Hierarchical relations and linear ordering

Pablo Picasso Feliciano de Faria*

Abstract

The present squib's discussion is centered on Kayne's (1994, 2010) proposals, which postulate a direct relation between the order of asymmetric c-command relations and linear precedence relations at PF. To put it briefly, Kayne argues that asymmetric c-command is mapped to linear precedence at PF and concludes that there is a universal hierarchical/linear order: Specifier-Head-Complement. This universal order would predict the cano- nical order SVO found in many languages. Any other linear order, whether canonical or not, would then be obtained through movement operations. Details of the arguments in Kayne (1994, 2010) are presented and discussed in the present squib with focus on two goals: first, to show that the strict mapping of asymmetric c-command to linear precedence is questionable and, second, that linear precedence relations are not relevant for syntax, with only hierarchy playing a fundamental role — as also argued elsewhere (see CHOMSKY, 1995, 2004, 2005, 2008; URIAGEREKA, 1999; GUIMARÃES, 2000). In doing this, circularity problems in Kayne's arguments are highlighted as well as other issues. Subsequently, an alternative account of the relationship between syntax and PF is suggested, in an effort to maintain the spirit of Kayne's LCA while at the same time making it compatible with more recent minimalist views.

Keywords: Language universals, Linear ordering, Syntactic hierarchy, LCA

Resumo

A discussão no presente *squib* está centrada nas propostas de Kayne (1994, 2010), que postulam uma relação direta entre a ordem nas relações de c-comando assimétrico e as relações de precedência linear em PF. Em suma, Kayne argumenta que c-comando assimétrico é mapeado como precedência linear em PF e conclui que há uma ordem universal hierárquica e linear: Especificador-Núcleo-Complemento. Esta ordem universal prevê, portanto, a ordem canônica SVO encontrada em várias línguas. Quaisquer outras ordens lineares, canônicas ou não, seriam, então, obtidas por meio de operações de movimento. Detalhes dos argumentos de Kayne (1994, 2010) são apresentados e discutidos neste *squib*

*Universidade Estadual de Campinas, Unicamp. Currently, a postdoctoral fellow funded by FAPESP (13/18.090-6). *E-mail*: pablofaria@gmail.com. Special thanks to Charlotte Galves, for advising the study in which the present issues were investigated, to the reviewers for their comments and suggestions, and finally to FAPESP for the doctoral grant (09/17172-3), which made my doctoral and the present study possible.

com o foco em dois objetivos: primeiramente, mostrar que o mapeamento estrito de c-comando assimétrico em precedência linear é questionável e, em segundo lugar, que relações de precedência linear não são relevantes para a sintaxe, apenas a hierarquia tendo aí um papel fundamental — como argumentado alhures (ver CHOMSKY, 1995, 2004, 2005, 2008; URIAGEREKA, 1999; GUIMARÃES, 2000). Ao fazer isso, problemas de circularidade nos argumentos de Kayne são assinalados, assim como outras questões. Subsequentemente, uma proposta alternativa da relação entre a sintaxe e PF é sugerida, num esforço de manter o espírito do LCA de Kayne, ao mesmo tempo em que o tornamos compatível com visões minimalistas mais recentes.

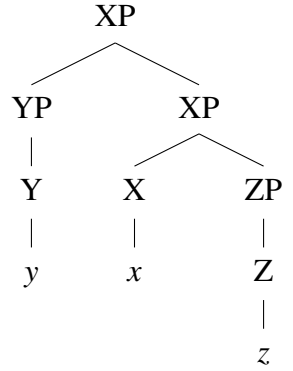
Palavras-chave: Universais da linguagem, Ordem linear, Hierarquia sintática, LCA

1 Introduction

Kayne (1994, 2010) argues that asymmetric c-command is mapped as linear precedence at PF. The author further tries to derive a universal hierarchical/linear order, claimed to be Specifier-Head-Complement. This universal order would predict the canonical order SVO found in many languages. Any other linear order, whether canonical or not, would then be obtained through movement operations. It is possible to organize Kayne's (1994, 2010) argumentation in two main steps.

