Asymmetric T-to-C movement in ATB constructions

A PF deletion analysis

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I argue in this paper that across-the-board movement constructions are derived by applying deletion to a full sentential coordinate structure in PF. The relevant properties of the deletion operation in question can be summarized by its sensitivity to the periphery (or edge) and its insensitivity to constituency (i.e., it is based on linear order), which I take to indicate that it is a PF phenomenon. Based on this, I show that a previously unnoted phenomenon, which I call *asymmetric T-to-C movement*, is best explained by the PF deletion analysis of ATB constructions, while it is problematic for other approaches.

1. Introduction

The structure and derivation of across-the-board movement constructions (henceforth, ATB constructions), as in (1), are one of the perennial issues that has consistently received attention over the past several decades.

(1) Who will John like and Mary dislike?

Various mechanisms have been put forward in the literature, such as conjunction reduction (Chomsky 1957; Ross 1967), deletion (Tai 1969; van Oirsouw 1987; Wilder 1994, 1997), factorization (Williams 1977, 1978), three dimensional representation (Goodall 1983, 1987; Moltmann 1992), null operator movement (Munn 1993), sideward movement (Hornstein & Nunes 2002), and multi-dominance (Citko 2005), among others.

In this paper, I argue that there is reason to believe that a deletion approach to ATB constructions is the desirable one. Specifically, I suggest that ATB constructions are derived by applying deletion in PF to a full sentential coordinate structure. Based on this, I discuss a previously unnoted phenomenon, which I call *asymmetric T-to-C movement* that provides support for the PF deletion analysis. It is also shown that the current analysis sheds light on the nature of head movement. Especially, the current analysis provides support for the recent claim that head movement is a PF phenomenon (Boeckx & Stjepanović 2001; Chomsky 2000, 2001).

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This paper is organized as follows: in section 2, I briefly summarize two previous analyses of ATB constructions – namely, the parallel movement analysis and the multi-dominance analysis; in section 3, I describe the properties of the PF deletion operation in question. I will focus on its sensitivity to the notion of edge and its insensitivity to constituency; in section 4, I introduce the phenomenon of asymmetric T-to-C movement; in section 5, I provide an analysis of asymmetric T-to-C movement based on the PF deletion analysis of ATB constructions; in section 6, I discuss some remaining issues; section 7 concludes.

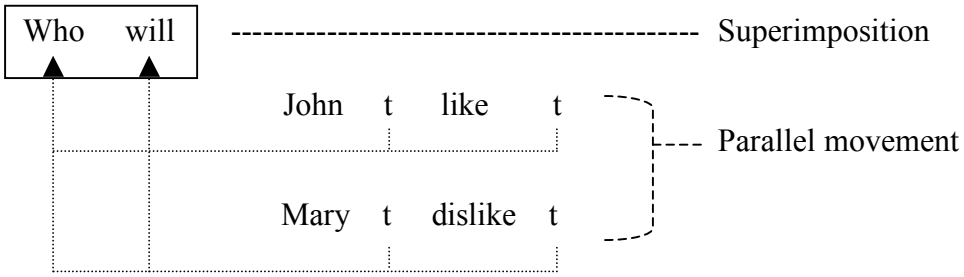
2. Previous analyses

In this section, I will very briefly discuss two previous analyses of ATB constructions – namely, the parallel movement analysis and the multi-dominance analysis.[1]

2.1. Parallel movement analysis

The gist of the parallel movement analysis is that sentences like (1) are derived via parallel movement followed by some kind of "superimposition" process that is made possible by the identity of the moved elements. This is illustrated in (2).

(2)



This line of analysis is pursued by Williams (1978), Goodall (1983), Burton & Grimshaw (1992). The immediate question that arises is: what is this superimposition process? While the idea of superimposition is plausible, postulating such an operation would be nothing more than a restatement of the facts. In addition, as Wilder (1997) points out, the superimposition operation (or the ATB formalism, to be more precise) is apparently only needed in ATB constructions, which makes it desirable to eliminate it and derive the relevant sentences in a more natural way.

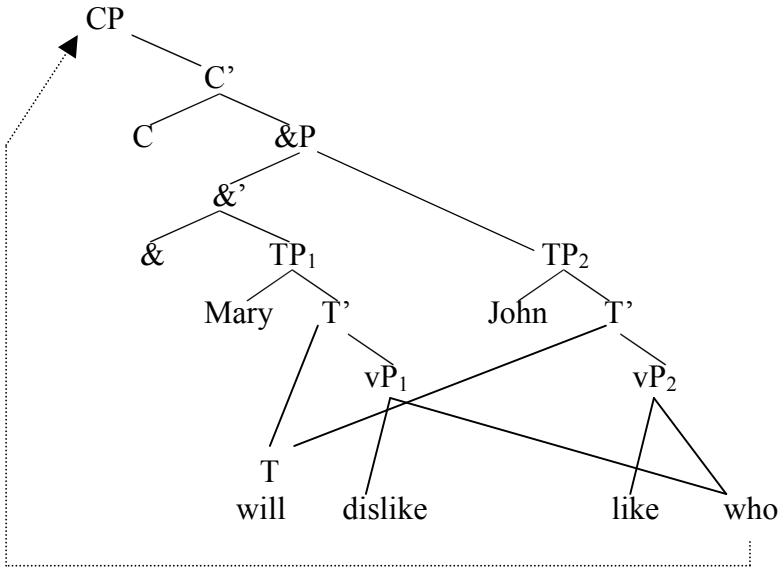
[1] For reasons of space, I have chosen to include only these two analyses here because the former seems to be the most straightforward one and the latter the most recent one in the literature. This selection does not imply the superiority of these over others that are not discussed. Regarding these, see the references cited above. In any case, I would like to mention that the data discussed below also pose a problem for them as well.

