

A PF View of Phases

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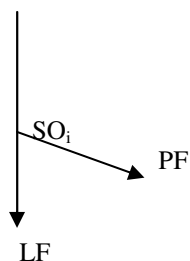
1. Introduction

- A phase should be “a natural syntactic object SO, an object that is relatively independent in terms of interface properties” (Chomsky 2000:106).
- On the LF side, a phase = the closest syntactic counterpart to a proposition, CP and vP (or v*P after Chomsky 2001).
- On the PF side, a phase has “a degree of phonetic independence” (Chomsky 2001:12).
- ♣ This paper focuses on the sound side of the two interfaces, and considers (mainly conceptual) advantages of the PF-based approach to phases. I argue that the PF-based approach to phases calls for **Left-to-Right** (as opposed to Bottom-Up) structure-building in the computational component, and brings a conceptually welcome consequence that the grammar is shaped in response to interface conditions, namely conditions on **parsing**.

2. Phases and Syntax-PF Mapping

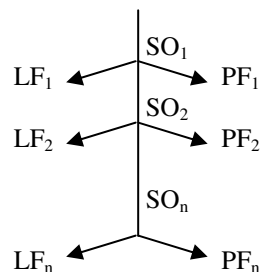
2.1. Multiple Spell-Out of Phases

(1) a. Single spell-out



(EST, Chomsky 1995)

b. Multiple spell-out



(where SO = CP and vP
in Chomsky 2000)

(Uriagereka 1999, Weinberg 1999)

-- (1b) explains why raising (e.g. (2b)) is possible at all.

- (2) a. *I expected [_α _ to be a proof discovered].
b. I expected [_α a proof to be _ discovered].

-- Computational complexity is reduced with each stage of the derivation accessing only part of LA.

-- In Chomsky (2001) the role of phases becomes more significant and is extended to a cycle of spell-out. This means that the phonological cycle proceeds essentially in parallel.

(3) Phase Impenetrability Condition (PIC)

The domain of H (= YP) is not accessible to operations at ZP, but only H and its edge (= α).

[_{ZP} ... [_{HP} α [H YP]]] (ZP, HP = phases, i.e. CP and vP)

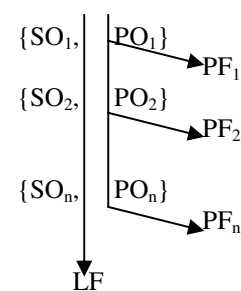
In effect, H and its edge α in (3) belong to the ZP phase for the purpose of spell-out, under PIC (Chomsky 2001).

- ♣ Given that a phase is not merely a derivational cycle but a phonological cycle of spell-out, why not define it in phonological terms? Furthermore, it should be more minimalist if the size of phase is determined by interface conditions, e.g. in phonological terms.

(4) A Prosodic Phase Hypothesis

A syntactic object SO is spelled out as a prosodic object PO. (Shiobara 2004:15)

(5) Multiple spell-out under a Prosodic Phase Hypothesis



(where PO = Intonational Phrase in Shiobara 2003, 2004,
but the size could differ from one language to another.)

(Wagner 2003, and references therein)

-- Epstein and Seely (2002) point out that the syntactic definition of a phase is problematic in that it requires a computational look-ahead: “how can we know that they are relatively independent *at the interface* if spell-out applies *before* the interface is reached, and without access to interface properties?” (p.78); “why should PF care about the propositional content of what is spelled out?” (ibid.)

