Extending 0-Search and 0-Merge Hypothesis to the Linearization of Syntactic Objects and its Biolinguistic Implication

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Abstract

The 0-Search and 0-Merge hypothesis proposed by Kato et al. (2016) and Fukui et al. (2017) attempts to reduce the operations outside the narrow syntax by further reducing Merge into a set of primitive operations. This is only possible if operations such as Agreement, Binding, Chain Formation, and Labeling are expressed as set-theoretic relations. With this premise, we argue that $M_0°S_0$ hypothesis can be extended to the linearization of syntactic objects (SOs). In particular, we propose that (i) linear order of two SOs when expressed as a set-theoretic relation, $\{\{α\}, \{α, β\}\}$, can be captured by $M_0°S_0$, (ii) Minimality condition on $M_0°S_0$ (WS) and Structural Prominence can stand in place of Asymmetric C-command Condition adopted by Kayne's (1994) Linear Correspondence Axiom, (iii) $M0°S0$ only linearizes SOs inside a Current in line with the Multiple Spell-Out model of Uriagereka (2001, 2012), and (iv) this extension of the $M_0°S_0$ (WS) hypothesis to include linearization has an implication on Chomsky's theory of evolution of language i.e., linear order may have been a result of exaptation of Internal Merge to another domain—speech.

1. INTRODUCTION

Since the conception of the Minimalist program, Merge has been thought of as the only elementary operation in the narrow syntax, and it cannot be further broken down into more primitive operations (Berwick, 2011). This assumption, however, was challenged by Kato et al. (2016) and Fukui et al. (2017) on the basis that Merge alone cannot fully account for other relation-forming operations outside the narrow syntax including Agreement, Binding, Chain formation, and Labeling which were earlier unified under the operation Search (Kato et al., 2017) Kato et al. (2016) and Fukui et al. (2017) argued that Merge and Search seem to involve the same two basic operations. They pointed out that aside from combining two syntactic objects (SOs), Merge also has to look for and select these SOs from the Lexicon. On the other hand, Search involves combining two SOs to establish the relation between them. They propose

the idea that Merge and Search are both accomplished by two operations that search SOs and combine them to form a set. They called these two operations, 0-Search and 0-Merge. 0-Search is responsible for picking out SOs from the lexicon and the previously derived SOs unified under Workspace, and 0-Merge is the operation responsible for combining them to form an unordered set. 0-Search and 0-Merge or $M_0 \circ S_0$ basically unify Merge and other relation-forming operations under Search. Excluded from this unification, however, was Linearization, another relation-forming operation interpreted outside the narrow syntax as per Chomsky's (1995) interpretation of the Linear Correspondence Axiom (LCA). If operations such as Agreement, Binding, Chain formation, and Labeling under Search can be unified with External and Internal Merge by reducing Merge to two more primitive operations, why is linearization not included in this unification? In this paper, I offer a proposal that extends $M_0 \circ S_0$ to linearization. Specifically, I argue that the mathematical definition of an ordered set $\{\{\alpha\}, \{\alpha, \beta\}\}$, which states that α precedes β, is formed by 0-Search and 0-Merge or $M_0 \circ S_0$. I will show that 0-Search is responsible for picking out an element α from the unordered set of $\{\alpha, \beta\}$, where $\alpha \in \Sigma$ and $\Sigma = \{\alpha, \beta\}$. 0-Merge then forms a set from $\{\alpha\}$ and $\Sigma = \{\alpha, \beta\}$ to produce $\{\{\alpha\}, \{\alpha, \beta\}\}$. This set is then transferred to the sensorimotor interface and interpreted as there is a precedence relation between α and β. In addition, I adopt Relative Minimality Condition and Structural Prominence as constraints that determine the target SOs of S_0 replacing the Asymmetric C-command Condition used in the LCA. I also attempt to integrate this hypothesis in Uriagereka's (2001, 2012) Multiple Spell-Out models by limiting the application of $M_0 \circ S_0$ to current (previously termed as Command Unit), a unit assembled by the continuous application of Merge (Weinberg, 2001). This results in the version of 0-Search and 0-Merge for linearization defined as, $M_0 \circ S_0 (WS) = \{\{\alpha\}, \{\alpha, \beta\}\}$ where WS is equivalent to a current. Lastly, I discuss the biolinguistic implication of the present proposal.

2. LITERATURE REVIEW
2.1. Merge

In 1995, Chomsky proposed to reduce the complexity of X-bar theory to a basic operation Merge. This operation takes two objects and combines them into a single syntactic object (SO). This operation leaves these two objects unordered. It takes the basic form of (1):

(1)   Merge (Berwick & Chomsky, 2016 p. 10)

       Merge (X, Y) = {X, Y}

The merge operation reduces phrase structure into a single operation and takes syntactic derivation as a bottom-up process. This particular combinatorial operation also derives many properties of X-bar theory e.g., Agree, Labeling, and other relation-forming grammatical

operations. Additionally, Merge can also account for movement or displacement which, according to Chomsky (2004), is an instance of Internal Merge (IM). Internal Merge is different from the Merge defined in (1), which is known as External Merge (EM) because it takes two SOs in which the first SO is a member of the second SO. Internal Merge can be defined as:

(2) Merge {α, Σ} where α ∈ Σ

To illustrate how Merge, be it External (EM) or Internal Merge (IM), works, consider the derivation in (3):

(3) a. Num.={I[+past], *John*, *meet*, *Anna*}

    b.   {*meet*, *Anna*}

    c.   {*meet* {*meet*, *Anna*}}

    d.   {*John* {*meet* {*meet*, *Anna*}}

    e.   {I {*John* {*meet* {*meet*, *Anna*}}

    f.   {I {I {*John* {*meet* {*meet*, *Anna*}}

    g.   {IP {*John* {I {I {t {*meet*{*meet*, *Anna*}}

The derivation proceeds as follows: combine *meet* and *Anna* via EM in (3b)—both lexical items (LIs) are taken directly from the numeration in (3a) —to form an unordered set in (3c). This set is then combined with *John* in (3d) to form {*John*, Σ} where Σ is a previously constructed SO. The derivation continues as I is combined with {*John* {*meet* {*meet*, *Anna*}} to form (3f). Because I has an External Projection Principle feature or EPP feature and nominal case, the derivation requires the closest NP to move to the Spec, IP. This is accomplished via IM. I selects *John* from Σ where Σ= I {I {*John* {*meet* {*meet*, *Anna*}}, and copies it at the Spec, IP, and merge it with Σ. The lower copy of John is deleted at the Sensorimotor Interface. This process is shown in (4).

