Linearizing Multidominance Structures[1]

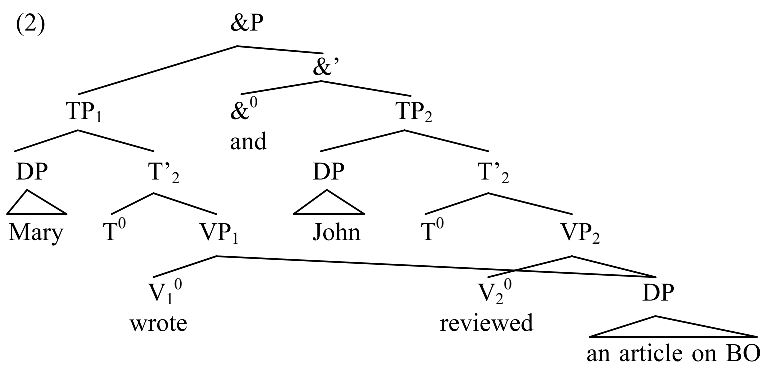
Martina Gracanin-Yuksek

1. Introduction

A multidominance (MD) structure is a structure where at least one node has more than one mother node. Sentences that involve Right-Node Raising (RNR), like (1), have been proposed to have an MD representation in (2), where the object DP *an article on Barack Obama* is simultaneously dominated by two mother nodes: VP_1 and VP_2 (Bachrach and Katzir 2006; Levine 1985; McCawley 1982; McCloskey 1986; Moltmann 1992; Muadz 1991; Wilder 1999). The multiply dominated DP is said to be *shared* between the two VPs and all the nodes that dominate them.

(1) *Mary wrote and John reviewed an article on Barack Obama.*

(2)



One question that structures like (2) immediately raise is how they are linearized. Kayne’s (1994) Linear Correspondence Axiom (LCA), given in (3), is incompatible with MD.

(3) Linear Correspondence Axiom
d(A) is a linear ordering of T,
(T the set of all terminal elements; *A* the set of ordered pairs of non-terminals, where the first member asymmetrically c-commands the second; *d(A)* the set of terminals dominated by *A*.

This is due to the fact that LCA relies on the strict notion of precedence, i.e. if α asymmetrically c-commands β, then *all terminals* dominated by α precede *all terminals* dominated by β. Let us see how strict precedence results in making (2) non-linearizable.

Consider, for example, the relationship between the V^0_2 *reviewed* and non-terminal nodes dominated by the shared DP *an article on Barack Obama* (D^0, N^0, P^0, NP) The set $A_{(\&P)}$, set of ordered pairs of non-terminals, such that the first member asymmetrically c-commands the second, contains pairs $\langle V_2^0, D^0\rangle$, $\langle V_2^0, N^0\rangle$, $\langle V_2^0, P^0\rangle$, and $\langle V_2^0, NP\rangle$, among others. Based on these, the following precedence relations must hold:

(4) $\langle V_2^0, D^0\rangle$: *reviewed < an*
$\langle V_2^0, N^0\rangle$: *reviewed < article*
$\langle V_2^0, P^0\rangle$: *reviewed < on*
$\langle V_2^0, NP\rangle$: *reviewed < Barack Obama*

The terminals of the DP are linearized as is informally shown in (5).

(5) *an < article < on < Barack Obama*

Thus, according to (4), the verb *reviewed* must precede the multiply dominated DP *an article on Barack Obama*. So far, no problems have revealed themselves in linearizing (2) by the LCA. However, $A_{(\&P)}$ also contains the pair $\langle TP_1, TP_2\rangle$, since TP_1 asymmetrically c-commands TP_2. Strict precedence requires that all terminals dominated by TP_1 precede all terminals dominated by TP_2. Since TP_1 dominates the shared DP, this DP must precede everything dominated by TP_2, including the verb *reviewed*.[2] Thus, based on the ordered pairs in (4), the shared DP must follow the verb *reviewed*, but based on the pair $\langle TP_1, TP_2\rangle$, it must precede the verb *reviewed*. This violates the requirement that the linear ordering be antisymmetric, i.e. that given two terminals, x and y, $\neg$ (xLy and yLx), where L is a relation of linear precedence. Thus, it seems that if we want to keep the LCA, we must abandon MD and *vice versa*.

In this paper, I propose a linearization algorithm that rests on asymmetric c-command, but is compatible with MD. The paper is organized as follows: In section 2, following Wilder (1999), I propose modifications to the LCA, which make it compatible with MD. I show that RNR structures, like (2), where the shared material is shared as a single constituent, can be correctly linearized under the present proposal. I call structures like that in (2) *bulk sharing* structures, because the string of shared material in such structures is shared as a constituent, i.e. in a bulk. In section 3, following Gracanin-Yuksek (2007), I introduce *non-bulk sharing,* in which the string of shared material does not form a constituent. Non-bulk sharing is exemplified by multiple wh-questions containing coordinated wh-words *(What and why did John sing?)*, which I refer to as *Q&Qs*. I show that the proposed algorithm correctly linearizes these structures as well. In section 4, I show how principles of linearization developed here may be singled out as the factor that rules out certain Q&Qs whose ill-formedness otherwise remains mysterious. In section 5, I discuss how movement of a shared constituent to a position outside the coordination may save an otherwise non-linearizable structure. Across-The-Board (ATB) questions, such as *Who does John love and Mary hate?* represent the case in point. Section 6 is the conclusion.

It is worth noting that my goal here is not to argue for the MD analyses of the phenomena that I discuss (RNR, ATB questions, Q&Qs). Instead, I aim to provide a linearization algorithm that is capable of linearizing various MD representations, simply assuming that these representations are correct. As noted by an anonymous reviewer, other proposals have been made to account for each of these constructions. Munn (1993), for example, analyzes ATB questions as involving movement of a null operator, thus assimilating ATB constructions to parasitic gaps. One of the approaches to RNR argues for the PF deletion of material in the first conjunct (Hartmann 2000, 2003; Swingle 1993 among others). Similarly, besides receiving the MD analysis adopted here, Q&Qs in English have been analyzed as involving reverse sluicing in the first conjunct (Giannakidou and Merchant 1998) or as being in principle derived like mono-clausal, non-coordinated multiple wh-questions with the addition of a conjunction between the wh-phrases, as proposed with different implementations by Zhang (2007) and Zoerner (1995).

In this paper, I would like to remain agnostic as to which approach to any of these constructions is correct. Since the aim of the present proposal is to account for the challenges that MD as such poses for linearization, in the rest of the paper I will assume that MD structures of the relevant phenomena are the ones which the linearization algorithm operates on and will suggest a way in which this proceeds.

