

## 1. INTRODUCTION

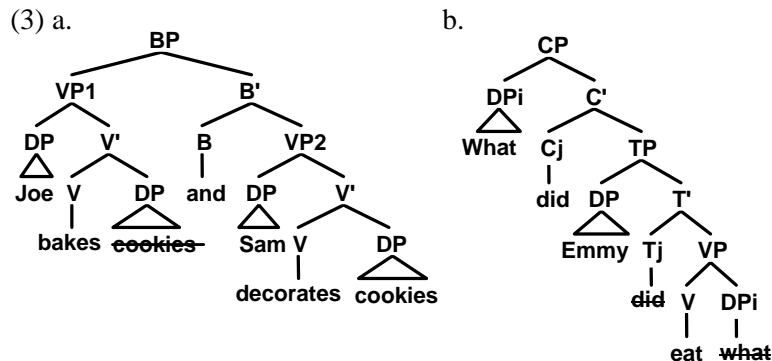
### 1.1 Multiple Linking

- Some constructions appear to allow a single lexical element to play multiple grammatical roles.
- These roles are usually associated with distinct positions.

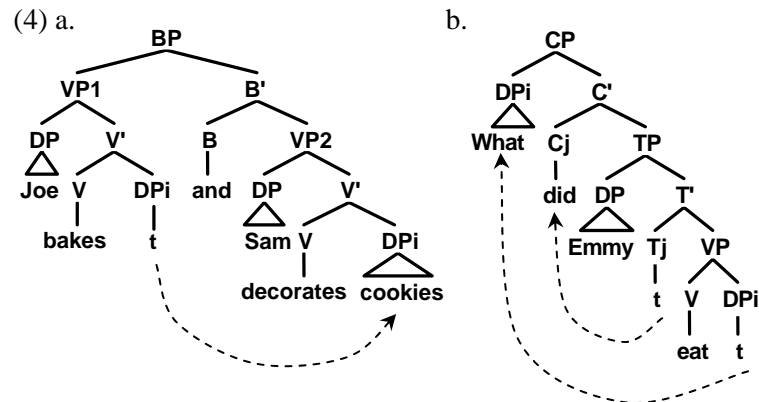
- (1) *Joe bakes \_\_\_<sub>i</sub> and Sam decorates cookies<sub>i</sub>.*
  - *bakes* and *decorates* both take two arguments.
  - *cookies* satisfies both verbs' need for an object.
- (2) *What<sub>i</sub> did Emmy eat \_\_\_<sub>i</sub>?*
  - *what* serves as both an operator and object of *eat*.
  - the operator is sentence initial but the verb's object typically follows the verb (in English).

### 1.2 Traditional Tree-Based Approaches

- Ellipsis



- Movement



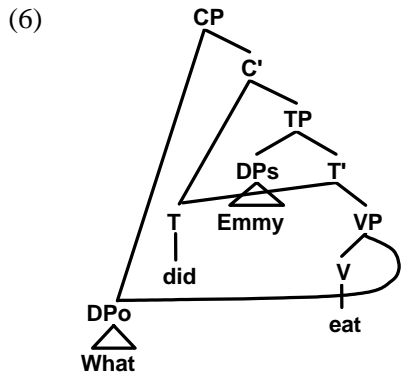
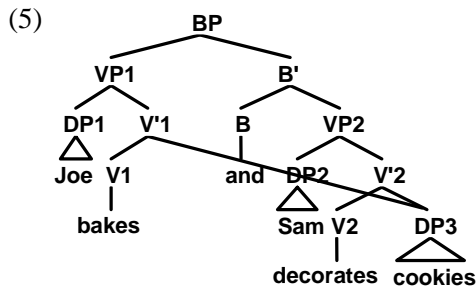
- (4)a, b Are not, strictly speaking, trees: co-indexing of nodes is essentially a mechanism for allowing an element to be immediately dominated by more than one parent.
- Instead we have characterized syntactic structures as:
  - involving *chains*, a moved element and its traces as a single syntactic object (Chomsky 1981)
  - sets of sets (Chomsky 1995).

... Unlike the phrase structure rules of early generative grammar, these characterizations do not appear to have clear graph-theoretic analogues.

### 1.3 Alternative Multidominance Approach

Also pursued by Gärtner (1997), Wilder (2001), Abels (2004), Goodall (1987), Moltmann (1992).

- Representation of syntactic structures with nodes and edges
- A *multi-dominance* approach: allow nodes to be immediately dominated by multiple parent nodes
  - Relax the one-parent-per-node restriction of trees.
- The set of syntactic structures is expanded to include non-tree graphs.
  - Structures below are possible analyses of (1), (2).



## Research Questions

... addressed in next talk (stay tuned!):

### How are the terminals in such graphs linearized?

How are multidominance structures pronounced?

... addressed in this talk:

### How are such graphs generated?

What introduces multidominance into the system?

- A Minimalist answer attributes the sort of multidominance in (6) to the syntactic operation of *Internal Merge* (Will it extend to coordination? If so how?)
- Tree Adjoining Grammar introduces multidominance via the *node contraction* operation (Sarkar and Joshi 1996). This is the answer pursued here.

What restrictions are there on multidominance?

- We will appeal to a notion of derivational locality that is required of multiply dominated elements.