Note also that the analyses described here are only intended to capture the intuition behind the analyses proposed by the authors cited in the text and is not to be taken as literal reproduction of their work. Needless to say, the original proposals of these authors are more sophisticated than this. For instance, Williams (1978) proposes an elaborate system of factorization, not the simplistic superimposition rule shown in (2), that allows identical elements to undergo ATB movement. However, these details do not matter for the current purposes.

2.2. Multi-dominance analysis

Citko's (2005) multi-dominance analysis of ATB constructions is based on a very precise interpretation of the phrase structure building process in the minimalist program. The gist of Citko's analysis is that the element that undergoes ATB movement is shared when it enters the structure.[2] Consider (3). (Irrelevant details are omitted.)

(3)



Citko points out that there is nothing inherent in the system that prohibits an element from being dominated by multiple mother nodes, though such a structure often leads to a crash due to violations of other independent principles – in particular, linearization. However, once the linearization issue is resolved, a multi-dominance structure can in fact be sanctioned (up to other principles) and, according to Citko, this is exactly what is happening in ATB constructions. For instance, since *who* in (3) is contained in TP_2 that occupies Spec&P, it must precede everything contained in TP_1 that occupies the complement position of &P. However, since *who* appears in the complement position of vP_1, it must also follow everything in TP_1. Therefore, there is a contradiction. However, if *who* moves to SpecCP, the ordering contradiction disappears, since in that position, *who* can precede everything.

While this analysis captures several properties of ATB constructions (see Citko 2005 for further discussion), it also seems to induce some complications. For instance, note that if an element undergoes ATB movement, it must have been shared at some earlier point. Given this, note that in (1), *will* also undergoes ATB movement. This then leads us to assume that it is multi-dominated by TP_1 and TP_2, which requires the auxiliary to project two maximal categories simultaneously. The system also appears to complicate the feature checking system. For instance, in (3), *who* has to check accusative Case feature (and also theta-role) with both vP_1 and vP_2. Reversely, the nominative Case (and/or the EPP) feature of the shared T would have to be checked by two DPs in $SpecTP_1$ and $SpecTP_2$.[3]

[2] In some sense, this is a mirror image of the parallel movement analysis. That is, in the multi-dominance system, superimposition takes place before movement.

[3] Note that English does not allow multiple nominative constructions.

3. Deletion in coordinated structures

In this section, I outline the analysis of ATB constructions proposed in this paper. The crucial idea is that ATB constructions underlyingly involve a full sentential coordination and that it is subsequently reduced to give the surface ATB format. In particular, I argue that the relevant operation that reduces the underlying sentential coordination is a PF deletion process that is based on linear order. The main goal of this section is to suggest that such a PF deletion process, which I will call *Coordinate Deletion* for convenience, is independently required to capture certain aspects of sentences involving coordination. As a preview of the current analysis, derivation of ATB sentences like (1) can be represented as in (4).

(4) [$_{CP}$ Who does John like] and [$_{CP}$ ~~who does~~ Mary dislike]

Here, *who does* in the second conjunct is deleted under identity with the corresponding elements in the first conjunct.[4] This line of analysis of ATB constructions has actually been proposed in the literature in various forms (Chomsky 1957; Ross 1967; Tai 1969; Van Oirsouw 1987; Wilder 1994, 1997). The current analysis can therefore be considered a reinterpretation of these studies in more updated minimalist terms.

Below, in section 3.1 and 3.2, I will discuss two properties of Coordinate Deletion that are relevant for our current purposes: its sensitivity to periphery and its insensitivity to constituency. Then, in section 3.3, I will provide empirical evidence in support of the current analysis.

3.1. Sensitivity to periphery

Coordinate Deletion is sensitive to periphery. What this means is that the element deleted should appear in the peripheral position or edge of the relevant portion of the structure. Furthermore, if an edge element is deleted, then the next element adjacent to the deletion site is considered to be peripheral and is subject to further deletion (up to other constraints such as identity). This is illustrated by (5).

(5) a. [~~X~~ Y Z …]
b. [~~X~~ ~~Y~~ Z …]
c. * [X ~~Y~~ Z …]

In (5a), X can be deleted, since it occupies the periphery. As shown by (5b), after deletion of X, Y can also be deleted, since it is now the peripheral element. However, in environments like (5c), deletion of Y is not allowed, since it does not occupy the peripheral position.

[4] Basically, I adopt the traditional notion of 'deletion under identity'. However, the question of how to define the notion of identity is a very complicated issue, which I will not be able to discuss here. See Sag (1976), Neijt (1980), Dyła (1984), Franks (1993), Munn (1993), Wilder (1994, 1997), Johannessen (1997), among others, for relevant discussion.

3.2. Insensitivity to constituency

Note that under the analysis sketched in (4), repeated below as (6), the deleted materials do not form a constituent.[5] That is, in (6), Coordinate Deletion targets SpecCP and C, which are not a constituent.

(6) [$_{CP}$ Who does John like] and [$_{CP}$ ~~who does~~ Mary dislike]

Den Dikken, Meinunger & Wilder (2000) argue independently that Pseudocleft constructions, such as (7), are also derived by applying PF deletion to an underlying full sentential form, which is exactly like the current analysis of ATB constructions in relevant respects. The relevant derivation of (7) is illustrated in (8).