2. The proposal

As we saw above, the problem with linearizing MD structures by the LCA stems from the fact that a shared node is linearized one way based on the asymmetric c-command relations that hold within one conjunct, and a different way based on the asymmetric c-command relation that holds between the conjuncts themselves. In order to avoid this problem, Wilder (1999) proposed the following modification of the LCA:

(6) d(X) = the (unordered) set of terminals *fully dominated* by X.
Wilder, 1999, pg. 9

Wilder further defines the notions of full dominance and sharing in the following way:

(7) X fully dominates α iff X dominates α and X does not share α.
Wilder, 1999, pg. 6

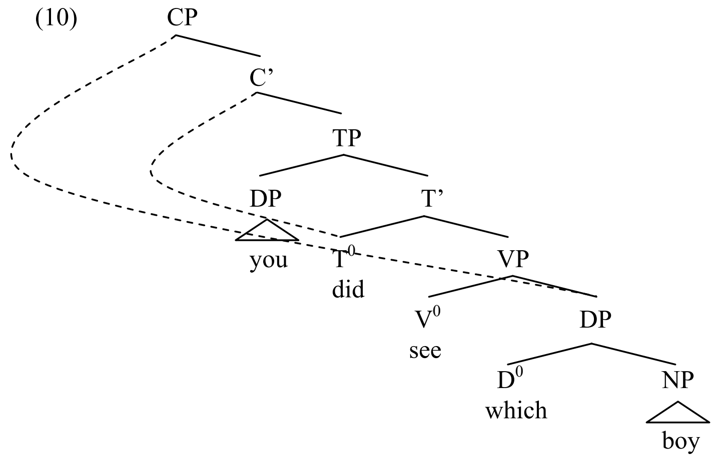
(8) α is shared by X and Y iff (a) neither of X and Y dominates the other, and (b) both X and Y dominate α.
Wilder, 1999, pg. 6

The modification in (6), together with the definitions it relies on, allows for a shared node to be "overlooked" when the conjuncts are ordered with respect to one another. This preempts contradictory ordering of the shared node, as desired.

It is worth noting here that in Wilder's system, a node α is considered to be shared if and only if neither of the nodes that dominate α dominate each other. Consequently, movement or *re-merge* of a constituent with a node that dominates it as, for instance, in the wh-question in (9), with the structural representation in (10), does not create an MD structure. In (10), the DP *which boy* is dominated, for example, by both VP and CP, but since CP dominates VP, in this system the DP does not count as shared. As a result, both CP and VP fully dominate the wh-phrase.

(9) *Which boy did you see?*

(10)



My proposal borrows from Wilder (1999) the idea that the LCA should be relaxed in such a way that in ordering a complex node A with respect to a complex node B, only those terminals that are *completely* dominated by both A and B should be considered.[3] I propose the following definitions of *d(A)* and complete dominance.

(11) *d(A)*: the unordered set of terminals completely dominated by *A*.

(12) Complete dominance
α completely dominates β if every path from β upwards to the root includes α.

Fox and Pesetsky (in preparation)

The notion of a path is defined as follows:

(13) Path from X to the root
The set of nodes that non-reflexively dominate X and its sister.

The definition of complete dominance in (12) has as a consequence the fact that even a "moved" constituent, such as the wh-phrase in (10) is treated as shared (Blevins 1990; De Vries 2007; Frampton 2004 among others).[4] In (10), CP completely dominates the wh-phrase, because every path from the wh-phrase to the root includes the CP. However, VP does not completely dominate the wh-phrase, because there is a path from the wh-phrase to the root that does not include the VP (the one that traces the dotted line). This will prove crucial when we consider non-bulk sharing structures in the next section.

Given the fact that in the present proposal, movement is reduced to a remerge of the same constituent into a new position (i.e. the structure contains no copies or traces), a question arises as to which position of the remerged constituent is the one which c-command relations are computed on. Since at first sight the wh-phrase *which boy* in (10) both c-commands and is c-commanded by everything else in the sentence, we need to somehow ensure that c-command is computed by taking into consideration only the highest position of this phrase. I therefore define c-command as in (14).

(14) C-command
α c-commands β iff
  (i) α does not (reflexively) dominate β,
  (ii) β is not a highest sister of α,
  (iii) for every highest mother M of α, one of the shortest paths from β to the root includes M.

The notions *highest sister* and *highest mother* are defined as follows:

(15) Highest sister of α
A sister of α, whose mother is a highest mother of α.

(16) Highest mother of α
A mother M of α not dominated by a mother of α other than M.

In the discussion that follows, I will be using the shorthand $HS_{(X)}$ for *highest sister of x*, and $HM_{(X)}$ for *a highest mother of x*.

We must also define how the length of the path from a node to the root is computed. This is done in (17).

(17) A path P from X to the root is shorter than a path P’ from X to the root iff P is a subpath of P’.

Finally, we stipulate that only those ordered pairs in the set *A* in which both members are either heads or maximal projections result in any ordering statements. This stipulation prevents ordering of terminals completely dominated by a bar-level of a projection of X^0 with respect to terminals completely dominated by a specifier of XP.

In sum, the proposed algorithm builds on the LCA in that it computes the linear order of terminals in a structure based on asymmetric c-command. It departs from Kayne's original proposal in relaxing the notion of precedence so that, following Wilder (1999), in ordering a complex node α with respect to a complex node β, only terminals completely dominated by α are ordered with respect to terminals completely dominated by β. Next, in the present proposal, a node α is multidominated or shared whenever it has more than one mother, even if one of the mothers of α dominates the other(s). As a result, movement creates MD structures.

Finally, it is important to note that while in Kayne's system asymmetric c-command consistently translates into precedence, in the proposal developed here it is a prerequisite for two nodes to be *ordered* with respect to one another, but whether this order maps onto precedence or subsequence is determined by something else (perhaps it is built into the structure-building operation itself).[5] This will play a role in section 5, where I discuss linearization of RNR examples under the assumption that the shared constituent moves.

With this much in mind, let us see how the proposed algorithm linearizes the wh-question in (10) and the RNR structure in (2).

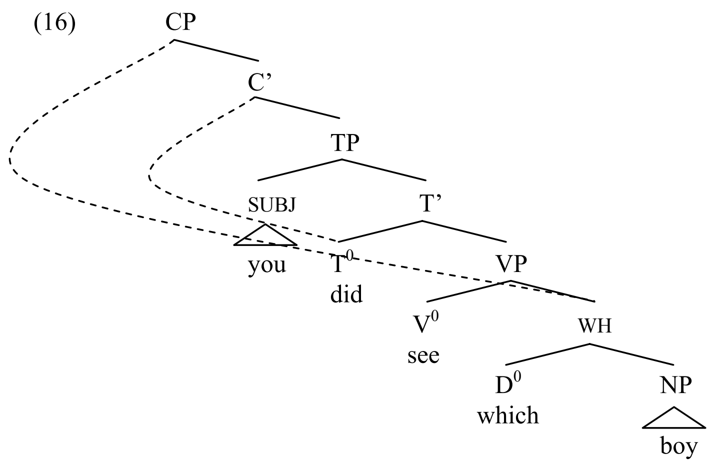
2.1. Linearizing (wh-)movement and RNR

We will first examine the wh-question in (10). The structure is repeated in (16) below for convenience.

The first question is whether the wh-phrase asymmetrically c-commands the auxiliary *did,* the subject *you,* and the verb *see*. The answer is yes. Consider, for example, the relation between the wh-phrase (WH) and the subject DP (SUBJ). WH does not (reflexively) dominate SUBJ, and SUBJ is not a $HS_{(WH)}$. Thus, the first two clauses in the definition of c-command are met. WH has only one highest mother, the CP. There is only one path from SUBJ to the root, the one that includes the nodes TP, C', and CP, so this is the shortest path. Since CP is included in this path, WH c-commands SUBJ.

