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Synchronizing meaning with sound and beyond: The role of physical markings in thematic, modal, and informational interpretations

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Abstract
This paper has three interlocking goals. The first is to demonstrate that overt subjects must always appear at the left periphery of their sentences so that they can be adjacent to a particular functional head in both finite and nonfinite clauses in English. The second is to argue that the functional head to which the subject must be adjacent serves as the clause's modal anchor, relating the content of the clause to a contentful eventuality. We identify three distinct flavors of the modal anchor, keyed to whether it appears in a finite clause, a *for-to* clause, or an ECM clause. Finally, the third goal is to argue that the observed adjacency effect reflects a broader pattern of physical–logical synchronization in grammar, whereby key logical dependencies at LF are physically signified in the course of derivation toward PF, implemented by paired physical–logical requirements lexically encoded in the Numeration.

Keywords Modality · (Non)finiteness · Adjacency · Subject position · PF–LF synchronization

1 Subject-adjacency effects

We begin our investigation by closely examining the observation that overt subjects must always be located at the left periphery of their sentences, and analyzing this

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phenomenon as the need for a subject's adjacency to a particular functional head. We turn first to finite clauses (Sect. 1.1), second to *for-to* clauses and $\varnothing_{for}$*-to* clauses (Sects. 1.2 and 1.3, respectively), and then finally to ECM clauses (Sect. 1.4). The sort of data that we will be concerned with are previewed in (1).

(1) a. **Has** (**possibly*) **John** lost his mind?
b. I want very much **for** (**tomorrow*) **John** to leave.
c. I **want** (**tomorrow*) **John** to leave.
d. John **believes** (**very strongly*) **Bill** to be a genius.

In the literature, data like (1b–d) have frequently been understood as arising from locality restrictions between the subject and its case assigner. On the other hand, researchers like Cardinaletti (2004), Sigurðsson (2004), and Rizzi (2005) (among others) have argued that the "left-edge filling" requirement for a sentence cannot be reduced to Case theory or to a prosodic requirement for overt elements but instead are rooted in interpretive requirements such as "predication" (Cardinaletti), "matching of interpretable grammatical features" (Sigurðsson), and "aboutness interpretation" (Rizzi). We would like to extend this line of research further and propose that this requirement be analyzed as stemming from a common semantic need for modal anchoring.

After laying out the syntactic analysis of the clausal left periphery in this section, we pursue in Sect. 2 our second goal of developing an approach to the compositional semantics of the clauses of interest in which a dedicated left-peripheral functional head serves as modal anchor. In Sect. 3, we attempt to rationalize how subjects come to be chosen to physically indicate the association of the modal anchors and sentences. In Sect. 4, we carry out the paper's third goal of understanding the observed subject-adjacency effects in the context of a broader pattern of physical–logical synchronization in grammar. While the focus of this paper is overt-subject clauses, and the extension of our analysis to null-subject clauses (i.e., control and raising) will be left to future work, we offer some tentative remarks on extending the proposed analysis to null-subject clauses in Sect. 5. Finally, we conclude in Sect. 6, briefly providing further implications for future research. In order to streamline the arguments running through these sections, certain additional discussions are relegated to Appendices A–I. These discussions supplement our arguments in the main text.

1.1 FIN-subject adjacency in finite clauses

First, we propose that the subject of a finite clause in English must always appear at the left-periphery of TP so that it can be adjacent to the functional head FIN. The primary piece of empirical support for this proposal comes from data like (2).

(2) a. ***Has**$_1$ *possibly* **John** [$_T$ _$_1$] lost his mind?
b. **Has John** *possibly* [$_T$ _$_1$] lost his mind?
c. **John** *possibly* **[$_T$ has]** lost his mind.
d. *Possibly*, **John [$_T$ has]** lost his mind.

We observe here, first, the obligatory adjacency of the subject of a finite clause to an auxiliary that has undergone subject-Aux inversion as in (2a) in contrast to (2b–d). The unacceptability of (2a) cannot be attributed to subject-Aux inversion *per se*,

given the acceptability of (2b). Nor can it be attributed to the placement of the adverb *possibly* before the subject; as shown in (2c and d), *possibly* is in principle grammatical on either side of the subject. Finally, it cannot arise from locality restrictions between the subject and its case assigner since *John* is in a perfectly local configuration with its putative case assigner T(ense)/I(nfl) in (2a). Note also that a problem does not arise even when the subject and T/I are not adjacent as in (2c). (See Johnson (1991).)

We propose to attribute the unacceptability of (2a) to a general requirement in English that the subject of a finite clause be at its periphery and adjacent to the functional featural head FIN, as suggested by Yoon (2012). By way of theoretical background, we adopt as a working hypothesis the core insight of Rizzi's (1997) "Split COMP" proposal, according to which the left periphery of a finite clause contains several functional heads and their projections, typically in the hierarchical order in (3).

(3) SPEECH ACT/FORCE > TOPIC > FOCUS > FIN

Against this backdrop, we represent the relevant aspects of the structures for (2a–d) as in (4a–d), respectively.

(4) a. *[FORCE-Q [$_2$ **Has$_1$-FIN**]] [Top *possibly*$_3$] ___$_2$ [**John** t_3 __$_1$ lost his mind]]?

b. [FORCE-Q [$_2$ **Has$_1$-FIN**]] ___$_2$ [**John** *possibly* __$_1$ lost his mind]]?

c. [FINP **FIN** [TP **John** *possibly* [T has] lost his mind]

d. [Top P *Possibly*$_3$ **FIN** [**John** t_3 has lost his mind]]

In the interrogative sentences (4a) and (4b), when an inverted Aux is preposed to the interrogative Force feature (Force-Q), it lands at the closer head position (__$_2$) first and picks up the finite featural head on the way. Under Bare Phrase Structure, in which each functional phrase is analyzed as the projection of a featural head, such cyclic head movement has the effect of removing the FIN head at the intermediate landing site.[1] This results in the interference of the adjacency between the subject and FIN by the preposed adverbial topic *possibly* in (4a) but not in (4b).[2] Finally,

[1] As far as we can tell, this is nothing new but has been a standard assumption since it was argued under the Split INFL Hypothesis that a verb undergoes head movement cyclically and amalgamates with relevant functional featural heads like *v* and T (or Agr_O, T and Agr_S).

[2] We will compare this account of (2a) with that of Rizzi's in the next subsection. An anonymous reviewer points out a number of apparent exceptions to the claim that a subject must be adjacent to its inverted auxiliary, shown here:

(i) a. Could *possibly* Mary do it?
b. Could *maybe* Mary do it?
c. Could, *in your opinion*, John have lost his mind?

The reviewer suggests, however, that the acceptability of these sentences may depend on the availability of a parenthetical interpretation of the topicalized adjunct, which is especially apparent in examples like (ic) (where, we observe, comma intonation is necessary). We are grateful to the reviewer for this insight.

in the absence of subject-Aux inversion, adjacency of the subject to FIN is satisfied regardless of whether the adverb remains *in situ*, as in (4c), or is preposed, as in (4d).

Another manifestation of the subject-FIN adjacency requirement comes from quotative inversion structures like (5), where we see that an adverb cannot intervene between a preposed quotative verb and its subject (see Collins 1997:36).

(5) "I don't have enough money," **said** *{*cleverly}* **John** *{cleverly}*.

As represented schematically in (6) below, we can explain this effect by appealing to the idea that quotative inversion involves, first, the preposing of the quoted utterance, and second, the movement of the verb to a Speech Act head (Quote) in the left periphery of the clause, picking up the finite feature along the way at $\_\__3$.

(6) *[$_{\text{QuoteP}}$ [$_1$ "I don't have enough money,"] [$_3$ **said$_2$-FIN]-Quote** [$_{\text{Top}}$ *cleverly*] $\_\__3$ [$_{\text{TP}}$ **John** $\_\__2$ t_1].

The adjunct intervening between FIN and the subject therefore induces the same kind of adjacency effect that we have just proposed to explain the subject-Aux inversion facts.[3,4]

1.2 *For*-subject adjacency in *for-to* clauses

In this subsection, we argue that, just as there is a requirement for the subject to be adjacent to FIN in finite clauses, there is a parallel requirement in *for-to* clauses, whereby the subject must be adjacent to *for*. By way of background, consider the minimal pair in (7) due to Rizzi (1997: 301), showing that *tomorrow* as a topic in the subordinate clause is allowed to disrupt adjacency between finite complementizer *that* and the subject but not between nonfinite complementizer *for* and the subject.

(7) a. I think that, *tomorrow*, John will leave.
b. *I would prefer **for**, *tomorrow*, **John** to leave.

[3] When the subject is not inverted, it does not need to be adjacent to the verb:

(i) "I don't have enough money," **John** *{cleverly}* **said** *{cleverly}*.

This is predicted by our account: in (i), the verb does not move to FIN and therefore does not give rise to the adjacency effect. We are grateful to an anonymous reviewer for pointing this out.

[4] An anonymous reviewer points out that some clause-introducing subordinators (the reviewer mentions *when*, *while*, *so*, *(and) then*, *before*, *because*, and *after*) may also require adjacency to the embedded subject, as brought out by examples like the following:

(i) John left before{**mysteriously*} Bill {*mysteriously*} arrived.

In (i), the adverb *mysteriously* is degraded when it appears between *before* and the embedded subject (especially when there is no comma intonation on the adverb—see footnote 2 above). Anticipating our proposal in Sect. 2, it is conceivable that these subordinators play a modal anchoring role akin to FIN and therefore that effects like that in (i) fall out from a more general version of our proposal, though in the interest of space we leave a detailed investigation of this issue to future work.

Rizzi's (1997: 301–305) solution to this asymmetry is the proposal that complementizer *that* occupies Force, as in (8a), whereas complementizer *for* occupies the category Fin, as in (8b).

(8) a. … [$_{\textbf{Force}}$ **that**] *Topic* [$_{\textbf{Fin}}$ [+Fin]] [$_{\text{IP}}$ John …].
b. … [Force] *Topic* [$_{\textbf{Fin}}$ **for**] [$_{\text{IP}}$ John …].

If we adopt this approach, then the ungrammaticality of (7b) is actually overdetermined: first, it is ungrammatical because the topical adverb *tomorrow* does not occupy the expected position above *for* (Topic > Fin). Second, it is ungrammatical because Case for the subject *John* cannot be sanctioned by *for* under head government; it gives rise to a Relativized Minimality violation.

However, Rizzi's account faces the following problem. A sentence like (9a) below is ungrammatical, even though the topical adverb is higher than *for* in accordance with (8b) and even though nothing intervenes between *for* and the subject. Similarly, (9b) is grammatical only if the adverb *strongly* is construed as a matrix-level adverb (modifying *prefer*); it cannot be construed as a subordinate adverb (modifying *insist*). Generalizing across (9a and b), it appears that a preposed topic cannot precede *for*, against the expectations of Rizzi's account.

(9) a. *I preferred, [$_{\text{Top}}$ *tomorrow*], [$_{\textbf{Fin}}$ **for**] [$_{\text{IP}}$ **John** to leave].
b. I would prefer, [*strongly*], [$_{\textbf{Fin}}$ **for**] [$_{\text{IP}}$ **John** to insist on the plan].

Accordingly, we propose the following two revisions to Rizzi's syntax of the left periphery. First, we propose that—at least in English—both complementizers *that* and *for* occupy a position higher than Topic, as shown in (10).

(10) Proposed hierarchical order of "split COMPs":
(i) *that* > Topic > FIN > [$_{\text{TP}}$ …]
(ii) *for* > Topic > [$_{\text{TP}}$ …]

Second, we will depart from the notion of syntactic category and assume instead that the label of a maximal projection faithfully and strictly reflects only the featural property of the head that *additionally* contributes to the syntactic projection.[5] In the present context, for example, the notions speech act, and force become relevant only when the introduced featural functional head makes a nontrivial semantic contribution. Thus, while *whether* and $\varnothing_{\text{Wh-Q}}$ add interrogative force, *that* does not, the latter involving only the default declarative property of a clause. Similarly, we consider that FIN is a featural head (with the value PRES or PAST) that projects only in finite clauses, while it is not projected in nonfinite clauses. Therefore, when the preposed subordinate topic is missing in (10-ii), *for* appears immediately above the infinitival TP just as FIN appears just above a finite TP in (10-i). In fact, we will argue in Sect. 2 that the *for* adds modality to an infinitival TP just as FIN adds modality to a finite TP.

[5]On this view, the category/label we customarily provide for a syntactic constituent (e.g., NP, VP, CP) is simply *only one of the features of the head* that we would like to pay attention to in our analyses. In this regard, we should not treat Rizzi's cartographic claim as if it prescribes an obligatory phrase structure of a clause periphery.

In a nutshell, we do not postulate any obligatory categories like Speech Act, Force, COMP and Fin, although we will continue to use these tags for ease of reference.[6]

If the subject is indeed required to be adjacent to *for* or FIN ordered as in (10), all of the relevant data are captured as follows.

(11) I think [$_{\text{COMP}}$ that] [$_{\text{Top}}$ *tomorrow*] **FIN** [$_{\text{TP}}$ **John** will leave]. (=(7a))

(12) *I would prefer [**$_{\text{COMP}}$ for**] [$_{\text{Top}}$ *tomorrow*] [$_{\text{TP}}$ **John** to leave]. (=(7b))

(13) *I preferr*ed*, [$_{\text{Top}}$ ***tomorrow***], [**$_{\text{COMP}}$ for**] [$_{\text{TP}}$ John to leave]. (=(9a))

(14) I would prefer *strongly* [**$_{\text{COMP}}$ for**] [$_{\text{TP}}$ **John** to leave]. (=(9b))

First, (11) (= (7a)) is grammatical because the subject is at the periphery of TP and adjacent to FIN. By contrast, (12) (= (7b)) is ungrammatical because *tomorrow* disrupts locality between *for* and the subject. Next, (13) (= (9a)) is ungrammatical because it violates the ordering *for* > Top. Finally, (14) (= (9b)) is grammatical on a matrix construal of the adverb, because there is no violation of the ordering *for* > Top within the embedded clause, and *for* is adjacent to the subject at the periphery of TP.

Another issue for Rizzi's proposal is that it does not immediately explain data like (15a and b) (from Rizzi 1997: 303–304), similar to what we presented in Sect. 1.1.

(15) a. ***Did** *yesterday* **John** come? (≈our (2a))
= [**$_{\text{Force}}$ Did$_1$**] [**$_{\text{Topic}}$ yesterday**] **Fin** [$_{\text{TP}}$ *John* [**$_{\text{Tense}}$ $_{-1}$**] come?

b. ***Had** *yesterday* **John** done that, ...
= [**$_{\text{Force}}$ Had$_1$**] [**$_{\text{Topic}}$ yesterday**] **Fin** [$_{\text{TP}}$ *John* [**$_{\text{Tense}}$ $_{-1}$**] done that, ...

In Rizzi's system, there is no problem of word order, since the Topic in these sentences is higher than Fin. Also, there is no problem of Case, since Nom can be assigned to *John* by Tense. Accordingly, Rizzi concludes that these examples require a different treatment. He proposes that they are ungrammatical because they violate the Head-Movement Constraint: Aux raising skips Top^0. Under our proposed approach, by contrast, all of the crucial data presented so far including (15a and b) can be uniformly accounted for by (16).

(16) (To be refined below)
At **PF**, a **subject** must appear **at the left periphery of TP** so that:
(i) **FIN** and the **subject** are **adjacent** to each other (in a finite clause), and
(ii) ***for*** and the **subject** are **adjacent** to each other (in a nonfinite clause).

While (16i and ii) may appear to be heterogeneous in nature, we will argue below that they in fact are quite homogeneous, first, from the perspective of the parallel semantic

[6] *That* and *for* of course share a function as physical markers of subordinate clauses, i.e., complementizers, just as case particles are markers of nominals in case-particle languages. Case particles and complementizers show another parallelism. Default case particles like NOM and ACC generally are without any semantic content, one exception being oblique cases. Likewise, complementizers like *that* and $\varnothing_{\text{that}}$ are semantically vacuous but *for* presumably has a similar status to that of oblique case markers and adds modality to its infinitival complement, as will be argued in Sect. 2.

contribution of FIN and FOR (Sect. 2), and second, in the context of physical–logical synchronization (Sect. 4).

1.3 $\varnothing_{for}$-subject adjacency in $\varnothing_{for}$-*to* clauses

In this subsection, we extend our investigation to overt-subject infinitives like (17), which lack an overt *for* complementizer but can in principle be augmented with one, as illustrated in (18). These stand in contrast with overt-subject infinitives for which *for* is categorically ungrammatical, as in (19); we label such overt-subject infinitives "ECM infinitives" and postpone their discussion until Sect. 1.4.

(17) John *prefers*/*wants*/*expects* [Bill to be happy]

(18) John *prefers*/*wants*/*expects* [**for** Bill to be happy]

(19) John *believes*/*considers*/*suspects*/*imagines* [(***for**) Bill to be happy]

Following much previous work, we propose that infinitives like those in (17) instantiate a silent complementizer $\varnothing_{\text{for}}$.[7] This is supported by three lines of reasoning. The first is the possibility of overt *for* as already shown in (18). We can unify the analysis of sentences like (17) with sentences like (18) by treating them as differing only in whether *for* is overt or not. The second consideration is semantic: sentences like (17) are truth-conditionally identical to their overt-*for* counterparts like (18). The most straightforward way of modeling this truth-conditional identity is adopting a syntactic analysis in which their truth conditions are derived via the composition of the same meaningful parts. Anticipating our compositional semantic analysis in the next section, in which *for* plays a crucial role in the semantics in sentences like (18), this then implies a silent counterpart of *for* in (17) that plays an analogous role in contributing to the sentences' truth conditions. Finally, the third reason is that the same kinds of word-order restrictions in effect for overt *for* are also operative when *for* goes missing, as witnessed in (20).

(20) a. ***John prefers**, [[$_{\text{Top}}$ *tomorrow*], [$_{\textbf{COMP}}$ **for**] **Bill** to leave the camp].
b. *John **prefers**, [[$_{\text{Top}}$ *tomorrow*], [$_{\textbf{COMP}}$ $\varnothing_{\textbf{for}}$] **Bill** to leave the camp].
c. *John **prefers** [[$_{\textbf{COMP}}$ **for**], [$_{\text{Top}}$ *tomorrow*], **Bill** to leave the camp].
d. *John **prefers** [[$_{\textbf{COMP}}$ $\varnothing_{\textbf{for}}$] [$_{\text{Top}}$ *tomorrow*], **Bill** to leave the camp].

If we posit $\varnothing_{\text{for}}$, then (20a) and (20b) have the same diagnosis, running afoul of the COMP > Top ordering requirement, and (20c) and (20d) also have the same diagnosis: the subject is not adjacent to *for*/$\varnothing_{\text{for}}$.

This is not to say that *for-to* clauses and $\varnothing_{for}$-*to* are syntactically identical in all respects; in fact, there is at least one systematic source of divergence between them—but one that we argue has an entirely principled basis stemming precisely from the overt status of *for* in contrast with covert status of $\varnothing_{for}$. In particular, as seen in (21) and (22), overt *for* is required whenever the infinitive is not right-adjacent to an embedding verb.

[7] This analysis can be traced back at least to Bresnan's (1972: 171) postulation of deep structure *for*-COMP. Chomsky (1981: 19) also assumes that a rule of the PF-component deletes *for* directly after *want*/*prefer* in the dialects that do not permit "want/prefer for …". See also Bošković (1997) and Martin (2001).

(21) a. John **wants** *very much* [$_{CP}$ [**$_{COMP}$ for**] **Bill** to leave].
b. *John **wants** *very much* [$_{CP}$ [**$_{COMP}$ $\varnothing_{\textbf{for}}$**] **Bill** to leave].
(cf. Martin's 2001 (64): 157)

(22) a. Pseudocleft:
What we **want** *is* [$_{CP}$ {**for/*$\varnothing_{\textbf{for}}$**}] [$_{IP}$ John to tell us everything]].
b. Right Node Raising:
They **expected** __ *and we preferred* [$_{CP}$ {**for/*$\varnothing_{\textbf{for}}$**}] [$_{IP}$ Peter to visit the hospital]].
c. Gapping:
Mary would **prefer** {**for/$^{ok}\varnothing$**} *Peter to finish school and Bill* __ [$_{CP}$ {**for/*$\varnothing_{\textbf{for}}$**}] [$_{IP}$ Peter to get a job]].
d. Topicalized CP:
[$_{CP}$ {**For/*$\varnothing_{\textbf{for}}$**}] [$_{IP}$ John to like Mary]], *Jane didn't* **expect** __.

This in fact is reducible to an independently recognized difference between overt and covert COMP, which is witnessed also for finite complementizer *that* and its silent counterpart:

(23) a. We **believe [$_{CP}$** {**that/$^{ok}\varnothing_{that}$**} he is innocent**]**.
b. We **believe** *quite strongly* **[$_{CP}$** {**that/*$^{?}\varnothing_{that}$**} he is innocent**]**.

(21)–(23) are only a portion of the observations reported by many researchers (Stowell 1981; Lamontagne and Travis 1987; Pesetsky 1991; Pesetsky and Torrego 2001; Bošković and Lasnik 2003; An 2007; McFadden 2012, among others), who have recognized "null-overt" contrasts involving COMPs in different contexts and have offered distinct approaches.[8] At this point, we do not attempt to answer the question of whether, and if so, how, all of these "null-overt" contrasts should be captured uniformly. We would just like to point out that whatever principle explains it should extend straightforwardly to (21) and (22), and that it does not threaten the postulation of $\varnothing_{\text{for}}$.[9]

1.4 $\varnothing_{Dox}$-subject adjacency in ECM clauses

In this subsection, we turn our attention to ECM infinitives, which we diagnostically identify as those overt-subject infinitives that reject overt *for*. Some examples are given in (24).