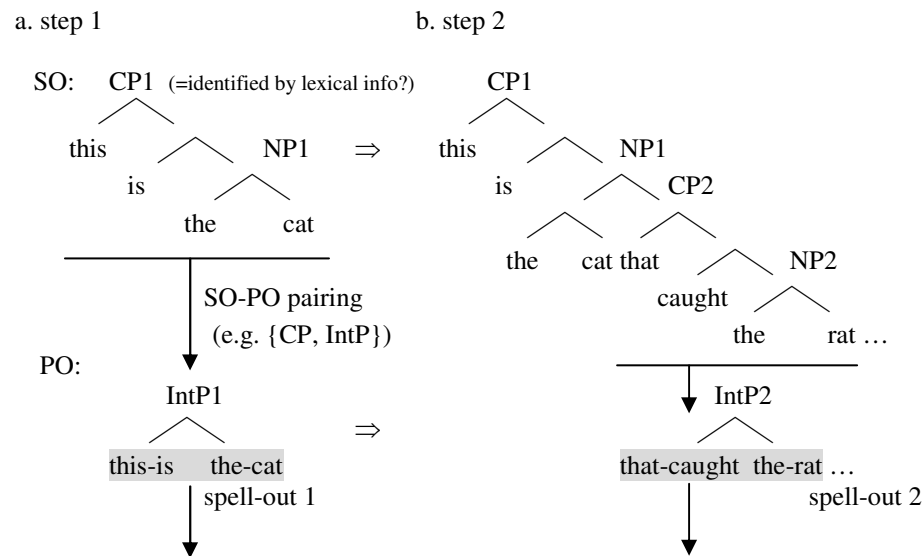
♣ Under the PF-based approach to phases, prosodically identified SO-PO pairs act as units of spell-out.

2.2. Left-to-Right Derivation by Prosodic Phase

♣ I argue that the Prosodic Phase Hypothesis in (4), schematically represented in (5), is most naturally implemented if we assume Left-to-Right (L-to-R) derivation in the computational component (Shiobara 2003, 2004, following Phillips 1999).

- (6) a. [CP₁ This is [NP₁ the cat [CP₂ that caught [NP₂ the rat [CP₃ that stole [NP₃ the cheese
b. [IntP₁ This is the cat] [IntP₂ that caught the rat] [IntP₃ that stole the cheese]...
(Chomsky and Halle 1968:372)

(7) Left-to-Right structure-building¹



¹ Terminal elements that belong to one prosodic word are connected with hyphens, and prosodic units are shaded.

♣ In L-to-R derivation, terminal elements are merged into an SO, spelled out into the phonological component and linearized, all of which happen from left to right.

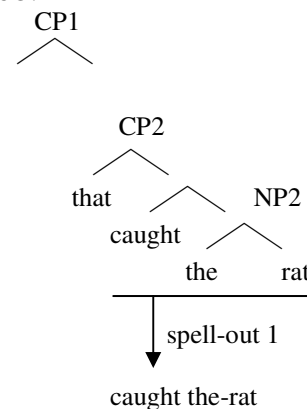
In (7), we can see that spell-out defines (i) linear order and (ii) prosodic phrasing without any additional mechanism: what is spelled out first precedes what is spelled out next; and what is spelled out corresponds to a prosodic unit, namely an IntP.

-- In contrast, neither linear order nor prosodic phrasing is trivially determined by spell-out if we assume Bottom-Up structure-building.

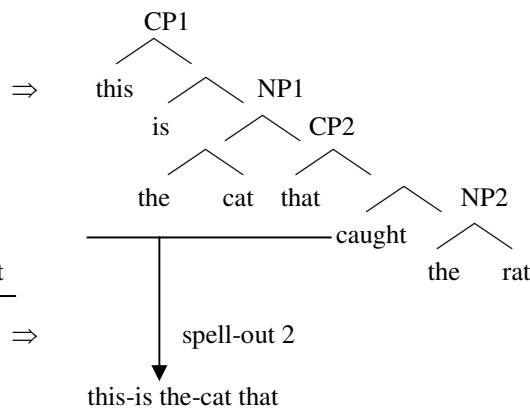
(8) Bottom-Up structure-building

a. step 1

SO:



b. step 2



-- Re (i) linearization:

An additional phonological mechanism is needed to ensure that what is spelled out first is placed *after* what is spelled out next (= “Assembly Problem” in Dobashi 2003:25, see also Uriagereka 1999:256 and Tokizaki 2006:2-3 for related discussions).