(7) What John bought was some wine

(8) What John bought was [~~he bought~~ some wine]

The point to note here is that just like (6), the deleted materials in (8) do not form a constituent.

3.3. Evidence for Coordinate Deletion

In this section, I provide empirical evidence in support of Coordinate Deletion. Consider the following data[6]:

(9) * Yesterday John ate like a pig and today Ø drank all the beer (Ø= John)

In (9), although *John* in the second conjunct satisfies the identity requirement, it cannot be deleted, since it does not occupy the edge of the second conjunct. However, once the adverb *today*, which occupied the peripheral position, is removed, it becomes possible to delete *John*, as shown in (10).

(10) John ate like a pig yesterday and Ø drank all the beer today (Ø= John)

It is also noteworthy that in (11), the gap must be understood as *yesterday John*, which is also predicted by the current analysis.

(11) Yesterday John ate like a pig and Ø was very sick (∅= yesterday John)

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[5] Note, however, that this does not necessarily mean that Coordinate Deletion does not have to target a constituent. It is in fact possible that Coordinate Deletion targets constituents, but applies cyclically. For instance, (6) may involve separate applications of Coordinate Deletion to SpecCP and, then, to C. It has to be borne in mind that the apparent insensitivity to constituency is a direct consequence of the edge-sensitivity property of Coordinate Deletion discussed in section 3.1.

[6] Some speakers find (9) not very bad. However, even for these speakers, there is a clear contrast between (9) and (i). That is, (9) is considerably worse than (i).

(i) Yesterday John ate like a pig and today he drank all the beer

To be fair, I would like to mention that although the English data in (9)-(11) are suggestive, it is not impossible to derive them without relying on Coordinate Deletion (though I will not dwell on the alternative derivations of (9)-(11) here). Therefore, I will present further data below that illustrate the relevant properties of Coordinate Deletion in a more striking way, providing strong support for the current analysis. The relevant data are from Korean. Consider (12).[7,8]

(12) [$_{CP}$ Masa-nun [$_{CP}$ Ana-ka ppang-ul mekess-tako] ~~malhayssta~~] kuliko
M-TOP A-NOM bread-ACC ate-COMP said and
[$_{CP}$ Natasha-nun [$_{CP}$ Ana-ka bap-ul mekess-tako] malhayssta]
N-TOP A-NOM rice-ACC ate-COMP said
'Masa (said) that Ana ate bread and Natasha said that Ana ate rice.'

(12) involves a coordination of complex sentences. Here, the matrix verb of the first conjunct is deleted under identity. Note that the deleted verb in (12) occupies the periphery of the first conjunct. Next, consider (13).

(13) [$_{CP}$ Masa-nun [$_{CP}$ Ana-ka ppang-ul ~~mekess-tako~~] ~~malhayssta~~] kuliko
M-TOP A-NOM bread-ACC ate-COMP said and
[$_{CP}$ Natasha-nun [$_{CP}$ Ana-ka bap-ul mekess-tako] malhayssta]
N-TOP A-NOM rice-ACC ate-COMP said
'Masa (said that) Ana (ate) bread and Natasha said that Ana ate rice.'

In (13), the matrix verb and the embedded verb are deleted. Crucially, deletion of the latter is made possible as a result of deletion of the matrix verb. Compare (13) with (14), in which only the embedded verb is deleted, violating the periphery requirement.

(14)* [$_{CP}$ Masa-nun [$_{CP}$ Ana-ka ppang-ul ~~mekess-tako~~] malhayssta] kuliko
M-top A-nom bread-acc ate-comp said and
[$_{CP}$ Natasha-nun [$_{CP}$ Ana-ka bap-ul mekess-tako] malhayssta]
N-top A-nom rice-acc ate-comp said

The ungrammaticality of (14) corroborates the relevance of the periphery requirement discussed in section 3.1.

In (15), the domain affected by Coordinate Deletion is further extended. Note that although the embedded verb and the embedded object are not originally peripheral to the first conjunct, they can be deleted without any problems if Coordinate Deletion applies sequentially, from the most outer element to subsequently inner elements, as suggested earlier. Therefore, in the derivation of (15), we first apply deletion to the matrix verb, which makes the embedded verb

[7] Note that in Korean, the direction of deletion is opposite to that of English. That is, while English deletes elements in the second conjunct in the relevant contexts, Korean deletes elements in the first conjunct. Ross (1967, 1970) argues that this directionality correlates with the head parameter. That is, the direction of deletion is basically opposite to the direction of heads in the language. Therefore, in head-initial languages, deletion targets elements in the second conjunct, while it affects elements in the first conjunct in head-final languages. Although there are some exceptions to this generalization (see van Oirsouw 1987), this is sufficient for our current purposes.

[8] Below, I will parenthesize the words in English translation that correspond to the deleted items in the Korean sentence to make it easier for the reader to see which element is being affected by Coordinate Deletion.

the outermost element. Deletion of the embedded verb then induces the same effect on the embedded object, allowing further application of Coordinate Deletion.[9]

(15) [$_{CP}$ Masa-nun [$_{CP}$ Ana-ka ~~ppang-ul~~ ~~mekess-tako~~] ~~malhayssta~~] kuliko
M-TOP A-NOM bread-ACC ate-COMP said and
[$_{CP}$ Natasha-nun [$_{CP}$ Nina-ka ppang-ul mekess-tako] malhayssta]
N-TOP N-NOM bread-ACC ate-COMP said
'Masa (said that) Ana (ate bread) and Natasha said that Nina ate bread.'