(4) a. {*John* {I {I{*John* {*meet*{*meet*, *Anna*}}

    b. {*John* {I {I{*John* {*meet*{*meet*, *Anna*}}

The main difference between EM and IM is that EM takes one or both LIs from the Numeration. External Merge may also take a previously constructed SO as one of its inputs. IM, on the other hand, takes an element out of a previously syntactic object Σ, and merges it with Σ itself. This conception of IM, which requires a Copy-Delete mechanism is known as Copy theory of movement.

2.2. Search

Chomsky (1995, 2004) was able to eliminate both phrase structure rules and transformation from Generative Grammar and replaced them with a single operation Merge. Many argue that syntax only needs Merge since adding further operations runs counter to the spirit of Minimalism. However, Merge was not enough to explain grammatical relations that are interpreted at the Conceptual-Intentional (CI) and Sensorimotor interfaces (SM). These other relations are analyzed by different operations in syntax e.g. Feature Checking for Agreement. Having separate operations for grammatical relations at the Conceptual-Intentional (CI) or SEM and Sensorimotor interfaces (SM) or PHON can be deemed as problematic to Minimalism if its main goal is to reduce the complexity of the grammatical system. A solution to this problem suggested by Kato et al. (2014) as cited in Kato et al. (2016) and Fukui et al. (2017) was to reduce them into one operation. They noted that these operations share one common property that can be the basis for unification. This property is the "identity searching" operation. Feature Checking, for instance, can be considered as searching for matching features between a Probe and its Goal in the Probe-Goal model of feature checking of Chomsky (2000, 2001). Binding and Chain-formation may be regarded in this term as well. Binding can be described as the relation established between the antecedent and reflexive having the same reference. The antecedent may initiate a Search-for-similar-reference operation within its domain. Similarly, Chain formation may also be described as Search-for-Copy operation. This cluster of relation-forming operations can be unified under one operation known as Search which is defined by Fukui et al. (2017):

(5)   Search (Fukui et al., 2017, p. 76)

Let α be an element which initiates Search and β be the c-commanding domain of α. Then Search is an operation which searches through β for a feature or complex of features identical to the one contained in α and establishes a relation between those features.

Fukui et al. believed that this definition of Search is a generalized application of the Probe-Goal system that Chomsky (2000, 2001) had elaborated. Search perfectly captures Agreement, Binding, Chain-formation and even Labeling.

2.3. 0-Search and 0-Merge Hypothesis

After the other relation-forming operations at the periphery of narrow syntax had been unified under Search, the syntax has now two primitive operations, namely, Search and Merge. However, Kato et al. and Fukui et al. proposed a further reduction of these two principles. They

asked whether this reduction could pave the way for the unification of Search and Merge. To this end, they put forward the 0-Search and 0-Merge hypotheses. This hypothesis rests on the idea that two same primitive operations underlie Search and Merge or in other words, Search and Merge are composite of two primitive operations. They called these two operations, 0-Search and 0-Merge or $M_0°S_0$ (WS).

(6)   Definition of 0-Search and 0-Merge (adopted from Fukui et al., 2017, p. 129)

   a. 0-Search (S_0):

   0-Search is an operation such that it picks out n elements contained in a given domain as an input to 0-Merge.

   b. 0-Merge (M_0):

   0-Merge is an operation such that given n objects, it forms a set of these objects.

In this definition, 0-Search is an operation that selects lexical items or non-lexical items from the workspace which is defined as the union of the Lexicon and the previously constructed Syntactic Objects (SO) in the derivations, WS= $(\Sigma 1,…,\Sigma n) \cup$ Lexicon= $\{ \Sigma 1,…,\Sigma n, LI_1,…LI_m \}$. 0-Search takes the entire workspace as its input, S_0(WS). 0-Merge, on the other hand, forms an unordered set out of the syntactic objects selected by 0-Search, $(\alpha 1,…\alpha n)= \{ \alpha 1,…\alpha n \}$. 0-Merge takes S_0 (WS) as its input making this operation a composition of two primitive operations, $M_0(S_0$ (WS)) or $M_0°S_0$ (WS). In addition to reducing Merge, $M_0°S_0$ (WS) attempts to capture Agree, Binding, Labeling, and Chain formation. This is only possible if those operations are expressed as set-theoretic relations to be interpreted by either Conceptual-Intensional or Sensorimotor interface as "there is a relation between X and Y".

To illustrate first how Merge can be recast as $M_0°S_0$ (WS) operation, take for example the workspace that contains the lexical items *the*, *paper* thus WS= *the*, *paper*. 0-Search applies on this WS producing S_0(WS)= (*the, paper*). After this, 0-Merge applies to produce the unordered set M_0(*the*, *paper*) = {*the*, *paper*}. External Merge may also combine a lexical item from the lexicon, and a previously constructed syntactic object Σ, $M_0°S_0$ (WS)= {LI, Σ}. This can be captured due to the definition of workspace as a union of the lexicon and the domain of the previously constructed syntactic objects Σs. Take for example the verb phrase {*read* {*the*, *paper*}}. This SO is formed when 0-Search selects *read* from the numeration, and the previously constructed SO, {*the*, *paper*}. 0-Merge then applies to form {*read* {*the*, *paper*}}. $M_0°S_0$ can also apply to two Σs, $M_0°S_0$ (WS)= {Σ, Σ}. This operation is shown when {*read* {*the*, *paper*}} is

merged with a complex DP which has been constructed by EM as well e.g., {*the*, *lady*}. The resulting derivation will then be $M_0°S_0$ (WS)= {{*the, lady*}, {*read* {*the*, *paper*}}}. In terms of movement or Internal Merge, 0-Search picks out an element that is a member of a previously constructed SO Σ and the SO Σ itself. These two SOs are then 0-Merged. This process is encapsulated in $M_0°S_0$ (WS)= {α, Σ} (where a copy of α is contained in Σ).

Example of Wh-question (modified from Fukui et al., 2019, p. 130)

(7) a. What did John buy?

b. S_0= *what*, Σ

c. M_0= {*what* {*John,* {*buy, what*}}}}

A concrete example of this is the wh-movement in (7a). To derive this structure, 0-Search picks out what from the Σ {*John,* {*buy,* what}} *and* Σ *itself in (7b), and combines it with the rest of the structure via 0-Merge in (7c).*

In addition to Merge, Kato et al. and Fukui et al. also argued that Agree, Binding, Labeling, and Chain formation can be captured by $M_0°S_0$. Three of these, Agree, Binding, and Chain Formation, have already been unified by a general operation Search in Kato (2014). Search is a generalized probe-goal mechanism that underlies operations outside the narrow syntax. So, in order for the $M_0°S_0$ to account for these operations, Search needs to be reduced into 0-Search and 0-Merge.