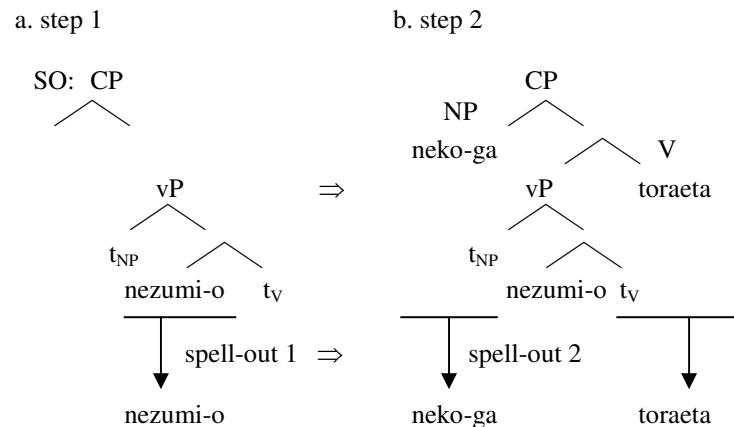
-- Re (ii) prosodic phrasing:

The spell-out unit does not correspond to any prosodic unit and yet another phonological mechanism should be in charge of prosodic phrasing.

-- In Japanese, a head-final language with (arguably) overt V-raising (Koizumi 2000, Ishihara 2000), if we assume Bottom-Up derivation, the elements which are supposed to be spelled out together are not even string adjacent.

- (9) a. [CP Neko-ga [vP t_{NP} nezumi-o t_v] toraeta].
 cat-Nom rat-Acc caught
 ‘A cat caught a rat’
 b. [PO1 Neko-ga] [PO2 nezumi-o toraeta].

(10) Bottom-Up structure-building



-- Re (i) linearization and (ii) prosodic phrasing:
 An additional phonological mechanism is needed that guarantees that the object NP that is spelled out first is prosodically phrased together with the V, but not with the subject NP, both of which are spelled out at the next higher phase level.²

-- Note that:
 Chomsky (1995) assumes that Kayne’s (1994) Linear Correspondence Axiom (LCA) is in charge of linearization and the LCA applies only in the phonological component (pp.334-337). This is minimalist in that linearization is taken to follow from interface conditions, because it is the sensorimotor (SM) interface that requires that the SO derived must be linearized after all.

² Furthermore, if LCA is in charge of linearization, it should be the case that the object NP ends up in a higher position than the V to derive the object-V order, and this needs to stipulate a sort of object-raising in Japanese.

However, it is not obvious exactly how LCA works in the phonological component. Furthermore, the implementation becomes less clear when derivation proceeds by phase because SOs are mapped to PFs iteratively by multiple spell-out, not all at once.

♣ In L-to-R derivation, terminal elements are merged into an SO, spelled out into the phonological component and linearized, all of which happen from left to right.

3. More on Left-to-Right Derivation

3.1. External Support for Left-to-Right Derivation

3.1.1. Parallelism with Parsing Mechanism

♣ Parallelism between the computational mechanism and the parsing mechanism ((11)-(13)) is much in accordance with the minimalist spirit in that the grammar is shaped by external requirements (Phillips 1996, 2003:42).

(11) Left-to-Right Computation

L-to-R is indeed the way time flows, and L-to-R derivation mimics the way terminal elements are “parsed” on-line. (cf. Phillips’ 1996 “Parser Is Grammar” view, see also Phillips 2003, 2005.)

Recall that Kayne’s (1994) LCA in itself does not determine whether Spec-Head-Comp or Comp-Head-Spec is the base order, and Kayne refers to “the asymmetry of time” to choose the former over the latter (Kayne 1994:38, see also Uriagereka 1999:254 for relevant discussion).

(12) Prosodically determined phase as a computational cycle

Phase as a computational cycle is reminiscent of a “chunk” as a performance unit (Gee and Grosjean 1983, Abney 1991).

(13) Locus of Merge: right-edge

In L-to-R derivation, terminal elements are merged at the right edge of the present structure. (See e.g. Schneider 1999 and Shiobara 2004:ch.2 for detailed illustrations of L-to-R structure-building in the computational component.)

This sort of right-attachment may ultimately be related to the extensively motivated bias for right-branching structures in on-line processing of syntactic ambiguities, e.g.

“Right Association” in Kimball (1973), “Late Closure” in Frazier (1978), and “Recency” in Gibson (1991).

