economical.

- (3) a. Tu as vu qui?
 you have seen whom
 'Who did you see?'
 b. Qui as-tu vu?
- (4) a. Pierre a demandé qui tu as vu.
 Pierre has asked whom you have seen
 b. *Pierre a demandé tu as vu qui.
- (5) a. Qui que tu as vu?
 whom C you have seen
 'Who did you see?'
 b. *Que tu as vu qui?

Bošković (1998) provides an analysis of (3) where everything is indeed not equal in (3) and where (3a) and (3b) do not merely differ in an optional application of a single movement operation. Traditionally, it has been assumed that lexical insertion can only take place in overt syntax, otherwise the sound-meaning relation would collapse. Chomsky (1995) proposes a deduction of this assumption from Full Interpretation: Suppose a lexical item like *John* is inserted in LF. The derivation would then crash due to the presence of phonological features of

¹ The tacit assumption here is that numeration-formation itself is costless. This is natural; numerations, which are comprised of lexical categories, determine what we want or choose to say, which is not determined by the computational mechanism of the human language.

John, which LF cannot interpret. On the other hand, if *John* is inserted in PF, PF will not be able to interpret the semantic features of *John*. The only way for the derivation to proceed is to insert *John* before spell-out: PF then strips off the phonological features of *John*, with the semantic features of *John* proceeding into LF. This analysis allows LF insertion of lexical items, as long as they are phonologically null and the insertion occurs at the top of the tree, to satisfy the cycle. Bošković (1998) argues for an LF C-insertion analysis of French wh-in-situ. Wh-in-situ is in fact possible in French only in the contexts where LF insertion is in principle possible, namely, when the C is phonologically null and located at the top of the tree. (This is the case in (3) but not in (4)-(5). Not all dialects of French allow overt C examples like (5a).) Under this analysis, (3a) and (3b) do not merely differ in an optional application of wh-movement. In fact, the paradigm in (3)-(5) indicates that we cannot simply assume that French interrogative C optionally triggers wh-movement. If that were the case, we would not be able to enforce the +wh-movement option in (4) and (5). Bošković (1998) then argues that French interrogative C requires wh-movement. The difference between (3a) and (3b) is in the timing of C-insertion. In both cases, the C triggers wh-movement immediately upon its insertion (note French wh-in-situ shows locality-of-movement effects): however, the C is inserted overtly in (3a), hence it triggers overt wh-movement, and it is inserted covertly in (3b), hence it triggers covert wh-movement here. (4b) and (5b) are ruled out because the LF C-insertion derivation is blocked for independent reasons (in (4b) because the C is overt and in (5b) because of the cycle, i.e. because it does not take place at the top of the structure). The above discussion illustrates what one would expect to find in the cases involving seemingly optional movements: not everything is equal in the movement and non-movement options.

The French data in question also show that economy should be evaluated locally, without look-ahead. Chomsky (1995) argues that covert movement is more economical than overt movement, hence should be preferred to overt movement when both are in principle possible. The reason here concerns the general economy requirement to carry as little material as possible under movement. The underlying assumption is that movement takes place in order to license formal features. Given the requirement to carry as little material as possible under movement, we may then expect movement to affect only formal features that need licensing. Such movement would, however, cause a problem in PF under the assumption that scattered lexical items, where parts of a lexical item are located in different places due to feature movement, cannot be pronounced in PF. Overt movement then has to carry full lexical items for PF reasons. On the other hand, in LF, where the considerations of pronunciation do not apply, movement of parts of lexical items, i.e. only the relevant features, is in principle possible hence forced by the economy requirement to carry as little material as possible under movement. LF movement is then favored to overt movement (when both are in principle possible) by the economy requirement to carry as little material as possible under movement, which deduces the Procrastinate principle of Chomsky (1993) (for further discussion of the requirement, which minimizes pied-piping, see Stateva 2002 and Bošković 2004; the latter applies it to quantifier float, arguing that quantifier float is obligatory due to the requirement in question whenever it is possible, the cases where it is not possible involving a different structure which disallows quantifier float).