(8)
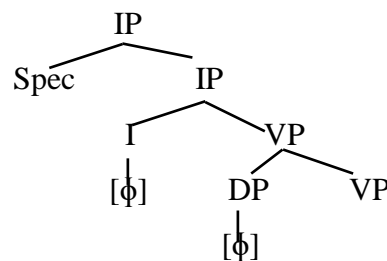
To illustrate this, take for example the instance Agreement. In Agreement, specifically subject-verb agreement, the phi-features of I must initiate Search to find a matching feature below it. The tree in (8) shows this. In $M_0°S_0$ (WS) terms, features of *I* initiates 0-Search which selects DP at the Specifier of VP. 0-Merge then applies to form {[ɸ] (of I), ([ɸ] (of DP)}. This set is then transferred to SM and interpreted as, there is ɸ-agreement relation between [ɸ] of I and [ɸ] of DP.

Example of Anaphor-binding (adopted from Fukui et al., 2017, p. 132)

(9)   a. *John criticized himself.*

b. [*John* [VP *criticized himself*

c. S_0= *John*, *himself*

d. M_0= {*John*, *himself*}

Binding and Chain formation can also be reformulated in this way. Binding involves the matching of the references between the anaphor and its antecedent. In (9a), *John* has the same reference as the anaphor *himself* in VP. Thus, a relation can be established between them. (9c) shows that 0-Search picks out *John* and *himself* then these two elements are formed into an unordered set by 0-Merge in (9d). This set is then transferred to CI and interpreted as there is a binding relation between *John* and *himself*.

(10)   a. *What did John buy*?

        b. [*John*, [$_{VP}$*buy what]]*

        c. $M_0°S_0$ (WS)= {*what* (at the Spec of CP, *what* (at the Comp of VP)}

Chain formation follows the same operations. Take for example the structures in (10). Once the Internal Merge applies, moving *what* to the Specifier position of CP, it and its copy would be selected by 0-Search, and then 0-Merge forms {*what* (at the Spec of CP), *what* (at the Comp of VP)} as shown in (10c). This is then interpreted at both CI and SM as there is a Chain relation between *what* (at the Spec. of CP) and *what* (at the Comp of VP). It can be assumed that at SM, one of the *what*'s is deleted.

Kato et al. (2016) and Fukui et al.'s (2017) also claimed that $M_0°S_0$ (WS) can capture labelling by adopting (11):

Labelling (adopted from Kato et al., 2016, p. 33)

(11) $M_0°S_0$ (Σ)= {Σ, λ}

They exemplified the labelling of SO {*love*, *himself*}. *love*, and Σ= {*love*, *himself*} are selected by 0-Search and then 0-Merged to form a set. This is shown in (12).

(12) $M_0°S_0$ ({*love*, *himself*}) = {{*love*, *himself*}, *love*}

This is interpreted as, "love" is the label of the relevant constituent.

Kato et al. and Fukui et al.'s further reduction of Merge and other relation-forming operations to a set of primitive operations,0-Search and 0-Merge, had practically unified operations at the narrow and broad syntax. Their hypothesis can be further extended to another operation that has been considered outside the narrow syntax (Chomsky, 1995; Chomsky & Berwick, 2016).

2.4. Linear Order

One of the first and most prominent attempts to capture the linear order of syntactic objects within the generative framework is the theory of Antisymmetry and the Linear Correspondence Axiom (LCA) of Kayne (1994). The antisymmetry and the LCA relate hierarchical structure to linear order by stipulating that asymmetric c-command directly mirrors precedence. The LCA is given in (13).

(13) d(A) is a linear ordering of T

where:

d is the non-terminal to terminal relation.

A is a set of ordered pairs of non-terminals such as that the first *asymmetrically c-commands* the second.

where *asymmetric c-command* is defined as:

A asymmetric c-commands B if and only if A c-commands B and B does not c-command A.

T is the given phrase marker.

The LCA states that asymmetric relations among non-terminals directly translates to the precedence of terminals via dominance relation. To be more concrete, take a look at how terminals x, y, and z can be ordered based on the phrase marker illustrated below.

(14)
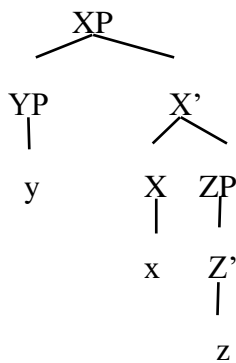
In diagram (14), YP asymmetrically c-commands X, ZP and Z' thus LCA would produce a set of ordered pairs <YP, X>, <YP, ZP>, <YP, Z'>. And since these pairs are mapped into linear order of terminal string via d, the terminal string would be ordered <y,x>, <y,z>. y precedes x and z. To compute the order of x relative to z, the LCA would produce the set <X, Z'> since X asymmetrically c-commands Z'. This will produce the ordered pair <x,z> for terminals x and z. This last ordered pair achieves transitivity of relation that LCA conforms to, R (y, x) & R (x, z)➔ R(y, z). LCA is also asymmetric in such as R (y, x)➔~ R (x, y) which means that in a

given phrase marker, no terminals can precede each other. The LCA must also achieve totality by which all terminals must linearized relative to one another.

The LCA was able to capture the basic structure of X-bar schema and explained many of its properties including the structures it does not allow. One of these structures is the double head construction shown in (15).

(15)

```
        Z
      /   \
    X       Y
    |       |
    x       y
```
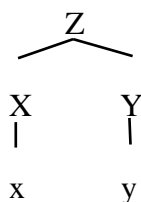
In diagram (15), neither non-terminals asymmetrically c-command the other so no possible linear order can be established between the terminals. In X-bar theoretic terms, no head can be combined with another head. Another structure that LCA prohibits is the combination of two complex phrases such as the one illustrated in (16).
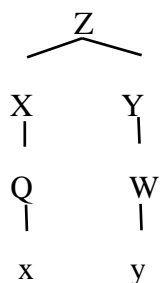
(16)

```
        Z
      /   \
    X       Y
    |       |
    Q       W
    |       |
    x       y
```

