# ESSLII 2004

## Language Dynamics and The Dialogue Challenge

Ruth Kempson, Ronnie Cann

kempson@dcs.kcl.ac.uk; ronnie@ling.ed.ac.uk

Extracts from:

## The Dynamics of Language

Ruth Kempson, Ronnie Cann, Lutz Marten

**WORKING DRAFT MAY 2004**

# Contents


**1 The Dynamics of Interpretation** **1**
- 1.1 A sketch of the process . . . 1
- 1.2 The Tools of Dynamic Syntax . . . 4
  - 1.2.1 Treenode Decorations . . . 5
  - 1.2.2 Requirements and Tree Growth . . . 6
  - 1.2.3 The Logic of Trees . . . 8
- 1.3 Constructing Trees . . . 11
  - 1.3.1 Starting Off . . . 11
  - 1.3.2 Lexical Information . . . 13
  - 1.3.3 Completing the Tree . . . 17
- 1.4 Left Dislocation Structures . . . 23
- 1.5 Anaphora . . . 30
  - 1.5.1 Pro drop and word order variation . . . 36
- 1.6 Wellformedness and ungrammaticality . . . 41

**2 Relative Clause Construal** **45**
- 2.1 Relative Clauses 1: Linked Structures . . . 45
  - 2.1.1 Nonrestrictive relatives . . . 46
- 2.2 Interactions of Anaphora and Long-Distance Dependency: crossover 49
- 2.3 Quantifier Phrases as Terms . . . 54
  - 2.3.1 Scope Effects of Indefinites . . . 57
  - 2.3.2 Term-Operator Evaluation Rules . . . 63
  - 2.3.3 The Process of Name Construction . . . 65
- 2.4 Relative Clauses 2: specifying domain restrictions . . . 67
  - 2.4.1 Restrictive-relative construal . . . 68
  - 2.4.2 Quantification and nonrestrictive construal . . . 70
- 2.5 Appendix A: The Scope Evaluation Algorithm and mixed quantification construal. . . . 73

**3 Tree Growth and Language Typologies** **74**
- 3.1 The basic variants of clausal structure . . . 75
- 3.2 Towards a Relative Clause Typology . . . 76
  - 3.2.1 Resumptive pronouns in Arabic . . . 76
  - 3.2.2 Mixed Systems . . . 80
  - 3.2.3 Romance Languages, resumptive pronouns and locality . 83
  - 3.2.4 Resumptive Pronouns in English . . . 85
- 3.3 Towards a left periphery typology . . . 90
  - 3.3.1 Building linked structures at the left periphery . . . 92

3.3.2 Overlapping analyses . . . 95
3.4 Summary . . . 103

**4 On the Right Periphery 105**
4.1 Right Dislocation . . . 105
4.2 Linked structures and Recapitulation effects . . . 106
4.3 Late *Adjunction . . . 110
4.3.1 Extraposition . . . 112
4.3.2 Subject Inversion . . . 115
4.3.3 Clitics in Porteno Spanish . . . 117
4.4 Summary. . . . 120

**5 General Perspectives 122**
5.1 Well-formedness in a Non-encapsulated System . . . 122
5.1.1 Defining Context . . . 122
5.1.2 Context and Wellformedness . . . 124
5.1.3 Acceptability . . . 130
5.2 Grammars and Parsers . . . 134
5.3 Dialogue as a window on production . . . 136
5.3.1 Dialogue Data . . . 136
5.3.2 Production - The Dynamic Syntax Account . . . 138
5.3.3 The context-sensitivity of production . . . 139

**6 Bibliography 144**

# Chapter 1

# The Dynamics of Interpretation

We have a two-fold challenge ahead. The first is to set out a model of how interpretation is recovered in context. The second is to establish why this constitutes the basis for syntactic explanations. As we saw in the previous chapter, the heart of the explanation is our commitment to reflecting the way humans can manipulate partial information and systematically map one piece of partial information into another in language processing, using each piece of information provided as part of the context for processing each subsequent input. The challenge is to use these, intrinsically dynamic, concepts to replace analyses which depend on a discrete syntactic vocabulary, involving concepts such as movement, etc. It is in this respect, above all, that this formalism will depart from all other widely adopted grammar formalisms, such as minimalism, HPSG, LFG, categorial and tree-adjoining grammar formalisms. In this chapter, we set out the basic framework, beginning with a sketch of the process of building representations of content and subsequently developing the concepts and technical apparatus.[1] The discussion will be kept as informal as possible, but more formal material is introduced so that readers can get a feel for the formal basis of the theory.[2] In later chapters, formal material will be relegated to appendices.

## 1.1 A sketch of the process

What we will be modelling is the process whereby information is built up on a left-to-right, word-by-word basis relative to some context against which choices may be made as the construction process proceeds. To do this, we take the concept of a TREE STRUCTURE familiar in syntax and use it to represent, not structure defined over words in a string, but the interpretations assigned to words uttered in context. Thus, the tree we assign to a string like *Hilary upset Joan* is not something like those in Figure 1.1 but like that in Figure 1.2.

[1]This chapter and the next will be particularly indebted to Wilfried Meyer-Viol, whose work in articulating the formal foundations of Dynamic Syntax, it essentially reports.

[2]Full details of the formal characterisation of the system can be found in Kempson, et al. 2001.

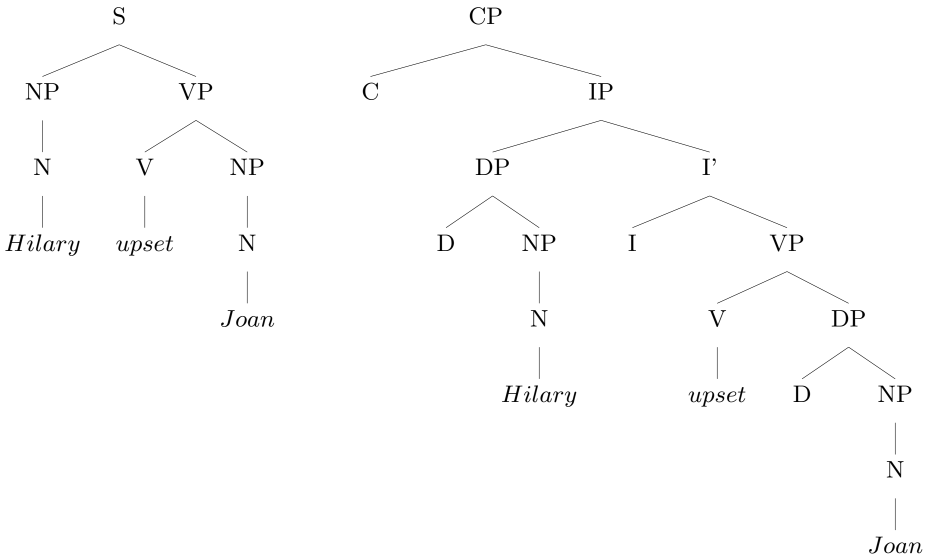



Figure 1.1: Representing the structure of strings

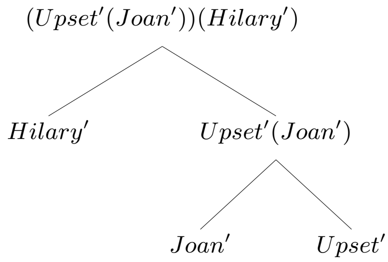



Figure 1.2: Propositional Structure as Tree Structure

So what is the difference between the trees in Figures 1.1 and 1.2? In the first place, the tree in Figure 1.2 contains no information about word order. There is no claim here that English is verb final! Instead, the tree represents the semantic structure of the propositional content expressed by the string *Hilary upset Joan* so that what labels the nodes in the tree are compositionally derived CONCEPTS, expressed in some lambda calculus, just as in certain versions of Categorial Grammar (see, for example, Morrill 1988, Carpenter 1998, etc.). The tree thus reflects a jigsaw view of how we can entertain complex concepts (Fodor 1999), but notably not a jigsaw view about words (the notation for words and concepts will be distinguished by the word being italic, *John*, the concept being non-italic and with a prime, $John'$). The trees in Figure 1.1, on the other hand, reflect putative properties of words in strings that define structure over those strings. So, VP labels a node that consists of a word that is a verb plus another word that functions (simultaneously) as a noun and a noun phrase (and possibly a determiner and determiner phrase). The syntactic structure determined (or projected) by the words exists independently of the words themselves and is constrained by independently defined rules or principles, again stated over strings of words.

Tree structures in Dynamic Syntax are, however, not representations of the structures of sentences, where a sentence is a string of words in a particular order. They are structured representations of the interpretation assigned to sentence in the contexts in which they are taken to be uttered. And these are importantly different. Given the Fodorian perspective on interpretation, the representations constitute the means we have for interpreting the sequence of words, and are essentially not just some structural arrangement of the words themselves.

A second difference between the Dynamic Syntax conception of trees and that of declarative frameworks like HPSG (Wasow and Sag 2000) is that the steps by which one reaches the final output are as important as that output itself. As we shall see later in this book, certain interpretations are constrained by the way that the final tree is constructed; and concepts like topic and focus may be derived through the process of tree construction rather than being attributed either to some other layer of information (Valduvi) or being encoded directly in the syntactic representation (Rizzi 1998, XXX). Furthermore, unlike derivational theories such as Principles and Parameters or the Minimalist Program (Chomsky 1981, 1995), the process by which a representation such as that in Figure 1.2 is built up is on a strictly word-by-word basis from left to right. The process is thus, as discussed in the previous chapter, the parsing process, extracting information from a string in context.

The way this is achieved is to begin from a goal associated with some very partial structure and progressively enrich that structure through the parse of a string of words. Following Sperber and Wilson, the starting point for any parsing effort is simply the goal to establish some propositional formula as interpretation, and this overall goal may lead to other subgoals as more information comes in. Thus, in establishing the structure in Figure 1.2, we assume stages like those shown in Figure 1.3, starting from the goal to build a tree with propositional content (shown as the requirement $?Ty(t)$, see below) and adding information as each word is parsed and finally building up the dominating nodes in the tree with the semantic information associated with those words.

We shall see below that parsing a string like *Joan, Hilary upset* while it leads to an output tree structure identical to that in Figure 1.2 undergoes a process of tree growth unlike that in Figure 1.3. Rather, the parsing of *Joan* leads to the introduction of a node decorated by the term $Joan'$, WITHOUT that node being fixed in the tree. A regular tree is then constructed as before from *Hilary* and *upset* which provides a node for the internal argument node, which can then be unified with the node decorated by $Joan'$. Hence, the very same tree is derived as from the parse of *Hilary upset Joan.* It is this difference in the PROCESS of getting to the resulting logical form that gives rise to the different informational characteristics of the left dislocated construction. The goal of this chapter is to flesh out these ideas.

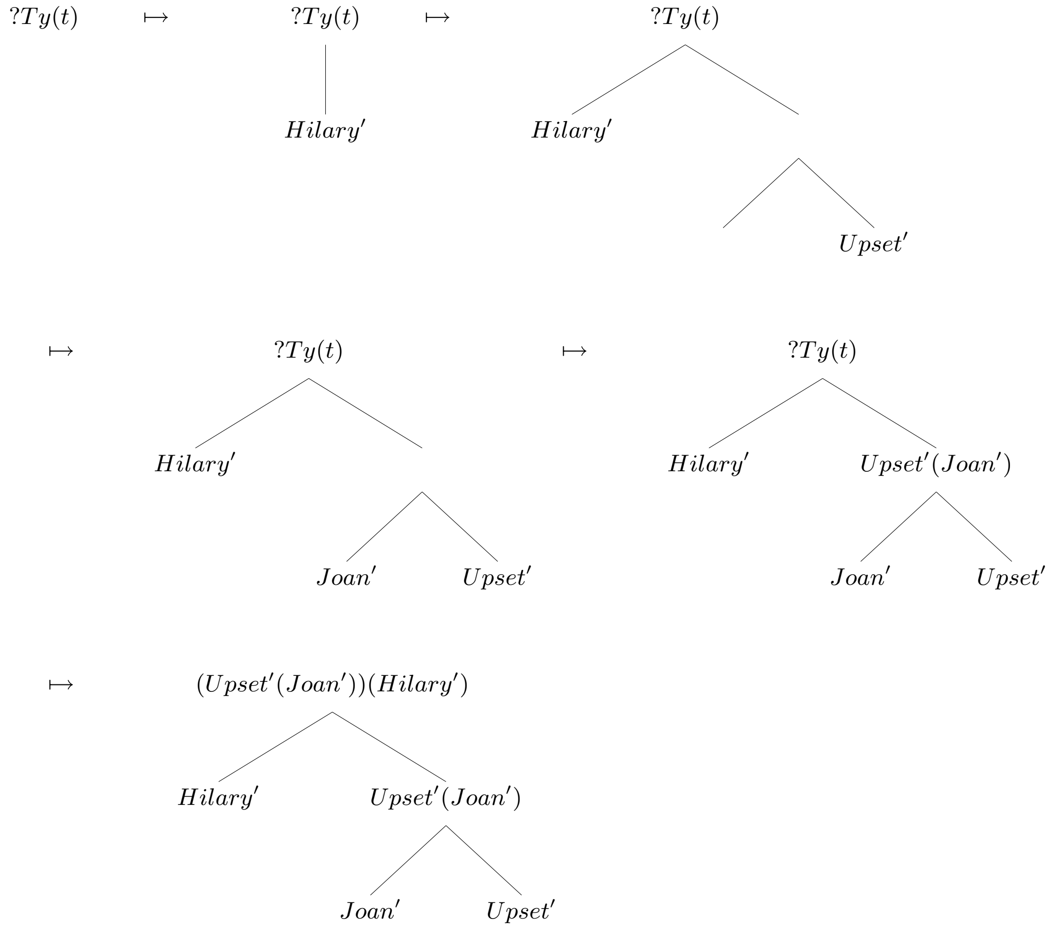



Figure 1.3: Parsing *Hilary upset Joan*

## 1.2 The Tools of Dynamic Syntax

We now start providing the tools for deriving interpretations of strings in context. The presentation in this chapter (and throughout the book) will remain relatively informal, while at the same time introducing the technical concepts needed to understand how the system works. This chapter is thus of necessity fairly technical to allow the reader to understand the formal basis of the framework. In later chapters, this formality will be eschewed in favour of a more informal exposition, with technical matters largely relegated to appendices. As indicated above, we are assuming that logical forms for sentences are represented as trees with each subterm of the logical form decorating a discrete node in the tree. The first step we have to take is to be more explicit about the representation language itself and then the trees that show the content of utterance strings. To do this, we need to define what it means to be a tree, what it means to be a partial tree, and what it means to grow from one tree into another.

### 1.2.1 Treenode Decorations

We have seen how the nodes of our trees are decorated with semantic expressions (or concepts). We call these FORMULAE and express them as values of a predicate $Fo$. So we write $Fo(Sing'(John'))$ for the semantic information expressed by the string *John sang* (ignoring tense here). Formula values, we take as representations of the concepts that words are taken to mean. So we assume that from the English word *John*, we construct the concept $John'$, itself a term denoting a particular individual called John; from the word *sing* we construct the concept $Sing'$, and so on.[3]

The formula is just one of several LABELS that can decorate a node. In addition to the formula label, we also have a label that gives information about the TYPE of the formula expression. The type of an expression is its semantic category, associating an expression with a particular sort of denotation. So, an expression of propositional type $t$ denotes a truth value; that of type $e$ is a term that denotes some entity. Functor types are represented as conditional statements so that expression of type $e \rightarrow t$ expresses a (one-place) predicate, since when it combines with a term (of type $e$) it yields a proposition (of type $t$) and denotes a set (see any number of introductory books on formal semantics, e.g. Chierchia and McConnell-Ginet 1991, Cann 1993, Gamut 1991, Carpenter 1998). Although most theories of types assume a recursive definition, yielding an infinite set of types, Dynamic Syntax makes use of only a small, predefined, set consisting of three basic types $e,\ t,\ cn$[4]; and a restricted set of functors based on these to provide sufficient structure to account for the number and types of arguments of verbal and nominal predicates. There is also a type $cn \rightarrow e$ that is assigned to quantifiers (see chapter 2). Type raising operations and the higher order types associated with Montague and Categorial Grammar play no part in the grammar formalism, since, as with the replacement of movement, concepts of underspecification of update replace those of type-lifting and composition of functions. The table in(1.1) lists the most common types used in this book with a description and examples. The various types will be discussed very shortly.[5] the first exemplified

[3]It should be noted here that we are not in this book probing the internal structure of concepts themselves. So we have nothing to say about the concept *Sing'* or *Love'*; and indeed nothing to say about the relation between the word *loves* and the concept which it expresses, other than that it expresses the concept *Love'*. This is a huge and complex topic. At the two extremes, some have argued for definitions associated with words (eg Bierwisch 1969), others for a one-to-one word-concept correspondence (Fodor 1981), with various intermediate positions (eg Pustejovsky 1995, Rappaport and Levin 1998). Yet others have noted that concepts vary according to the particular context in which they are used, so there is a context-dependency to the use of words to express concepts much like the context-dependence in using pronouns (Carston 2002). For the purposes of this book, we adopt the view of Fodor 1981 that words express primitive concepts, with a word and the concept it expresses being in one-to-one correspondence (see Marten 2002).

[4]The latter being the type assigned to common nouns where the formula consists of an ordered pair of variable plus a propositional formula where that variable occurs free. See chapter 2.

[5]All quantifying expressions are analysed as terms of type $e$, for example the term $\epsilon, x, Student(x)$ listed is the analogue in these terms of existential quantification $\exists, x, Student(x)$.

(1.1) **Common Types**

| **Type** | **Description** | **Example expression** |
|---|---|---|
| $Ty(e)$ | Individual term | $Fo(Mary'), Fo(\epsilon, x, Student(x))$ |
| $Ty(t)$ | Proposition | $Fo(Sing'(John'))$, $Fo((Upset'(Hilary'))(Joan')$ |
| $Ty(e \rightarrow t$ | (1-place) Predicate | $Fo(Upset'(Hilary')), Fo(Run')$ |
| $Ty(e \rightarrow (e \rightarrow t))$ | (2-place) Predicate | $Fo(Upset'), Fo(Give'(John'))$ |
| $Ty(e \rightarrow (e \rightarrow (e \rightarrow t)))$ | (3-place) Predicate | $Fo(Give'), Fo(Put')$ |
| $Ty(t \rightarrow (e \rightarrow t))$ | (Proposition taking) Predicate | $Fo(Believe'), Fo(Say')$ |
| $Ty(cn)$ | Nominal | $Fo(x, Student'(x))$, $Fo(y, Father(John)(y))$ |
| $Ty(cn \rightarrow e)$ | Quantifier | $Fo(\lambda P.\epsilon, P), Fo(\lambda P.\tau, P)$ |

Trees should, therefore, show nodes decorated not only with formulae but also their associated types, as in Figure 1.4. In fact, all information holding at, or annotating, a tree node are stated as DECLARATIVE UNITS, or tree node descriptions. These declarative units (DUs) consist of consistent sets of labels expressing a range of different sorts of information. This tree displays how in-

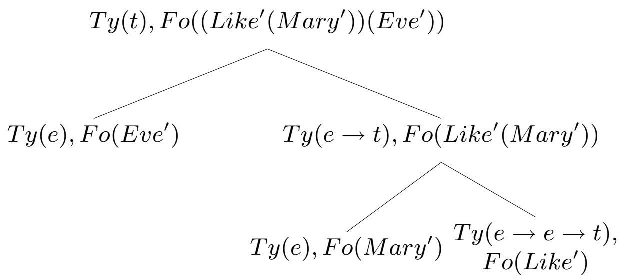



Figure 1.4: Representation of content of *Eve likes Mary*

formation from the functor nodes combines with information from the argument nodes to give the complex formula value at the mother node. Similar to Categorial Grammar, application of modus ponens over type values is paralleled by function-application over formula values.[6]

### 1.2.2 Requirements and Tree Growth

We now have the minimum required to introduce the vocabulary for talking about how complex concepts can be incrementally built up. The dynamics of the DS system is defined by characterising how trees grow. This means that DS derivations, or parses, start from only minimal trees and proceed through stages of partial trees until the tree is fully developed, providing the propositional content of a string in some context of utterance. What pushes the parsing process along is the need to specify underspecified information through the process of satisfying REQUIREMENTS. A requirement specifies a goal to be undertaken with respect to providing an instance of some label at the current node:[7] it is shown

[6]However, in this notation, DS types are conditional types without any implication for the order of natural language expressions (unlike the “forward-slash” and “backward-slash” of Categorial Grammars).

[7]Requirements may be modal in form in which case the specified goal may be achieved by an instance of the label at some other node, see below.

by a question mark in front of the label to be instantiated. While requirements may operate with respect to any label, the building blocks of a tree are provided by requirements to establish formulae of particular types. So, for example, the universal requirement to establish propositional content is shown by the requirement $?Ty(t)$. This requirement provides the minimal initial tree of a derivation, a tree with only a root node, underspecified of content but with a goal to derive a formula of type $t$: thus, $Ty(t)$ holding at a node means that some formula of type $t$ is constructed at that node, while $?Ty(t)$ holding at a node shows that all that has been established is a **goal** of constructing such a formula. This goal is then satisfied when the information provided by some string of words yields a propositional formula, allowing the label $Ty(t)$ to be annotated on the root node.

Requirements may be satisfied in a number of ways but a common way is to break the current task down into subgoals – in effect replacing the current goal with smaller goals which, if successful, will lead to the satisfaction of the current goal. At any stage in a derivation of a tree, therefore, some information might have been established, and some other goals might remain outstanding. The derivation is completed if, after all information from the lexicon has been incorporated into the tree, all requirements have been fulfilled.

For any stage in a derivation, a current node can be identified. This is by the use of a "pointer" – $\diamondsuit$, itself part of the language for describing trees. When a pointer is at a node, the requirements holding at that node show what task state is currently under development. So the initial tree in a derivation should look like:

$$?Ty(t), \diamondsuit$$

We assume that the parse of *Eve likes* gives rise to the tree in Figure 1.5 through mechanisms that we shall see below. At this stage, there are three requirements,

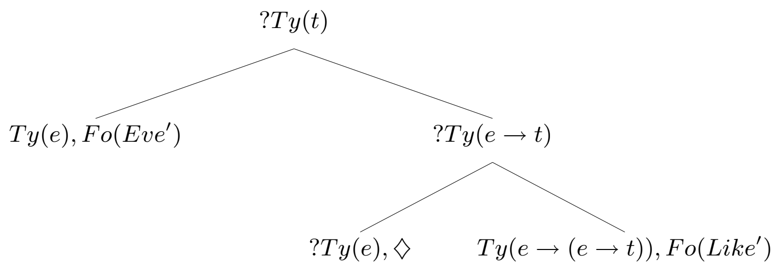



Figure 1.5: Parsing *Eve likes*

$?Ty(t)$ , $?Ty(e \rightarrow t)$, and $?Ty(e)$. The pointer symbol, $\diamondsuit$, shows that, following the processing of *Eve likes*, the node under development is the internal argument node of the predicate projected by the verb. The current task state is thus $?Ty(e)$, a requirement to construct a term. If, in this situation, information from the lexicon provides an expression of $Ty(e)$ (such as by a parse of *Harriet*), it can be introduced into the tree at that node, since it matches, and so satisfies, the current requirement. However, if the next word is *sing*, its associated predicate $Fo(Sing')$ cannot be introduced into the tree even though its type, $Ty(e \rightarrow t)$, matches one of the requirements. This is because the pointer is not at the node at which this requirement holds and so no update can be provided by the word *sings*, and the sequence of actions induced by parsing the verb cannot lead to a completed logical form. Hence, the sequence of words **Eve likes sings* is not a grammatical one. The pointer thus gives important information about the current state of a parse and the theory of how the pointer moves will form a significant role in the analyses to be presented in later chapters of the book. As you can see from this sketch of a simple example, the notion of grammaticality rests, not merely on whether a certain parse leaves requirements unsatisfied, but also on where the pointer is at any particular point in a parse.

### 1.2.3 The Logic of Trees

The formal backbone of the theory of tree growth sketched above, and elaborated in the next section, is the logic of finite trees (LOFT) (Blackburn and Meyer-Viol 1994, Kempson et al 2001). This is a modal logic which describes binary branching tree structures, reflecting the mode of semantic combination in functional application. Nodes in a tree may be identified by a numerical index ranging over 0 and 1 as in Figure 1.6. By convention, the left daughter node of

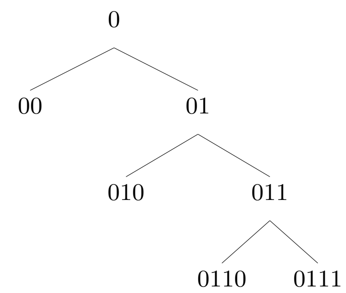



Figure 1.6: Tree Locations

a node $n$ is assigned the index $n0$ and the right daughter is assigned the index $n1$. This information may form part of a Declarative Unit (the information collected at a node) and is expressed by the predicate $Tn$ (tree node) which takes as value some index, as illustrated in the tree in Figure 1.7. In this tree,

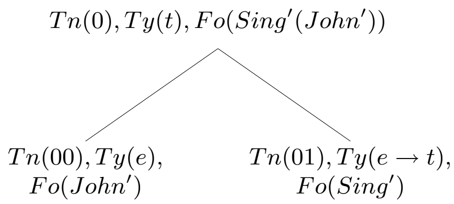



Figure 1.7: Tree-locations from a parse of *John sings*

the left daughter is decorated with an argument formula, the right daughter is decorated with a formula which is a functor that applies to that argument to yield the decoration at the mother. As a convention, this is a pattern we shall retain throughout: arguments as left daughters, and functors as right daughters.

So far our vocabulary can only describe individual nodes. However we can describe the relation between tree nodes if we add modal operators to the language of description. The relations between tree nodes can then be described by modal statements which provide a means to state that some information holds at a daughter or at a mother node, and more important, as we shall later see, a means to express requirements that need to be satisfied at some node other than the current node.

There are two basic modalities, one corresponding to the DAUGHTER RELATION, $\langle\downarrow\rangle$ 'down', and one corresponding to the MOTHER RELATION, $\langle\uparrow\rangle$ 'up'. These can be used with and without the numerical subscript, depending on whether it is important to distinguish between left (argument) and right (functor) branches. Hence, $\langle\downarrow_1\rangle$ refers to the functor daughter, while $\langle\downarrow_0\rangle$ refers to the argument daughter node (and similarly for the mother relation, $\langle\uparrow_1\rangle, \langle\uparrow_0\rangle$, but in this case there is only ever a single mother). As these symbols form part of a modal logic, an expression like $\langle\downarrow_0\rangle Ty(e)$ at node $n$, means 'there exists an argument daughter that node $n$ immediately dominates which is decorated by the label $Ty(e)$' (i.e. node $n$ has a term as its argument daughter).

Furthermore, modality operators can be iterated, e.g. $\langle\downarrow\rangle\langle\downarrow\rangle$, $\langle\downarrow\rangle\langle\uparrow\rangle$, etc. This provides a means of identifying from one node in a tree that some property holds of some other node It is thus possible to describe the whole of the tree in

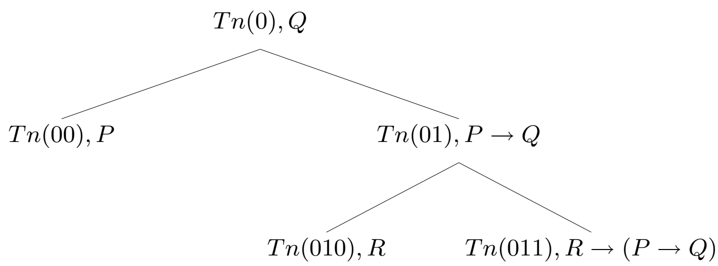



Figure 1.8:

Figure 1.8 from any node within it. Hence, the statements in (1.2) are all true of this tree from the node with treenode address 010, i.e. that one decorated by $R$.

(1.2) a. $\langle\uparrow_0\rangle P \rightarrow Q$
at my mother, $P \rightarrow Q$ holds

b. $\langle\uparrow_0\rangle\langle\downarrow_1\rangle R \rightarrow (P \rightarrow Q)$
at my mother's functor daughter, $R \rightarrow P \rightarrow Q$ holds

c. $\langle\uparrow_0\rangle\langle\uparrow_1\rangle Q$
at my mother's mother, $Q$ holds

d. $\langle\uparrow_0\rangle\langle\uparrow_1\rangle\langle\downarrow_0\rangle P$
at my mother's mother's argument daughter, $P$ holds

The tree may be described in many different ways using the modal operators, depending on the 'viewpoint', the node from which the description is made. Another is shown in (1.3) which takes the topnode as the point of reference and provides a complete description of the tree. In this description, each node is described in terms of the information that holds at that node.

(1.3)
a. $Tn(0), Q$
at node 0, $Q$ holds

b. $\langle\downarrow_0\rangle P$
at my argument daughter $P$ holds

c. $\langle\downarrow_1\rangle P \rightarrow Q$
at my functor daughter $P \rightarrow Q$ holds

d. $\langle\downarrow_0\rangle\langle\downarrow_1\rangle R$
at the argument daughter of my functor daughter $P \rightarrow Q$ holds

e. $\langle\downarrow_1\rangle\langle\downarrow_1\rangle R \rightarrow (P \rightarrow Q)$
at the functor daughter of my functor daughter $P \rightarrow (P \rightarrow Q)$ holds

As we shall see shortly, the use of this logic is crucial for many analyses in the system. It allows, for example, specifications of lexical information that constructs nodes within a tree or annotates the current or other nodes with some information. So, for example, in our analysis of English, the node that 'triggers' (provides the context for) the parse of a verb is a predicate node. However, finite verbs do not just induce expansions of this node in various ways, they also induce the annotation of the dominating propositional node with information about tense.

The modal operators also come into play with respect to parsing particular words to check aspects of the local linguistic context (the partial tree constructed so far) to ensure that the parse is well-formed. As an example, one way of expressing case relations is to articulate them as a constraint on decorating the current node only if its mother bears a certain kind of decoration. Hence, one might define a subject pronoun in English, such as *they*, as licensed just in case the node that dominates the current node carries a propositional requirement, $\langle\uparrow_0\rangle?Ty(t)$, i.e. the current node is a subject node. Such a constraint is satisfied in the first tree in Figure 1.9 (showing part of the analysis of *They sing*) but not in the second (disallowing **Kim likes they*).