(24) John **believes/considers/suspects/imagines** (*for*) [**Bill** to be talented].

As is well known, material cannot intervene between an embedding verb and an ECM subject, as illustrated in (25).

[8] Honoring this precedent, we also recognize these "null-overt" contrasts. At the same time, however, we are also aware that there is some variation among speakers with respect to the detection of some of the contrasts. See Bošković and Lasnik (2003: 529, footnote 4).

[9] We will discuss the prohibition of null COMPs in cases like (21)–(23) and argue for why and in what ways adjacency matters, first, directly below when we deal with ECM clauses in Sect. 1.4, and second, when we attempt to identify the theoretical implications of our analyses in Sect. 4.

(25) a. John **believes/considers/suspects/imagines** (**unwisely*) **Bill** to be hiding the details.
b. John **believes/considers/suspects/imagines** (**very strongly*) [**Bill** to be talented].

The intervention problem observed in the ECM sentences in (25a and b) is generally considered to uniformly involve case adjacency disruption between the higher verb and the lower subject. In departure from the usual approach, though, we consider that the adjacency requirement in (25) is not unitary but involves two distinct types of adjacency disruption.

First, we propose that the adjacency requirement in (25a) is not with respect to the embedding verb itself, but rather to a silent ECM-specific complementizer, which, for reasons to become clear soon, we call $\varnothing_{\text{Dox}}$. Then, the source of unacceptability for sentences like (25a) is the lack of adjacency between the subject and $\varnothing_{\text{Dox}}$, as schematized in (26a), where that adjacency is disrupted by a topicalized subordinate-level adjunct.

(26) a. *John **believes** [$_{\text{CP}}$ **$\varnothing_{\text{Dox}}$** *unwisely* [$_{\text{TP}}$ **Bill** to be hiding the details]].
[***$\varnothing_{\text{Dox}}$**⌒Ajct⌒**Sbj**] cf. (12)
b. *****John **believes** [$_{\text{CP}}$ *unwisely* **$\varnothing_{\text{Dox}}$** [$_{\text{TP}}$ Bill to be hiding the details]].
[*Topic > COMP] cf. (13)

The unacceptability may also arise from the illegitimate order of Topic and COMP if $\varnothing_{\text{Dox}}$ appears after the topicalized adjunct as in (26b). In other words, the problem here can be completely assimilated to that in the paradigm in (12) and (13), with the complementizer in (10-ii) expanded to include $\varnothing_{\text{for}}$ and $\varnothing_{\text{Dox}}$ as well. (We will return to the adjacency disruption in (25b) shortly below.)

The primary piece of independent motivation for the presence of $\varnothing_{\text{Dox}}$ in ECM infinitives is semantic in nature and comes from the work of Moulton (2009). Moulton observes that perception reports with bare infinitives (i.e., infinitives lacking the infinitive marker *to*) or present participles do not entail anything about whether the subject believes the content associated with the perception. On the other hand, when perception reports instantiate ECM *to*-infinitives, they do give rise to such belief entailments. This is illustrated by the contrast between (27) and (28) for perception reports with *see*, *hear*, and *feel*, respectively.

(27) a. Martha ***saw*** [Fred **drive/driving** too fast], but she believed he wasn't.
b. Martha ***heard*** the former German Army soldier [**sing(ing)** *Die Fahne hoch!*], but she ***believed*** he wasn't.
c. Lewis ***felt*** [his cat **lick(ing)** his face], but Lewis ***believed*** that someone was rubbing sandpaper across his face.

(28) a. Martha ***saw*** [Fred **to be** driving too fast], #but she ***believed*** he wasn't.
(Moulton 2009: 128)
b. Martha ***heard*** the former German Army soldier [**to be** singing *Die Fahne hoch!*], #but she ***believed*** he wasn't.
c. Lewis ***felt*** [his cat **to be** licking his face], **#**but Lewis ***believed*** that someone was rubbing sandpaper across his face.
(adapted from Moulton 2009: 140)

Moulton's account of this pattern is to propose that ECM *to*-infinitival complements to perception verbs instantiate a modal functional head that contributes the belief semantics, what we call $\varnothing_{\text{Dox}}$, where 'Dox' abbreviates 'Doxastic' (i.e., belief-related). Then, we can have a uniform semantics for perception verbs by which they simply contribute an event of seeing, hearing, feeling, etc. Moulton is noncommittal about whether his approach to ECM complements to perception verbs should extend to all syntactic contexts in which ECM infinitives appear. We take the position that a uniform approach to ECM *to*-infinitives is highly desirable and therefore propose that they always instantiate $\varnothing_{\text{Dox}}$. (In the following section, we will see the compositional semantic details of this approach.) Accordingly, just like finite clauses (4a), we can maintain that *for-to* infinitives (20c), $\varnothing_{for}$*-to* infinitives (20d), and ECM infinitives (26a) all display a subject-adjacency effect.

We also propose that the adjacency disruption in (25b) is not with respect to the higher verb and the lower subject nor with respect to the ECM-COMP $\varnothing_{\text{Dox}}$ and the subject. Instead, we ascribe the problem in (25b) to an adjacency requirement between the "null-COMP CP" and the higher verb as illustrated by the contrast between (29a) and (29b) below, which can be assimilated to the overt vs. covert COMP contrast observed in (21)–(23) in the previous section. (Note that the adjacency in (29b) is disrupted by a matrix-level adjunct *very strongly*.)

(29) a. John **believes** [$_{\underline{\text{CP}}}$ $\varnothing_{\textbf{Dox}}$ Bill to be talented]. [$^{\text{ok}}\mathbf{V_{ECM}}\frown\mathbf{CP_{\varnothing Dox}}$]

b. *John **believes** *very strongly* [$_{\underline{\text{CP}}}$ $\varnothing_{\textbf{Dox}}$ Bill to be talented]. [*$\mathbf{V_{ECM}}\frown Ajct_{Matrix}\frown\mathbf{CP_{\varnothing Dox}}$]

c. *John **believes** [$_{\underline{\text{CP}}}$ **for** Bill to be talented]. [*$\mathbf{V_{ECM}}$+*for*]

d. *John **believes** *very strongly* [$_{\underline{\text{CP}}}$ **for** Bill to be talented]. [*$\mathbf{V_{ECM}}$+*for*]

The analyses here lead us to predict that the only cases in which the $\varnothing_{\text{Dox}}$*-to* infinitives become grammatical are those in which nothing intervenes between $\varnothing_{\text{Dox}}$ and the lower subject, and at the same time nothing intervenes between the higher embedding verb and the complement CP as in (29a). The paradigm in (29), however, differs from that in (21)–(23) in that the overt-subject infinitives here categorically reject the overt COMP *for* as shown in (29c and d), which we identified above as the diagnostic characteristics of ECM infinitives (cf. (19)). In a grammatical ECM infinitive as in (29a), because of the phonetically null status of $\varnothing_{\text{Dox}}$, the subordinate subject always appears to show up superficially adjacent to the embedding verb, which provides us with the impression that sentences like this call for the so-called exceptional Case marking by the higher verb, misleadingly in our opinion.

These investigations take us back to the "ECM" paradigm (24) and (25) presented at the outset of this subsection (repeated here for convenience together with the possible analyses of (25a) in (26)).

(24) John **believes/considers/suspects/imagines** (**for*) **Bill** to be talented.

(25) a. John **believes/considers/suspects/imagines** (**unwisely*) **Bill** to be hiding the details.

b. John **believes/considers/suspects/imagines** (**very strongly*) **Bill** to be talented.

(26) a. *John **believes** [$_{CP}$ **∅$_{Dox}$** *unwisely*, [$_{TP}$ **Bill** to be hiding the details]].
[***∅$_{Dox}$**⌒*Ajct*⌒**Sbj**]

b. *John **believes** [$_{CP}$ *unwisely*, **∅$_{Dox}$** [$_{TP}$ Bill to be hiding the details]].
[*Topic > COMP] cf. (10-ii)

This paradigm involves three distinct problems: ***(i)*** in (24), the "ECM" verbs select the incorrect COMP *for* (as illustrated in (29c and d) above); ***(ii)*** in (25a), the subject and $\varnothing_{\text{Dox}}$ in the complement clause are not adjacent to each other or Topicalized subordinate adjunct and COMP are in illegitimate order (as illustrated in (26a) and (26b), respectively), and ***(iii)*** in (25b), the "null-COMP CP" and the higher verb are not adjacent to each other (as illustrated in (29b) above). We claim here, in other words, that what has long been considered to be a problem of lacking adjacency necessary for exceptional case marking of a subordinate subject is actually an amalgam of miscellaneous grammatical problems. All of these cases contrast with a well-formed (erroneously called) "ECM" infinitive as in (29a), in which the higher verb selects a complement clause headed by the correct COMP $\varnothing_{\text{Dox}}$ and the adjacency is not disrupted either between the higher verb and the complement CP, or between the subordinate subject and the modal COMP $\varnothing_{\text{Dox}}$.

One issue we have not taken up in our discussion of ECM infinitives is whether this construction involves raising of the ECM subject. Rather than making a digression on this controversial topic here, we will discuss in Appendix A some of the arguments provided in the literature for and against such an analysis and how they can be related to the approach proposed in the current work.

2 Modal anchoring

In the previous section, we identified a set of left-peripheral functional heads that the subject of the clause must be adjacent to: FIN, *for*, $\varnothing_{\text{for}}$, and $\varnothing_{\text{Dox}}$. In this section, we argue that these heads constitute a natural semantic class: they serve as modal anchors that relate the content of their clause either to the speech act (in unembedded contexts) or to the contentful eventuality introduced by the embedding predicate (in embedded contexts). The gist of the argument for this proposal is that, when we look at the distribution of clauses that instantiate each of these four heads, those distributions form natural modal classes: FIN clauses generally occur in *information* contexts, *for* and $\varnothing_{\text{for}}$ clauses generally occur in *preference* contexts, and $\varnothing_{\text{Dox}}$ clauses occur in *doxastic* contexts. To account for this, we propose that the heads themselves encode these modal flavors, imposing the observed restrictions in the environments that they can appear in.

According to a popular view, declarative clauses denote, on some level, sets of world–time pairs. For example, as sketched in (30), a sentence like *Kim was happy* denotes all of those world–time pairs $<w,t>$ such that Kim is happy in w at some time before t.

(30) $[\![\text{Kim was happy}]\!] = \{<w,t>: \text{Kim is happy in } w \text{ at some time before } t\}$

If a declarative clause is modeled as denoting a set of world–time pairs, what would enable it to be used as an assertive speech act? Very broadly speaking, two kinds

of views are found in the literature. On one view, a sentence's illocutionary force is not grammatically encoded but is instead a pragmatic effect; for example, on Stalnaker's (1978) approach, declarative clauses denote propositions, which are of the appropriate type to be added to the Common Ground. On the other view, a sentence's illocutionary force is in some way grammatically encoded: see, e.g., Ross 1970; Rizzi 1997; Cinque 1999, and many others for various versions of this view. Here, we adopt a version of the grammatical encoding view, because we think that it helps explain the pattern of data in (31)–(33) concerning the distribution of finite and nonfinite clauses.

(31) a. Sandy **is** happy.
b. #For Sandy **to be** happy.

(32) a. Kim *thinks* that Sandy **is** happy.
b. *Kim *thinks* for Sandy **to be** happy.

(33) a. *Kim *wants* that Sandy **is** happy.
b. Kim *wants* for Sandy **to be** happy.

In (31), we see that finite clauses can be used in unembedded contexts as assertions, whereas *for-to* infinitives cannot be so used. In (32), we see a similar pattern in an embedded context: *think* can embed a finite clause but not a *for-to* clause. Finally, (33) shows the opposite patterning: *want* cannot embed a finite clause but it can embed a *for-to* clause. These patterns raise two related questions: first, what property unites assertion and belief to the exclusion of desire? Second, why does this property correlate with finite vs. *for-to* clauses?

Our core idea is that assertions and belief both characterize what we call, following Anand and Hacquard (2013), information states: sets of propositions that are either true or false. Desires, on the other hand, characterize preference states: sets of propositions that are either fulfilled or unfulfilled. Prior to combination with FIN or *for*, a sentence (TP) denotes a set of world–time pairs, and the function of FIN or *for* is to anchor the sentence by relating its world–time pairs to an information state or a preference state, respectively. In other words, we regard a sentence as a phrase projecting (unsaturated) world and time, although we will continue to label it "TP (Tense Phrase)," following the more familiar practice.

Formally, we achieve this by treating FIN as an information modal (i.e., a modal that quantifies over an information state in the sense of Anand and Hacquard 2013), as in (34). Complementizer *for*/$\varnothing_{\text{for}}$, by contrast, we treat as a preference modal, as in (35).[10] (We use PRIORITY to characterize preference modality; this is Portner's (2007) term for the broad modal category that encompasses deontic [norm-related], teleological [goal-related], and bouletic [desire-related] modality.)

(34) a. $[\![\text{FIN}]\!] = \lambda p_{<s,it>}.\lambda e_{\varepsilon}.\forall <w',t'> \in \text{INFO}(e)\text{: } p(w')(t')$
b. $\text{INFO}(e) = \{<w,t>\text{: } <w,t> \text{ is compatible with the information in e}\}$
c. *'All those world–time pairs compatible with the* ***information*** *in e are ones at which p is true'*

[10]Here, we draw on a long tradition of treating *for-to* clauses as having their own semantics distinct from that of finite clauses; for various implementations of this view, see, among others, Bresnan (1972), Portner (1997), and Grano (2016).

(35) a. $[\![\text{for}/\varnothing_{\text{for}}]\!] = \lambda p_{<s,it>}.\lambda e.\forall <w',t'> \in \text{PRIORITY}(e)$: $p(w')(t')$
b. PRIORITY(e) = {<w,t>: <w,t> is compatible with the highest ranked preferences in e}
c. *'All those world–time pairs compatible with the highest ranked* ***preferences*** *in e are ones at which p is true'*

Then, in an unembedded context, the eventuality e introduced by the modal represents the speech act itself. Thus, a finite clause like *It's raining* characterizes an information state, and is therefore useable as an assertion, as described in (36).

(36) a. $[\![\text{FIN it's raining}]\!] = \forall <w',t'> \in \text{INFO}(e_{\text{speech act}})$: $\text{rain}(w')(t')$
b. *'All world–time pairs compatible with the* ***information*** *in e are ones at which it's raining'*

By contrast, a *for-to* clause like *for it to be raining* characterizes a preference state, as described in (37), and is therefore not useable as an assertion.[11]

(37) a. $[\![\text{for}/\varnothing_{\text{for}}\ \text{it to be raining}]\!] = \forall <w',t'> \in \text{PRIORITY}(e_{\text{speech act}})$: $\text{rain}(w')(t')$
b. *'All world–time pairs compatible with the highest ranked* ***preferences*** *in e are ones at which it's raining'*

In embedded contexts, by contrast, e is contributed by the embedding predicate. This is illustrated in (38) for composition of *believe* with a finite complement and in (39) for composition of *want* with a *for-to* clause.

(38) a. $[\![\text{believe}]\!] = \lambda x.\lambda e.\text{belief}(x)(e)$
b. $[\![\text{believe that FIN it's raining}]\!] = \lambda x.\lambda e.\text{belief}(x)(e) \wedge \forall <w',t'> \in \text{INFO}(e)$: $\text{rain}(w')(t')$
c. $[\![\text{Kim believe that FIN it's raining}]\!] = \lambda e.\text{belief}(k)(e) \wedge \forall <w',t'> \in \text{INFO}(e)$: $\text{rain}(w')(t')$
d. True of an eventuality e iff e is a **belief** of Kim's such that all world–time pairs compatible with the **information** in e are ones at which it is raining.

(39) a. $[\![\text{want}]\!] = \lambda x.\lambda e.\text{desire}(x)(e)$
b. $[\![\text{want for}/\varnothing_{\text{for}}\ \text{it to be raining}]\!] = \lambda x.\lambda e.\text{desire}(x)(e) \wedge \forall <w',t'> \in \text{PRIORITY}(e)$: $\text{rain}(w')(t')$
c. $[\![\text{Kim want for}/\varnothing_{\text{for}}\ \text{it to be raining}]\!] = \lambda e.\text{desire}(k)(e) \wedge \forall <w',t'> \in \text{PRIORITY}(e)$: $\text{rain}(w')(t')$
d. True of an eventuality e iff e is a **desire** of Kim's such that all world–time pairs compatible with the highest ranked **preferences** in e are ones at which it is raining.

In general, this approach follows the so-called decompositional approach to propositional attitude reports espoused by Kratzer (2006), Moulton (2009), Bogal-Allbritten

[11] Under some conditions, an unembedded *for-to* clause can be used to express a wish or a regret (Portner 1997), consistent with the status of *for* as a preference modal.

(2016), and others, according to which it is not the embedding verb but rather a modal in the left periphery of the complement clause that induces quantification over attitude alternatives.

On this approach, we can account for complement restrictions like those illustrated in (40) below as stemming from semantic incompatibility: in these sentences, mutually incompatible requirements are imposed on the described eventuality, leading to incoherent truth conditions and hence intuitive unacceptability. That is, in (40a), the predicate is compatible only with preference-related eventualities but the modal only with information-related eventualities, and vice versa in (40b).[12,13]

(40) a. *John **wanted/intended/planned** [*that* FIN Bill was happy].
b. *John **believed/knew/claimed** [*for* Bill *to* be happy].

Independent support for treating *for-to* clauses as instantiating preference modality comes from data such as (41).

(41) a. [**For** Bill to leave] would be a good idea.
b. Here is a book [**for** you to read].
c. I opened the window [**for** the plants to get some fresh air].

What we see here is that even when the *for-to* construction appears in environments beyond complementation, i.e., sentential subjects, infinitival relatives (see especially Bhatt 1999), or purpose clauses, it still maintains its signature preference-/purpose-related semantics.[14]

[12] Recall that, as discussed in and around footnotes 5 and 6 in Sect. 1.2, we identify and analyze a syntactic phrase in accordance with its featural contents rather than with frozen syntactic categories like Force and Fin proposed under Rizzi's Split-COMP. While both *that* and *for* function as physical markers of subordinate clauses (i.e., as complementizers), only *for* is a modal anchor (which lacks the feature FIN). It therefore is also natural that the featural head FIN as a modal anchor and *for* behave in a parallel manner as in (40).

[13] Two qualifications are in order here. First, there are apparent exceptions to the claim that preference predicates are always incompatible with finite complements. Notably, the preference predicate *hope* is compatible with both finite and nonfinite complements. This is parallel to a notorious problem in the mood-choice literature: crosslinguistically, 'hope' tends to pattern like 'believe' and unlike 'want' in sometimes accepting indicative complements. See Portner and Rubinstein (2020) for a recent attempt at a solution to this problem that we believe could be adapted to our setting without too much fuss. In a nutshell, these authors propose that preference predicates that obey certain belief-like rationality constraints (including *hope*) can, under some conditions and in a crosslinguistically idiosyncratic way, take on the syntax of belief predicates (for semantically principled reasons that would take us too far afield here).

Second, it is not a crosslinguistic universal that predicates like 'want' reject finite complements. In German, for example, 'want' combines with finite complements, and in other languages, there is arguably no finite/nonfinite distinction at all. However, Hacquard and Lidz (2019) show that there is a robust generalization to be made: crosslinguistically, complements to 'believe' tend to resemble declarative main clauses, whereas complements to 'want' tend not to. This is true even in German, where complements to 'believe' can exhibit the same V2 syntax seen in main clauses but complements to 'want' cannot. While a full investigation of the crosslinguistic situation is beyond the scope of this paper, we hypothesize that the distinct modal anchors associated with belief reporting vs. desire reporting may be a linguistic universal, even though its syntactic manifestation may vary from one language to the next.

[14] *For-to* complements to *too* and *enough* constitute one exception to this generalization, in that they can instantiate epistemic possibility:

(i) This argument is **too** clever [**for** Pat **to** have constructed it].

Finally, following Moulton (2009) as reviewed above, we assign $\varnothing_{\text{Dox}}$ a semantics that encodes belief, as in (42).

(42) Compositional implementation:

a. $[\![\varnothing_{\text{Dox}}]\!] = \lambda p_{<s,it>}.\lambda e.\forall <w',t'> \in \text{DOX}(e)\text{: } p(w')(t')$

b. $[\![\text{believe}]\!] = \lambda x.\lambda e.\text{belief}(x)(e)$

c. $[\![\text{believe } \varnothing_{\text{Dox}} \text{ it to be raining}]\!] = \lambda x.\lambda e.\text{belief}(x)(e) \wedge \forall <w',t'> \in \text{DOX}(e)\text{: rain}(w')(t')$

d. $[\![\text{Kim believe } \varnothing_{\text{Dox}} \text{ it to be raining}]\!] = \lambda e.\text{belief}(k)(e) \wedge \forall <w',t'> \in \text{DOX}(e)\text{: rain}(w')(t')$

e. True of an eventuality e iff e is a **belief** of Kim's such that all world–time pairs compatible with the **doxastic content** of e are ones at which it is raining.

We thereby accurately predict the restriction of $\varnothing_{\text{Dox}}$ clauses (ECM infinitives) to belief contexts.

3 Subjects as pivot of utterance

Above, we have argued that the subject must always be adjacent to a sentence's modal anchor, as a PF correlate of the LF effect of anchoring. Now, we address the question: why is it specifically the subject that must be adjacent to the anchor? We propose that modal anchoring selects the subject for this purpose because the subject has a privileged status in the establishment of the coherence of utterances in a discourse.