Diagram (16) shows that X asymmetrically c-commands W producing the ordered pair <X, W>. This ordered pair gives the order of terminals <x, y> via d. This structure, however, does not respect the property *asymmetry*, R(y, x)→~ R(x, y), since Y also asymmetrically c-commands Q that produces <Y, Q> ordered pair which linearizes their respective terminals into <y, x>. Diagram (16) contains both ordered pairs <x, y> and <y, x> which violates asymmetry. Kayne claims that these types of structures are not allowed by X-bar schema due to their failure to be linearized giving conceptual grounds to his theory. Kayne claimed that LCA applies at all levels of syntax barring points of symmetry throughout the derivation including at the level of D-structure. Chomsky (1994), on the other hand, relegated LCA as an operation in the Phonetic-Articulatory interface or PF since terminals only need to be linearized

when they are spoken or externalized. Chametzy (1999) echoed this argument when he said that, "linearization is the consequence of the physics of speech". These claims render linear order or externalization as an operation outside the narrow syntax. Uriagereka (2001, 2012), meanwhile, pointed an ad hoc theoretical device that both Kayne (1994) and Chomsky (1995) employed in order to circumvent the LCA's inability to linearize Spec. and Head-Complement structure. He integrated the LCA in his Multiple Spell-Out model as the Linearization Mechanism that applies to command units (later termed as current).

In summary, Kato et al. (2016) and Fukui et al. (2017) have shown that $M_0°S_0$ hypothesis can account for the operations outside the narrow syntax if these operations are assumed to be set-theoretic relations. Their hypothesis, however, did not include the externalization of syntactic objects which is considered peripheral to the narrow syntax in the minimalist program.

3. METHODOLOGY

This paper employs analytic and armchair method. The analytic method is defined by Chametzky (1999) as, "concerned with investigating the (phenomenon) domain in question. It deploys and tests concepts and architecture developed in theoretical work, allowing for both understanding of the domain and sharpening of the concepts." (p. xviii). This paper synthesizes 0-Search and 0-Merge Hypothesis, the LCA, and the Multiple Spell-Out Model to reconceptualize linearization as Search-Merge based operation which further unifies the operations outside narrow syntax. Examples sentences used to illustrate how linearization can be recast as $M_0°S_0$ are from Tagalog and English languages. English sentences were contrived examples while the Tagalog sentences were adopted from Ceña & Nolasco (2011).

4. DISCUSSION

Kato et al. (2016) and Fukui et al. (2017) left a research gap in their proposal when they did not address how the linearization of syntactic objects can be recast in $M_0°S_0$ terms. Just like Agree, Binding, Labeling, and Chain formation, linearization or externalization is an operation at the broad syntax (Berwick & Chomsky, 2016 cf. Kayne 2013), and thus should be captured by $M_0°S_0$ as well. To this end, we propose (17):

Linear Order

(17) a. $S_0 = \{\alpha\}, \Sigma$ where $\Sigma = \{\alpha, \beta\}$

    b. $M_0(\{\alpha\}, \Sigma) = \{\{\alpha\}, \Sigma\}$

    c. $M0°S_0 (\{\alpha, \beta\}) = \{\{\alpha\}, \{\alpha, \beta\}\}$ or $<\alpha, \beta>$

In (17a), 0-Search picks out two SOs, the α expressed as a unit set {α}, and Σ which is the previously constructed syntactic object {α, β}. (17b) combines these two SOs, {{α}, Σ} the output of which is the set-theoretic expression of linear order of two elements, {{α}, {α, β}}. This ordered set is transferred and interpreted in SM as, there is a precedence relation between α and β. Linearization shares a common property with Internal Merge, Labeling, and Chain formation in that it takes two SOs in which the first SO α is copied from the second SO Σ.

(18) a. S_0= {*read*}, {*read* {*the, paper*}}

    b. M_0= {{*read*}, {*read* {*the, paper*}}}

    c. $M_0°S_0$ ({*read* {*the, pape*r}}}) = {{*read*}, {*read <the, paper>*}} or *<read, <the paper>*

(18) illustrates how this operation can order the SO {*read* {*the paper*}}. 0-Search picks out {*read*}, and {*read, <the, paper>*}. These SOs are then combined via 0-Merge to form the ordered set, {{*read*}, {*read* {*the paper*}}} which is interpreted as there is a precedence relation between *read* and *the paper*. To further expound the operation, take a look at (19), a sentence from Filipino/Tagalog—a verb-initial language.

(19)   Filipino Sentence (taken from Ceña and Nolasco, 2011, p. 70)

        Bumili   *ang*   *tao*   *ng*   *basi*

        Perf.trans-*buy* ABS   *person*   ERG *wine*

(20)   a. S_0= {*Bumili*}, {*Bumili*, {*ang tao ng basi*}}

               b. M_0= {{*Bumili*}, {*Bumili*, {*ang tao ng basi*}}}

               c. $M_0°S_0$=({{*Bumili*}, {*Bumili*, {*ang tao ng basi*}}}

The derivation in (20) shows the linearization of the verb *Bumili* relative to the constituent *ang tao ng basi*. The linearization of the latter is put aside for brevity but it can be assumed that the linearization for this constituent is also accomplished via (17) as well. The derivation in (20) shows that S_0 picks out the verb *Bumili* from Σ= {*Bumili* {*ang tao ng basi*}} and Σ itself resulting in (20b). These two syntactic objects, {*Bumili*} and {*Bumili* {*ang tao ng basi*}}, are then 0-Merged in (20c). This ordered set is interpreted at the Sensorimotor interface as there is a precedence relation between *Bumili* and *ang tao ng basi*.

4.1. Asymmetric C-command and Minimality Condition

The proposal above has left some questions that need be addressed. One of these is how S_0 pick out its target contained in Σ. For this question, I will adopt the Minimality Condition as defined by Kato et al. (2016) and Fukui et al. (2017). Kato et al. and Fukui et al. claimed that the Minimality Condition applies to any instance of $M_0°S_0$ (WS). Minimality Condition is defined as:

(21)   Minimality Condition on $M_0°S_0$ (modified from Kato et al.,2016, p. 38)

For any linguistic relation R, $M_0°S_0$ (WS) may generate $\{\alpha, \beta\}$ as an instance of R if

a. $\{\alpha, \beta\}$ meets formal restrictions on R, and

b. There is no γ such that $\{\alpha, \gamma\}$ also meets formal restrictions on R and Depth $(\gamma)<$Depth (β) where Depth is defined as the inverse of structural prominence.

where Structural Prominence is defined as (taken from Kato et al.,2016, p. 38):

