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Approaches to Linearization in Universal Grammar: A Review

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Approaches to Linearization in Universal Grammar: A Review

Evrensel Dilbilgisi'nde Çizgiselleştirme Yaklaşımları: Bir İnceleme

Abstract

Linearization, by its definition, is an interface requirement imposed onto syntactic objects by the Articulatory-Perceptual (A-P) system, which is in close interaction with PHON. Therefore, as soon as syntactic objects are mapped to PF, they lose their two-dimensional structures by means of a special operation. Various approaches have been proposed in literature in order to explain the algorithm of this special operation. The aim of this study is to introduce these approaches and review them with the relevant operations of the approach. In this sense, we only focused on the derivational approaches proposed within Universal Grammar tradition.

Keywords: Linearization, Syntax-PF Mapping, Multiple Spell-Out, PF-Interface, Phase Theory

Özet

Çizgiselleştirme, tanımı itibariyle, sözdizimsel nesneleri SES ile etkileşim halinde olan Sesletimsel-Algısal (S-A) dizgenin güdümüne sokma işidir. Buna göre, sözdizimsel nesneler, sözdizimden SB'ye eşlenirken iki boyutlu yapılarını tek boyutlu bir yapıya indirgeyen bir işleme uğrarlar. Alanyazında, bu işlemin işleyiş sürecini açıklamaya çalışan çeşitli yaklaşımlar önerilmiştir. Bu çalışmanın amacı, bu yaklaşımları tanıtmak ve yaklaşımın ilgili işlemleriyle yaklaşımları gözden geçirmektir. Bu bağlamda, yalnızca Evrensel Dilbilgisi çerçevesinde önerilmiş türetimsel yaklaşımlara odaklanılmıştır.

Anahtar Sözcükler: Çizgiselleştirme, Sözdizim-SB Eşleştirmesi, Çoklu Dağıtım, SB-Arakesiti, Evre Kuramı

Linearization: the Definition

The common belief in Generative Grammar tradition is that the grammatical operations are structure dependent and that they do not make use of linear dependency relations. However, starting from *Linear Correspondence Axiom* (LCA) (Kayne, 1994), linearization and linear dependencies has begun to be realized as a prominent field with such studies as Chomsky (2000s.), Nunes & Uriegereka (2000), and Fox & Pesetsky (2005a) among others. If we are to set off from the definition of the term 'linearization', it simply means to reshape a two-dimensional object into a single dimension. On the other hand, in technical terms, it refers to the interface requirement imposed onto syntactic objects by the Articulatory-Perceptual (A-P) system as soon as the syntactic objects are spelled-out, which enables the system to read off the structure (Hornstein, Nunes & Grohmann, 2005: 219).

Linearization: the Approaches

Given that linearization is an interface requirement imposed by A-P system, there are two levels where the syntax-PF[i] mapping of the syntactic structures takes place: syntax or phonology. In literature, there are syntax-based linearization approaches (Chomsky, 1981; Fox & Pesetsky, 2005a; Kayne, 1994; Nunes & Uriagereka, 2000; Richards, 2007; Uriagereka, 1999) as well as phonology-based linearization approaches (Dobashy, 2004; Ishiara, 2007; Kratzer & Selkirk, 2007; Selkirk, 1972; Selkirk, 2011; Shiobara, 2009; Tokizaki, 2009).

Approaches to Linearization – I: the Syntactic Perspective

What syntax-based linearization approaches have in common is that they all regard syntax as the first and the core determinant of the linear order. We will cover the approaches which make use of *Multiple Spell-Out* (MSO) (following Uriagereka, 1999); that is, the approaches presented with a minimalist point of view[ii].

Before moving on to the approaches presented within the framework of the MP, we should first state the other derivational approaches within the *Extended Standard Theory* (EST) tradition, which can be counted as the preliminary versions of the recent approaches:

(1) *Approaches before the MP*

Directionality Parameter (Chomsky, 1981)

Linear Correspondence Axiom (Kayne, 1994)

As we will see, the algorithms of these two approaches are somehow embedded in the recent approaches which are the MSO (Nunes & Uriagereka, 2000), the Dynamic Linearization (DL) (Richards, 2007) and the Cyclic Linearization (CL) (Fox & Pesetsky, 2005a).