A persistent idea in the literature is that the subject is what the sentence is "about" (see, e.g., Cardinaletti 2004; Rizzi 2005). To substantiate this idea, we adopt the basic tenets of Centering Theory as laid out by Grosz et al. (1995).[15] These authors are concerned with contrasts in perceived coherence between sequences of utterances like (43a–d) and (44a–d). Although (43) and (44) convey the same information, "Discourse [(43)] is clearly about John" (p. 206), whereas "Discourse [(44)] has no single clear center of attention" (p. 206); instead, the center of attention seems to oscillate between John and the store, leading to a less coherent sequence than (43).

(43) a. John went to his favorite music store to buy a piano.
b. He had frequented the store for many years.
c. He was excited that he could finally buy a piano.
d. He arrived just as the store was closing for the day.

(44) a. John went to his favorite music store to buy a piano.
b. ?It was a store John had frequented for many years.
c. ?He was excited that he could finally buy a piano.
d. ?It was closing just as John arrived.

(ii) This argument is clever **enough** [**for** Pat **to** have constructed it].

See Grano (2022) for a discussion.

[15] See also Barros and Frank (2022) for a recent application of Centering Theory to an account of clause-boundedness and its exceptions.

In order to make sense of data like this, the authors propose a theory in which every utterance is associated with a set of forward-looking centers, and every noninitial utterance is associated with a backward-looking center. Forward-looking centers are ranked by a number of factors, with one essential factor being grammatical function. Crucially for us, the subject is the highest ranked. Discourses are more or less coherent to the extent that they conform to various centering constraints. One constraint ("Rule 1") concerns pronominalization: in a sequence of utterances U_n and U_{n+1}, if any forward-looking center of U_n is realized as a pronoun in U_{n+1}, then the backward-looking center of U_{n+1} must also be realized as a pronoun. For example, in the following sequences of utterances, the forward-looking center of (45a) (*John*) is identical to the backward-looking center (realized as *he*) in (45b). In (45c), it would be quite odd to realize this backward-looking center as *John* as opposed to the pronoun *he*, given the pronoun later in the utterance *him* referring to Mike.

(45) a. John has been acting quite odd.
b. He called up Mike yesterday.
c. {He/$^{??}$John} wanted to meet him urgently. (adapted from Grosz et al. 1995, p. 215)

Another constraint ("Rule 2") dictates that, optimally, in a sequence of noninitial utterances U_n and U_{n+1}, both utterances share the same backward-looking center, and, in the most optimal case, this backward-looking center is furthermore the highest-ranked forward-looking center of U_{n+1}. For example, in the discourse in (46), the transition between (46b) and (46c) is the most optimal, that between (46c) and (46d) is the second most optimal, and that between (46d) and (46e) is the least optimal.

(46) a. John has been having a lot of trouble arranging his vacation.
b. He cannot find anyone to take over his responsibilities.
c. He called up Mike yesterday to work out a plan.
d. $^{?}$Mike has annoyed him a lot recently.
e. $^{??}$He called John at 5 AM on Friday last week.
(adapted from Grosz et al. 1995, p. 217)

In (46c), the backward-looking center (John, realized as *he*) is the same as that of (46b), and is furthermore the highest-ranked forwarding-looking center of (46c) (realized in subject position). In (46d), the backward-looking center (John, realized as *him*) is the same as that of (46c), but it is not the highest-ranked forward-looking center (not realized in subject position) in (46d). Finally, in (46e), the backward-looking center (Mike, realized as *he*) is not the same as the backward center of (46d), making the transition between (46d) and (46e) the least optimal transition in the discourse.

An upshot of this theory is that, all else being equal, a discourse is most coherent when each utterance is centered around the same individual, optimally realized in subject position. We take it that this substantiates the intuition that the subject is what the sentence is "about": the subject is what the sentence is "about" in the sense that it creates an expectation about what will link one utterance in a discourse to the next.

Also, given this privileged status of the subject, we think it is a natural choice for the physical marking of a sentence's modal anchor.[16]

4 Synchronization of physical and logical properties in the grammar

In the previous sections, we pursued our descriptive goal of demonstrating the generalization summarized as in (47).

(47) A modal (FIN, *for*, $\varnothing_{\text{for}}$, and $\varnothing_{\text{Dox}}$) induces quantification over attitude alternatives, and the subject must appear at the left periphery of TP in order to be adjacent to that modal anchor.

This generalization itself, we believe, provides a working hypothesis that is worth further examination. However, it also invites us to ask why conceptual and sensorial phenomena must coincide in this particular way. Although a full-scale pursuit of this inquiry is beyond the scope of the current work, in what follows, we conduct an initial survey on this issue.

4.1 Numeration and physical–logical synchronization

We first would like to clarify the theoretical stance and the model of grammar we adopt. Simply put, our investigation is couched in the Minimalist Program (MP: Chomsky 1995, 2001b, 2004), but only loosely. We adopt its core spirits, insights, and tenets but, as will be clarified directly below, not necessarily the specific executions that are often adopted as part of its package.

First, we will pursue the spirit of Chomsky's strongest minimalist thesis (SMT) and confine ourselves to defining grammar appealing only to *logical* properties relevant to LF and *physical* properties relevant to PF in the end. Crucially, "physical" here is a broader notion than "overt sound segments," including any physical relation and flow (i.e., early to late in the flow of time) such as adjacency, periphery, and prosody.

Accordingly, we embrace the following major tenets: (i) the *legibility conditions*, which require the physical and logical information on linguistic expressions to be completely split (by Spell-Out/Transfer) for the legible interface representations, (ii) the *inclusiveness condition*, which requires that the interface representations consist only of the information already represented on lexical items, and (iii) *local economy*, which prohibits derivational steps from anticipating (or *looking-ahead* to) their non-immediate consequences based upon a global scan of the derivation (cf. Collins 1997: 4, Collins 2001: 58).

Traditionally, to avoid such "look-ahead," any pre-Spell-out operation (e.g., overt displacement and Agree) has been thought to require some local trigger that has no interface import. EPP features (including Edge features) and Case features have been

[16] We suggest that the periphery of a sentence is an ideal position for an item to be presented in an utterance as a center. That is, placing a subject at the left and highest periphery of the sentence suits the need of identifying the utterance center in the discourse, even if the notion of center is not explicitly specified in the sentence grammar.

postulated to fulfill such a need. Their theoretical validity, however, has now been repeatedly questioned by many researchers (Marantz 1991; Sigurðsson 2004; McFadden 2004; Sigurðsson 2009; Levin 2015, to name only a few).

In this section, we will pursue an approach in which all steps of the grammatical derivation obey *local economy* triggered by the *interface-oriented physical and logical properties*. We will also impose the inclusiveness condition even on these derivation-inducing physical and logical properties in such a way that they can be introduced only into lexical items when the Numeration is formed. Such properties indicated on lexical items, on the other hand, would have to be properly split and separately sent to each interface in order to satisfy the legibility conditions at every stage they are mapped onto physical and logical representations.

Since de Saussure (1916), it has generally been considered that any linguistic sign consists of its *signifier* (form) and *signified* (concept). This view is inherited in MP in such a way that a pair of form (π) and concept (λ) are introduced into the Numeration as a lexical choice, e.g., (/bUk/$_{\pi}$, $[\![\text{book}]\!]_{\lambda}$) (Chomsky 1995: 225). While they must be represented separately at PF and LF, they are regarded as a compatible signifier and signified making up a single lexical item, crucially because they are represented as the pair (π, λ) in the Numeration.

Expanding this standard minimalist view further, we would like to pursue below an approach in which the "signifier–signified" relation specified at the Numeration is extended from lexical items to syntax, which would permit us to capture otherwise inexplicable synchronization of PF and LF in various grammatical phenomena.

While the Numeration is often described as a mere set or array of lexical items to be inputted to a syntactic derivation, we consider that it plays much more important roles than that. First, as described just above, it crucially functions as the pivot of PF–LF synchronization taking place at the two separate interfaces. Second, it should also be deemed as what has a *potential* to indicate the *utterance blueprint*, which involves much richer syntactic and semantico-pragmatic properties than mere pronunciation and denotation of words. Such a property of the Numeration, in fact, has already been assumed at least implicitly since its inception. Chomsky (1955: 236–237), for instance, proposed that optional grammatical features like number and case are added to a lexical item when the Numeration is formed, as illustrated in (48), which foresees that the nominal *book* appears as a plural object in a sentence.

(48) /bUk/$_{\text{P}}$, $[\![\text{book}]\!]_{\text{L}} \Rightarrow$ /bUks/$_{\text{P}}$, $[\![\text{book}]\!]_{\text{L}}$, **plural**$_{\text{L}}$, **accusative**$_{\text{P}}$

We would like to pay attention to these two functions of the Numeration: (i) pivoting PF–LF synchronization and (ii) indicating a (potential) blueprint of utterance, and claim that some consistent association of physical and logical properties in various syntactic phenomena are captured when "signifier–signified" relations of relevant lexical entries are obligatorily indicated as pairs at the Numeration and their properties are successfully realized at each of the interface representations.

4.2 Logically signified syntactic phenomena and their physical signifiers

We recognize at least three types of logical signification in syntax listed in (49), each of which involves a distinct syntactic and interpretive domain.

(49) Three basic logically signified phenomena in syntax:
  a. Thematic anchoring;
  b. Modal anchoring;
  c. Informational anchoring.

One of the logically/semantically signified phenomena involves *thematic anchoring* within the projection of a (typically verbal) predicate. This of course is nothing new. As has been generally assumed, the projection of a lexical entry appearing as an argument is thematically underspecified and a predicate as its thematic anchor specifies its semantic role. The second phenomenon involves *modal anchoring*, which we investigated in Sect. 2. A sentence (TP) is underspecified in modality (world–time), and anchored to one of the modal anchors, FIN, COMP_{for}, $\text{COMP}_{\varnothing for}$, or $\text{COMP}_{\varnothing \text{DOX}}$, within a clause. This modal anchor then quantifies over the world–time alternatives of the sentence. The third and final phenomenon involves *informational anchoring*. When a modal-specified sentence involves information packaging like focus and/or marked speech act like interrogation, it contains an item whose ordinary value is yet to be defined. It therefore must be anchored to an appropriate higher operator head like $\varnothing_{\text{FOCUS}}$ and $\varnothing_{\text{QUESTION}}$. (Informational anchoring will be taken up again in Sect. 4.4, and more detailed analyses will be presented in Appendix G and Appendix H.)

Our main claims are that each of these logically signified phenomena at LF must be paired with a relevant *physical signifier* at PF, and that such "signifier–signified" pairings must be encoded into relevant lexical items at the Numeration. The three-step reasoning behind this claim is very simple. First, since the goal of linguistic communication generally is to convey and understand our thoughts and intention rather than to produce or perceive a sequence of sounds,[17] the physical representation of the logical contents must have its own *raison d'être*. Second, if the correct interpretation of a lexical item is achieved by successfully pairing its meanings at LF and its sounds at PF based upon their pairing at the Numeration, there is no reason why the same cannot be true of the interpretations involving larger syntactic objects like those logically signified syntactic phenomena described above. Finally, when various interpretive phenomena in (49) must involve the anchoring of the underspecified expressions to their interpretive anchors at LF, it is reasonable to hypothesize that grammar attempts to guarantee its successful achievement by physically signaling their association, based upon the "signifier–signified" pairing represented at the Numeration.

We also consider that such physical signifiers at PF appeal to *any physical means* that can be identified by the human mind in order to ensure the correct matching of the interpretive domain and its anchor (obviously within the range limited by UG). That is, they involve not only the sound segments themselves but also any *linearly* indicated relation (e.g., early to late in the flow of time). Moreover, if we hypothesize that syntactic derivation also inputs to PF the set containment relations created by merge, it is not surprising that even a *hierarchically* indicated relation (i.e., constituency) may be tacitly provided and appealed to by physical signifiers. Thus, we hypothesize that physical signification may be achieved by any (combination) of (50a–d).

[17] Throughout, we will concentrate on spoken languages for the sake of simplicity.

(50) Potential means of physical signification:
  a. marking Y with phonetic contents P [overt morphology]
  b. locating Y immediately following (or preceding) X [adjacency]
  c. locating Y at the beginning (or end) of a domain Z [peripherality]
  d. superimposing prosodic information P over Y (and a domain Z) [prosody]

That is, we take the position that overt morphology (50a), adjacency (50b), peripherality (50c), and prosody (50d) can function as a physical signifier of the logically signified phenomena listed in (49).[18] We also expect that the choice of which particular options in (50) are adopted as well as how they are combined is crosslinguistically varied.

In order to avoid any confusion, we should straighten out the terminologies here. If the truly final representations of the interfaces PHON and SEM are derived via phonology/phonetics and semantics, respectively, we should postulate the final *syntactic* representations that underlie them. While LF (as opposed to "logical form") has been used by many as the label for such a syntactic representation on the logical/semantic side, "PF" has been used by many to label PHON, the grammatical representation directly inputted to the sensorimotor performance system. We therefore will avoid using "PF" to refer to the final *syntactic* representation on the physical side, although we have loosely used the term PF so far. From now on, we call this syntactic representation *Physical Form* (ϕF) instead. Our claim, then, is that, in order for syntactic objects to be successfully signified thematically, modally, and informationally at SEM, they must achieve correct anchoring as in (49) at LF, and they must be associated with some specific signifiers at ϕF appealing to one or more means listed in (50), which we will call "physical signification" (henceforth ϕ-signification). We will also subclassify ϕ-signification into three different types and label them: (i) *Morph*(ological)-*signification* (50a), (ii) *Loc*(ational)-*signification* (50b and c), and (iii) *Prosod*(ic)-*signification* (50d).

4.3 Thematic anchoring

We now spell out the details of our claims on ϕ-signification, starting with the discussion on the ϕ-signification for thematic anchoring under the verbal projection. Morph-signification in Korean is exemplified in (51) and Loc-signification in English is exemplified in (52).[19]

(51) Jina-ka mwue(s)-{**ul**/*∅} *chimtay-eyse* ilk-ess-ni?
Jina-NOM what-{**ACC**/*∅} *bed-at* read-PAST-Q
'What did Jina read on the bed?' (Yoon and Kitagawa 2018: 282)

[18] In Sect. 4.4, we will argue that the physical signification appealing to peripherality (50c) is eventually reduced to that appealing to adjacency (50b). It also is an interesting question to ask if, just as the pronunciation of phonetic contents can be a physically signifier (50a), its absence at the position where it is generally expected (i.e., empty argument) can be a physical signifier. We will take up and briefly discuss this possibility in Sect. 5.

[19] We will discuss Morph-signification in English later in this subsection.

(52) The professor **recommended** (**strongly*) [**John**].

In our terms, the accusative marking -(*l*)*ul* in (51) Morph-signifies the thematic anchoring of the object by the predicate. In (52), on the other hand, the adjacency between the predicate and the object Loc-signifies their thematic anchoring. Both of these phenomena have generally been dealt with under the theory of case appealing to abstract Case and the case-adjacency condition.

A common view adopted in generative syntax is that Case is a formal mechanism that syntactically licenses NPs/DPs and determines their distribution (appealing also to some version of the Case Filter) as well as their morphological forms. There also seems to be a consensus that accusative Case concerns the licensing of an NP/DP under the verbal projection while nominative Case concerns that under TP/IP involving finite tense (in nominative-accusative languages). Each of such licensing is also often analyzed to be achieved by some (functional) head.

Simply put, however, abstract Case (or any version of a formal case feature) is an artifact devised to capture the uniform distribution and function of morphologically marked and nonmarked nominal expressions. Need for an abstract notion of case as a syntactic entity, in fact, has been repeatedly questioned by many researchers, although the realization of correct morphological case at surface has remained an issue (Zaenen et al. 1985; Marantz 1991; McFadden 2004; Bobaljik 2008; Sigurðsson 2009; Preminger 2011, and Yoon and Kitagawa 2018, among others). In developing his Probe-Goal analysis, even Chomsky, the major advocate of abstract Case, admits that Case is "demoted in significance" and raised "the question of why Case exists at all." (Chomsky 2000: 127) As pointed out by Bobaljik and Wurmbrand 2009: 58, it perhaps is not an exaggeration to say that Chomsky's unvalued Case features are postulated only to ensure the correct morphological forms at a surface. If so, valuing of Case features before Spell-Out is *looking-ahead* to its ultimate consequence at ϕF and PHON, violating the Local-Economy Condition. In short, a fair number of researchers have started to think that morphological case may be the only grammatical device that needs to be postulated in the theory of case. In Appendix B, we will point out that Marantz's analysis of productive morphological case marking can be reduced to thematic anchoring and its Morph-signification.

The options of ϕ-signification introduced in (50) can compensate for one another within an individual language although which particular options are adopted and how they interact may vary depending on the language. For example, Loc-signification is often appealed to when the interpretive domains are not overtly marked by Morph-signifiers. The paradigm from colloquial Japanese in (53) below illustrates this point rather clearly and supports this characterization of ϕ-signification. (See also Kuno 1973; Saito 1985 and Takezawa 1987, among others, for relevant observations.)

(53) a. dare-{**ga**/*∅} ano toki nani-{**o**/∅} **tabe**-**ta**-ka-nante
who-{NOM/*∅} that time what-{ACC/∅} eat-PAST-COMP$_{wh}$-such.as
oboetenai.
not.remember
'(I) don't remember (such a thing as) who ate what at that time.'

b. nani-{**o**/*∅} ano toki dare-{**ga**/*∅} **tabe**-**ta**-ka-nante
what-{**ACC**/*∅} that time who-{**NOM**/*∅} eat-PAST-COMP$_{wh}$-such.as
oboetenai.
not.remember

c. dare-{**ga**/*∅} nani-{**o**/*∅} *iyaiya* **tabe**-**ta**-ka-nante
who-{**NOM**/*∅} what-{**ACC**/*∅} *reluctantly* eat-PAST-COMP$_{wh}$-such.as
oboetenai.
not.remember
'(I) don't remember (such a thing as) who ate what reluctantly.'

Japanese has a rather rich inventory of case markers and actively appeals to Morph-signification for both thematic and modal anchorings. When overt case particles as Morph-signifiers do not appear on the nominal arguments, on the other hand, Loc-signification involving adjacency is required. Similarly, when Loc-signification by adjacency cannot be achieved, Morph-signification by a case particle is required.[20] Thus, under the proposed ϕ-signification approach, the following state of affairs is predicted. The absence of the accusative particle *-o* from the object is permitted immediately preceding a transitive verb as in (53a) but is prohibited (as indicated by -{**o**/*∅}) when the object is scrambled over a subject as in (53b) and when an adjunct (VP-adverb) intervenes between the object and the verb as in (53c). In a nutshell, thematic anchoring in Japanese (and Korean) can be achieved when the interpretive domain (argument) is overtly marked by a designated morpheme. Or else, it must be achieved *locally* with the argument positioned adjacent to the thematic anchor (predicate). If, on the other hand, the object NPs in (53b and c) ever appear in their bare forms (NP-∅) without causing any problem, we would have to question the validity of the proposed ϕ-signification approach. We will discuss directly below in Sect. 4.4 the obligatoriness of nominative marking in (53a–c) in the context of modal anchoring.[21]

Contrary to languages like Japanese and Korean, English has relatively impoverished morphological means. Accordingly, Morph-signification plays a much more restricted role in this language. For example, the failure of ϕ-signification in (54) below with an accusative pronominal suggests that Morph-signification on nominals cannot properly compensate for the absence of Loc-signification in English for either thematic or modal anchoring.[22]

(54) a. We **recommended** (**strongly*) {**him**/John}.
b. I would prefer **for** (**tomorrow*) {**him**/John} to leave.

[20] *Wh*-arguments are used here in order to avoid the 'no particle topicalization strategy' permitted in languages like Japanese and Korean (cf. Kuno 1973; Yoon and Kitagawa 2018).

[21] Yoon and Kitagawa (2018) discuss a similar adjacency effect within *unaccusative* and *nominal* constructions in Korean, thereby demonstrating the irrelevance of abstract case in the case adjacency phenomena observed in this language.

[22] One may attempt to account for the adjacency effect as in (54) by appealing to Levin's (2015: 21) pseudo noun incorporation analysis of object nominals. If we respect his argument based upon Tongan data, however, we would incorrectly predict that the case adjacency effect arises even in (i) due to the intervening adjective phrase, contrary to fact.

(i) He **planted** *very small* **seedlings**.

Thus, only Loc-signification by adjacency can ϕ-signify the interpretive anchorings here, requiring the intervening adjuncts *strongly* and *tomorrow* to be eliminated. The well-known Case-adjacency condition, in other words, can be reduced to a more general approach of ϕ-signification. We will consider cases like Heavy NP Shift, Verb Raising, and Object Shift below when we discuss derivational transfer in Sect. 4.7.

We have witnessed, however, one exception to the dysfunction of Morph-signification in modern English. This exception is observed in the "null-overt" contrast of COMPs as discussed at the end of both Sects. 1.3 and 1.4. In the examples repeated below, Loc-signification by adjacency and Morph-signification by an overt COMP exhibit a significant complementing function in the ϕ-signifying of the thematic anchoring of the complement clause by a higher verb.[23]

(23b) We **believe** *quite strongly* **[**$_{\underline{\mathbf{CP}}}$ {**that/***$\varnothing_{\textit{that}}$} he is innocent**]**.

(21) John **wants** *very much* [$_{\underline{\mathbf{CP}}}$ {**for/***$\varnothing_{\textit{for}}$} **Bill** to leave**]**.

(29b) John **believes** (**very strongly*) **[**$_{\underline{\mathbf{CP}}}$ $\varnothing_{\mathbf{Dox}}$ Bill to be talented**]**.

See also Appendix B, where we will argue that Marantz's analysis of productive morphological case marking can be reduced to thematic anchoring and its Morph-signification, and Appendix C, where we will discuss the deterioration of Morph-signification in English in a historical setting.