The sentence in (16) is somewhat more complicated. Here, the object of the embedded clause is fronted.

(16) [$_{CP}$ Masa-nun [ppang-ul$_i$ ~~Ana-ka~~ t_i ~~mekess-tako~~] ~~malhayssta~~] kuliko
M-TOP bread-ACC A-NOM ate-COMP said and
[$_{CP}$ Natasha-nun [bap-ul Ana-ka t mekess-tako] malhayssta]
N-TOP rice-ACC A-NOM ate-COMP said
'Masa (said that) bread, (Ana ate) and Natasha said that rice, Ana ate.'

Regarding the position of the fronted object, note that the contrast in (17) and (18) shows that the object is still within the embedded clause. This is because it is impossible to place a matrix element after the fronted object.[10]

(17) a. Masa-nun na-ekey ppang-ul$_i$ Ana-ka t_i mekess-tako malhayssta
M-TOP I-DAT bread-ACC A-NOM ate-COMP said
'Masa said to me that Ana ate bread.'
b. * Masa-nun ppang-ul$_i$ na-ekey Ana-ka t_i mekess-tako malhayssta
M-TOP bread-ACC I-DAT A-NOM ate-COMP said
'Masa said to me that Ana ate bread.'

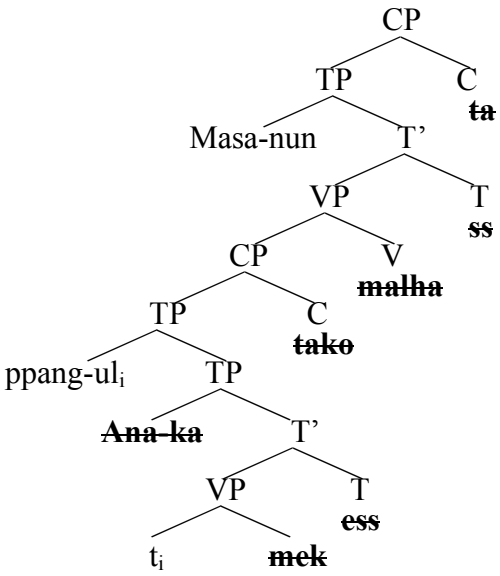
(18) a. Masa-nun kun sori-ro ppang-ul$_i$ Ana-ka t_i mekess-tako malhayssta
M-TOP big-sound-by bread-ACC A-NOM ate-COMP said
'Masa said loudly that Ana ate bread.'
b. * Masa-nun ppang-ul$_i$ kun sori-ro Ana-ka t_i mekess-tako malhayssta
M-TOP bread-ACC big-sound-by A-NOM ate-COMP said
'Masa said loudly that Ana ate bread.'

Given this, following the usual assumption, I assume that the fronted object in (16) is adjoined to the embedded TP. The relevant structure of (16) can be represented as follows:

[9] Note that in all these cases, deletion is possible only up to other constraints – in particular, identity.

[10] In (18), we are only concerned with the reading where *kun soriro* 'loudly' modifies the matrix predicate *malha-ta* 'say'. In fact, (18b) is good under the reading where *kun soriro* 'loudly' modifies the embedded predicate *mek-ta* 'eat', meaning something like 'to eat with loud noise'. We are not concerned with this reading.

(19)



Note that here, fronting of the object makes it possible to delete the embedded subject. In other words, the subject would not be adjacent to the deletion site if the object had not moved. This is illustrated by the ungrammaticality of (20) which is exactly the same as (16) but for the lack of object fronting.

(20) * [$_{CP}$ Masa-nun [$_{CP}$ ~~Ana-ka~~ ppang-ul ~~mekess-tako~~] ~~malhayssta~~] kuliko
M-TOP A-NOM bread-ACC ate-COMP said and
[$_{CP}$ Natasha-nun [$_{CP}$ Ana-ka bap-ul mekess-tako] malhayssta]
N-TOP A-NOM rice-ACC ate-COMP said
'Masa said that Ana ate bread and Natasha said that Ana ate rice.'

The crucial property to note in all the grammatical sentences in (12)-(16) is that in none of these sentences do the deleted items form a constituent. Furthermore, the data clearly illustrate the property of the periphery requirement and its transitive nature. Based on these pieces of evidence, I conclude that Coordinate Deletion is a PF process that is based on linear order.[11]

4. Asymmetric T-to-C movement

In this section, I will describe the properties of asymmetric T-to-C movement (henceforth, ATM). Recall that one of the preconditions for ATB movement is identity of the moving element. However, as I showed in An (2005a,b), there are cases of grammatical ATB constructions where the identity requirement is not met (see also Johannessen 1998 for similar cases). This is illustrated in (21).

(21) Who **does** <u>he</u> like and <u>they</u> hate?

[11] Cedric Boeckx (p.c.) raised the question of why the deletion process in the Korean examples applies from right to left, although it is argued to be based on linear order. While the exact nature of this directionality requires further investigation, I think this has something to do with the head parameter. See footnote 7.

Here, the subjects of each conjunct do not have the same agreement value, which entails that the relevant INFLs agreeing with these subjects will also be non-identical. Therefore, given the lack of identity, we expect that ATB T-to-C movement of INFL will be impossible. Indeed, it appears that parallel T-to-C movement is blocked here, since the INFL that appears in C is singular. That is, given that the subject of the second conjunct is plural, the singular INFL in C in (21) could not have originated from the second conjunct. Moreover, when there is such a mismatch, it is always the INFL of the first conjunct that is affected by T-to-C movement, as shown by (22) (see also Aoun, Benmamoun & Sportiche 1994, 1999 for similar cases).