3.1.2. Reducing Computational Complexity

- ♣ In L-to-R derivation, what is spelled out always forms a constituent at the stage where it is spelled out.
- ♣ In L-to-R derivation, it is always the “right” edge of a phase that is accessible to the next computational cycle.

-- In Bottom-Up derivation:

(3) Phase Impenetrability Condition (PIC)

The domain of H (= YP) is not accessible to operations at ZP, but only H and its edge (= α).

$[ZP \dots [HP \ \alpha \ [H \ YP]]]$ (ZP, HP = phases, i.e. CP and vP)

In effect, H and its edge α in (3) belong to the ZP phase for the purpose of spell-out, under PIC (Chomsky 1999:10).

-- The reference to “H and its edge” seems to obscure the significance of phase as a defining unit of the computational cycle. In other words, H and its edge do not seem to be a conceptually natural unit in the sense that they do not necessarily form a syntactic or prosodic constituent. (cf. Marantz 1981, Bouchard 2002:342f, as cited in Inaba 2006)

In Bottom-Up derivation, H and its edge could be at the left edge, or the right edge, or both, of a phase, depending on whether the given language is head-initial (e.g. English, see (8)) or head-final (e.g. Japanese, see (10)).

-- How does L-to-R derivation allow raising?

- (2') a. *I expected [α (a proof) to be a proof discovered].
 b. I expected [α a proof to be (a proof) discovered].
 ... a copy generated (Phillips 2003)

In the context of L-to-R derivation, the question is reinterpreted as how leftward movement is implemented in an L-to-R manner (cf. Phillips 1996, 2003, Richards 1999, 2002 and Aoshima et al. 2004).

3.2. Internal Support for Left-to-Right Derivation

3.2.1. Prosodically Conditioned Linearization

- ♣ Heavy NP shift seems to be influenced by phonological factors such as prosodic weight (Zec and Inkelas 1990, Zubizarreta 1998, Shiobara 2001, 2004). It constitutes supporting evidence for the PF-based approach to phases, and hence for L-to-R derivation.³

(14) Prosodic Pattern exemplified by heavy NP shift

(Zec and Inkelas 1990, Rochemont and Culicover 1990:105, Zubizarreta 1998:149)

non-shifted order: [_{PO} V – NP – PP]

shifted order: [_{PO} V – PP] [_{PO(=IntP?)} NP]

(15) A: What happened yesterday?

B1: [_{PO} Meg donated novels by Mishima to the library].

B2: # [_{PO} Meg donated to the library] [_{PO} novels by Mishima].

B2': \surd # [_{PO} Meg donated to the library] [_{PO} her old and precious collection of novels by Mishima].

B2'': \surd # [_{PO} Meg donated to the library] [_{PO} novels by MISHIMA] (but not those by MURAKAMI).

(16) Prosodically based generalization about heavy NP shift in English

Let the non-shifted order = [_{PO} ... V – NP – PP], and

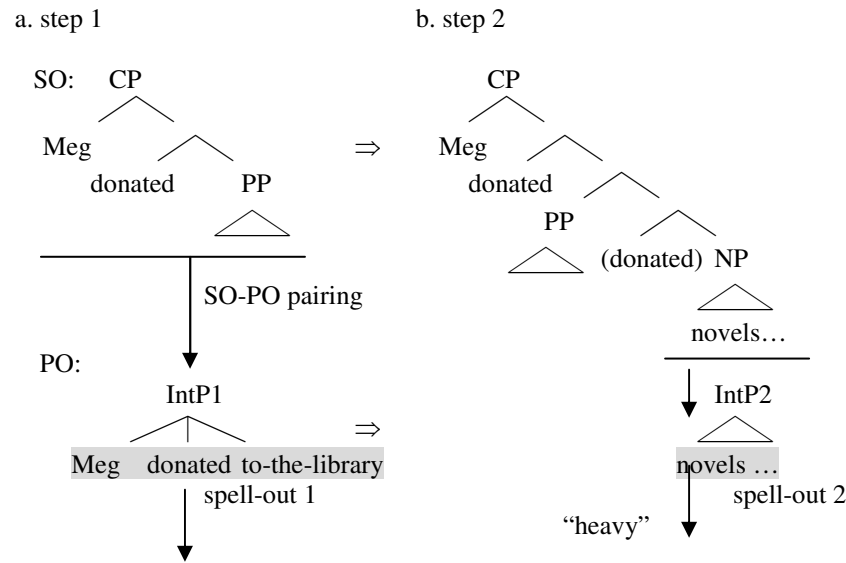
the shifted order = [_{PO} ... V – PP] [_{PO} NP],

- a. select either order when the {SO,PO} that is spelled out finally satisfies right-edge heaviness;⁴ else
- b. select the non-shifted order.