## 2. TREE ADJOINING GRAMMAR BASICS

- Classic TAG (Joshi, Levy, and Takahashi 1975)
- Syntactic structures are built up by combining smaller pieces of structure.
- The primitive structures are a finite set of bounded pieces of structure called the *elementary trees*.
- The two combinatory operations are *substitution* and *adjoining*.
- A central claim of the TAG framework: All syntactic dependencies occur within the bounds of an elementary tree.

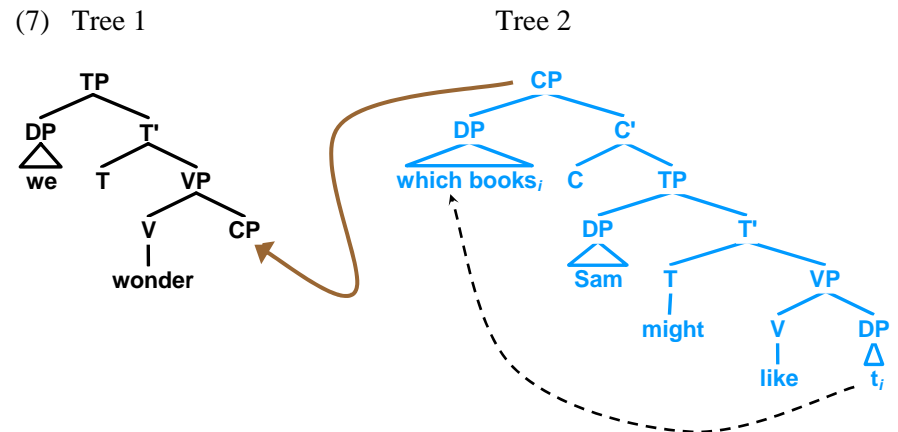
### 2.1 Elementary Trees

- The dependencies between:
  - A lexical head and its arguments
  - A moved element and its base position
 ... are part of the same elementary tree (Frank 1992).

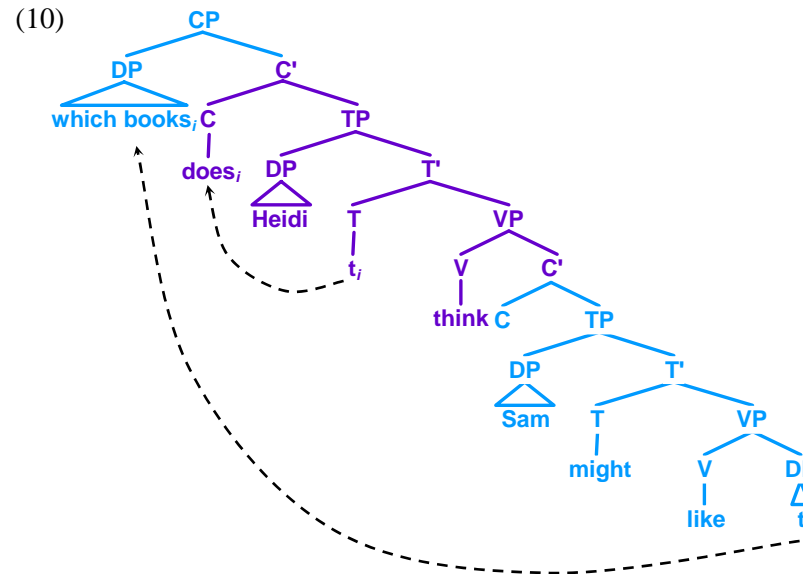
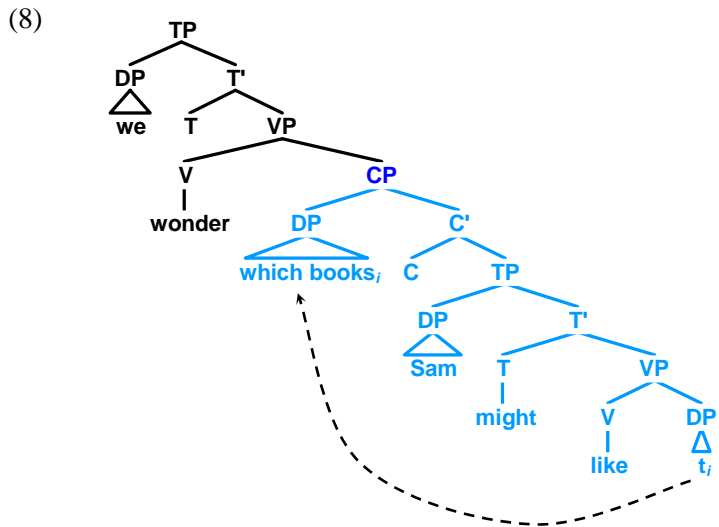
*More on the nature of elementary trees may be found in the appendix.*