Suppose that Depth $(\alpha)= m$ $(m\geq0)$ is the order of depth—the inverse of the relation of

prominence—associated with the SO α, with the lower prominence indicated by a
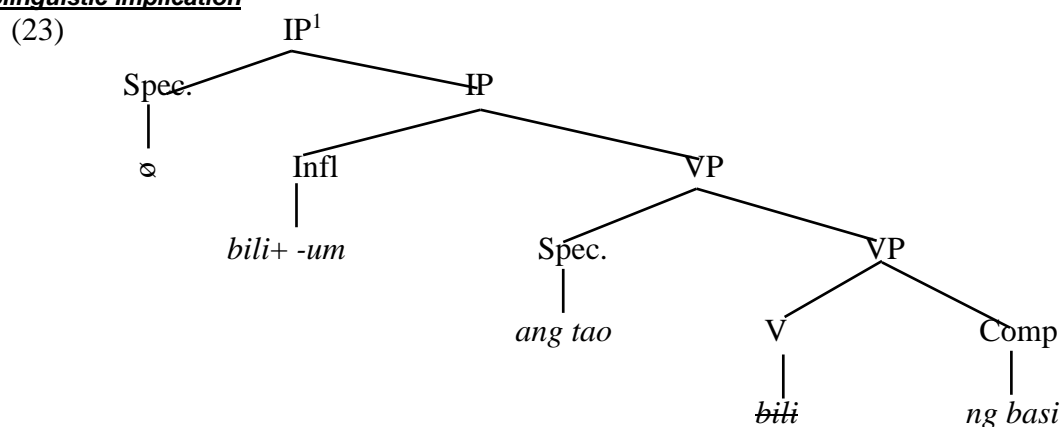
a higher value of depth. Then, we can say:

a. Depth $(\alpha)=0$ if there is no SO β such as $\alpha \in \beta$ (i.e., α is the root SO dominated by no other SO).

b. If Depth $(\alpha)= m$, then Depth $(\beta)= m+1$ for any β such as that $\beta \in \alpha$ (i.e., β is the daughter of α.

The Minimality Condition on $M_0°S_0$ states that in order for R relation to be established between α and β, $\{\alpha, \beta\}$ must meet formal restrictions on R and that there is no γ such as that γ is more prominent than β. For linearization, a formal restriction can be expressed in (22).

(22)   Precedence

$<\alpha, \beta>$ may count as an instance of Precedence only if α does not dominate β.

In (20), the selection of *Bumili* by S_0 meets the Minimality condition as shown in (23).

(23)

```
                              IP¹
                 ┌─────────────┴─────────────┐
               Spec.                          IP
                 │               ┌────────────┴────────────┐
                 ∅             Infl                          VP
                               │                ┌────────────┴──────────┐
                             bili+ -um        Spec.                      VP
                                               │                ┌────────┴────────┐
                                             ang tao            V                Comp
                                                                │                 │
                                                              bili              ng basi
```

The phrase marker in (23) clearly shows that the Infl that houses *bili+um= bumili* is the most prominent SO in the tree and that neither Infl nor VP dominates the other, which meets the formal restriction in (22). The (asymmetric) c-command condition for linear order adopted by the LCA can be considered as the natural consequence of minimality condition similar to what Kato et al. (2016) and Fukui et al. (2017) suggest for Binding.

4.2. Linearizing beyond Head-Complement Structure

$M_0°S_0$ (WS) hypothesis for linearization, just like the LCA, faces the problem of how to linearize the specifier to the head-complement. The problem stems from the fact that asymmetric c-command cannot be established between these two components. Although $M_0°S_0$ (WS) hypothesis for linearization indirectly relies on this syntactic relation through the minimality condition, it does not do away with the problem. In a typical sentence structure for instance, both the specifier DP and the lower IP have equal Depth as shown in (24) based on (21).

(24)

```
                 IP=0
          ┌───────┴───────┐
        DP=1             IP=1
```
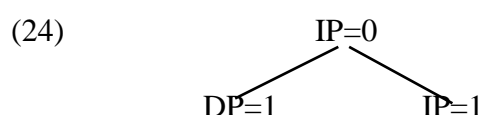
An ad hoc solution to this problem in LCA terms was adopted by Kayne (1994) and Chomsky (1995). They resorted to a more complicated definition of c-command based on the segment/category distinction. Uragiereka (2001, 2012), however, pointed out the seemingly ad hoc nature of segment/category distinction. He has argued that beyond purpose of allowing for the linearization of complex branching phrases e.g., specifier and head-complement, this distinction has no independent basis. Uragiereka (2001, 2012) put forward an alternative solution embodied in his Multiple Spell-Out model (MSO). The central claim of the MSO model is that Spell-Out, the process of mapping or transferring from syntactic representation
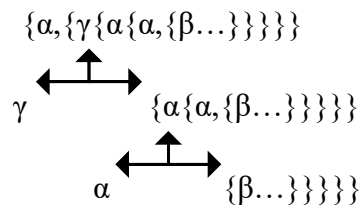
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[1] I ignore several details in this phrase marker such as the small vP and the internal structures of Spec, IP, Spec, VP, and Comp, VP

to PF, applies multiple times and by chunks. This architectural feature provides a solution to the problem of linearizing the specifier and head-complement without recourse to segment/category distinction. The MSO can easily be integrated into $M_0°S_0$ (WS) hypothesis.
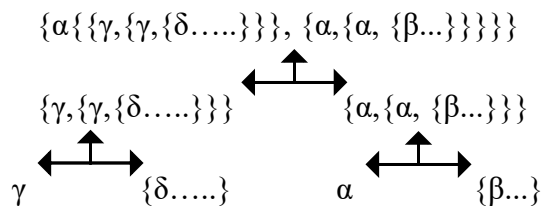
The key feature of Uriagereka's (2001) solution is to limit the application of LCA to a structure known as Command Unit (or Current in Uriagereka (2012)) in (25).

(25)   Command Units or Current (Uriagereka, 2001, p. 252)

a.   Command Unit

$$\{\alpha,\{\gamma\{\alpha\{\alpha,\{\beta\ldots\}\}\}\}\}$$

γ $\{\alpha\{\alpha,\{\beta\ldots\}\}\}\}\}$

α $\{\beta\ldots\}\}\}\}\}$

b.   Not a command unit

$$\{\alpha\{\{\gamma,\{\gamma,\{\delta\ldots\}\}\}, \{\alpha,\{\alpha, \{\beta\ldots\}\}\}\}\}$$

$\{\gamma,\{\gamma,\{\delta\ldots\}\}\}$ $\{\alpha,\{\alpha, \{\beta\ldots\}\}\}$

γ $\{\delta\ldots\}$ α $\{\beta\ldots\}$

Uriagereka (2001) defines CU as a structure constructed by continuous application of Merge as in (25a). This is in contrast with (25b) which involves two separately assembled structures that are joined together. Uriagereka (2012) renamed this structure as Current to which he attributes the following definition:

(26)   Derivational Current (Uriagereka, 2012, p. 86)
        A set of phrasal representations is a derivational current if and only if all its symbols can be expressed in FS fashion without information loss.