Returning to French wh-in-situ, given these considerations, the LF C-insertion derivation should be more economical than the overt C-insertion derivation, since it triggers covert wh-movement, which is more economical than overt wh-movement. It seems then that (3a), the LF C-insertion derivation, should block (3b), the overt C-insertion derivation. However, this is the case only if look-ahead is allowed. C-insertion itself works in exactly the same way whether it is covert or overt; there is no reason to prefer one of the two options. It is true that later down the road one of these operations will lead to a more economical movement. However, if economy considerations must be evaluated locally, without look-ahead, rather than globally, with look-ahead, we get exactly the right outcome, allowing both (3a) and (3b). The data under

consideration thus favor local over global economy, as one would expect from a system with efficient design. In fact, Collins (1997) argues for a conception of economy where economy is quite generally evaluated locally based only on immediately available structure and syntactic objects within a derivation; this conception excludes comparison of different derivations or look-ahead within a single derivation when it comes to economy considerations.

The guidelines of local economy have played a prominent role in syntactic theorizing within MP, even regarding fundamental questions like the nature of the interaction with the interfaces. MP assumes that the syntactic computation is driven by the need to eliminate from the computation objects that are illegitimate at the interfaces, since the interfaces cannot deal with them. The exact implementation of the need has taken various forms, from syntactic operations (like movement) taking place to eliminate features that would not be interpretable at the interfaces to movement taking place to make labeling of syntactic structure possible, under the assumption that labels are needed for interpretation (Chomsky 2013). In this context, Epstein et al (1998) raise an important question which is relevant to the issue of look-ahead, discussed above: how can a syntactic operation at some intermediate point of the derivation be driven by the notion of legitimacy at the interfaces if these interfaces access only the final PF and LF representations? Both GB and early Minimalism assumed that there is a single point of spell-out, where the derivation separates into the phonology and the semantics branch. A number of authors (e.g. Uriagereka 1999, Epstein 1999, Epstein et al 1998, Chomsky 2000, 2001) have, however, argued that spell-out may apply multiple times, arguing for a radically derivational nature of the computation where the interfaces access syntactic computations as the derivation proceeds without the mediation of PF and LF levels of representation. Syntactic derivation itself plays the central role in this approach, as there are no real levels of representation. This approach alleviates the look ahead problem regarding syntactic operations being driven by the notion of legitimacy at the interfaces since in the derivational multiple spell-out model the interfaces interface with the syntax throughout the syntactic derivation.

As noted above, when it comes to economy of derivation considerations within MP, the guiding principles are do something only if you need to; and if you do need to, do it in the most economical/efficient way. The former has resulted in the last resort nature of movement, with the Inclusiveness Condition also having this flavor. The above discussion has also noted one instantiation of the latter: movement carries as little material as possible. We now turn to another illustration of the economy effect on movement where when movement does take place, it must take place in the most efficient way. In particular, it is as short as possible.² The effect is illustrated by traditional superiority effects, which provide a rather strong confirmation of the idea of economy in language. Consider (6), whose structure prior to wh-movement is given in (7).

- (6) a. Who did you tell that she should buy what?
b. ?*What did you tell who that she should buy?
- (7) You tell who that she should buy what

The GB account of the (6) was based on Chomsky's (1973) Superiority Condition (see (8)), which says that if X and Y are candidates for a particular movement operation, and X asymmetrically c-commands Y, then X rather than Y undergoes the movement in question: *Who* is superior to *what* in (7), hence (8) requires that *who* undergoes wh-movement in (6) (there are many accounts of the Superiority Condition as well as attempts to reduce it to independently

² It is worth noting here that Fukui (1996) observes a number of cases involving the same notion of economy in physics and combinatorial mathematics.

motivated principles; see, e.g., Cheng and Demirdash 1990, Hornstein 1995, Kayne 1984, Lasnik and Saito 1992, Pesetsky 1982, Watanabe 1992).

- (8) No rule can involve X, Y in the structure ..X...[...Z...WYV...] where the rule applies ambiguously to Z and Y, and Z is superior to Y. The category A is superior to the category B if every major category dominating A dominates B as well but not conversely.