### 2.2 Substitution and Adjoining

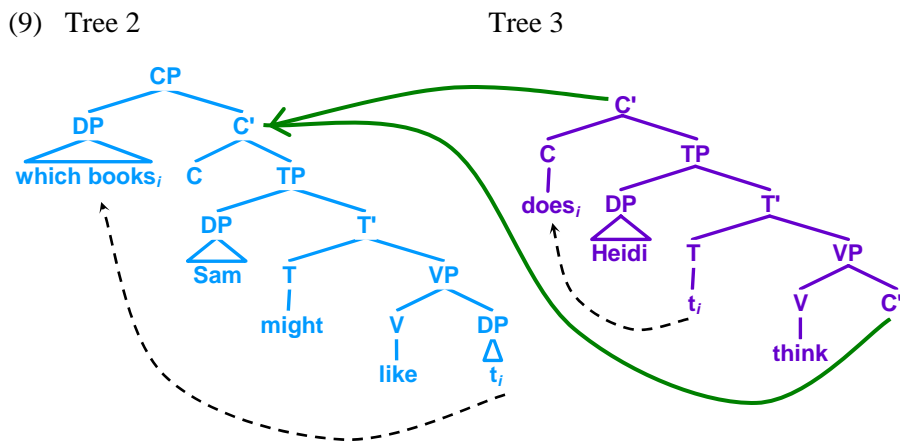
- The Substitution Operation: takes the root of one tree and identifies it with a node along a second tree's periphery.
- e.g. Tree 2 substitutes into Tree 1 at node CP to yield (8)



Note that in this classic TAG approach, *wh*-movement takes place within the elementary tree Tree 2. Thus, *like* and its arguments are in the same elementary tree.



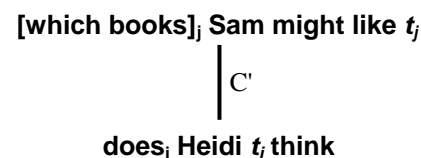
- The Adjoining Operation: Rewrites a node in one tree as an *auxiliary tree*.
  - *Auxiliary trees* are recursive: some node along their periphery is labeled identically to the label of its root node.
- e.g. Tree 3 adjoins into Tree 2 at node C' to yield (10)



### 2.3 Derivation Structures in TAG

- The sequence of derivational steps can be represented as a *derivation structure* (Vijay-Shanker 1987), a tree in which
  - nodes represent elementary trees
  - edges represent combination via adjoining or substitution.
    - The edge connecting a mother elementary tree A to a daughter elementary tree B indicates that B has either substituted or adjoined into A.
  - edge labels represent the locus of combination.
- e.g. The combination of Tree 3 and Tree 2 as shown in (9) can be represented with the derivation structure below.

(11) Derivation structure indicating Tree 3 combines with Tree 2 at C'.



Note that in this analysis of *Which books does Heidi think Sam might like*, the wh-movement is not cyclic. Rather, an auxiliary tree stretches the distance between *which books* and its base position.

### 3. NODE CONTRACTION IN TAG

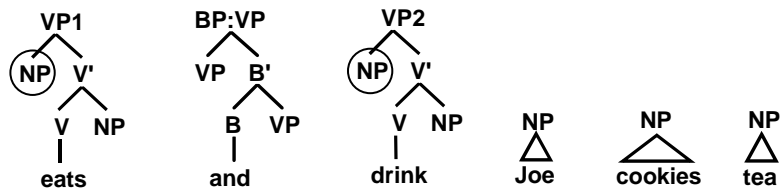
- Multidominance TAG = Classic TAG + node contraction

#### 3.1 Coordinate Structures in TAG (Sarkar and Joshi 1996)

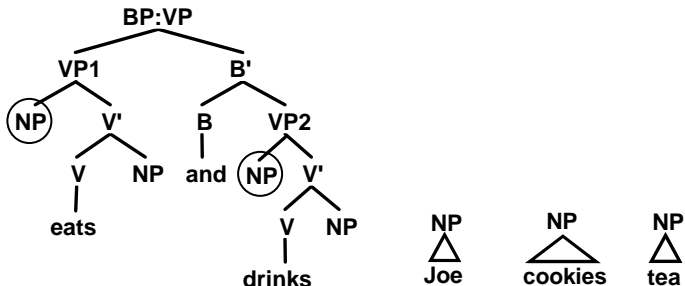
(12) *Joe eat cookies and drinks tea.*

- The Problem: coordination requires some means for two elementary trees to share arguments:
  - *Joe* is an argument of both *eats* and *drinks*.
  - *Joe* must be in the elementary tree headed by *eats* and the elementary tree headed by *drinks*.
- Sarkar and Joshi's (1996) Solution: introduce *node-contraction*, an operation that collapses two nodes that are both marked for contraction and of like categories into a single node.
- e.g. VP coordination example
  - Each lexical item anchors an elementary tree.
  - Circled nodes denote nodes marked for contraction.