Currents must follow the Finite State Limit in (27).

(27)   Finite State Limit on Phrase Structure (Uragiereka, 2012, p. 53)
        An exhaustively binary phrase marker, none of whose branches symmetrically bifurcates, can be expressed in FS fashion.

In the example given by Uriagereka (2012), he identifies (28a) as a single current but not (29a).

(28)

      a. He saw her

      b. {*saw*, {*he*,{*saw*,{*saw, her*}}}}

      c.   *he* ⟷↑ {*saw*, {*saw, her*}}

      d.   *saw* ⟷↑ *her*

(29)

      a. *The man saw a woman.*

      b.   {*saw*, {*saw*, {*a*, {*a, woman*}}}}

      c. {*the*, {*the, man*}}   *saw* ⟷↑ {*a*, {*a, woman*}}

         the ⟷↑ *man*

      d. {*saw*, {{*the*, {*the, man*}}, {*saw*, {*saw*, {*a*, {*a, woman*}}}}}}

         {*the*, {*the, man*}} ⟷↑ {*saw*, {*saw*, {*a*, {*a, woman*}}}}

(28a) is a current because it is assembled by a continuous application of Merge and that no branches symmetrically bifurcate. (29a), on the contrary, is assembled in two separate derivational cascades. It also violates the FS limit in (27). Uriagereka (2012) claims that the LCA only applies within these "linearizable chunks" (p.73). The concepts of Current and Multiple Spell-Out help avoid the problem noted early in this section. Observe how the sentence in (30) can be linearized based on Current-based derivation. (31) shows the phrase markers representing the currents in (30).

(30)

      a. *The lady reads the paper.*

      b.   {*reads*, {*reads*, {*the*, {*the, paper*}}}}

      c.   *reads* ⟷↑ {*the*, {*the, paper*}}

      d.   *the* ⟷↑ *paper*

      e. {*the*, {*the, lady*}}

      f. *the* ⟷↑ *lady*

      g. {*reads*, {{*the*, {*the, lady*}}, {*reads*, {*reads*, {*the*, {*the, paper*}}}}}}

         {*the*, {*the, lady*}} ⟷↑ {*reads*, {*reads*, {*the*, {*the, paper*}}}}

(31)

   a.

```
                        VP
              V                    DP
              |              D          NP
            reads           |          |
                           the        paper
```

   b.

```
                   DP
            D            NP
            |            |
           the          lady
```
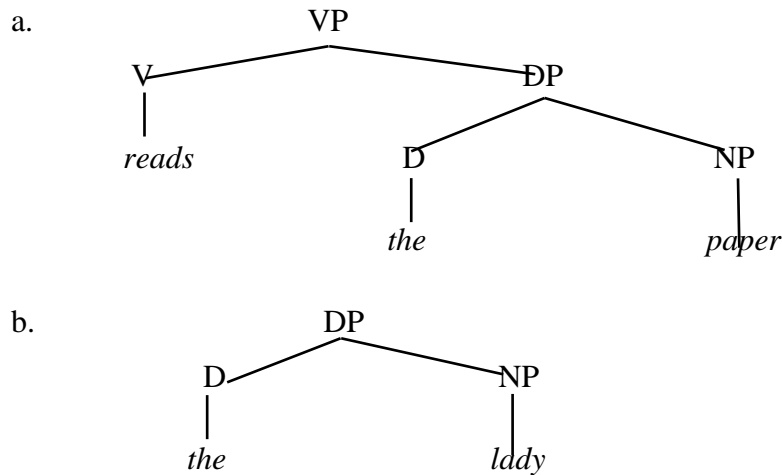
(30a) is assembled by first merging *the* and *paper* in (30d). This SO is then merged with the verb *reads* in (30c) resulting in (30b). (30b) is a current because it is assembled by continuous application of Merge and its branches do not symmetrically bifurcate as shown (31a). The linearization mechanism then applies to linearize the lexical items contained in this current. (30) also shows that the Specifier is assembled in another derivational cascade. It is assembled by merging *the* and *lady* as illustrated in (30f). This set meets the criterion of being a current. The lexical items in these currents are linearized separately by the linearization mechanism which, in Uriagereka (2001, 2012), is the LCA. By applying the LCA in separate currents, the problem of asymmetric c-command relation between these currents does not arise.

Linearizing the elements of each current separately does not allow any interaction among these elements outside their current. How then are these elements linearized in relation to one another? Uriagereka (2001, 2012) offers two solutions; the conservative and the radical one. The conservative solution proposes that once a current is spelled out it becomes a "giant lexical compound or a frozen idiom" (p. 89). This lexical compound can only enter into another derivation as a word with its tree structure gone. The structure-less unit is barred from entering relations that are predicated on its hierarchical structure making c-command relation impossible. The linear order of the elements in different currents is only possible via Induction in (32).

(32)   Induction (Uriagereka, 2012 p. 85)

         If a non-terminal X dominates a terminal y, and X is linearized with regard to terminal z, then y is linearized with regard to z.
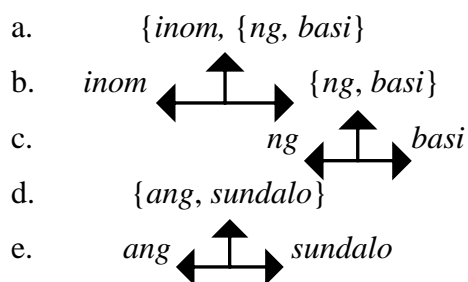
Induction ensures that precedence relation among the elements of two different currents can be established through the precedence relations of their mothers. Induction is also used to avoid the Untangling Condition of Partee et al. (1993). The radical solution, on the other hand, proposes that spelt out currents do not even merge with each other, and that the final process of interphrasal association is accomplished in the performative component (Uriagereka, 2001). In both solutions, elements of different currents do not interact with one another and are only linearized based on precedence relation of their mothers.

Uriagereka's (2001, 2012) solution to the problem of linearizing the Specifier to the head-complement structure can be adopted by the linearization algorithm proposed in this paper in a simple fashion. According to Uriagereka's (2001, 2012), when a phrase marker reaches an FS limit it is spelled out that is, the linearization mechanism applies to the phrase marker. In Uriagereka's works, the linearization mechanism adopted was the LCA. In the current proposal, this is replaced by $M_0°S_0$. Take for example the Tagalog sentence in (33) adopted from Ceña and Nolasco (2011, p. 51). The current-based derivation is shown in (34).