(22) * Who **do** <u>he</u> like(s) and <u>they</u> hate?

In (22), INFL of the second conjunct is moved to C and the sentence is ungrammatical, regardless of what happens to the INFL of the first conjunct. If we switch the order between the first and the second conjunct in (21), we get the same pattern, as shown in (23).

(23) Who **do** <u>they</u> like and <u>he</u> hate**s**?

Here, the subject of the first conjunct is plural. As expected, a plural INFL must appear in C. Again, T-to-C movement out of the second conjunct is impossible.

(24) * Who **does** <u>they</u> like and <u>he</u> hate?

From this, I conclude that when there is a mismatch between INFLs, only the INFL of the first conjunct undergoes T-to-C movement. Hence, T-to-C movement here is asymmetric and is crucially not across-the-board.

In addition, (23) manifests another important property. Note that in the second conjunct, singular INFL is overtly realized on the verb. In fact, if INFL is not realized, the sentence becomes ungrammatical.[12]

(25) * Who do they like and he hate?

This shows that in ATM environments, it is not that INFL of the second conjunct just disappears, but that it has to be licensed independently. I assume that the same consideration applies to (21) as well, although it is not so obvious because it happens that plural agreement in English is phonologically null. In other words, the surface structure of (21) should be represented as follows, to be more precise:

(26) Who does he like and they hate+Ø

ATM can also be observed in yes-no questions, which is another environment that requires T-to-C movement.[13]

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[12] There is speaker variation regarding (23) and (25). I will discuss this issue in section 6.1.

[13] In yes-no questions involving ATM, the object has to be shared (i.e., identical across conjuncts). This can be achieved by applying Right Node Raising to the object. For some reason unknown to me, if the object is distinct, the sentence gets degraded.

(i) ?? Does he like the student from NY and they hate the student from CT?

However, this is a separate issue that does not concern us here.

(27) **Does** he like, and they hate, the student from Storrs?

(28) **Do** they like, and he hate**s**, the student from Storrs?

(29) **Has** John liked and the children adored these plays?[14]

Since the data in (27)-(29) manifest exactly the same behavior as the other ATM data examined above, I will not discuss them further.

To summarize, I have described in this section the properties of the previously unnoted phenomenon of ATM. I have shown that when there is a mismatch between INFLs, only the INFL of the first conjunct moves to C via T-to-C movement, while the one in the second conjunct has to be overtly realized on the verb within the second conjunct. One of the questions ATM data raise at this point is how asymmetric T-to-C extraction is possible, given the coordinate structure constraint in (30).

(30) Coordinate Structure Constraint (CSC)
In a coordinate structure, no conjunct may be moved, nor may any element contained in a conjunct be moved out of that conjunct. (Ross 1967)

Note, in addition, that it is very unclear how the grammaticality of the ATM data can be explained under the previous approaches to ATB movement. Apparently, there is no ATB movement of INFL here in the first place.[15] In other words, we have no room for applying superimposition or multi-dominance to the relevant INFLs here. Therefore, these analyses would need additional mechanisms. In the next section, I will argue that the deletion analysis of ATB constructions can account for the ATM data without any problem.

5. ATM by coordinate deletion and PF T-to-C movement

I show in this section that the deletion analysis of ATB constructions provides an account of the ATM data.

5.1. The nature of overt movement

Note that we are dealing here with an instance of overt head movement. Chomsky (1995:262-263) argues that overt movement in fact creates two separate chains. That is, a chain of formal

[14] (29), which is drawn from Aoun, Benmamoun & Sportiche (1994:218), is in fact somewhat different from other ATM data. I will return to this in section 6.1.

[15] Hagit Borer (p.c.) pointed out to me an interesting possibility. She suggests that the agreement value of INFL is not determined in syntax at all. Rather, it is determined in the morphological component. In other words, in syntax, there is an underspecified category, say, u-INFL, in T. Then, there is no mismatch between the relevant INFLs in ATM environments, and it is possible to apply T-to-C movement out of each conjunct in a parallel fashion, i.e., *symmetric* T-to-C movement. When the structure is sent to the morphological component later in the derivation, Φ-features of the closest subject, i.e., the subject of the first conjunct, will determine the agreement value of u-INFL that now appears in C.

While this idea seems reasonable, it cannot explain the data in (23), (25), and (28), where INFL has to be realized in the second conjunct. Therefore, I do not adopt the analysis here. See also section 6 for related discussion.

features (CH_{FF}) and a chain of phonological features (CH_{CAT}). Here, the latter step induces the effect of overt movement.[16] The rationale behind this proposal is considerations of economy of feature checking. Chomsky argues that when there is a need to check formal features (henceforth, {ff}), the most economical way of checking these features would be to move only the relevant {ff}. In other words, for purposes of {ff} checking, formation of a CH_{FF} is sufficient. However, Chomsky further notes that where {ff} movement takes place before Spell-Out, considerations of the phonological component require that a CH_{CAT} be created as well, i.e., phonological features (henceforth, {pf}) should also move. Chomsky suggests that this is because scattered features of a lexical item are illegitimate, i.e., unpronounceable, in PF.