In MP, Superiority effects follow from general considerations of economy of derivation; in fact, they provide perhaps the most straightforward illustration of economy of derivation, which requires that every movement requirement be satisfied through the shortest movement possible. English interrogative C requires its Spec position to be filled by a *wh*-phrase, however this requirement is to be implemented. In (7), the requirement can be satisfied by moving either *who* or *what*. Since the former results in shorter movement, (6a) is preferred to (6b). (6b) is thus ruled out because the formal inadequacy of the interrogative C has not been satisfied in the most economical way, i.e. through the shortest movement possible.

The economy account is simpler hence conceptually preferable to the account based on (8). There are also empirical reasons that favor the economy account. Consider the following Bulgarian multiple *wh*-fronting (MWF) data.

- (9) a. *Koj e vidjal kogo?
 who is seen whom
 b. Koj kogo e vidjal?
 'Who saw whom?'
(10) a. Kogo kakvo e pital Ivan?
 whom what is asked Ivan
 'Whom did Ivan ask what?'
 b. ?*Kakvo kogo e pital Ivan?

All *wh*-phrases move to SpecCP in Bulgarian MWF. The *wh*-phrase that is highest prior to *wh*-movement (the subject in (9) and the indirect object in (10)) must be first in the linear order. This has been analyzed as a Superiority effect, which means the highest *wh*-phrase moves first, the second *wh*-phrase either right-adjoins to the first *wh*-phrase (Rudin 1988), or moves to a lower SpecCP (Richards 2001). As discussed in Bošković (1999), like English +*wh*-C, Bulgarian +*wh*-C requires movement to its Spec. Additionally, there is a focusing requirement on *wh*-phrases, which is also satisfied by moving *wh*-phrases to SpecCP. Consider now constructions involving three *wh*-phrases. Assuming that the *wh*-phrase that moves first to SpecCP satisfies the requirement of the interrogative C to have a filled SpecCP, the *wh*-phrase that is highest prior to *wh*-movement must move first to SpecCP; this way the formal inadequacy in question is satisfied in the most economical way. The other *wh*-phrases then move to SpecCP to satisfy their focusing requirements. Whichever order the *wh*-phrases move in, the requirements are satisfied through the movements of the same length, i.e. they cross the same maximal projections. We would then expect that the highest *wh*-phrase will move first, and then the other two *wh*-phrases can move in any order. As discussed in Bošković (1999), the prediction is borne out: the highest *wh*-phrase must move first (hence is first in the linear order), the order of the second and the third *wh*-phrase is free. Thus, while the dative must move before (and precede) the accusative in (10), this is not the case in (11), where their order of movement is free. (Note the subject must be first.)

- (11) a. Koj kogo kakvo e pital?
 who whom what is asked
 'Who asked whom what?'

b. Koj kakvo kogo e pital?

On the other hand, the account based on (8) will always force the higher wh-phrase to move first, which means the order of all three fronted wh-phrases should be fixed, reflecting their order prior to wh-movement; i.e. under this account (and the same holds for other accounts of Superiority cited above), we would expect the superiority effect from (10a-b), i.e. the strict ordering of the wh-phrases, to be maintained in (11a-b). These data thus provide an argument for the economy account of Superiority and for the general notion of economy in language. They also show that economy does not always rule out all but one option. When several options are equally economical they are all allowed.

Bulgarian MWF may provide another argument for the shortest movement requirement. Consider again (9) under the multiple-specifier analysis, where each wh-phrase is located in a SpecCP. As discussed above, the nominative wh-phrase must move first, so that the strong +wh-feature of C can be licensed in the most economical way. Richards (2001) interprets (9) as indicating that the second wh-phrase must move to a lower SpecCP, i.e. it must tuck in under the already existing Spec of CP, not create a SpecCP on top of the already existing one. This can be interpreted as a result of the Shortest Move requirement, an analysis Richards actually argues for: the tucking-in movement is shorter than movement on top of the existing SpecCP, hence preferred by economy of derivation.

A final note on Superiority: the superiority effect is semantically conditioned. Consider (12).