Crucially, the reverse is not the case. There are two paths from WH to the root: path P, which includes nodes VP, T', TP, C', and CP, and path P', which includes only the CP. Since P' is a subpath of P, P' is the shortest path from WH to the root. The only $HM_{(SUBJ)}$ is the TP, and there is no shortest path from WH to the root that includes this node. Thus, SUBJ does not c-command WH. Consequently, the wh-phrase *asymmetrically* c-commands the subject DP.

(16)



The next question we might ask is whether SUBJ (asymmetrically) c-commands elements dominated by WH. Here, the answer is no. Let us examine whether SUBJ c-commands the determiner D^0. There are two paths from D^0 to the root: path P, which includes nodes WH, VP, T', TP, C', and CP, and path P', which includes nodes WH and CP. Since P' is a subpath of P, P' is the shortest path from D^0 to the root. As mentioned above, the only $HM_{(SUBJ)}$ is the TP, and the shortest path from D^0 to the root (P') does not include this node. Thus, SUBJ does not c-command D^0 *which* or, by parity of reasoning, NP *boy*.

Following the same computation for the rest of the nodes, we arrive at the correct order of terminal nodes in the sentence, informally stated in (17):

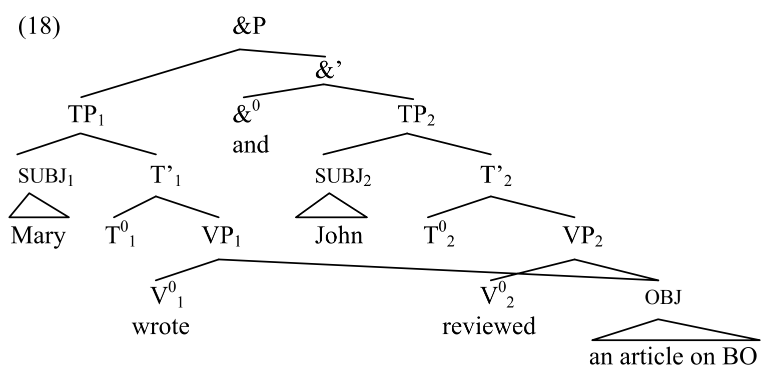
(17) *which* < *boy* < *did* < *you* < *see*

Let us now turn our attention to the RNR example in (2), repeated below as (18).

The subject DP of the first conjunct, *Mary* (SUBJ$_1$) asymmetrically c-commands the shared object DP *an article on Barack Obama* (OBJ). The first two clauses of the definition of c-command in (14) are satisfied, since SUBJ$_1$ does not (reflexively) dominate OBJ, and OBJ is not a highest sister of SUBJ$_1$. There are two paths from OBJ to the root: path P, which includes VP$_1$, T'$_1$, TP$_1$, and &P and path P', which includes VP$_2$, T'$_2$, TP$_2$, &', and &P. Crucially, both of these paths are shortest paths, since neither is a sub-path of the other. Since path P includes TP$_1$, which is the only HM$_{(\text{SUBJ1})}$, the third clause of (14) is also satisfied: for every HM$_{(\text{SUBJ1})}$, one of the shortest paths from OBJ to the root includes this node.

The reverse is not the case, since the only (shortest) path from SUBJ$_1$ to the root does not include either of the highest mothers of the OBJ (VP$_1$ and VP$_2$). Thus, the subject DP *Mary* asymmetrically c-commands the shared object DP.

(18)



The verb of the first conjunct *wrote* (VERB$_1$) does not c-command OBJ, because OBJ is a HS$_{(\text{VERB1})}$. For the same reason, OBJ crucially does not c-command VERB$_1$. However, VERB$_1$ does c-command constituents embedded inside OBJ. Let us examine the relation between V^0_1 and the D^0 *an.* There are two shortest paths from D^0 to the root: path P, which includes OBJ, VP$_1$, T'$_1$, TP$_1$, and &P, and path P', which includes OBJ, VP$_2$, T'$_2$, TP$_2$, &', and &P. For every HM$_{(\text{VERB1})}$, and there is only one, namely VP$_1$, there is a shortest path from D^0 to the root which includes VP$_1$ (namely, path P).

Thus, VERB$_1$ c-commands D^0 *an*. The same holds for other nodes dominated by OBJ.[6]

Based on asymmetric c-command relations in the first conjunct, we obtain the following order:

(19) *Mary < wrote < an article on Barack Obama*

By parity of reasoning, terminals in &' are ordered as in (20).
(20) *and < John < reviewed < an article on Barack Obama*

We next have to look at what nodes TP$_1$ asymmetrically c-commands. These include &^{0}, TP$_2$, SUBJ$_2$, T'$_2$, T$^0_2$, VP$_2$, and V$^0_2$. Given (11), this means that everything completely dominated by TP$_1$ will be ordered before everything completely dominated by the nodes that TP$_1$ asymmetrically c-commands. This yields the ordering statements in (21):[7]

(21)	⟨TP$_1$, &^{0}⟩:	*Mary < and, wrote < and*
	⟨TP$_1$, TP$_2$⟩:	*Mary < John, Mary < reviewed*
		wrote < John, wrote < reviewed
	⟨TP$_1$, SUBJ$_2$⟩:	*Mary < John, wrote < John*
	⟨TP$_1$, VP$_2$⟩:	*Mary < reviewed, wrote < reviewed*
	⟨TP$_1$, V$^0_2$⟩:	*Mary < reviewed, wrote < reviewed*

The orders in (19), (20) and (21) taken together yield a unique non-contradictory order in (22), as desired.[8]

(22) *Mary < wrote < and < John < reviewed < an article on BO*

Given the discussion in this section, it seems that the proposed algorithm correctly linearizes both MD structures created by "movement," as well as those which involve bulk sharing, i.e. those that contain a complex shared constituent, under the hypothesis that this constituent remains *in situ*.

In the next section I introduce a different kind of MD structures, referred to as non-bulk sharing. I proceed to show that these can also be linearized by the proposed algorithm.

3. Non-bulk sharing (from Gracanin-Yuksek 2007)

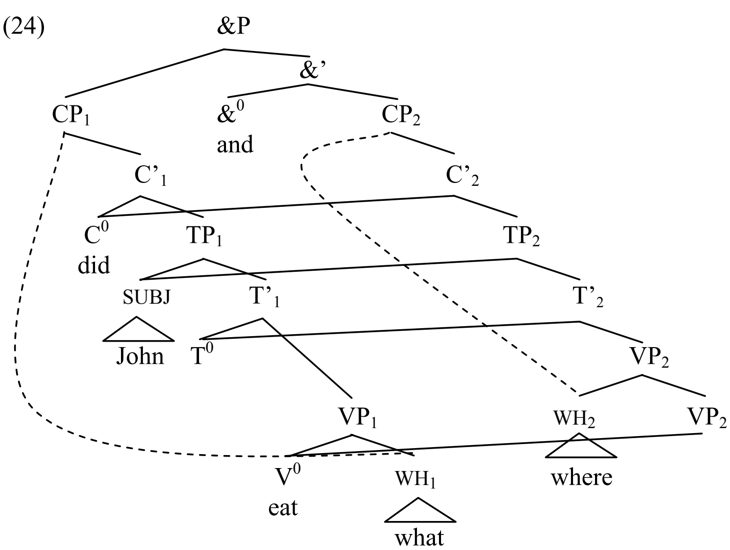
A non-bulk sharing structure is one in which a string of shared material is not shared as a single constituent. Evidence for non-bulk sharing comes from multiple wh-questions with two wh-phrases that seem to be coordinated at the left periphery of the clause. As noted in the Introduction, I refer to these questions as Q&Qs.[9] An example of a Q&Q is given in (23).