³ A prosodically based approach could be extended to not only similar kinds of linearization (e.g. scrambling, Right Node Raising, Gapping etc.), but also linearization of head and dependents, which seem to be also prosodically conditioned, at least partially. (See Shiobara 2004 for scrambling in Japanese, Féry and Hartmann 2005 for Right Node Raising and Gapping in German, Donati and Nespor 2003 for VO/OV order cross-linguistically, and Taylor 2005 for VO/OV in Old English.)

⁴ See Shiobara (2001, 2004) for a detailed analysis of how to define weight prosodically.

(17) Left-to-Right structure-building



-- The prosodic condition on heavy NP shift is not easy to accommodate in any syntactically based approaches to phases with Bottom-Up derivation (cf. representational approaches aside).⁵

- ♣ Given the generalization in (16), optionality of heavy NP shift should arise only when the NP is heavy enough to form its own IntP, and the gradient acceptability associated with heavy NP shift is attributable to the gradient nature of prosodic factors such as phonetic realization of prominence (Ladd 1986:329).

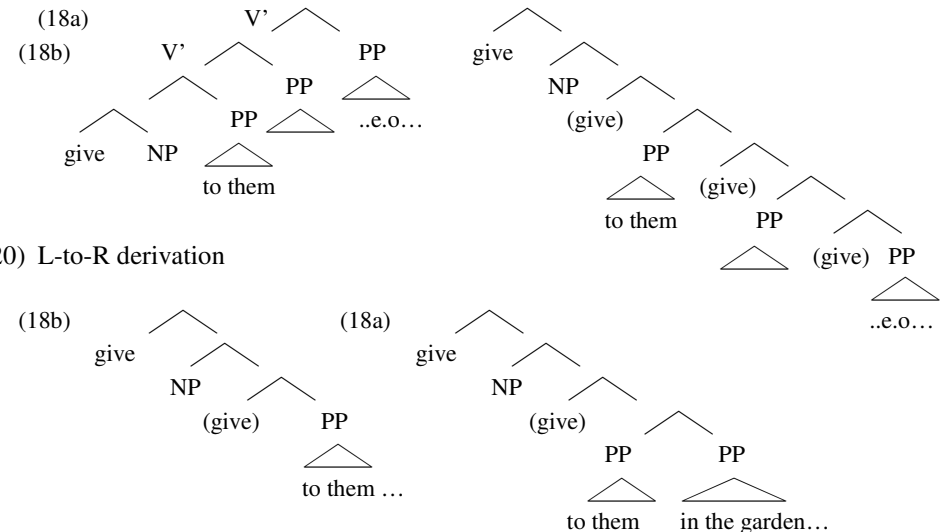
3.2.2. Syntactic Phenomena

- ♣ On a purely syntactic basis, Phillips (1996, 2003) argues that the changes in constituent structure over the course of L-to-R derivation offer a natural account of cases where different constituency tests yield different results in English (see also Pesetsky 1995 for such examples).

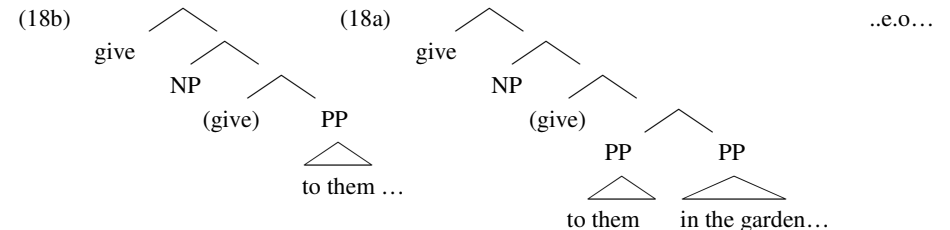
⁵ Recently there have been insightful analyses of phonological phenomena in terms of cyclic derivation by phase with Bottom-Up derivation, e.g. Dobashi (2003), Kahnemuyipour (2004) and Selkirk (2006), to name a few. Unlike L-to-R derivation, however, they have to postulate their own mechanisms of linearization or prosodic phrasing (see 2.1).