(33)

    a. *Uminom*   *ang sundalo ng basi*   (Ceña & Nolasco, 2011, p. 51)

       Perf.trans-drink   ABS soldier   ERG wine

(34)

    a.   {*inom,* {*ng, basi*}

    b. *inom* ⟷⬆⟶ {*ng, basi*}

    c.   *ng* ⟷⬆⟶ *basi*

    d.   {*ang, sundalo*}

    e. *ang* ⟷⬆⟶ *sundalo*

The derivation in (34) shows that the sentence in (33) is composed of two currents. The one in (34a) is formed by merging the lexical items (LIs) *inom* and *ng basi* while (34d) is formed by merging the determiner *ang* and the noun *sundalo*. The phrase markers representing these two currents are shown in (35).

(35)

(a)

(b)
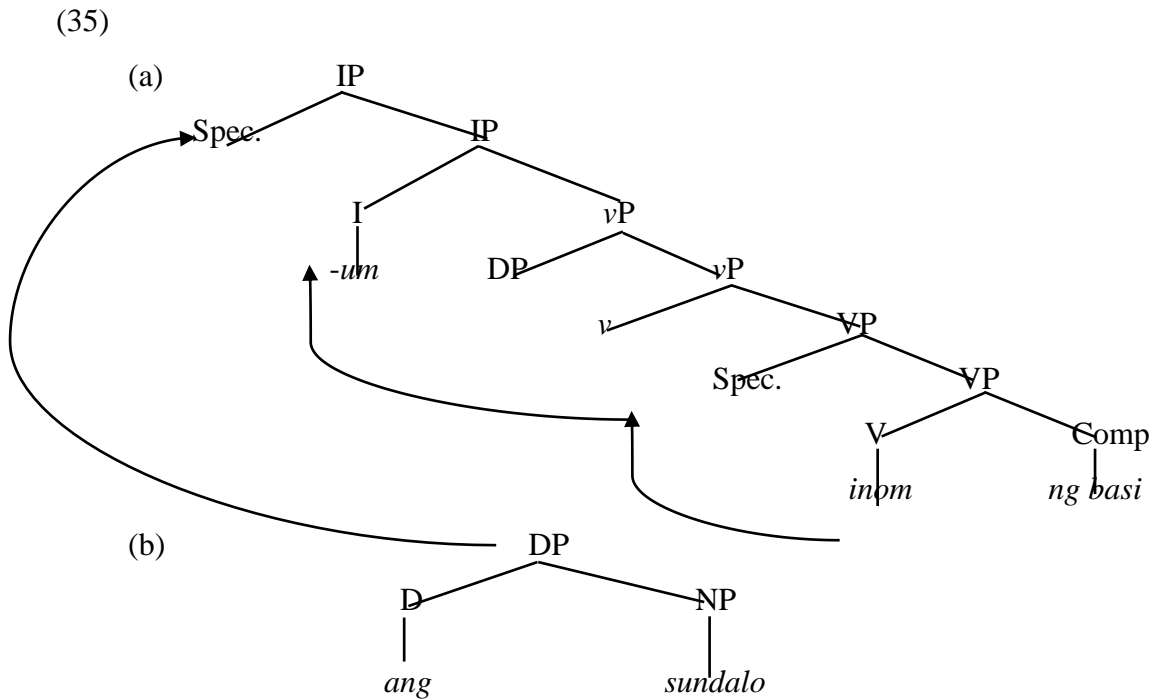
We would assume that *–um* is within the same current as *inom* and *ng basi*. Placing *–um* in another current would make the raising of V *inom* to I *-um* as a current-to-current extraction. Uriagereka (2001) used Principle of Cyclicity which states that "all syntactic operations take place within the derivational cycles of CUs" (p. 274) as a constraint that prevents such movement to occur. (36) shows the phrase marker in which the DP current has been attached, and that the V has been moved to I.

(36)
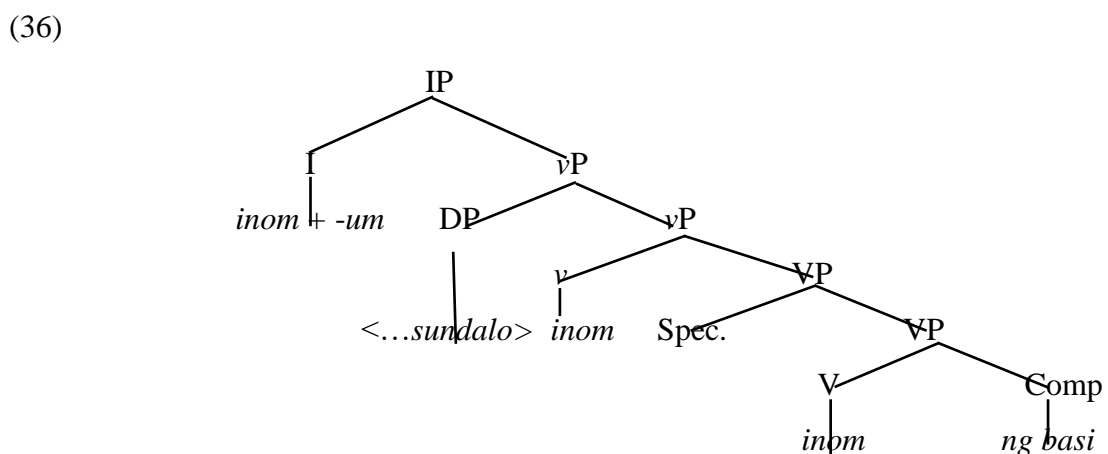
Applying the 0-Search and 0-Merge operations results in (37) where the order of each current is computed separately.

(37)

   a. S_0= {*uminom*}, {*uminom, ng basi*}

      M_0({*uminom*}, {*uminom, ng basi*}) = {{*uminom*}, {*inom, ng basi*}}

      $M_0°S_0$ ({*uminom*}, {*uminom, ng basi*}) = {{*uminom*}, {*uminom, ng basi*}} or

   <uminom,

        ng basi>

   b. S_0= {*ang*}, {*sundalo*}

      M_0({*ang*}, {*sundalo*}) = {{*ang*}, {*ang, sundalo*}}

      $M_0°S_0$ ({*ang*}, {*sundalo*}) = {{*ang*}, {*sundalo*}} or *<ang, sundalo>*

When elements inside each current have been spelled out, they are not allowed to interact with one another thus the problem of symmetric c-command between the specifier and head-complement does not arise. The kind of derivation shown above is compatible with Uriagereka's (2001, 2012) conservative and the radical solutions.