First, the author brings forth the representation of an ordered pair $\langle x, y \rangle$, taken from Set Theory, which means that *x* and *y* are ordered (relative to each other) by some relation *R*. The ordered pair representation, however, does not determine *per se* the *direction* of the ordering between the two elements; it depends on how the relation *R* is specified. In Kayne (1994), this relation is the asymmetric c-command between nodes in a tree, in the framework of an X-bar theory (CHOMSKY, 1986) restricted by Kayne's Linear Correspondence Axiom (LCA) to license at most one specifier (or adjunct) per XP. In Kayne's proposal, the ordered pair $\langle x, y \rangle$ is read as "x asymmetrically c-commands y". Notice, however, that it could be *conventionally* read as "x is asymmetrically c-commanded by y": as explained above, the direction of the relation is conventional, not an inherent property of the ordered pair representation.

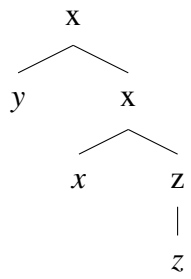
(1)



According to Kayne's (1994) version of the LCA, only nonterminal nodes in asymmetric c-command relation are visible to the axiom. Consequently, for the phrase marker in (1), X and ZP, for instance, do not constitute an ordered pair, since they are in a symmetric c-command relation. In a revision of the LCA, now from a minimalist perspective, even though Chomsky (2008) suggests that the output of *Merge* be represented as an unordered pair,{x,y}, Kayne (2010) assumes the ordered pair representation as both a representation of the output of *Merge* and as a relation of asymmetric c-command.

Kayne (2010) also assumes a *bare phrase structure* (BPS) view of syntax (CHOMSKY, 1995), which is known for its incompatibility with the LCA. In order to overcome this, Kayne first assumes Guimarães' (2000) proposal, in which the operation Merge is allowed to take two instances of the same object as input. Guimarães calls this "self-Merge". Issues with this proposal aside (see FARIA, 2014), Kayne then revises the definition of the LCA so that it now applies to all the nodes in a tree, not only to terminal nodes. Symmetric c-command relations remain invisible to the axiom. Thus, in (2), a revision of (1) on BPS grounds, the nodes *x* (terminal) and z (nonterminal) are not ordered, though the terminals *x* and *z* are.

(2)



The second step of Kayne's argument is to demonstrate (in different ways, but to the same effect, both in 1994 and 2010) that the specifier (S) and the complement (C) are always at "opposite sides" of the head (H). Kayne (1994, p. 33-35) uses the structure in (1) to show that the set of ordered pairs of asymmetric c-command are ⟨S,H⟩ and ⟨H,C⟩, thus, S-H-C as the full ordering. Once this structural order is obtained, the question is whether asymmetric c-command is linearized (by default) as precedence or succession: precedence would produce the linear order S-H-C and succession would produce C-H-S (the remaining orders could only be derived by movement). Kayne (1994) argues that since S-H-C is more attested in the world's languages than C-H-S, it is more plausible to take the former as the universal order.

In Kayne (2010), alternatively, the author tries to derive such opposition from the *Merge* operation itself and a number of extra assumptions. As previously mentioned, the author first assumes that the object formed through *Merge* is an ordered pair, $\langle x, y \rangle$, with a very special property: x "temporarily precedes" y.[1] Under this second assumption, Kayne obtains the

[1]Kayne (2010) resorts to a number of linguistic facts — such as backward pronominalization, for instance —

ordering H-C. In order to yield the full ordering S-H-C, additional assumptions are necessary. A third assumption is about the nature of precedence: the author proposes that it is *immediate* precedence (i-precedence). Kayne goes further to assume that Merge must always involve at least one head.

Under these two assumptions, a specifier S is merged directly to the head H, not to the object ⟨H,C⟩ formed by the head and the complement. Given i-precedence and that ⟨H,C⟩ is formed before the specifier is merged, S must precede H, since the latter cannot i-precede both S and C, thus obtaining ⟨S,H⟩. Also because of i-precedence, H can only be merged twice, thus restricting specifiers to only one per head as in the original LCA. Note that a consequence of this proposal is that H is a term of two distinct objects formed by *Merge*. A questionable consequence of this move is that the concept of syntactic tree is profoundly affected: since now a node may have two different parent nodes, the tree will not be strictly binary anymore (see Kayne's, 2010, arguments on this).

Nonetheless, this proposal raises an inconsistency: *Merge* produces both a head-initial order (H-C) and a head-final one (S-H), a problematic optionality for the inner workings of the operation. In order to deal with it, Kayne resorts to additional assumptions, postulating that the order is head-initial when H is (or contains) a *probe*,[2] otherwise (in specifier merge) the order is free or mandatorily head-final if the head had already been merged to a complement. Given all these assumptions, Kayne (2010) concludes for S-H-C is the universal hierarchical and linear order, since asymmetric c-command implicates linear precedence.