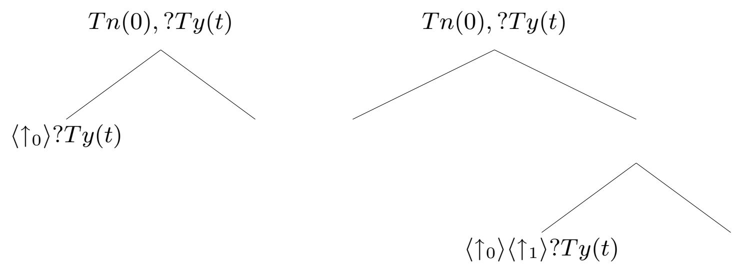



Figure 1.9: Proper and improper contexts for parsing *they*

The modal operators may also be used in conjunction with the notion of requirement to constrain the development of the tree. So while an annotation such as $\langle\downarrow_0\rangle Fo(\alpha)$ indicates that the formula value $\alpha$ holds of my argument daughter (and is therefore only true if within the tree as currently constructed, $Fo(\alpha)$ actually does decorate that node), one such as $?\langle\downarrow_0\rangle Fo(\alpha)$ merely states that *at some point in constructing the current tree*, $Fo(\alpha)$ must decorate my argument daughter. This gives us another way to express case – as providing a filter on the output tree. So we might also express nominative case as providing a decoration of the form $?\langle\uparrow_0\rangle Ty(t)$. Notice that in this second characterisation of case that the '?' precedes the modal operator, so this formulation expresses the constraint that in order to achieve a well-formed result, the current node must be immediately dominated by a node which has the decoration $Ty(t)$. This isn't of course achieved at any stage prior to the final goal, hence it is a filter on the output tree. As we can already see, this will give us a flexibility with respect to the analysis of case; and invididual languages or indeed individual case specifications may differ in the restrictions they impose. Quite generally, we shall see that such modal requirements are very important and will be used extensively throughout this book.

## 1.3 Constructing Trees

We are now in a position to flesh out the framework for tree growth and show how full propositional trees can be gradually constructed from an initial requirement $?Ty(t)$ through a step-by-step parsing procedure. The development of tree structure involves the step from one parse state to another. A transition from one tree description to another can be licensed in two ways; either by one of a number of general transition rules, or by lexical actions (cf. Kempson et al. 2001: 80-95).

### 1.3.1 Starting Off

We begin by considering a pair of TRANSITION RULES that allow one goal to be broken down into subgoals and thus allow a tree decorated with a type requirement on some node to grow into another that has daughter nodes decorated with other type requirements. Transition rules are general rules for tree construction, assumed to be universally available, and akin in many ways to the schematic Immediate Dominance Rules of HPSG with the important difference that transition rules do not characterise hierarchical relations between *words*, but between *concepts*. Formally, transition rules are stated in terms of tree descriptions, with an input tree description and an output description, as illustrated in (1.4), the form being reminiscent of a rule of natural deduction with the 'premises' on the topline leading to the 'conclusion' shown in the bottom line.

(1.4) TRANSITION RULES

a. $\dfrac{\text{Input Tree description}}{\text{Output Tree Description}}$

b.

$$\frac{\{\ldots\phi\ldots\Diamond\}}{\{\ldots\psi\ldots\Diamond\ldots\}}$$

As already noted, a pair of transition rules together drive the process of growth by breaking down goals into subgoals. The rule of INTRODUCTION is effectively an inference from an initial goal to one in which two subgoals are added in the form of requiring the tree to grow and be annotated by information that together can satisfy the original goal. Specifically, the rule unpacks a requirement to find an expression of one type into requirements to have daughters which are decorated by expressions of other types which can be combined through functional application to give an expression of the appropriate type. In other words, the rule adds to a node with a requirement to be decorated with an expression of type $X$, requirements to have daughters decorated with expressions of type $Y$ on one node and type $Y \rightarrow X$ on the other. This is formally defined in (1.5) in terms of tree descriptions and shown in terms of tree growth in (1.6).[8] relation

(1.5) Introduction 1

$$\frac{\{\ldots ?Ty(Y) \ldots \Diamond\}}{\{\ldots ?Ty(Y), ?\langle\downarrow_0\rangle Ty(X), ?\langle\downarrow_1\rangle Ty(X \rightarrow Y), \ldots \Diamond\}}$$

(1.6) Introduction 2

$$?Ty(X), \Diamond \quad \mapsto \quad ?Ty(X), ?\langle\downarrow_0\rangle Ty(Y), ?\langle\downarrow_1\rangle Ty(Y \rightarrow X), \Diamond$$

Notice that the tree in (1.6) has not actually grown the daughter nodes: it has merely acquired requirements to have such nodes. So the tree, as in the input, consists of only one node. The second rule, PREDICTION actually introduces the required nodes and decorates them with requirements to be decorated by expressions of the required type. As before, we give the formal definition in terms of tree descriptions (1.7) followed by the same information shown in terms of tree growth (1.8).[9]

(1.7) Prediction 1

$$\frac{\{Tn(n), \ldots, ?\langle\downarrow_0\rangle\phi, ?\langle\downarrow_1\rangle\psi, \Diamond\}}{\{Tn(n), \ldots ?\langle\downarrow_0\rangle\phi, ?\langle\downarrow_1\rangle\psi\}, \{\langle\uparrow_0\rangle Tn(n), ?\phi, \Diamond\}\{\langle\uparrow_1\rangle Tn(n), ?\psi\}}$$

(1.8) Prediction 2

$$?Ty(X), ?\langle\downarrow_0\rangle Ty(Y), ?\langle\downarrow_1\rangle Ty(Y \rightarrow X), \Diamond \quad \mapsto \quad ?Ty(X), ?\langle\downarrow_0\rangle Ty(Y), ?\langle\downarrow_1\rangle Ty(Y \rightarrow X)$$

$$?Ty(Y), \Diamond \qquad ?Ty(Y \rightarrow X)$$

Introduction thus licenses the introduction of *modal* requirements which PREDICTION 'transforms' into non-modal type requirements, by constructing the appropriate nodes. Together the rules license, for example, the introduction of the requirement for a subject when the type variables are instantiated as $t$ for $X$ and $e$ for $Y$. (1.9) shows the effect of this instantiation for the rule of introduction and (1.10) the effect for the rule of prediction.

[8] Recall that $\langle\downarrow_0\rangle$ indicates a relation from mother to argument daughter, $\langle\downarrow_1\rangle$ a relation from mother to functor daughter.

[9] Notice that the rule builds the two required nodes and puts the pointer on the argument node, as the first of the two nodes to be expanded. Although this is not *necessary* from the point of view of the grammatical formalism, we take this move to be universal and a reflection of the fact that (for example) subjects are typologically more frequently found before their verbs than after them. We will see below and throughout the book how other word orders may be achieved.

(1.9) Introduction - Subject and Predicate

$$\frac{\{?Ty(t), \Diamond\}}{\{\ldots?Ty(t), ?\langle\downarrow_0\rangle Ty(e), ?\langle\downarrow_1\rangle Ty(e \to t)\Diamond\}}$$

(1.10) Prediction - Subject and predicate

$$\frac{\{\{Tn(0), ?\langle\downarrow_0\rangle Ty(e), ?\langle\downarrow_1\rangle Ty(e \to t), \Diamond\}\}}{\{\{Tn(0), ?\langle\downarrow_0\rangle Ty(e), ?\langle\downarrow_1\rangle Ty(e \to t)\}, \{\langle\uparrow_0\rangle Tn(0), ?Ty(e), \Diamond\} \atop \{\langle\uparrow_1\rangle Tn(0), ?Ty(e \to t)\}\}}$$

The effect of these rather complex looking rules is, in fact, best illustrated by a single step of tree growth as shown in Figure 1.10 which shows a tree growing simply from a requirement of type $t$ to a new tree with two new nodes decorated with requirements to find expressions of types $e$ and $e \to t$.[10] Although we will continue to show the transition rules in their more formal form in this chapter in order to familiarise the reader with the technical apparatus, we will illustrate the effects of all such rules using figures that show tree growth directly. In later chapters, we will generally dispense with the formal definitions of transition rules and rely on the more immediately comprehensible illustrations of tree growth, relegating the formal definitions to appendices. One property of these

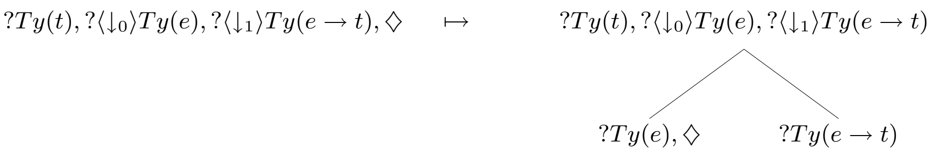



Figure 1.10: Introduction and Prediction of Subject and Predicate

rules should be noted immediately: all rules are optional, so the system is constraint-based. In this respect, the system is like HPSG and LEFG and unlike minimalism (see Pullum and Scholz 2001 for discussion of the difference between constraint-based systems and what they call generative-enumerative systems).

## 1.3.2 Lexical Information

Introduction and prediction, then, permit the initial unfolding of a propositional requirement in a language like English. The parsing process in Dynamic Syntax is, however, principally driven by the lexicon. In this, the framework follows recent trends towards assigning lexical items a more central role in syntax, as found, for example, in LFG (Bresnan 2001) or HPSG (Sag and Wasow 2000). Unlike these frameworks, however, lexical information within DS is *dynamic*, inducing tree growth that may go beyond the simple annotation of terminal nodes: parsing a word can add information to non-terminal nodes, add further requirements or even build partial trees, even to the point of inducing the construction of full propositional structure (see below). This approach adopts into the syntactic domain ideas from Relevance Theory in which words are taken

[10] In fact, in English, it is solely this variant of Introduction that we shall use.

as providing instructions on how to construct an interpretation of an utterance (see Sperber and Wilson 1995, etc.). Since the trees constructed within the framework are representations of content, parsing words necessarily achieves this goal, albeit in a rather different sense to that intended within Relevance Theory.

The structure of lexical entries interacts with the general format of tree description introduced so far. Lexical information provides annotations on nodes and specifies how a particular lexical item contributes to the process of structure building. To this end, the general structure of a lexical entry is shown in (1.11) as a conditional statement, where the initial condition is of a particular sort, the TRIGGER that induces the successful parse of the word (in other words, the appropriate context in which the word may appear). Typically, this takes the form of a type requirement, but other information may make suitable triggers in certain cases. The consequent of the initial condition being met provides a sequence of ACTIONS which include the predicates `make`(...) which makes a new node; `go`(...) which moves the pointer to the node specified in the value; and `put`(...) which annotates a node with certain information. Finally, there is an ELSE statement that induces other actions if the original trigger is not met which will, in the general case, be an instruction to abort the current parse process.

(1.11) *Format of Lexical Entries*

| | | |
|---|---|---|
| IF | ?Ty(X) | Trigger |
| THEN | ... | Actions |
| ELSE | ... | Elsewhere Statement |

For example, an expression like a proper name is of $Ty(e)$ and requires that there be a current requirement $?Ty(e)$ at the stage at which the lexical entry is scanned. This provides the appropriate trigger. The THEN statement lists the particular actions which are performed if the condition in the IF statement is met. In the case of a proper name, this can be taken to be a simple annotation of the current node with type and formula information, using the predicate `put`().[11] Finally, the only other possibility is to abort the parse. The lexical entry for a name like *Hilary* is thus as shown in (1.12) and its effect is to induce the transition shown in Figure 1.11 from the output tree in Figure 1.10 above.

| | | | | |
|---|---|---|---|---|
| | | IF | $?Ty(e)$ | Trigger |
| (1.12) | *Hilary* | THEN | $\texttt{put}(Ty(e), Fo(Hilary'), [\downarrow]\bot)$ | Annotation |
| | | ELSE | ABORT | Failure |

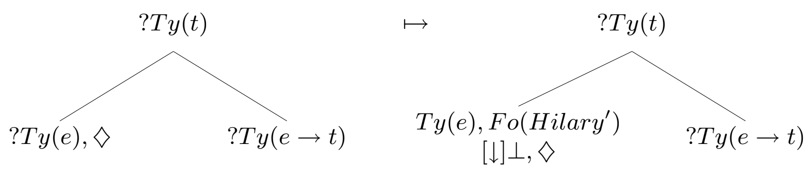



Figure 1.11: Parsing *Hilary*

[11]This view of proper names as having no internal structure will be revised in Chapter 3, when we incorporate an account of quantification.

The one strange decoration in this sequence of actions is $[\downarrow]\bot$, what we call "the bottom restriction". This annotation is to express that the word decorates a terminal node in the tree. Formally it reads: "necessarily below the current node (for every node the current node immediately dominates), the falsum holds" : i.e. the current node has and will have no daughters with any properties at all. Intuitively, this is the reflection in this system that words provide the minimal parts from which interpretation is built up. So we reflect a compositionality of meaning principle like anyone else; but the information projected by words may be considerably more than merely providing some concept.

Within lexical entries, the order of the action predicates is important. For example `put`(...) before `make`(...) means 'put information at current node, then build a new node', while `make`(...) before `put`(...) means 'build a new node and put some information there'. This is important, for example, in parsing verbs in English. We take the parsing of verbs in English to be triggered by a context in which there is a predicate requirement, $?Ty(e \to t)$[12]. The actions induced by parsing finite verbs involve at minimum the annotation of the propositional node with tense information and the annotation of the predicate node. This is all that will happen with intransitive verbs, as shown in the lexical entry for *danced* in (1.13).

(1.13) *danced*

| | | |
|---|---|---|
| IF | $?Ty(e \to t)$ | Predicate Trigger |
| THEN | $\texttt{go}(\langle\uparrow_1\rangle ?Ty(t))$, | Go to propositional node |
| | $\texttt{put}(Tns(PAST))$, | Tense information |
| | $\texttt{go}(\langle\downarrow_1\rangle ?Ty(e \to t))$, | Go to predicate node |
| | $\texttt{put}(Ty(e \to t), Fo(Dance'), [\downarrow]\bot)$ | Formula information |
| ELSE | ABORT | |

There are a number of things to notice about the information in this lexical entry. In the first place, the condition for the introduction of the information from *danced* is that the current task state is $?Ty(e \to t)$. Then there is movement from that node up to the immediately dominating propositional node, given by the instruction $\texttt{go}(\langle\uparrow_1\rangle)$ 'go up to the immediately dominating node'. This node is then annotated by tense information which we have represented simplistically in terms of a label $Tns$ with simple values $PAST$ or $PRES(ENT)$ (for English).[13] Notice that this means of encoding tense obviates the need for 'percolation' or 'copying' devices, as required in HPSG and other frameworks, to ensure that information introduced by a word gets to the place where it is to be interpreted. This is done entirely through the dynamics of parsing the verb.[14] The pointer then returns to the open predicate node and annotates that

[12]Differences in the trigger for classes of expression is one of the ways in which parametric variation is accounted for in DS.

[13]This should not be taken to be a serious account of tense: its use here is purely illustrative. A better account would include proper semantic information manipulating indices so that the tense label does not look like a simple *syntactic* label. See chapter 3 where the account of tense is somewhat expanded in conjunction with the discussion of quantification.

[14]It might be objected that tense information should be generalised, otherwise one might expect different verbs within the same language to behave differently with respect to matters such as tense. Arguably, in morphologically regular constructions, the phonological information provided by the consonant cluster indicates a separate lexical specification for the suffix, an analysis of phonological clustering advocated within Government Phonology (Kaye 1995). In fact, it is relatively easy to structure the lexicon within Dynamic Syntax as is done in

with type and formula information (and the bottom restriction) as we saw with parsing *Hilary*.

Notice that the order in which the action predicates occur is important, reflecting the dynamic nature of the analysis. If the action $\texttt{put}(Tns(PAST))$ preceded the action $\texttt{go}(\langle\uparrow_1\rangle?Ty(t))$, the predicate node would be decorated with the tense information and not the propositional node. Similarly, the ordering of $\texttt{put}(Ty(e \rightarrow t), Fo(Dance'), [\downarrow]\bot)$ before $\texttt{go}(\langle\downarrow_1\rangle?Ty(e \rightarrow t))$ would give rise to the propositional node being annotated with the wrong type and so lead to a failure of the parse (since the satisfaction of the propositional requirement on the topnode would contradict the predicate type annotated by the verb).

So intransitive verbs add information about tense and supply a one-place predicate. Transitive verbs, however, not only add tense, but create new nodes: a two-place predicate node which it annotates with type and formula values and a node for the internal argument, decorated with a type $e$ requirement. This is illustrated in the lexical entry for *upset* in (1.14).

(1.14) *upset*

| | | |
|---|---|---|
| IF | $?Ty(e \rightarrow t)$ | predicate trigger |
| THEN | $\texttt{go}(\langle\uparrow_1\rangle?Ty(t))$, | Go to propositional node |
| | $\texttt{put}(Tns(PAST))$, | Tense information |
| | $\texttt{go}(\langle\downarrow_1\rangle?Ty(e \rightarrow t))$, | Go to predicate node |
| | $\texttt{make}(\langle\downarrow_1\rangle)$, | Make functor node |
| | $\texttt{put}(Fo(Upset'), Ty(e \rightarrow (e \rightarrow t), [\downarrow]\bot)$; | Annotation |
| | $\texttt{go}(\langle\uparrow_1\rangle)$, | Go to mother node |
| | $\texttt{make}(\langle\downarrow_0\rangle)$; | Make argument node |
| | $\texttt{go}(\langle\downarrow_0\rangle)$; | Go to argument node |
| | $\texttt{put}(?Ty(e))$ | Annotation |
| ELSE | ABORT | |

The condition for the introduction of the information from *upset* is that the current task state is $?Ty(e \rightarrow t)$. If this condition is met, a new functor node is built and annotated with the formula and type values specified, and following the return to the mother node, a new daughter node is built with a requirement for a formula of type $e$. To be fully explicit, the decoration $Fo(Love')$ should be given as $Fo(\lambda x \lambda y[Love'(x)(y)])$, with $\lambda$-operators indicating the number and type of arguments with which the predicate *Love'* has to combine, and the order in which this functor will combine with them.[15]

---

HPSG (e.g. Sag 1999, etc.) so that past tense (for example) can be stated generally as an instruction to go up to the mother node and decorate that with the past tense label:

| | | |
|---|---|---|
| *tense-past* | IF | $Ty(e \rightarrow t)$ |
| | THEN | $\texttt{go}(\langle\uparrow_1\rangle), \texttt{put}(Tns(PAST), \texttt{go}(\langle\downarrow_1\rangle))$ |
| | | *content* |

where *content* is the basic actions induced by all forms of the verb, in the case of *dance* merely the decoration of the predicate node with the appropriate formula, type and bottom restriction. There are differences between HPSG accounts and what is necessary in the current dynamic framework, but we do not pursue these refinements in this book. What cannot differ between lexical specifications is the specification of tense necessary for the appropriate semantics to be given, here specified as a decoration on the type $t$-requiring node as a promissory note for a formal characterisation. See chapter 3, and chapter 6, where we see that the past-tense morpheme of Japanese plays a particular role in determining the way in which interpretation is incrementally built up.

[15]The $\lambda$ operator is an abstraction operator which constructs functions from some input

To illustrate the effect of the parse of a transitive verb, Figure 1.12 shows the transition from the output tree in Figure 1.11 to a tree with the pointer at the open predicate node, which triggers the parse of the verb *upset* to give the second tree. With the pointer again at an open $Ty(e)$ node, it is possible to

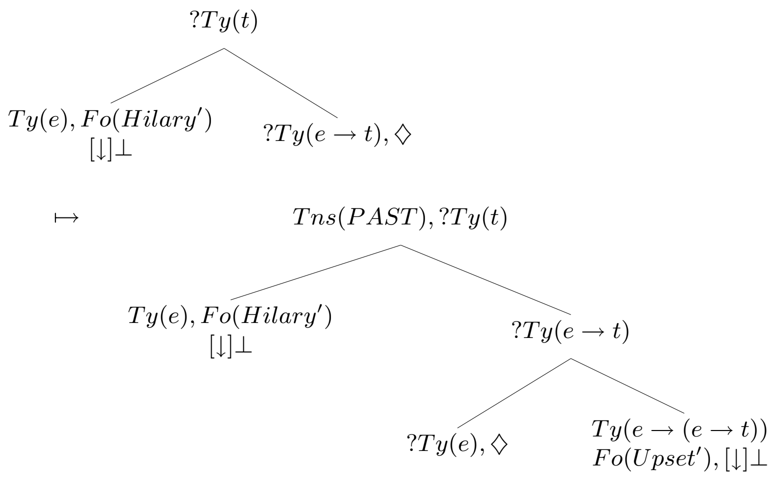



Figure 1.12: Parsing *Hilary upset*

parse another proper noun, say *Joan*, to yield the tree shown in Figure 1.13.

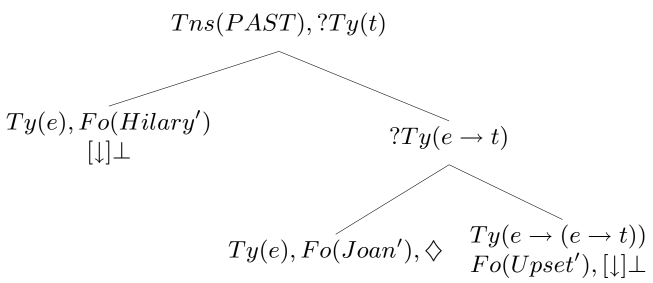



Figure 1.13: Parsing *Hilary upset Joan*

### 1.3.3 Completing the Tree

While the rules discussed in the preceding subsection are concerned with the unfolding of tree structure during the parse of a string, the rules presented in this section deal with the accumulation of established information. We need three things:

- a means of eliminating requirements;

to a determined output. Here the formula $\lambda x \lambda y[Love'(x)(y)]$ is a function from a pair of arguments of type $e$ taken in order onto an output of type $t$. Taking the arguments in the formula given here from outside in, the $\lambda$ operator binding $y$ is a function from variables of type $e$ onto a formula which is itself a function from variables of type $e$ onto the formula $Love'(x)(y)$ which is of type $t$. Hence a two-place predicate with individual-type arguments is of type $(e \rightarrow (e \rightarrow t))$ (see any introduction to Formal Semantics. eg Cann 1993, Gamut 1991, Dowty, Wall and Peters 1981).

- a means of moving the pointer away from completed nodes;
- and a means for compiling the information gathered at the terminal nodes in the tree to satisfy higher requirements.

The first rule provides a means for stating that requirements have been fulfilled:

(1.15) THINNING

$$\frac{\{...\phi...?\phi..., \Diamond\}}{\{...\phi..., \Diamond\}}$$

All this rule does is to simplify the information accumulated at a node (a Declarative Unit): if, at the current node a DU holds which includes both a fact and the requirement to fulfil this fact, the requirement is deleted and the pointer remains at the current node. This is the only means of getting rid of decorations, rather than adding them. Hence, in the transition shown in Figure 1.11, there are really three steps, not two, as shown in figure 1.14. In general, however, we will not show the final transition determined by THINNING, assuming its application whenever a task is fulfilled.

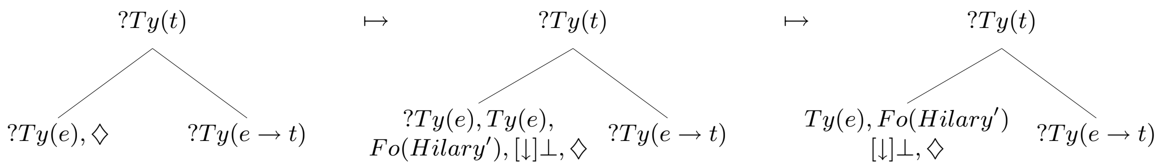



Figure 1.14: Parsing *Hilary* with THINNING

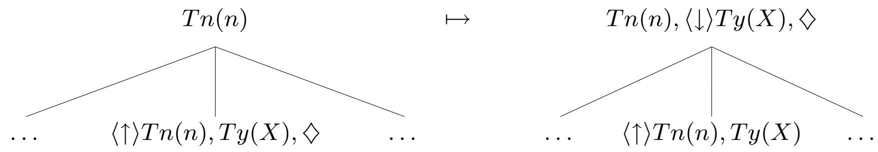
We also need transition rules that move the pointer on from a type-complete node and by so doing to satisfy the modal requirement imposed by INTRODUCTION. In Kempson et al. (2001) this is done by a rule called COMPLETION (which can be regarded as the inverse of PREDICTION) which moves the pointer up from a daughter to a mother and, crucially, annotates the mother node with the information that it indeed has a daughter with certain properties. This latter move has the effect of satisfying the modal requirement introduced by INTRODUCTION. The rule of COMPLETION is given in (1.16) and the effect in terms of tree growth is shown in (1.17). Hence, COMPLETION states that if at a daughter node some information holds which includes an established type, and the daughter is the current node, then the mother node may become the current node.

(1.16) COMPLETION:[16]

$$\frac{\{Tn(n)...\}, \{\langle\uparrow_i\rangle Tn(n), \ldots, Ty(X), \ldots, \Diamond\}}{\{Tn(n), \ldots, \langle\downarrow_i\rangle Ty(X), \ldots, \Diamond\}\{\langle\uparrow_i\rangle Tn(n), \ldots, Ty(X), \ldots, \}}$$
$$i \in \{0, 1\}$$

[16]We state this as $i$ a restriction on daughter nodes, $i \in \{0, 1\}$ since we will shortly generalise this to cover the return of the pointer having constructed and decorated an unfixed node. In the tree-display, we use a ternary branching format to emphasise the neutrality of Completion between functor and argument daughters.

(1.17)



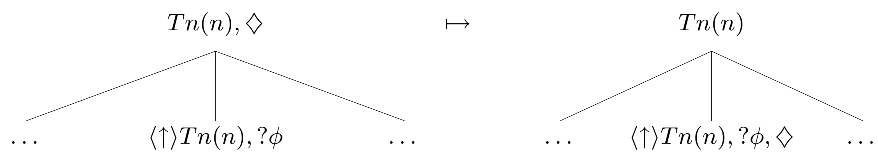

Notice how this formulation of COMPLETION brings out how the use of modal statements reflects the perspective of the node in the tree at which they hold. So in the rule as formulated, some daughter node is defined to have a mother node $Tn(n)$ above it: i.e. it itself is defined as $\langle\uparrow_i\rangle Tn(n)$. In the input state defined by the rule, $Ty(X)$ holds at the daughter node. The effect of the rule is to license the pointer to shift up to the mother node; and from the perspective of the mother node, to record the fact that $\langle\downarrow_i\rangle Ty(X)$ holds. The latter annotation, as noted, satisfies the requirement $?\langle\downarrow\rangle_i Ty(X)$ written to the mother node by INTRODUCTION and the node can duly be thinned.

We also need a rule for moving the pointer **down** at tree which we call ANTICIPATION and which moves the pointer from a mother to a daughter which has an outstanding requirement[17]. The rule is given in (1.18) and the effect on tree growth is shown in (1.19).

(1.18) ANTICIPATION:

$$\frac{\{Tn(n), \ldots, \diamondsuit\}, \{\langle\uparrow\rangle Tn(n), \ldots, ?\phi, \ldots\}}{\{Tn(n), \ldots\}\{\langle\uparrow\rangle Tn(n), \ldots, ?\phi, \ldots, \diamondsuit\}}$$

(1.19)




The rules for pointer movement mean that the transitions in Figure 1.12 are mediated by the further transitions shown in Figure 1.15: the first licensed by COMPLETION; the second by THINNING and the third by ANTICIPATION. Although these transitions are formally necessary (and have an effect on licit derivations, as we shall see in later chapters), we will, in general, ignore this sort of straightforward development, assuming that the pointer always moves directly from a type-complete node to a (sister) node hosting an open requirement.

Finally, in the derivation of the complete tree representing the propositional content of the string *Hilary upset Joan*, we need a means of satisfying the outstanding type requirements holding at the non-terminal nodes in the output tree in Figure 1.13. This is achieved by means of a rule of ELIMINATION which can be regarded as the opposite of INTRODUCTION. This rule takes the formulae on two daughter nodes, performs FUNCTIONAL APPLICATION over these and annotates the mother node with the resulting formula and type, thus satisfying an outstanding type requirement on the non-terminal mother node. as before, the rule is given first in (1.20) and its effect on tree growth is illustrated next in (1.21).

[17]The term 'anticipation' being intended to convey the idea that the movement of the pointer is in anticipation of satisfying some open requirement.

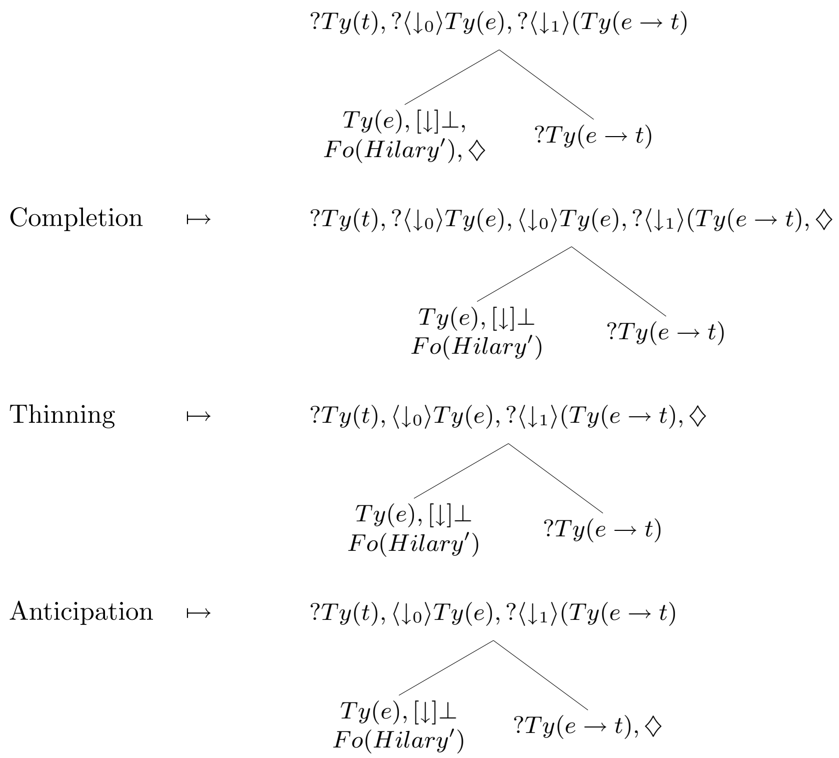
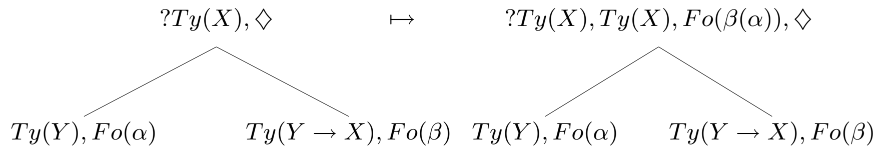



Figure 1.15: Parsing *Hilary* with COMPLETION and ANTICIPATION

(1.20) *Elimination*

$$\frac{\{...\langle\downarrow_0\rangle(Fo(\alpha), Ty(Y)), \langle\downarrow_1\rangle(Fo(\beta), Ty(Y \to X))..., \Diamond\}}{\{...Fo(\beta(\alpha)), Ty(X), \langle\downarrow_0\rangle(Fo(\alpha), Ty(Y)), \langle\downarrow_1\rangle(Fo(\beta), Ty(Y \to X))..., \Diamond\}}$$

(1.21)




Notice that ELIMINATION does not introduce a new node, but only changes annotations holding at one node: if a given node immediately dominates an argument and a functor daughter which are both annotated with a formula and a type value, then the two type values can combine by modus ponens, with the corresponding *Formula* expressions combined by function-application. For example, in completing the analysis of *Hilary upset Joan* from the output tree in Figure 1.13 (shown as the initial tree in Figure 1.16), COMPLETION licenses the movement of the pointer to the open predicate node. Then ELIMINATION applies to satisfy that type requirement as shown in the last of the partial trees in Figure 1.16.