(23) What and where did John eat?

I argue elsewhere (Gracanin-Yuksek 2007) that questions like the one in (23) show several properties which indicate that their underlying structure contains two full-fledged interrogative CPs, which share everything *except the wh-phrases,* as in (24).[10]

Here, I present two arguments for the structure in (24): the contrasts due to the choice of the verb, and the interpretation of Q&Qs.

(24)



3.1. Evidence for non-bulk sharing

A Q&Q that contains an optionally transitive verb, as in (25), contrasts in grammaticality with one that contains an obligatorily transitive verb, shown in (26).[11]

(25) *What and why did Peter sing?*

(26) **What and why did Peter fix?*

This contrast follows straightforwardly from the structure in (24): given that wh-phrases are *not* shared between the conjuncts, the second conjunct in both (25) and (26) does not contain the direct object *what*. Since the verb *fix* obligatorily subcategorizes for a direct object, the fact that *what* is absent from the second conjunct necessarily leads to ungrammaticality of that conjunct and consequently of the entire sentence. The verb *sing,* on the other hand, may surface with or without a direct object, so in (25), the fact that the wh-object is absent from the second conjunct does not affect the grammaticality of the sentence. Note that the only way for the terminals *did, Peter,* and *sing* to be shared between the conjuncts *to the exclusion* of the wh-direct object is by virtue of non-bulk sharing.

Another piece of evidence that argues for the structure in (24) is the interpretation of a Q&Q. In particular, the Q&Q in (23) has the reading in (27) below, which I call the *at-all-reading,* but crucially not that in (28), which I refer to as the *it-reading.* In other words, the question in (23) requires answers as to what John ate and where he ate (27), but not answers as to what John ate and where he ate the *things that he ate* (28). Thus, if John ate pizza (at Domino's), and he also ate something else (at McDonald's), the answer to (23) may be: John ate pizza and he ate at McDonalds.[12]

(27) What did John eat and where did he eat (*at all*)*?*

(28) #What did John eat and where did he eat *it?*

Again, the structure in (24) accounts for this fact. Since the wh-object is absent from the syntactic representation of the second conjunct, it cannot contribute to the semantic interpretation of this conjunct, thus excluding the possibility of a Q&Q having an it-reading.

Having empirically motivated the non-bulk sharing structure in (24), in the next section I show that the linearization algorithm devised in section 2 correctly derives the linear order of non-bulk sharing structures.

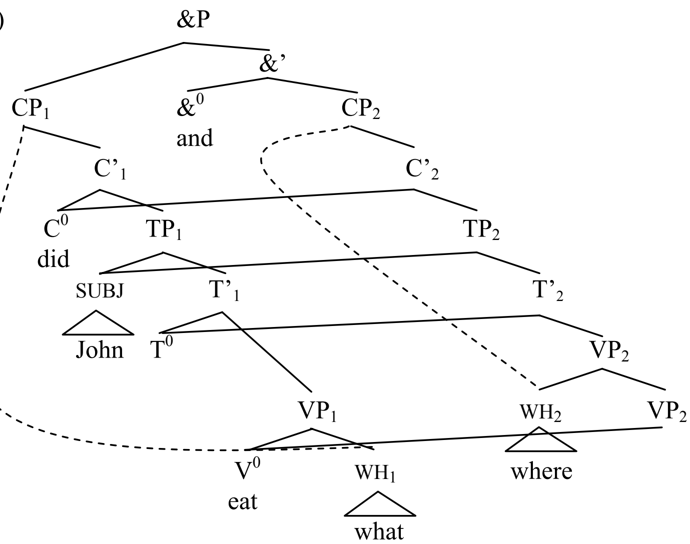
3.2. Linearizing non-bulk sharing

Let us take a look how the structure in (24), repeated below as (29), is linearized.

In the first conjunct, all the peripheral nodes other than the wh-phrase (C^0, SUBJ, T^0, and V^0) are shared between CP_1 and CP_2. Each has two highest mothers because each has only two mothers and neither of the mothers dominates the other. For each of these nodes then there are two paths to the root, and they both count as shortest paths. To illustrate, let us focus on the subject DP (SUBJ). There are two paths from SUBJ to the root: path P includes nodes TP_1, C'_1, CP_1, and &P, and path P' includes nodes TP_2, C'_2, CP_2, &' and &P. Since neither of these paths is a subpath of the other, both are shortest paths. The same is true of C^0, T^0 and V^0.

The object wh-phrase in the first conjunct (WH_1) c-commands C^0, SUBJ, and V^0. Let us examine the relation between the WH_1 and SUBJ. WH_1 has one $HM_{(WH1)}$, namely CP_1. For every $HM_{(WH1)}$ there is a shortest path from SUBJ to the root which includes CP_1, namely path P. Thus, WH_1 c-commands SUBJ. The same reasoning leads us to conclude that WH_1 also c-commands the rest of the shared nodes, C^0, T^0, and V^0.

(29)



Crucially, the reverse does not hold. None of the shared nodes c-commands WH_1. Again, I will examine the relationship between WH_1 and SUBJ, as a concrete example. It is not the case that for every $\text{HM}_{(\text{SUBJ})}$ there a shortest path from WH_1 to the root which includes $\text{HM}_{(\text{SUBJ})}$. SUBJ has two highest mothers: TP_1 and TP_2. There is only one shortest path from WH to the root: path P, which includes only CP_1 and &P.[13] Since no shortest path from WH to the root includes either TP_1 or TP_2, SUBJ does not c-command the wh-phrase. The same is true of the relation between WH_1 and other shared nodes, C^0, T^0 and V^0: none of these nodes c-commands WH_1. Consequently, WH_1 asymmetrically c-commands all of the shared nodes. The wh-phrase also asymmetrically c-commands TP_1, T'_1, and VP_1.

The set $A_{(CP1)}$ contains the following relevant ordered pairs (abstracting away from the pair $\langle \text{WH}_1, T^0\rangle$, since T^0 does not dominate any terminal nodes, and the pairs containing bar-level nodes, which yield no ordering statements):

(30) $\langle \text{WH}_1, C^0\rangle$, $\langle \text{WH}_1, \text{TP}_1\rangle$, $\langle \text{WH}_1, \text{SUBJ}\rangle$, $\langle \text{WH}_1, \text{VP}_1\rangle$, $\langle \text{WH}_1, V^0\rangle$

The pairs in (30) result in the orders of terminal nodes given in (31).

(31) $\langle$WH$_1$, C$^0\rangle$: *what < did*
$\langle$WH$_1$, TP$_1\rangle$: no ordering statements since TP$_1$ completely dominates nothing
$\langle$WH$_1$, SUBJ$\rangle$: *what < John*
$\langle$WH$_1$, VP$_1\rangle$: no ordering statements since VP$_1$ completely dominates nothing
$\langle$WH$_1$, V$^0\rangle$: *what < eat*

In addition, $A_{(CP1)}$ contains the ordered pairs in (32).