2 Circularity and too many assumptions

Kayne's (1994, 2010) arguments are questionable in many respects. As we shall see soon, they even end up being circular. In Kayne (2010), the circularity is obvious: if one assumes a temporal ordering of terms as a property of *Merge*, then there is nothing to be demonstrated about the ordering among elements in asymmetric c-command relation, since this relation is built through *Merge*, that is, the ordering is given in the premise. In Kayne (2010), moreover (but not in Kayne, 1994), there is a high theoretical cost involved, since some traditional properties of syntactic trees, such as uniqueness of the root node and parent nodes in general, binarity, etc., would have to be abandoned.[3]

Furthermore, in Kayne's proposal, Merge is sometimes triggered by a probe, and is some-

which he takes as empirical evidence for the temporal ordering of the elements merged, arguing that hierarchy alone could not account for them.

[2] According to him, the search involving the probe and the target shares the same directionality of parsing and sentence production, that is, from left to right.

[3] As pointed out by one of the reviewers, however, an argument based on a claimed theoretical cost is weak, if Kayne's proposal can be shown to be correct. I agree with this observation.

times unmotivated, or triggered by some unclear property. Kayne also assumes a distinction between lexical items and syntactic objects in the core of syntax: *Merge* cannot take two syntactic objects as input. Such a strong assumption needs very convincing arguments, something lacking in Kayne (2010). Without it, the minimal assumption of Chomsky (1995) should be maintained: *Merge* takes as input both minimal objects (lexical items) and objects already formed by *Merge* in previous steps of the derivation. After all, these are all bundles of features, no matter how they were assembled (i.e., by *Merge* or in the Numeration).

The reasoning in Kayne (1994) is more substantive and less speculative, for it is based on X-bar Theory. Nonetheless, this is where its weakness is found: since we currently find reasons to think that syntactic structures lack the richness of levels of projection postulated by X-bar Theory, once one removes such levels from the representation, therefore ending up with BPS, the c-command asymmetry between H and C disappears. Moreover, the circularity problem appears here as well: even if one accepts that the asymmetric c-command pairs involved are $\langle$S,H$\rangle$ and $\langle$H,C$\rangle$, one cannot conclude that S and C are at (linear) "opposite sides" relative to H — as Kayne does — for hierarchical opposition *per se* has nothing to do with linear sides. Claiming that that is the case, therefore, is only possible under the assumption that asymmetric c-command implicates linear precedence. As one can see, this conclusion is again given in the premise.

Given the above discussion, we see that there are problems with Kayne's conclusions, both in strictly mapping asymmetric c-command to linear precedence and in claiming that S-H-C is the universal order. On the other hand, this is not to deny a relationship between hierarchy and linear ordering: it is a fact that syntactic structures are subject to linearization and, thus, there must exist a relation. In what follows, I will sketch an argument in favor not of a correspondence but of a conditional relationship between hierarchical asymmetry and linear ordering of elements in PF.

3 Asymmetry as a condition on linearization

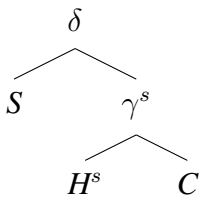
Although we may not find conclusive reasons to postulate a strict relation between asymmetric c-command and linear precedence (or succession) in PF, we may, with reasonable certainty, consider a conditional relation between these properties. In other words, it is plausible that, in order for items to be ordered in PF, they must meet a criterion, one that arguably makes linearization possible. We need not go too far to find a good candidate criterion: these items must be ordered in syntax according to inherent syntactic properties of which asymmetric c-command is an obvious candidate. By sticking with asymmetric c-command, we also adhere to the core of Kayne's (1994) LCA.