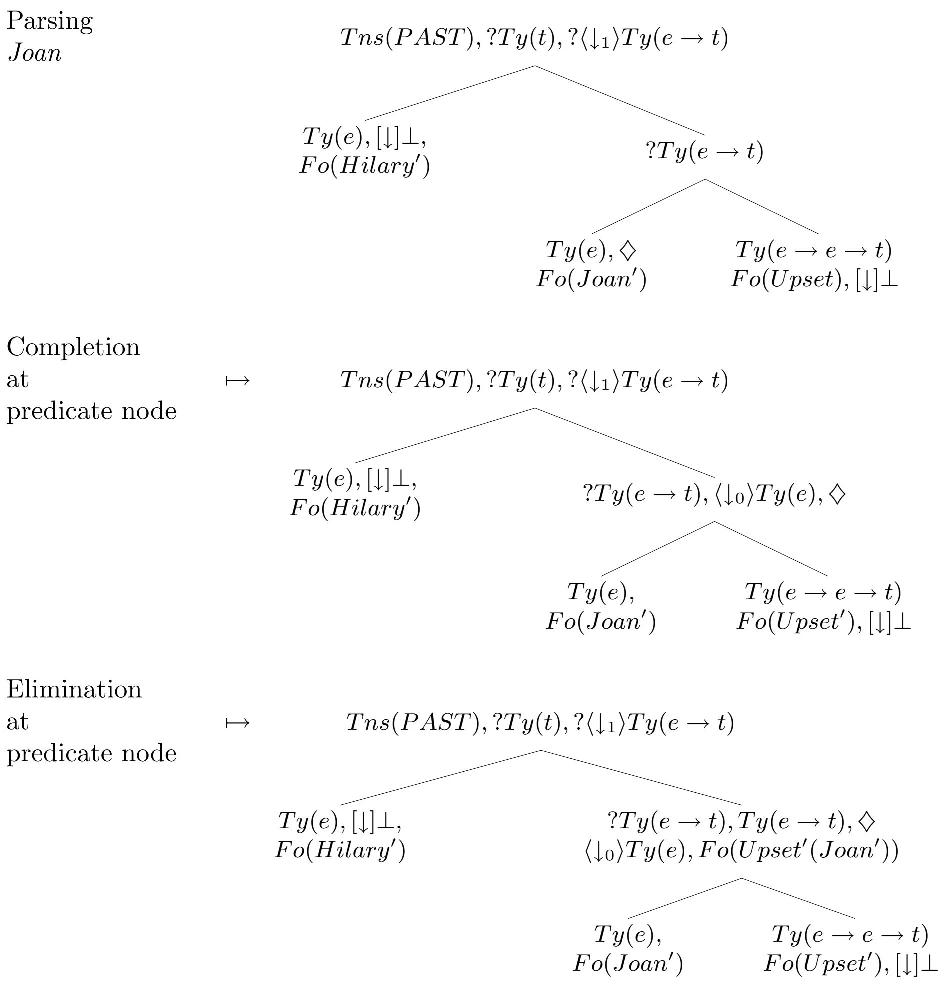



Figure 1.16: Decorating the predicate node in processing *Hilary upset Joan*

THINNING applies to the last tree in the display of Figure 1.16, followed by an application of COMPLETION and then a final application of ELIMINATION at the topnode and a subsequent application of THINNING as shown in Figures 1.17- 1.18, the first of which starts with the transition via THINNING from the final tree in Figure 1.16.[18] The result, in the end, is a fully decorated tree with all nodes, terminal and non-terminal, sporting *Formula* and *Type* decorations, hence with all requirements fulfilled.

[18]Notice that in the function-argument notation in the *Formula* language, the functor always precedes the argument. So if we have two successive applications of functional application, as in the projection of interpretation for *Hilary upset Joan*, the result at the top node will be the formula $Fo((Upset'(Joan'))(Hilary'))$, since the functor $Fo(Upset')$ will have applied to $Fo(Joan')$ to yield $Fo(Upset'(Joan'))$, and this functor term will have applied to $Fo(Hilary')$ to yield the final result.

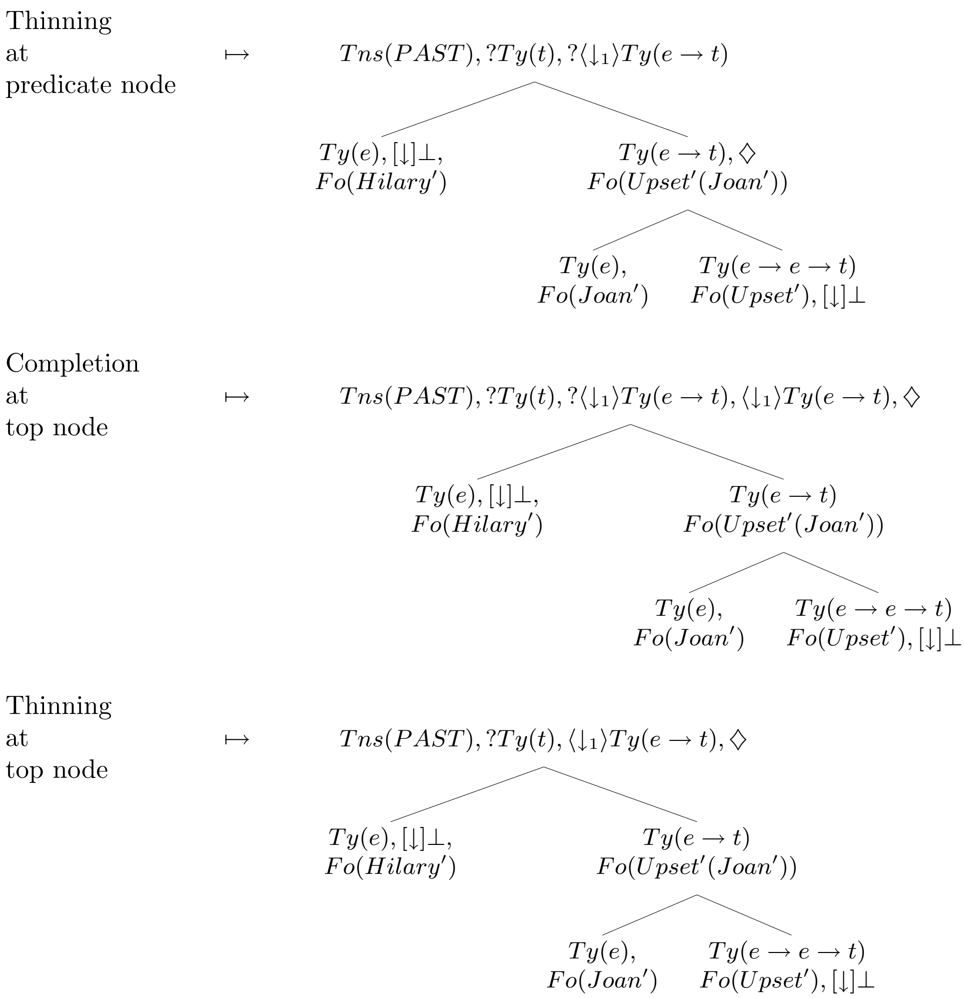



Figure 1.17: Moving the pointer to top-node in processing *Hilary upset Joan*

In the remainder of this study, we will display derivations in considerably less detail, and concentrate on the growth of tree structure, as opposed to the combination of information, as it is in the growth of emergent structure that variation is possible. We also omit information from the DU statements unless pertinent to the point at hand. So, as in displays in other frameworks, the trees used as illustrations should not be taken as more than a convenient form of display. The formal content has always to be checked by establishing what rules have applied and how.

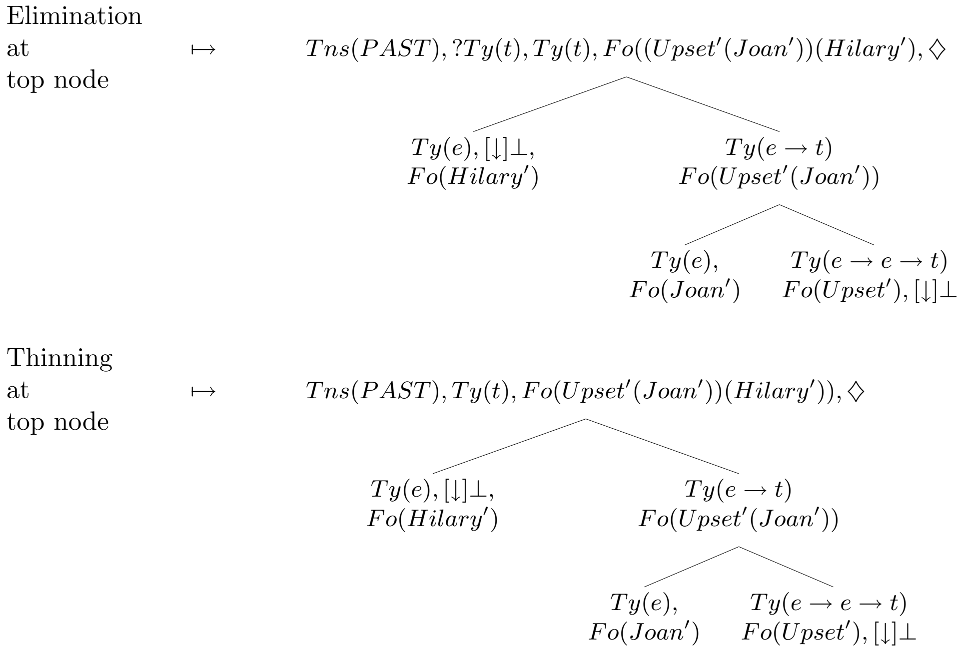



Figure 1.18: Completing the parse of *Hilary upset Joan*

## 1.4 Left Dislocation Structures

Focussing as we have done on the process of building up interpretation, it might seem that we would have to give a much more abstract analysis of constructions such as left dislocation structures (topics, questions, relative clauses, etc.) which in other frameworks have posited movement, or feature passing. However, it is very straightforward to express such structures in ways that reflect the dynamics of processing them. The key to our approach lies in the notions of underspecification and requirement, just as in the analysis of non-dislocated constructions given in the previous section. The intuition we wish to express is that dislocated left-peripheral expressions decorate nodes that are not yet fixed within the unfolding tree, and that continuing on with the parsing process will establish their contribution to the overall structure later on.

The principal basis for the analysis in terms of two (mirror-image) underspecified modal relations. The modality $\langle\uparrow_*\rangle$ is an underspecified modal relation pointing to some node that dominates the current node. It is defined over the reflexive, transitive closure of the mother relation as shown in (1.22) and has an obverse relation, $\langle\downarrow_*\rangle$, over the daughter relation defined in (1.23).

(1.22) $\langle\uparrow_*\rangle\alpha =_{def} \alpha \vee \langle\uparrow\rangle\langle\uparrow_*\rangle\alpha$

(1.23) $\langle\downarrow_*\rangle\alpha =_{def} \alpha \vee \langle\downarrow\rangle\langle\downarrow_*\rangle\alpha$

A modality like $\langle\uparrow_*\rangle?Ty(t)$ holds just in case EITHER the current node is decorated by $?Ty(t)$ OR some node dominating the current node is so decorated.

These recursive definitions provide a means to express the underspecification of tree locations. Consider the tree in Figure 1.19 There are four decorated

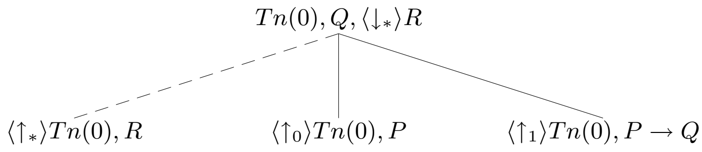



Figure 1.19: An Unfixed Node

nodes in this tree, but only three of them are in fixed locations. The fourth is described as holding at $\langle\uparrow_*\rangle Tn(0)$ indicating that it holds at some node within the tree along a sequence of daughter relations from the topnode but without that sequence being further specified. In short, the only information provided is that it is dominated by $Tn(0)$. Correspondingly, the modal statement at $Tn(0)$ indicates that at some dominated node, $R$ holds (where this dominated node may turn out to be the current node). This underspecified relation is indicated shown by the dashed line in the figure (and subsequently).[19]

This definition of underspecified tree location is the tool employed in DS for the analysis of preposed constituents such as *wh*-pronouns or left dislocated topics. Intuitively, our analysis rests on the idea that an initial phrase in a string may be parsed, but without being assigned a fixed position within the partial tree that is currently being developed. All that is known is that the unfixed subtree is dominated by the top, propositional, node and, crucially, that it needs to be assigned a fixed position for the resulting tree to be interpreted. Confirming this very weak relation at this point in the parse, all such nodes will be introduced with a requirement that the node obtain a fixed tree relation, which we write as $\exists x.Tn(x)$. This is just like the tense requirement we saw associated with the complementizer *that*: it is satisfied just in case some value is provided for the appropriate label, in this case for the treenode predicate. This illustrates the general principle that all aspects of underspecification are associated with a requirement for update to a fixed value. As the parse of the remainder of the string proceeds, there will occur, in any well formed dislocation construction, a fixed position into which the unfixed subtree can be slotted, thereby satisfying some outstanding type requirement and the requirement to find a fixed position for the unfixed node. The output tree thus contains no indication that it was formed in such a way, through fixing an unfixed node, merely expressing the same content as a structure in which there was no left dislocation.

We will go through the analysis of the left dislocated version of the string we discussed briefly in section 2 (uttered in a context like *John, Bill amused, but*):

(1.24) Joan, Hilary upset.

[19] As we have seen before, this pair of decorations, $\langle\uparrow_*\rangle Tn(0)$, and $\langle\downarrow_*\rangle R$, clearly show how the use of modal statements reflects the perspective of the node in the tree at which they hold. So at some node dominated by $Tn(0)$, the first of these formulae holds: the root node is somewhere above it. At node $Tn(0)$, given some node within the tree, the second statement holds: the node decorated by $R$ is somewhere below it. In this way, the use of modal formulae invariably reflect information about the tree from the perspective of the node at which the formulae are stated to hold.

What we need in the first place is a means to introduce an unfixed node. This is achieved by a rule of *ADJUNCTION which defines a transition from a partial tree containing only one node (described by the set of formulae holding at that node) with requirement $?Ty(t)$ to one that has an additional node, requiring a type $e$ decoration, and is described as being dominated by the input node, without further specification of what that relation consists in. The new node is decorated with a requirement to find a fixed position within the unfolding tree. Finally, the pointer is left at this unfixed node, indicating that it is the next to be developed. The rule is given formally in (1.25) with its effect on tree growth shown in (1.26).

(1.25) *ADJUNCTION

$$\frac{\{\{Tn(a), \ldots ?Ty(t), \Diamond\}\}}{\{\{Tn(a), \ldots, ?Ty(t)\}, \quad \{\langle\uparrow_*\rangle Tn(a), ?\exists x Tn(x), \ldots, ?Ty(e), \Diamond\}\}}$$

(1.26)

$$?Ty(t), \Diamond \quad \mapsto \quad Tn(a), ?Ty(t)$$

$$\langle\uparrow_*\rangle Tn(a), ?Ty(e), ?\exists \mathbf{x}.Tn(\mathbf{x}), \Diamond$$

The output tree in (1.26) provides an environment in which the proper name *Joan* can be parsed. Presuming on the generalisation of COMPLETION to apply also to unfixed nodes,[20] the parse of the string in (1.24) then proceeds through INTRODUCTION and PREDICTION to provide subject and predicate requirements, permitting the parse of *Hilary upset*, with the unfixed node on hold, so to speak. These steps are shown in Figure 1.20.[21]

At the point reached at the last tree in Figure 1.20, the pointer is at a node with an open type $e$ requirement. Since this matches the type of the unfixed node, the latter may MERGE with that position.[22] The output of this process is the unification of the information on the unfixed node with that on the internal argument node. This ensures that the open type requirement on the latter and the outstanding requirement on the unfixed node to find a treenode address are both satisfied, because the result is the DU in (1.27a). THINNING applies to this to provide the set of decorations in (1.27b), as required.

(1.27) a. $\{\langle\uparrow_*\rangle Tn(0), \langle\uparrow_0\rangle\langle\uparrow_1\rangle Tn(0), ?\exists \mathbf{x}.Tn(\mathbf{x}), Tn(010),$
$?Ty(e), Ty(e), Fo(Joan'), [\downarrow]\bot, \Diamond\}$

b. $\{\langle\uparrow_0\rangle\langle\uparrow_1\rangle Tn(0), Tn(010), Ty(e), Fo(Joan'), [\downarrow]\bot, \Diamond\}$

This process is shown informally in Figure 1.21 where the dashed arrow indicates the MERGE process and the second tree shows the output. Notice that

[20] This generalisation requires the means of distinguishing an unfixed node, with its associated requirement $?\exists x.Tn(x)$, constructed by application of *Adjunction from some node $Tn(a)$, from other nodes which $Tn(a)$ dominates. See Kempson et al 2001 for the distinction between 'internally dominate', which applies to unfixed nodes only, and to 'externally dominate' which is the general *dominate* relation.

[21] In all trees that follow, the bottom restrictions imposed by lexical specifications will be omitted, unless relevant.

[22] The process of MERGE used in DS should not be confused with the entirely different process of Merge in the Minimalist Program (Chomsky 1995, etc.). A better term in DS would be UNIFY, but we adhere to the term introduced in Kempson et al. (2001).

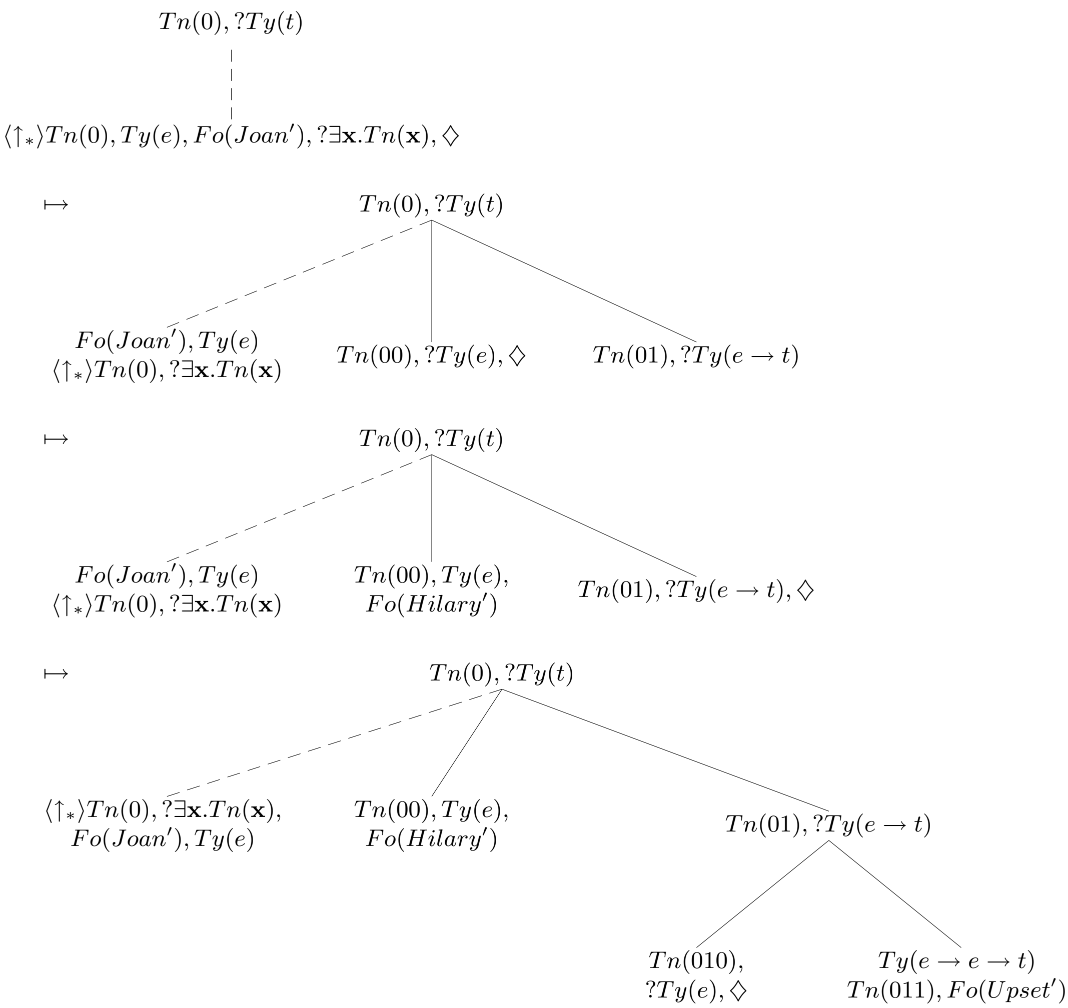



Figure 1.20: Parsing *Joan, Hilary upset*

when compiled and completed the second tree in Figure 1.21 is identical to the output tree for *Hilary upset Joan* in Figure 1.18. The informational differences between the two strings are thus not encoded in the representation, as in many current theories of syntax, either as a separate layer of grammatical information (Valduvi 1991) or in terms of functional categories projected at the left periphery of the clause (as, for example, Rizzi 1998, and others following him). Instead, the differences, we assume, derive from the different ways that the final tree is established. With the left dislocated object, a term is presented to the hearer which provides an update for a propositional structure to be established from the rest of the string – a type of focus effect (see Kempson, Kiaer and Cann forthcoming for further discussion). Note, in passing, the direct reflection of a concept of one term isolated as providing an update to some remainder that is described in terms of focus in other frameworks (Valduvi 1991, Erteschek-Shir 1997), a perspective on focus which we pursue somewhat further in chapter 4.

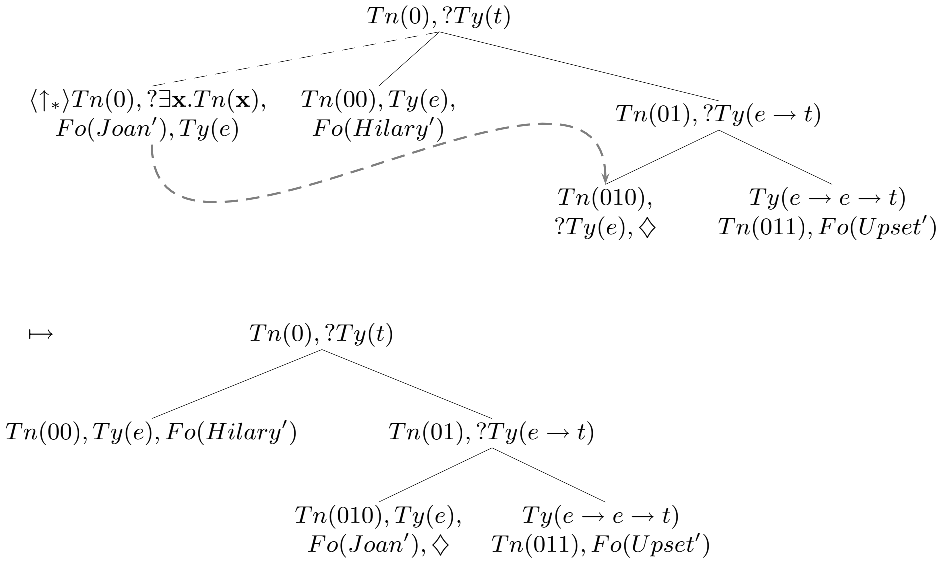



Figure 1.21: Parsing *Joan, Hilary upset* with MERGE

Although it looks from the tree displays that the left dislocated node is somehow associated with some position on the left periphery, this is merely an artefact of the use of tree diagrams to illustrate the concepts used. Technically, all initially unfixed nodes are checked against each partial tree as successive pairs of daughter nodes are introduced. So in effect, the information from such nodes is passed down the tree step by step until a fixed position for the node can be established. MERGE may then take place at any stage where the information on the unfixed node is compatible with that on the fixed position. The development shown in Figure 1.20 might thus be more accurately shown as Figure 1.22, where the information associated with the unfixed node is carried down the tree along with the pointer. Note that at each of these intermediate nodes, the decorations on the unfixed node are checked for consistency with that intermediate node. And at any one of these nodes $Tn(a)$, the unfixed node can be described as $\langle\uparrow *\rangle Tn(a)$ because, according to this concept of 'be dominated by', the relation holds between two nodes if there is ANY sequence of daughter relations between the two nodes in question, including the empty one, hence if the property holds at that node.

At this point we need to be a bit more precise as to what the process of MERGE involves. Quite simply, all it does is to unify two node descriptions, here referred to as $ND, ND'$ (a pair of node descriptions) as indicated in the formal rule in (1.28).

(1.28) MERGE

$$\frac{\{...\ \mathbf{ND}, \mathbf{ND'}\ ...\}}{\{...ND \sqcup ND'...\}}$$
$$\diamondsuit \in ND'$$

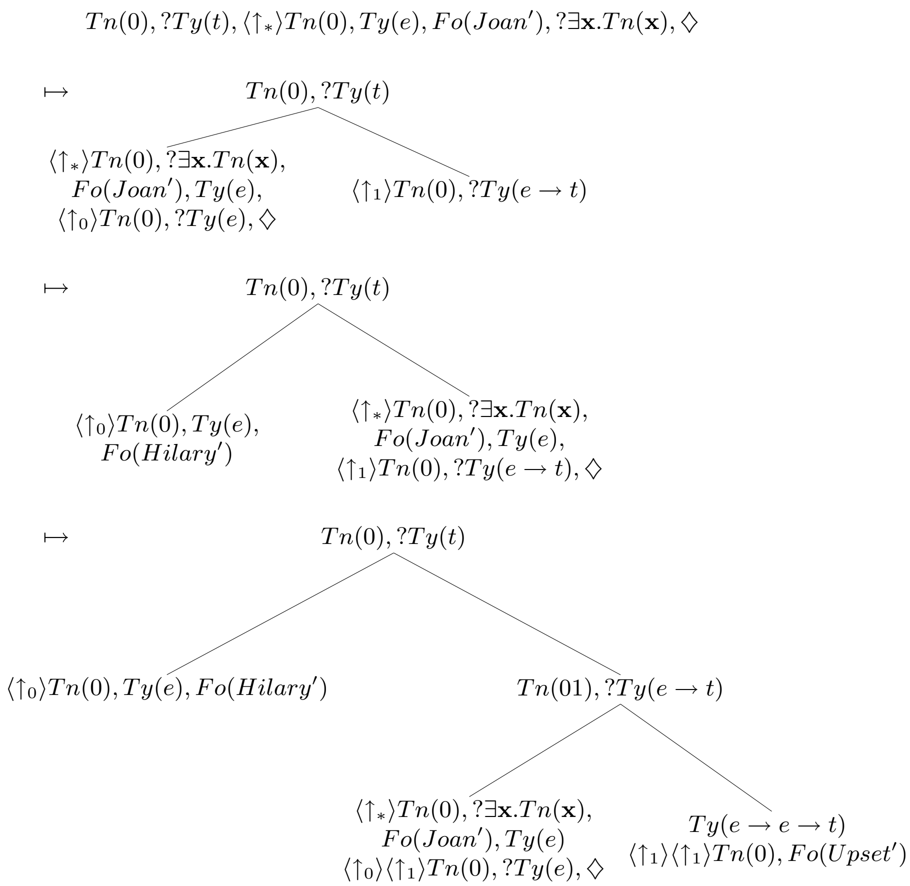



Figure 1.22: Parsing *Joan, Hilary upset*

We have to use the concept of node description here, as this is a unification of ALL information of the nodes to this juncture introduced as two discrete nodes, and not just their type and formula specification. The only constraints on this completely general rule are that: (a) the pointer is one of the decorations on one of the DUs (the fixed node) and (b) that the two DUs unify.[23] This in effect is a concept of unification of information familiar from such theoretical frameworks as Generalised Phrase Structure Grammar (Gazdar et al. 1985, Bennett) and Head-driven Phrase Structure Grammar (Pollard and Sag 1987, 1994). For example, the rule does not need to refer explicitly to any unfixed node: two fixed nodes will not be able to merge, as they will not meet the entailment/unification constraint. Hence, while $\langle\uparrow_0\rangle\langle\uparrow_1\rangle Tn(0) \models \langle\uparrow_*\rangle Tn(0)$ (since the fixed modality implies the underspecified modality), $\langle\uparrow_0\rangle\langle\uparrow_1\rangle Tn(0) \not\models \langle\uparrow_0\rangle Tn(0)$ (the modalities are inconsistent). Also, no node can have more than one specification of any individual category unless one such specification entails the other. So $Fo(\mathbf{U}), Fo(John)$ is a licit combination, where $\mathbf{U}$ is a metavariable, since

[23]For a full formal definition, see Kempson et al 2001.

metavariables are merely underspecified formula values and $Fo(\alpha) \models Fo(\mathbf{U})$ for any formula value $\alpha$. $Fo(Bill), Fo(John)$, however, is an impossible combination because neither formula value entails the other.[24]

Characteristically *Merge* takes place where there is an unfixed node annotated with a formula of a certain type and a fixed node requiring that type (although this is not determined by the rule in (1.28)). Consider the trees in Figure 1.22. In the second tree with the information on the unfixed node currently matched with that on the subject node, MERGE could occur, but such a move would cause the parse to abort as the pointer would move on to the predicate node but the next word that would be parsed (*Hilary*) is of type $e$ and so incompatible with that node. The DU decorating the unfixed node, thus gets passed to the predicate node where no MERGE can take place (the type requirement and the specified type are incompatible), and finally to the internal argument position, where MERGE can, and indeed must, take place.