However, notice that Chomsky does not explicitly say when a CH_{CAT} has to be created. It appears to me that, if formation of a CH_{CAT} is based on considerations of PF, it is reasonable (or, at least, should be possible) that the relevant operation takes place in PF. Given this, I assume that formation of a CH_{CAT} can in principle be done in PF.[17]

5.2. ATM under Coordinate Deletion

In this section, I will provide a step-by-step illustration of how an ATM sentence is derived under the current analysis. Recall that under the Coordinate Deletion analysis, an ATB wh-question is derived as follows:

(31) [$_{CP}$ Who does John like] and [$_{CP}$ ~~who does~~ Mary dislike]

Under this analysis, an ATM sentence like (23), repeated below as (32), will have the structure in (33) at some point in the derivation. (Irrelevant details are ignored.)

(32) Who do they like and he hates?

(33) [$_{CP}$ Who C+{ff} they {pf} like] and [$_{CP}$ who C+{ff} he {pf} hate]

Now, suppose that Coordinate Deletion applies to (33), deleting *who* and the C+{ff} complex that occupy the periphery of the second conjunct. This will result in (34).

(34) [$_{CP}$ Who C+{ff} they {pf} like] and [$_{CP}$ ~~who C+{ff}~~ he {pf} hate]

Then, in the first conjunct, {pf} of the plural INFL move to its {ff}, as shown in (35), which will eventually surface as *do* after *do*-support.

(35) [$_{CP}$ Who C+{ff}+{pf} they like] …

Now, the important question arises concerning the second conjunct in (34). Note that in the second conjunct, {ff} of the singular INFL are deleted. Therefore, it appears that we ended up with stranded {pf} here. Recall that Chomsky suggested that {pf} separated from their {ff} are illegitimate in PF. Why, then, is the sentence grammatical? I will answer this question in the next section.

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[16] This is called 'Generalized Pied-Piping' (Chomsky 1995).

[17] The system is often called the *Two Chain Hypothesis* (TCH). See Ochi (1999) for an extensive discussion of the TCH.

5.3. Affix-hopping in ATM

I argue that the reason why the derivation depicted in (34) is not ruled out is due to the nature of a lexical item involved in the derivation. Crucially, note that we are dealing here with INFL which is an affix in English. I think that it is reasonable to attribute the affixal property of INFL to its {pf}.

Given this, note that the {pf} in question are adjacent to the verb in (34). Therefore, under the standard assumption that affix hopping requires adjacency (Chomsky 1957; Lasnik 1995; Bobaljik 1994, 2002), it should be possible to apply affix hopping to the {pf} in question. Therefore, it is predicted that singular inflection will appear on the verb in the second conjunct, which is indeed the case, as we have seen earlier.

(36) … [$_{CP}$ ~~who C+{ff}~~ he hate+{pf}] → … he hate**s**?

Given the independently needed assumptions about affix hopping and overt movement, the deletion analysis of ATB constructions correctly captures the idiosyncratic properties of the phenomenon of ATM without introducing any additional assumptions. I will not discuss other grammatical instances of ATM, since it is easy to see how the current analysis applies to them.

Note that the current analysis makes interesting predictions. First, if it is correct that affix hopping takes place in the second conjunct, as shown in (36), then it is predicted that *do*-support will be triggered when there is negation in the second conjunct. The prediction is indeed borne out.

(37) Who **do** they like and he **does** not like? (cf. (23))

(38) Who **does** he like and they **do** not like? (cf. (21))

In (37) and (38), negation breaks adjacency between the {pf} of INFL and the verb. Therefore, *do*-support must apply, just like in normal negative sentences.

Second, it is predicted that if the element that appears in T in the second conjunct is not an affix, e.g., an auxiliary, then the sentence will be excluded, because we will not be able to apply affix hopping to save the stranded {pf}. In other words, the sentence will be ruled out because there will remain unpronounceable {pf}. This prediction is also borne out.

(39) * What are they arguing against and he **is** arguing for?

(40) * What is he arguing for and they **are** arguing against?

For instance, in (39), what occupies T is an auxiliary *be*, which is not an affix. After Coordinate Deletion, we will get the following configuration in the second conjunct:

(41) … [$_{CP}$ ~~what C+{ff}~~ he {pf_{BE}} arguing for]

Here, we cannot apply affix hopping, because the {pf} of *be* are not affixal. We cannot resort to *do*-support either, since the operation is reserved for affixes. Therefore, there is no way to

save the stranded {pf} in (41).[18,19] I present some more data below that pattern with (39) and (40). That is, a non-affixal auxiliary in the second conjunct leads to ungrammaticality.

(42) a. * What do they argue against and he will argue for?
b. * What do they argue against and he has argued for?
c. * What are they arguing against and he will argue for?
d. * What are they arguing against and he has argued for?

5.4. Summary

In this section, I have shown how the current PF deletion analysis of ATB constructions applies to the ATM data. It is shown that the current analysis captures the relevant properties of ATM without any additional assumptions.

Moreover, recall that the crucial question in section 4 was why there is no violation of the CSC in ATM environments. Under the current analysis, the question disappears, since there is no asymmetric extraction of T out of one conjunct in the first place, whereas previous analyses of ATB constructions must introduce additional assumptions to explain this.

In addition, it is important to notice that the crucial steps in the derivation of a grammatical ATM sentence, such as (34), (35), and (36), all take place in PF. Especially, in (35), movement of the {pf} of INFL that induces the effect of overt head movement, takes place in PF. In this respect, the current analysis provides empirical support for Boeckx & Stjepanović's (2001) and Chomsky's (2000, 2001) proposal that head movement is a PF phenomenon.[20]

6. Further issues

In this section, I will discuss some further issues and speculate on their implications.