- (12) a. Who bought what?
b. *What did who buy?
c. Who wonders who bought what
d. Who wonder what who bought

Who, rather than *what*, must undergo wh-movement in (12a-b), a familiar Superiority effect. However, (12d) is grammatical in spite of *what* wh-moving over *who*. Importantly, (12d) is not ambiguous: it is acceptable only if *who* takes the matrix scope; it is unacceptable on the multiple indirect question reading, where both *what* and *who* are interpreted in the embedded SpecCP. Apparently, superiority effects are conditioned on the relevant wh-phrases being interpreted in the same interrogative SpecCP. It is not clear how to capture this effect since bringing in semantic considerations here appears to require a considerable look ahead: at the point of movement of *what* to SpecCP, which takes place before the matrix clause is built in (12d), (12b) and (12d) are in fact identical. It is not clear how to make this step of movement sensitive to what will happen later in the derivation and the final semantics of the examples in question (for some discussion, see Golan 1993, Fox 1995, 2000 and Reinhart 2006 who argue that only constructions with essentially the same semantic interpretation can be compared regarding economy of derivation).

We have seen above that under economy guidelines, movement takes place only when there is a need for it, and when it does take place, it takes place in the most economical way: it is as short as possible and carries as little material as possible. Furthermore, economy is evaluated locally on the basis of immediately available structure. These economy considerations leave little room for truly optional movements since options are in principle allowed only when they are equally economical.

We now turn to the role of phases as an efficient design mechanism. The early research within the generative paradigm has noticed that syntactic dependencies can span only a limited amount of structure. In the current theory, the locality of syntactic dependencies is treated in terms of phases, the goal here being to have an optimal and efficient computational system. This

is accomplished in the phase theory, combined with multiple spell-out, by limiting the number of syntactic objects and the amount of syntactic structure that the syntactic derivation is working on. This is achieved by transferring parts of syntactic structure to the interfaces during the derivation, the transferred parts not being accessible for further syntactic operations (Uriagereka 1999), with phases determining the transfer points. This approach captures the successive-cyclic character of long-distance movement with a new twist. It is well-known that long-distance movements do not take place in one fell swoop, but rather through a series of shorter movement steps.³ As noted above, in the phase system, phases determine when syntactic structure is sent to spell-out; in particular, what is sent to spell-out is the complement of a phasal head (Chomsky 2000, 2001). Given that what is sent to spell-out is no longer accessible to syntactic computation, this means that a moving element needs to move to the phasal edge, and out of the phasal complement before the complement is sent to spell-out. Successive-cyclic movement then must target phasal edges. In fact, given the ban on superfluous movement, i.e. last resort, unless there are reasons that are independent of the phase-related locality considerations just discussed for movement to stop in any other intermediate position, we would expect successive-cyclic movement to target only phasal edges, nothing else (the issue is controversial though, see Kang 2014 for an approach where successive-cyclic movement indeed targets only phasal edges).⁴

A rather dramatic illustration of the ban on superfluous intermediate steps is provided by local subject questions. Consider the following paradigm (for discussion of the paradigm see Bošković 2016, Messick 2016 and references therein).

- (13) Who left?
 (14) a. *Who bought what the hell?
 b. What the hell did John buy?
 c. Who the hell bought that house?
 (15) Who loves everyone? (who>everyone; *everyone>who)
 (16) Someone loves everyone. (someone >everyone; everyone>someone)
 (17) Who_i was arrested all t_i in Duke Street?
 (18) *They_i were arrested all t_i last night. (West Ulster English, McCloskey 2000)

Questions like (13) are sometimes assumed not to involve wh-movement (e.g. Carstens et al 2016, Chomsky 1986). There is, however, evidence that the wh-phrase in (13) does not remain in SpecIP. Taking (14a-b) to indicate that *the hell* can only modify wh-phrases in SpecCP, (14c) provides evidence that *who* in (13) does not stay in SpecIP. Consider also (15)-(16). *Everyone* can take scope over the subject in (16) but not in (15). This is unexpected if the subject in (15) could stay in SpecIP. (14)-(16) thus provide evidence that *who* does not stay in SpecIP in (13). The WUE data in (17)-(18) provide evidence that *who* does not even pass through SpecIP on its

³The intuition here is that movement cannot be too long. It has also been argued that movement cannot be too short, which is referred to as antilocality (see e.g. Bošković 1994, Saito and Murasugi 1999, Abels 2003, Grohmann 2003). In other words, movement needs to be just right, not too short or not too long (see Abels 2003 for a suggestion to derive antilocality from Last Resort).