3.1 An asymmetric syntax

In order to remove any specific choice about order from the LCA, it needs to be revised and this revision demands changes to the notions *Merge* and *c-command*, given that these notions are crucial for the definition of the axiom. Let us suppose that *Merge* is not a blind operation that combines anything and even the same thing with itself ("self-Merge", cf. Guimarães, 2000), but, instead, that it is an operation that must be triggered by some property of the objects combined. This is not a new idea. Chomsky (1998) and Collins (2002) consider the possibility that *Merge* is driven by a "selector" feature present in one of the terms of *Merge*, which will, consequently, be the head of the phrase and determine the phrase's label.[4]

Let us assume, therefore, that *Merge* is triggered by a selector included in one of its terms. Furthermore, let us assume that there is no restriction on the kinds of items combined by *Merge* such that an object γ formed previously can be combined with a specifier, S, γ being the (complex) head of the newly formed object, δ (see example 3, below).[5] In this case, as also suggested in Chomsky (1998) and Collins (2002), the specifier is nothing more than a reference to a second application of *Merge* to a given head, in this case, the head of γ, H. Now, following Hornstein (2009), given that one of the terms of Merge contains the selector and triggers the operation, we can interpret Merge as an inherently asymmetric operation, in the concrete sense that one of its terms asymmetrically c-commands the other.

(3)



Contrary to Hornstein, however, let us assume it is actually the complement that asymmetrically c-commands the head. This may seem too strong an assumption, but a possible piece of evidence in favor of it is the fact that many languages display not only control of the subject over the verb in terms of agreement morphology, but also of the object over the verb. Another welcome outcome of it is that feature checking would not require movement of the object anymore, since it already asymmetrically c-commands the head from the start, that is, the structural conditions for feature checking would be unified for specifiers and complements.

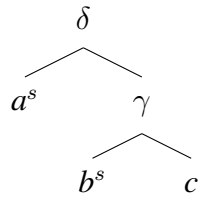
As a last important detail, note that the structure in (3) does not show why the LCA has to resort to the dominance relation. To demonstrate this, we need another possible structure,

[4] Adjuncts certainly pose a challenge to this view that goes beyond the goals of the present paper. However, even for adjuncts, we may think that there is some sort of selection involved and, if this is the case, it may be possible to account for adjuncts in a fully developed version of the framework suggested here.

[5] "s" superscripts mark the terms containing the selector.

such as (4). In this case, we have the set T = $\{a,\ b,\ c\}$ for which the set of asymmetric c-command relations between terminals (without resort to dominance) would be the unitary set $\{\langle c, b\rangle\}$, lacking the ordering of the terminal *a* relative to the others. Since γ asymmetrically c-commands *a*, if we assume that all nodes dominated by γ also c-command *a*, we obtain the full ordering of terminals necessary for linearization at PF.

(4)



3.2 Linearizing asymmetric structures

Given the framework sketched above, let us take, for instance, the tree in (3) above, where δ and γ are formed during the derivation, S, H, and C, all come from the Numeration, and H contains two selector features. We know that a sequence of lexical items is asymmetric: the temporal line goes only in one direction, thus the position of a given item is crucial to its relation to the others. It is hardly the case that linear order is strictly free in any language: distinct options are, consequently, motivated. One crucial assumption kept here is that what is relevant for PF is the set of asymmetric c-command pairs between terminals of the tree.

The structure in (3) is absolutely non-ambiguous about its terminal and nonterminal nodes: there is a unique asymmetric c-command relation for any given pair of nodes. In particular, from (3) we extract the crucial pairs ⟨S,H⟩, ⟨S,C⟩, and ⟨C,H⟩, along with ⟨S,γ⟩, all available at PF for linearization purposes. At PF, these pairs are mapped into linear relations, with precedence or succession attributed to each pair. However, a constraint must apply to this mapping: the final linear ordering obtained has to be *coherent*, that is, the transitive character of linear relations in a sentence must be kept, such that, for example, if S precedes H and H precedes C, S also precedes C.

The idea is that PF needs clear conditions to establish linear asymmetries between terminals and that is what asymmetric c-command relations provide. In other words, terminal nodes are ordered throughout the derivation, but the specific ordering within syntax need not be isomorphic with the ordering after PF. With respect to acquisition, it is plausible to assume that canonical linear orders are learned (and fixed) for pairs of asymmetric c-commanding syntactic objects at early stages, such that non-canonical orderings are produced only for marked structures, that is, those in which movement operations have applied or where phonological properties trigger movement of elements after PF.