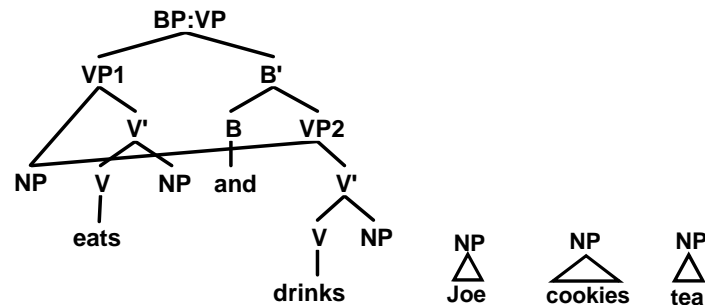
(13) Elementary trees involved in *Joe eats cookies and drinks tea.*



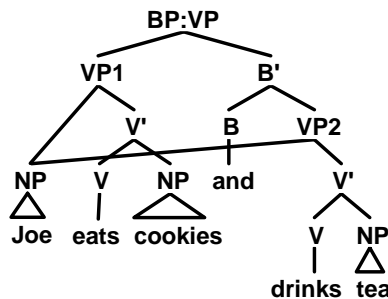
(14) Trees after some composition but before node contraction



(15) Trees after node contraction identifies the two NP nodes

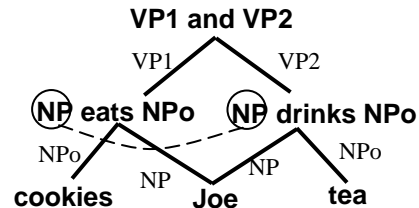


(16) Final structure after NPs substitute in.



- Augmented derivation structures
  - a new kind of edge corresponding to node contraction, marked with a dotted line.
  - use all the frontier nodes of an elementary tree as its label

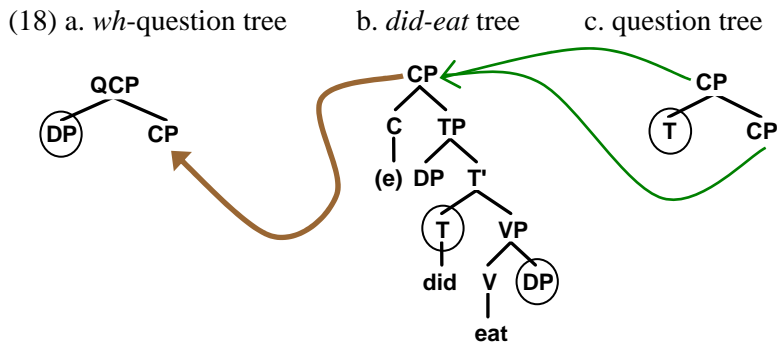
(17) Derivation structure for *Joe eats cookies and drinks tea.*



• **Proposal:**  
 Instead of being restricted to coordination . . .  
 Node contraction is a general mechanism in the TAG system.

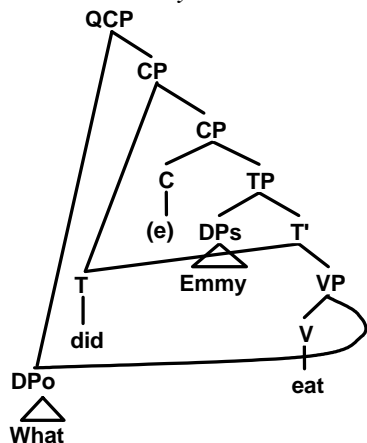
### 3.2 Generation of Questions

- Node contraction can replace elementary tree internal movement.
  - Only one copy of the “moved” element
  - Only one position.
  - This element is immediately dominated by two nodes.
- All elements are in their canonical position of interpretation.
  - The *did-eat* (with a T contraction node and a DP contraction node) substitutes into the CP node of (18a)
  - (18c) is adjoined into the *did-eat* tree



- Elements marked for contraction are collapsed
- Appropriate lexical items substitute into the DP nodes

(19) Structure for *What did Emmy eat?*



Side note for TAG enthusiasts: Augmenting the set of operations in TAG to include node contraction also allows the derivation of the interleaved constructions such as *Does<sub>i</sub> Sam<sub>j</sub> t<sub>i</sub> seem t<sub>j</sub> to like pizza?*. See appendix

### 4. DERIVATIONAL LOCALITY & ISLAND EFFECTS

- Island effects show that syntactic displacement is subject to certain restrictions: extraction is blocked from certain domains, e.g. adverbial modifiers:

(20) \* *Who<sub>i</sub> did Jane buy a new house [after t<sub>i</sub> got a raise]?*

- What restrictions on node contraction account for island effects?

#### 4.1 Locality Condition on Node Contraction (for English)

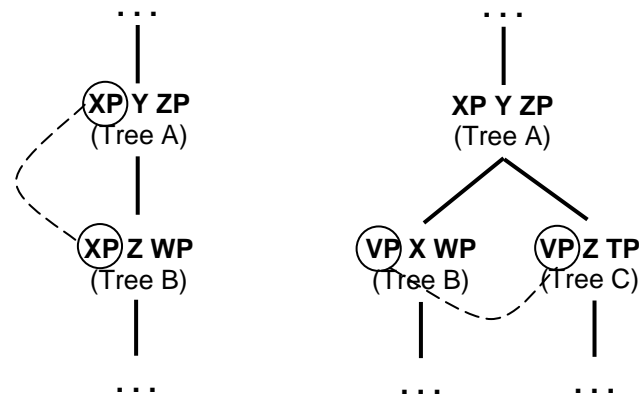
- If a node in tree A contracts with a node in tree B in a derivation C, then one of the following relationships hold in the derivation structure for C

- A is the mother of B,
- A is the daughter of B, or
- A is the sister of B.