⁴This approach to successive-cyclic movement eliminates a tension between two notions of economy: shortest move and fewest derivational steps. Consider successive-cyclic movement. If such movement keeps to shortest move, it will have more steps, and if it minimizes the number of steps, it will have longer moves. Chomsky (1993) resolved this tension by adopting Form Chain as the basic transformational operation. A long-distance movement operation has only one Form Chain operation, with shortest move minimizing chain links internal to that Form Chain operation. In later work the Form Chain operation was eliminated. The tension noted in this footnote has dissolved: shortest move can no longer apply internal to Form Chain, which has been eliminated. Rather, the steps of successive-cyclic movement are determined by phases, i.e. derivational spell-out. Movement must target phasal edges: there is no choice between fewest steps and shortest moves at phasal edges since the latter are now required. An one-fell-swoop movement across a phasal boundary is not an option.

way to SpecCP. WUE allows quantifier float under wh-movement, as in (17). Importantly, (18), which is unacceptable in standard English, is also unacceptable in WUE. If the wh-phrase were to move to SpecIP on its way to SpecCP the quantifier in (17) would be floated under movement to SpecIP, but (18) indicates that this is not possible. Based on this, McCloskey (2000) concludes the wh-phrase moves directly to SpecCP. But what happens then with the usual requirement that SpecIP be filled in English?

There are two approaches to the traditional EPP effect: (a) movement to SpecIP is driven by an inadequacy of the target (I), which requires a Spec; (b) the movement is triggered by a problem in the structure prior to the movement to SpecIP, i.e. by a problem in the base-generated position where *who* is located in SpecvP (see e.g. Bošković 2007, Epstein and Seely 2006, Chomsky 2013). Chomsky (2013) provides a labeling account of this issue (see Messick 2016). He provides a labeling algorithm for determining the nature of an object formed by Merge when in the case where a head and a phrase are merged, the head projects (see below). When two phrases (i.e. non-heads) merge, labeling is possible if the elements in question undergo agreement, otherwise one of the two elements has to move. Since traces are ignored for labeling the remaining element then determines the label. Consider then (13). Under the vP-internal subject hypothesis *who* is merged with vP. Since we are dealing here with the merger of two phrases that do not agree, *who* needs to move away to resolve the labeling problem (the movement is not driven by a property of I). With subject wh-questions, the external argument must move anyway to SpecCP, vacating SpecvP. Wh-movement to SpecCP then enables the labeling of vP. The object formed by the merger of I and vP is labeled by I since this is the case of a head-phrase merger. Since a wh-phrase and an interrogative CP undergo agreement (for the Q-feature), CP is labeled by the feature-sharing of the wh-phrase and the interrogative CP. Chomsky's (2013) system thus derives (13) via direct movement of the wh-phrase to SpecCP.

But why is it that wh-movement in (13) cannot even proceed via SpecIP, as indicated by WUE (17)-(18). Economy of derivation, in particular, the ban on superfluous steps, is relevant here. Given the above discussion, this step of movement, i.e. movement to SpecIP, is not necessary in (13). As a result, given the ban on superfluous operations, it should not take place.⁵ Notice also that nothing would in fact go wrong under the above discussion if *John* in (19) moves to a position above SpecIP.

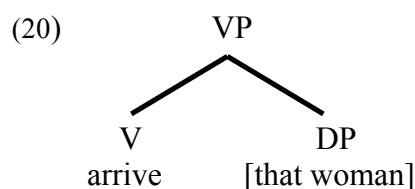
(19) John left

Bošković (2007) argues the reason why this does not happen is also economy, this time the shortest move requirement. *John* needs to move from its base-position, as discussed above (under Bošković's analysis, *John* needs to move to a position that c-commands I); movement to SpecIP results in shorter movement than movement to a higher position, hence this derivation is preferred.