Notice that though there is a specific principle which deletes requirements, there is no specific principle to delete any annotations which are entailed by other updating annotations upon an application of MERGE. They will always simply be irrelevant to subsequent updates, and so can be in ignored. So in Figure 1.21, $?\exists x.Tn(x)$ and $?Ty(e)$ get removed from node $Tn(010)$ once Merge has taken place, but $\langle\uparrow_*\rangle Tn(0)$ remains as a decoration, coexisting with $\langle\uparrow_0\rangle\langle\uparrow_1\rangle Tn(0)$, both of which after Merge will hold at $Tn(010)$, the underspecified modality, however, no longer providing information because the specific modality holds.

A common question at this juncture is: What does this concept of underspecification of tree relations consist in? Since, in English, one may not know until the verb is parsed, whether the constituent just parsed is the subject, shouldn't one be analysing all nodes before the verb as unfixed, subject and object alike in left-dislocation structures such as *Mary, John upset*? Why does the subject get introduced by application of Introduction and Prediction, and left-dislocated constituents by *Adjunction? The answer is that it is possible for subjects to be introduced by *Adjunction, rather than Introduction and Prediction (and in some languages this must be what is happening, see next section), but equally an analysis in terms of a discrete fixed number of alternatives is a possibility. The situation is analogous to ambiguity of meaning. Indeed, what we confront IS a form of ambiguity - a processing ambiguity. As we know from studies of lexical ambiguity, the fact of a hearer being not necessarily able to determine which sense of an ambiguous item such as *bank* is intended without reference to context is not in itself a criterion for analysing the word itself as underspecified. The choice of whether some word should be said to be ambiguous or simply underspecified with respect to some property depends on the patterns elsewhere in the language. Whether or not to analyse all noun phrases as unfixed until the verb is processed therefore turns not solely on the lack of information available to the parser, but on whether there are grounds elsewhere in the language to wish to preserve the distinction between the concepts of subject and long-distance dependency. There are also topic structures in addition (sometimes called Hanging Topic Left Dislocation - see Anagnastopoulou et al eds. 1995). And, indeed, we shall see a great deal of evidence in subsequent chapters

[24]In Chapters 5, and 8, in discussing conjunction and apposition, this last combination will be modified under particular conditions.

to distinguish these three concepts. For these reasons, we elect to characterise only left-dislocation structures for English corresponding to what is elsewhere analysed as Move $\alpha$ (see Chomsky 1981 etc) as a form of underspecification expressed in terms of a weak notion of domination, while preserving an ambiguity between distinct processing alternatives in distinguishing the processing of subject from that of long-distance dependency or, as we shall see in chapter 4, topic structures.

Before leaving the more technical discussion of *Adjunction and Merge, it is worth reflecting on the analysis of long-distance dependency proposed. It is concepts of underspecification and subsequent tree growth that replace altogether the concept of 'movement', acclaimed in GB and minimalism, with its presumption of discrete levels of representation. At different stages in the parsing process, a node may be described in different ways: first as unfixed, and subsequently as identified with a fully determinate position. An immediate advantage of this analysis is that it matches the intuitive concept of information growth during the parse process for such sentences. As will emerge in chapter 3, the concept of tree growth for such structures is also just what we need to explain how the supposedly syntactic phenomenon of long-distance dependency structure can interact with context-dependent processes which have previously been thought to be semantic or pragmatic and so of no consequence to the articulation of syntax as the central component of the grammar. So the supposed indication of the imperfection of language will turn out to be nothing more than what it means to be a parsing-directed system.

It is worth noticing also why the concept of a node described as dominated, without further specification at some early juncture in the parsing process, is so naturally expressed in the vocabulary which Dynamic Syntax makes available. This turns on manipulating the modal logic LOFT. This potential is due not so much to the specifics of LOFT, as a modal logic, since this is expressible in any language for describing trees. It resides, rather, in the move to describe trees explicitly, using a tree description language, rather than simply taking their properties for granted, as in standard linguistic formalisms. In particular, in order to describe what it means for a tree to be partial, we needed a language to describe such objects: they can't simply be drawn. This move is exactly analogous to the move within semantics to set up languages to describe partial contents, as in DRT (see Kamp and Reyle 1993, etc.). In order to articulate what it means to have a representation of partial content for some expression, one needs a language that describes such contents. One might express it as a slogan: "To go partial, you need a language of description". Or, to put it another way, once one has to hand a language for describing some set of objects, articulating explicitly the set of properties necessary to be one such object, it is straightforward to express what it means to have part of one such object.

## 1.5 Anaphora

We have so far been considering the processing of sentences pretty much as though in isolation. We now have to rectify this, and take up the challenge put out in chapter 1 that, to have any hope of a unitary characterisation of pronominal anaphora, we have to assume that a pronoun is a place-holder for some **logical expression** which has been constructed within the context. Antecedents, though they may be given by previous words, cannot be the words themselves as this gives quite the wrong result over and over again. Presuming that the antecedent of the pronoun in (1.29a) is the quantifying expression wrongly fails to predict what is the appropriate interpretation of (1.29a), and wrongly predicts that it should have the same interpretation as (1.29b).

(1.29) a. Every child thinks that he should get a prize.

b. Every child thinks that every child should get a prize.

Assuming the general stance that words provide lexical actions in building up representations of content as established in context, to the contrary, gets us on the right track. We can thus say that the pronoun may pick out some logical term if that term is provided in the discourse context, whether it is a full logical name or a variable introduced by some quantifying expression, and so on. We consider only the simplest cases here, leaving a discussion of the quantificational cases until the next chapter, but the effect of such an assumption, together with the adoption of the epsilon calculus to provide an account of quantification (see chapter 3) is to capture both the fact that pronouns contribute very differently to interpretation depending on the antecedent that they have, and that a pronoun is nevertheless not lexically ambiguous in the sense of having a number of quite different interpretations defined in the lexicon.

To achieve the simple notion that pronouns pick out some logical term from the discourse context, we again have recourse to underspecification, in this case the underspecification of content, rather than, as with our account of left dislocation, underspecification of position. So we extend the vocabulary of our *Formula* values to allow **placeholders** for values. These we call METAVARIABLES in the logical language and represent as boldface capitals $\mathbf{U}, \mathbf{V}, \ldots$.. Pronouns then project one such metavariable as the $Fo$ value given by its lexical actions. As a metavariable is just a placeholder for some contentful value, they are associated with a requirement to establish such a value, $?\exists x Fo(x)$, just as unfixed nodes with the underspecified modality $\langle \uparrow_* \rangle Tn(n)$ are associated with a requirement to find a value for its treenode label, $?\exists \mathbf{x}.Tn(\mathbf{x})$. Following the general pattern that all requirements have to be got rid of in any well-formed derivation, the formula requirement ensures that metavariables will be replaced by a term in the $Formula$ language as part of the construction process. Such replacement is established through a pragmatically driven process of SUBSTITUTION which applies as part of this construction process.

As an illustration, in processing an example such as (1.31), uttered in the context of having just parsed an utterance of (1.30), we assume the steps of interpretation in processing the subject and object expressions shown in Figure 1.23.[25]

(1.30) John ignored Mary.

(1.31) He upset her.

As is now familiar, INTRODUCTION and PREDICTION license the introduction of subject and predicate nodes, the first of which is decorated by the pronoun *he* (1). SUBSTITUTION then occurs to yield the tree in (2) and the pointer moves

[25]The trees are shown schematically and types and other requirements, once established, are not further represented.

to the predicate node through COMPLETION and ANTICIPATION, permitting the parse of the verb to give the tree in (3). Parsing *her* satisfies the type requirement on the internal argument node, but leaves a formula requirement which is satisfied through SUBSTITUTION to yield the tree in (4). Notice that the metavariables are replaced, at step (2), and at step (5), so there is no record thereafter of there having been a pronominal form of input. The tree resulting from the parse of *John upset Mary* and that of *He upset her* - as uttered in the context of having just parsed (1.30) - is identical in the two cases.

The lexical specification for the pronoun *he* can now be given. It must express both the need for the pronoun to have a value established in context, and specify whatever other constraints the pronoun imposes. So, for example, *he* is associated with a constraint on substitution that whatever term is substituted for the metavariable projected by the pronoun is describable (in context) as having the property $Male'$. This sort of constraint (a presupposition) we show as a subscript on the metavariable.[26] Additionally, the case of a pronoun constrains which node in a tree the pronoun may decorate. For nominative pronouns in English, where the morphological specification of case is very restricted, we take nominative case specification to take the form of an output filter – a requirement that the immediately dominated node be decorated with type $t$. In English, of course, there is a further constraint that nominative pronouns only appear in finite subject positions, so that the actual constraint is shown as a requirement to be immediately dominated by a propositional node with a tense decoration.[27]

(1.32) *he*

| | | |
|---|---|---|
| IF | $?Ty(e)$ | |
| THEN | $\mathtt{put}(Ty(e),$ | Type statement |
| | $Fo(\mathbf{U}_{\mathbf{Male'}}),$ | Metavariable and Presupposition |
| | $?\exists x.Fo(x),$ | Formula Requirement |
| | $?\langle\uparrow\rangle(Ty(t) \wedge \exists \mathbf{x}.Tns(\mathbf{x})),$ | Case Condition |
| | $\downarrow[\bot])$ | Bottom Restriction |
| ELSE | ABORT | |

Other pronouns and other case-forms project analogous information. So, for example, the first and second pronouns project presuppositions that whatever is substituted for the metavariable must be the speaker or the hearer/addressee, respectively (i.e. $\mathbf{U}_{Speaker'}, \mathbf{U}_{Hearer'}$). Notice that, just as with third person pronouns, the metavariable projected by *I/me* or *you* will be replaced by some logical term, picking out the speaker or hearer, and so the output propositional form ceases to contain a semantic deictic expression, requiring anchoring in the discourse domain. Instead, the representation of the content of the string *I'm going to Wales* uttered by Hilary is $Go'(To - Wales')(Hilary')$, directly expressing the appropriate proposition.

The process of substitution is thus entirely free relative to the constraints imposed by any presuppositions projected by an expression. However, it also applies relative to a general filter, which precludes any substitution which results

[26]We do not, in this book, go into presuppositional effects or the formal analysis of such things, but see Cann 2004 for some discussion.

[27]We make no pretence that this gives a complete characterisation of case. As we saw in section 3, there is more than one way to express case restrictions. This will be taken up in more detail in chapter 6, where we shall see that in Japanese, nominative case specification is arguably different from other case specifications.

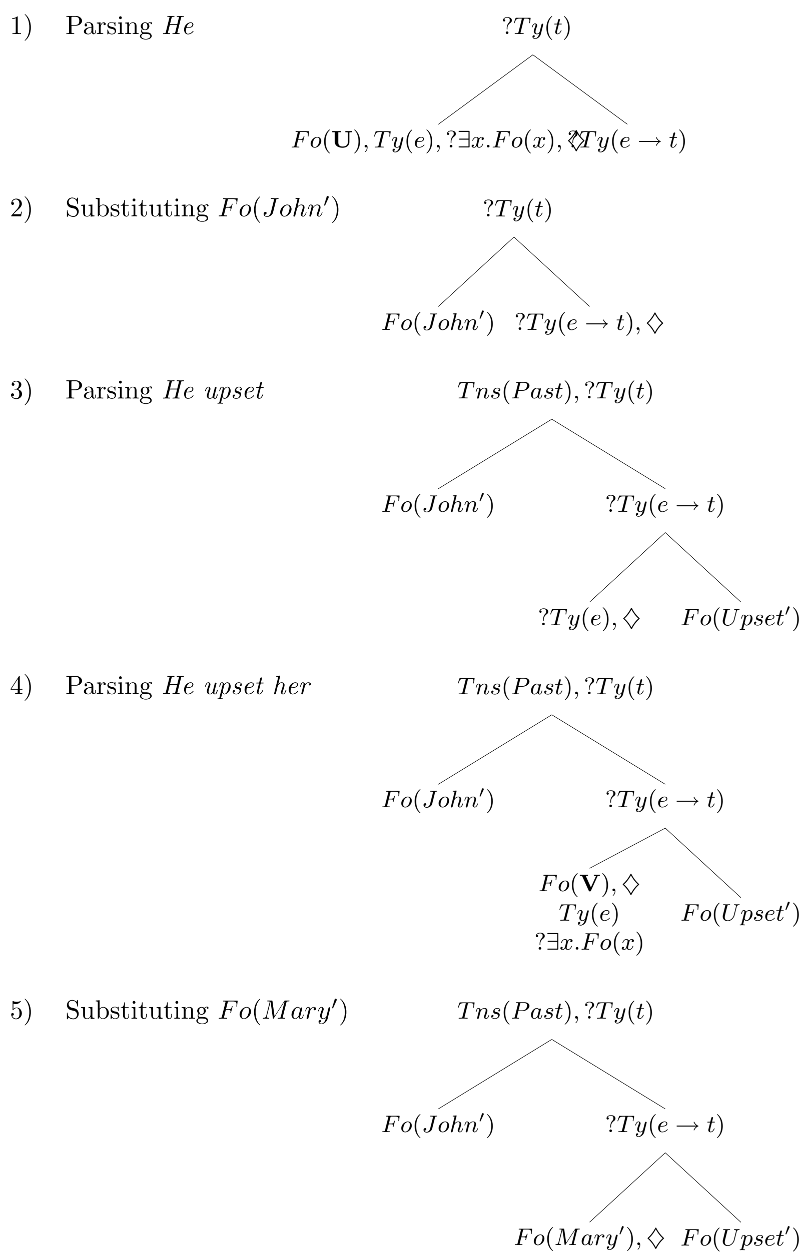



Figure 1.23: Stages in processing *He upset her*

in any two *co-arguments* being identical, i.e. an analogue of Principle B of the Binding Theory of the Priciples and Parameters framework (Chomsky 1981), but restricted to an argument domain[28]. The tree-description vocabulary can thus capture the type of generalisations that other frameworks rely on such as familiar concepts of locality (indeed rather more, since the characterisation of partial trees is the central motivation for turning to a formal tree-description language).

In this connection, consider the schematic tree in Figure 1.24, with its labelling of argument relations in terms of grammatical relations as defined on the semantic tree (Indirect Object is the lowest argument, Subject is the highest argument, Direct Object is the intermediate object) On this tree, we can show

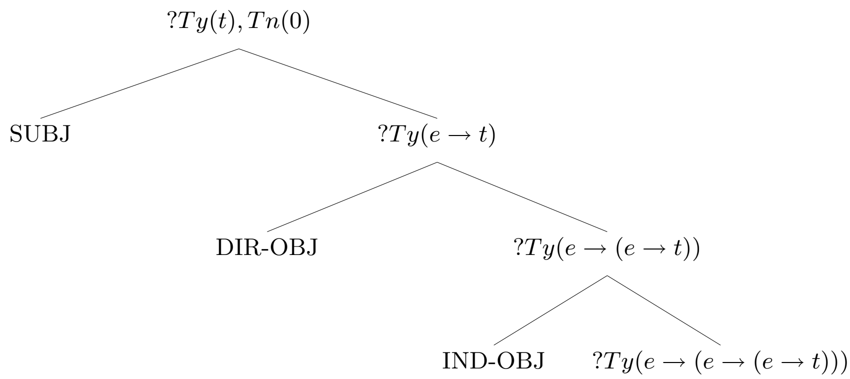



Figure 1.24: Locality Tree

the relations between the lowest argument node, the indirect object, using tree modalities as in (1.33a-c). These all involve going up from an argument node, up through one or more functor nodes and then down to an argument node. To abstract from these to a general concept of locality, we can generalise these relations to that shown in (1.33d), where the underspecified modality $\langle\uparrow_1^*\rangle$ expresses a path through a series of (possibly null) dominating nodes, all of which are functor nodes. This is formally defined in (1.33e).

(1.33)
a. IND-OBJ to IND-OBJ: $\langle\uparrow_0\rangle\langle\downarrow_0\rangle$
b. IND-OBJ to DIR-OBJ: $\langle\uparrow_0\rangle\langle\uparrow_1\rangle\langle\downarrow_0\rangle$
c. IND-OBJ to SUBJ: $\langle\uparrow_0\rangle\langle\uparrow_1\rangle\langle\uparrow_1\rangle\langle\downarrow_0\rangle$
d. $\langle\uparrow_0\rangle\langle\uparrow_1^*\rangle\langle\downarrow_0\rangle$
e. $\langle\uparrow_1^*\rangle\alpha \ =_{def}\ \alpha \vee \langle\uparrow_1\rangle\langle\uparrow_1^*\rangle\alpha$

Taking the relation in (1.33d) as the relevant locality domain, we can now define *Substitution*, along the lines of Kempson et al 2001, as an operation that substitutes only formulae that do not decorate local nodes, as in (1.34).[29]

[28]See Huang 2000, HPSG, for arguments and discussion.

[29]We might alternatively define a local domain in terms of some identified $Ty(t)-$requiring node being the closest. See chapter 6, where this is explored in connection with Japanese.

| | | | | |
|---|---|---|---|---|
| (1.34) | *Subst*($\alpha$) | IF | $Fo(\mathbf{U}), Ty(e)$ | |
| | | THEN | IF | $\langle\uparrow_0\rangle\langle\uparrow_1^*\rangle\langle\downarrow_0\rangle Fo(\alpha)$ |
| | | | THEN | Abort |
| | | | ELSE | $\mathtt{put}(Fo(\alpha))$ |
| | | ELSE | Abort | |

Taking this as a locality domain means that the subject, indirect and direct objects are all local to each other nodes, and restricting substitution using this means that formulae decorating of these nodes cannot be used as an antecedent for a metavariable decorating any of the others. Furthermore, if there is an unfixed node decorated in the tree, it too will be local to other arguments in the tree, since in being evaluated at each node along the path between the node where it is introduced and the node where it merges, the decorations on that node are evaluated for whether they hold at that very node, including some decoration $Fo(\alpha)$, and this entails $\langle\uparrow_0\rangle\uparrow_1^*\rangle\langle\downarrow_0\rangle Fo(\alpha)$. With this approach, then, neither *Hilary likes her* nor *Hilary, she likes* can ever be associated with the propositional formula $Like'(Hilary')(Hilary')$.

This substitution process is assumed to be defined over a context of structures from which putative antecedents are selected. At this stage, we rely on a purely intuitive concept of context, with context construed as an arbitrary sequence of trees, including the partial tree under construction as the parsing process unfolds incrementally. So we presume that the context relative to the parsing of *John thinks that he is clever* at the stage of parsing the pronoun includes the partial tree under construction, hence making available $Fo(John')$ as a putative antecedent (see chapter 9 for a more detailed discussion of context).[30]

There is a general property of lexical actions which should not get lost sight of here: they are expressed in exactly the same formal language as computational actions, as the procedural style of lexical definition makes clear. In principle they can provide input to other tree-update processes, both general and lexical, thus allowing extensive interaction between lexical and general processes at ALL stages of the construction process. We shall see in this and subsequent chapters how it is the potential for interaction of anaphora construal and what in other frameworks are taken to be syntactic processes which is so fruitful in articulating a broad range of cross-linguistic generalisations, and which singularly distinguishes this framework from all others.

[30]Notice that the same locality can be used to ensure reflexives get properly 'bound' in the most common circumstances. However, Substitution is not involved here but the lexical actions associated with a reflexive identify a local formula and use that as a substitute as part of the parsing process directly. A word like *herself* is thus associated with a lexical entry like:

| | | | | |
|---|---|---|---|---|
| *herself* | IF | $?Ty(e)$ | | |
| | THEN | IF | $\langle\uparrow_0\rangle ?Ty(t)$ | |
| | | THEN | Abort | |
| | | ELSE | IF | $\langle\uparrow_0\rangle\langle\uparrow_1^*\rangle\langle\downarrow_0\rangle Fo(\alpha)$ |
| | | | THEN | $\mathtt{put}(Ty(e), Fo(\alpha), [\downarrow]\bot)$ |
| | | | ELSE | Abort |
| | | ELSE | Abort | |
| | ELSE | Abort | | |

See chapter 6 for a discussion of the anaphor *zibunzisin* in Japanese.

### 1.5.1 Pro drop and word order variation

A point to notice about the analysis of pronouns in English suggested above is that they are associated with the 'bottom restriction' $[\downarrow]\bot$, which, as we have seen, means that the node decorated by the pronoun is a terminal node and can not be further developed. One of the consequences of this is that, in English, pronouns cannot be associated with initially unfixed nodes in question or analogous 'topicalisation' structures (1.35):[31]

(1.35) a. *Which barman did Mary upset him?

b. *Bill, Hilary amused but John, she upset him.

As we shall see in chapter 4, however, there are languages in which some pronouns do not have this restriction and so can be associated with such left dislocated material. Such an effect can be seen in the clitic doubling structures evident in languages such as Modern Greek, as illustrated in (1.36).

(1.36) *ti* *Maria* *tin* *ksero*
the$_{ACC}$ Maria her$_{CL-ACC}$ I know
'I know Maria'

We go into such constructions in more detail later in the book, but essentially the clitic *tin* in (1.36) projects a metavariable but does not decorate that node with the bottom restriction. This allows the unfixed node decorated by *ti Maria* to MERGE with that node, yielding a structure identical to that derived by parsing the non-dislocated string *ksero ti Maria*.

The example in (1.36) also shows another common property of natural languages: pro-drop. This is the phenomenon in many languages of licensing the occurrence of a verb without any independent expression providing the argument for the predicate, presuming on its identification from context. The dissociation of a metavariable from the bottom restriction illustrated by clitic doubling, however, also provides a straightforward way to analyse such languages.

As we have seen in this chapter, subject nodes in English are introduced by the construction rules INTRODUCTION and PREDICTION while the lexical actions associated with verbs are triggered by a predicate requirement, $?Ty(e \rightarrow t)$. As such, transitive verbs do not decorate their subject nodes and overt subjects are thus necessary to guarantee the well-formedness of strings because, without one, the pointer can never reach the triggering predicate node. However, certain languages are best treated as having the parsing of verbs triggered by a propositional requirement, rather than a predicate node. So, for example, in a VSO language like Modern Irish, we may analyse (non-copular) verbs as being triggered by a type $t$ requirement and providing a full propositional template with the pointer left at the subject node for development next. Thus, the verb *chonaic* 'saw' in (1.37) may be given the lexical entry in (1.38) which has the effect shown in Figure 1.25. The fact that the pointer is at the subject node allows the immediate parsing of the first person pronoun *mé* in (1.37) and the pointer then travels down the tree using ANTICIPATION (twice) to allow the internal object to be parsed.

[31]The terminology in this area is extremely confusing, with 'topicalisation' as one standard term for long-distance dependencies that are characteristically used for the focus effect of isolating one term as update to some remaining structure.

(1.37) *Chonaic mé an cú*
saw I the dog

I saw the dog

(1.38) *chonaic*

| | | |
|---|---|---|
| IF | $?Ty(t)$ | |
| THEN | $\mathtt{put}(Tns(PAST));$ | Tense |
| | $\mathtt{make}(\langle\downarrow_1\rangle); \mathtt{go}(\langle\downarrow_1\rangle); \mathtt{put}(?Ty(e \rightarrow t));$ | Predicate Node |
| | $\mathtt{make}(\langle\downarrow_1\rangle); \mathtt{go}(\langle\downarrow_1\rangle);$ | |
| | $\mathtt{put}(Fo(Chon'), Ty(e \rightarrow e \rightarrow t), [\downarrow]\bot)$ | Main Functor |
| | $\mathtt{go}(\langle\uparrow_1\rangle); \mathtt{make}(\langle\downarrow_0\rangle); \mathtt{go}(\langle\downarrow_0\rangle); \mathtt{put}(?Ty(e));$ | Internal Argument |
| | $\mathtt{go}(\langle\uparrow_0\rangle\langle\uparrow_1\rangle); \mathtt{make}(\langle\downarrow_0\rangle); \mathtt{go}(\langle\downarrow_0\rangle); \mathtt{put}(?Ty(e))$ | Subject |
| ELSE | Abort | |

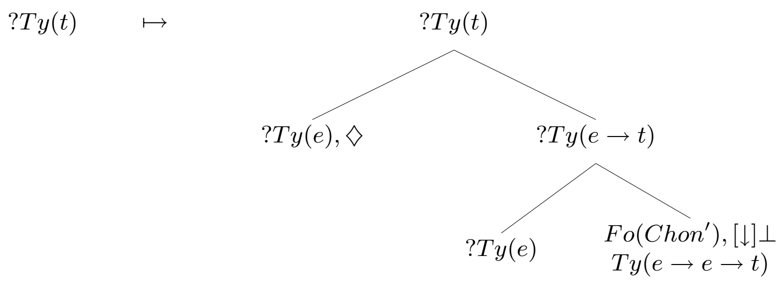



Figure 1.25: Parsing *chonaic*

There is, of course, much more to say about the analysis of Modern Irish, but this brief sketch of the parsing of main verbs shows one of the ways in which word order variation can be achieved within Dynamic Syntax – through the manipulation of triggers (between propositional, main predicate and n-place predicate requirements) and where the pointer remains after the lexical actions have occurred. It also provides a means of accounting for subject pro drop languages such as Modern Greek. While in Modern Irish the subject node is decorated by a type requirement (at least for analytic forms such as *chonaic*), indicating the need for an overt subject, in Modern Greek we may analyse verbs as decorating their subject nodes with METAVARIABLES. Such metavariables, like those projected by pronouns in the way we have seen, are associated with a formula requirement and so must be updated with some contentful expression. This is achieved by lexical actions such as those associated with the verb *ksero* 'I know' shown in (1.40). Figure 1.26 shows the parse of the sentence in (1.39) with substitution of the subject metavariable being made on the assumption that Stavros utters the string.[32] The resulting proposition is, as expected, $Fo(Kser'(Maria')(Stavros'))$.[33]

(1.39) *ksero ti Maria I know*
the$_{ACC}$ Maria

[32]The analysis ignores the import of the definite article.

[33]We leave on one side here the question of how to express the $VSO$ ordering, except to say that the rule of LATE*ADJUNCTION to be proposed in chapter 5 provides a straightforward mechanism for accounting for this frequent structure. For a first account of a verb-initial language using the DS framework, see Turner 2003.

'I know Maria'

(1.40) *ksero*

| | | |
|---|---|---|
| IF | $?Ty(t)$ | |
| THEN | $\texttt{put}(Tns(PRES));$ | Tense |
| | $\texttt{make}(\langle\downarrow_1\rangle);\texttt{go}(\langle\downarrow_1\rangle);\texttt{put}(?Ty(e\rightarrow t));$ | Predicate Node |
| | $\texttt{make}(\langle\downarrow_1\rangle);\texttt{go}(\langle\downarrow_1\rangle);$ | |
| | $\texttt{put}(Fo(Kser'),Ty(e\rightarrow e\rightarrow t),[\downarrow]\bot)$ | Main Functor |
| | $\texttt{go}(\langle\uparrow_1\rangle);\texttt{make}(\langle\downarrow_0\rangle);\texttt{go}(\langle\downarrow_0\rangle);\texttt{put}(?Ty(e));$ | Internal Argument |
| | $\texttt{go}(\langle\uparrow_0\rangle\langle\uparrow_1\rangle);\texttt{make}(\langle\downarrow_0\rangle);\texttt{go}(\langle\downarrow_0\rangle);$ | |
| | $\texttt{put}(Ty(e),Fo(\mathbf{U}_{Speaker'}),?\exists\mathbf{x}.Fo(\mathbf{x}))$ | Subject Metavariable |
| ELSE | Abort | |

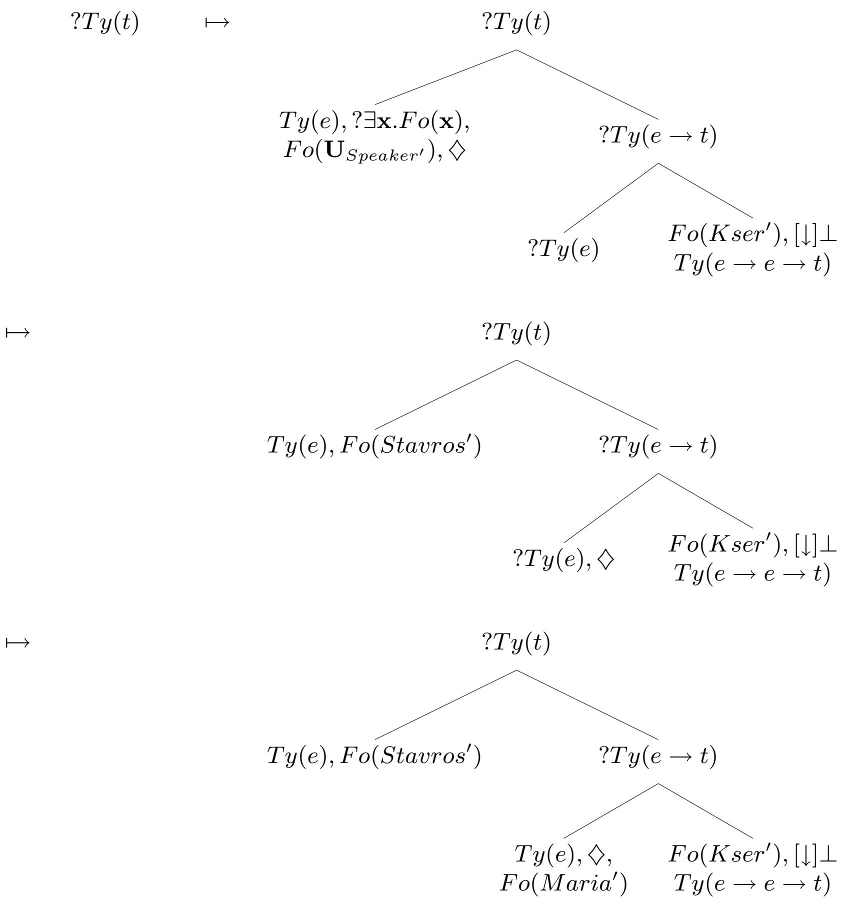



Figure 1.26: Parsing *ksero ti Maria*

Greek, like Irish, is a canonically verb-subject-order language (a 'verb-initial' language), though subject pro-drop. This is reflected, in this analysis on which node at the end of the macro of actions provided by the verb, the pointer ends up at - in (1.40) at the subject node. It is then a simple matter to reflect subject pro-drop languages in which subject-verb-object is the unmarked order, such as the Romance languages of Spanish, Italian, etc. We define a macro of actions for the verb identical in format to that of Greek except that, by a simple re-ordering of the sequence of lexical actions, the pointer ends up at the object argument node. In this case, because the object node is only decorated with a requirement for a node of type $e$, the necessity of an expression immediately following the verb which can satisfy this requirement is immediate.