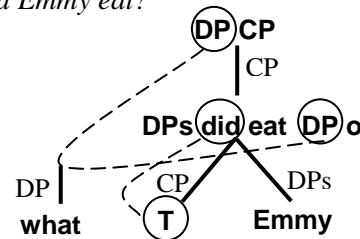
- examples of permitted configurations

(21) a. Contraction between mother and daughter

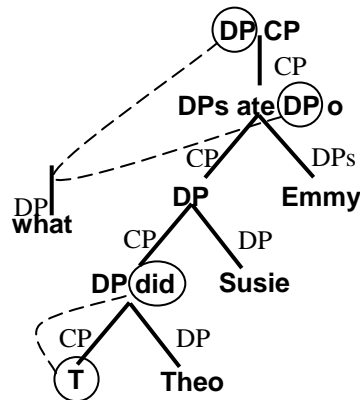
b. Contraction between sisters



(22) *wh*-question: contraction between mother and daughter:  
*What did Emmy eat?*

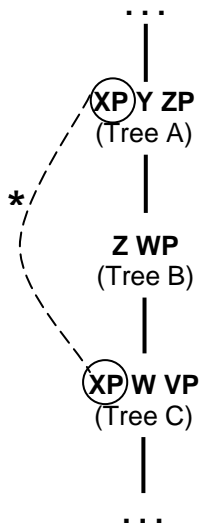


(23) cyclic *wh*-movement: contraction between mother and daughter  
*What did Theo think Susie said Emmy ate?*

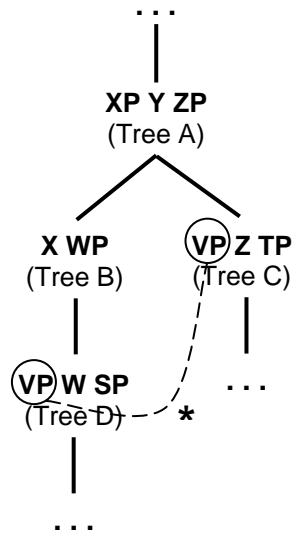


- examples of banned configurations

(24) a \* Contraction between grandmother and granddaughter



b. \* Contraction between aunt and niece



Let us turn to some linguistic consequences of excluding such configurations.

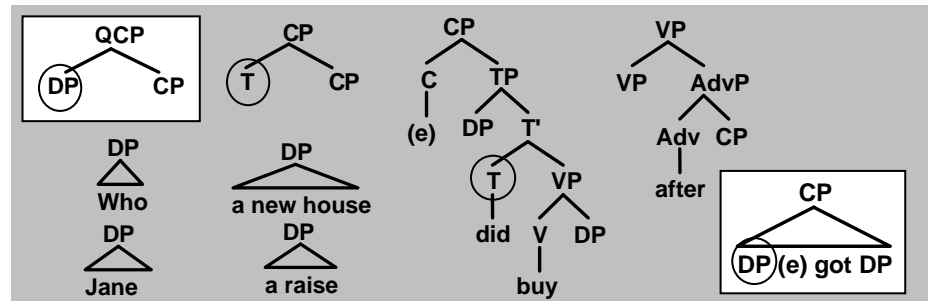
#### 4.2 Adverbial Modifiers Islands

- Extraction from adverbial modifiers is prohibited.

(25) \* *Who<sub>i</sub> did Jane buy a new house [after *t<sub>i</sub>* got a raise]?*

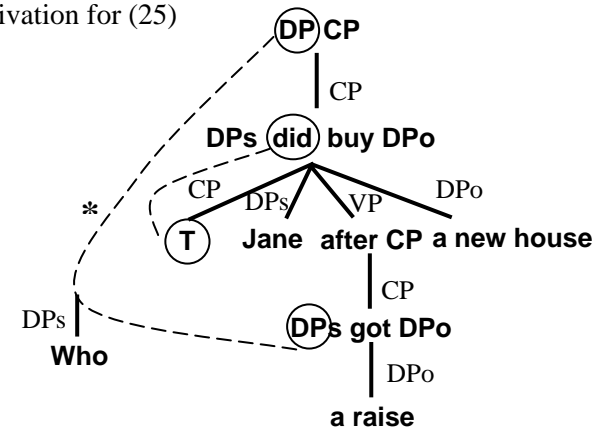
(26) Elementary trees that would be involved in deriving (25)

- contraction of nodes between the two boxed trees is prohibited



- To achieve the desired displacement, a pair of DP nodes, one from each boxed tree, must contract.
- This will violate the locality constraint. Consider the derivation tree:

(27) Failed derivation for (25)



- The question tree (DP CP) may only contract with nodes in its sole daughter tree, the matrix clause (DPs *did buy* DPo).
- Nodes in the modifying clause (DPs *got* DPo) may only contract with nodes in its mother tree, the auxiliary tree (*after* CP).
- Extraction from an adverbial modifier would involve contraction between trees in a great-grandmother-great-grandchild relationship: a configuration banned by the locality condition in 4.1.