What the discussion of (13) and (19) indicates is that economy minimizes derivational steps (cf. the lack of movement to SpecIP in (13)) and requires them to be as short as possible. The guiding ideas behind these two have been applied to other domains. Thus, one case of the former is provided by Nunes (2004). Under the copy theory of movement, where movement leaves behind a copy rather than a trace (in accordance with the Inclusiveness Condition), a question arises which copies will be realized in PF. The issue is approached through copy deletion: copies

⁵ What we are dealing with here is essentially a ban on movement to the subject position feeding wh-movement. In more traditional minimalist terms, we are dealing here with the ban on A-feature-checking movement feeding A'-feature-checking movement. Bošković (2008) argues this ban is much more general: no feature checking movement can feed another feature checking movement, which Bošković (2008) argues ultimately follows from economy considerations.

that are not deleted are realized in PF. Nunes (2004) develops a system where the reason why the highest copy is typically realized in PF (this is not always the case, see e.g. Bošković and Nunes 2006) has to do with considerations of word ordering (Kayne's 1994 LCA) and crucially economy: Nunes shows that deletion applies in the most economical way, with the fewest instances of deletion applying, if the highest copy fails to be deleted, hence receiving PF realization (when this option is in principle possible); this is basically another example of fewest steps, though rather different from the movement cases discussed above. Regarding shortest move, as discussed above, this economy notion is responsible for superiority effects, where in (7) the interrogative C attracts the closest wh-phrase to minimize the movement length. This guiding economy idea is also present in the labeling algorithm of Chomsky (2013) though in a rather different form. Chomsky (2013) argues that labeling is not an automatic part of the Merge operation, which combines syntactic objects, proposing an algorithm that provides labels (at the point when labeling is required, which is the phasal level for Chomsky 2013). As noted above, the base part of the algorithm is that when a head and a phrase merge, the head determines the label of the resulting object. Thus, when *arrive* merges with *that woman* in (20), the object in question is verbal in nature, not nominal, because *arrive*, the head, projects).



What is behind this is Minimal Search, which in (20) searches for the first computational atom, i.e. a lexical item/head, which is *arrive*. This element then labels the result of the merger of *arrive* and *that woman* in (20). A similar mechanism is taken to be involved in agreement, where an agreeing head searches for the closest element it can Agree with, thus always agreeing with the closest element. Abstractly, these cases illustrate the same notion of economy as the shortest move from the paradigm in (6)-(7).

3. Derivational economy in semantics

In the previous section, we showed that overt movement operations are constrained by economy considerations. Covert movement operations also exhibit such effects. Take e.g. scopally ambiguous sentences involving two quantificational elements such as (21a). A standard analysis of the inverse scope reading (i.e., the reading paraphrasable as “for all movies *x* there exists some critic *y*, such that *y* likes *x*”) is that the DP *every movie* undergoes covert movement above the DP *some critic* (e.g., May 1985), referred to as Quantifier Raising (QR). The LF for the inverse scope reading is (21b).

- (21) a. Some critic likes every movie.
 b. [[Every movie]_i [Some critic [likes t_i]]]

Like the movement operations discussed in the previous section, QR is subject to economy conditions. Thus, Fox (1995, 2000) proposes (22).

- (22) *Scope Economy*
OP [Authors: Scope shifting operations] can only apply if it affects semantic interpretation (i.e., only if the inverse and surface scope are semantically distinct). (Fox 2000:21)

The intuition behind (22) is the same as with the last resort cases of overt movement discussed in section 1: movement takes place only if there is motivation for it. However, the motivations for the overt and covert movement cases are distinct. For overt movement the motivation is to eliminate crash-inducing formal features, while the motivation for covert movement (i.e., scope shifting operations) is to give access to new semantic interpretations.

The evidence Fox gives in favor of (22) comes from elliptical constructions with quantificational elements. Fox begins with the observation that in Verb Phrase Ellipsis (VPE) constructions that involve two quantificational elements in both the antecedent clause (AC) and the elided clause (EC) the structure is only two ways ambiguous out of four possible readings. Either both the antecedent and the elided clause have surface scope or both have inverse scope. The readings where the two clauses mismatch in scope are unavailable, as (23) shows (elided material is given in <...>)

- (23) [_{AC} A boy admires every teacher], and [_{EC} a girl does <admire every teacher> too].
- a. AC: ($\forall > \exists$) EC: ($\forall > \exists$)
 - b. AC: ($\exists > \forall$) EC: ($\exists > \forall$)
 - c. #AC: ($\exists > \forall$) EC: ($\forall > \exists$)
 - d. #AC: ($\forall > \exists$) EC: ($\exists > \forall$)

Fox accounts for this by appealing to an independently motivated constraint on ellipsis known as *Parallelism*. We can assume a simplified definition of Parallelism in (24).