- (18) a. John wanted to give books to them in the garden, and [_V give the books to them in the garden] he did on each other's birthdays.
 b. John wanted to give books to them, and [_V give books to them] he did in the garden on each other's birthdays. (Phillips 2003:40)

- (19) a. V'-fronting vs. b. Binding

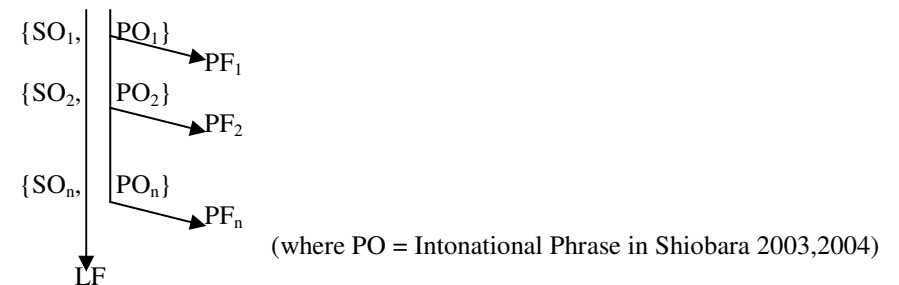


(20) L-to-R derivation



3.3. An LF View of Left-to-Right Derivation

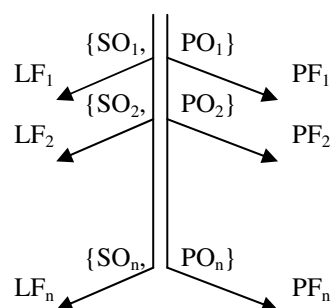
(5) Multiple spell-out under a Prosodic Phase Hypothesis



-- In (5), there may or may not be covert movement after the last mapping to PF. After all, sentential meaning is calculated on the LF from bottom up in a compositional way.

-- What if mapping to LF is also multiple?

(21) Multiple spell-out to PFs and LFs under a Prosodic Phase Hypothesis



-- Supporting evidence for (20)?

Scope interpretation in Japanese

In (22), the shaded elements form a phonological unit and it corresponds to the wh-scope of the sentence (Ishihara 2003, Kitagawa 2005).

- (22) a. [CP John-wa [CP Mary-ga nani-o tabeta-ka] shirabeteiru-no]
 John-Top Mary-Nom what-Acc ate-Comp checking-Q
 ‘Is John checking what Mary ate?’
- b. [CP John-wa [CP Mary-ga nani-o tabeta-ka] shirabeteiru-no]
 ‘What is it that John is checking if May ate?’
 (Kitagawa 2005:320, brackets represented are based on Bottom-Up structure-building)

-- Assuming Bottom-Up derivation, the scope crosses the embedded CP boundary in (22b) and does not correspond to any syntactic constituent.

♣ In L-to-R derivation, on the other hand, it does form an SO when the rightmost element (the matrix Q –no) is merged.⁶

⁶ One thing still needed to be considered is how to semantically include the topic NP or the subject NP, which are also in the scope of Q. (Thanks to Satoshi Oku for pointing this out to me.) They make a mismatch of semantic scope and a phonological unit.

This suggests that L-to-R derivation by prosodically determined phases may also be adequate for the mapping from syntax to LF, presumably where wh-scope is calculated.

4. Summary

♣ Prosodically based definition of phases

→ Left-to-Right (L-to-R) structure-building in the computational component, which has independent conceptual motivations in that L-to-R is the way terminal elements are parsed on-line in performance.

-- Remaining task... (huge) impact on syntax and syntactic phenomena

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