Multiple spell-out (Nunes & Uriagereka, 2000; Uriagereka, 1999)

X-bar approach does not propose any machinery or operation for transforming the hierarchical structure into linear order. Kayne (1994) was the first to suggest that the linear order can be deduced from the hierarchy:

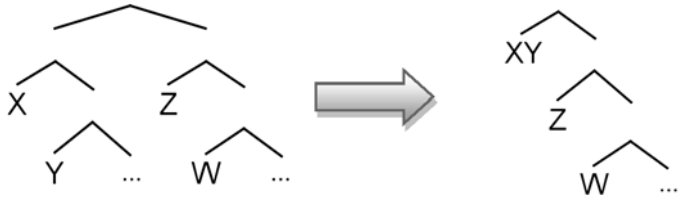
(2) *Linear Correspondence Axiom*

a. Base Step: If α (asymmetrically) c-commands β, then α precedes β.

b. Induction Step: If ɣ precedes β and ɣ dominates α, then α precedes β.

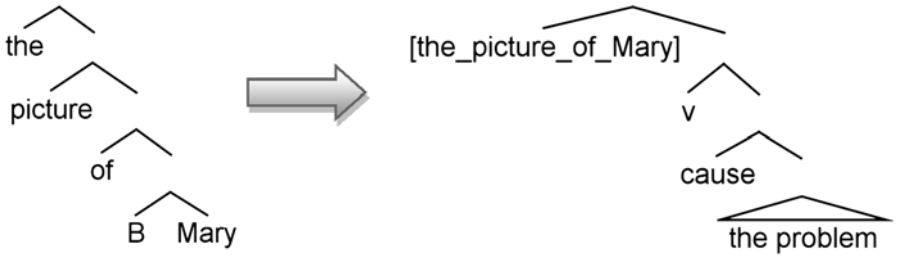
The main proposal of the MSO was to remove the induction step of LCA. In order to delete the step, he maintained that the spell-out should take place more than once in a derivation. Therefore, every time a complex specifier enters the derivation, it should be spelled-out before it is merged into a specifier position. In this way, the induction step can be eliminated from LCA. The derivation will be as follows:

(3)



To be more clear, let us see (4) from Sheehan (2009: 234):

(4)



MSO → [the_picture_of_Mary]

In sum, the MSO makes use of the base step of the LCA to linearize the terminal nodes, and suggests that spell-out should occur more than once in a derivation as a *last resort* imposed onto complex specifiers due to the c-command considerations. The MSO also takes the basic assumptions of LCA as granted such as left-branchingness, and spec-head-complement order, which means that all word orders are derived from the universal SVO order.

Dynamic linearization (Richards, 2007)

Cyclic spell-out allows the dynamic linearization to proceed with optimal computational efficiency. In this respect, the term 'dynamic' refers to the periodic transfer of the phases (in the sense of Chomsky, 2008), and thus, linearizing process at each spelled-out domain, and to the fact that this linearization process do not stop until the derivation ends.

Richards constructs his algorithm over the *Precedence Resolution Principle* (PRP) (Epstein *et. al.*, 1998), which basically states that the linear order is determined via the symmetric c-command relation between the sisters. According to PRP, if two sister categories c-command each other symmetrically, one of the possible c-command relations are ignored on the basis of the head-directionality (Chomsky, 1981).

Given that we have the linear order information in hand provided by the PRP, there are two precedence possibilities. To make it more explicit, let us say that we have a sister set {α, β}. Therefore, we will have two c-command relations as follows: α>β, β>α. In order to determine the precedence relation between this two conflicting relations, one of the c-command relations is deleted from the interfaces according to the PRP, which is based on the head-directionality parameter. However, Richards maintains that the PRP cannot account for the alternation between VO and OV in Icelandic in the domain of vP since it makes use of the merge relations in the base position. The PRP, therefore, fails to derive shape effects of Icelandic type. As a result of this, Richards puts forward the *Parametrized Desymmetrization*, which is a strategy applied at the PF interface stating that a consistent subset of c-command relations is deleted in any given language (Richards, 2007: 216):

(5) *Parametrized Desymmetrization*
Merge (α,β) → {<α,β>, <β,α>}
a. VO = Delete all O > V [i.e. {<α,β>, <β,α>} → {<α,β>}]
b. OV = Delete all V > O [i.e. {<α,β>, <β,α>} → {<β,α>}]

The operation 'delete all' limits this operation with phases; therefore, the conflicting c-command and precedence relations are deleted within a given phase. Richards also states that the linearization information does not feed the following linearization information of the phasal domains since this algorithm is *forgetting-based*. The forgetting-based mechanism predicts that the linearization information is forgotten throughout the derivation.