(24) *Parallelism*

Variables must be bound from parallel positions in the AC and EC.

(24) allows us to account for the observed pattern in (23), assuming that QR leaves a trace in its base position that is interpreted as a variable. In order for the AC to get an inverse scope reading as in (23a), the DP *every teacher* must undergo QR to a position higher than *a boy*. In order for Parallelism to be satisfied, a parallel application of QR must take place in the EC, moving *every teacher* to a structurally higher position than *a girl*. If no scope shifting operations take place in the AC (resulting in surface scope), as in (23b), then Parallelism can only be satisfied if likewise no scope shifting operations take place in the EC. The interpretations that require an instance of QR in only one of the AC or EC (23c-d) violate Parallelism, and hence are unavailable.

With this in mind, consider a minimally different example in (25). As in the previous example, both the subject and the object in the AC are quantificational DPs, but unlike the previous example, only the object in the EC is quantificational; the subject in this case is a non-quantificational DP, *Mary*. Crucially, unlike the previous example, (25) is unambiguous. It only allows the surface scope reading in the AC.

- (25) [_{AC} A boy admires every teacher] and [_{EC} Mary does <admire every teacher>] too.
 ($\exists > \forall$) *($\forall > \exists$)

Fox argues that this follows from the interaction of the Scope Economy constraint in (22) and Parallelism in (24). For the inverse scope to obtain in the AC, *every teacher* must undergo QR. There are two potential representations to consider. The first, given in (26a), has *every teacher* undergoing QR in the AC, but not in the EC, where the DP stays in its base position. This representation satisfies Scope Economy as the application of QR of *every teacher* to a position over *a boy* results in an interpretation distinct from the surface scope. However, Parallelism is

Above, we have seen that the semantic economy constraint Scope Economy has the same intuition as the Last Resort view of syntactic movement operations: an operation only occurs if there is motivation for it. We now turn to economy constraints that restrict binding possibilities. We will see that the intuition behind these constraints is similar to the Shortest Move constraint discussed above: long dependencies are blocked by more local dependencies. To illustrate, consider Fox (2000)'s Rule H (for similar proposals and extensions, see e.g. Reinhart 1983, Grodzinsky and Reinhart 1993, Buring 2005, Roelofsen 2011; Rule H is also conceptually similar to Rizzi 1990's *relativized minimality*).

(29) *Rule H*

A pronoun α , can be bound by an antecedent β , only if there is no closer antecedent, γ , such that it is possible to bind α to γ and *get the same semantic interpretation*.

(Fox 2000:115)

The effect of Rule H is illustrated by (30), where there are two bound pronouns. Consider the two LFs for (30) in (31). In (31a), the λ -expression appended directly below *John* binds both pronouns in the embedded clause in what is termed co-binding. In (31b) (which involves transitive binding), the λ -expression appended directly below *John* only binds the pronoun *he*; the pronoun *his*, in turn, is bound by the λ -expression appended directly below *he*. As both of these LFs result in the same interpretation, Rule H rules out the co-binding representation in favor of the transitive binding representation.

(30) John_i said the he_i likes his_i mother.

(31) a. *John λ_1 said that he₁ likes his₁ mother. (Co-binding)
 b. John λ_1 said that he₁ λ_2 likes his₂ mother. (Transitive binding)

The evidence for Rule H again comes from possible interpretations of VPE constructions. Bound variables in elliptical constructions can be interpreted in two ways, as shown in (32). In (32a) (the so-called strict interpretation), the elided pronoun refers to *John*. In (32b) (the so-called sloppy reading), the elided pronoun is bound by *Bill*.

(32) John loves his dog and Bill does too.

a. ...love John's dog. (Strict)
 b. ...love Bill's dog. (Sloppy)

Now consider a VPE construction that takes a sentence like (30) with two pronouns as its antecedent. Assuming that both pronouns have the ability to be strict or sloppy, we expect the sentence to be four ways ambiguous, but as indicated in the judgments in (33), only three of the four readings are available.