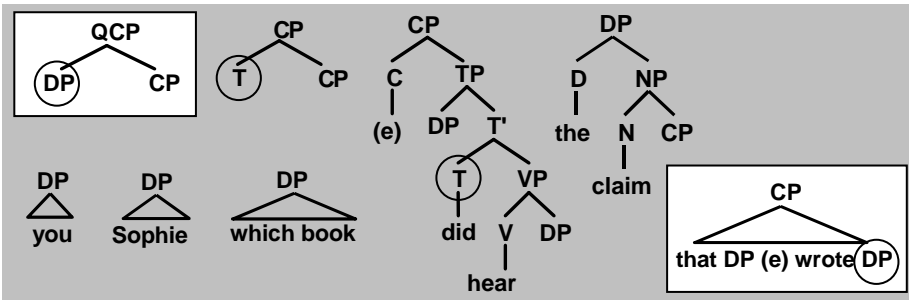
### 4.3 Complex NP Islands

- Extraction from complex NPs is prohibited.

(28) \* [Which book]<sub>i</sub> did you hear [the claim that Sophie wrote t<sub>i</sub>]?

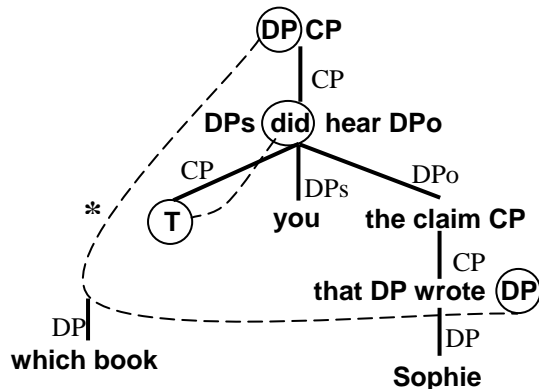
(29) Elementary trees that would be involved in deriving (28)

- contraction of nodes between the two boxed trees is prohibited



- To achieve the desired displacement, a pair of DP nodes, one from each boxed tree, must contract.
- This will violate the locality constraint. Consider the derivation tree:

(30) Failed derivation for (28)



- The question tree (DP CP) may only contract with nodes in its sole daughter tree, the matrix clause (DPs *did hear* DPo).
- Nodes in the clausal complement of *the claim* (that DP *wrote* DP) may only contract with nodes in its mother tree (*the claim* CP).
- Extraction from a complex NP would involve contraction between trees in a great-grandmother-great-grandchild relationship: a configuration banned by the locality condition in 4.1.

### 4.4 Coordinate Structure Constraint

- Part 1: generally, extracting elements from within a conjunct is prohibited.

(31) \* *What<sub>i</sub> will Jane [[buy t<sub>i</sub>] and [might wrap a gift]]?*

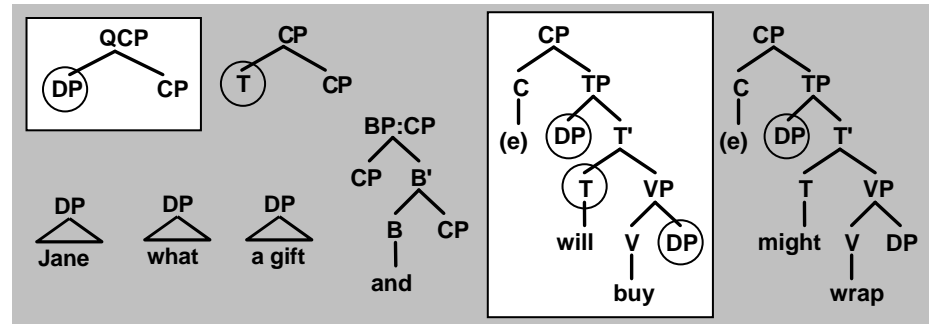
- Part 2: generally, extraction of a conjunct itself is prohibited.

(32) \* [*What*]<sub>i</sub> did Alice cook [ *t<sub>i</sub>* and [*pasta*]]?

#### 4.4.1 CSC Part 1: No Extraction of an Element from Within a Conjunct

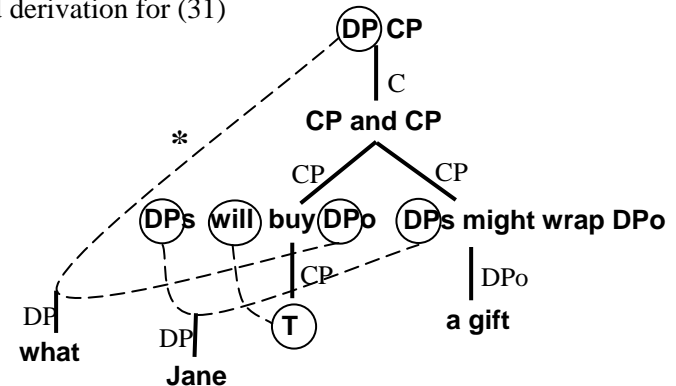
(33) Elementary trees that would be involved in deriving (31)

- contraction of nodes between the two boxed trees is prohibited



- To achieve the desired displacement, a DP node from the question tree (in the upper left corner) must contract with the object DP node from the *will-buy* tree (second from the right).
- Because each conjunct must substitute into the coordination tree which must then substitute into the wh-question tree, the conjuncts and the wh-question are in a grandmother-granddaughter relationship: not a local relationship.