There is a consequence to giving distinct lexical specifications for verbs (and other expressions) in different languages. All languages, equally, can realise pairs of expressions corresponding to a subject plus its verb, though some apparently don't have to project such pairs in order to convey a subject-predicate relation as interpretation. This might seem to pose a problem: in all these languages in which the verb decorates the subject as part of its own actions, if the subject is also explicitly marked by a discrete constituent, the subject position in the resulting logical form will get decorated twice, once by the subject expression, and once by the verb itself, as illustrated in (1.41).

| | | | | | |
|---|---|---|---|---|---|
| (1.41) | *o* | *Stavros* | *kseri* | *ti* | *Maria* |
| | the$_{NOM}$ | Stavros | he knows | the$_{ACC}$ | Maria |
| | 'Stavros knows Maria' | | | | |

Should we avoid this outcome by characterising verbs in pro-drop languages as sometimes projecting a subject from the lexicon, and sometimes not? The answer is that this isn't necessary. There are several alternatives. For example, all cases in which there is an explicit subject expression will allow a derivation in which that expression is taken to decorate a node which is initially introduced as unfixed, only subsequently merging with the subject node projected by the verb. This is the analysis we have already motivated in English for left-dislocation structures, such as *Mary , John dislikes.* The string in (1.41) could then be analysed with the subject *o Stavros* as providing an update for the propositional template given by the verb through the MERGE process as illustrated graphically in Figure 1.27.[34] Notice that MERGE is licit here because the subject node is **not** decorated by the bottom restriction, $[\downarrow]\bot$. The node may, therefore, grow and accommodate an initially unfixed subtree.[35]

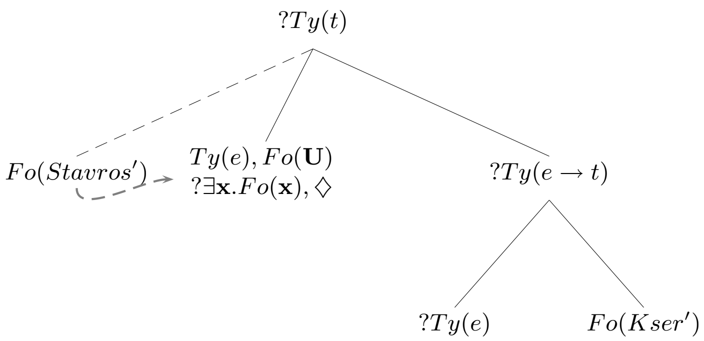



Figure 1.27: Parsing *o Stavros kseri*

[34]The dashed arrow here and below indicate MERGE.

[35]The fact that the subject node grows in Figure 1.27 is not obvious as we currently do not show the internal structure of proper names which in chapter 3 will be rectified when they are treated as terms which have internal structure, as a form of quantifying expression.

There is, however, a further way in which subjects can be accommodated in pro-drop languages: through the straightforward use of INTRODUCTION and PREDICTION. The subject is introduced as we have seen for English, as in tree A in Figure 1.28. The verb is parsed to yield a full propositional template with the subject node decorated by a metavariable to give the *apparently* inconsistent tree B in Figure 1.28. However, the inconsistency is only apparent as can be seen if we consider the description of the tree, rather than its representation. From the point of view of the topnode tree B has the description in (1.42) – six introduced nodes, each with their itemised properties, including a description of their relation to the top node:

(1.42)

| | | |
|---|---|---|
| 1 | $\{Tn(0), ?Ty(t)\}$ | Topnode |
| 2 | $\{\langle\downarrow_0\rangle Tn(0), Ty(e), Fo(Stavros'), [\downarrow]\bot\}$ | Initial Subject Node |
| 3 | $\{\langle\downarrow_0\rangle Tn(0), Ty(e), Fo(\mathbf{U}), ?\exists\mathbf{x}.Fo(\mathbf{x}), \Diamond\}$ | Introduced Subject Node |
| 4 | $\{\langle\downarrow_1\rangle Tn(0), ?Ty(e \rightarrow t)\}$ | Predicate Node |
| 5 | $\{\langle\downarrow_1\rangle\langle\downarrow_0\rangle Tn(0), ?Ty(e)\}$ | Internal Argument Node |
| 6 | $\{\langle\downarrow_1\rangle\langle\downarrow_1\rangle Tn(0), Ty(e \rightarrow e \rightarrow t), Fo(Kser'), [\downarrow]\bot\}$ | Functor Node |

The important thing to notice about this description is that lines 2 and 3, giving the descriptions of the initial and introduced subject nodes, describe THE SAME NODE, the argument node immediately dominated by the topnode. The full description of that node should thus be that in (1.43a) with the two descriptions unified, which itself reduces to (1.43b) once fulfilled requirements and uninformative information (i.e. the metavariable) are removed.

(1.43) a. $\{\langle\downarrow_0\rangle Tn(0), Ty(e), Fo(Stavros'), [\downarrow]\bot, Fo(\mathbf{U}), ?\exists\mathbf{x}.Fo(\mathbf{x}), \Diamond\}$

b. $\{\langle\downarrow_0\rangle Tn(0), Ty(e), Fo(Stavros'), [\downarrow]\bot, \Diamond\}$

Tree B in Figure 1.28 is thus equivalent to tree C in the same figure. This example thus shows the usefulness of the tree description language which highlights directly the number and type of nodes in a tree which may be obscured by apparently contradictory sets of computational and lexical actions.

It might be objected that having multiple ways of deriving a parse is problematic for the framework. But this is not the case. As we shall see later in this book, different parsing strategies (possibly signalled by variations in prosodic information) may give rise to different pragmatic effects. Even if this is not the case, as is presumed in Categorial Grammar, derivations, eg for coordination, with its infinitely flexible constituency assignment, the fact that there are multiple paths to achieve a successful parse is not inimical to the exercise provided that the output is appropriate and each step of a derivation is licensed by computational or lexical actions: it is the process that is important. We discuss well-formedness and ungrammaticality in more detail below, but to conclude this section, it is useful to note that the differences we attribute to lexical actions form the basis for our account of linguistic variation. In the chapters that follow, we will use different sets of lexical actions for verbs and pronouns along lines suggested in this section in accounting for different grammatical properties, in particular the interaction of dislocated or scrambled expressions with anaphora.

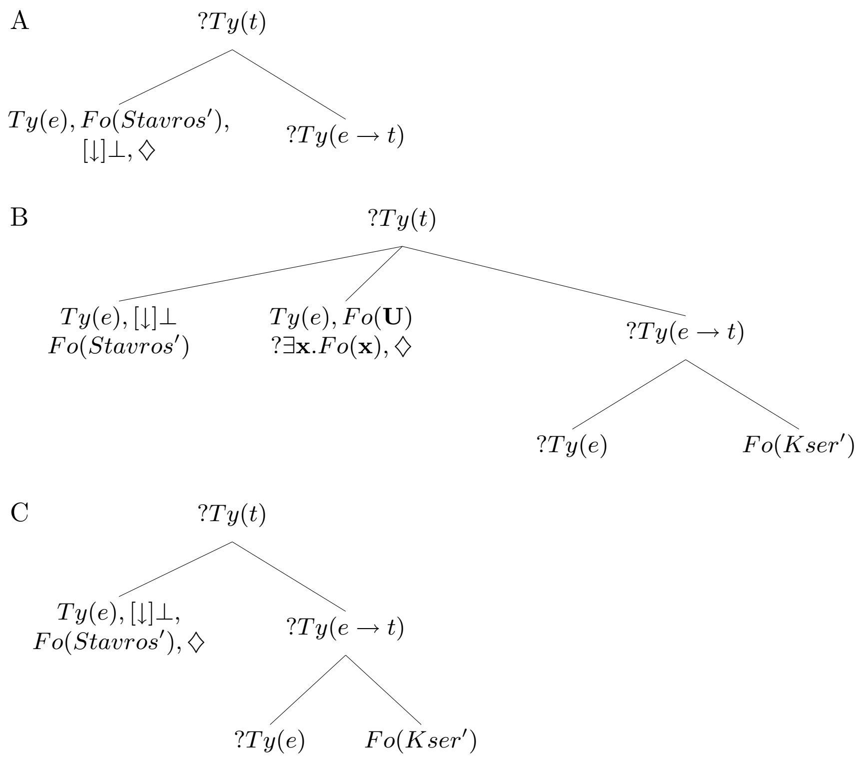



Figure 1.28: Parsing *o Stavros kseri* 2

## 1.6 Wellformedness and ungrammaticality

Before branching out into more complex structures, there is one more essential preliminary step. We need to be clear about the concept of wellformedness that this formalism provides. In what sense can such a parsing-oriented formalism constitute a grammar formalism? More pointedly, given the way we have set out the framework so far, how can only considering one sequence of transitions through a set of options be sufficient to determine wellformedness? This is a good question; because the answer is of course that it can't. If a system is to constitute a grammar formalism, then it has at the very least to provide a filter mechanism determining which sequences made up of English words are not wellformed sentences of the language. In order to determine this concept of wellformedness, we need to look at sequences of transitions which are wellformed, and at what it is that causes a given sequence of transitions to abort.

The wellformed sequences that we have so far established have a number of properties in common. First, the concept of tree growth is central. Decorations are invariably added to the tree: nothing is taken away except requirements, and these go only when fulfilled. Secondly this concept of growth is essentially progressive: no trivial additions are allowed.[36] Thirdly, all sequences of tran-

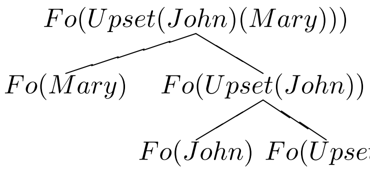
[36]More formally, the process of growth is upward monotonic, a property which is developed

sitions share the following pair of properties. The starting point is the axiom, the initial statement that imposes the goal of establishing a logical form of type $t$. The output for all successful sequences is reaching that goal, and with no outstanding requirements: so all goals, and all subgoals have to be met. Furthermore they have to be met by following the actions as provided by the words in the linear sequence in which the words are presented. No actions from any word can be put on hold, and used at some arbitrary point later.

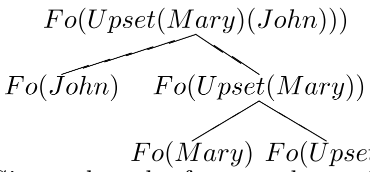
These observations give us enough to articulate a preliminary concept of wellformedness. To be a wellformed string, there must be a sequence of actions that follows from the initial goal to the construction of a logical form decorating the top node of a tree with actions from each word having been used in the sequence presented in combination with computational actions as applicable, with no requirements outstanding in the end result.

More than one logical form may be available, and more than one sequence of actions. It is notable in fact, given that the concept of interpretation modelled is that of an interpretation selected relative to context, that there may be a large number of logical forms that can be associated with a given sequence of words. This has a consequence for ungrammaticality, which represents something of a challenge. In order to be ungrammatical, given rules of the system, there must be no possible sequence of transitions using the information presented incrementally by the words in combination with computational actions that yield a single logical form. This means that in checking claims of ungrammaticality, one has to check all possible sequences and establish that no logical form is derivable.

To see that this is no mean task, let's take a simple case. How is it that the system guarantees that *John, Mary upset* must map onto the tree equivalent to the string *Mary upset John*, i.e.:




In particular, how does the system preclude it from being mapped onto:

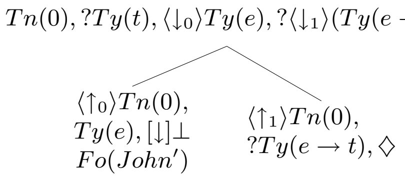



Given what the framework provides, why can't *John* be construed as subject and *Mary* as object in parsing *John Mary upset*? Several possible derivations might spring to mind. Why can't *Mary* be taken to decorate an object node which is introduced first on developing the predicate-requiring node? Or why can't *Mary* be taken to decorate an unfixed node introduced after the subject node is established and decorated, which is then merged with the object node?

The answer is simple enough, though a bit laborious to establish. As so far set out, there are two choices at the outset of the construction process. Either *Adjunction applies and the word *John* is taken to decorate an unfixed node

in depth in Kempson et al 2001.

with $Fo(John')$; or Introduction and Prediction are applied and *John* is taken to decorate the subject node. The former strategy gives us naturally what we want, so we can leave that on one side as unproblematic. Suppose to the contrary that *John*, as the first word in the string, is taken to decorate the subject node:




We then immediately face a difficulty in parsing the second noun phrase *Mary*, for once the subject node is parsed, the pointer goes back to the top node, and from there by Anticipation to the predicate-requiring node which Prediction introduced. *Adjunction cannot now apply: it is defined (for English at least) to apply only when the pointer is at the node decorated with $?Ty(t)$ (i.e. not from the predicate-requiring node).*Adjunction also cannot apply recursively: this is ensured by the requirement that it apply only when there are no other nodes in the (sub)tree of which it is the top. Again this will turn out to be a language-particular stipulation, which may not hold in free word-order languages. This is the significance of the double brackets {{ in the condition on applicability of *Adjunction:

$$\{\{Tn(a), \ldots ?Ty(t), \diamondsuit\}\}$$

As soon as either one application of *Adjunction has taken place, or an application of Prediction, this condition will no longer apply. With *Adjunction inapplicable, given the assumption that *John* has been taken to decorate a subject node, then the only option is to use Anticipation to move to the predicate-requiring node.[37] But with the pointer at the predicate-requiring node, then the condition for carrying out the actions of the name *Mary* cannot be applied – its trigger of $?Ty(e)$ has not been provided. Applying the actions of the verb could of course be carried out if the verb were next in the sequence, as this requirement is the appropriate condition for its sequence of update actions. However, it is *Mary* that, according to the test, lies next in the sequence of words. But with Introduction and Prediction only applying in English at the level of expanding a propositional node, i.e. with $?Ty(t)$ as the condition on their application, the trigger for the actions provided by the word *Mary* is not provided and the sequence aborts. Hence the impossibility of building an interpretation 'John upset Mary' from the sequence *John, Mary upset.* The only way for a successful derivation to take place, once the decoration on the subject node has been established, is for the update action of the verb to be carried out first. And to enable this to take place, the verb has to be positioned before the noun phrase to be construed as object.

This explanation turned on what may seem to be an ad hoc stipulation that the only form of Introduction and Prediction that are available in English con-

[37] In principle, another daughter node could be introduced, but any such move would be trivial, as any such node being already introduced would immediately satisfy the requirement $?Ty(e)$ removing the requirement. By a very general principle of tree growth, such trivial updates are debarred.

cern expansion in preparation for decorating subject and predicate nodes. If the more general type-neutral variants of Introduction and Prediction are preferred, then Prediction could in principle apply, and we would need to ensure that the verb's actions then abort. This is straightforwardly definable for verbs, eg *upset*, by adding one level of complexity to the lexical specification forcing the sequence of actions to abort in the presence of some constructed daughter node; and since such a definition provides a useful illustration of how lexical specifications can be manipulated, we list it here as an option. Such a characterisation would take the form:

*upset*

| | | |
|---|---|---|
| IF | $?Ty(e \rightarrow t)$ | |
| THEN | IF | $? \downarrow \top$ |
| | THEN | Abort |
| | Else | make($\langle\downarrow_1\rangle$);<br>go($\langle\downarrow_1\rangle$); put($Fo(Upset)$);<br>go($\langle\uparrow_1\rangle$); make($\langle\downarrow_0\rangle$);<br>put($?Ty(e)$) |
| ELSE | Abort. | |

The only novel aspect to this definition is the use of the symbol $\top$, "the true", the converse symbol to the falsum $\bot$ which we have already used in characterising lexical actions as decorating terminal nodes in the tree structure. What this specification indicates is that if at some daughter some arbitrary property holds, then the sequence is aborted. Literally, the requirement is of the form that at a daughter node some property holds: if this is the case, this sequence of actions is aborted. Since in building a daughter node, a value for the $Tn$ (tree-node) predicate will hold, this specification will be satisfied should any daughter node be introduced, no matter what its decorations are otherwise. However, this lexical specification is not, in the event, necessary, since we do not presume on a general process of Introduction and Prediction. This is not just an ad-hoc stipulation as, unlike categorial grammar formalisms, there is in Dynamic Syntax no presumption of a general process of type-introduction. We manipulate only a small number of types, and apart from the introduction of the subject-predicate distinction, these are lexically induced.

This example is important because it shows the challenge ahead. For a string to be ungrammatical, there must be no possible sequence of actions whereby a logical form can be constructed. To check a wellformedness prediction then is easy: there merely has to be at least one route through the maze. To check that something is excluded is much more laborious: there must be no possible route. A consequence of this is that the system doesn't select between possible parse strategies - in this it is unlike real-time parsing - it simply makes available a set of sequences of partial trees for a string, any one of which might be used in parsing, and any one of which is sufficient to determine that the string is wellformed.

# Chapter 2

# Relative Clause Construal

## 2.1 Relative Clauses 1: Linked Structures

In the previous chapter, we have seen how individual trees can be built up following information provided by both general rules and lexical instructions, establishing an interpretation in part relative to some previously constructed context. We have so far assumed that this process is sentence by sentence: each sentence is parsed relative to some context to which it incrementally adds its own structure once that is compiled. Formally, what we have so far defined is the articulation of a goal-directed process of unfolding and then compiling individual trees. However, there may also be an interweaving of structures, with one partial structure acting as the context for the next. First one partial structure is constructed; then another process uses that partial structure as its context to yield a further structure; and finally the pointer returns to the first partial structure to complete it in the light of having constructed the intermediate tree as a side-routine. In this way, the human processor can build structures in tandem. In this chapter, we introduce the compound task involved in building such paired structures, in so doing, treating a major subpart of natural-language recursion as the progressive projection of individually simple structures. We shall also be providing the background, including an account of quantification, for subsequently spelling out the interactions between structure building processes and anaphora resolution.[1]

The methodology, as before, is to closely follow the dynamics of time-linear processing. This is in contrast almost all analyses of of relative clause construal, which standardly involve bottom-up projection of structure/interpretation to be bound by some operator after the structure it is to bind has been built up (see all work in the various Chomskian paradigms, the Montague-paradigm analyses, HPSG analyses etc. etc.) The shift in emphasis means that we distinguish three stages in the process: (i) the context that provides the input to the construction of the sub-structure currently under development, (ii) intermediate steps in the progressive emergence of the particular sub-structure, and (iii) the contribution of that sub-structure to the containing structure once it is completed. The third of these stages will be familiar from orthodox frameworks in which composition-

[1]This chapter, like the previous chapter, incorporates results of Kempson et al 2001, though with some additions, in particular the discussion of non-restrictive relative clause construal.

ality is defined bottom-up, since all frameworks agree on there being some level over which compositionality of content as assigned to natural language expressions is defined. But the two earlier stages will be novel in that they make essential reference to the progressive time-linear emergence of structures over which the interpretation is to be built up.

### 2.1.1 Nonrestrictive relatives

We start straightaway with our analysis of the process of adding a relative clause modifier to a name, the so-called nonrestrictive relatives, as, unlike in standard frameworks, these provide the most transparent illustration of the form of account that we adopt.[2] The account is essentially that of the grand master of English descriptive linguistics, Otto Jespersen; an analysis we shall subsequently generalise to other languages. So consider what is going on in the processing of (2.1):

(2.1) John, who I like, smokes.

(2.1) involves a dual assertion about John, namely that I like him and that he smokes, though the assertion that I like John is in some sense to be made precise subordinate to the assertion that he smokes. Two correlated structures have to be built, linked structures as we shall call them, sharing in their assigned semantic structure a common term. The intuition about how these structures are built up is that the word *who*, correctly described by Jespersen (1927) as a relative "pronoun", provides the pivot from one structure to the other, enabling information from one structure to be copied to the other.[3] Moreover, its position at the left periphery of the clause it introduces, is, we take it, a reflection of the fact that this copy is introduced at an unfixed node in this newly emergent structure, its contribution to that structure as yet unidentified. To model this, we assume that trees may be constructed as pairs, with a transition from a node in one tree across a LINK relation, described a modal operator $\langle L \rangle$, to the topnode of a tree upon which is imposed a requirement that this node be developed to contain a copy of that first node. In (2.1) for example, the word *John* is processed to yield a partial tree for (2.1) in which the formula $Fo(John)$ annotates a subject node in the tree (the 'head' node), this partial tree provides the context for the development of a second structure. A transition which we call LINK Adjunction licenses the construction of a relation from that node, leaving the first partial tree and introducing the topnode of a new tree. This node, assumed to have the requirement $?Ty(t)$ indicating that a propositional structure is to be constructed, is also assigned a requirement for an occurrence of the formula $Fo(John)$ at some node, without further specification as to where in the newly introduced tree that might be (see figure 1). This requirement is then immediately satisfied by the introduction and decoration of an unfixed node. The process of tree construction then proceeds as in a left-dislocation case, with the initially unfixed node having its position in that tree established in due course through the process of *Merge*.

The details involved in this sequence of actions now need to be spelled out rather more. A rule of LINK Adjunction licenses a transition from the node

[2]We take up the analysis of restrictive relatives such as *every man who I like* once we have introduced quantification: see section 4.

[3]'Pivot' is Jespersen's term.

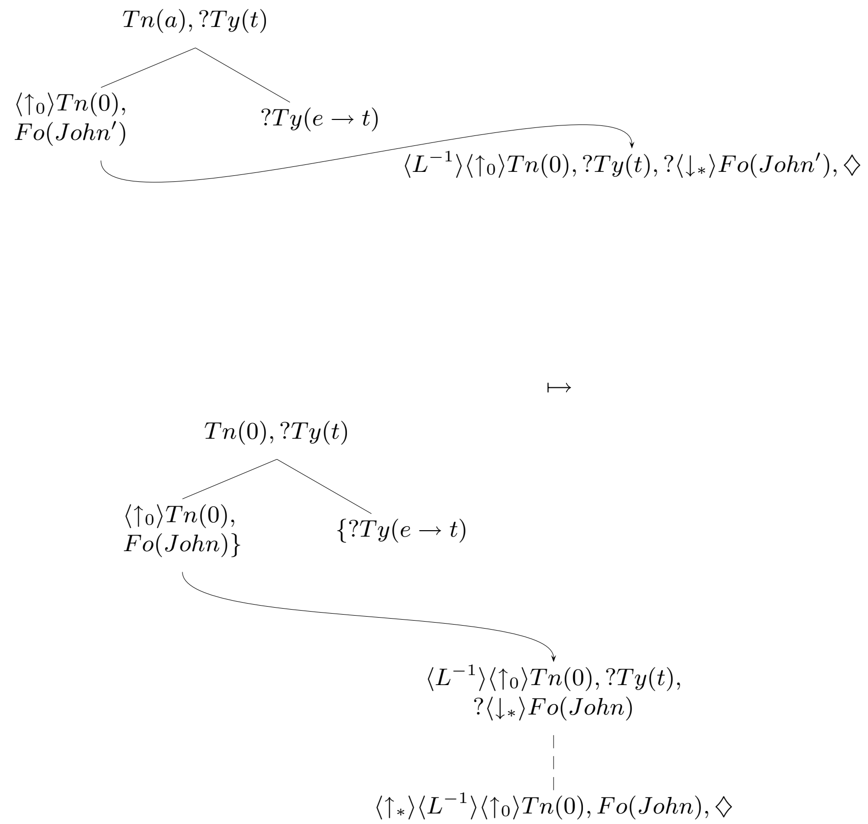



Figure 2.1: parsing *John, who*

$\langle\uparrow_0\rangle Tn(0)$ in figure 1 to a new node, introducing a LINK relation; so the node introduced is labelled with the treenode description $\langle L^{-1}\rangle\langle\uparrow_0\rangle Tn(0)$, $\langle L^{-1}\rangle$ being the inverse of the LINK relation:

*Link Adjunction (English)*

$$\frac{\{..\overbrace{\{Tn(a), Fo(\alpha), Ty(e), \diamondsuit\}}^{\text{head}}\}}{\{..\underbrace{\{Tn(a), Fo(\alpha), Ty(e)\}}_{\text{head}}, \underbrace{\{\langle L^{-1}\rangle Tn(a), ?Ty(t), ?\langle\downarrow_*\rangle Fo(\alpha), \diamondsuit\}}_{\text{linked node}}\}}$$

What the rule then does is to add to the new node the requirement $?Ty(t)$ PLUS the requirement for an occurrence of the formula $\alpha$ decorating the head at some node within that tre.[4] This takes the form of $?\langle\downarrow_*\rangle Fo(\alpha)$. Formally, this requirement is a combination of the concept of requirement and a modal statement that the formula decorating the head should hold at some unfixed location in the tree construction. This, remember, is the tool used to characterise

[4]We shall call such adjunct trees LINKed trees, distinguishing them where necessary by this nomenclature from the tree from which the LINK relation was constructed.

a left-dislocation structure as having an initially unfixed node. Here, expressed as a requirement, it embodies the restriction that somewhere in the ensuing construction of the tree from this node, there must be a copy of the formula decorating the head.[5]

This restriction need not be satisfied immediately: all it requires is its satisfaction at some point before the tree whose topnode is just introduced is completed. When we turn to other languages, this will be significant, as this combination of requirement and modal statement provides a natural means of expressing a range of nonlocal discontinuities between either the head or some clause-initial complementiser and a pronoun within that clause functioning resumptively. Unlike other frameworks, at no point does there need to be adjacency between the term providing the requisite formula as head and the term realising the requirement for a copy of it - the modality in the formula specification captures all that is needed to express long-distance dependencies of this form. In English, as it happens, the requirement imposed by the construction of a LINK transition is met immediately, a restriction induced by the lexical actions of the relativisers *who*, *which*, and *that*, which are defined as rule-governed anaphoric devices that decorate an unfixed node:

| | | |
|---|---|---|
| $which_{rel}$ | **IF** | $?Ty(e), ?\exists x.Tn(x), \langle\uparrow_*\rangle\langle L^{-1}\rangle Fo(\mathbf{x})$ |
| | **THEN** | $\text{put}(Fo(\mathbf{x}), Ty(e), [\downarrow]\bot)$ |
| | **ELSE** | **ABORT** |

This action is notably like that of a pronoun except that the value is fully determined as being that decorating the head from which the LINK transition is defined. What this conditional action says is that IF back from an unfixed node along this unfixed relation and then back along the LINK relation $Fo(\mathbf{x})$ holds, THEN put a copy here, here being where the pointer is, of that formula $Fo(\mathbf{x})$, for some arbitrary value of $\mathbf{x}$. Notice in the condition the requirement $?\exists x.Tn(x)$. This requirement for a fixed tree node position ensures that this action of the relative pronoun takes place only at a node currently unfixed, and not at some fixed node that, equally, is dominated by the top node. So the application of an intermediate step of *Adjunction is enforced. However, nothing prevents further nodes having been introduced subsequent to that step of *Adjunction, since these too will be characterisable as being dominated without fixed extension by the node linked to the head node, so pied-piping cases are covered without any special stipulation:

(2.2) A Givenchy shirt, the collar of which was faded, was in the sale.

Indeed, in order to prevent such cases, as with $who_{rel}$ and $that_{rel}$ an extra condition is needed to abort the action if there is an immediately dominating node:

| | | | |
|---|---|---|---|
| $that_{rel}$ | **IF** | $?Ty(e), ?\exists x.Tn(x),$ $\langle\uparrow_*\rangle\langle L^{-1}\rangle Fo(\mathbf{x})\}$ | |
| | **THEN** | **IF** | $\uparrow\top$ |
| | | **THEN** | ABORT |
| | | **ELSE** | $\text{put}(Fo(\mathbf{x}), Ty(e), [\downarrow]\bot)$ |
| | **ELSE** | **ABORT** | |

What $\uparrow\top$ indicates is that the actions will abort if the pointer is at a fixed node

[5] This restriction is notably transparent stated in this modal logic vocabulary.

in a tree. Notice also the terminal-node restriction. What is copied is just the formula compiled at the head node, no matter what the history of building that up was. So from the point of view of the linked structure now being established, there is no internal structure to that node.

With the relative pronoun interpreted as decorating this constructed unfixed node, the interpretation process continues as set out in chapter 1. The subject node can be introduced and decorated, the predicate node unfolds, and, with the verb also introducing an argument node, this node duly merges with the unfixed node, and an interpretation compiled for the entire linked structure. With this structure completed, the pointer can return to complete the parsing of the main structure. And once the two structures are completed, a LINK evaluation step licenses the step of combining the two derived formulae into a single conjoined formula.[6]

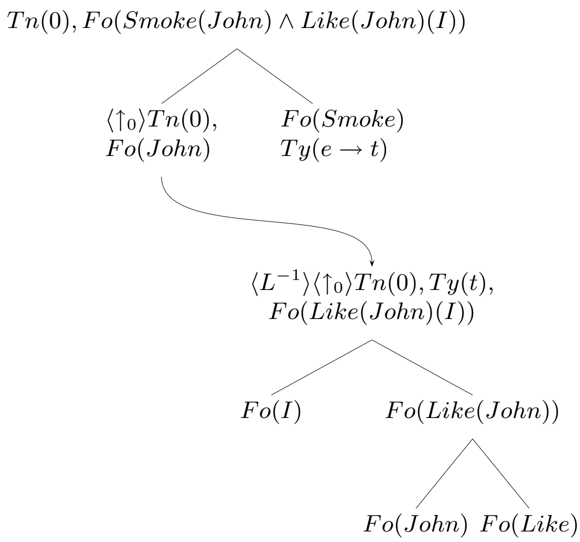



Figure 2.2: Completing the parse of *John, who I like, smiled*

## 2.2 Interactions of Anaphora and Long-Distance Dependency: crossover

There is a more general significance to this analysis. Long-distance dependency, anaphoric expressions, and relative clause construal each display the property of projecting some weak specification of structure which is subsequently enriched.

[6]The analysis as formulated here does not capture the obligatoriness of a relative pronoun in nonrestrictive forms of construal. We could force this by defining as a lexical macro of actions the entire sequence of steps involved in introducing the topnode of a linked structure and its attendant unfixed node. This would mean that the defined sequence of actions could not be split up by any intervening general computational actions. But this would leave pied-piping constructions without explanation, so we prefer to allow a relatively liberal system which allows (i) as wellformed:
(i) John, he's a pain, has cancelled his appointment.
(ii) John, I think Sue said he'd be in tomorrow, will be at the meeting.