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[18] Note that (39) and (40) provide a minimal pair with the ATM data examined above. Here, too, there is a mismatch between the elements in T with respect to their number features, and all else is equal. The only difference from the ATM data is that (39) and (40) contain a non-affixal T.

[19] The question arises why the following sentence is ruled out:

(i) * Who does he like and she hates?
(cf. Who does he like and she hate?)

Suppose that (i) undergoes the derivation depicted in (ii).

(ii) [$_{CP}$ Who C+{ff}+{pf} he like] and [$_{CP}$ ~~who C+{ff}~~ she {pf} hate]

If affix hopping applies to the stranded {pf} in the second conjunct, nothing seems to go wrong, contrary to fact. Compare this with the grammatical derivation in (iii).

(iii) [$_{CP}$ Who C+{ff}+{pf} he like] and [$_{CP}$ ~~who C+{ff}+{pf}~~ she hate]

I think there is a notion of maximality of deletion at work here, which I think derives from considerations of economy (den Dikken, Meinunger & Wilder 2000 also note the maximality-of-deletion effect in a different context). Note that I assume that both (ii) and (iii) are convergent at PF. However, (ii) is blocked since (iii) is shorter. That is, we need an additional operation in (ii), i.e., affix hopping. True, (iii) also involves an additional step of {pf} movement. But, it seems reasonable that PF can ignore it or, at least, consider it 'less costly' than affix hopping, since it is only a subcomponent of overt movement that was initiated earlier.

[20] See also Aoun & Benmamoun (1998) for a proposal that clitic left-dislocation in Lebanese Arabic is an instance of PF head movement.

6.1. Pseudo-ATM

It appears that there are some speakers (henceforth, the pseudo-ATM speakers) who accept the following variant of ATM:[21]

(43) Who do they like and he **hate**?

Compare this with the corresponding original ATM data repeated below. In fact, those speakers who accept (43) disallow (44).

(44) Who do they like and he hate**s**? (=(23))

Recall that in deriving the ATM data in (44), it was assumed that PF deletion applies before movement of the {pf} of INFL. Given this, let us suppose that for the pseudo-ATM speakers, the opposite is the case. That is, movement of the {pf} takes place before deletion. If this is the case, (43) must involve the following derivation:

(45) [$_{CP}$ Who C+ff+pf they like] and [$_{CP}$ ~~who C+ff+pf~~ he hate]

Note that after deletion, there is no stranded affixal {pf} in the second conjunct. Therefore, the analysis correctly captures the fact that the verb does not bear any agreement inflection in (43).

Notice that in applying deletion in (45), we are actually ignoring the number mismatch between the INFLs. I assume that for the pseudo-ATM speakers, number mismatch does not cause a problem in establishing identity for deletion (see also Wilder 1994, 1997 for relevant discussion). In this respect, Aoun et al.'s (1994:218) example in (29), repeated below as (46), is relevant.

(46) Has John liked and the children adored these plays?

Under the current analysis, (46) is derived as in (47).

(47) [Has John liked] and [~~have~~ the children adored] these plays?

Clearly, we are ignoring the difference between *has* and *have* in (47).

It is interesting to note that the speakers who accept the original ATM data in (44) (and disallow the variant in (43)) do not accept (46). What this means is that for these speakers,

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[21] Alan Munn (p.c.) pointed out this variation to me. However, the majority of my consultants accept the original ATM data and reject (43).

In addition, note that pseudo-ATM speakers also accept the following sentence, which is superficially identical to (21):

(i) Who does he like and they hate?

As pointed out earlier, this example does not immediately tell us anything on its own. That is, since plural agreement in English is phonologically null, we cannot easily tell where INFL is located in the second conjunct. However, the current analysis predicts that for the pseudo-ATM speakers, in (i), plural INFL will be in C, but not on the verb.

number mismatch leads to a failure of the identity requirement for deletion.[22] That is, deletion cannot target *have* in (47), since it is 'not identical enough' to its counterpart in the first conjunct to license deletion.

Given this conclusion, there seems to be an alternative way of capturing the difference between the ATM and the pseudo-ATM speakers without resorting to the relative ordering between deletion and {pf} movement. First, suppose that in principle, deletion can freely apply either before or after {pf} movement. Suppose further that speakers differ with respect to whether number mismatch between INFLs causes a problem for the identity requirement for deletion. That is, I suggest that there is a correlation between whether a speaker allows (pseudo-)ATM and whether number mismatch causes a problem for the identity requirement for deletion: a speaker who (or whose Coordinate Deletion mechanism, to be more precise) tolerates number mismatch will accept the pseudo-ATM data, while a speaker who does not tolerate number mismatch will produce the original ATM data.

Under these assumptions, let me briefly illustrate again how a (pseudo-)ATM sentence can be derived. Consider the derivational stage of (48) as in (49).

(48) Who do they like and he hates?

(49) [$_{CP}$ Who C+{ff} they {pf} like] and [$_{CP}$ $\boxed{\text{who C+\{ff\}}}$ he {pf} hate]

As discussed in the previous section, if deletion applies at this point, we correctly get the ATM sentence in (48) (after subsequent {pf} movement in the first conjunct and affix hopping in the second conjunct). Suppose, on the other hand, that deletion applies after {pf} movement.