Cyclic linearization (Fox & Pesetsky, 2005a; 2005b)

One of the basic assumptions of the CL is that it presupposes the derivation to proceed in a bottom-up fashion. Furthermore, the CL assumes that the spell-out should occur more than once in a derivation. The CL uses the term Spell-out Domain to refer to the constituents mapped to PF by Spell-out. However, the list of spell-out domains includes CP, VP and DP, which means that the spell-out domain and phase refer to the same domain where syntax-PF mapping takes place. Whenever the spell-out occurs, the derivation constructs a

Spell-out Domain '*D*', and Spell-out linearizes D. Each time this happens, Spell-out linearizes the new material in the new D and cumulatively adds this information to the *ordering table*, where the linearization information is kept. The key proposal of the CL is as follows (Fox & Pesetsky, 2005a: 6):

(6) *Order Preservation Principle*

Information about linearization, once established at the end of a given Spell-out domain, is never deleted in the course of a derivation

This means that if there is contradictory information in the ordering table, the derivation crashes at PF. In accordance with the Order Preservation, let us have a look at the derivational scenarios introduced in Fox & Pesetsky (2005a):

(7) *Scenario 1*(movement from a left-edge position)

α [$_D$ X Y Z] (α, enters the derivation.)

[$_{D'}$... X_i α [$_D$ t_i Y Z]] X< α X<Y

α<D → α<Y Y<Z

The command 'X<α' is understood by PF as a meaning that the last element dominated by X precedes the first element of α. Traces are of no significance here as the CL assumes that PF cannot pronounce elements which have no phonetic content. What is important here is that the leftmost element in a Spell-out Domain can be extracted, since the ordering within the table is not distorted. Now, see the scenario in which an element is extracted from a non-edge position:

(8) *Scenario 2* (movement from a non-left-edge position)

*[$_{D'}$... Y_i α [$_D$ X t_i Z]] Y< α X<Y

α<D → α<X

In (8), Y is not at the left edge of D; as a consequence, the new ordering statements are not consistent with the already-existing ordering statements. The command 'α<A' means that α precedes A throughout the derivation. Nevertheless, there was the command 'X<Y' within the ordering table. Y precedes α; α precedes X, and X precedes Y; thus, yielding a phonetic contradiction. Now let us look at the scenario 3:

(9) *Scenario 3* (Movement from edge and non-edge positions)

[$_{D'}$... X_i Y_j α [$_D$ t_i t_j Z]] X<Y X<Y

Y< α Y<Z

$$\alpha<D \rightarrow \alpha<Z$$

This scenario is banned by the *Phase Impenetrability Condition* (PIC). According to this scenario, the movement of Y does not yield a contradiction although it is moved from a non-edge position, since the ordering between X and Y has been preserved. On the other hand, the PIC would cross this scenario out as the movement from a non-edge position is not allowed by the PIC. Now, let us look at the scenario in which scrambling can take place according to the order preservation:

(10) *Scenario 4* (Scrambling)

$[_{D'}\ldots\ Y_j\ \alpha\ [_D\ Y_j\ X\ t_j\ Z]]$ $\quad Y<\alpha \quad Y<X$

$\quad Y<X \quad X<Z$

According to this scenario, the scrambled element proceeds to the leftmost edge of the Spell-out Domain to reconfigure the ordering in D and to send this ordering command to ordering table. Therefore, throughout the derivation, the command 'Y<X' is maintained.

Approaches to Linearization – II: the Phonological Perspective

What phonological approaches to linearization have in common is that they all put forward that the syntax-PF mapping is determined by the phonology in a direct or indirect fashion. We will again cover the approaches proposed with a minimalist point of view. However, let us first count the approaches to linearization with a phonological perspective proposed before the MP era:

(11) *Approaches before the MP*

Boundary Theory (Chomsky ve Halle 1968; Rotenberg, 1978; Selkirk, 1972)

Direct Access Theory (Kaisse, 1985)

The Prosodic Hierarchy Theory

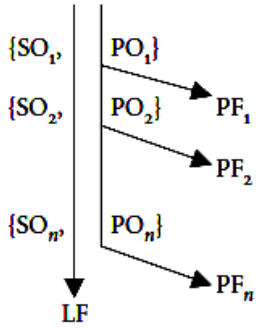
- *Relation-based approach* (Nespor & Vogel, 1982)
- *End-based approach* (Selkirk, 1986)

Prosodic Phase Hypothesis (Shiobara, 2004; 2009)

Shiobara (2009) states that the phases are defined in the literature with reference to their LF features; that is, their semantic dimensions. In other words, as has been put by Chomsky (2008), *v*P phase is the smallest theta-complex, while CP phase is the smallest propositional-complex including the force of the statement. Shiobara (2009: 185), on the other hand, defines phases with reference to their PF features; that is, they are in fact *Prosodic Phases:*

(12) *The Prosodic Phase Hypothesis (PPH)*

A syntactic object SO is spelled out as a prosodic object PO.