In the case of long-distance dependency such as *Mary, I like*, as we saw in chapter 2, the first constituent is analysed as providing some information identifying who is being talked about by the term *Mary* but not the role of that term in the structure. Anaphoric processes project a formula which is interpreted in context as taking the value of some antecedently selected term.

We have already seen the interaction of introducing a linked structure and an unfixed node. One type of underspecification that has not played a part in the process of relative clause construal so far is the process of anaphora resolution. Yet in analysing the construal of anaphora, relative clause and long-distance dependency all as different aspects of the same sort of process – that of tree growth – we might expect there to be interaction between the three processes of interpretation, and indeed there is.In (2.3) the word *he* cannot be construed as picking out the same individual as the expression *John*, while, in (2.4), it can:[7] [8]

(2.3) John, who I'm certain he said would be at home, is in the surgery.

(2.4) John, who I'm certain said he would be at home, is in the surgery.

This restriction was classified in Postal (1993) as a mystery, and remains a major challenge.[9] The problem is that the data have to be seen, as in the original Postal analysis, as splitting into at least two different phenomena, called strong and weak crossover, each is yet further subdivided into two further subcategories - 'extended strong' and 'weakest' crossover. In Lasnik and Stowell's account (1992), a discrete concept of gap called a 'null epithet' was posited in addition to the array of empty categories already posited at the time; and there remains no satisfactory integral explanation within movement frameworks. Indeed it has become standard to treat these phenomena as entirely separate phenomena requiring very different analyses.[10]

The extent of the puzzle can be traced directly to the static methodology of the jigsaw view of language. The problem arises in that type of framework, because, being taken to be a syntactic phenomenon, this distribution is analysed exclusively in terms of the hierarchical relationship between pronoun and posited empty position, 'the gap', all reference to the dynamics of left-right processing being, by standard assumptions, debarred in syntactic explanations

[7] We cite these here without any indexing indicating the licensed interpretation, contrary to normal methodology, as these sentences are fully well-formed. It is simply that some interpretations are precluded.

[8] When first observed by Postal in 1972, this phenomenon was called crossover to reflect the fact that analysing word order variation in terms of moving expressions from one position to another, the *wh* expression is moved, "crossing over" a pronoun, an effect which debars interpretation of *wh*, pronoun and gap as co-referring.

[9] This was certainly granted to be so in the early 90's in the Principles and Parameters framework, and the analysis of Lasnik and Stowell, which requires the splitting up of the phenomena into yet further categories, has been carried over into analyses since then, as though such a proliferation of discrete phenomena weren't problematic: Boeckx, ... de Cat, ....

[10] There have been a number of relatively recent analyses in non-movement frameworks attempting to reduce them to a single phenomenon, but the phenomenon remains very generally intransigent in any account which fails to reflect the linearity intrinsic to the distribution. See Hepple 1992, which requires an account of all cross-sentential anaphora as an entirely distinct phenomenon, Safir..., which the author himself notes fails to extend appropriately cross-linguistically. Dalrymple et al 2001, Kempson 1998, Barker 2002, by contrast all invoke concepts of linearity as an integral part of the explanation.

of linguistic data (see chapter 1). According to this standard perspective, if pronoun and gap are both arguments and the pronoun c-commands the gap (as (2.3) would standardly be analysed), an interpretation in which the pronoun and *wh*-expression are taken to denote the same entity is not possible given the binding principle C whereby an empty category must not be interpreted as referring to the same entity as ANY c-commanding argument expression, the gap supposedly having name-like properties which require it to be free.[11] This principle-C style of analysis will not apply if the pronoun precedes but does not c-command the gap because the principle C filter won't apply. Crossover environments in which the pronoun is contained in a complex determiner are accordingly analysed as a distinct phenomenon, under some circumstances these being able to be construed as co-referring (weakest crossover – (2.5)).[12]

(2.5) $\text{John}_i$, $\text{who}_i$ Sue said $\text{his}_i$ mother worries about $e_i$, has stopped working.

The surprise for this form of analysis, in the standard terminology, is that if the pronoun c-commands the gap but the binder is complex, then the judgements don't coincide with strong crossover cases as might be expected, but coincide with those of weak crossover – allowing co-referring interpretations, despite their classification with the much stronger 'strong crossover' restriction – the so-called extended strong crossover restriction (2.6):[13]

(2.6) $\text{John}_i$, $\text{whose}_i$ $\text{mother}_j$ $\text{he}_i$ worries about $e_j$ far too much, has stopped working.

The parallelism in the acceptability judgements of examples such as (2.5) and (2.6) is entirely unexplained; and it was problems such as these that led Lasnik and Stowell to posit the "null epithet" as a further form, behaving not like a name as the principle C account would expect but like a pronoun, hence subject to principle B. But positing an additional type of empty category just adds to the puzzle (see Safir 1996, 1999).

With a shift into a methodology which pays close attention to the way in which interpretation is progressively built up within a given structural context, the account is, by comparison, strikingly simple. Using steps introduced in chapter 2 and section 1 of this chapter, the emergent structure of (2.3), which we now take in detail, can be seen as built up following a combination of computational and lexical actions. The expression *John* can be taken to decorate a fixed subject node, and, from that, a LINKed structure is initiated and an unfixed node is constructed within that newly introduced structure and duly decorated by copying in a second occurrence of the term $Fo(John)$ as the formula value

[11] Incidentally, this observation of unique binding of the gap by the *wh* expression as an operator guarantees that despite the adoption of predicate-logic forms of binding as the working metaphor for LF representations, nevertheless the "binding" of the gap by the associated *wh* HAS to be distinct from a quantifier-variable binding operation because quantifiers can bind an arbitrary number of variables - hence the specially defined concept of a "syntactic operator" (Chomsky 1981, Koopman and Sportiche 1982).

[12] In this and the following examples, we revert to the standard methodology of co-indexing to indicate the relevant possible interpretation. In particular we use the trace notation without any commitment to such entities to indicate the position in the interpretation process at which the unfixed node associated with the parsing of *who* will be resolved.

[13] The debate is often discussed in connection with *wh*-question data, but here we restrict our attention to crossover phenomena in relatives. See Kempson et al 2001 for a fuller discussion which includes *wh*-questions.

decorating the unfixed node – all this to successfully carry out the parsing of *John*, followed by the parsing of *who*. Subsequent parse steps then lead in succession to the setting up of a subject node ( decorated with a formula denoting the speaker), the introduction of a predicate-requiring node (decorated with $?Ty(e \rightarrow t)$), the construction of a functor node (decorated with $Fo(certain)$) and its attendant second-argument node (decorated with $?Ty(t)$), leading to the construction of the embedded subject node, with the lexical actions of the pronoun providing a metavariable $Fo(\mathbf{U})$ of type $e$ as decoration.

The question is, can this decoration provided from the pronoun be updated by $Fo(John)$, thereby licensing an interpretation of the subject as the same John as already being talked about? And what are the consequences of selecting this interpretation? The answer is that there is nothing in the content of either the formula $Fo(John)$ or the formula assigned to the pronoun to prevent the update of its metavariable by $Fo(John)$. $Fo(John)$ is a possible update for $Fo(\mathbf{U})$, and because only the formula is copied over conforming to the requirement imposed by the LINK transition, the terminal node restriction on the pronoun is satisfied. But IF that is the adopted choice, then there will be a fixed node in the structure as decorated by the term given by *John*, for the fixed tree position decorated by the pronoun is a possible update for $\langle\uparrow_*\rangle Tn(0)$. So the necessary update to the unfixed node by determining its fixed role within the structure will be available by a step of *Merge*. As it turns out moreover, this use of *Merge* to unify these partially specified nodes is the ONLY way of updating the metavariable projected by the pronoun under this interpretation. Substitution is inapplicable here. This is because of the interaction between the constraints on pronoun construal and the tree growth properties of any tree containing an unfixed node awaiting resolution. As we saw in chapter 2, we can define this as: :

$SUBS(Fo(\alpha))$:

| | | |
|---|---|---|
| IF | $Fo(\mathbf{U}), Ty(e)$ | |
| THEN | IF $\langle\uparrow_0\rangle\langle\uparrow_1^*\rangle\langle\downarrow_0\rangle Fo(\alpha)$ | |
| | THEN | Abort |
| | ELSE | $\texttt{put}(Fo(\alpha))$ |
| ELSE | Abort | |

This might seem not to apply to unfixed nodes, but it does, because between the step introducing an unfixed node into a partial tree and the step at which that structural underspecification is resolved, the unfixed node is evaluated step by step against each new node that is introduced in the emergent tree. But, recall from chapter 2 that within a partial tree of which one node is unfixed, the contents of this node are passed down node by node seeking a point of Merge. This means that at the point of evaluation, immediately prior to Merge, the embedded subject node is being evaluated for a set of decorations at which both $Fo(John)$ and $Fo(\mathbf{U})$ hold. For application of Merge, this situation is impeccable. But, to the contrary, application of Substitution as an alternative strategy, substituting the formula $Fo(John)$ as the selected value for the metavariable $Fo(\mathbf{U})$ is debarred, because formulae that are debarred are ALL those matching the description:

$$\langle\uparrow_0\rangle\langle\uparrow_*\rangle\langle\downarrow_0\rangle Fo(\alpha)$$

And, given that all Kleene star relations include the empty relation, this description applies to any formula decoration that is at the node itself. So Substitution of the formula $Fo(John)$ is precluded, even though the node from which some other copy of that formula might be in a suitably non-local relation. The fact of there being a copy in a precluded local relation is sufficient to debar its selection. Hence Merge is the only means of securing $Fo(John)$ as the selected update to the metavariable projected by the pronoun in the embedded subject position. But, this turns out to be a precluded choice of strategy in any event, as if *Merge* is adopted at the point of having processed the pronoun, thereby establishing the position in the configuration of the unfixed node, things go wrong thereafter. For there will then be nothing left to provide the necessary construal of the subordinate structure when the parsing gets to the point where there is no subject provided, which is between the words *said* and *would*. Since no subject is provided at this point, the parsing will break down; and on this interpretation of the pronoun *he* in (2.3) no successful outcome will be achieved.

In (2.4), no such problem arises. This is because the process which merges the unfixed node and the open node requiring a subject takes place, assuming a left-right dynamics to the projection of interpretation, BEFORE the pronoun is ever processed. So when the interpretation process reaches that point, there is no problem interpreting the pronoun. It can be interpreted as either John or Tom, Dick or Harry: any choice will lead to a wellformed interpretation.

The answer to the question as to why the pronoun can be identified with the $wh$ relativizer in both (2.5) and (2.6) now reduces to the question of whether the node the pronoun decorates is relevant to identifying the fixed tree position for the unfixed node in these two cases, and the answer is that it isn't relevant, in either case. If, in (2.7) the pronoun is identified as identical to the $wh$ expression by virtue of being interpreted as a copy of the head, this has no consequences for identifying the tree position of the unfixed node because the $wh$ expression projects merely a subterm for the formula decorating the unfixed node. That is, construal of *he* as 'John' cannot be the result of establishing the tree position for the node annotated by a formula constructed from *whose mother*:

(2.7) John$_i$, whose$_i$ mother$_j$ Sue says he$_i$ worries about $e_j$ far too much, is at the hospital.

Not only will consistency of node annotations rule this out; so too will the terminal node restriction imposed by the pronoun. To similar effect, in the case of weak crossover, no node internal to a determiner can provide an update for the unfixed node projected by the relative pronoun *who*. In this case, with the $wh$ expression not being complex, the account turns on the analysis of genitive pronouns such as *his*. These might be analysed as defining a complex operator introducing a metavariable as part of its restrictor without assigning it any independent node, in which case the terminal node restriction imposed by the $wh$ pronoun will fail to be met. Alternatively, *his* might be analysed along with more complex genitive constructions as projecting a distinct linked structure whose internal arguments cannot provide an update for a node unfixed within the structure initiated by the relativizing particle.[14] Either way, as with extended strong crossover effects, there will be no interaction between the

[14]See Kempson et al 2001. By assumption, the top node of a LINKed tree is not a daughter of its head, and a node described as unfixed, i.e. dominated by some topnode, HAS to be resolved within a single tree, i.e. across a sequence of daughter relations. This is the analogue of Ross's Complex NP Constraint (Ross 1975).

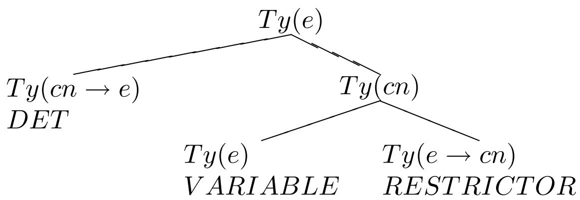
construal of the *wh* expression and the pronominal, and an interpretation of the pronoun as picking out the same individual as is picked out by the head is available:[15]

(2.8) $\text{John}_i$, $\text{who}_i$ Sue said $\text{his}_i$ mother was very worried about $e_i$ has stopped working.

We thus have the beginnings of an account of crossover data that spans strong, weak and extended strong crossover data without any grammar-internal stipulations particular to these sub-cases: the different forms of interpretation available emerge solely from the interaction of the process of building up structure for the construal of the relative and the process of establishing a value for a pronoun within the context within which its lexically projected meta-variable is processed.

## 2.3 Quantifier Phrases as Terms

It is now high time that we turn to quantification so that the internal structure for noun phrases can be properly spelled out. Against the normal trend, we presume on an analysis of natural language quantification in which the mapping of quantified expressions is never onto a type higher than type $e$.[16] The type of structure we shall define is:[17]




There is a containing, higher node of type $e$, as the node projected by the noun phrase as a whole; and there is a lower node of type $e$ which is decorated by a variable. This variable is introduced by the noun, and is ultimately going to be the variable which gets bound by the quantifying element projected by the determiner. The nonrestrictive construal of a relative clause that we have seen so far involves a LINK transition built from the higher type $e$ node. As we shall argue in a little while, the restrictive construal involves a LINKed structure built from the lower type $e$ node.

[15] The analysis of genitives as 'implicit relatives' is well attested in the literature (see Baker 1996, Kayne 1994, etc). Notice that this form of analysis provides a basis for characterising their island-like status: dependencies are in general not available between a pair of terms, one external to some structure projected from a genitive marker and one within that structure. An alternative is to analyse genitives as locally unfixed with respect to the node introduced from a $?Ty(e)$ decoration. this characterisation of a genitive as decorating an unfixed node will prevent application of some unfixed node as putative argument of a genitive imposed structure, as the appropriate tree update will not be available (see chapter 5 for discussion of *Local*Adjunction* in connection with Japanese).

[16] This section relies very heavily on chapter 7 of Kempson et al 2001; and its formal substance is due to Wilfried Meyer-Viol, for whom we here flag a particular debt of gratitude.

[17] For readability, we have decided within the internal structure of quantifying terms to put the determiner node at the left against the general convention of setting our displays to put functor relations invariably on the right branch. Nothing whatever turns on this.

This type of structure may look familiar, since it looks very similar to the Determiner Noun configurations of standard syntax, with NP as the local dominating node. But you should be asking, how does this fit in with the methodological assumption that what is being built up is semantic structure for a resulting logical form. How can this be what is wanted for quantifying expressions?

To see what is going on here, we need to start from the stance that others adopt about quantification, and the internal structural properties of noun phrases, in order to see to what extent the Dynamic Syntax account is different. The point of departure for all formalisms is that predicate-logic, in some sense to be made precise, provides the most appropriate underpinning for representing the semantic properties of natural language quantification.[18] The existential and universal quantifiers of predicate logic give the right truth conditions, at least for the analogous natural language quantifiers, *every* and the indefinite singular *a/some*. However there is an immediate problem, because, at least on the face of it, the syntax of predicate logic and the syntax of natural languages are NOT alike. In predicate logic, the quantifiers are propositional operators – they take open propositional formulae, and bind variables in them to yield a closed propositional formula:

$$\forall x(Student(x) \rightarrow Smoke(x))$$

The open formula is $Student(x) \rightarrow Smoke(x)$. Considered in terms of its combinatorial properties – in other words its logical type – the quantifier $\forall$ is accordingly of type $t \rightarrow t$, an expression that maps propositional formulae into propositional formulae. This makes it structurally quite unlike quantified expressions in natural languages, which fill argument positions just like other NP expressions.

The move that was made in Montague semantics and all formal semantic formalisms following that tradition (Montague 1974, Dowty, Wall, and Peters 1980, Carpenter 1998, Morrill 1994, etc) was to retain the insight that the predicate logic formula for a universally quantified statement expresses the right truth conditions for a sentence such as *Every student smokes*, but that the projection onto that content cannot be by mapping the words of English onto the predicate logic formula directly: to do so would mean lifting the determiner *every* to become a propositional operator, thereby denying its combinatorial properties as a determiner, i.e. an expression that combines with a noun. The solution Montague proposed was to define the types of *every*, *student* and *smokes* so as to make sure that the determiner could be seen as combining first with the noun, and then with the predicate (as its argument) to yield a propositional formula. Since *student* and *smoke* are predicates according to predicate logic assumptions, this meant defining *every* as of type $(e \rightarrow t) \rightarrow ((e \rightarrow t) \rightarrow t)$. When such a type combines with a noun the result is an expression of type $((e \rightarrow t) \rightarrow t)$; and this type assignment to the subject noun phrase shows that it combines with a predicate, the verb phrase, to yield a sentence (of type $t$). The consequence, then, is that the noun phrase subject in particular is no longer the last ARGUMENT that the predicate combines with to yield a propositional formula, but it is the verb phrase which has become the argument – the functor argument roles of subject and predicate are flipped from what they might be

[18] Despite the fact that it is often argued that more complex quantifiers like *most* require a more complex logical analysis ( see Keenan and Stavi 1986 etc. but cf. fn.23)h.

expected to be. The advantage of this was that the semantics of universally quantified sentences of English is preserved as being that of the corresponding predicate logic formula, while preserving the parallelism with syntax that all noun phrases can be analysed as having a single type. However, its disadvantage is that the argument-predicate roles in the case of the subject to some verb are different from those of all its other arguments (unless the type of verb, and everything else accordingly is driven up to increased levels of complexity of type specification).[19] The general problem underpinning this is the methodology: the move is what one might call "preparing for the worst". That is, the analysis is being driven by the example which displays the need for greatest complexity.

However, there is an alternative point of departure for looking at NPs in natural languages, and that is to look not at predicate-logic FORMULAE, but at predicate-logic PROOFS. In particular, given the goal of modelling the way in which information is incrementally established in natural language, it is instructive to look at the closest analogue to natural language reasoning. This is the natural deduction proof method, in which valid inference is defined through the step-by-step way in which some conclusion is established from a set of premises. Natural deduction proofs for predicate logic all follow the same pattern – there are licensed steps for getting rid of the quantifiers, replacing them with so-called arbitrary names substituted in place of the variables. The body of the proof is then carried out with names:[20]

$\forall x.F(x) \rightarrow G(x),\ \forall x.F(x) \vdash \forall x.G(x)$

| | | |
|---|---|---|
| 1. | $\forall x.F(x) \rightarrow G(x)$ | ASSUMPTION |
| 2. | $\forall x.F(x)$ | ASSUMPTION |
| 3. | $F(a) \rightarrow G(a)$ | Universal-Elim. |
| 4. | $F(a)$ | Universal-Elim. |
| 5. | $G(a)$ | Modus Ponens |
| 6. | $\forall x.G(x)$ | Universal-Intro. |

As this simple proof shows, the end of the proof, like the beginning of the proof, involves steps specific to the quantifiers, proto-typically rules re-introducing the quantifiers. But in between these opening and closing steps, simple proof steps are defined over the interim names that are introduced. These rules of proof involve constructed so-called arbitrary names; and the sequence of proof steps is defined over these names. The rules for eliminating and re-introducing quantifiers have, of course, to be sensitive to the individual quantifiers, and there are context-sensitive checking devices to make sure that the names are appropriately

[19]There have always been problems in manipulating the higher type $((e \rightarrow t) \rightarrow t)$ to nonsubject nounphrases, as the predicate with which it is defined to combine is never available.

[20]There is a regular objection to the move to use arbitrary names for natural-language semantics. It is that quantifiers such as *most* are essentially generalized quantifiers, for which no proof-theoretic account is available. Only the generalized quantifier analysis has the appropriate generality to be applicable to all noun phrases. This, however, is not an appropriate form of criticism to the proposed analysis. In the DS system, it is the progressive compilation of the logical form which requires all terms projected by noun phrases to be of type $e$. (This style of natural deduction proof is due to Prawitz. For an introduction to logic in terms of such natural deduction, see Lemmon 1964.) The logical forms that result are then subject to a step of evaluation, as we shall see shortly; and in this step, one might define a step onto a generalized quantifier formula, eg in cases involving *most*. The system as it stands is restricted by the expressive power of the selected calculus, but in principle the assumption that computation of semantically relevant structure is via the working assumption of type $e$ terms has more general application: See Appendix I.

introduced and got rid of to ensure that only valid inferences are generated. The effect of the arbitrary names is however to keep things simple, enabling regular rules of inference to be carried out: all the complexity is in the semantics of the names (or in proof terms, the control on the elimination and introduction of the quantifiers).

Suppose then that instead of taking predicate-logic itself as the point of departure for natural language quantification, we take the arbitrary names of the predicate-logic natural deduction system.[21] The resulting construction of logical forms defined over trees will have to be in two steps. We can incrementally introduce name-like devices as a determiner-noun sequence is parsed; but the full interpretation of these names will have to depend on scope choices for this and other such names, and so will have to be stated at the closing steps in compiling an interpretation for the clause as a whole. The details of this, we shall get to in due course. But, in the meantime, what advantages would this bring us? The first advantage is that syntax and semantics are back in tandem, synchronised for all NPs, but as the lower rather than higher type, that is as type $e$. The primary formal (and methodological) advantage is that the complexity of the semantics of quantification is hidden in favour of the relative simplicity of the presumed naming devices, which represent that content. However, this aspect is not what we wish to emphasise here. Rather, there is empirical evidence for thinking that this is the right route to try. This lies in a problem with natural-language quantifiers when one looks at the phenomenon from a model-theoretic perspective; and it is a problem which from that perspective can be resolved ONLY by invoking lexical ambiguity. But this, as we've already seen with anaphoric expressions, is an evasion of the problem. At best, it is simply a shift into the pretence that there are two different natural-language words, and, as we shall see, it is inappropriate. The puzzle is provided by the scoping possibilities of indefinites.

### 2.3.1 Scope Effects of Indefinites

Unlike most other quantifiers, indefinites freely allow interpretations in which they are interpreted as taking scope wider than the clause in which they are contained.[22] (2.9) has several interpretations:

(2.9) Everyone agreed that most examiners marked two good scripts.

It can either mean that the general agreement is that the largest proportion of examiners each marked two good scripts (in which *two good scripts* has narrow scope with respect to *most examiners*, and hence also narrow scope with respect to *everyone*). Or it can mean that for each of two good scripts everyone agrees that most examiners marked that script (in which *two good scripts* has wide scope over both *most examiners* and over *everyone*). (2.10) on the other hand does not have this range of interpretations:

(2.10) Everyone agreed that two examiners marked most good scripts.

[21] The formal study of such arbitrary names was provided by Hilbert in the epsilon calculus, and it is this we are going to adopt (Hilbert and Bernays 1939). For a recent study, see Meyer-Viol 1995.

[22] Indefinite determiners include the singular *a*, *some*, all numeral expressions, and *many*.

It can have the interpretation in which *most good scripts* is interpreted as taking wide scope with respect to *two examiners*, but it cannot be interpreted as meaning that for some large proportion of scripts it is the case that for each such script everyone agreed that two examiners had marked it. In other words, *most* cannot have wide scope over the structure projected by the whole containing clause. More generally, indefinites, and only indefinites, can be freely interpreted both with respect to their own clause and with respect to some expression outside their immediately containing clause. If we take a mixed quantified sentence with no indefinites, the ambiguity disappears:

(2.11) Most students studied every book by Chomsky.

Can (2.11) be understood as an assertion about every book by Chomsky that most students have studied it (not necessarily the same students for each book)? Surely not? The same problem goes for (2.12):

(2.12) Few students understand most papers by Chomsky.

This asymmetry between individual quantifiers is a puzzle for all standard accounts of quantification. On the basis of the freedom with which indefinites can be construed, it has been assumed that this will have to be a general process, since quantifier scoping has to be defined over a propositional domain, so it cannot be a lexical process. All quantifiers, accordingly, are said to be subject to such scope variation, with a general process of either quantifier raising (in the syntax – see May 1985) or quantifier storage (in the semantics – see Cooper 1983). But this then leaves as a complete mystery why there should be variation between individual quantifiers.

One response to this is to suggest that indefinites are ambiguous between a regular quantifier and some kind of name, referring to an particular individual or set taken to be picked out by the speaker. Such an analysis has the advantage of leaving undisturbed a generalised quantifier analysis of a sub-class of indefinites with no need of a general process of quantifer-storage. However, as observed by a number of people over the years (Farkas 1981, Cormack and Kempson 1990, Abusch 1994, Winter 1997, Reinhart 1998), such an ambiguity account fails to capture cases in which the indefinite can be construed as taking intermediate scope, with scope over the clause or noun phrase within which the indefinite is contained but nevertheless interpreted as within the scope of some preceding quantifier:

(2.13) Every professor insisted every student of theirs read a recent MIT thesis.

(2.14) Each student has to come up with three arguments that show that some condition proposed by Chomsky is wrong.

Each of these examples allows an interpretation, as one amongst several, in which the indefinite in the embedded clause can be understood as taking broader scope than the nearer of the two quantified expressions preceding it but narrower scope than the subject quantifier – that is as 'For each professor there may be a recent MIT thesis that the professor insisted that their students read.' – one MIT thesis per professor, but not the same thesis. So for these cases, in any event, indefinite expressions must apparently be analysed as expressions that function as quantifiers taking scope over some arbitrarily larger domain. Analysing a sub-case of interpretations of indefinites as name-like doesn't solve the problem.

If, however, we look at this phenomenon from a processing perspective, then there is an alternative account in terms of interpreting the indefinite relative to its context, which is naturally expressible only if we analyse quantified expressions as a form of name, initially underspecified. We can get at this alternative way of looking at the problem by asking: How does ambiguity as displayed by (2.13) arise? How, for example, does it differ from a simpler structure such as (2.15)?

(2.15) Every student is reading a recent MIT thesis.

One obvious answer is that (2.13) has three quantified expressions, (2.15) only two. The clue, we suggest, lies exactly in this.

The ambiguities in (2.15) are straightforward enough. Either the second quantifier is interpreted relative to the first, or the first quantifier is interpreted relative to the second. This is the standard way of describing this phenomenon. However, there is another way of expressing this observation, expressing the dependence solely in terms of the indefinite. Either the expression *a recent MIT thesis* in (2.15) is understood relative to the interpretation assigned to *every student*. Or it is understood relative directly to the speaker's time of utterance. Schematically:

(i) "For each student$_x$ there is now a recent MIT thesis$_y$ such that $x$ is reading $y$"
(ii) "Now there is a recent MIT thesis$_y$ such that for each student$_x$, $x$ is reading $y$."

In the case of (2.13), the ambiguities multiply, because there is another quantifier. There are the analogues to (i) and (ii), which are (i') and (ii'):

(i′) "For each professor$_x$ and for each of his students$_y$, there is a recent MIT thesis$_z$ such that $x$ insists $y$ read $z$."
(ii′) "There is a recent MIT thesis$_z$ such that each professor $_x$ and each of his students$_y$ $x$ insist $y$ read $z$."

However there is in addition the reading in which the indefinite is interpreted as dependent on the first quantified expression but not on the second:

(iii′) "For each professor $_x$, there is a recent MIT thesis$_z$, such that for every student$_y$, $x$ insist $y$ read $z$."

There are more than three readings that can be distinguished for (2.13), but these three are sufficient to tease out what is going on. The number of interpretations available for indefinites depends on the number of terms elsewhere in the structure under analysis. Such terms may include other quantifying expressions, but they may also include expressions in the structure representing time construal. Interpretation of an indefinite involves choosing some other term in the structure to be dependent on. As we shall very shortly see, this choice may be made both with respect to what has already been constructed in the partial tree, but may also be made with respect to terms that are constructed later. Furthermore, as (2.14) shows, this free availability of interpretations is not restricted by syntactic considerations: even though the indefinite may be contained inside a relative clause, a classic so-called "strong island" restriction, it may nevertheless be interpreted as dependent on terms which are constructed from expressions occurring in the sentence but outside that clause.[23] (2.14) can be interpreted as with the term *some condition proposed by Chomsky* dependent on either the time of utterance or on the students. The very lack of structural restrictions of a familiar sort, and the fact that the numbers of interpretations are directly computable given the number of appropriate terms constructed in the context suggests that the problem of multiple scope-ambiguities is parallel to that of pronouns in the following sense – the interpretation of indefinite noun phrases and their scope potential are resolved in context during the process of logical-form construction. Indefinites, that is, have to be interpreted as dependent on something, even if it is only on some temporal specification having been made available by the tense information, and what that is gets decided on the basis of what else is available during the interpretation process.

It might seem surprising that choice of scope should be said to parallel choice of pronoun construal, because cataphoric interpretations for pronouns in English are generally NOT available in English, yet scope inverted interpretations surely ARE.[24] We can interpret (2.16) as meaning that all the patients got interviewed, but not necessarily all by the same nurse because of what we know about the burdens of the national health service:[25]

(2.16) A nurse interviewed every patient

Yet *he* in (2.17) cannot be interpreted as picking up on its interpretation from the following occurrence of *John*:

(2.17) He knows that John is clever.

This is certainly true; but this is not the end of the matter. There are the expletive pronouns, which are interpreted in precisely forward-looking manner:

(2.18) It is likely that I'm wrong.

The *it* in (2.18) is construed as identical to the interpretation assigned to the following clausal expression *I'm wrong*. In the literature, such pronouns are analysed as completely different phenomena, the so-called expletive pronouns, unrelated to their anaphoric counterparts. However, there is reason to think that they are nevertheless but a subcase of the pronoun *it*, a matter we come back to later (chapters 6 and 9). Here it is sufficient to know that cataphoric processes

[23]It has been argued by de Ruys (1998) that indefinite plurals display island sensitivity in disallowing the construal of individual members of the set quantified over independently of the island in which the indefinite expression is contained. However, in (i), given the disambiguation provided by the presented elaboration, wide scope potential for the indefinite seems possible ((ii) is de Ruys' example):
(i) If two of my sons ever help me do the washing up I buy them a beer by way of thanks. If they both do, I get out the champagne.
(ii) If two of my uncles give me a house, I shall receive a fortune.