4.4 Modal anchoring, informational anchoring, and EPP effects

Let us now turn to the ϕ-signification for the modal anchoring of a sentence. As we saw above, when a topicalized subordinate adjunct appears without obstructing the adjacency between the modal anchor and a sentence as in (55a) below, no problem arises. When the fronted topic interrupts such adjacency as in (55b and c), on the other hand, the sentence fails.

(55) a. I think [$_{\text{COMP}}$ that] [$_{\text{Top}}$ *tomorrow*] $\varnothing_{\underline{\mathbf{FIN}}}$ [**John** will leave]. (= (11))
b. Did-$\varnothing_{\underline{\mathbf{FIN}}}$ (**yesterday*) [**John** come]? (= (15a))
c. John prefers $\varnothing_{\underline{\mathbf{for}}}$ (**tomorrow*) [**Bill** to leave the camp]. (= (20d))

Since nothing can Morph-signify the sentence as an interpretive domain here, its anchoring must rely on Loc-signification by adjacency to ensure that it is successfully achieved *locally* by a higher syntactic head as its modal anchor. This is quite similar to the obligatory Loc-signification for the thematic anchoring of a complement CP when this CP cannot be marked by an overt COMP, as in (56).

(56) John **believes** (**very strongly*) **[**$_{\underline{\mathbf{CP}}}$ $\varnothing_{\mathbf{Dox}}$ Bill to be talented**]**. (= (29b))

We have argued above that the successful Loc-signification of modal anchoring in (55a–c) is achieved by the subject's appearance at the periphery of a sentence. Let us rationalize this mode of Loc-signification, asking ourselves why and how it must

[23] Recall that we argued in Sect. 1.4 that the adjacency disruption in (56) (= (29b)) for thematic anchoring of the complement clause has traditionally been regarded erroneously as disruption for the so-called exceptional Case marking of the subordinate subject by the higher verb.

be realized in this particular way. We could perhaps follow common practice and stipulate that the interpretive anchoring in (55a–c) must be *locally* achieved at LF between the modal anchor and a sentence as its interpretive domain.[24] However, if ϕ-signification as an interface-oriented syntactic process is designed to signal its associated interpretation physically recognizable at PHON, the Loc-signification in (55a–c) may initially appear to fall short of this grammatical goal.

The issue is that the adjacency relation between the higher modal and the sentence in (55a–c) may not be directly (overtly) recognized at PHON since there is no morpheme that can Morph-signify the interpretive domain (sentence), and at the same time the modal anchor itself ($\varnothing_{\text{FIN}}/\varnothing_{\text{for}}$) is phonetically empty. We consider that, in the face of this adversity, grammar has conspired to Loc-signify the local anchoring by placing a subject as a designated overt element to show up at the periphery of the interpretive domain, thereby forcibly inducing its overtly recognizable adjacency (and hence the domain's adjacency as well) to the anchor. That is, Loc-signification appealing to peripherality (50c) is eventually reduced to that appealing to adjacency (50b). As we argued in Sect. 3, a subject has its own discourse-related motivation to appear at the periphery of a sentence as well.

Languages like Japanese and Korean also adopt a similar strategy of using a subject to ϕ-signify the modal anchoring of a sentence, but in a way totally distinct from English. Being absolutely head-final languages that preclude any rightward movement within a sentence, Japanese and Korean cannot appeal to the subject's adjacency to a finite head appearing at the right periphery of a clause. Morph-signification with the NOM-marked subject therefore is obligatory for the modal anchoring of a sentence. The approach taking into consideration such an interaction between Morph- and Loc-signification permits us to predict the prohibition against "case-marker drop" from subjects in Japanese as shown in (57a and b) (and also in Korean).

(57) a. dare-{**ga**/*∅} ano toki nani-o tabe-**ta**-ka-nante
who-{**NOM**/*∅} that time what-ACC eat-**PAST**-COMP$_{\text{wh}}$-such.as
oboetenai.
not.remember
'(I) don't remember (such a thing as) who ate what at that time.'

b. nani-o ano toki dare-{**ga**/*∅} tabe-**ta**-ka-nante
what-ACC that time who-{**NOM**/*∅} eat-**PAST**-COMP$_{\text{wh}}$-such.as
oboetenai.
not.remember

Presumably due to the availability of this Morph-signification strategy, the position of the subject is given more freedom as long as it is NOM-marked, as illustrated in (57a and b) ($\approx$ (53a and b)).

Certainly, we do not necessarily think that other languages also exhibit the pattern of ϕ-signification exactly as in Japanese/Korean or English. Although the options of ϕ-signification introduced in (50) can compensate for one another, which particular options are adopted and how they interact may vary depending on the language. How

[24] A local licensing/agreement involving a featural head and its complement/specifier, in fact, is quite commonly postulated in many areas of generative grammar.

exactly each option of ϕ-signification is mixed and in what strength they are imposed also reflect the historical development of the morphology and syntax within an individual language, as discussed in Appendix C on English. For instance, in some languages, e.g., German, head-directionality in syntax may vary depending on categories and/or subordination, which may affect the strength of Loc-signification in those languages. We will discuss crosslinguistic variation in ϕ-signification again from a different angle in Sect. 4.7, where we propose that ϕ-signification is achieved dynamically in a bottom-up derivational transfer.

The need for Loc-signification for modal anchoring can also account for the obligatory presence of the subject in sentences as in (58) and (59) below, which has long been recognized as an EPP effect since Chomsky (1982).[25]

(58) a. **FIN** [***(She)** *will* be the next President].
b. **FIN** [***(A grain of truth**$_1$**)** *lies* t_1 in what he said].
c. **FIN** [***(It)** is inevitable that she *will* be the next President].
d. **FIN** [***(There)** *may* lie a grain of truth in what he said].

(59) a. John hopes **for** [***(Bill)** *to* win the prize].
b. John suspects $\varnothing_{for}$ [***(Bill)** *to* have stolen the money].
c. John hopes **for** [***(it)** *to* be clear that the current plan would not work].
d. John suspects $\varnothing_{for}$ [***(there)** *to* exist/be ulterior motives].

A fair number of researchers have long been aware that EPP is a mere restatement of the problem rather than its solution, whether it is regarded as a straightforward requirement for the presence of a subject in a sentence or as a feature requiring a spec. (See Bošković (2007) for a relevant discussion.) In fact, expressing their skepticism of EPP as a grammatical device, many researchers have had the insight that some postsyntactic requirement on the "P" side of computation seems to exist that requires the left edge of a sentence to be filled by some phonetically overt element, not necessarily by a subject—An 2007; Sigurðsson 2010; McFadden and Sundaresan 2018; Jouitteau 2020, among others. We do share their core insight and inherit the same direction of research but we claim that it should be placed in a more general setting incorporating the semantic aspects of language. (In Appendix D, we summarize the reasons why we are disinclined to analyze the left-edge filling as a purely phonological phenomenon, at least in the ways suggested in the literature.)

As summarized in Appendix C, reinterpreting Hulk and van Kemenade's (1995) analysis, Kiparsky (1997) argues that the erosion of case morphology in Middle English caused the need for a positional licensing of a subject in Spec-IP that confers nominative case, and ultimately induced the obligatoriness of the subject in this position. In our terms, the decline of nominal morphology forced the grammar to switch from Morph-signification to Loc-signification for modal anchoring, requiring the subject to appear at the left periphery of a sentence. In other words, we may consider that need for this Loc-signification induced obligatory A-movement of the subject from

[25] Languages like Japanese and Korean are known not to exhibit the same kind of EPP effect. We naturally expect this since these languages must appeal to the Morph-signification rather than Loc-signification involving a subject for modal anchoring of sentences.

within a verbal projection to the periphery of a sentence as in (60), without recourse to the EPP (feature) or the notion of case.

(60) $\underline{\varnothing_{\text{FIN}}}$ [**John**$_1$ will [$_{\text{Vmax}}$ **t**$_1$ leave]]

It may in fact be the case that a similar situation is arising in the familiar A′-movement phenomena if we reanalyze overt movement along the line of Sigurðsson (2004) and Sigurðsson and Holmberg (2008). They argue that the movement of an item to the left edge of the constituent selected by a phonetically empty featural head "illusorily looks like movement into Spec" (Sigurðsson 2010: 163), and that such movement involves "tucking-in" to the right and c-commanded position of this head as in (61i) rather than in (61ii).

(61) (i) [$_{\text{Fmax}}$ $\underline{\varnothing_{\text{F}}}$ [$_{\text{Zmax}}$ $\underline{\text{Y}}_1$ [$_{\text{Zmax}}$ … **t**$_1$ …]

(ii) [$_{\text{Fmax}}$ $\underline{\text{Y}}_1$ $\underline{\varnothing_{\text{F}}}$ [$_{\text{Zmax}}$ … **t**$_1$ …]

We believe that the movement in (61i) in fact need not involve "tucking-in" since it is induced by the need for Loc-signification specified on the moved item in the Numeration, which is required to be moved to the top of Z_{max} to await the external merge of $\varnothing_{\mathbf{F}}$ in order to satisfy an output condition on ϕF. (We will return to this point in Sect. 4.7.) Under this approach, overt *wh*-movement in English, for example, would be analyzed as in (62).

(62) I wonder $\underline{\varnothing_{\text{Wh-Q}}}$ [$_{\text{FINP}}$ **what**$_1$ $\varnothing_{\text{FIN}}$ [you liked **t**$_1$ most]].

If such an analysis can be maintained, we can once again consider that Loc-signification induces obligatory A′-movement of a *wh*-phrase to the periphery of a sentence in English, this time in order to ϕ-signify *informational anchoring* between the $\varnothing_{\text{Wh-Q}}$ and the sentence (FINP) it selects. This analysis would permit us to dispense with Chomsky's Edge/Periphery/Occurrence feature, which is simply an EPP feature introduced at the periphery of a functional projection higher than a sentence. (In Appendix G, we describe in more detail how Loc-signification for information anchoring can be achieved.)

4.5 A brief look at phi-signification in Mandarin Chinese

How would the theory laid out here be reflected in a highly analytic language like Mandarin Chinese? While a full investigation along these lines would take us too far afield, we briefly consider here some suggestive data.

Given its highly analytic status, we predict ϕ-signification in a language like Mandarin to take the form of Loc- or Prosod-signification rather than Morph-signification, and in fact, this prediction bears out. In particular, Li (1990) argues that case assignment in Mandarin is subject to an adjacency requirement, and the data that she uses to

argue for this are amenable to reinterpretation in the context of the theory presented in this paper, as reflecting ϕ-signification of modal anchoring and thematic anchoring, respectively. Consider first the minimal pair in (63a) and (63b), which shows that in constructions with the embedding verb *yao* 'want', the embedded subject must be adjacent to *yao*. That is, a sentence like (63b) is ungrammatical even though in principle, as can be seen in matrix clauses like (63c), *zuotian* 'yesterday' can go before or after the subject.

(63) a. Wo yao [$\varnothing_{\textbf{Pref}}$ [**ta** *zuotian* lai]].
I want him yesterday come
'I wanted him to come yesterday.'

b. *Wo yao [$\varnothing_{\textbf{Pref}}$ [*zuotian* **ta** lai]].
I want yesterday him come (adapted from Li 1990: 35)

c. {*Zuotian*} Zhangsan {*zuotian*} lai le.
yesterday Zhangsan yesterday come PRF
'Zhangsan came yesterday.'

This pattern is just like some of the English data discussed in Sect. 1.3, suggesting a parallel analysis whereby there is null complementizer that is a counterpart to English $\varnothing_{\text{for}}$ and that, like its English counterpart, introduces preference modality and must be adjacent to the embedded subject to ϕ-signify modal anchoring.

Similar adjacency facts hold with respect to objects in Mandarin. By way of background, Mandarin has some intensifiers like *hen* 'very' that appear before the predicate they modify and others like *dehen* 'extremely' that appear after. However, when the predicate takes a direct object, only the former sort of intensifier is a possibility, as witnessed by the contrast between (64a) and (64b).

(64) a. Ta *hen* **manyi** **nide biaoxian**.
he very satisfied your performance
'He is very satisfied with your performance.'

b. *Ta **manyi** *dehen* **nide biaoxian**.
he satisfied extremely your performance (adapted from Li 1990: 36)

This suggests that a direct object must be adjacent to its predicate in Mandarin, which we interpret as the need to ϕ-signify thematic anchoring.

Although tentatively, we take the above data as strongly suggestive of the crosslinguistic applicability of our core proposals. We are grateful to one of the anonymous reviewers for encouraging us to explore such expansion of our research.

4.6 The interpretation of expletives

In Sect. 3, we put forward our hypothesis that a subject is designated to Loc-signify the adjacency between the modal anchor and TP as its interpretive domain because of its interpretive role as the center of an utterance. This view may strike some researchers as contradictory since even expletive subjects play the same role as in (58c and d) and (59c and d) above. Expletives are usually identified as a special class of proforms that do not refer to anything. Accordingly, they can (in fact must) appear as a mere place-holder for the subject position of a sentence when this position would

otherwise remain unfilled due to the lack of a θ-role. However, there are good reasons to consider that even expletive subjects are interpreted at the periphery of a sentence. We will present three arguments – the first one in regard to binding, the second one in regard to the centering theory, and the third one in regard to the combination of both.

First, anaphor-binding in general observes a certain locality constraint, as illustrated in (65a and b) below, in which an intervening subject *I* and *the stolen picture* obstruct such a locality.

(65) a. **They*$_1$ know [that **I** believe [that *each other*$_1$*'s* book will be best-sellers]].
b. **They*$_1$ think [that **the stolen picture** is hanging [in *each other*$_1$*'s* room]].

Quite mysteriously, however, such a locality constraint is not observed when the expletive *it* intervenes between the anaphor and its antecedent, as shown in (66a) below (Chomsky 1981). The same phenomenon is observed when the expletive *there* intervenes between the anaphor in the locative phrase and its antecedent, as in (66b) (Lisa Travis (p.c.)).

(66) a. *They*$_1$ think [that **it$_2$** is unlikely [**$_{CP2}$** that *each other*$_1$*'s* book will be best-sellers]].
b. *They*$_1$ think [that **there$_2$** is a stolen picture (hanging) [**$_{PP2}$** in *each other*$_1$*'s* room]].

These puzzling facts follow, however, if each expletive is represented at LF in such a way that the entire content of its associate clause and locative, respectively, is reconstructed in its position, as illustrated in (66′a and b).

(66′) a. **LF**: *They*$_1$ think [that [$_{CP2}$ **that *each other*$_1$'s book will be best-sellers]** is unlikely __]
b. **LF**: *They*$_1$ think [that [$_{PP2}$ **in *each other*$_1$*'s* room]** is a stolen picture (hanging) __]

An implicit underlying assumption here is that the so-called expletives *it* and *there* are proforms that can be anaphoric to a CP and a locative expression, respectively. These subjects are required for the Loc-signification of modal anchoring when no argument within the predicate phrase was summoned to Loc-signify modal anchoring.[26]

The investigations above lead us to consider that even expletive subjects are interpreted at the left periphery of a sentence, i.e., being adjacent to the modal anchor.[27]

[26] We will refrain from pursuing a syntactic analysis of these interpretive phenomena except for noting that the expletives in (66′a and b), *in effect*, have covertly attracted their associates when their binding of the associates as in (66) (*in*$_2$ … CP$_2$ and *there*$_2$… PP$_2$) would potentially violate Condition C. (Note that such covert attraction would not induce any thematic conflict since the expletives are showing up in a nonthematic position.) See Kitagawa (1995) for an analysis along these lines. In fact, if we adopt this analysis, it provides a possible solution to a potential problem to the hypothesis that the expletive *it* is a proform anaphoric to a CP. This issue is discussed at the end of Appendix E.

[27] We assume that when a *there* construction does not contain an overt locative, a phonetically empty locative expression is involved as an obligatory component of the involved eventuality description, as illustrated in (ia and b).

Thus, not only the obligatory presence of an expletive subject (EPP effect) as in (58c and d) and (59c and d) above but also the disruption of their adjacency to the modal anchors (FIN/*for*) as in (67) below is completely reducible to the ϕ-signification approach argued for above.

(67) a. **Is-FIN** (**absolutely*) [**it** inevitable that she will be the next President]?
b. **Might-FIN** (**tacitly*) [**there** lie a grain of truth in what he said]?
c. John hopes **for** (**today*) [**it** *to* be clear that the current plan would not work].
d. I would prefer **for** (**today*) [**there** *to* be someone remaining here].

The kind of data brought to bear in Centering Theory can be adapted to expletive subjects in a way that provides further evidence for our claim that expletives are in fact contentful anaphors. Consider first (68) below. (68a) and (68b) are perceived as a more coherent sequence of utterances than (68a) and (68b′).

(68) a. **It$_1$** bothers her **[$_{CP1}$** that he hasn't returned **the key$_2$]**.
b. **It$_1$** means that he could use **it$_2$** to have access to all of the company's accounting records anytime he wants to.
b′. **?It$_2$** is the only one that gives access to all of the company's accounting records, which makes **it$_1$** a matter of concern to her.

This follows from Centering Theory coupled with the idea that so-called expletive *it* is actually anaphoric to its associate CP. In (68b), the backward-looking center is also the highest-ranked forward-looking center (it_1). In (68b′), by contrast, the backward-looking center (it_1) is not the highest-ranked forward-looking center (it_2), leading to a less coherent sequence.

Similar facts hold for so-called expletive *there*: after the sequence (69a) and (69b), the follow-up utterance (69c) is more coherent than (69c′), because only in (69c) is the backward-looking center ($there_1$) also the highest-ranking forward-looking center.

(69) a. **There$_1$** reached a bomb cyclone **[$_{PP1}$** on the east coast **]** after it swept away everything **[$_{PP2}$** on the Caribbean islands **]**.
b. **There$_1$** reside over 15 million people who need to be evacuated.
c. **There$_1$** may arise a huge tornado again just like the one that had devasted everything in the Caribbean a few days ago.
c′. **?**As we witnessed a few days ago, a huge tornado devasted everything in the Caribbean, which might be repeated again **there$_1$**.

For further exploration of this issue, please see Appendix E. In its first half, we can further see that expletive subjects are interpreted at the left periphery of a sentence when we examine variable binding by a quantifier. In the latter half of this appendix, we also provide additional arguments (namely, the third of the three types of arguments mentioned at the outset of this subsection) in regard to the combination

(i) a. **There** arrived a spy [$_{Loc}$ **e**].
b. John suspects $\varnothing_{for}$ [**there** to exist/be ulterior motives [$_{Loc}$ **e**]].

of centering theory and anaphor binding, which further substantiates the view that expletive subjects themselves are contentful anaphors. Finally, we also consider and defuse a potential problem for the hypothesis that expletive *it* is a proform anaphoric to a CP.

4.7 Signifier–signified paring at the numeration and dynamic transfer

In Sects. 4.1–4.4, we first characterized the Numeration as a (potential) blueprint of an utterance. We then hypothesized that physical–logical synchronization exhibited by some syntactic phenomena is captured by the "signifier–signified" pairs lexically represented at the Numeration, and that such pairs come to be computed separately at each of the interface syntactic representations ϕF and LF.

Let us here provide some examples of such pairings at the Numeration between physical signifiers as in (70) below and logically signified phenomena as in (71).

(70) ϕ-signifiers: ($\approx$ (50))
- a. Morph-signifier
- b. Loc-signifier:
  - (i) Adjacency: $\{\mathbf{X}, \mathbf{Y}\}$ $\Rightarrow$ X and Y are **cojacent** to each other
  - (ii) Peripherality: $\{\mathbf{X}\ \{_{Z}\ \mathbf{Y}, Z\}\}$ $\Rightarrow$ X and Y are **subjacent** to each other
- c. Prosod-signifier:

(71) Logically signified: (= (49))
- a. Thematic anchoring
- b. Modal anchoring
- c. Informational anchoring

Before we start, recall that in Sect. 4.4, we argued that Loc-signification by peripherality ((50c) in Sect. 4.2) is eventually reduced to that by adjacency (50b). Let us distinguish these two cases of adjacency by labeling them "cojacency" (70b-i)) and "subjacency" (70b-ii), which will allow us to indicate them distinctly and concisely at the Numeration. Informally put in familiar syntactic terms, cojacency refers to "adjacency between sisters" and subjacency refers to "adjacency between a specifier and a higher head."

Now, let us turn to the ϕ-signifiers for thematic anchoring in Korean.

(72) a. Jina-ka **mwue(s)**-{**ul**/∅} ilk-ess-ni?
Jina-NOM **what**-{ACC/∅} read-PAST-Q
'What did Jina read?'

b. **mwue**(s)$_1$-{**ul**/*∅} Jina-ka t_1 **ilk**-ess-ni?
what-{ACC/*∅} Jina-NOM | **read**-PAST-Q
↑_____|

The possibility and impossibility of case marker drops in examples (72a and b) indicate that either Morph-signification by the accusative particle (*-lul*) or Loc-signification by cojacency can achieve signification at ϕF for the thematic anchoring

of the internal θ-role at LF in Korean. Thus, when the object nominal *mwue*(*s*) 'what' is selected into the Numeration for each sentence in (72), it is specified with one of the "signifier–signified" pairings in (73) below, where […]$_{\phi}$ indicates ϕ-signifiers and […]$_{\mathrm{L}}$ indicates the logically signified interpretation.

(73) *mwues* 'what':
(i) [ACC-particle]$_{\phi}$ - [Internal θ]$_{\mathrm{L}}$ (Morph-signification)
(ii) [Cojacency to V]$_{\phi}$ - [Internal θ]$_{\mathrm{L}}$ (Loc-signification)

An obvious assumption here is that any such specification added to a lexical head can be projected at its phrasal level as well. Thus, (73i) for instance, requires the maximal projection of the noun *muwes* 'what' to be marked with *-ul* 'ACC' at ϕF, which Morph-signifies that this NP is thematically anchored and logically signified with the internal θ-role of the verb at LF.