(32) $\langle$C^0, SUBJ$\rangle$, $\langle$C^0, V$^0\rangle$, $\langle$ SUBJ, V$^0\rangle$

Let us convince ourselves that this is indeed so. Let us focus on the pair $\langle$C^0, V$^0\rangle$. For every HM$_{(C0)}$, namely C'$_1$ and C'$_2$, there is a shortest path from V^0 to the root which includes a HM$_{(C0)}$: there is a shortest path from V^0 to the root which includes C'$_1$, and there is also a shortest path from V^0 to the root which includes C'$_2$. Thus, C^0 c-commands V^0. The reverse is not the case, as the reader may verify for herself.

The same reasoning applies to other ordered pairs in (32), which then translate into the following ordering statements:

(33) $\langle$C^0, SUBJ$\rangle$: *did < John*
$\langle$C^0, V$^0\rangle$: *did < eat*
$\langle$ SUBJ, V$^0\rangle$: *John < eat*

Ordering statements in (31) and (33) yield the linear order given in (34).

(34) *what < did < John < eat*

By the same reasoning, the order established in &' is the one in (35).

(35) *and < where < did < John < eat*

Next, the conjuncts have to be ordered with respect to one another. The $A_{(\&P)}$ contains the relevant ordered pairs in (36).

(36) $\langle$CP$_1$, &$^0\rangle$, $\langle$CP$_1$, CP$_2\rangle$, $\langle$CP$_1$, WH$_2\rangle$, $\langle$CP$_1$, TP$_2\rangle$, $\langle$CP$_1$, VP$_2\rangle$[14]

Recall that in ordering a complex constituent α with respect to a complex constituent β, only terminals completely dominated by α are ordered with respect to terminals completely dominated by β. This means that each ordered pair in (36) yields the following ordering statements, and only these:

(37) $\langle CP_1, \&^0 \rangle$: *what < and*
$\langle CP_1, CP_2 \rangle$: *what < where*
$\langle CP_1, \text{WH}_2 \rangle$: *what < where*
$\langle CP_1, TP_2 \rangle$: no ordering statements since TP_2 completely dominates nothing
$\langle CP_1, VP_2 \rangle$: no ordering statements since VP_2 completely dominates nothing

The final order of all terminals in the structure is given in (38). This order is total, and it is compatible with the orderings in (34), (35) and (37).

(38) *what < and < where < did < John < eat*

Thus, the algorithm proposed here correctly linearizes MD structures that result from instances of internal merge (movement), those that contain bulk sharing (RNR) as well as those that contain non-bulk sharing (Q&Qs).

4. Linearization as a constraining factor on MD

In section 3.1 above, we saw that in order for a Q&Q to be well-formed, both conjuncts must be well-formed.[15] In this section we will examine an example of a Q&Q in which each of the conjuncts is well-formed, but the Q&Q itself is nevertheless bad. I will suggest that ill-formedness of such Q&Qs follows from their not being linearizable.

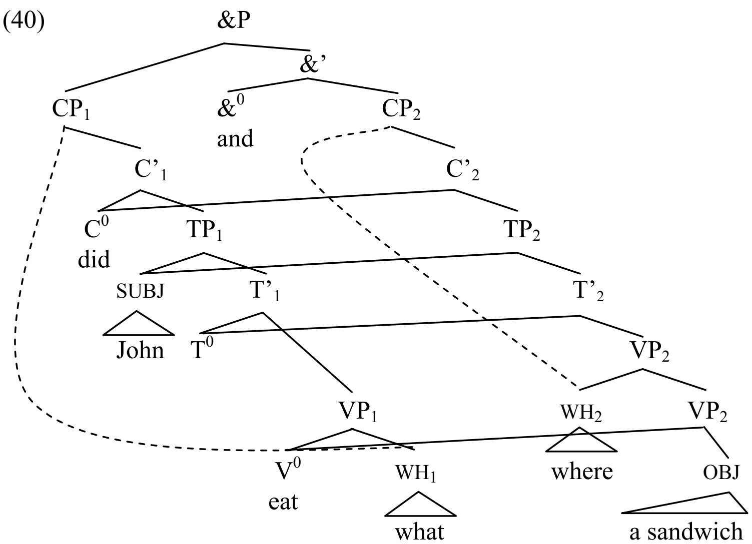
Consider the Q&Q in (39), whose structure is given in (40).

(39) **What and where did John eat a sandwich?*

This Q&Q contains two well-formed conjuncts: *what did John eat* and *where did John eat a sandwich*. Given this, we would expect (39) to be grammatical, contrary to fact.

One reason why (39) is ill-formed might be the fact that it is not linearizable. In particular, the problem lies in establishing linear order between terminals dominated by any of the shared nodes (C^0, SUBJ, T^0, and V^0) and terminals dominated by the unshared object DP (OBJ) in the second conjunct *a sandwich*. This is because it is not the case that any of the shared nodes c-commands OBJ, nor is it the case that OBJ c-commands any of the shared nodes.

(40)



For illustration, let us examine the relation between the C^0 and OBJ. C^0 has two highest mothers: C'_1 and C'_2. In order for C^0 to c-command OBJ, there should exist a shortest path P from OBJ to the root that includes C'_1, and there should exist a shortest path P’ from OBJ to the root that includes C'_2. This requirement is not satisfied, given that there is only one path from OBJ to the root, which includes C'_2, but there is no (shortest) path from OBJ to the root that includes C'_1. Thus, C^0 does not c-command OBJ. For the same reason, C^0 does not c-command the constituents embedded inside OBJ, the determiner *a* and the NP *sandwich*.

Extending this reasoning to other shared nodes, we conclude that neither SUBJ nor V^0 c-command OBJ or the non-terminals it dominates.

On the other hand, OBJ does not c-command C^0, since none of the shortest paths from C^0 to the root includes $HM_{(OBJ)}$, namely VP_2. For the same reason, the OBJ does not c-command T^0, or SUBJ. Finally, OBJ does not c-command V^0, since V^0 is the highest sister of OBJ.

Thus, no (asymmetric) c-command relation holds between any of the shared nodes (C^0, T^0, SUBJ, and V^0) and the unshared object DP in the second conjunct. Moreover, the order between these nodes cannot be deduced from any asymmetric c-command relation that holds among other non-terminals in the structure. For example, C^0 does not c-command TP_2, T'_2, or VP_2 (which all completely dominate OBJ) because for each of these nodes there is only one shortest path to the root, and while this path includes one $HM_{(C0)}$, namely C'_2, it does not include the other, namely C'_1.[16]

Since lack of asymmetric c-command leads to the lack of ordering statements, none of the terminals dominated by shared nodes may be ordered with respect to terminals dominated by the unshared object DP in the second conjunct. This makes the MD structure in (40) inadmissible.

In effect, the linearization algorithm developed here, and in particular the way in which c-command is defined, makes it impossible for a shared node X with more than one highest mother to (asymmetrically) c-command an unshared node Y which it would (asymmetrically) c-command if X were not shared. In other words, in an MD structure, no shared node with more than one highest mother can be structurally higher than any unshared node. Should this be the case, the structure is not linearizable, since the lack of asymmetric c-command results in the lack of ordering statements. This is a welcome result. It predicts that, if a structure contains any sharing (that does not result from "movement"), shared nodes cannot be interleaved with unshared nodes.