A direct consequence of such proposal is that, as proposed by Epstein et al (1998), the parameter of (linear) order lies within PF, that is, it is not a syntactic parameter. We could

then move on to consider Uriagereka's (1999) hypothesis that the less costly linearization is the one in which asymmetric c-command is always mapped as precedence: in this case, the order obtained would be SOV. Indeed, if the present proposal is on the right track, it would not be a mere coincidence that the most attested word order (cf. DRYER, 2008) is SOV, this being an evidence that there may be principles of economy playing a role in language functioning and evolution.[6]

Another important consequence of this proposal is that none of the canonical word orders found among natural languages is, in principle, excluded as the "base" generated order at PF. In other words, although the universal hierarchical order is S-C-H, any of the possible canonical linear word orders can be produced at PF without resort to movement operations for it is only a matter of "setting parameters" of linear ordering. Table 1 below provides a general picture of the mappings necessary for each type of language (with respect to the canonical word order) and the percentage of each type relative to the known natural languages:

Mapping (precedence) $R^C = \{\langle S, C\rangle, \langle S, H\rangle, \langle C, H\rangle\}$	Order	Languages (cf. Dryer, 2008)
S $\leftarrow$ C, S $\leftarrow$ H, C $\leftarrow$ H	SOV	41%
S $\leftarrow$ C, S $\leftarrow$ H, C $\rightarrow$ H	SVO	35,4%
S $\leftarrow$ C, S $\rightarrow$ H, C $\rightarrow$ H	VSO	6,9%
S $\rightarrow$ C, S $\rightarrow$ H, C $\rightarrow$ H	VOS	1,8%
S $\rightarrow$ C, S $\rightarrow$ H, C $\leftarrow$ H	OVS	0,8%
S $\rightarrow$ C, S $\leftarrow$ H, C $\leftarrow$ H	OSV	0,3%

Table 1. Linear orderings obtained in the syntax-PF mapping

Interesting aspects emerge from this picture. There seems to be some predictability relative to the distribution of types of language. Languages seem to "prefer" orderings in which the arguments come first, although there seems to be a strong resistance in having the object coming first. It is likely that both pragmatic and processing factors are at work here and affect how these PF parameters have been set for different languages throughout our history.

This framework also makes an empirical prediction: if movement operations have some kind of computational cost for online processing, the processing of canonical sentences, despite the type of language, is predicted to be faster and easier when compared to marked orders within a given language. The reason is that canonical order in this framework is supposed to involve no movement at all or, at least, no movement for matters of linear ordering. There seems

[6]Of course, this is not the entire picture. There is some evidence that the preferred order in processes of creolization is SVO. If this is indeed the fact, how this could be fit into the present framework is unknown at the moment.

to be some evidence to support this prediction (see SEKERINA, 2003, ERDOCIA et al, 2009), although semantic and morphological aspects must be considered as possible factors affecting processing.

4 Final remarks

In the present paper, Kayne's (1994, 2010) proposals regarding the relation between hierarchy in syntax and linear order were discussed with the intent of showing that Kayne fails to motivate the strict link he draws between asymmetric c-command and linear precedence and his conclusion about SVO being the universal hierarchical and linear order among natural languages. In the first case, it is shown here that his arguments are circular and, thus, invalid. In the second case, it is demonstrated not only that SOV is more plausibly the universal hierarchical order, but also that it does not implicate that all other possible canonical linear word orders must be derived by movement, since canonical word order is proposed to be set as a PF mapping parameter, imposed on asymmetric c-commanding pairs provided by syntax (a relation captured by the LCA).

Consequently, the relation between syntax and PF here is less "invasive" — in the sense of Guimarães (2000) — than traditionally assumed. Syntax satisfies PF to the extent that its structures show a particular property, crucial for linearization at PF: all nodes in a tree are fully ordered by the relation of asymmetric c-command. Since no movement is necessary to motivate distinct canonical linear orderings, the present proposal makes a stronger claim about the strictly LF-motivated nature of syntactic operations. Different mappings at PF are nothing more then a byproduct of such operations for they produce different sets of pairs of asymmetric c-commanding elements.

Finally, empirical assessments of the proposal sketched here would surely make it more sound and convincing. This is a necessary following step to be taken in a future study. For instance, if we consider other domains beyond the arguments of verbs, such as the DP domain, one would expect, based on the present proposal, that determiners are c-commanded by nouns and, thus, followed the latter, as a default linear ordering.[7] This could, indeed, be extended to all relations between functional and substantive categories in the formation of extended projections.