[24]Apart from expletives, cataphoric effects may be expected if there are grounds for analysing the node the pronoun decorates as unfixed, since there is a later stage at which the needed substitution operation can apply. But this isn't the operative consideration in simple SVO sequences.

[25]These scope inverted interpretations are regularly said not to be preferred, but nevertheless agreed to be available.

of anaphora are available, even when the pronoun decorates a fixed node in the structure, if choice of pronoun and accompanying predicate is appropriate.

There is further evidence that this is the right move to make, for analysing the apparent reversal of scope of a pair of quantifiers when the first is indefinite and the second nonindefinite provides a solution to what is otherwise a baffling form of variation in the scope construal of nonindefinites poses. The puzzle is that quantifiers such as *most* appear to give rise to wide-scope construal when they follow an indefinite noun phrase, but not when they follow a nonindefinite noun phrase. In (2.10), for example, we observed that the expression *most good scripts* could take wide scope over *two examiners* but nevertheless not wide scope over *everyone*:

(2.10) Everyone agreed that two examiners marked most good scripts.

Beside that, however, the interpretation of (2.19) generally follows the linear order in which the quantified expressions occur. The only natural interpretation of (2.19) is as an assertion about all examiners that each marked most scripts:

(2.19) All examiners marked most scripts.

And, conversely, the only natural interpretation of (2.20) is an assertion about each member of some larger proportion of scripts that all examiners checked it:

(2.20) Most scripts, all examiners marked.

If we analyse all quantified expressions as having a wide-scope potential, these facts are mysterious, for sometimes quantified expressions containing *most* seem to allow interpretations in which they take scope over other quantified expressions, but sometimes not. If, on the other hand, we analyse all scope inversion for pairs of quantified expressions as an idiosyncracy of indefinites that they can be interpreted as taking scope NARROWER than some term, and that in some contexts this can be constructed an expression following them in the sequence of words, then the puzzle is resolved. *Most* itself provides no potential for being interpreted outside the immediate structural context within which it is processed: it is the indefinite which provides an underspecified term, with a choice of scope dependency that ranges over any term made available during the construction process.[26]

In any case, the analysis that is being proposed is not that indefinites and pronouns are identical in their process of interpretation, so the expectation is not for absolute parallelism in their mode of interpretation. The claim is simply, more weakly, that both have a context-dependent element to their interpretation – for pronouns, it is the context that provides the value of the metavariable which these pronouns project, for indefinites, it is the context of the proposition under construction that provides a discrete term relative to which the relative scope of the indefinite can be identified.

[26]Confirming this analysis is the fact that parallelism between indefinite construal and pronoun choice go hand in hand in all languages. If the language is very sensitive to linearity in its choice of pronouns, then so is its choice of scope construal for indefinites. For detailed demonstration of this see Kempson and Meyer-Viol 2002 and Kempson et al 2001.

#### 2.3.1.1 Formulating context-dependent constraints on scope construal

This bringing together of the process of interpretation of anaphoric expressions, and the process of choice of scope-dependence for indefinites can be fitted in to the account of quantifiers as arbitrary names, and remarkably smoothly. We take all determiner noun sequences to project only a preliminary specification of the appropriate quantifying operator, for example $\epsilon, x, Man(x)$ for the singular indefinite *a man*, and $\tau, x, Man(x)$ for the universally quantified expression *every man*.[27] We also presume that part of the update actions which they project is the instruction to add a relative scope statement to the accumulating set of scope statements. In general, quantifier scope follows linear order, so a quantifier processed first on a left-right basis is presumed to have scope over a quantifying term that follows it; and a sequence of scope statements is accumulated during the construction process at some type $t$ requiring node ensures this, with each scope statement successively added to the end of the sequence. However indefinites provide a systematic exception to this general principle, and are lexically defined to have a more open characterisation of scope effects, subject to choice.[28] We can now express the parallelism between indefinites and pronouns by defining an indefinite as adding to the set of scope statements a relatively weak scope restriction that it be interpreted as taking NARROW scope with respect to some term to be chosen, represented by the meta-variable **U**:

$$\mathbf{U} < x$$

The value of **U**, in the lexical specification of a pronoun, is established in the structural context in which it occurs. There is one difference from regular anaphoric processing in that there can be no possible indexical construal, since the term under construction is a quantifying term and must ultimately be subject to evaluation as part of the overall proposition being constructed. Apart from the constraint that the choice to be made must range only over other terms used in the interpretation of the string, it is structurally unrestricted. This gives us a basis for characterising the arbitrarily WIDE scope properties of indefinites, if we make the additional assumption that representations of time are also taken as a term in the language. Suppose that every formula of type $t$ is of the form $\mathbf{S}_i : \psi$, with $\mathbf{S}_i$ a term denoting the time at which the formula $\psi$ is said to hold.[29] To reflect this, we also modify the starting point $?Ty(t)$ so that it also contains one term in the attendant scope statement, namely $S_i$, the constructed index of evaluation. Morphological tense (or adjuncts) then add predicates on $S_i$ restricting its construal. With this beginnings of a reflection of what is needed for the incremental buil up of tense construal, the relatively unrestricted range

[27] The $\epsilon$ ("epsilon") operator corresponds to the existential quantifier, but is the analogous variable-binding term operator – creating an arbitrary name. The $\tau$ ("tau") operator is the variable-binding operator term operator analogous to the universal quantifier.

[28] Another exception is when the terms decorate a node which is not yet fixed in the structure. Some languages allow quantified expressions to decorate such nodes, others do not. Those that license such left-peripheral occurrence will allow scope statements to be entered, subsequent to the step of Merge which assigns the unfixed node, a definitive position in the tree. There is some indication here of sensitivity to whether the process involves separation from that position across a propositional boundary. See chapter 7.

[29] Throughout this book, we make no attempt to formally address tense or mood construal. See Gregoromichelaki in preparation.

of scope effects for indefinites follows immediately. If the value selected for the first argument of the scope relation is some variable associated with a discrete quantifying determiner, we get narrow scope interpretations, if it is chosen to be a term of the form $\mathbf{S}_i$ which is itself not construed as taking narrow scope with respect to such quantifying expressions, then the indefinite will be construed as able to take wide scope relative to those quantifying expressions. In (2.21) there is only one choice, this being that the indefinite is interpreted relative to $\mathbf{S}_i$, the term representing the index of evaluation:

(2.21) A student fainted.

Notice the mode of interpretation for indefinites and pronouns do not project identical forms of dependence on context. To start with, indefinites can't be interpreted as dependent on some term outside the process of construction. They are in any case distinct forms of input: pronouns are not scope-inducing terms. Any idiosyncracy distinguishing them is thus easily expressible in the distinct sets of lexical actions.[30] By contrast the parallelism between anaphora and indefinites is inexpressible on accounts of quantification in model-theoretic terms, as generalised quantifiers; there is no room to express under-specification of a generalised quantifier. So the very smoothness with which the anaphoric-style of account of indefinites and the analysis of all quantifying expressions as names goes together provides further evidence for this analysis of the compilation of quantification structures in type-$e$ terms.

### 2.3.2 Term-Operator Evaluation Rules

Once the various scope statements have been incrementally collected, satisfying the requirement for such scope statements associated with the introduction of each new term, everything is in place for application of a scope evaluation process. This is a process which algorithmically determines a full specification of interpretation from a pair of a sequence of scope statements and some associated logical formula as input. The rule takes scope statements one by one on an inside-out basis, and dictates the form of name that reflects, in its internal structure, the quantificational force of the overall formula. [31]

The algorithm follows the pattern given by the predicate-logic epsilon-calculus equivalence

$$\frac{\exists \mathbf{x} \phi(\mathbf{x})}{\phi(\epsilon, \mathbf{x}, \phi(\mathbf{x}))}$$

There is an important property shown by this two-way equivalence. All information projected by the propositional formula $\phi$ bound by the existential quantifier in the familiar predicate logic variant is, in the epsilon calculus equivalent, repeated in the restrictor of the corresponding (epsilon) term. The term denotes exactly that property $\phi$ that makes $\exists.x.\phi(x)$ true - hence the two occurrences of $\phi$ in the formula $\phi(\epsilon, x, \phi(x))$. By definition, that is, an epsilon term denotes an arbitrary witness of the truth of the containing formula – and, equally, it is an arbitrary witness of the corresponding predicate-logic formula.

[30] See Kempson et al 2001 for full lexical specifications of the determiners *every*, *a*.

[31] This work is that of Meyer-Viol's as reported in Kempson et al 2001.

To see what this correspondence resides in, and how it relates to natural-language quantification, consider a simple statement such as (2.22) and its predicate logic formulation (2.22′):

(2.22) Something is burning

(2.22′) $\exists, x, Burn'(x)$

In deciding how to represent this in the epsilon calculus, we have to construct a term which contains all the information presented by the containing formula in the restrictor of the term itself, i.e. we can construct the epsilon term:

(2.22″) $\epsilon, x, Burn'(x)$

Accordingly, the formula replacing the predicate logic formula (2.22′) is:[32]

(2.22‴) $Burn'(\epsilon, x, Burn'(x))$

The English pattern is one step more complex than this, but the essential pattern remains the same.

The example so far has involved just one occurrence of the term under evaluation; but in more complex cases the enriched term will replace all occurrences of the partial term under evaluation. To see this let's take a case of universal quantification with a pronoun that is to be construed as bound by the quantifying expression. In *Every student insisted that she had worked*, we shall have a second occurrence of this partial term, for the tau term $\tau, x, Student'(x)$ will have been used as substituend of the metavariable provided by the pronoun:

$$Fo(Insist'(Work'(\tau, x, Student'(x)))(\tau, x, Student'(x)))$$

In this formula, both occurrences of the tau term will be replaced by $a$ in the expansion resulting from the Evaluation rule :[33]

$$student'(a) \rightarrow Insist'(Work'(a))$$

where

$$a = (\tau, x, Student'(x) \rightarrow Insist'(Work'(x)))$$

Notice how the problems which arise in any analysis of pronominal anaphora in which the pronoun constitutes a copy of its antecedent linguistic expression do not arise on the present account: anaphora resolution involves constructing a copy of the partial but unevaluated term, not a copy of the linguistic expression.

The general result is as we would expect of an epsilon calculus analysis. The formula as represented by the names is relatively simple; and indeed names can always be represented in a form that maximises the simplicity. The complexity is hidden in the terms themselves, and it is these that make explicit the relative quantificational scope of terms in the containing formula, hence the semantic dependencies.This pattern applies to combinations of quantifiers, and can be extended to all quantifiers (see Appendix A to this chapter for the definition of the Evaluation Algorithm ).

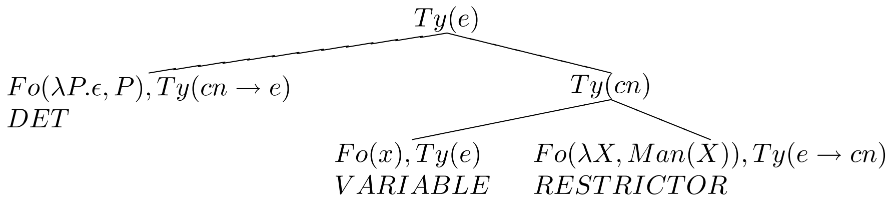
[32]Notice the heuristic for making the appropriate conversion from predicate logic formula to equivalent epsilon-calculus formula. From some predicate logic formula, here (2.22′), the algorithm takes the predicate and applies it to some constructed term. That term is itself constructed by replacing the predicate logic formula with the corresponding epsilon operator. Hence from (2.22′), we get the epsilon formula (2.22‴).

[33]The connective → reflects the requisite truth conditions, as the algorithm dictates.

### 2.3.3 The Process of Name Construction

Given that this framework sets great store on the process of building up logical forms, the account of quantification isn't yet complete, even setting aside the complexities of mixed quantification; for we have now to set out the process of building up such structures.

What we need as a projection of structure for a noun phrase is a complex form of name – of type $e$ but containing within its structure a Determiner node to carry the information about the kind of quantification to be projected later, a node to be decorated with the restrictor predicate, $Man$, $Book$, etc, and another node for the variable, itself also of type $e$, a familiar individual variable. This is as we saw earlier:




The determiner projects the variable-binding term-creating operator, in the case of the indefinite, a promissory note for an epsilon term:[34]

$a_{indef}$

| | |
|---|---|
| IF | $?Ty(e)$ |
| THEN | $\texttt{put}(Indef(+)); \texttt{make}(\langle\downarrow_1\rangle); \texttt{go}(\langle\downarrow_1\rangle); \texttt{put}(Fo(\lambda P(\epsilon, P)), Ty(cn \rightarrow e));$ $\texttt{go}(\langle\uparrow_1\rangle); \texttt{make}(\langle\downarrow_0\rangle); \texttt{go}(\langle\downarrow_0\rangle); \texttt{put}(?Ty(cn))$ |
| ELSE | ABORT |

And the noun projects both a fresh variable, an essential attribute for any quantifying noun phrase, and the nominal term:[35]

*man*

| | |
|---|---|
| IF | $?Ty(cn)$ |
| THEN | $\texttt{make}(\langle\downarrow_0\rangle); \texttt{go}(\langle\downarrow_0\rangle); \texttt{freshput}(x, Fo(x)); \texttt{put}(Ty(e));$ $\texttt{go}(\langle\uparrow_0\rangle); \texttt{go}(\langle\uparrow_0\rangle); \texttt{put}(?SC(\mathtt{x})); \texttt{go}(\langle\downarrow_0\rangle);; \texttt{make}(\langle\downarrow_1\rangle); \texttt{go}(\langle\downarrow_1\rangle);$ $\texttt{put}(Fo(\lambda X(X, Man(X))), Ty(e \rightarrow cn)); \texttt{go}(\langle\uparrow_1\rangle);$ $\texttt{go}(\langle\downarrow_0\rangle)$ |
| ELSE | ABORT |

The English word *man* projects a complex term $\lambda X(X, Man'(X))$, so that the noun itself provides the structure which will ensure the occurrence of the variable in some $cn$ value of the form $x, Man'(x)$.[36]

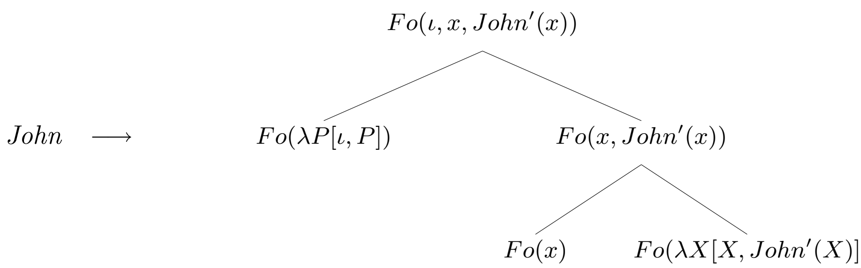
[34]The feature '+INDEF' is a classifying mechanism so that the rule for fixing quantifier scope distinguishes between indefinites which are relatively unconstrained, and nonindefinites, which follow linear order more closely.

[35]The sequence of actions that achieves the 'freshput' instruction is a rather primitive device scanning the set of variables already introduced, and aborting the lexical action for each one that corresponds to such a variable. For a full account of quantification, see Kempson et al 2001 ch.7.

[36]Reminder note: The $\lambda$ operator is a function-defining operator here defining a function from some variable of type $e$ onto what is inside the brackets, viz. the pair of a variable and an open formula containing that variable. $SC$ here means scope, so $?SC$ is a requirement for a scope statement.

These lexical actions will provide the backbone both for ensuring that a scope statement will accompany every logical form, and the compilation of content for noun phrases, eg as $(\epsilon, x, Man'(x)), (\tau, x, Professor'(x))$, etc. First, let's take the compilation of interpretation for the sub-structure of the noun phrase. To construct the term to assign to *a man* as defined over the tree structure in figure.3, steps of *Completion* and *Evaluation* (see chapter 2) will apply to yield a $Formula$ decoration at the *cn* node, of $Fo(x, Man'(x))$, and again to yield the $Formula$ decoration $Fo(\epsilon, x, Man'(x))$ at the top type $e$ node. Secondly, we have to build up a succession of scope statements for each individual term; and this is driven by the requirement $?SC$ which each noun projects, this ensuring that once both the decorations on a pair of determiner and nominal nodes are combined together, there will be an action placing a scope statement for the constructed term, with its variable, at the type-$t$-requiring node most locally dominating the node which the term decorates. The general case, as we've already seen informally, is for the scope statements to follow the order of introduction of the terms into the structure: the exception are the indefinites whose scope dependency is subject to choice of value for the metavariable lexically associated with the first argument of the indefinite's scope statement.[37] This sequence of individual scope-dependency statements thus gradually accumulates as terms are progressively introduced into the structure through regular steps of Introduction, Prediction, and lexical scanning, to lead ultimately to the pair of a compiled logical formula of type $t$ with accompanying scope statement which constitutes the input to the scope evaluation procedure (See Appendix B for a setting out of the sequence of steps for constructing the requisite logical form *Every dog ate a biscuit*).

In the light of setting out these assumptions about the way in which determiners and nouns lead to the accumulation of term-internal structure, we can now spell out more precisely our earlier statement that names and question words might be analysed as projecting complex structure. Linguistic names can be seen as inducing a quantifying term, the single word projecting an iota term,[38] with internal variable-binding term-operator, variable, and predicate as a restrictor:[39]




[37]The details of how these scope actions are formulate isn't going to be needed later, so this we leave on one side. See Chapter 7 of Kempson et al 2001 for formal details.

[38]The $\iota$ ("iota") operator is the operator expressing Russellian uniqueness, so an iota term is a type of epsilon term in which uniqueness of the set picked out is essential. There is a vast literature on the semantics to be assigned to proper names, and nothing turns on the particular choice made here. See chapter 8

[39]Since in this book, we do not address the details of formally representing syntactic and semantic properties of questions, we leave a detailed discussion of *wh* question-words on one side; though see Kempson et al 2001 for discussion of syntactic properties of *wh* questions, and the analysis of *wh* question words as a particularised form of meta-variable.

Like English indefinite plurals, names in English will impose the projection of a full type $e$ template of structure. And like other quantified expressions, they will impose the choice of a fresh-variable, thereby inducing the effects of what has been known in the syntactic literature as principle C effects. With this form of characterisation, it is of course straightforward enough to specify a disjunctive entry that allows the name either to project a complete type $e$ as in (2.23) or merely a predicate, as in (2.24):

(2.23) The John that I met in Birmingham was clever.

(2.24) Most Matthews I know come from Scotland.

As this discussion of names shows, there is considerable variation in noun phrases as to what structure is projected by the linguistic elements, both in an individual language as well as cross-linguistically. English singular nouns project only a substructure of what is needed for a quantifying term to be projected, indefinite plurals might be said to project the full structure,[40] and pronouns project merely a place-holder for some requisite formula (possibly with internal structure). The context-dependence of words such as *the*, *that*, *this* was set out very informally in chapter 1, and this would have to be reflected by defining these determiners in terms similar to pronouns. In the DS formulation this is reflected in defining such determiners as projecting a metavariable. However, unlike pronouns, occurring with these metavariables is a recursively complex restrictor specification, constraining the substituend of the metavariable, so that, for example, *the man* projects a partial specification of a term, which we might articulate provisionally as $Fo(\mathbf{U}, Man'(\mathbf{U})), Ty(e), ?\exists x.Fo(x)$. We return to the detailed specification of how such terms might be constructed in chapter 8.[41]

## 2.4 Relative Clauses 2: specifying domain restrictions

All that now remains to see the overall picture of noun-phrase construal and different forms of relative-clause construal, is to put together our analysis of noun-phrase construal in terms of type $e$ terms with the analysis of relative clause construal as involving the building of paired, linked structures.

By way of preliminary to this, it is worth rehearsing what is the distinction between restrictive and nonrestrictive relative clauses that we are about to model. The distinction can be seen in the pair of construals for two utterances of the string, differentiated only by some distinguishing intonation, or, as in the written form, punctuation:

(2.25) Two students who are from Philosophy are taking our course.

(2.26) Two students, who are from Philosophy, are taking our course.

In (2.25), with no distinguishing intonation, the likely interpretation is that out of some larger bunch of students there are two that are from Philosophy, with

[40] Though see chapter 8 for an alternative analysis.

[41] See also Kempson et al 2001 where such a specification is taken to be a constraint on model-theoretic evaluation of the resulting term.

the relative clause contributing to the restriction on the set the quantifer ranges over. With a pause after *students*, and again after *Philosophy*, the information about the relative clause is taken to be an additional fact about a set of students sufficiently described by just the determiner-noun sequence *two students*, hence the term 'nonrestrictive'. However, it shouldn't go unnoticed that there isn't any morphological distinction on which these interpretations depend: the distinction is made solely by the intonation (or punctuation) used to indicate the units to be built up in the interpretation of the string. Like anaphora, this is another phenomenon where linguists talk about *nonrestrictive relative clauses* and *restrictive relative clauses* as though these were clearly distinct forms of expression, which they singularly are not. Advocating of linguistic ambiguity as though effectively there were distinct forms is purely a construct of the analysis.

### 2.4.1 Restrictive-relative construal

With this name-based analysis of quantification, we have just the tools we need to reflect both restrictive and nonrestrictive construals of relative clauses. Remember that our posited logical structure for noun phrases involved two type $e$ nodes, the top-node of type $e$, and the lower node of type $e$, the lower being decorated by a variable as its $Formula$ value. In our characterisation of nonrestrictive relative construal, what we presumed on was the construction of a LINK transition from the higher of these two nodes, though in the case of names, with which we started, we simply presumed that the logical form assigned to them had no internal structure. Now, with a more fine-grained analysis, with two nodes of type $e$ in principle available, we expect a transition from the lower-node, equally, to be available. This provides a natural basis for restrictive relative construal, since we have to hand a means of articulating further propositional structures containing a copy of the variable. We presume, that is, that the LINK transition for restrictive relatives such as in (2.27) is an action which follows the action provided by a noun such as *man*, introducing a LINK relation from the node decorated by the variable:

(2.27) the man who Sue likes

Indeed, this rule of LINK-Introduction applies exactly as defined for nonrestrictive forms of construal. As before, what the rule does is to introduce a new LINKed structure built from the node decorated by the variable as 'head', and at the topnode of that LINKed structure it puts a requirement for the occurrence of a copy of the very variable projected by the noun. There is then an intermediate step of **Adjunction*, which then provides the condition which enables the relative pronoun to provide the required copy (see figure 3).

From this juncture on, the process of parsing the string is exactly as in simple clauses. Nodes are introduced by the rules of Introduction and Prediction or by lexical actions given by the verb, and a step of Merge duly takes place unifying the unfixed node (that had been decorated by the relative pronoun) with some open node, such as in (2.27), the object node projected by a verb's action. The only additional rule needed to reach this structure is a rule of LINK evaluation for restrictive relatives that puts together the information provided by the completed LINKed structure, a formula of type $t$ containing at least one occurrence of the variable projected from the head, and puts it together with the nominal predicate to yield a complex restrictor for the variable at the

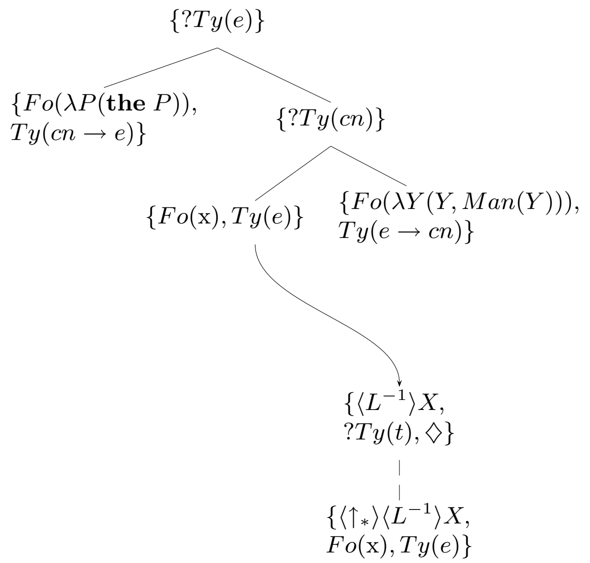



Figure 2.3: Structure resulting from processing the relative pronoun in (2.27)

*cn* node. The final output of any such construction process is a pair of linked structures, for the secondary LINKed structure once complete is taken to lead to the construction of a complex predicate decorating the type *cn* node as in figure 4.[42]

Notice how, just as in the process of building up a nonrestrictive form of construal, the relativising element *who* acts as an anaphoric device. This is quite unlike the analysis of restrictive relative clauses in other frameworks. Standardly, the relativizing element is defined as a variable-binding operator, binding a gap in some constructed structure, the gap resulting in movement analyses as a result of the *wh* expression having moved from the position of the gap up to some (Spec)-CP position.[43] In the analysis here, everything is the other way round. The noun projects the variable, which is the element to be copied into the structure projected by the relative. The relative pronoun simply has the job of ensuring that the LINKed structure introduced has the appropriate copy at an unfixed node.

[42]This rule has to be stated as a rule distinct from the general LINK evaluation process as in nonrestrictive relative construals, since we need it to yield the result that the conjunction is taken as a decoration on the *cn* node, hence resulting in complex restriction on the domain of the variable bound by the determiner.

In this display and subsequently, there are a number of simplifications, to keep the diagram simple. We project *man* as projecting a formula $Man'$ rather than the more complex $\lambda X(X, Man'(X))$. We assume that *the* projects an iota operator, though see chapter 8 for an account in terms of projecting a meta-variable with complex restrictor. And we revert to a simplified representation of proper names.

[43]See Chomsky 1981 and many references thereafter. In Minimalist analyses, this movement of the *wh* expression itself may not be necessary, since in some analyses, movement is restricted to feature-movement. Nonetheless, the underlying variable-binding operator analysis of relative clauses is retained.

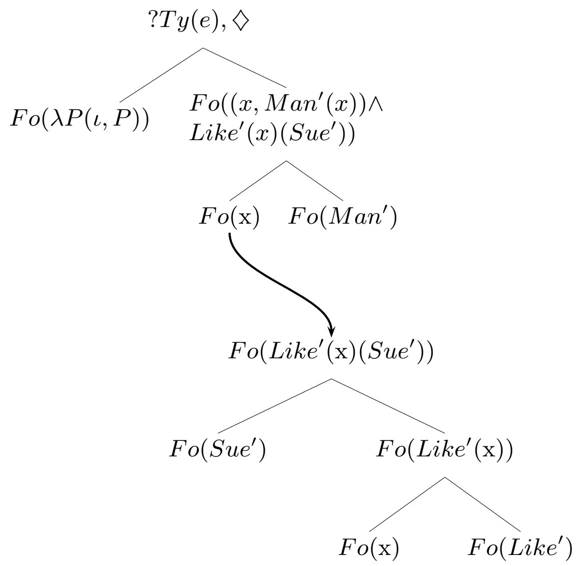



Figure 2.4: Completing interpretation for a restrictive relative

The availability of such restrictive construal without any relative pronoun is very simple to define. We have to allow the analogue of a null complementiser - a phonological free-ride that is defined to allow the free creation of a copy at some unfixed node (introduced by successive steps of LINK Adjunction and *Adjunction) as long as the node which constitutes the head is itself immediately dominated by a *cn*-requiring node:

| | | |
|---|---|---|
| **IF** | $?Ty(e), ?\exists x.Tn(x),$ $\langle\uparrow_*\rangle\langle L^{-1}\rangle Fo(\mathbf{x})$ | |
| **THEN** | **IF** | $\langle\uparrow_*\rangle\langle L^{-1}\rangle\langle\uparrow_0\rangle ?Ty(cn)$ |
| | **THEN** | put$(Fo(\mathbf{x}), Ty(e), [\downarrow]\bot)$ |
| | **ELSE** | **ABORT** |
| **ELSE** | **ABORT** | |

This lexical characterisation is identical to that of the relative pronoun *which* bar the extra condition that the head formula be internal to the type $e$ substructure.

### 2.4.2 Quantification and nonrestrictive construal

We have captured the difference between restrictive and nonrestrictive construals of a string in terms of the different point in the interpretation process at which the LINK transition is initiated, a choice which leads to different evaluation processes.[44] With the construction of a LINK transition from an introduced

[44]This is unlike many analyses of nonrestrictive relatives, which are often said to be some form of discourse-licensed parenthetical, merely adding incidental information about the object described. See Fabb 1991, Safir 1996 who analyses them as involving some post-LF level of

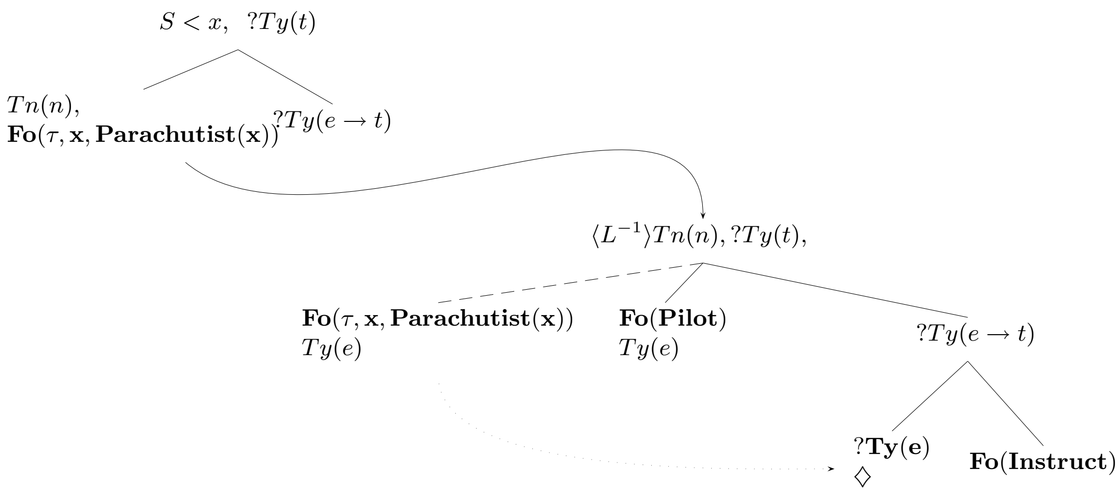



Figure 2.5: Parsing (2.29)

variable, the result, once the linked structure is fully compiled, will be an open propositional formula contributing to the restriction of the domain of that variable. With the construction of the LINK transition from a constructed term, on the other hand, the result will be a conjunction of predicates containing one and the same term, forming part of the overall assertion made despite the use of a processing form of subordination, and not part of that term's restrictor.[45]

A first consequence of this analysis is that we expect nonrestrictive relative modification to be freely available to all noun phrases, not merely indefinites or names:[46]

(2.28) Every referee, who I had personally selected, turned down my research application.