Syntactic objects and prosodic objects are built independently of, but in parallel with, each other, and they are spelled out into the phonological component. On the LF side, Shiobara (2009) assumes that syntactic structure is mapped to LF all at once, as in the EST-based model.

PPH assumes a *left-to-right derivation* proposed by Philips (2003). This is a merge-right approach and it is based on building the structure incrementally. This is called the *Incrementality Hypothesis* in which the structure is built in a way that terminal elements are parsed from left to right. Here, the proposal lies within the fact that the derivation begins from the very left of the sentence which are spelled-out to constitute φ-phrases:

(13) a. [CP1 This is [NP the cat [CP2 that caught [NP the rat …

b. [φ1 this is the cat] [φ2 that caught the rat]

(Shiobara, 2009: 186)

CP1 is spelled-out to form φ1 and CP2 is spelled-out to form φ2. Therefore, spell-out decides the linear order and the intonational phrasing with no resort to any other mechanism. What is more, as left to right parsing requires, φ1 precedes φ2, which does not necessitate any *trace-back* to set an order between the spelled-out φ-phrases. This overcomes the problem Dobashi (2004) points out as the Assembly Problem[iii].

To sum up, the PPH uses the operation to merge the terminal elements. New elements are merged to right in a binary fashion. To be more explicit, let us see (14):

(14) Numeration: {we, sing, songs}



First, the subject ‘we’ and the verb ‘sing’ are merged; and then the new element; that is, the object ‘songs’ is merged to the very right. As can be seen, the derivation proceeds in an incremental fashion.

Spell-out before you merge (Tokizaki, 2009)

Tokizaki (2009) argues that a contradiction arises between bottom-up merge and top-down linearization as suggested by the MP and following studies. This contradiction is the one pointed out by Dobashi (2004); that is, the assembly problem. According to this problem, there is no *a priori* reason to state that a linearization set A should precede another linearization set B, or vice versa. Furthermore, Tokizaki also points out the problems that the merge-right PPH approach brings out. As we have pointed out, Tokizaki states that wrong prediction on left branching structures is a serious problem of the incrementality-based linearization approaches.

To solve out such problems, Tokizaki (2009: 100) proposes that Spell-Out sends lexical items with information about the constituent structure to be built before Merge combines two syntactic objects. He argues that the computational system puts a lexical item with a syntactic bracket in the working space of derivation and spells out them to PF simultaneously. Then, the derivation proceeds in the following steps:

(15) a. [Alice
b. [Alice [INFL
c. [Alice [INFL [loves
d. [Alice [INFL [loves [small
e. [Alice [INFL [loves [small [hamsters

(Tokizaki, 2009: 100)

Merge has not been applied yet; however, as put by Tokizaki, top-down linearization is applied. In his model, the operation merge is applied when a closing bracket is added. For instance, consider (15e) repeated below in (16):

(16) [Alice [INFL [loves [small [N hamsters]

A closing bracket is added to make a non-branching constituent [hamsters]. Here, the difference between spell-out mechanism and phasal mechanism is that in Tokizaki’s system spell-out occurs every time a new lexical item is introduced into the derivation. The LF-features, on the other hand, are checked within the framework of the phases; that is, CP and *v*P.

He states that brackets can be assumed as lexical units; thus, they should be included in the numeration as many times as they will be used. They have phonetic features, and every time a bracket is added to the derivation, a silent demibeat (symbolized with 'x') is introduced to PF. Given these assumptions, consider the derivation in (17). Remember that the LF features are checked in *v*P and CP phases:

(17) Num: {*Alice,* INFL*, loves, small, hamsters,* [x5,]x5 }

a. [Alice [I' INFL [VP loves [small [hamsters]]]]

PF: x alice x loves x small x hamsters xxxx

LF: 'loves small hamsters'

b. [IP Alice [INFL [loves [small [hamsters]]]]]

PF: x alice x loves x small x hamsters xxxxx

LF: 'alice loves hamsters'

The first lexical item *Alice* and a bracket are introduced into the derivation and their phonetic features are spelled-out at the same time. The syntactic and semantic features of *Alice* remain in the derivation. The derivation keeps introducing a lexical item and a bracket until all the lexical items are spelled-out. Here, Tokizaki assumes that the ınfl and traces are invisible to spell-out as they are phonologically empty. After the all the lexical items are introduced, closing brackets come into play and merging begins. When the derivation reaches to the first phase as shown in (17a) semantic features of VP are sent to LF. Then, merge reaches to CP level and the whole sentence is sent to LF. He also assumes that the semantic features of the subject are added to LF after the CP phase is spelled-out. Therefore, top-down linearization has been applied just as all the syntactic and semantic features are mapped to LF.