For thematic anchoring in English as in (74) below, on the other hand, only Loc-signification at ϕF permits the object to be properly signified at LF.

(74) The professor **recommended** (**strongly*) [**John**].

The object nominal *John* therefore is specified as in (73ii) above (like Korean) at the Numeration, and is required to appear cojacent to the verb at ϕF in order to be thematically anchored at LF to the internal θ-role of the verb.[28] Presumably, the object nominal is specified as in (73ii) in a Mandarin Chinese sentence like (64a) examined in Sect. 4.5 when a similar thematic anchoring takes place.

In modal anchoring as well, only Loc-signification at ϕF permits the subject to be properly signified at LF in English. As we argued above, in an English sentence like (75) below, a subject is extracted from VP and placed at the periphery of the sentence. Its subjacency to the modal head $\varnothing_{\mathrm{FIN}}$ (in the sense of (70b-ii)) Loc-signifies the modal anchoring of TP to FIN.

(75) $\underline{\varnothing_{\mathrm{FIN}}}$ [$_{\mathrm{TP}}$ $\underline{\mathbf{John_1}}$ will-$\varnothing_{\mathrm{T}}$ [$_{\mathrm{VP}}$ **t$_1$** leave]]

This sentence is derived when the subject nominal and the head of TP are specified with the "signifier–signified" pairing as in (76) at the Numeration.

(76) a. *John*:
[Subjacency to FIN]$_{\phi}$ - [Leftover θ]$_{\mathrm{L}}$
b. $\varnothing_{\mathrm{T}}$:
[Overt subject's subjacency to FIN]$_{\phi}$ - [TP's modal anchoring to worlds and times compatible with the information modality of FIN]$_{\mathrm{L}}$

[28] If a DP like *the student* appears as the object nominal here, we may consider that either the determiner head is specified in the Numeration as in (ia), or the core nominal is specified as in (ib), which is projected up to the entire DP due to "extended projection" (Grimshaw 2000).

(i) a. *the*: [Cojacency to V]$_{\phi}$ - [Internal θ]$_{\mathrm{L}}$
b. *student*: [Cojacency to V]$_{\phi}$ - [Internal θ]$_{\mathrm{L}}$

The label "[Subjacency to FIN]$_{\phi}$" indicated in (76a), for example, is meant to be equivalent to "At ϕF, it must appear at the periphery of TP that has been merged with FIN," which functions as an output condition on ϕF when it is mapped onto PHON. Presumably, all that a subject must achieve is to either internally or externally merge with T′. When the newly derived TP further merges with FIN, the required ϕ-signification succeeds. If not, it fails. It therefore is not necessary for the merger of the subject with T′ to wait for the appearance of the higher FIN and to tuck itself in. "Leftover θ" in (76a) refers to the external θ-role to be assigned by the unergative verb in (75) – see our discussion at the end of Appendix B on θ-markings other than that of a transitive object.

Just as in English, when Chinese sentences undergo similar modal and thematic anchorings as examined in Sect. 4.5 (see (63a) and (64a)), the involved subjects and objects should also be specified as in (76a) and (73ii), respectively.[29]

Now that we have portrayed the "signifier–signified" pairings specified at the Numeration, the next thing to be clarified is how they come to be realized at ϕF and LF *separately yet synchronously*. Such synchronization must also take place with respect to each of the three distinct types of "signifier–signified" pairs (thematic, modal, and informational) involving distinct syntactic elements and constituents. We believe that this seemingly contradictory computation can be achieved when different types of "signifier–signified" pairs can be mapped onto ϕF and LF with the *dynamic* (or *derivational*) *application of transfer*. First, we adopt the core insight of Chomsky's (2001b) Phase Theory and assume that such mapping can be fulfilled at two specific points of syntactic derivation, namely at the periphery of a verbal projection and at the periphery of a clause.[30] Moreover, we follow Platzack (2000), Grohmann (2000), and Sigurðsson (2004) in spirit, and hypothesize that each of V(erbal)-domain and C(lausal)-domain transfers distinct types of "signifier–signified" pairs. In particular, at the end of V-domain (in the bottom-up derivation), the "signifier–signified" pair concerning thematic anchoring is transferred to ϕF and LF, respectively. At the end of the C-domain, on the other hand, the "signifier–signified" pair concerning modal anchoring and informational anchoring undergo such transfer. Thus, the "signifier–signified" pairs as in (73) are transferred under the V-domain while those in (76) (and (131) in Appendix G) under the C-domain. This mode of transfer guarantees that each of the "signifier–signified" pairings specified at the Numeration can be satisfied separately at ϕF and LF while properly inducing the physical–logical synchronization in all of thematic, modal, and informational phenomena.

Finally, following Yoon and Kitagawa (2018), we assume that crosslinguistic variation exists in the way derivational transfer is achieved. They claim that in some languages, the synchronized mapping to ϕF and LF must be satisfied under both V-domain and C-domain, while in other languages it is satisfied only under the C-domain. The former type of languages permit an object NP and verb not to appear ad-

[29]The third type of ϕ-signification, "Prosod-signification" in (70c), will be discussed below in relation to "informational anchoring" in (71c).

[30]We will, however, remain neutral in this work about the particular executions and assumptions of Chomsky's Phase Theory such as the complement of Phase as its Spell-Out domain, the notion edge, and the Phase-Impenetrability Condition.

jacent to each other under the C-domain, for example, with the application of Heavy NP shift as in (77a), Topicalization as in (77b), or Verb Raising as in (77c).

(77) a. Mary [$_{VP}$ **invited t_1** to the party], **[$_{NP1}$ several of her brother's best FRIENDS]**.

b. **This book$_1$**, I thoroughly enjoyed [$_{VP}$ **reading t_1**] (though I didn't like the others you lent to me).

c. **Aime$_1$**-t-il [$_{VP}$ **t_1 Marie**]?
love-he Marie
'Does he love Marie?'

The thematic anchoring of the object NPs in these sentences can be properly achieved with the Loc-signification involving cojacency under the V-domain, in which both verb and object are located under the verbal projection. The dislocation then is induced for interpretive effects beyond thematic interpretation such as information packaging and speech act under the C-domain.[31]

In some other languages, in which Loc-signification is not the primary means of ϕ-signification for interpretive anchorings, the synchronized mapping can presumably be satisfied under the C-domain alone. In Korean (and Japanese), for example, the object need not be cojacent to the verb for its thematic anchoring. Instead, it can be achieved anywhere in a sentence as long as it is properly Morph-signified, as observed in (72a and b) above. The subject can also achieve modal anchoring anywhere in a sentence when it is properly Morph-signified, as in the Japanese examples (53a and b) (Sect. 4.3).

Although the exact relation between the richness of morphology and word-order restriction is much more complex, the proposed analysis appealing to ϕ-signification at least offers a new window into the nature of free word-order phenomena. It should be made clear, however, that this approach is proposed as the architecture/design of grammar rather than as that for processing of sentences. Thus, in those languages where ϕ-signification is achieved in both V- and C-domain, the physical–logical synchronization achieved under the V-domain does not necessarily correspond to what is perceived at surface and hence does not directly influence processing. In a sense, the notion "surface" is defined dynamically.

In Appendix F, we will provide further discussion on the interaction of distinct methods of ϕ-signification for thematic anchoring, examining the so-called differential object marking (DOM). Please also see Appendix G, where we briefly discuss how "informational anchoring" in (71c) can be achieved via "Loc-Signification" (70b-ii), and Appendix H, where we briefly examine the cases of "informational anchoring" via "Prosod-signification" (70c) that are reported in the literature.

[31] See Rochemont (1978) for the claim that Heavy NP Shift involves focusing. The so-called Topicalization in English can also be better characterized as a topic element undergoing focus movement – See Krifka (2008), Tomioka (2010), and Choi (2019) for analyses of focalized topics. Holmberg (1999) also argues that object shift and verb movement in Swedish are PF phenomena controlled by the notion focus, which in our terms is Loc-signification under the C-domain.

5 Preliminary remarks on control and raising infinitives

While the focus of this paper is overt-subject clauses, in this section, we offer some preliminary remarks on the analytical implications of null-subject (i.e., control, raising, and passive raising) clauses like (78).

(78) a. John$_1$ hopes [**PRO**$_1$ to leave].
b. John$_1$ seems [**t**$_1$ to have left].
c. There$_1$ seems [**t**$_1$ to exist ulterior motives].
d. He$_1$ is believed [$_{CP}$ **t**$_1$ to be a competent leader].

Our thoughts on how to extend our account to such sentences are guided by two main ideas. First, we hypothesize that when the subject appears in a phonetically empty form in any clause, it signals the absence of a relevant local semantic anchor and instead the involvement of anchoring from the matrix clause. In other words, just as the pronunciation of phonetic content can be a physical signifier for local anchoring, its absence at the position where it is generally expected, i.e., the appearance of an empty argument, can be a physical signifier for nonlocal anchoring. From this generalization also emerges a general *raison d'être* for empty subjects: they are PF indicators of complement clauses that are smaller than CP. Second, in control and raising constructions, the empty subject is anaphoric to an argument in the higher clause, and we hypothesize that this anaphoric link is what permits semantic anchoring of a lower clause to the higher clause.

While we leave it to future work to pinpoint the precise syntactic and semantic mechanisms by which a matrix clause comes to anchor its null-subject infinitival complement, we can point to two empirical considerations that lend general support for this sort of view.

First, whereas overt-subject infinitives—as documented earlier in this paper—have distributions that are fairly regular and semantically well-defined, null-subject infinitives, in sharp contrast, have distributions that are both lexically idiosyncratic and semantically heterogeneous. Lexical idiosyncrasy is exemplified in data like (79)—where we see that *claim* accepts control infinitives even though semantically similar predicates like *affirm*, *assert*, and *declare* do not—and in data like (80)—where we see that *likely* accepts raising complements, whereas the semantically similar predicate *probable* does not.

(79) John **claimed/*affirmed/*asserted/*declared** [PRO to be a genius].

(80) It$_1$ was **likely/*probable** [**t**$_1$ to rain].

Semantic heterogeneity is seen in data like (81) and (82) below as well. Compared with *for*/$\varnothing_{for}$ and ECM infinitives, control and raising infinitives have a much freer semantic distribution not easily definable in terms of any particular modal flavor.

(81) John **claimed/wanted/started** [PRO to be happy].

(82) It$_1$ **needed/seemed/tended/was likely/started** [**t**$_1$ to rain].

In (81), we see control infinitives occurring across informational (*claim*), preferential (*want*), and even aspectual (*start*) environments; in (82), we see raising infinitives

occurring in a similarly broad range of semantic contexts. Taken together, the lexical idiosyncrasy and semantic heterogeneity of null-subject clauses supports the view that such clauses, unlike their overt-subject counterparts, do not come packaged with their own well-defined semantic anchor that determines their distribution; instead, they appear to be acceptable in a variety of semantic settings, but subject to the whims of the matrix predicate. This involvement of the matrix predicate suggests that the anchoring comes from the matrix clause rather than being supplied locally.

The second consideration that supports this view of null-subject infinitives is that such infinitives do not give rise to the sorts of adjacency effects found with overt-subject infinitives. This is illustrated in (83) for control infinitives and (84) for raising infinitives.

(83) a. She$_{\mathbf{1}}$ at least **tried** [*in time for her exam* **PRO$_{\mathbf{1}}$** to learn the material].
b. They$_{\mathbf{1}}$ **attempted** [*by noon* **PRO** to fix it].
c. Kelly **persuaded** Sarah$_{\mathbf{1}}$ [*until the end* **PRO$_{\mathbf{1}}$** to remain silent].
d. Sarah$_{\mathbf{1}}$ **promised** Kelly [*tomorrow* **PRO$_{\mathbf{1}}$** to remain silent].

(84) a. He$_1$ is likely [*at last/finally* **t$_{\mathbf{1}}$** to have forgiven her].
b. John$_1$ seems [*wisely* **t$_{\mathbf{1}}$** to have given it up].

On our view, this absence of adjacency effects goes hand-in-hand with the phonetically empty subject: one physical marker (adjacency) is replaced by another (phonetic emptiness), signaling that a different mechanism of anchoring—one that involves the matrix clause—is at play. Though briefly, we will also present our conjectures on the highly tentative analyses of what has been labeled in the field as *pro* in Appendix I.

On a final note, an anonymous reviewer encourages us to consider how *wager*-class verbs fit in with our proposals. As first described by Postal (1974) and further investigated by Pesetsky (1991) and others, *wager*-class verbs are similar to verbs that take ECM complements, except that *wager*-class verbs tend to be semantically agentive and their complements are restricted to having trace subjects, typically derived via passivization or relativization.

(85) a. *We wagered Jill to be the best person for the job.
b. Jill was wagered to be the best person for the job.
c. Jill, who(m) we wagered to be the best person for the job, was not available.

While we do not have any special insight into the paradigm in (85) (nor are we aware of any good explanations for it in previous literature), we can at least check to see whether the facts surrounding *wager*-class verbs are compatible with our proposals. In particular, given the obligatorily empty status of the embedded subject in *wager*-class sentences, we predict that they should pattern like control and raising sentences in *not* giving rise to adjacency effects with respect to the embedded subject. As illustrated in (86), this prediction is borne out.

(86) a. Jill$_1$ was wagered [*clearly* **t$_1$** to be the best person for the job].
b. Jack$_1$ was alleged [*definitely* **t$_1$** to be the culprit].

We leave a more thorough investigation of *wager*-class verbs to future work.

6 Summary, conclusions, and implications

In this paper, we first pointed out that overt subjects must always appear in English at the left periphery of their sentences so that they can be adjacent to a particular functional head. We then argued that this functional head serves as the clause's modal anchor, relating the content of the clause to a contentful eventuality. We identified three distinct flavors of the modal anchor – information ($\varnothing_{\text{FIN}}$), preference (*for*/$\varnothing_{for}$), and belief ($\varnothing_{\text{DOX}}$), keyed to whether it appears in a finite clause, a *for-to* clause, or an ECM clause, respectively. Finally, we made our initial attempt to capture the observed adjacency effect in a more general theory of "physical–logical synchronization" in grammar. Under this approach, it was hypothesized that the key logical dependencies are signified on the "P"-side of the grammar (at ϕF) through various physical means including overt morphology (Morph-signification), adjacency relations (Loc-signification), and suprasegmentals (Prosod-signification). Such "ϕ-signification" was also assumed to be implemented by paired physical and logical requirements encoded onto lexical items at the time the Numeration is formed. It was also argued that this ϕ-signification approach can be extended to capture, among other things, the required adjacency of a nominal object to a transitive verb or its morphological marking (for thematic anchoring) and the required overt A-movement of a subject (for modal anchoring) and A′-movement of focalized elements in English (for informational anchoring). We consider it to be a theoretical advantage of the ϕ-signification approach that it is capable of accounting for all the empirical observations presented above in a uniform general setting under a simple grammar described in Sect. 4.1.

(87) below lists distinct types and some concrete examples of ϕ-signifiers, paired with various types of logical signification examined in the current work. Some relevant example sentence numbers are also mentioned for each case. The provisional view adopted in the current work is that Morph-, Loc-, and Prosod-signifiers exhaust the possible types of ϕ-signifiers. Even within each type, ϕ-signifiers presumably are quite limited. The most common Morph-signifier is case morphology indicated on nominals, though agreement morphology indicated on predicates may also play a similar role in some languages. Specific Loc-signifiers are likely to be even more limited—adjacency involving only a linear relation (= cojacency) and adjacency involving both linear and hierarchical relations (= subjacency). Specific Prosod-signifiers are also likely to involve limited patterns of pitch contours like some characteristic rising of pitch, possibly combined with pitch lowering, as in focus prosody.

(87) ϕ-signifiers: (≈ (70))

a. Morph-signifier:
e.g.,
$[o]_{\phi}$ — For thematic anchoring of object NPs in Japanese
See (53a–c).
$[ga]_{\phi}$ — For modal anchoring of tensed TPs in Japanese
See (57a and b).
$[that/for_{\text{COMP}}]_{\phi}$ — For thematic anchoring of CPs in English
See (23b) and (21a and b).
$[wa]_{\phi}$ — For thematic or modal anchoring of NPs in Kiswahili
See (103a and b).

b. Loc-signifier:
e.g.,
[Cojacency to V]$_{\phi}$
— For thematic anchoring of object NPs in Japanese/English/Mandarin
See (53a), (54a and b) and (64a).)
[Overt subject's subjacency to FIN]$_{\phi}$
— For modal anchoring of finite TPs in English/Mandarin
See (55a and b) and (63a).)
[Overt *wh*-phrase's subjacency to $\varnothing_{WH\text{-}Q/FOC}$]$_{\phi}$
— For informational anchoring of *Wh*-Qs in English
See (130).

c. Prosod-signifier:
e.g.,
[Focus prosody (*wh-in-situ* $\sim$ $COMP_{Wh}$)]$_{\phi}$
— For informational anchoring of *Wh*-Qs in Japanese
See (134a and b).
[Compensatory Strengthening]$_{\phi}$
— For thematic anchoring of object NPs in Korean
See (132b).

In closing, we would like to emphasize that the approach proposed in the current work can be most distinctively characterized by its sharp distinction between sensorimotor and conceptual properties of grammar, as compared to much previous research. Even after the Minimalist Program was introduced and accepted as a new theoretical stance to pursue syntax, the field has, in a sense, maintained certain suppositions from earlier theories of generative syntax that were built around the postulation of overt syntax. As a result, the major tenets of the Minimalist Program, namely, the *legibility conditions*, the *inclusiveness condition*, and (*local*) *economy*, have been preserved only loosely. One issue that well captures this less-than-ideal situation is the repeatedly observed "look-ahead" problem involved in the characterization of overt syntax defined as pre-Spell-Out operations. (88a–d) below lists a few such examples, all of which involve some pre-Spell-Out operation that is claimed to apply in anticipation of some required effects or problems at PF or LF. As far as we can tell, many researchers regard these analyses as legitimate even today.

(88) a. Baker's (1988) Incorporation as *overt* syntactic (rather than PF) movement is triggered by *surface boundness of morphemes at PF*.

b. Rizzi's (1997) Informational Criteria trigger *overt* displacement of topic, focus and *wh*-interrogatives for their *interpretation at LF*.

c. Chomsky's (2001a, 2001b) Agree must apply *before Spell-Out*. The valued agreement features on Probe (= functional head) may provide *phonetic effects at PF* but *do not play any role at LF* (and cause trouble, being indistinguishable from the interpretable agreement features on Goal (= NP)). The valued ϕ-features on Probe therefore must be eliminated from narrow syntax and sent to PF by Spell-Out undergoing Agree.

d. Chomsky's (2013) Labeling Algorithm triggers **overt** movement in order to permit *semantic interpretation of the host phrase at LF*.

In all these analyses, if simultaneous effects are induced at PF and LF, they arise accidentally, so to speak, as byproducts. Another such accidental achievement of simultaneous physical–logical effects has long been pursued with the postulation of EPP features (including Edge features) characterized as "I need a Spec (of category X)." EPP features have no interface import but are regarded as *viruses that need to be immediately eliminated* from the derivation, and hence *trigger overt movement before Spell-Out* (Chomsky 2000, 2001b, cf. Uriagereka 1998). By embracing these analyses, the field has, in a sense, overlooked the exceptional bending of obligatory local economy in order to maintain the earlier view of overt syntax as a grammatical component.

The approach proposed in the current work, to the contrary, pursues the minimalist tenets mentioned above much more rigidly. It has been argued that all steps of grammatical derivations that achieve simultaneous effects in sensorimotor and conceptual performances are triggered by paired physical and logical signifiers, each inducing separate effects toward the derivation of ϕF and LF, respectively. In a way, traditional overt syntax has been decomposed into two separate but paired physical and logical derivations that proceed in parallel. Since each such derivation is strictly toward a single type of interface and each such step is triggered by a single type of *interface-oriented property* (physical or logical), the *legibility condition* is strictly observed with *local economy* maintained. Moreover, since the derivation-inducing physical and logical properties are required to be introduced into lexical items when the Numeration is formed, the *inclusiveness condition* is also obeyed. Thus, the proposed approach leaves no room for adopting triggers of computational steps that have no interface import such as EPP features and abstract Case features. Finally, regarding prosody as a possible type of ϕ-signifier, the approach extends the notion of overt syntax from mere overt displacement (and agreement) to a broader phenomenon of physical and logical synchronization, expanding its empirical coverage – see Appendix H for a brief description of Prosod-signification. The current work may be said to share the core intuition offered in the following statement made by Sigurðsson (2004: 3–221):

> Given MINIMAL DESIGN or the strong minimalist thesis (SMT, see Chomsky 2001a: 3), "the initial conditions on language acquisition" include only interface conditions and general properties (of biological systems and computational systems). If so, many traditional assumptions about clausal architecture are stipulative and should be dispensed with, unless they are strongly empirically justified.[32]

Appendix A: On the raising analysis of ECM subjects

So far in the current work, we have assumed that an ECM subject remains in the canonical subject position in an embedded sentence. Many arguments have been offered in the literature, on the other hand, to support the so-called raising-to-object analysis (or its descendant) of ECM subjects, most of which can be categorized roughly into two types as in (89).

[32] Sigurðsson (2009: 41–42) also emphasizes the need to distinguish PF marking and the semantic system.

(89) (i) Matrix material can intervene between the ECM subject and the *to*-infinitive.
(ii) The ECM subject must be regarded as c-commanding some matrix material.