Consequently, in an MD structure, shared nodes may remain *in situ* only if the structure contains no structurally lower unshared nodes. This is the case in a Q&Q and the non-movement analysis of RNR, which we saw above. Alternatively, a shared node X may be remerged in such a way that the re-merge creates a *unique* highest mother of X. This possibility, exemplified by ATB questions and the moving analysis of RNR, is discussed in the next section.

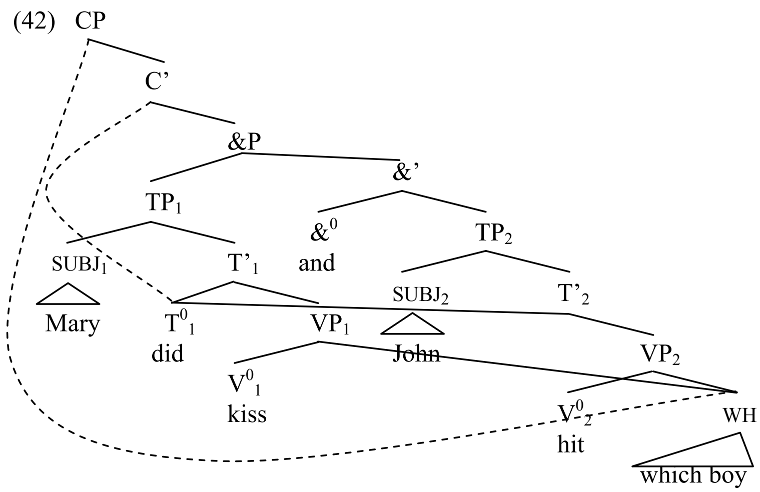
5. When a shared node "moves"

In this section we will see how the proposed linearization algorithm fares with respect to those MD structures in which a shared node X that has no unique highest mother in its base position undergoes re-merge that creates such a mother of X. We will start our discussion with an ATB question in (41).

(41) *Which boy did Mary kiss and John hit?*

Citko (2005) proposes that the question in (41) contains two coordinated TPs, which initially share the object wh-phrase *which boy* (WH). The conjunction phrase is then merged with a single C^0, to the specifier of which the shared WH moves. Citko's original proposal was that movement results in the base copy being reduced to a trace (silent copy), which could then be overlooked for linearization purposes, thus making the structure compatible with the LCA. In (42) below I recast the structure of the ATB question in the present framework, in which "movement" is re-merge of a node into a new position.

(42)



From its derived [Spec, CP] position, WH c-commands all the other nodes. It has a single $HM_{(WH)}$, namely CP, which is at the same time the root. It is therefore the case that for each node in the structure, a shortest path to the root includes CP. On the other hand, no node c-commands WH. There is only one shortest path from WH to the root, P, which includes only the CP node. Since P includes no highest mothers of any of the nodes in the structure, no nodes c-command WH. Thus, *which boy* precedes all other terminals in the structure. Similarly, C^0 (the re-merged T^0) c-commands everything except WH. Thus, *did* precedes all terminals except *which boy*.

The set $A_{(TP1)}$ contains the relevant ordered pairs in (43), which yield the ordering statements in (44), and the order in (45).

(43) $\langle$SUBJ$_1$, VP$_1\rangle$, $\langle$SUBJ$_1$, $V^0{}_1\rangle$

(44) $\langle$SUBJ$_1$, VP$_1\rangle$: *Mary < kiss*
$\langle$SUBJ$_1$, $V^0{}_1\rangle$: *Mary < kiss*

(45) *Mary < kiss*

The set $A_{(\&')}$ similarly contains ordered pairs in (46), which yield ordering statements in (47), and the order in (48).

(46) $\langle\&^0$, SUBJ$_2\rangle$, $\langle\&^0$, VP$_2\rangle$, $\langle\&^0$, $V^0{}_2\rangle$, $\langle$SUBJ$_2$, VP$_2\rangle$, $\langle$SUBJ$_2$, $V^0{}_2\rangle$

(47) $\langle\&^0$, SUBJ$_2\rangle$: *and < John*
$\langle\&^0$, VP$_2\rangle$: *and < hit*
$\langle\&^0$, $V^0{}_2\rangle$: *and < hit*
$\langle$SUBJ$_2$, VP$_2\rangle$: *John < hit*
$\langle$SUBJ$_2$, $V^0{}_2\rangle$: *John < hit*

(48) *and < John < hit*

Thus, the final order is the one given in (49), as desired.[17]

(49) *which < boy < did < Mary < kiss < and < John < hit*

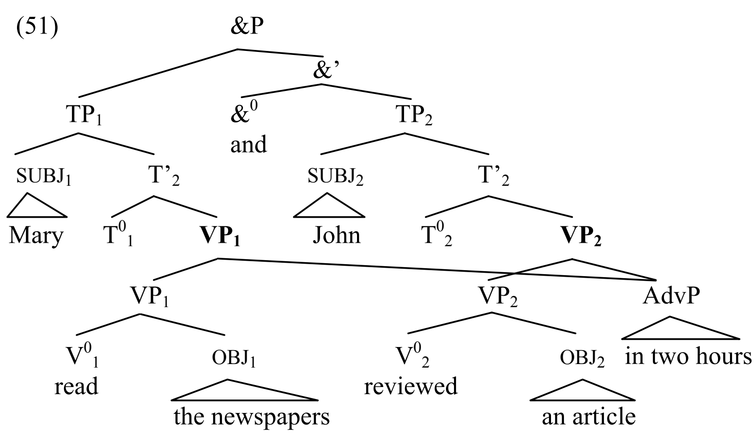
Finally, let us consider an example of RNR when the shared (RNR-ed) constituent is not a direct object, but something that occupies a higher position, for example an adverb. A relevant example is given in (50), with the structural representation in (51).

(50) *Mary read the newspapers and John reviewed an article in two hours.*

The structure in (51) is not linearizable under the present proposal. The reason for this is the fact that the shared adverb is interleaved with unshared material: the unshared subjects of both TPs are structurally higher, but the material dominated by both unshared VPs is structurally lower than the adverb.[18] Consequently, there is no c-command relation between AdvP and either the verbs or the objects of both VPs. For illustration, let us examine the relation between AdvP (ADV) and V^0_2 (VERB$_2$).

ADV does not c-command VERB$_2$. ADV has two highest mothers: VP$_1$ and VP$_2$, bold-faced in (51). On the other hand, there is only one shortest path from VERB$_2$ to the root, the one which includes nodes VP$_2$, **VP$_2$**, T'$_2$, TP$_2$, &', and &P. Since there is no shortest path from VERB$_2$ to the root that includes the other HM$_{(ADV)}$, namely VP$_1$, clause (iii) of the definition of c-command in (14) is not met, and the outcome is that ADV does not c-command VERB$_2$.