Phonological phrasing (Dobashi, 2004)

Dobashi (2004) proposes a model of syntax-PF mapping during which phonological phrases are formed to linearize the elements in syntax. He assumes *v*P and CP to be phases, and MSO approach, in which the operation TRANSFER strips away the spell-out domain of a phase each time it takes place. The syntactic phrases are mapped to PF as p(honological)-phrases.

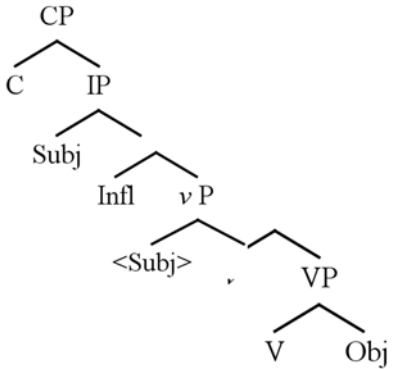
Dobashi constructs his linearization approach through this algorithm:

(18) a. X precedes Y if X checks the OCC/EPP feature of Y,

b. X precedes Y if X asymmetrically c-commands Y.

For instance, if we have a structure such as in (19), we will have the following phonological phrases:

(19)



In the first spell-out domain, we have "V<<Obj" command; while in the second, we get "Subj<<Infl<<*v*" on the basis of the algorithm stated in (19). Here, Dobashi emphasizes an *assembly problem*. According to this problem, there is no information as to the precedence relation between these two linearization commands. To overcome this problem, he proposes an *assembly process*, in which the linear order between two linear strings is defined by virtue of the shared member. To determine the shared member between two linear strings, he formulates an escape mechanism as follows:

(20) Spell-out sends a linearly ordered string to PF except for the initial element.

If we consider the derivation in (20), first, spell-out applies to the sister of *v*:

(21) SO (sister of *v*)

a. Linear Order: V<<Obj

b. Mapping to PF: Obj

c. PF: $(Obj)_{\varphi}$

When the mapping takes place in (21b), the initial element in the linear set "V<<Obj" (that is, "V") escapes the mapping and remain accessible to the next spell-out. After this mapping, spell-out of C occurs:

(22) SO (sister of C)

a. Linear order: Subj<<Infl<<*v*<<V

b. Mapping to PF: Infl<<*v*<<V

c. PF: $(\text{Infl } v \text{ V})_{\varphi}\,(Obj)_{\varphi}$

As the first element of the former spell-out domain has escaped and remained accessible to the following phasal operations, it is mapped to PF with the spell-out of C domain. The order between the p-phrases is set with respect to the unit that has escaped in the previous spell-out. At PF, the mapping results in $(\text{Infl } v \text{ V})_{\varphi}\,(Obj)_{\varphi}$ order. When the whole derivation is completed with the same mechanism, we have the following p-phrases corresponding to the syntactic phrases:

(23) $[_{CP}$ C $[_{TP}$ Subj Infl $[_{vP}$ <Subj> *v* $[_{VP}$ V Obj]]

(C Subj)$_{\varphi}$ (Infl *v* V)$_{\varphi}$ (Obj)$_{\varphi}$

Conclusion

In this paper, we overviewed the linearization approaches proposed within the framework of the MP and Phase Theory. First, we looked at the syntax-based approaches; i.e. the Multiple Spell-Out (Nunes & Uriagereka, 2000), the Dynamic Linearization (Richards, 2007a), and the Cyclic Linearization (Fox & Pesetsky, 2005a). Then, we moved on to the phonology-based approaches; i.e. the Prosodic Phase Hypothesis (Shiobara, 2004; Shiobara, 2009), Spell-Out Before You Merge (Tokizaki, 2009), and the Phonological Phrasing (Dobashi, 2004).

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Notlar

[i] The term ‘PF’ should arise no confusion here, since we have employed the term to refer to the interface ‘PHON’ in Phase Theory (Chomsky, 2008) terminology; thus, it has nothing to do with the PF-level in EST (as in the distinction between ‘overt’ vs. ‘covert’ operations).

[ii] We cannot touch upon the approaches presented before the MP due to the space limitations. We refer the reader to the relevant studies for more information about those works.

[iii] We will touch upon this problem in section 2.2.3