Both of these arguments, however, face challenges. One typical argument of the type (89-i) claims that a matrix adjunct can successfully intervene between the ECM subject and the *to*-infinitive as in (90) below because the subject has been raised to the matrix clause (Postal 1974: 146).

(90) Successful intervening matrix adjunct
(Subject$_{\mathbf{ECM}}$⌒*Ajct*$_{Matrix}$⌒*to*-infinitive):
a. Jane believes **Bob**, *if I am not mistaken*, **to** be Hungarian.
b. Jane proved **Bob**, *unfortunately*, **to** be a werewolf.
c. I believed **Nixon**, *incorrectly*, **to** be interested in ending the war.
d. I have found **Bob** *recently* **to** be morose.

The acceptability of such examples, however, has always been controversial. Some accept them and others find them deviant when parsed with the intended matrix interpretation of the adjuncts.

One possibility is that such sentences are found acceptable when the adjuncts are interpreted as parentheticals. A potential indication of such interpretations is the involvement of a comma intonation, though it might not always be required by every speaker. Note that most of Postal's examples, in fact, are presented (by Postal himself) accompanied by commas enclosing the adjuncts in question, providing the impression that such an intonation was intended. There also is a good possibility that, to the extent that the word order [V_{+}*Matrix*⌒*Ajct*$_{Matrix}$⌒ Subject$_{\mathbf{ECM}}$] as in (91) below is accepted (Toquero-Pérez 2022: 134), it is due to such a parenthetical interpretation.

(91) I **believe** *with all my heart* [[**a friend of McNulty**] to have won the election].

Neeleman and Payne (2019: 3) also argue that the intervention of a matrix adjunct as in (90) (as well as the particle of a matrix verb–particle combination) becomes possible when the word order in (90) is derived by the extraposition of the predicate phrase as in (92) rather than the raising of the ECM subject.

(92) a. John [$_{VP}$ believed [**Mary** $\underline{\mathbf{t}}_{\mathbf{1}}$] *sincerely*] [$_{\mathbf{1}}$ **to** be the winner].
b. John [$_{VP}$ *made* [**Mary** $\underline{\mathbf{t}}_{\mathbf{1}}$] *out*] [$_{\mathbf{1}}$ **to** be a liar].

Next, some typical arguments of the type (89-ii) involve observations on binding. Ascribing the original observation to Bach (1970), Postal (1974: 120–124) argued that binding involved in the ECM construction supports the raising analysis of ECM subjects, which Lasnik and Saito (1991: 327–328) further extended in a more recent theoretical framework. The ECM subject allegedly lifted to the matrix clause c-commands the relevant item in the matrix clause and induces a violation of Condition C of Binding Theory (BT(C)) as in (93) and satisfaction of Condition A of Binding Theory (BT(A)) as in (94).

(93) *BT(C)
John [believes **him**$_{*\mathbf{1}}$ [to be a genius] even more fervently than **Bob**$_{\mathbf{1}}$'s mother does].

(94) ^{ok}BT(A)
The DA [proved **the defendants**$_{\mathbf{1}}$ [to be guilty] during **each other**$_{\mathbf{1}}$'s trials].

Similarly, successful licensing of a negative-polarity item in the matrix clause by a negative ECM subject as in (95) below has been regarded as a relevant argument to support the raising analysis of the ECM subject (Lasnik and Saito 1991: 329).

(95) Negative-polarity licensing by the ECM subject:
$^{?}$The DA [proved **none of the defendants** [to be guilty] during **any** of the trials].

While these arguments seem to have acquired overwhelming support for the raising analysis of ECM subjects in the field, there in fact have existed observations that seriously undermine the validity of such arguments. Pettiward (1998: 557) points out that, crucially, the violation of BT(C) is detected even with an *object* pronoun within the ECM construction.

(96) *BT(C) with the object:
John [expects [the DA to acquit **him**$_{*?\mathbf{1}}$ **]** even more fervently than **Bob**$_{\mathbf{1}}$'s mother does].

In the same vein, successful negative-polarity licensing is observed with a negative object within the ECM construction as in (97).

(97) Negative-polarity licensing by a negative object:
The DA [proved [the guilt to lie with **none of the defendants**] during **any** of the trials].

At the least, these observations neutralize the arguments built on the observations in (93)–(95).[33] Alternative accounts of not only the observations in (93) and (95) but also those in (96) and (97) more or less seek the idea that the boundary of the ECM infinitives that separates the ECM subject from the matrix is transparent. Adopting Williams' (1994) thematic approach to binding, Pettiward (1998: 557) analyzes the ECM infinitive as what she calls a functor complement rather than a thematic complement of the matrix verb, and assumes that arguments of the embedded verb also count as arguments of the higher verb. Sato (2023: 346, 348), on the other hand, analyzes the ECM infinitive as a *v*P selected directly by the higher verb, and accordingly the entire clause is monoclausal, assimilating it to causative/perceptive constructions (e.g., *Rosa {had/saw}* **[**$_{\boldsymbol{v}\mathbf{P}}$ *me clean her office* **]**). Pesetsky (2021), while maintaining

[33] Contrary to (94), BT(A) cannot be satisfied with the object in the ECM infinitive, as shown in (i).

(i) The DA proved [the defendants$_1$ to have assaulted the policemen$_2$] during each other$_{1/*2}$'s trials.

As Pettiward points out, the subject–object asymmetry like this is expected since the existence of the ECM subject in (i) precludes the object from satisfying the locality condition imposed on the anaphor binding.

the raising of the ECM subject, also attempts to derive a transparent ECM-infinitive by applying his Exfoliation rule to reduce a full CP to an infinitive.

In short, the raising analysis of ECM subjects is no less unsettled than an in-situ analysis. Selecting one approach over the other, or proposing a new analysis, goes beyond the scope of the current work and must be left for future research. We therefore remain noncommittal about this issue in the current work.

We would like to point out, though, that even if the subordinate ECM subject is analyzed as having been raised to the matrix, we could still make such an analysis compatible with our physical–logical synchronization approach involving modal anchoring under bottom-up dynamic transfer. Even if such raising takes place, the anchoring between $\varnothing_{\text{Dox}}$ and the ECM subject can be properly established via Loc-signification within the subordinate C-domain as in (98a)–(100a) below. Binding and negative-polarity licensing, on the other hand, can be established presumably under the higher V-domain (VP or *v*P) after the subordinate subject is raised as in (98b)–(100b).

(98) a. **[$_{\text{CP}}$ $\varnothing_{\text{Dox}}$ him** to be a genius **]**
—**ok**[$_{\text{CP}}$ $\varnothing_{\text{Dox}}$⌒Sbj]

b. **[$_{\text{VP}}$** John believes **him**$_{*1}$ [$_{\text{CP}}$ $\varnothing_{\text{Dox}}$ **t$_1$** to be a genius] even more fervently than **Bob$_1$**'s mother does **]**
—*BT(C)

(99) a. **[$_{\text{CP}}$ $\varnothing_{\text{Dox}}$ the defendants** to be guilty **]**
—**ok**[$_{\text{CP}}$ $\varnothing_{\text{Dox}}$⌒Sbj]

b. **[$_{\text{VP}}$** The DA proved **the defendants$_1$** [$_{\text{CP}}$ $\varnothing_{\text{Dox}}$ **t$_1$** to be guilty] during **each other$_1$**'s trials **]**
—**ok**BT(A)

(100) a. **[$_{\text{CP}}$ $\varnothing_{\text{Dox}}$ none of the defendants** to be guilty **]**
—**ok**[$_{\text{CP}}$ $\varnothing_{\text{Dox}}$⌒Sbj]

b. **[$_{\text{VP}}$** The DA proved
none of the defendants$_1$ [$_{\text{CP}}$ $\varnothing_{\text{Dox}}$ **t$_1$** to be guilty] during **any** of the trials **]**
—**ok**Negative polarity

Appendix B: Marantz's morphological case and thematic anchoring

Claiming that morphological case can be divorced from syntactic licensing, Marantz (1991: 245, 247) develops a system of morphological case realization, whose core insight has been widely accepted in the literature (e.g., Bittner and Hale 1996; Bobaljik 2008, and Preminger 2011, to name only a few). He claims that nominals appear with an underspecified (unvalued) case affix, and its morphological features (values) like ACC and NOM are inserted just before it reaches PF, based upon his "case realization disjunctive hierarchy" as in (101), which proceeds from more specific to more general in the order of (i)–(iv).

(101) Morphological-case realization disjunctive hierarchy:
(i) "Lexically governed" case – quirky case
(ii) "Dependent" case – ergative and accusative case
(iii) "Unmarked" case – contextual case (NOM under IP and GEN under NP, ABS in Ergative languages)
(iv) "Default" case – ACC in English (see Schütze 2001; Quinn 2005)

What is important to us is (101ii) and (101iii), the core and productive part of the morphological case realization. As perspicuously summarized by Bobaljik (2008: 300, 306), Marantz's dependent case is assigned *only in the presence of a local case competitor*. That is, it is assigned only when more than one NP in a single domain is eligible to receive morphological case. For nominative–accusative languages, the dependent case is accusative, and is assigned to the lower NP in the domain, while for ergative languages, the dependent case is ergative, assigned to the higher NP. The unmarked case morphology in (101iii), on the other hand, is claimed to be assigned in accordance with a syntactic environment – NOM under (finite) TP/IP in nominative-accusative languages and GEN under NP/DP.

In investigating Loc-signification of thematic anchoring in English, we have noticed something peculiar: while Loc-signification by adjacency is required for the internal argument of a transitive verb, as has been observed in (54a) repeated below, no such adjacency seems to be required for the internal argument of an unaccusative verb, as illustrated by (102).

(54a) We recommended (**strongly*) { him / John }.

(102) Unaccusative:

a. There arose *quickly* a storm in several places.
b. There lies *lazily* an old cat in the sun.

If all arguments are thematically underspecified and must be anchored to a predicate's thematic roles, why is ϕ-signification required for the thematic anchoring of the internal arguments in a transitive construction but not in an unaccusative construction? One plausible generalization we can draw from this observation is that Loc-signification of an internal argument is necessary *only in the presence of a local competitor*, that is, only when a need to distinguish two argument positions arises in a transitive construction. The generalization proposed here is identical to that offered in Marantz's analysis of morphological cases. As reviewed above, it characterizes each of accusative and ergative as a "dependent case," which is assigned only *in the presence of a local competitor*. We consider that this property common to morphological case assignment and Loc-signification did not arise by coincidence but of necessity. We claim that the "dependent" property of morphological cases reflects the minimal necessity for ϕ-signification to be implemented for correct thematic anchoring.[34] It arises from the need to identify one of the two arguments of a two-place predicate for the thematic anchoring involving the correct θ-role. Depending on the type of languages, it may be the internal θ-role (nominative-accusative languages) or the external θ-role (ergative-absolutive languages).[35] We also consider that as long as these

[34]Note that the need for discriminating the internal and external arguments in a transitive construction in ϕ-signification and also the need for explaining its absence in an unaccusative construction arises whether or not little-v is postulated. We will therefore simplify our discussions and representations without referring to little-v.

[35]This view is compatible with the observation that no ergative case is assigned to an argument moved into a nonthematic subject position (Marantz 1991: 236–237). Apparently, ϕ-signification of the thematic anchoring by an external θ-role in ergative-absolutive languages may involve an extra condition such as tense/aspect added to verbs in split ergativity, e.g., Aorist in Georgian. The present paper, however, is not the appropriate space to sketch an entire theory of ergativity.

θ-markings are correctly achieved, all other instances of θ-marking are freely executed involving the only thematically underspecified argument in the local domain. In other words, the thematic anchoring to the internal θ-role of an unaccusative verb, and presumably that to the external θ-role of both transitive and unergative verbs, can be correctly and unmistakably achieved even without the need for ϕ-signification, at least in English. Since the purpose of linguistic communication is semantic interpretation rather than pronouncing case morphology, we find it natural if the generalization on morphological case realization is reduced to that on thematic anchoring rather than the other way round.

Appendix C: On the deterioration of morph-signification in modern English

As is well known, morphology on nominal expressions used to be much richer in Old English, showing up not only on pronouns but also on lexical nouns and determiners. Accordingly, Morph-signification appealing to nominal morphology presumably was more functional at that time. It is, however, significantly deteriorated in modern English and has become considerably undermined as a full-fledged means for ϕ-signification. It thus cannot fully compensate for Loc-signification in modern English, exhibiting the ϕ-signification failure as in (54) repeated here.

(54) a. We **recommended** (**strongly*) { **him** / John }.
b. I would prefer **for** (**tomorrow*) { **him** / John } to leave.

At least some of the overt morphology on pronouns, on the other hand, have been relatively better maintained than in nouns (except for possessive morphology), and it remains an *ad hoc additional requirement* to be satisfied as a *defunct historical residue of Morph-signification*. We believe this gave rise to the failure of Morph-signification by pronouns as in (54) while their morphology must still be indicated in the way the old-day Morph-signification would have.

Reinterpreting Hulk and van Kemenade's (1995) analysis, Kiparsky (1997) offers a summary and analysis of diachronic changes in English as follows, which supports this view of ours. In Old English, both position and case functioned as independent licensers of nominal arguments, interacting in a complex and systematic way. In the course of the Middle English period, however, phonological and morphological changes resulted in the nearly complete loss of case marking on lexical nouns and determiners, which induced a shift from morphological case to positional licensing of argument NPs. Morphological case marking on pronouns remained reasonably robust for some time but eventually "ceased to have a morphosyntactic licensing function" (p. 32).[36]

Moreover, we have already pointed out with (54) that Loc-signification for thematic anchoring must be achieved irrespective of overt case morphology of pronouns

[36] See also Quinn (2005) for relevant discussion on the distribution of pronouns with different case morphology in modern English, which she attempts to capture with her "violable surface constraints." This is reminiscent of Marantz's proposals regarding morphological case.

in English. Loc-signification for complement clauses in English does not involve any prototypical case morphology, either, although we consider that an overt COMP fulfills the same function at ϕF, being an overt marker. This suggests that the generalization in question should not be captured under the theory of case but in a more general context of physical marking – in ϕ-signification in our opinion.[37]

Recall also that Marantz analyzed NOM as an "unmarked" morphological case realized under a finite sentence (101iii). Here, we reinterpret it as Morph-signification indicated on a subject for the modal anchoring of a sentence by $\varnothing_{\text{FIN}}$ in languages like Japanese and Korean. Nominative inflection on pronominal subjects in English, on the other hand, is regarded as a defunct historical residue of Morph-signification, as is the accusative inflection on pronominal objects of prepositions as well as the lower subjects adjacent to prepositional modal anchors (*for*/$\varnothing_{for}$/$\varnothing_{\text{DOX}}$). Nominative is used in the context of finite anchoring and the accusative is used everywhere else. See Schütze (1997), Quinn (2005), and Preminger (2011) for discussions that could possibly lead us to identify their potential origins in Old English.

Another obvious candidate for a Morph-signifier is agreement inflection indicating person, number, and/or gender. In fact, some researchers consider that not only morphological case but also agreement inflection is a morphological signal functioning as the PF exponent of some other properties. Sigurðsson (2009: 43, 46–47), for instance, characterizes agreement as an ambiguity-reducing PF mechanism facilitating processing. (See also Sigurðsson 2003 and Bobaljik and Wurmbrand 2009 for relevant discussion.) A well-known case of subject and object agreement in Kiswahili as in (103) below, for example, can perhaps be regarded as an instance of Morph-signification for thematic as well as modal anchorings.

(103) a. *mw*alimu **a**-me-**wa**-ona [*wa*nafunzi *wa*nya]
1.teacher **1**-PERF-**2**-see 2.student 2.new
'(The) teacher has seen (the) new students.'

[37] At this point, we do not have any compelling explanation as to why the subject clause must still be accompanied by an overt COMP, as in (i) below, which would not be required by the proposed ϕ-signification.

(i) a. [$_{\text{CP}}$ {**That** / ***$\varnothing_{\textbf{that}}$**} John has not showed up] bothers me.
b. [$_{\text{CP}}$ {**For** / ***$\varnothing_{\textbf{for}}$**} John to like Mary] surprised everyone.

We surmise that it may involve possibly more than one problem. For instance, we note that the absence of an overt COMP at least in (i) would always force the parsing of this construction to start with the misanalysis of a clausal subject as a matrix clause, which falls under the rubric of a phenomenon frequently discussed in the psycholinguistics literature (Fodor and Garrett 1967; Bever and Langendoen 1971; Frazier 1985; Grant 2013, among others). Frazier (1985: 137–138), for instance, proposed (ii) as processing-induced constraint.

(ii) Impermissible Ambiguity Constraint:
Languages prohibit constructions containing a clause that is misanalyzed the same way every time it occurs regardless of the particular words contained in the clause.

Foreseeing the ϕ-signification of relative clauses to be discussed in footnote 41 below, we also point out that this exposition predicts the need for an overt relative pronoun in (iii) as well, which would otherwise remain mysterious.

(iii) The man [$_{\text{CP}}$ {**who**/***$\varnothing_{\textbf{who}}$**} $\varnothing_{\textit{that}}$ entered] tripped.

b. [*wa*nafunzi *wa*pya] **wa**-me-**mw**-ona *mw*alimu
2.student 2.new **2**-PERF-**1**-see 1.teacher
'(The) new students have seen (the) teacher.'

As Kiparsky (1997) points out, on the other hand, morphological agreement on verbs in English followed a similar fate as morphological case after its deterioration in the fourteenth century, and ceased to have a morphosyntactic licensing function. As a result, only a remnant of it, i.e., third-person singular in the present tense, remained to be a *semiproductive additional requirement* in modern English, supplementing the required Loc-signification for modal anchoring. This contrasts with more agreement-rich languages. See, for example, Sigurðsson (2004), Sigurðsson (2009), and Sigurðsson (2010) for detailed analyses of agreement in Icelandic and other Indo-European languages treating it as a more serious morphological licensing mechanism somewhat similar to Morph-signification discussed above. Our approach shares and inherits part of his big picture of grammar while pursuing a distinct route regarding its manifestation.

Appendix D: On the phonological approach to "left-edge filling"

In Sect. 4.3, we proposed to reduce the "null COMP prohibition" in the sentences below to the need of Morph-signification for the thematic anchoring of a clausal argument. (See also (22).)

(23b) We **believe** *quite strongly* [$_{\underline{\text{CP}}}$ {**that/*∅**$_{\textit{that}}$} he is innocent].

(21) John **wants** *very much* [$_{\underline{\text{CP}}}$ {**for/*∅**$_{\textit{for}}$} **Bill** to leave].

(29b) John **believes** *very strongly* [$_{\underline{\text{CP}}}$ *∅$_{\textbf{Dox}}$ Bill to be talented].

An (2007: 61), on the other hand, attempts to account for this phenomenon postulating the constraint on phonological representation stated in (104), which McFadden (2012) and McFadden and Sundaresan (2018) also adopt.

(104) Intonational Phrase Edge Generalization (IPEG):
The edge [= spec + head (xx)] of an Int(onational)-phrase cannot be empty (where the notion of edge encompasses the specifier and the head of the relevant syntactic constituent).

A crucial hypothesis they appeal to is the theory of prosodic phonology, which maps a syntactic representation onto a new and distinct level of representation labeled with prosodic categories, typically as summarized in (105) (for English) (Selkirk 1981; Nespor and Vogel 1986, among others).

(105)

	<Category in syntactic structure>		<Category in prosodic structure>
a.	Clause	→	**Intonational phrase** (ι)
b.	Phrase	→	Prosodic phrase (ϕ)
c.	Word	→	Prosodic word (ω)

An (2007) claims that his constraint concerns prosodic properties of an utterance and disallows an intonational phrase whose boundary cannot be properly demarcated at

PF by an overt element.[38] In our physical signification approach, we certainly share his core intuition that the presence of a phonetically overt element at the periphery of a clause matters. On the other hand, we also have reasons to be hesitant about adopting this purely prosodic/phonological approach couched in Phase Theory.

To begin with, it is not at all clear if an appeal to prosodic phonology is appropriate in constraining a phonetically empty syntactic element. Ascribing his view mainly to Nespor and Vogel (1986), An (2007: 60) assumes that the boundary of an intonational phrase (IntP) must occur at the juncture between two prosodic words in the prosodic structure. Assuming further that prosodic words can be built only with overtly pronounced elements, he is led to the conclusion that the edge of IntP cannot start with any empty material. However, as Nespor and Vogel (1986) argue at length in their Sect. 2.3.2, there are reasons to consider that empty elements do not play any role in prosodic phonology, being invisible to and disregarded by phonological rules. If so, the null COMP postulated in the syntactic representation in (23b′-i) below is disregarded in prosodic phonology, and the same sentence can and perhaps should be represented as in (23b′-ii).

(23′b) (i) Syntactic:
*I believe [$_{\text{Adv}}$ sincerely] [$_{\text{CP}}$ $\varnothing_{\textit{that}}$ [$_{\text{TP}}$ [$_{\text{NP=N}}$ he] is innocent]].
(ii) Prosodic:
*I believe **[**$_{\omega}$ sincerely **]** **[**$_{\iota}$ **[**$_{\phi\,=\,\omega}$ he] is innocent]].

Note then that the IntP boundary (ι) appears at the juncture between two prosodic words (ω) in (23b′-ii), which would satisfy IPEG and incorrectly permit this prosodic structure.[39]

Second, we are also concerned that IPEG seems to have to rely on an ad hoc assumption in order to properly achieve its goal when it encounters the following problem. If a clause is generally mapped onto IntP in prosodic structure (105a), it is predicted that, in principle, no clauses would be allowed to start with a null COMP. Therefore, one obvious problem that requires explanation is the possibility of a null COMP (and hence optionality of an overt COMP) in sentences like (23a) below, which minimally contrasts with (23′b) examined just above.