It is not entirely clear to me whether these two kinds of relation (argumental and "extensional") are strictly the same regarding c-command. It is an issue to be investigated, given the present proposal. However, assuming these two relations are the same, it may look odd, at first, that substantive complements c-command functional categories. It is curious, however, that a

[7]The issue involving the DP domain was pointed out by one of the reviewers.

similar picture involving the orders SOV and SVO — that is, both are predominant but the former is more frequent — emerges when we consider the ordering between demonstratives and nouns. According to Dryer (2013), the Noun-Dem order is the most frequent, although very close to Dem-Noun. In addition, when the demonstrative appears as an affix (whether a prefix, suffix or a circumfix), the preferred option is the suffix ($\sim$52%) (with circumfix accounting for $\sim$31% and prefix for $\sim$17%). This fact can be a coincidence or it may be another evidence of how c-command is operating in syntactic structures, that is, directionally inverse to what it is traditionally thought. Further studies are necessary, involving different types of functional heads.

References

CHOMSKY, N. *Knowledge of Language*: Its Nature, Origin and Use. Praeger, New York, 1986.

CHOMSKY, N. Bare phrase structure. In: WEBELHUTH, G. (Ed.). *Government and Binding Theory and the Minimalist Program*. Oxford: Blackwell, 1995. p. 383-439.

CHOMSKY, N. Minimalist Inquires: The Framework. *MIT Occasional Papers in Linguistics*. n. 15. Cambridge: The MIT Press, 1998.

CHOMSKY, N. Beyond explanatory adequacy. In: BELLETTI, A. (Ed.). *The Cartography of Syntactic Structures*. Oxford: Oxford University Press, 2004. p. 104-131.

CHOMSKY, N. Three factors in language design. *Linguistic Inquiry*, v. 36, n. 1, p.1- 22, 2005.

CHOMSKY, N. On phases. In: FREIDIN, R., OTERO, C., & ZUBIZARRETA, M., (Eds.). *Foundational Issues in Linguistic Theory. Essays in Honor of Jean-Roger Vergnaud.* Cambridge: The MIT Press, 2008. p. 291-321.

COLLINS, C. Eliminating labels. In: EPSTEIN, S. D. & SEELY, T. D. (Eds.). *Derivation and explanation in the Minimalist Program*. Maden, MA: Blackwell, 2002. 2, p. 42-64.

DRYER, M. S. Order of subject, object and verb. In: HASPELMATH, M., DRYER, M. S., GIL, D., & COMRIE, B. (Eds.). *The World Atlas of Language Structures Online*. Munich: Max Planck Digital Library, 2008.

DRYER, M. S. Order of Demonstrative and Noun. In: DRYER, M. S. & HASPELMATH, M. (Eds.). *The World Atlas of Language Structures Online*. Leipzig: Max Planck Institute for Evolutionary Anthropology, 2013. (Available online at http://wals.info/chapter/88, Accessed on 2016-04-22)

EPSTEIN, S. D., GROAT, E., KAWASHIMA, R. & KITAHARA, H. *A Derivational Approach to Syntactic Relations*. New York/Oxford: Oxford University Press, 1998.

ERDOCIA, K., LAKA, I., MESTRES-MISSÉE, A. & RODRIGUEZ-FORNELLS, A. Syntactic complexity and ambiguity resolution in a free word order language: Behavioral and electrophysiological evidences from basque. *Brain and Language*, v. 109, n. 1, p. 1-17, 2009.

FARIA, P. O Axioma da Correspondência Linear e a Estrutura Sintagmática Nua: um levantamento de propostas de compatibilização. *Filologia e Linguística Portuguesa*, 16 (spe), p. 261-285, 2014.

GUIMARÃES, M. In defense of vacuous projections in bare phrase structure. In: GUIMARÃES, M., MERONI, L., RODRIGUES, C., & MARTIN, I. S. (Eds.). *University of Maryland Working Papers in Linguistics*, v. 9, p. 90-115. College Park, MD: UMWPiL, 2000.

KAYNE, R. S. *The Antisymmetry of Syntax*. Cambridge: The MIT Press, 1994.

KAYNE, R. S. *Why are there no directionality parameters?* New York University, 2010.

HORNSTEIN, N. *A theory of syntax*: Minimal operations and universal grammar. Cambridge, UK: Cambridge University Press, 2009

SEKERINA, I. A. Scrambling and processing: Dependencies, complexity, and constraints. In: KARIMI, S. (Ed.). *Word order and scrambling* United Kingdom: Blackwell, 2003. p. 301-324.

URIAGEREKA, J. Multiple spell-out. In: EPSTEIN, S. D. & HORNSTEIN, N. (Eds.). *Working Minimalism*. Cambridge: The MIT Press, 1999. p. 251-282.

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