(51)

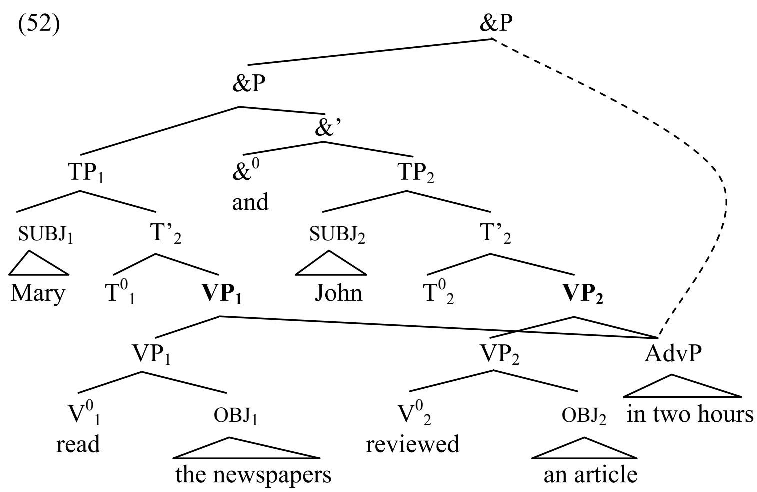


The problem is that VERB$_2$ does not c-command ADV either, since no shortest paths from ADV to the root include HM$_{(VERB2)}$, namely the non bold-faced VP$_2$. Since there is no c-command relation between ADV and VERB$_2$, these two nodes cannot be ordered with respect to one another, and the structure should be ill-formed. However, the sentence in (50) is judged as good.

The only way to reconcile the well-formedness of (50) with the linearization principles developed here is to assume that the shared AdvP undergoes re-merge to a position where it has a single highest mother, parallel to the re-merge of the wh-phrase in the ATB question we saw in (42). This possibility is represented in (52).[19]

In its derived adjoined position, AdvP c-commands everything else in the structure, and is no longer c-commanded by anything. It is now possible to order terminals dominated by this phrase with respect to terminals dominated by all other nodes. Given all the previous examples we discussed, we would expect the terminals dominated by AdvP to *precede*, rather than *follow* all other terminals in the sentence, contrary to fact.

(52)



However, recall from the Introduction that in the system developed here, asymmetric c-command is a prerequisite for *ordering* two nodes with one another, but this ordering may translate either into precedence or into subsequence. This is a departure from the standard kayneian system, in which asymmetric c-command uniformly translates into precedence.[20] This departure may be viewed as a weakness of the present proposal. However, given the controversial status of the analysis of RNR (movement *versus* non-movement approaches), perhaps this is not so.

It is also possible that the condition on well-formedness of syntactic structures is, in fact, the existence of c-command relations among the nodes in a syntactic representation. Here, this idea is implemented through tying this condition to linearization, but it is quite possible that the two are independent of each other. More work is needed to establish which of these views is correct.

6. Conclusion

In this paper, I developed a linearization algorithm that is based on the LCA, but is compatible with MD. The proposal relies on Kayne's original idea that linear order of terminals in any phrase marker M is derived from asymmetric c-command relations that hold among non-terminal nodes in M. It borrows from Wilder (1999) the insight that in ordering a complex constituent A with respect to a complex constituent B, only those terminals completely dominated by A are ordered with respect to only those terminals completely dominated by B.

One advantage that this proposal has over previous attempts to reconcile MD with the LCA is that it treats any node that has more than one mother as shared. More precisely, constituents that come to have more than one mother as a result of movement or re-merge are treated no differently than other constituents with more than one mother. The proposed linearization algorithm is thus capable of linearizing MD structures that contain a constituent which is shared across trees (Q&Qs, RNR on an *in situ* analysis), MD structures that contain a constituent which is shared within a single tree (for example, wh-questions), and MD structures that contain both (ATB questions, RNR on a "movement" analysis).

The proposal here differs crucially from Kayne's system in that, although asymmetric c-command between two non-terminal nodes is viewed as a necessary condition for ordering terminals dominated by these nodes, this relation does not necessarily translate into precedence. Rather, a node A that asymmetrically c-commands a node B might end up preceding or following B. This allows for both "movement" and *in situ* approaches to RNR.

Finally, it was suggested that what constrains (MD) structures is the requirement that there exist asymmetric c-command relations among the non-terminal nodes in the structure, rather than the requirement that the structure be linearizable. Proposing that linear order results from asymmetric c-command relations unifies the two requirements in a reasonable way, but whether or not they can, in fact, be unified is for future research to show.

Notes

1. This paper has its roots in my Ph.D. dissertation, written at MIT in 2007. I would therefore like to thank my advisor, David Pesetsky, for many helpful comments on various versions of this work. I am grateful to Norvin Richards for making me work on the topic of linearization and for the long discussions we had of the problems tackled here. Special thanks go to Danny Fox for his invaluable Skype-help on the proposals made in the paper. I am also grateful to two anonymous reviewers, whose comments led to a considerable improvement of this work. All remaining errors are, of course, my own.
2. The DP is also required to precede itself.
3. See Bachrach and Katzir (2009) for a related proposal, where a shared node is exempt from Spellout.
4. Given that sharing is attested in non-coordinate structures, it is to be viewed as independent of coordination.
5. See Johnson (2007) for a related proposal.
6. For the verb to c-command the material contained within the direct object, the latter cannot be a bare head. This rules out the possibility that pronominal objects are bare determiners.
7. I omit the pair $\langle TP_1, T'_2\rangle$, since it yields no ordering statements, as well as the pair $\langle TP_1, T^0_2\rangle$, since T^0_2 dominates no overt material.
8. An anonymous reviewer asks (i) why the object DP *an article on Barack Obama* is not linearized in both conjuncts and (ii) why there is no condition on linearizing shared constituents in the second conjunct, instead of relying on the asymmetric c-command in conjunction with complete dominance. The answer to the first question is that there is only one instance of the object DP in the structure, and it therefore cannot be linearized in two places. As to the second question, a condition that shared material must be linearized in the second (final) conjunct would be specific to sharing in coordinate structures, while the proposal developed here handles the linearization of shared material both "across trees" (as in RNR) and "within a single tree" (as in movement constructions) by appealing to the same set of principles.
9. The construction has been investigated under different names: "coordinated wh-constructions" in Kazenin (2000), "conjoined question words construction" in Zhang (2007), and "coordinated multiple wh-questions" in Gribanova (2009).
10. In Gracanin-Yuksek (2007: ch. 2), I present ample evidence which argues against the approach to Q&Qs in English on which they are derived from a single clause by wh-movement of wh-phrases to the left periphery of the clause, where they are coordinated (Zhang 2007; Zoerner 1995). In Gracanin-

Yuksek (2007: ch. 5), I argue against the reverse sluicing analysis of these constructions, proposed by Giannakidou and Merchant (1998), as well as against a bulk sharing approach to Q&Qs.

11. See also Whitman (2002: ch. 3) for experimental evidence which shows that Q&Qs with optionally transitive verb are significantly more acceptable to speakers than those with obligatorily transitive verb.
12. With respect to interpretation, the Q&Q in (23) differs from a similar question in (i) in that (i) necessarily has the it-reading, i.e., in the scenario described in the text, the answer to (i) must be: 'John ate pizza and he ate *it at Domino's.*'

    i. *What did John eat and where?*

    Examples like (i) are presumably derived by sluicing in the second conjunct, along the lines of Merchant (2001), and do not involve sharing.
13. P is a subpath of the other path, P', from WH to the root, since P' includes nodes VP_1, T'_1, TP_1, C'_1, CP_1, and &P. Thus P it is a shorter path than P'.
14. CP_1 does not c-command C^0, T^0, the subject DP, or the verb, since CP_1 dominates these nodes.
15. The observation that a coordinate structure is grammatical only if individual conjuncts are grammatical goes back to Goodall (1983).
16. In addition to this, other conditions on c-command may be unsatisfied, such as the non-sisterhood condition stated in clause (ii) of (14).
17. An anonymous reviewer points out that the proposed linearization algorithm does not predict the ill-formedness of (i), discussed in Williams (1978), even though both conjuncts are well-formed.