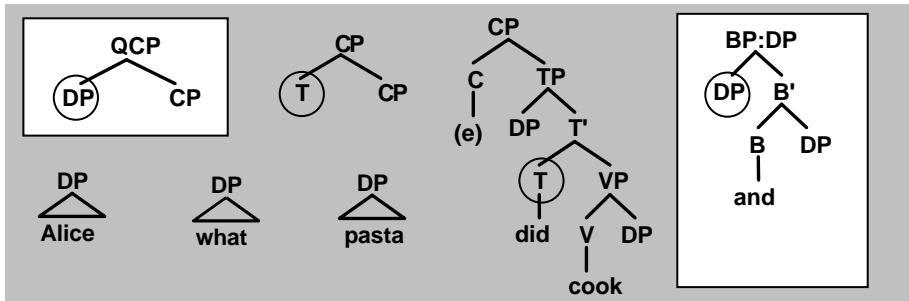
(34) Failed derivation for (31)



#### 4.4.2 CSC Part 2: No Extraction of a Conjunct

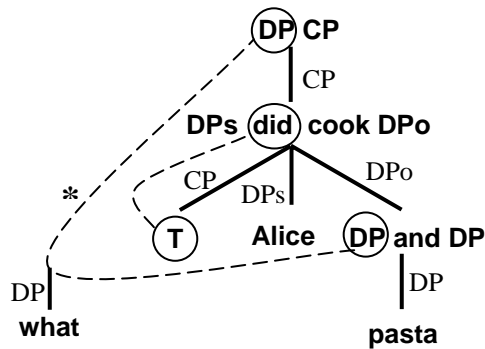
(35) Elementary trees that would be involved in deriving (32)

- contraction of nodes between the two boxed trees is prohibited



- To achieve the desired displacement, a pair of DP nodes, one from each boxed tree, must contract.
- Extraction of a conjunct would require contraction between nodes in a grandmother tree and granddaughter tree: not a local relationship.

(36) Failed derivation for (32)



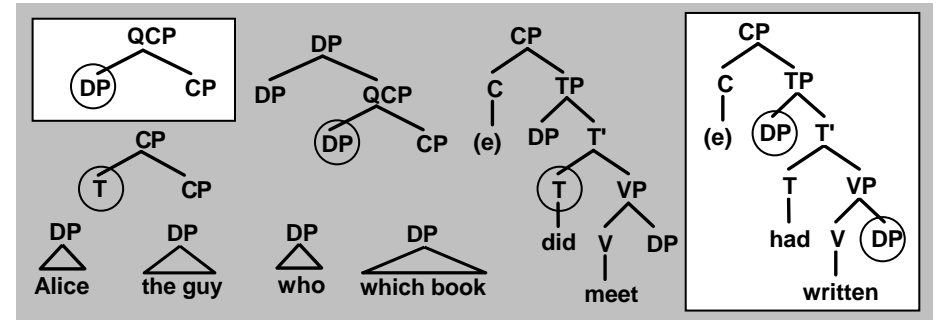
#### 4.5 Relative Clauses

- Extraction from relative clauses is prohibited.

(37) \* [Which book]<sub>i</sub> did Alice meet the guy [who had written t<sub>i</sub>]?

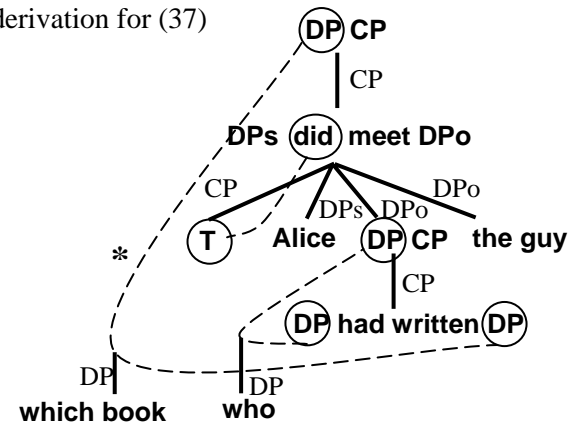
(38) Elementary trees that would be involved in deriving (37)

- contraction of nodes between the two boxed trees is prohibited
- Note that this set includes a relative clause tree: the *wh*-question tree + a recursive piece of structure to allow it to modify a DP.



- To achieve the desired displacement, a DP node from the question tree (in the upper left corner) must contract with the object DP node from the *had-written* tree (on the right).
- This will violate the locality constraint. Consider the derivation tree:
  - (The derivation below depicts the relative clause tree as adjoined to the matrix clause, even though the more standard assumption is that the relative clause adjoins into the object DP. This assumption minimizes the distance between the relative clause itself and the *wh*-question tree, making it the more generous of the two possibilities.)

(39) Failed derivation for (37)



- The question tree (DP CP) may only contract with nodes in its sole daughter tree, the matrix clause (DPs *did meet* DPo).
- Nodes in the relative clause (DP *had written* DP) may only contract with nodes in its mother tree, the relative-clause tree (DP CP).
- Extraction from a relative clause would involve contraction between trees in a great-grandmother-great-grandchild relationship: not a local relationship.

## Derivational Locality Summary

- Locality condition at the derivational level derives strong island effects, such as:
  - Adverbial Modifiers
  - Complex NPs
  - Coordinate Structure Constraint, parts 1 & 2
  - Relative clauses
- Given the elementary trees assumed for English, derives language particular island effect, such as:
  - Wh-islands
  - Subject islands

(not shown here – but please do not hesitate to ask for details)

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## 5. SUMMARY

- Multidominance is introduced via general node contraction.
- Allowing general node contraction in TAG provides a unified mechanism for coordination and movement (sans traces).
- A locality condition at the derivational level restricts node contraction to derive island effects are.