(33) John said that he likes his mother and Bill did too.

a. ...say that John likes John's mother.
 b. ...say that Bill likes Bill's mother.
 c. ...say that Bill likes John's mother.
 d. ...*say that John likes Bill's mother.

Recall that there is an independent constraint on ellipsis that forces the antecedent and the elided clause to be parallel regarding the position of variables and their binders. So if the pronouns in the elided clause are interpreted as bound by *Bill* (i.e. sloppy interpretation), then that binding

relation must be matched by a binding relation in the antecedent. With this in mind, the LFs for the possible interpretations of the elided clause are given in (33) (assuming that the assignment function maps the index 1 to *John*).

- (34) a. Bill₄ said that he₁ likes his₁ mother.
b. Bill λ₄ said that he₄ λ₃ likes his₃ mother.
c. Bill λ₄ said that he₄ likes his₁ mother.
d. Bill λ₄ said that he₁ likes his₄ mother.

For the LFs that involve bound variable interpretations (34b-d), there must be parallel binding relations in the antecedent in order to satisfy Parallelism. In the LF (34b), the binding relations between λ₄ and *he*₄ and λ₃ and *his*₃ are parallel to the binding relations in the LF of the antecedent in (31b). The binding between λ₄ and *he*₄ in (34c) is likewise parallel to the binding found in (31b). The binding between λ₄ and *his*₄ in (34d), on the other hand, is not parallel to any binding relation in the transitive binding LF in (31b). The only LF for the antecedent that would allow for a parallel binding with (34d) would be the co-binding representation in (31a), but such an LF is blocked by Rule H. Since a parallel LF for the antecedent cannot be constructed, the LF in (34d) is not licit; hence we correctly capture the fact that the interpretation in (33d) is ruled out. Without Rule H, an antecedent with parallel binding relations to (34d) could be generated, hence the LF would be licit and we would incorrectly predict that (33d) is a possible interpretation of the construction.

A number of other proposals to deduce or simplify binding theory by appealing to economy considerations have been made in the literature (e.g. Reinhart 1983, Safir 2004, 2014, Schlenker 2005 and references therein). Take e.g. Schlenker (2005)'s *Minimize Restrictors!* from (35).

- (35) A definite description *the A B* [where the order of *A* vs. *B* is irrelevant] is deviant if
a. *the B* is grammatical and has the same denotation as *the A*.
b. *A* does not serve any other purpose.

This constraint essentially forces short definite descriptions over longer ones; a similar intuition to the Minimize Structure constraints (see section 1). *Minimize Restrictors!* can account for Condition C of the Binding Theory (and its exceptions) if one assumes that pronouns are short definite descriptions. Take e.g. (36). (36a) is a Condition C violation where an R-expression (*John*) is c-commanded by a coreferent expression. Under (35), this construction is ruled out by the availability of (36b), where a pronoun is used in place of *John*, because the pronoun is a shorter description than the R-expression. Turning to (36c), (36c) is acceptable despite *the idiot* being c-commanded by a coreferent R-expression. This is also captured by (35). If a pronoun was used in place of *the idiot*, then information would be lost (i.e., the information that the speaker thinks John is an idiot), so the use of *the idiot* serves a pragmatic purpose that the shorter description cannot capture. Because of this, (35) does not force the use of the pronoun in this example, and (36c) is correctly predicted to be grammatical. If Condition C were to be applied blindly to (36c), it would incorrectly rule it out.

- (36) a. ??John_i ran over a man who tried to give John_i directions.
b. John_i ran over a man who tried to give him_i directions.
c. John_i ran over a man who tried to give [the idiot]_i directions.

In summary, the considerations of economy of derivation require movement to take place for a reason (with both syntactic and semantic considerations playing a role here), also banning

superfluous steps/operations. When movement does take place, it is as short as possible and carries as little material as possible. Economy should be evaluated locally, on the basis of immediately available structure. The locality of syntactic dependencies is also enforced by minimal search and by limiting the number of syntactic objects and the amount of structure that are accessible (or present) in the derivation.

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