(23a) We **believe [$_{\text{CP}}$** {**that / $^{\text{ok}}\varnothing_{\textit{that}}$**} he is innocent **]**.

A similar contrast is also reported on relative clauses:

(106) a. I saw the child *yesterday* **[$_{\text{CP}}$ who** $\varnothing_{\textit{that}}$ Mary had adopted **]**.
b. I saw the child *yesterday* **[$_{\text{CP}}$** $\varnothing_{\textit{who}}$ **that** Mary had adopted **]**.
c. *I saw the child *yesterday* **[$_{\text{CP}}$** $\varnothing_{\textit{who}}$ $\varnothing_{\textit{that}}$ Mary had adopted **]**.

[38] An (2007) and McFadden (2012) also offer counterarguments to various alternative approaches to this problem such as the Case theory approach (Chomsky 1980), the ECP approach (Stowell 1981; Lamontagne and Travis 1987), the feature-checking approach (Pesetsky and Torrego 2001), and the affix hopping approach (Bošković and Lasnik 2003).

[39] Another theoretical issue is the relevance of the notion edge in prosodic phonology. "Edge" was postulated in the phase theory in order to provide an "escape hatch" for the movement of a syntactic head and that of a specifier phrase appearing in the intermediate landing site of cyclic movement. Although An (2007: 70) assumes that the specifier and head make up a unit in PF, it is not entirely clear if the mixture of the syntactic notion edge and prosodic phrasing can indeed be justified.

(107) a. I saw the child [$_{CP}$ **who** ∅$_{\textit{that}}$ Mary had adopted].
b. I saw the child [$_{CP}$ ∅$_{\textit{who}}$ **that** Mary had adopted].
c. I saw the child [$_{CP}$ ∅$_{\textit{who}}$ ∅$_{\textit{that}}$ Mary had adopted].

While the sequence of a null relative and a null COMP (= null edge of CP) cannot start the clause in (106c), the same sequence is permitted in (107c), contrary to what IPEG predicts.

To cope with such problems, An (2007) assumes that a CP appearing in a position as in (23b′) and (106a–c) (his 'noncanonical' position) is obligatorily mapped onto IntP while a CP appearing in a position as in (23a) and (107a–c) (his 'canonical' position) is only optionally mapped onto IntP. However, unless it is properly rationalized why CPs in canonical positions need not make up Int-Ps, the relevance of IntP in the null COMP prohibition cannot be confirmed. As a result, the IPEG cannot be regarded as a reliable general constraint, either. The contrast between canonical and noncanonical positions, in other words, is an issue to be explained rather than something that can simply be assumed. Under the IPEG approach, clauses in a noncanonical position are characterized as not having a tight relationship with what precedes them, e.g., clauses appearing as subject, topicalized, right-node-raised, extraposed, and so on. Their IntP status in fact is often said to be indicated phonetically by an intonational break (pause) preceding them.[40] Intonational breaks, however, are phonetic results of prosodic phrasing rather than something that induces prosodic phrasing. The real issue, in other words, is whether grammar can explain in a natural way how the "tight relationship" in question arises in the canonical case and it fails to arise in the noncanonical case. We believe that the ϕ-signification approach argued for above allows us to provide such an explanation. We can ascribe the null COMP prohibition in a noncanonical position to the need for the Morph-signification (with an overt COMP) of the CP's dependency on a higher head as its interpretive anchor when this CP cannot be cojacent to the head and fails to establish the "tight local relationship."[41]

McFadden (2012) and McFadden and Sundaresan (2018: M&S) attempt to support the IPEG approach claiming that its empirical coverage can be extended from the null COMP prohibition to all kinds of prohibitions against an empty edge of a sentence

[40] It probably is irrelevant to the argument here whether an adverb-intervention as in (23b′-i) should be analyzed as involving the extraposition of the object. The comparison of (ia) and (ib) below, however, leaves us with the impression that no strong motivation exists for such an analysis.

(i) a. I believe (*truly) his word of honor.
b. I believe truly that he's honest.

The NP object in (ia) is of a similar length as the CP complement in (ib) but it is not felt to be a particularly heavy NP. The CP complement in (ib) need not be preceded by any noticeable pause, either, while it appears in the alleged noncanonical position.

[41] See (70b-i) in Sect. 4.7 for the definition of "cojacency." The contrast between (106c) and (107c) on one hand and that between (106c) and (106a and b) on the other suggest that a restrictive relative clause is Loc-signified by its adjacency to the head noun and the failure of this Loc-signification requires Morph-signification, apparently by an overt *wh*-relative or the overt COMP. Clearly, we need to expand our ϕ-signification analysis further to the interpretation of adjunct clauses, though we must leave the pursuit of this project to future research. See the discussion on (iii) in footnote 37 above. See also An (2007: footnote 27, p. 58) for a relevant discussion.

at PF as listed in (108) below, namely, (strong) EPP phenomena, prohibition against "*for*-PRO-*to*" infinitives, and COMP-trace phenomena.

(108) a. John believes (**sincerely*) **[$_{CP}$ ∅$_{COMP}$ [$_{TP}$** {people/*∅} ∅$_T$ [$_{VP}$ like him]]].
b. **[$_{TP}$ *∅** ∅$_T$ [$_{VP}$ arose a storm]].
c. I$_1$ would like *for* **[$_{TP}$ *PRO$_1$** *to* punched Alex].
d. **Who$_1$** did you say *that* **[$_{TP}$ *t$_1$** punched Alex]?

Although this "enlarged" IPEG approach involves an extremely interesting and constructive extension of the analysis of the edge-filling phenomena, it encounters a direct counterexample each time it attempts to constrain a different type of empty edge listed in (108). In order to cope with each such exception, some new assumptions need to be made. Those assumptions, however, raise some issues that remain unresolved.

First, it was newly claimed that the Spell-Out domain of a phase is automatically mapped onto IntP. IPEG, therefore, forbids the edge of TP to lack phonetic contents, with the subject entirely missing as in (108a and b) or with an empty subject appearing there as in (108c and d), inducing the "strong" EPP effect. In a sense, therefore, both phase (CP) and its Spell-Out domain (TP) are claimed to be obligatorily mapped onto IntP. As we discussed above, however, the exception to this general mapping is allowed with the stipulation that a CP-phase is only optionally mapped onto IntP when it appears in a canonical position, e.g., when *sincerely* does not show up in (108a).

Second, under this enlarged IntP-mapping approach, it is not immediately clear why an EPP effect can be avoided in a PRO-*to* control infinitival as in (109), contrary to the finite clauses as in (108a and b).

(109) I would like **[$_{TP}$ PRO** ***to***$_T$ [punch Alex]].

In order to account for such a contrast, it was assumed that the embedded clauses are categorially distinct in the two cases, as indicated in (109) and (110).

(110) *Celine said [$_{CP}$ that **[$_{FinP}$ [e]$_1$ ∅$_{Fin}$** [$_{TP}$ t$_1$ ***will***$_T$ [t$_1$ play hockey]]].

What is crucial to these analyses is that the phonetically overt element (*to*/*will*) appears in a distinct functional head position in each sentence. In (109), the PRO-*to* control infinitival is analyzed as TP headed by an overt T head (*to*). IPEG therefore is satisfied even if the PRO subject is phonetically empty. In (110), on the other hand, a finite sentence is analyzed as FinP headed by an empty Fin head (**∅$_{Fin}$**) with an empty subject appearing as its Spec, violating IPEG. Crucially, the Aux *will*, though overt, appears within TP, which is too low to satisfy IPEG. Still another mystery is why an EPP effect resurfaces in the *for*-PRO-*to* control infinitival in (111).

(111) *I would like [$_{CP}$ ***for*** **[$_{FinP}$ PRO ∅$_{Fin}$ [$_{TP}$ to**$_T$ [punch Alex]].

To account for its contrast with the PRO-*to* control infinitival in (109), the *for*-PRO-*to* control infinitival in (111) is analyzed as CP involving a complement FinP headed by an empty Fin head (**∅$_{Fin}$**). The combination of PRO subject and **∅$_{Fin}$** therefore does

not satisfy IPEG. Crucially, the overt T head *to* appears too low in (111) to satisfy IPEG.

We have no objection to the categorial contrast of the complement clauses in (109) and (110), which we also argue for in Sect. 5. The paradigm in (112) below analyzed in accordance with M&S's proposal, however, urges us to suspect that *will* and *to* are not placed in the correct positions in (110) and (111).

(112) a. [$_{\text{FinP}}$ We$_1$ $\varnothing_{\text{Fin}}$ [$_{\text{TP}}$ t$_1$ **will/can/could/do/did**$_{\text{T}}$ [$_{\text{NegP}}$ ***not*** [t$_1$ do it]]]].

b. We tried/decided [$_{\text{TP}}$ ***PRO*** $\varnothing_T$ [$_{\text{NegP}}$ ***not*** **to** do it]].

First, if all the modal Auxes in (112a) appear in the T-head position, the negative word *not* is likely to be appearing in the phrase below the T head, possibly NegP. Next, the infinitive marking *to* in (112b) appears to the right of *not* and hence is unlikely to be heading TP in a position higher than the NegP.[42] The PRO-*to* control infinitival in (112b) therefore is likely to involve an empty edge (PRO+$\varnothing_{\text{T}}$) but it does not violate IPEG, contrary to the prediction.[43]

An account similar to that for (109) was offered for the possibility of a PRO subject in a gerundive clause as in (113).

(113) **[$_{\text{TP}}$** PRO Eat$_1$**-ing**$_{\text{T}}$ [$_{\text{VP}}$ **t$_1$** the samosas]] would be a mistake.

It was claimed that the head of TP is realized as the *-ing* suffix and fills its left edge, with the verb moved up to this position (p. 15). This analysis, however, is also questionable since V-*ing* appears to the right of a VP adverb like *hastily* as in (114).

(114) **[$_{\text{TP}}$** ***PRO*** $\varnothing_T$ **[$_{\text{VP}}$** ***hastily*** eat**ing** the samosas]] would be a mistake.

It suggests that V-*ing* is located within the verbal projection (VP or *v*P) rather than under TP in this construction and hence IPEG violation is unlikely to be evaded even with the presence of the *-ing* suffix in (114) or (113).

Finally, the "enlarged" IPEG approach also encounters an outright counterexample as in (115) below, in which overt *wh*-movement can successfully leave a trace behind under FinP (to be mapped onto IntP as the Spell-Out domain) without violating IPEG.

(115) [$_{\text{CP}}$ Who$_1$ **[$_{\text{FinP}}$ t$_1$ $\varnothing_{\text{Fin}}$** [$_{\text{TP}}$ t$_1$ [$_{\text{VP}}$ t$_1$ punched Alex]]]]?

To cope with this problem, McFadden and Sundaresan (2018, 20) postulate (116).

(116) IntP Extension:
Given a syntactic constituent XP that would normally be aligned with an

[42] When *to* appears to the right of *not* as in (i) below, *not* is likely to be scoping over the verb *repair*, as the naturalness of the contrastive expression *but to discard* following it suggests.

(i) We have decided **to not** repair *but to discard* it.

It is also unlikely that *not* is analyzable as having been raised to the left of *to* in (112b), given that the word order *not will/can/has*, etc. is not permitted in (112a).

[43] To begin with, it is not clear why the PRO-*to* infinitival in (109) is introduced as TP, while it is introduced as FinP in (111). Involving a higher CP projection in the latter does not necessarily seem to justify the presence of FinP, which also urges us to question the validity of the analysis in (111).

> IntP boundary by the categorial route [i.e., FinP as Spell-Out domain], if an element moves from the edge of XP into a constituent YP that contains XP, the IntP will be aligned with YP instead.

This new assumption permits the IntP status of FinP to be extended (or rather transferred) to CP in (115). IntP Extension is also claimed to capture the anti-*that*-trace effect in a restrictive relative clause as in (117).

(117) I saw the ***child*** **[$_{CP}$ ∅$_{who1}$** { **^{ok}that / *∅$_{that}$** } [$_{FinP}$ **t$_1$ ∅$_{Fin}$** was waiting for Mary].

Here, the COMP must be overt because, if the COMP is $\varnothing_{that}$, the edge of the CP as the "extended IntP" would be empty and IPEG would be violated.

We note, however, that this strategy is not at work when the relative clause is nonfinite as in (118a and b).

(118) a. The person **[$_{CP}$ ∅$_{who1}$** { ***for / ^{ok}∅$_{for}$** } [$_{FinP/TP}$ **t$_1$ to** have to apologize]] is John rather than Bill.

b. The doctor gave me some medicine **[$_{CP}$ ∅$_{1which}$** { ***for / ^{ok}∅$_{for}$** } [$_{FinP/TP}$ **t$_1$ to** be taken **t$_1$** three times a day]].

In both of (118a and b), whether the infinitival is analyzed as FinP or TP, IntP Extension should turn the entire relative clause (CP) into the "extended IntP." The contrast between (117) and (118) therefore makes us hesitant about adopting IntP Extension at least at face value. M&S informally portray the analyses in (115) and (117) stating that "IntP extension only happens when an element that would have satisfied the IPEG in its starting position moves up, bringing the edge of the IntP with it." (p. 20). What we would like to ask ourselves here is if we can formally anatomize such an impression without stipulating the IntP extension itself. We, in fact, consider that it is possible. What is crucially involved in the EPP amelioration in (115), for example, is that movement leaves behind an unpronounced subject (trace) whose interpretation is provided via its anaphoric dependency on the item located in a higher projection, as in (115′).

(115′) $\varnothing_{WH\text{-}Q/FOC}$ [$_{FinP}$ **Who$_1$ ∅$_{Fin}$** [$_{TP}$ **t$_1$** punched Alex]]?

In Sect. 5, we offer some tentative remarks on the possibility that ϕ-signification for modal anchoring of TP appealing to this method can be far-reaching and prevalent, taking place in a wider range of constructions involving a phonetically empty subject.

To sum up, although enlarging the empirical coverage of IPEG to all types of edge-filling phenomena is a quite intriguing, inspiring, and respectable project, the initial examination of the "enlarged" IPEG approach proposed by M&S leaves the impression that its goal is yet to be achieved successfully, leaving a number of issues unresolved.[44]

[44] As M&S are aware, motivating A-movement in syntax (for the satisfaction of EPP) appealing to IPEG as a prosodic constraint necessarily raises a serious "look ahead" issue.

Appendix E: Further argument for the interpretation of expletives

We can observe another interpretive phenomenon that leads us to conclude that expletives in fact are interpreted at LF in their surface positions. To begin with, the pronoun *his* can be interpreted as a variable bound by the quantified NP in (119a) but not in (119b).

(119) a. ***Someone***$_{\mathrm{x}}$ seems to [***his***$_{\mathrm{x}}$ colleagues] [**t** to be quite suitable for that position].

b. **There** seems to [***his***$_{*\mathrm{x}}$ colleagues] [**t** to be ***someone***$_{\mathrm{x}}$ quite suitable for that position].

That is, (119a) can but (119b) cannot be interpreted as "There exists at least one person such that this person's colleagues have the impression that s/he is quite suitable for that position." If a bound pronoun must be c-commanded by its antecedent, this contrast naturally follows. Surprisingly, however, such a bound-variable interpretation becomes available in a sentence like (120) below despite the lack of the required c-command relation between the pronoun and its quantified antecedent.

(120) **There**$_2$ seem to [***its***$_{\mathrm{x}}$ residents] [**t**$_2$ to exist many serious problems **[**$_{\mathrm{PP}2}$ **in** ***every major city***$_{\mathrm{x}}$**]**

In other words, the pronoun *its* in this sentence can be interpreted as a variable bound by *every major city*, yielding a distributive reading. Hence, the sentence may indicate, for example, that, in each of New York, Paris, London, and so on, the residents there have the impression that many serious problems exist in the city they live in. The crucial observation we would like to present here is that the quantified antecedent of the pronoun is located in what we identified as the locative associate of the expletive *there*. Once again, as illustrated in (120′) below, if the full content of the locative associate is represented at LF in the matrix subject position of the expletive *there* (via the trace) in (120), the unexpected bound-variable interpretation can be demystified.[45]

(120′) **LF**: **[**$_{\mathrm{PP}2}$ **in** ***every major city***$_{\mathrm{x}}$ **]** seem to [***its***$_{\mathrm{x}}$ residents] [**t**$_2$ to exist many serious problems __]

[45] One may consider that the bound-variable interpretation in (120) is possible because the quantificational locative expression has been introduced as an IP/TP-adjunct in the matrix clause and c-commands the pronoun *its*. We can, however, ensure the subordinate status of the locative associate of *there* in a sentence like (i).

(i) There seem to *its*$_{\mathrm{x}}$ residents [$_{\mathrm{IP}}$ to be [$_{\mathrm{NP}}$ many serious problems **t**$_1$] *in every city*$_{\mathrm{x}}$ **[**$_{\mathrm{CP}1}$ **that have no obvious solution]**].

In this sentence, the application of Extraposition from NP placed the relative clause CP_1 to the right of the locative *in every city*$_{\mathrm{x}}$. This movement, however, should not go beyond the IP-boundary due to the Right Roof Constraint (Ross 1967). It therefore is ensured that the locative *in every city*$_{\mathrm{x}}$ in (i) is located within the subordinate clause in overt syntax. Now, the sentence is somewhat difficult to compute due to its extreme length. However, all of about a dozen speakers we have consulted inform us that the bound-variable interpretation of the pronoun is still possible in (i).

Note also that, as can been seen in (119b) above and (121) below, when the quantified antecedent is located in what is often referred to as the nominal associate of the expletive *there*, a similar bound-variable interpretation is not permitted.

(121) **There$_2$** seems to [**its$_{*\mathbf{x}}$** residents][**t$_2$** to be [**a book about every city$_\mathbf{x}$**] in the Library of Congress].

The sentence in (121) therefore cannot mean that every city is such that its residents have the impression that a book about their own city exists in the Library of Congress. That is, even if one assumes that the expletive *there* covertly attracts either the entire semantic content or only the formal features of its nominal associate (cf. Lasnik 1995), the variable binding in (120) (and also the successful anaphor binding in (66b) in Sect. 4.6) would remain mysterious.

When we examine the kind of data brought to bear in Centering Theory, this time involving expletive subjects and anaphors contained in their interpretive associates, we can provide further evidence for our claim that expletive subjects themselves are in fact contentful anaphors. Consider first (122). After the center has shifted from *they* to it_1 in (122b), (122b), and (122c) is perceived as a more coherent sequence of utterances than (122b) and (122c′).

(122) a. *They*$_\mathbf{i}$ think **it$_1$** is likely **[$_{\mathbf{CP1}}$** that *each other*$_\mathbf{i}$*'s* book will receive **[$_{\mathbf{NP2}}$** this year's Pulitzer Award in fiction**]]**.
b. **It$_1$** would make a huge gap between these archrivals because of **its$_2$** dignity in the literary world.
c. **It$_1$** therefore would be rather shocking to them.
c′. ?**Its$_2$** recipient is almost guaranteed an instant bestseller and another book contract, which would make **it$_1$** even more intolerable to them.

This follows from Centering Theory coupled with the idea that so-called expletive *it* is actually anaphoric to its associate CP. In (122c), the backward-looking center is also the highest-ranked forward-looking center (it_1). In (122c′), by contrast, the backward-looking center (it_1) is not the highest-ranked forward-looking center (it_2), leading to a less coherent sequence. Now crucially, it_1 in all sentences in (122) keeps referring to CP_1 appearing in (122a) with the anaphor *each other*$_\mathbf{i}$ interpreted there referring to *They*$_\mathbf{i}$.

Similar facts hold for so-called expletive *there*: after the center has shifted from *they* to $there_1$ in (123b), the follow-up sequence utterance (123c) and (123d) is more coherent than (123c) and (123d′), because only in (123d) is the backward-looking center ($there_1$) also the highest-ranking forward-looking center. In (123d′), by contrast, the backward-looking center ($there_1$) is not the highest-ranked forward-looking center (*at least a couple more interesting artworks*), leading to a less coherent sequence.

(123) a. *The two competing but friendly phantom thieves*$_\mathbf{i}$ invite each other to dinner frequently.
b. *They*$_\mathbf{i}$ now think **there$_1$** is a stolen painting (hanging) **[$_{\mathbf{PP1}}$** in *each other*$_\mathbf{i}$*'s* dining room**]** several weeks after both expressed their interests in acquiring some of the artworks exhibited **[$_{\mathbf{PP2}}$** in the local museum**]**.

c. **There$_1$** in fact are several more stolen artworks they can recognize.
d. In the coming weeks, **there$_1$** probably will be at least a couple more interesting artworks, which they are looking forward to seeing.
d′. ?In the coming weeks, at least a couple more interesting artworks will probably be displayed **there$_1$**.

In this discourse again, *there*$_1$ in all sentences crucially keeps referring to the locative PP$_1$ appearing in (123b) with the anaphor *each other*$_{\mathbf{i}}$ interpreted there referring to *They*$_{\mathbf{i}}$.

Finally, let us return to our analysis of expletive *it* as a proform anaphoric to a CP. A potential problem for this hypothesis was raised by one of the anonymous reviewers, which in fact was discussed as early as McCloskey (1991). McCloskey noted that when coordinated clauses specify more than one distinct state of affairs, they exhibit plurality and can be referred to by a plural pronoun *they*, as in shown in (124).

(124) [[$_{\mathbf{CP}}$ That the president will be reelected **]** **and** **[**$_{\mathbf{CP}}$ that he will be impeached **]]** **are** equally likely at this point, but **they** can't both happen.

On the other hand, when we try to use *they* as the plural counterpart of the expletive *it* as in (125), the result is unacceptable.

(125) ***They** are equally likely [[$_{\mathbf{CP}}$ that the president will be reelected **]** **and** **[**$_{\mathbf{CP}}$ that he will be impeached **]]**.