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APPENDIX:

A. On the Nature of Elementary Trees

The way in which the primitive structures in TAG are characterized is built on the notion that syntactic dependencies occur within a local domain. Elementary trees are taken to be the local domain. One of the dependencies that is generally taken to occur within the bounds of an elementary tree is the relationship between a verbal head and its thematic arguments. Thus, it is typically assumed that elementary trees include slots for any arguments of the tree's lexical head. This is part (a) of the theta criterion for TAG, which is given in Frank (1992, 2002). Not only so, but every substitution node in an elementary tree must be assigned a theta role. This is stated in part (b).

- (1) Theta-Criterion (TAG version)
  - a. If H is the lexical head of elementary tree T, H assigns all of its theta-roles within T.
  - b. If A is a frontier nonterminal node of elementary tree T, A must be assigned a theta-role in T.

The dependency between a moved element and its base position is another dependency taken to be within an elementary tree. Thus, in a system without multidominance, head movement suggests that elementary trees must be larger than phrases. Based on V to I and I to C movement, Frank (2002, 1992) contends that an elementary tree can be as large as an extended projection, a claim that aligns with Grimshaw's (1991) arguments that extended projections behave as a syntactic unit. Below, we give the Condition on Elementary Tree Minimality given in Frank (1992, 2002).

- (2) Condition on Elementary Tree Minimality (CETM)
  - The syntactic heads in an elementary tree and their projections must form an extended projection of a single lexical head (in the sense of Grimshaw (1991)).

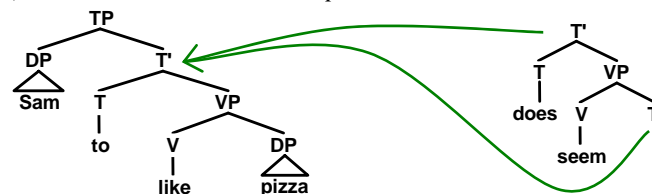
Taking the TAG Theta-Criterion and the CETM together, we can characterize elementary trees in traditional TAG as extended projections that include argument slots for any arguments of the tree's lexical head. In TAG with multidominance, we will distinguish between elementary trees that are lexically anchored vs. those that are not. Those that are lexically headed will still satisfy the Theta-Criterion. The CETM in classic TAG is argued for on the basis of requiring that a pronounced element and its silent copies be in the same elementary tree, but once we begin working within Multidomination-TAG, the trees need not obey the CETM to be in accord with the notion that syntactic dependencies are elementary tree local, as there is in fact only a single element. Instead, the CETM places an upper bound on the size of an elementary tree.

B. On Generating Interleaved Constructions

Above, we saw that a traditional TAG system has two types of dislocation: elementary tree internal movement (in the traditional transformation sense) and

stretching via adjoining a tree between two elements of another tree. Subject raising has been analyzed as the latter type of dislocation, as in (3).

(3) *Sam does seem to like pizza.*



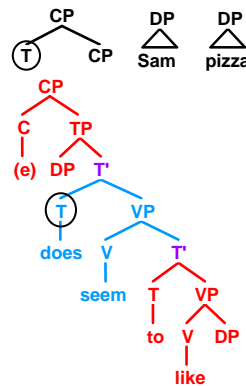
Head movement of *does* has been analyzed as elementary tree internal movement, so constructions such as the one in (4) involve both types of dislocation:

(4) *Does<sub>i</sub> Sam<sub>j</sub> t<sub>i</sub> seem t<sub>j</sub> to like pizza?*

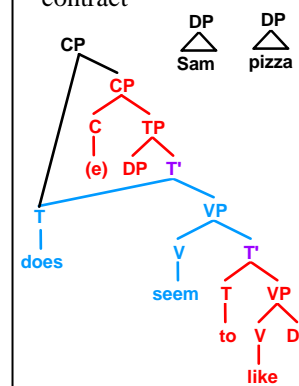
These constructions have been difficult for traditional TAG, because they require that adjoining and elementary tree internal movement interact in some manner that allows interleaving of elements of elementary trees. In this example, *does*, *seem*, and the position that *does* extracts out of all ought to belong to the same elementary tree, which is presumably adjoined into the *Sam to like pizza* tree. The puzzle is how the final position of *does* comes to be higher than *Sam* while the final position of *seem* (and presumably the trace of *does*) is simultaneously lower than *Sam*. The puzzle is not an isolated case. As Kulick (2000) discusses, constructions such as clitic climbing, long passives, and long scrambling case from Romance and Germanic languages also appear to involve interleaving of elements from two elementary trees. To address these types of constructions, a number of extensions to TAG have been proposed (e.g. (Rambow 1994), (Bleam 2000), (Kulick 2000)).

Augmenting the traditional combinatorial operations in TAG with node contraction also straightforwardly allows the derivation of interleaved constructions. The derivation of (4) is as follows.

(5) Trees after *does-seem* tree adjoins into the *to-like* tree in the usual fashion



(6) Trees after the *to-like* tree substitutes into the question tree and the T nodes contract



(7) Final structure after the DP's substitute in.