    i. **I know the man who Bill saw and likes Mary.*

    Indeed, since all we require for an MD structure to be linearizable is that a shared node which is structurally higher than some unshared node have a unique highest mother, (i) must be linearizable. The ungrammaticality of (i) should then be traced to a different source. A possible candidate is the parallelism requirement on ATB constructions proposed in Yim (2004), according to which movement that does not violate the Coordinate Structure Constraint (CSC) must proceed from "the same syntactic position in both conjuncts." (pg. 93) In (i), the wh-phrase *who* ATB-moves from the [Spec, vP] position in the first conjunct, while it ATB-moves from [Spec, TP] position in the second conjunct, in violation of the CSC.
    The claim here is not that linearization is the *only* factor constraining MD. Rather, it may be singled out as the reason for the ill-formedness of structures in which no other requirement seems to be violated (such as the Q&Q in [39]). Thus, the present proposal does render inadmissible the example in (ii),

from Wilder (1999), where no ATB movement of the shared DP *Mary* takes place:

ii. *John met and Mary laughed.
Intended reading: John met Mary and Mary laughed.

18. The problem does not arise if (by the end of the derivation), the adverb occupies the most embedded position, as proposed (with various implementations) by Alexiadou (1997), Larson (1988, 2004), Stroik (1990) among others. If this is the case, then, for all intents and purposes, (51) is parallel to the linearizable (18), where the shared node is the direct object.
19. See Sabbagh (2007) for a theory of how rightward movement (in RNR) proceeds.
20. Ernst (2001: ch. 4.3.) develops a proposal in which, unlike in Kayne (1994) and the literature following it, the structure featuring right-adjunction, as in (52), is in principle allowed. However, for Ernst, c-command is divorced from the linear placement of an (adjunct) phrase. Instead, principles of linearization make reference to specifiers (F-complexes) and complements (C-complexes). See also López (2009), where the LCA is preserved as a principle of linearization, but its effects are sometimes overridden by higher-ranking constraints, which require particular mapping between syntactic and intonational phrases.

References

Alexiadou, Artemis
1997 *Adverb Placement. A Case Study in Antisymmetric Syntax.* Amsterdam/Philadelphia: John Benjamins.

Bachrach, Asaf and Roni Katzir
2006 Right-Node raising and delayed spellout. In *Interphases: Phase-Theoretic Investigations of Linguistic Interfaces*, Kleanthes Grohmann (ed.), 283–316. Oxford: Oxford University Press.

Blevins, James
1990 Syntactic Complexity: Evidence for discontinuity and multidomination. Ph.D. diss., Department of Linguistics, University of Massachusetts.

Citko, Barbara
2005 On the nature of Merge: External Merge, Internal Merge, and Parallel Merge. *Linguistic Inquiry* 36 (4): 475–496.

Ernst, Thomas
2001 *The Syntax of Adjuncts.* Cambridge: Cambridge University Press.

Frampton, John
2004 Copies, traces, occurrences, and all that: Evidence from Bulgarian multiple wh-movement. Ms., Northeastern University, Boston, MA.

Giannakidou, Anastasia and Jason Merchant
1998 Reverse sluicing in English and Greek. *The Linguistic Review* 15: 233–256.

Goodall, Grant
1983 A three-dimensional analysis of coordination. In *Papers from the nineteenth regional meeting of Chicago Linguistic Society*, 146–154.

Gracanin-Yuksek, Martina
2007 About sharing. Ph.D. diss., Department of Linguistics and Philosophy, Massachusetts Institute of Technology.

Gribanova, Vera
2009 Structural adjacency and the typology of interrogative interpretations. *Linguistic Inquiry* 40 (1): 133–154.

Hartmann, Katharina
2000 *Right Node Raising and Gapping: Interface Conditions on Prosodic Deletion.* Amsterdam: John Benjamins.
2003 Background matching in right node raising constructions. In *The Interfaces: Deriving and Interpreting Omitted Structures,* Kerstin Schwabe and Susanne Winkler (eds.), 121–151. Amsterdam: John Benjamins.

Johnson, Kyle
2007 LCA+alignment=RNR. Paper presented at Workshop on Coordination, Subordination, and Ellipsis. University of Tübingen.

Kayne, Richard
1994 *The Antisymmetry of Syntax.* Cambridge, Mass: The MIT Press.

Kazenin, Konstantin
2000 On coordination of wh-phrases in Russian. Ms., Tübingen University and Moscow State University.

Larson, Richard
1988 On the double-object construction. *Linguistic Inquiry* 19 (3): 335–391.

Larson, Richard
2004 Sentence-final adverbs and "scope". In *Proceedings of NELS 34*, Matthew Wolf and Keir Moulton (eds.), 23–43. University of Massachusetts: GLSA.

Levine, Robert D.
1985 Right Node (non-)Raising. *Linguistic Inquiry* 16: 492–497.

López. Luis

2009 Ranking the Linear Correspondence Axiom. *Linguistic Inquiry* 40 (2): 239–276.

McCawley, James D.
1982 Parentheticals and discontinuous constituent structure. *Linguistic Inquiry* 13 (1): 91–106.

McCloskey, James
1986 Right Node Raising and preposition stranding. *Linguistic Inquiry* 17 (1): 183–186.

Merchant, Jason
2001 *The Syntax of Silence.* Oxford: Oxford University Press.

Moltmann, Friederike
1992 Coordination and comparatives. Ph.D. diss., Department of Linguistics and Philosophy, Massachusetts Institute of Technology.

Muadz, Husni
1991 Coordinate structures: A planar representation. Ph.D. diss., Department of Linguistics, University of Arizona, Tuscon.

Munn, Alan
1993 Topics in the syntax and semantics of coordinate structures. Ph.D. diss., Department of Linguistics, University of Maryland.

Sabbagh, Joseph
2007 Ordering and linearizing rightward movement. *Natural Language and Linguistic Theory* 25 (2): 349–401.

Stroik, Thomas
1990 Adverbs as V-sisters. *Linguistic Inquiry* 21 (4): 654–661.

Swingle, Kari
1993 The role of prosody in Right Node Raising. Ms., University of California, Santa Cruz.

Vries, Mark de
2007 Internal and external remerge: On movement, multidominance, and the linearization of syntactic objects. Ms., University of Groningen.

Whitman, Neal
2002 Category neutrality: A type-logical investigation. Ph.D. diss., Department of Linguistics, Ohio State University.

Wilder, Chris
1999 Right node raising and the LCA. In *Proceedings of the Eighteenth West Coast Conference on Formal Linguistics,* Sonya Bird, Andrew Carnie, Jason D. Haugen, and Peter Norquest (eds.), 586–598. Somerville: Cascadilla Press.

Williams, Edwin
1978 Across-the-board rule application. *Linguistic Inquiry* 9 (1): 31–43.

Yim, Changguk

2004 The EPP on vP level in English. Studies in Generative Grammar 14 (1): 87–101.

Zhang, Niina
2007 The syntactic derivations of two paired dependency constructions. *Lingua* 117 (12): 2134–2158.

Zoerner, Cyrill
1995 Coordination: The syntax of &P. Ph.D. diss., Department of Linguistics, University of California, Irving.