Since the approach proposed in the current work does not discriminate expletives from "regular" anaphoric items, this asymmetry is unexpected.

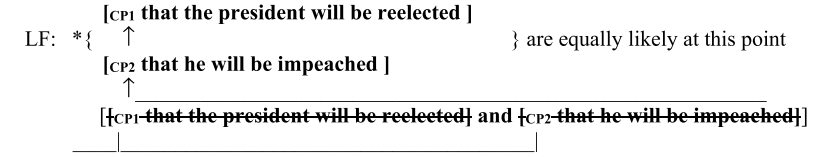
We believe that the key to understanding the problem here lies in the way the coordinated CPs are interpreted. In particular, the plurality arises in (124) and (125) from the aggregation of coordinand CPs rather than the collectivity of the entire coordinate structure. That is, individuality of each coordinand CP is maintained there. The plural pronoun *they* in each of these examples, in other words, is anaphoric to both of the coordinand CPs rather than the entire coordinate structure, similar to the familiar case of "split antecedents" involving nominals, as indicated by the coindexation in (126a and b).

(126) a. [[$_{\mathbf{NP1}}$ **Michael Jordan** **]** and **[**$_{\mathbf{NP2}}$ **LeBron James** **]]** are perhaps two of the most well-known players in the history of NBA, and coincidentally **they$_{\mathbf{1+2}}$** were both named after *an* uncle.
b. [[$_{\mathbf{CP1}}$ **That the president will be reelected** **]** and **[**$_{\mathbf{CP2}}$ **that he will be impeached** **]]** are equally likely at this point, but **they$_{\mathbf{1+2}}$** can't both happen.
c. ***They$_{\mathbf{1+2}}$** are equally likely at this point [[$_{\mathbf{CP1}}$ **that the president will be reelected** **]** and **[**$_{\mathbf{CP2}}$ **that he will be impeached** **]]**.

Note the singular expression "named after an uncle" in (126a), which clearly suggests that the individuality of each antecedent NP/DP is retained. The question then can be restated – why are split antecedents permitted in (126b) but not in (126c)?

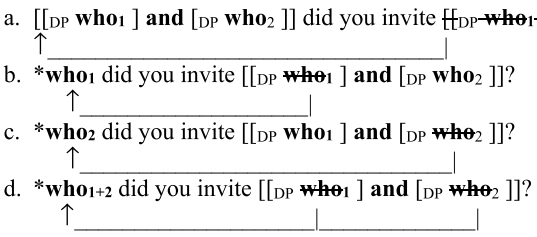
Here, if we adopt the syntactic analysis of expletive *it* mentioned in footnote 26 and assume that the expletive *it* covertly attracts its associate CP at LF in order to remedy the potential BT(C) violation (Kitagawa 1995), we can find an answer to this question. Under this analysis, the pronoun *They*$_{1+2}$ in (126c) above, for example, attracts both of the two coordinand CPs as illustrated in (127).[46]

(127)



As has been discussed repeatedly in the literature since Ross (1967) and illustrated in (128) below, however, extraction of any coordinand out of a coordinate structure is known to be quite restricted.

(128)



We can, in other words, assimilate the problem in (126c) to that observed in (128) adopting the covert CP-attraction analysis as illustrated in (127).[47] In short, the contrast between (124) and (125) does not necessarily constitute a counterargument to our analysis of the expletive *it* as a proform anaphoric to a CP.

Appendix F: More on the interaction of ϕ-significations

What we recognize as ϕ-signifiers (= those aspects of cognizable form that connect our minds to concept) are limited to notions that are meaningful and interpretable in

[46] It is not clear how exactly the split antecedents after covert attraction should be represented at LF. We tentatively represent them on top of each other as in (127), inheriting the tradition started by Williams (1978).

[47] Presumably, the expletive *it* as in (ia) below involves covert attraction of the entire coordinated CP as in (ib) and is free of this problem just as the movement of the entire coordinated NP is possible in (128a).

(i) a. **It** seems equally likely at this point **[CP that the president will be reelected and that he will be impeached]**.

b. LF: **[CP that the president will be reelected and that he will be impeached]** seems equally likely at this point ~~[CP that the president will be reelected and that he will be impeached]~~.

sensorimotor performance, and the logical anchorings we recognize are those semantic relations that are the core interpretations (thematic, modal, and informational) of the main components of utterances (predicates and clauses).

How exactly individual ϕ-signifiers interact with one another in individual languages, however, may vary. For example, we observed in Sect. 4.7 that Loc-signification and Morph-signification compensate for each other in Korean in such a way that one of them is called for when the other is not available, as illustrated in (72).

(72) a. Jina-ka **mwue(s)**-{**ul**/∅} ilk-ess-ni?
Jina-NOM **what**-{**ACC**/∅} read-PAST-Q
'What did Jina read?'

b. **mwue**(s)$_1$-{**ul**/*∅} Jina-ka t_1 **ilk**-ess-ni?
what-{**ACC**/*∅} Jina-NOM | **read**-PAST-Q
↑_____|

As an anonymous reviewer points out to us, the phenomenon known as differential object marking (DOM) may also represent an interesting case of the interaction of these two methods of ϕ-signification. DOM is widespread, found in languages like Hebrew, Romanian, Sakha, Sinhalese, and Turkish, among others, as has been discussed by many researchers, e.g., Gair (1970), Givón (1978), Bossong (1985), Aissen (2003), Baker (2015), to name only a few. In Hebrew, for instance, object case-marking is obligatory but is limited to definite objects (Givón 1978). (129a) below therefore is ungrammatical without *'et-* while (129b) is ungrammatical with it.

(129) a. Ha-seret her'a ***('et-)**ha-milxama.
the-movie showed **ACC**-the-war
'The movie showed **the** war.'
b. Ha-seret her'a **(*'et-)** milxama.
the movie showed **ACC**-war
'The movie showed **a** war.'

The phenomena here may create the impression that neither Loc-signification nor Morph-signification is capable of functioning as an appropriate method of ensuring the correct thematic anchoring, and hence that our hypothesis on ϕ-signification is not tenable. This, however, is not the case when we scrutinize the way the proposed ϕ-signification methods interact with each other supplemented by additional grammatical factors. DOM, in fact, presents an excellent case to demonstrate this point.

In analyzing the Hebrew data as in (129), Keenan (1976) submits the view that animacy and definiteness are unmarked properties for subjects but are marked properties for objects. Aissen (2003: 437–438) then summarizes the recurring intuition on DOM in the literature – those direct objects that most resemble typical subjects and are most in need of being distinguished from subjects become overtly case-marked. That is, the function of DOM is to disambiguate subject from object with overt morphological marking (cf. the discussion on "dependent case" at the end of Appendix B). We may interpret this situation as the required addition of Morph-signifier to Loc-signifier for thematic anchoring when the head of the (NP or DP) object is selected into the Numeration (cf. footnote 28). In Hebrew, it is the definiteness of the object that requires

the introduction of ACC-marking as a Morph-signifier. Here, we observe the interdependence of Morph- and Loc-signification just as in the Korean examples in (72) above. The only and crucial difference between the two cases is that what requires Morph-signification is absence of Loc-signification in Korean while it is insufficiency for ambiguity resolution in Hebrew.[48]

Appendix G: Loc-signification for informational anchoring

The *informational anchoring* and its ϕ-signification of a sentence works more or less in the same way as the modal anchoring and its ϕ-signification described in Sect. 4.4. When a(n already modal-specified) sentence involves information packaging like focus and/or a marked speech act like interrogation, it contains an item whose ordinary value is yet to be defined. It therefore must be anchored to an appropriate higher operator head like $\varnothing_{\text{FOCUS}}$ and $\varnothing_{\text{WH-QUESTION}}$ (or possibly their amalgam $\varnothing_{\text{WH-Q/FOC}}$). In *wh*-interrogation, for example, Beck (2006), following Hamblin (1973), assumes that a *wh*-phrase denotes a set of possible constituent answers. She then hypothesizes that the Hamblin denotation is the focus value of a *wh*-phrase (in the sense of Rooth 1992), and its ordinary value is undefined. A clause that contains a *wh*-phrase therefore lacks an ordinary value until it is anchored to a Q operator ($\varnothing_{\text{Wh-Q/FOC}}$), which is introduced later in the bottom-up derivation. In other words, the role of a Q operator is to elevate the focus value of its sister constituent to its ordinary value. It then makes sense that the *wh*-phrase is selected as the item to be placed at the periphery of a sentence to Loc-signify the adjacency between the informational anchor and its interpretive domain for their local anchoring. Such a parallel ϕ-signification role played by a subject and a *wh*-phrase leads us to the view that overt movement, both A-movement and A′-movement, is induced when there is a need to Loc-signify *modal anchoring* or *informational anchoring*, respectively, appealing to the item at the sentence-periphery. Again, there is no need to appeal to an EPP feature or a case feature.

Similarly, a *wh*-interrogative sentence in English as in (130) below is derived when the "signifier–signified" pairings of the *wh*-word and the head of FINP are specified as in (131) at the Numeration.

(130) I wonder $\varnothing_{\text{wh-Q/FOC}}$ [FINP **what**$_1$ $\varnothing_{\text{FIN}}$ you liked **t**$_1$ most].(=(62))

(131) a. *what*:
[Subjacency to $\varnothing_{WH\text{-}Q/FOC}]_{\phi}$ - [*wh*-interrogative/focus]$_{\text{L}}$

b. $\varnothing_{\text{FIN}}$:
[Overt *wh*-phrase's subjacency to $\varnothing_{WH\text{-}Q/FOC}]_{\phi}$ - [FINP's informational anchoring to $\varnothing_{WH\text{-}Q/FOC}]_{\text{L}}$

When the *wh*-phrase is dislocated to the periphery of the clause, its subjacency to the higher head $\varnothing_{WH\text{-}Q/FOC}$ Loc-signifies the informational anchoring of the *wh*-phrase to

[48] DOM is known to involve a certain amount of gradience and fuzziness in some languages. Aissen (2003) argues that this can also be treated in a formal way under Optimality Theory.

the question and focus properties at LF.[49] This informational anchoring elevates the focus value of the *wh*-phrase to the ordinary value and saturates the FINP containing it.[50]

Note that if *what* in (130) is specified in the Numeration as in (131a), it cannot remain in-situ but has its own motive to move to the periphery of FINP. When the newly derived FINP is merged with $\varnothing_{WH\text{-}Q/FOC}$, the required Loc-signification comes to be achieved. Once again, no "tucking-in" is necessary for this movement as long as the Loc-signification as an output condition comes to be eventually satisfied at the interface-oriented syntactic representation ϕF.[51]

Appendix H: Prosod(ic)-signification

Another type of ϕ-signifier is what we call a Prosod(ic)-signifier, which superimposes prosodic/suprasegmental information on relevant syntactic entities in order to achieve interpretive anchorings. Although we will not pursue this topic in this work, we report here some phenomena that can be analyzed as involving Prosod-signification.

First, Yoon and Kitagawa (2018) observe that when the object is scrambled away from the verb in a Korean sentence, it needs to be marked with -(*l*)*ul* 'ACC', as shown in (132a) below. That is, its Morph-signification is required, in our terms.

(132) a. **mwue**(s)$_1$-{**ul** /***∅**} Jina-ka t_1 **ilk**-ess-ni?
what-{**ACC** /***∅**} Jina-NOM **read**-PAST-Q
'What did Yuna read?'

b. *mwo**UE**$_1$-**∅**$_{ACC}$* (//) Jina-ka t_1 **ilk**-ess-ni?
what-∅$_{ACC}$ Yuna-NOM **read**-PAST-Q

Then, they notice that this requirement can be relaxed if the scrambled object is accompanied by what they call "Compensatory Strengthening." As indicated in (132b), this prosodic pattern alters the usual *wh*-focus prominence (rise+fall) in Seoul Korean by lengthening the last syllable with a distinctive rising intonation indicated by an arrow, which may be optionally followed by a pause indicated by the slashes in parentheses. We can recognize this as a case of Prosod-signification that is compensating for the absence of Morph- and Loc-signification for thematic anchoring, and add the specification (iii) to the "signifier–signified" pairings in the Numeration in (73i and ii) repeated here as (133i and ii):

[49] See (70b-ii) in Sect. 4.7 for the definition of "subjacency."

[50] The matter of what particular lexical items are selected into the Numeration is not determined by purely grammatical factors alone but by various extragrammatical factors like register and style as well – as in the selection of *angry*, *mad*, or *pissed off*. As such, Numeration can and should be regarded as an interface between the computational component (lexicon and syntax) of the minimalist grammar and other cognitive systems. Since information packaging, i.e., how we convey a message rather than what we convey, is also determined partly by extrasyntactic factors like discourse and pragmatics, we consider that Numeration is the appropriate level for the introduction of "signifier–signified" pairing concerning information anchoring as in (131).

[51] Yoon and Kitagawa (2018) take another step and claim that overt syntax should be completely separated from covert syntax, characterizing it as an "interface syntax" triggered solely by sensorimotor factors.

(133) *mwues* 'what':

(i) [ACC-particle –(*l*)*ul*]$_{\phi}$ - [Internal θ]$_{\text{L}}$ (Morph-signification)
(ii) [Cojacency to V]$_{\phi}$ - [Internal θ]$_{\text{L}}$ (Loc-signification)
(iii) [Compensatory Strengthening]$_{\phi}$ - [Internal θ]$_{\text{L}}$ (Prosod-signification)

Yoon and Kitagawa (2018) also present a case of sound-meaning association in the *wh*-interrogatives of Japanese, which has been observed by scholars such as Tomioka (1997), Deguchi and Kitagawa (2002), and Ishihara (2003), among others. As illustrated in (134) below, the scope interpretation of an embedded *wh*-phrase can be disambiguated prosodically.

(134) a. **Subordinate** *wh*-scope:
[**DO** **'no** ri'kisi-ga ka'tta-**ka**]
which sumo.wrestler-NOM won-**COMP$_{\text{Wh}}$**
kiNINARIMA'su-**ka**↑?
anxious.to.know-**COMP$_{\text{Y-N}}$**
'Are you anxious to know [**which sumo wrestler** won]?'

b. **Matrix** *wh*-scope:
[**DO** **'no** ri'kisi-ga ka'tta-**ka**]
which sumo.wrestler-NOM won-**COMP$_{\text{Whether}}$**
kininarima'su-**ka**↑?
anxious.to.know-**COMP$_{\text{Wh}}$**
'**Which sumo wrestler$_1$** is it that you are anxious to know
[*whether* **he**$_1$ won]?'

(adopted from Kitagawa and Hirose 2012: 619)

In Tokyo Japanese, "*wh*-focus prosody" adds pitch prominence to the *wh*-phrase (capitalized in a box) and let it be followed by significant pitch-range compression (underlined small fonts) up to the interrogative COMP (*-ka*) with which the *wh*-focus is interpretively associated. Thus, when this *wh*-focus prosody terminates at the end of the subordinate COMP as in (134a), the subordinate *wh*-focus scope interpretation arises. If it continues to the end of the matrix COMP as in (134b), the matrix scope arises. Characterizing this prosodic pattern as Prosod-signifier of informational anchoring allows us to naturally capture the observed direct correlation between sounds and meanings. It permits us to predict correctly that if an identical *wh*-in-situ sentence in (135a) and (135b) is accompanied by the reversed *wh*-focus prosody, each sentence would either be assigned an incorrect *wh*-scope interpretation or each intended scope interpretation is felt to be accompanied by a confusing intonation. Such phenomena, on the other hand, would otherwise pose a challenging problem to a conventional generative model of grammar, which does not permit PF and LF to be directly compared with each other. The Prosod-signification of *wh*-interrogative interpretations like this also presents an interesting crosslinguistic variation – the ϕ-signification of *wh*-interrogation (= interrogative foci) is achieved by Loc-signification in English as in (62) but by Prosod-signification in Japanese as in (134).

Even in English, in fact, Prosod-signification is observed, often as a supplementary means of ϕ-signification. For example, prosodic prominence as in (135) below has

long been discussed in the literature as a means to indicate focused items (Chomsky 1970; Jackendoff 1972; Bolinger 1965; Pesetsky 1987, among others).

(135) a. John eats **SÚ**shi, though he doesn't generally eat fish.
b. I need to write down **WHÓ** bought **WHÁT** so that I can reimburse the cost correctly.

Appendix I: On *pro*

In Sect. 5, we provided preliminary analyses of PRO and trace under the physical–logical synchronization approach, and pointed out that the absence of phonetic contents in the form of an empty subject may have the potential to signal the absence of a local modal anchor just as the presence of an overt subject in a designated location or form signals its presence. We hope that such an idea may open a new window into the study of empty arguments.

The interpretation and the surrounding environments of what is often identified as pro, on the other hand, is much more variant and rather clearly distinct from those of PRO. Their interpretations do not necessarily require anaphoric dependency to an element in a higher clause. Although we cannot offer a full-scale analysis of pro, we will attempt to provide some preliminary remarks on a possible way it can be analyzed in the approach developed in the present work.

In the case of the so-called null-subject (or pro drop) languages like Italian, its cooccurrence with an obligatory rich inflection on the verb as in (136) suggests a relation to the notion of Morph-signification. (See our brief discussion on agreement inflection as a possible Morph-signifier toward the end of Appendix C.)

(136) Italian:
a. __ parl**o**. 'I speak.'
b. __ parl**i**. 'You speak.'

On the other hand, the ϕ-signification involved in the use of zero pronouns (Kuroda 1965) in languages like Japanese, Korean, and Chinese is not at all clear, even though they also are often categorized as pro in the literature. A zero pronoun may appear as an argument in virtually any position in the sentence, and virtually no verbal agreement is indicated morphologically in its surroundings. For example, a zero pronoun may replace any of the arguments in (137) below, as indicated by [**e**] in (138a–c), and their interpretations can be sought in the discourse.

(137) [Preceding Discourse: Generally, people eat sushi only once in a while at the cafeteria, but John always eats sushi there.
(普通の人は、寿司はたまにしか食べないでしょ？ でも、ジョンはいつも寿司を食べます。)]
John$_1$-wa kinoo-mo **susi$_2$-o** tabeta-mitai.
John-TOP yesterday-also sushi-ACC ate-seem
'It seems that John ate sushi again yesterday.'

(138) a. **John$_1$-wa** kinoo-mo [**e**$_2$] tabeta-mitai.
John-TOP yesterday-also ate-seem
b. [**e**$_1$] kinoo-mo **susi$_2$-o** tabeta-mitai.
yesterday-also sushi-ACC ate-seem
c. [**e**$_1$] kinoo-mo [**e**$_2$] tabeta-mitai.
yesterday-also ate-seem

Apparently, these zero pronouns need to be treated differently from the pro in Romance languages. If we consider that [**e**$_2$] appears in-situ as indicated in (138a), it is cojacent to the predicate *tabe* 'eat' and properly Loc-signified to be interpreted as its internal argument. Here, rather paradoxically, the absence of phonetic contents in the expected position of an internal argument in fact may be physically signaling the need for thematic anchoring in that position in these languages.[52]

Alternatively or additionally, we may follow Huang (1984) and analyze [**e**]'s in (138a–c) as variables left behind by the movement of empty topic operators to the clause-initial position, as in (139a–c) below.

(139) a. **OP$_2$TOP** John$_1$-wa kinoo-mo [**e**$_2$] tabeta-mitai.
John-TOP yesterday-also ate-seem
b. **OP$_1$TOP** [**e**$_1$] kinoo-mo susi$_2$-o tabeta-mitai.
yesterday-also sushi-ACC ate-seem
c. **OP$_1$TOP OP$_2$TOP** [**e**$_1$] kinoo-mo [**e**$_2$] tabeta-mitai.
yesterday-also ate-seem

In these analyses, zero pronouns are claimed to be reducible to zero topics and the preposed empty topic operators are hypothesized to acquire their referents from the discourse (or pragmatics). Then, OP_{2TOP}s come to be thematically anchored to the internal θ-role of the verb at LF by way of the variables they bound. OP_{1TOP}s as the clause-initial topicalized subject (to be interpreted as utterance center), on the other hand, presumably are physically signifying the TP's modal anchoring to worlds and times compatible with the information modality of FIN. Yoshida (2004) argues that the clause-initial position of the preposed OP_{TOP}s can be verified when a particle-stranding ellipsis observable in recent colloquial Japanese applies as in (140a and b).

(140) [Preceding Discourse: I heard that all other people ate sushi yesterday. Did John also eat sushi again?
(昨日は、他のみんなも寿司を食べたって聞いたけど、やっぱりジョンも寿司を食べた？)]
a. **OP$_1$TOP-*wa*** [**e**$_1$] susi-o tabe-nakatta-ndesuyo.
sushi-ACC ate-NEG.PAST-COP
'As for John, he didn't eat sushi.'
b. **OP$_2$TOP-*wa*** John$_1$-wa [**e**$_2$] tabe-nakatta-ndesuyo.
John-TOP ate-NEG.PAST-COP
'As for sushi, John didn't eat it.'

[52] Recall our discussion on the asymmetry of thematic anchoring involving internal arguments and that involving external arguments at the end of Appendix B.

Although it is not clear if all instances of zero pronouns can be analyzed as involving zero topics, this analysis can be reasonably applied to at least some of them, and provides us with a potential way to identify how physical–logical synchronization is carried out for zero pronouns.[53] In short, the field is yet to know the exact identity of the entity that has been uniformly labeled as pro, which in fact seems heterogeneous, and it is as yet unclear exactly what calls for its presence in a sentence. The fuller investigation of this topic certainly must be left to future research.

Declarations

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[53] See Yoshida (2004) for further discussion of Huang's (1984) approach when it is combined with particle stranding ellipses.

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