5. BIOLINGUISTIC IMPLICATION

In addition to filling in the theoretical gap, when linearization of syntactic objects is recast in 0-Search and 0-Merge hypothesis terms, it resembles the operation Internal Merge (IM) at the narrow syntax; both operations pick out and merge two syntactic objects in which the first object is an element of the second object. This core property suggests that both operations can be reduced to one i.e., linearization being the application of Internal Merge at the interface level. This is an attractive hypothesis especially to Chomsky's biolinguistic program. Chomsky's thesis is that the "core property of language is its use in creating and formulating thought" contrary to the "modern view that language evolved as an instrument for communication" (Chomsky in Taylor & Krikorian, 2015). His thesis centers on the idea that language originally emerged for thought, and was later recruited via exaptation to other domains. In 2006, Chomsky alluded to one domain to which such a process of exaptation may have occurred—arithmetic:

> "Suppose that a language has the simplest possible lexicon: just one LI, call it "one". Application of Merge to the LI yields {one}, call it two. Application of Merge to {one} yields {one, {one}}, call it "three." And so on. In effect, Merge applied in this manner yields the successor function. It is straightforward to define addition in terms of Merge (X, Y), and in familiar ways, the rest of arithmetic […]. It may, then, have been a side product of some other evolved

capacity, and it has often been speculated that it may be abstracted from FL by reducing the latter to its bare minimum" (p.139).

What can be taken from Chomsky's claim is that the successor function is just the application of Internal Merge in another domain. Given that Linearization of syntactic objects and Internal Merge share the same core property, merging two syntactic objects in which the first object is an element of the second object, which is also true for successor function—WS={one}, S_0= one, {one}, M_0= {one, {one}} where one ϵ Σ={one}—I assume, although highly speculatively, that linear order is also a result of exaptation of Internal Merge from narrow to broad syntax.

6. SUMMARY

The preceding discussion focuses on the hypothesis that the linearization of syntactic objects (SO) can be recast as $M_0°S_0$ (WS) operation where S_0 picks out SOs for M_0 to combine. $M_0°S_0$ (WS) results in an ordered set of α and β, <α, β>. This extension of $M_0°S_0$ (WS) to include linearization fills in the gap of Kato et al. and Fukui et al.'s original 0-Search and 0-Merge hypothesis. In their original proposal, Kato et al. and Fukui et al. only applied $M_0°S_0$ (WS) to Agreement, Labeling, Binding, and Chain formation leaving linearization, which is also considered as an operation outside the narrow syntax (Chomsky, 1995; Berwick & Chomsky, 2016), untouched. The discussion also included the formulation of Minimality Constraint on linearization in $M_0°S_0$ (WS) terms. $M_0°S_0$ (WS) for linearization, however, also faces a problem of linearizing the specifier in relation to the head-complement just like the LCA. This is rooted in the fact that specifier asymmetrically c-commands the element dominated by the head-complement and vice versa. A solution adopted from Uriagereka (2001, 2012) was integrated in the hypothesis in order to circumvent this problem. Uriagereka (2001, 2012) proposed that linearization algorithms such as the LCA only applies to a command unit which he later termed as current. When a current is linearized via Spell-Out, its constituents are not allowed to interact with constituents inside another current leaving their linear order to Induction. Aside from further unifying the operations at the broad syntax, the working hypothesis also has a biolinguistic implication: linear order of SOs may be a result of exaptation of the core property of syntax to another domain i.e., communication or speech similar to the suggestion of Chomsky (2006) for arithmetic.

REFERENCES

Berwick, B.C. (2011). All you need is merge: Biology, computation, and language from bottom up. In A.M. Di Sciullo & C. Boeckx (eds), *The biolinguistic enterprise*. Oxford University Press.

Berwick, B.C., & Chomsky, N. (2016). *Why only us: Language and evolution*. MIT Press.

Ceña, R. M. & Nolasco, R.M.D. (2011). *Gramatikang Filipino: Balangkasan.* University of the Philippines Press.

Chametzky, R.A. (1996). *A Theory of Phrase Markers and Extended Base*. State University of New York Press.

Chomsky, N. (1995). *The Minimalist Program*. MIT Press.

Chomsky, N. (2000). Minimalist inquiries: The framework. In R. Martin, D. Michaels, & J. Uriagereka (eds), *Step by step: Minimalist essays in honor of Howard Lasnik* (pp.89-155). MIT Press.

Chomsky, N. (2001). Derivation by phase. In M. Kenstowicz (ed), *Ken Hale: A life in language*. MIT Press

Chomsky, N. (2004). Beyond explanatory adequacy. In A. Belleti (ed), *Structures and beyond: The cartography of syntactic structures*, volume 3 (pp.104-131). Oxford University Press.

Chomsky, N. (2006). On phases. In R. Freidin, C.P. Otero, M.L. Zubizarreta, *Foundational Issues in Linguistic Theory* (pp.133-166). MIT Press.

Fukui, N., Narita, H., Kasai., H., Kato., T., & Zushi, M. (2017). 0-search and 0-merge. In N. Fukui, *Merge in the mind-brain: Essays on theoretical linguistics and neuroscience of language* (pp. 127-154). Routledge.

Kato, T., Hiroki, N., Kasai, H., Zushi, M., & Fukui, N. (2016). On the primitive operations of syntax. In K. Fujita & C. Boeckx (eds), *Advances in biolinguistics: The human language faculty and its biological basis* (pp. 29-45). Routledge.

Kato, T., Kuno, M., Narita, H., & Zushi, M. (2017). Generalized search and cyclic derivation by phase. In N. Fukui, *Merge in the mind-brain: Essays on theoretical linguistics and neuroscience of language* (pp.75-93). Routledge.

 Kayne, R. (1994). *Antisymmetry of Syntax.* MIT Press.

Taylor, E., & Krikorian, A. (2015, June 5). *Dialogue between Noam Chomsky and Lawrence Krauss-March 2005* [Video]. https://www.youtube.com/watch?v=uBVb6wRdwV4

Uriagereka, J. (2001). Multiple spell-out. In S. D. Epstein & N. Hornstein (eds), *Working minimalism* (pp. 249-282). The MIT Press.

Uriagereka, J. (2012). Spell-out and the minimalist program. Oxford University Press.

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