(50) [$_{CP}$ Who C+{ff} they {pf} like] and [$_{CP}$ $\boxed{\text{who C+\{ff\}+\{pf\}}}$ he hate]

Here, if the speaker belongs to the ATM variety, deletion will fail, due to number mismatch. If the speaker belongs to the pseudo-ATM variety, deletion will take place without any problem and the result will be as in (43).[23]

If this is on the right track, then we do not need an explicit ordering between deletion and {pf} movement and the difference between the two speaker groups reduces to whether number mismatch matters for establishing identity or not.

6.2. Exceptions to the CSC

Previously, the question was raised why there were no violations of the CSC in the ATM environment. It is well-known that there are in fact systematic exceptions to the CSC, as shown by Culicover & Jackendoff (1997) and Postal (1998).

(51) a. That is the drug which$_i$ [athletes take t_i] and [become quite strong]
b. [How many dogs]$_i$ can [a person have t_i] and [still stay sane]?
c. The stuff which$_i$ [Arthur sneaked in] and [stole t_i]

[22] Note that for the speakers who allow ATM, even if the auxiliary in the second conjunct is allowed to stay in situ, the sentence will still be excluded due to the stranded {pf}, on a par with (39) and (40).

[23] The question arises why the derivation in (49) is not allowed for pseudo-ATM speakers. Regarding this question, see footnote 19.

Here, extraction only takes place from one of the conjuncts, while the sentence is still grammatical. Therefore, it appears that these sentences violate the CSC without any problem. However, there is a crucial difference between these and the ATM data. First, note that the data in (51) do not involve symmetric coordination. For instance, in (51a,c), the preceding conjunct stands in some kind of sequential or causal relation to the following conjunct. As a result, their order cannot be changed.

(52) * That is the drug which$_i$ [become quite strong] and [athletes take t_i]

In (51b), one conjunct represents a state of affairs that is unexpected given the state of affairs represented by the preceding conjunct. This is illustrated by the paraphraseability of *and* as *and nonetheless* (Goldsmith 1985; Culicover & Jackendoff 1997).

Crucially, none of these properties are observed with the ATM data. For instance, recall that the order between the conjuncts can be freely changed without affecting the grammaticality or meaning of the sentence. Therefore, I conclude that ATM is a genuine exception to the CSC (although there is actually no violation of the CSC under the current analysis).

6.3. Identity

In this subsection, I would like to briefly speculate on the question about identity conditions for Coordinate Deletion. In particular, an anonymous reviewer for ConSOLE asks how the current analysis would exclude the derivation in (53).

(53) * Who$_i$ does John like and ~~who$_k$ does~~ Mary dislike?

As indicated by the indices, the sentence is intended to be a question asking about two different persons, which is normally not what one gets from an ATB wh-question. In other words, ATB wh-questions (in fact, ATB sentences in general) require some kind of semantic identity of the ATB raised elements. Therefore, the question arises how this type of identity can be guaranteed under the current analysis, where ATB sentences are derived by PF deletion under morpho-phonological identity.

In essence, the question is how we would establish a connection or communication between LF and PF, as the reviewer also points out. It seems to me that there are several directions to explore (which can in fact be reduced to one under certain interpretation), although I cannot determine at this moment which direction would lead us to a more fruitful result. One possibility is to reconsider the nature of the computational system itself. Perhaps, a single output model, in the sense of Bobaljik (1995), might be relevant. Another way of allowing such a connection is pursued by Hankamer (1979) and Wilder (1997), for instance, where various identity conditions such as referential identity, contextual identity, or structural identity are examined and attempted to be directly incorporated into the licensing condition of deletion. Merchant (1999) postulates a syntactic ellipsis feature that mediates the connection between the two components in question. According to his proposal, this special feature is licensed in LF if certain semantic requirements are met. Moreover, the presence of the ellipsis feature on lexical items triggers deletion of that element in PF.

In any case, devising a precise notion of identity is a perennial question whose exact answer is known to be very elusive. I put aside this "real" question for future research.

7. Conclusion

In this paper, I have argued that ATB constructions are derived by applying deletion to an underlying sentential coordination. The current analysis can be considered a minimalist reinterpretation of the previous deletion approach that appeared in various forms at different times (Chomsky 1957; Ross 1967; Tai 1969; van Oirsouw 1987; Wilder 1994, 1997). In addition, I discussed a previously unnoted phenomenon of asymmetric T-to-C movement, where T-to-C movement apparently takes place out of only one conjunct in coordinated interrogative sentences, and showed that the deletion analysis successfully explains it. It was also pointed out that the current analysis provides evidence in support of the recent claim that head movement is a PF phenomenon (Boeckx & Stjepanović 2001; Chomsky 2000, 2001).

Before closing the paper, I would like to mention two questions (among others) that require further examination. First, recall that I suggested that {ff} of INFL move in syntax, while its {pf} can move in PF. However, it is somewhat unclear how the semantic features of INFL should be treated. There are at least three possibilities: they are moved with {ff} in the overt syntax; they are moved in LF; they stay in-situ. At this moment, I have no evidence in favor of one or another, especially, in the environment under investigation.

In addition, given that there appears to be no XP counterpart of ATM constructions and, also, given the usual interpretive properties of XP movement, it is unlikely that such a split movement system advocated in the current analysis (i.e., CH_{FF} in syntax and CH_{CAT} in PF) is available for maximal category movement. I speculate that the current state of affairs might be reflecting an inherent difference between XP and X^0 movement, though exactly how they are different requires further scrutiny. In this context, it is interesting to note that Grodzinsky & Finkel (1998) show that aphasic patients treat XP-chains and X^0-chains differently. Boeckx & Stjepanović (2001) point out further differences between XP and X^0 movement.

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