(2.29) Every parachutist, who the pilot had instructed meticulously, was warned not to open his parachute too early.

(2.30) Before I left, I managed to see most of my students, who I gave something to read to discuss with me when I got back.

In these cases, it is the term under construction — in (2.29)) $(\tau, x, Parachutist(x))$ — that is imposed as a requirement on the linked structure, duly copied at the unfixed node by the actions of the relative pronoun, and subsequently unified as an argument node in the subsequently constructed predicate (see Figure x) It is then the combination of the LINK evaluation rule and a subsequent single

LF', a level whose status is not well understood, either formally or conceptually.

[45]The observation that there is some form of semantic distinction between the two types of construal is currently analysed using the only other conventional means of characterising content, viz as a type of conventional implicature (see Chierchia and McConnell-Ginet 1984 and Potts 2001). On this analysis, the content of a nonrestrictive relative is a filter on the projection of the primary content, but not part of its resulting truth-conditions, an analysis

process of scope evaluation which ensures that the construal of the linked structure forms a conjunction in the consequent of the conditional associated with the evaluation of the tau term. The resulting logical form of (2.29) is:[47]

$$S < x : \ (Warned(\tau, x, Parachutist(x)) \ \wedge \\ (Instructed(\tau, x, Parachutist(x))$$

with its fully evaluated form:

$S : Parachutist(a) \rightarrow (Warned(a) \wedge Instructed(a))$

$a = \tau, x, Parachutist(x) \rightarrow (Warned(x) \wedge Instructed(x))$

We also expect that quantifiers in the main clause should bind pronouns in the relative (Safir 86):

(2.31) Every nurse alerted the sister, who congratulated her on her prompt reaction.

(2.32) Every parrot sang a song, which it ruined.

In the processing of (2.32), there are two terms under construction, $(\tau, x, Parrot(x))$, and $(\epsilon, y, Song(y))$ (see Appendix for expansion of a derivation). With the object having a relative clause as modification, it is $\epsilon, y, Song(y)$ that is imposed as the requirement on the newly introduced linked structure and projected onto the unfixed node in that structure. Nothing precludes the first term, $(\tau, x, Parrot(x))$, being identified as the antecedent to the pronoun in that relative. The LINK evaluation statement will be essential to the interpretation, creating the necessary conjunctive formula; and the result may be a logical form in which the epsilon term takes narrower scope than the tau term:

$$S < x < y \quad Sing((\tau, x, Parrot(x)), (\epsilon, y, Song(y))) \wedge \\ S' : Ruin((\tau, x, Parrot(x)), (\epsilon, y, Song(y)))$$

Its subsequent evaluation yields:

$S : (Parrot(a) \rightarrow (Song(b_a) \wedge Sing(a, b_a) \wedge S' : Ruin(a, b_a)))$

Notice how the content of the nonrestrictive emerges to the right of the major connective. The LINK evaluation rule, as before, acts as a scope extending device so that terms in any linked structure may be interpreted as within the scope of a term introduced in the primary structure, a result that in other frameworks would require an itemised rule of accommodation [**?**] to license the binding across the clausal boundary.[48]

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which does not provide a basis for explaining the interaction of anaphora and nonrestrictive relative construal in many of the data listed in this section.

[46]On the assumption that *wh*-question words are place-holding devices (see Kempson et al 2001), they will disallow nonrestrictive modification, since the value to be assigned to the relative pronoun must be some fixed *Formula* value, and not some open place-holder.

[47]The internal structure of the two verb-phrases *the pilot instructed meticulously* and *was warned not to open his parachute too early* are simplified to '*Instructed*' and '*Warned*' respectively.

[48]Such pronouns may occur in restrictive relative construals also:
(i) Every parrot sang one song which it ruined and one which it sang quite well.
In these cases too the anaphoric variable takes as its value the partially specified term prior to any scope evaluation process.

## 2.5 Appendix A: The Scope Evaluation Algorithm and mixed quantification construal.

Formulae of the form:

$$\phi(\nu_1, x_1, \psi_1), \ldots, (\nu_n, x_n, \psi_n)$$

are evaluated relative to a scope statement:

$$\frac{\langle S_i < x_1 < \ldots < x_n, \ldots, t\rangle \;\; \phi[\nu, x_n, \psi_n/x_n]}{\langle S_i < x_1 < \ldots < x_{n-1}, \ldots, t\rangle \;\; f_{\nu_n, x_n, \psi_n}(\phi),}$$

where for $x$ occurring free in $\phi$ and $S_i$ a (temporal) index, the values $f_{\nu x \psi}(\phi)$, for $\nu \in \{\epsilon, \tau, Q\}$, and $f_{S_i}(\phi)$ are defined by:

- $f_{\tau x \psi}(\phi) = (\psi[a/x] \rightarrow \phi[a/x])$
  where $a = \tau x(\psi \rightarrow \phi)$
- $f_{\epsilon x \psi}(\phi) = (\psi[b/x] \wedge \phi[b/x])$
  where $b = \epsilon x(\psi \wedge \phi)$
- $f_{Q x \psi}(\phi) = ((\psi[c/x])(\phi[c/x]))$
  where $c = \nu_Q x((\psi)(\phi))$.
- $f_{S_i}(\phi) = (S_i : \phi)$

**Mixed Quantification**

(2.33) Every child peeled an apple.

The two terms constructed are given schematically as $b$ and $a$ (with subscripts on $a$ to indicate the dependency):

$$(S < x < y) \quad Fo(Peel((\tau, x, Child(x)), (\epsilon, y, Apple(y)))), Ty(t).$$

$$S : (Fo(Child(b) \rightarrow (Apple(a_b) \wedge Peel(b, a_b)))), Ty(t)$$

The relative evaluation of the two quantifiers is in two steps:

Step 1 $S < x \;\; Fo(Apple(a) \wedge Peel(\tau, x, Child(x), a))$

where

$$a = (\epsilon, y, (Apple(y) \wedge Peel((\tau, x, Child(x)), y)))$$

Step 2 $Fo(Child(b) \rightarrow (Apple(a_b) \wedge Peel(b, a_b)))$

where:

$$a_b = (\epsilon, y, (Apple(y) \wedge Peel((b, y)))$$
$$b = (\tau, x, Child(x) \rightarrow (Apple(a_x) \wedge Peel(x, a_x)))$$
$$a_x = (\epsilon, y, (Apple(y) \wedge Peel(x, y))).$$

Notice that in the finally expanded formulae, $b$ occurs as a subterm of the narrower scoped term $a$, and $b$ itself contains a further occurrence of $a$, this time with $x$ as a subterm. But $x$ is bound by the $\tau$ operator, hence the entire term $a$ has all variables in it duly bound.

# Chapter 3

# Tree Growth and Language Typologies

In setting out the analysis of long-distance dependency (chapter 2), and English relative clause construal (chapter 3), we have been consolidating a perspective very different from orthodox frameworks. We have rejected the concept of there being a fixed structural element corresponding to each expression in the string: we have replaced it with an account in terms of initial underspecification of structure and growth of structure during the time-linear construction of an overall logical form, in so doing, rejecting all concepts of movement. Applying this methodology to relative clause construal, we turned our back on the analysis of a relativising complementiser as a variable-binding operator defined solely in terms of the hierarchical structure within which it is contained, in favour of an analysis which is essentially sensitive to context, defined as the building up of interpretation through anaphoric links between one structure and the next. We took the context for the initiation of a structure for relative clause construal to be the head node from which the LINK transition is defined and the partial tree in which that head-node is contained; and the relativising complementiser was then analysed as an algorithmically determined anaphoric device ensuring a copy of the head in the newly introduced structure at an unfixed node that then needs to be fixed in the emergent structure. As we have already seen in taking up the case of crossover with nonrestrictive relative forms of construal, this articulation of anaphoric and structural processes in the same vocabulary opens up a new perspective for analysing the interaction between structural and pragmatic processes.

In this central section of the book, we follow up on the characterisations of lexical variation set out in chapter 1, and turn to exploring these interactions in developing cross-linguistic typologies - much in the spirit of the methodological commitment of articulating universal properties of language-systems made standard by Chomsky throughout the past thirty years, but with a new twist, because the typologies emerge from paying careful attention to the time-linear way in which interpretation is built up over partial structures across the particular sequence of words which the individual languages license. In articulating these typologies of expected cross-linguistic variation which the system makes available, we will need to bear in mind that the framework is constraint-based, and not encapsulated. At any point in the development of a partial tree, the system determines a set of legitimate next moves. And, though it will not dictate what particular choice amongst such alternatives might be made, choices may nevertheless be made at that intermediate point; and the application of additional constraints superimposed externally may play a role in fixing interpretation of that partial structure. Part of the task in developing a cross-linguistic account, then, is to determine which forms of update are particular to language, which are particular to the individual language, and which are a consequence of general cognitive constraints.[1]

Our over-all aim in this section is to explain the interaction between anaphoric construal and structure building processes as displayed in relative clauses, and left and right periphery effects. The first step is relatively modest. We shall set out a preliminary partial typology of restrictive relative clause types, focussing on head-initial relatives. We then build on the partial parallelism between this and construal of left-peripheral expressions to set out a typology of left-periphery effects, using the concepts of linked structures, unfixed nodes and anaphora resolution. These areas have been subject to intensive study, and here we aim merely to show that the DS tools provide a natural basis for the gradient set of effects observable while retaining a unitary analysis of any individual pronoun. As things turn out however, the feeding relations between the different tree-update processes will provide the basis for a more fine-grained characterisation of the data than the two-way distinction of movement chains *vs* base generation that are standard.

Then in the following chapter, we turn to right-periphery effects which, expletive pronouns aside, have been the subject of much less study; and we shall show that the same concepts of anaphorically pairing linked structures and building unfixed nodes can be applied to rather different effect to capture generalisations about how interpretation is built up at later stages of the construal process.

## 3.1 The basic variants of clausal structure

As a preliminary to setting out the typologies the framework would lead us to expect, we need to set out the limits on variation which the framework imposes. Adopting a parsing perspective on the articulation of syntactic properties of natural language imposes a tight constraint on natural language variation, for it disallows any variation in type of *Formula* decoration. To drop the assumption of a shared language of inference, at least in structure, would mean adopting a wildly "Whorfian" position with respect to the culture-relativity of thought. In addition, there is no possibility of variation in the design properties of the construction process from language to language. All language is interpreted relative to context; and all language processing involves systematic update from one such context structure to another. Given our modelling of these concepts as the progressive building of decorated linked trees, we take the basic patterns of tree growth over linked partial trees to constitute the core formalism, common

[1] At this point in time, the cross-linguistic investigations have not incorporated results from verb-initial languages; but, as the discussion in chapter 1 indicates, we have reason to be confident that the concepts of tree growth, unfixed nodes in partial trees, and the building of linked structures apply equally to verb-initial phenomena.

to all languages. But this means that variation in language can only come from the relative distribution of computational and lexical actions, and the language-particular constraints on those actions that setting up the required complementarities between computational and lexical action imposes.

## 3.2 Towards a Relative Clause Typology

### 3.2.1 Resumptive pronouns in Arabic

In turning now to the articulation of a general typology of relatives, the most obvious form of variation in head-initial relative clauses is the mode of presenting the copy in the structure provided by the relative clause. Many languages involve obligatory use of pronouns in relative clauses; and these are standardly thought to require a device quite distinct from normal anaphoric uses of the pronoun. For example, Arabic, which is a prototypical subject-pro-drop language in never requiring specification of subject if this can be recovered contextually, requires use of pronouns resumptively in relative clauses in all positions being relativised upon except subject:

(3.1) *il* *mudarris* *illi* *Magdi* *darab-u*
the teacher who Magdi hit him
'the teacher who Magdi hit' [Egyptian Arabic]

(3.2) *il* *mudarris* *illi* *darab* *Magdi*
the teacher who hit Magdi
'the teacher who hit Magdi'

The general rule in this language is that something other than the relativising expression must provide the copy of the head within the relative-induced structure. However, from the perspective of the semantic tree, the apparent exception of subject specification doesn't need any special characterisation, for the restriction holds of the semantic specification and not of the morphological sequence of the natural language itself. So subjects don't need to be defined as exceptions to the general rule – it is merely that the subject node is decorated by actions of the verb and so needs no explicit morphological provision.

In other frameworks, resumptive use of pronouns is quite generally taken to be problematic, as they constitute an anaphoric device apparently hijacked into serving a structural process, hence requiring a quite different form of analysis either from other uses of pronouns, or from other characterisations of the long-distance dependency in question. Detailed treatments of resumption using both epithet phrases and pronouns are proposed by Aoun and colleagues (Aoun and Choueiri 1999, Aoun and Li 2003), distinguishing between true resumptive pronouns and nonresumptive pronouns, with true resumptives being a reflex of movement (copy and delete), nonresumptive uses being some form of base generation. (see also Anagnastopoulou 1997, Escobar 1997, Torrego 1997). But this gives rise to a nonunitary characterisation of even one sub-type of pronoun. One recent movement account (Boeckx 2002) takes up the challenge within minimalism of reducing this proliferation of lexical ambiguity, purporting to provide a unitary characterisation of resumption, though the challenge is only taken up in the relatively modest form of providing a characterisation that uniformly separates resumptive forms of anaphora from other forms. The extent to which it is successful even in this is questionable, as it explicitly relies on a separation of "true" resumptive and "intrusive" pronouns, dismissing the optional resumptive use of pronouns in English amongst other languages as not properly resumptive and therefore to be set aside. Thus the resumptive use of *he* in (3.3) is not covered by Boeckx's analysis:

(3.3) The new guy from history who Sue says he's interested in Celtic studies is coming to the party.

This distinction between resumptive and intrusive pronouns is of quite long standing, proposed by Chao and Sells 1984, on the grounds that these so-called intrusive pronouns can be analysed in terms of an E-type form of analysis. Yet this account is highly problematic, for both syntactic and semantic reasons. Such "intrusive" pronouns have to be interpreted as bound by the determiner plus noun head for they contribute to the specification of the restrictor for the quantifying determiner. Yet E-type forms of interpretation, in which the appropriate witness for some set constitutes the denotation of the pronoun, requires a semantic computation over the entire containing clause so that the witness for the term so picked out by the subject expression in (3.3) is that individual from history said by Sue to be interested in Celtic studies that is coming to the party. But the construction of the term that picks out any such individual is simply unavailable at the level of providing an interpretation of the pronoun itself if any concept of compositionality of interpretation is to be preserved (see Cann et al 2003). In relying on the Sells analysis, the Boeckx analysis thus turns out to be simply setting aside an entire subset of resumptive pronoun data; so the Boeckx claim of providing a unitary characterisation even of resumption isn't successful; and the more ambitious challenge of providing an account of anaphora that absorbs resumptive uses of pronouns as merely a subcase of the general phenomenon remains entirely open.[2]

What kind of analysis would Dynamic Syntax assumptions lead us to expect? Why, given this perspective, should one language obligatorily require use of the regular anaphoric device within the language, and another language license this, but only as a dispreferred option, and yet another debar them totally, as do German and Dutch. The need to invoke different kinds of pronouns in different languages might seem irresistible. Yet we can reflect this difference naturally without any shift away from the analysis of the pronoun as an anaphoric device if we pin down the differences between the three languages as a difference in the properties of the relativising element in those languages. English relatives were analysed in chapter 2 in terms of the relativising element being quasi-pronominal. The consequence of this analysis is that no anaphoric device is needed subsequently either to provide the copy of an item as the LINK analysis requires or to indicate the position in the construction process at which Merge takes place. Suppose, then, we analyse the relativising element in Arabic as NOT providing the necessary copy. It is not, let us suppose, a Jespersonian relative pronoun, even though it does indeed induce some LINK transition. All

[2]The Boeckx characterisation of the mixed array of effects involves the additional stipulation that certain types of chains require more than one checker, a disjunction internal to the account which undermines even the partial generality of the explanation.

*illi* does,[3] we suggest, is to introduce a LINK relation between the head node just parsed, and a node which is to be the topnode of a LINKed structure. As before, the node dominating the emergent linked structure gets decorated with a requirement that somewhere in the development of that tree there should be a copy of the formula decorating the head node. The result will be that we expect the obligatory use of a regular anaphoric device to provide that copy:

| | | |
|---|---|---|
| *illi* | IF | $\{Fo(\mathbf{x}), Ty(e), Def(+), [\downarrow]\bot\}$, |
| | THEN | make($\langle L\rangle$); go($L$); put($?Ty(t), ?\langle D\rangle(Fo(\mathbf{x}), Ty(e))$), |
| | ELSE | ABORT |

What the actions say is that in the presence of a type $e$ node decorated with some value which decorates a terminal node in the tree, then a LINK transition is constructed onto a new topnode requiring $?Ty(t)$ with an additional requirement for a copy of the formula decorating the head node from which the LINK relation was built. This specification is notably like the computational action of LINK Introduction as defined for English, but here defined as a lexical action, triggered by the definite marker *illi.* We stipulate a feature restricting this sequence of actions to variables marked as definite because this complementiser is restricted to occurring with definite noun phrases: it is also here defined specifically for restrictive relative clause modification. The $\langle D\rangle$ operator is an operator which ranges over both daughter and LINK relations, and thus imposes no structural constraint whatever on where in the construction process the copy be found, except that it be found subsequent to the introduction of the LINK transition. Indeed, the required pronoun may occur across a relative clause boundary, a classic island-restriction violation:[4]

(3.4) *t?arrafna ?ala l-muxrizh yalli laila sheefit l-masrahiyye*
met$_{1st.sg}$ on the-director that laila saw$_{3rd.sg.fem}$ the-play
*yalli huwwe ?axrazh-a* [Lebanese Arabic]
that he directed$_{3rd.sg.masc}$-it
'We met the director that Laila saw the play that he directed it.'

The first consequence of defining *illi* in this way is that, with no particular lexical item defined in the language as projecting the required copy in such structures, the only way of meeting this requirement, itself a necessary condition on wellformedness, is to use the regular anaphoric process of the language, for these by definition project a form which must be interpreted by providing a copy of some term from somewhere else. So there must be some pronoun occurring at some point in the subsequent string, and it must be interpreted as having an interpretation in which its value is that of the formula provided by the head node. Any other interpretation of the pronoun (replacing the pronoun's meta-variable with some independently available term e.g. *Tom, Dick ...* ) will leave the LINKed structure with a requirement outstanding, hence not wellformed. Any number of occurrences of a pronoun may occur in the subsequent string: all that matters is that one of them be interpreted as identical with the head from which the relative structure is induced.

The significance of this account is that unlike other characterisations of resumptive pronouns, this makes use of an entirely general account of such pro-

[3]The relativising complementiser takes somewhat different forms in the different variants of Arabic, all related to the definite article.

[4]This example is taken from Aoun and Choueiri 1999. Diacritics to be improved.

nouns. No special resumptive form for the pronoun needs to be posited, and there is no invocation of any "intrusive" pronoun either: the modal requirement does all the work. Despite the emptiness of the locality restriction that this particular form of requirement imposes (using the least constraining $\langle D \rangle$ operator), the requirement has the effect of enforcing application of the general process of substitution during the construction process. In order to meet the wellformedness condition that no requirements remain unsatisfied in the resulting logical form, the only possible sequences of transitions, given the non-anaphoric properties of *illi*, will be ones in which at least one anaphoric device is assigned a construal which allows the modal requirement to be satisfied. [5]

Recall now that in English, with the strong crossover data, we argued that there was a feeding relation between the decoration of an unfixed node with the value of the head and the existence of some node decorated by a pronoun with a metavariable of the same type $e$ as the formula decorating the unfixed node, because nothing precluded them from merging and so updating the tree, a choice of action which would lead a subsequent node requiring the same type with nothing to provide it with a value. Supposing we have a relative clause sequence introduced by *illi*, will the same distribution result? The predicted answer is no. It could not arise, because *illi* doesn't license the introduction of an unfixed node or provide any such node with a copy. All that it does is to license the transition initating a LINKed structure, imposing on it the requirement for a copy. But this means that no such crossover effects should ever arise in Arabic relative clauses, as the ONLY way to realise the requirement for a copy of the head in Arabic is through the use of pronouns. This prediction is correct. There are no analogous crossover data in Arabic relatives:[6]

(3.5) *ir-ragi:l illi nadya ftakkarit inn-u ?a:l inn Bill garaH-u*
man who Nadya thought that he said that Bill injured him
'the man who Nadya thought that he said Bill had injured him'

(3.6) *ir-ra:gil illi nadja ftakkarit inn-u ?a:l inn-u aiya:n*
the man who Nadya thought that he said that he was sick
the man who Nadya thought he said he was sick

Indeed, the situation presented by the Arabic data is the inverse of that with crossover. The explanation of the strong crossover data required that a particular value of the pronoun be debarred, ANY construal of it other than that of the head being possible. Here we have the opposite - that NO interpretation other than that of the head is possible. But in neither case do we have to invoke any structure-specific stipulation to the pronoun itself - the distribution emerges from the interaction of the dynamics of the tree growth process, given the different specifications of the relativising element in the two languages.

[5]The apparent lack of application of *Adjunction in unfolding the tree structure for a LINKed tree in Arabic following upon the transition ensured through the use of *illi* is no more than a superficial puzzle, given the analysis of Arabic as a subject pro-drop language, with verbs introducing a full propositional structure from a trigger $?Ty(t)$, decorating the introduced subject node with a metavariable. In cases in which an explicit subject expression is present in the string, there may then be an application of **Adjunction* – the subject value decorating the unfixed node and merging with that given by the verb.

[6]Demirdache 1991 and others have argued that there are crossover effects involving epithets; however it has been counter-argued, by Aoun and Choueiri 1999 that such cases constitute a Principle C effect. Given that we leave anaphoric uses of definite NPs on one side, we leave this issue on one side.

It might seem that such a simple account can't be sustained when more data are taken into account. For a start, with an indefinite head, no relative pronoun is possible. It is certainly true that there is a lot more to be said. Definites and indefinites are mutually exclusive in Arabic. Contrary to the definite head, which requires the presence of *illi*, if a relative clause modifies an indefinite noun phrase then there mustn't be any complementiser:

(3.7) **mudarris illi Magdi darab-u*
teacher who Magdi hit him
'a teacher who Magdi hit him'

(3.8) *mudarris Magdi darab-u*
teacher Magdi hit him
'teacher who Magdi hit'

So there IS a general computational action of LINK Introduction as in English, and it is one that cannot be defined in precisely the same terms as that for English, which also has a complementiserless relative. For Arabic, this process has to be defined only to apply to heads lacking a definite determiner, so that something must ensure a marking of the variable in question as -DEF. This process must furthermore ensure that not only is a LINK relation constructed but also that an unfixed node is introduced and decorated, as the output of this process must be such as to debar its applicability to any definite head.[7] However, this isn't a counter-argument to the proposed analysis of resumptive use of pronouns in Arabic, for relatives with either definite or indefinite head require the presence of such a pronoun. All it shows is that the particular balance of computational and lexical actions has to be defined for individual languages. Such difference of detail doesn't however undermine the common underpinnings of the analysis. The final resulting structure, and the general properties of the individual transitions nevertheless remains constant across languages, as we can see from Fig.1. The tree in figure 1 is notably essentially identical to the tree resulting from the rather different sequence of intermediate steps of parsing *John, who Mary hit.* No record remains of the fact that in the intermediate steps, the LINK transition may have been induced by a sequence of lexical actions, unlike in English, that the verb projected a full template of propositional structure, unlike in English, and that the presence of the variable was guaranteed by introduction and suitable identification of the pronoun. The resulting semantic structure is identical; and, though with minor variations, the syntactic moves allowed are only those which will lead to ensure that same semantic result. So, as we would expect, the two languages are sharing the same assumption about the resulting structure, and sharing also the general pattern of how such structures are established. They differ only in what is the precise form of computational and lexical actions that give rise to such structures.

### 3.2.2 Mixed Systems

We now turn to a further basis for cross-linguistic variation. Having more than one discrete strategy made available for building up relative-clause interpreta-

[7]See Kempson et al 2001 for a detailed specification of the required lexical and computational actions.

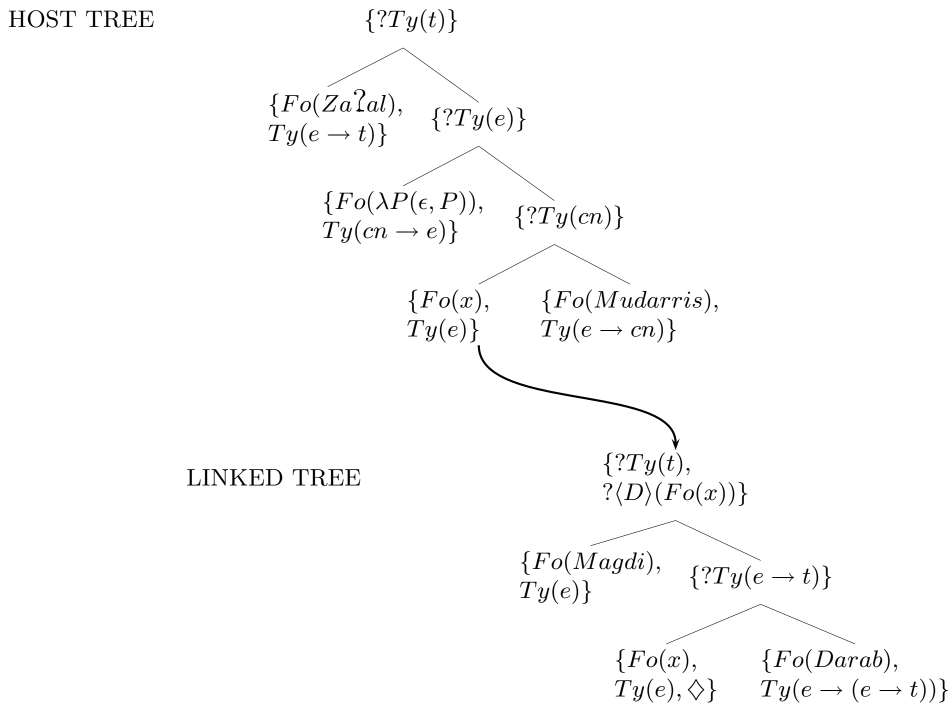



Figure 3.1: Projection of LINKed trees in Arabic with resumptive pronoun

tion by the parsing architecture, we might expect that some languages would use more than one strategy. Hebrew seems to provide just such a case (Demirdache 1991). Hebrew allows both a 'gap' in relative clause sequences as in English (or German), and also a resumptive pronoun as in Arabic.[8] This can be explained as a combination of the two patterns. On the one hand, we suggest, the Hebrew relative complementiser acts as a relative pronoun and has a verbal specification consistent with English, which is not subject pro-drop. On the other hand, it has a subject pro-drop strategy, and a relativising strategy which requires a resumptive pronoun. With this in place, this leads us to expect the following mixed effect. The complementiser *še* can project merely the weak form of modal requirement imposed on the topnode as in Arabic, but then on the assumption that the non-pro-drop strategy for projection of clause structure is subsequently followed, *Adjunction may be used to introduce a node to be decorated by a non-subject expression and the subject expression then be taken to decorate a fixed position as introduced by Introduction and Prediction. In such a sequence,

[8]There is a tendency for these options to be taken to be mutually exclusive, with the 'gap' strategy being used in simple clauses where there is no further embedding in the relative, the resumptive pronoun strategy being used where the long-distance dependency is across from one propositional structure to another. Defining these strategies to be mutually exclusive is easy enough, but since this appears not to be a hard and fast restriction, we leave these as equally available options. Whether or not the gap-requiring strategy is due to an analysis of *še* along German or English lines remains to be established, though, given its morphological simplicity, an analysis along English lines seems preferable.

it is the unfixed node introduced by a step of *Adjunction which may freely be decorated with the pronominal which is used to satisfy the requirement imposed by the LINK transition. In (3.9) this is the prepositional form of pronominal *ʔalav*:

(3.9)

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| *ha-ʔ-iš* | *še* | *ʔalav* | *ʔani* | *xošev* | *še* | *ʔamarta* | *še* | *sara* |
| the man | that | about him | I | think | that | you said | that | sara |
| *katva* | *šir* | | | | | | | |
| wrote | poem | | | | | | | |

'the man about whom I think you said that Sara wrote a poem'

Furthermore, since this option of using a step of *Adjunction to introduce the node to carry the formula value that satisfied the LINK-imposed requirement is available at the step of processing any new clausal structure, we expect this option to be available at the outset of any clausal sequence:

(3.10)

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| *ha-ʔ-iš* | *še* | *ʔani* | *xošev* | *še* | *ʔalav* | *ʔamarta* | *še* | *sara* |
| the man | that | I | think | that | about him | you said | that | sara |
| *katva* | *šir* | | | | | | | |
| wrote | poem | | | | | | | |

'the man about whom I think you said that Sara wrote a poem'

(3.11)

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| *ha-ʔ-iš* | *še* | *ʔani* | *xošev* | *še* | *ʔamarta* | *še* | *ʔalav* | *sara* |
| the man | that | I | think | that | you said | that | about him | sara |
| *katva* | *šir* | | | | | | | |
| wrote | poem | | | | | | | |

'the man about whom I think you said that Sara wrote a poem'

Whatever unfixed node is decorated by appropriate construal of the pronoun can then be updated by merging with a fixed node.[9]

There are two properties held constant in these accounts of Hebrew, Arabic and English. The first is that in all cases, the term assigned as construal of the head is defined (by the LINK transition rule) to provide the context relative to which the subsequent structure, with its imposed anaphoric dependency, is established. This is quite unlike the bottom-up strategy in most frameworks, in which a binding is established between some (possibly null) operator and some position (possibly identified by a pronoun) to create a predicate on the head, with the co-dependency of the head and that predicate only established in the light of the determination of that binding relation – to the contrary, on this analysis, this co-dependency between some assigned term and the open formula to be constructed is imposed from the outset of the initiation of the structure. The account is thus essentially anaphoric.

The second property of the account is that whatever pronoun may be taken to be inserted as a means of expressing these various long-distance dependency correlations has not involved any revision in the characterisation of the pronouns

[9] As (3.10)-(3.11) indicate, *še* is also the bare subordinating device. The challenge to reduce all uses of še to a single unambiguous particle remains: postulated ambiguity is a common property of analyses of *še* (see Shlonsky 1993). We have not given any lexical characterisation of *še* here, so this challenge remains completely open.

themselves.[10] In all cases, the use of a pronoun is assumed to be an unrestricted pragmatic process. It is the modal form of restriction dictating a well-formed completion of the tree which determines why the pronoun must be construed as identical to the formula decorating the head; and indeed, the pragmatic explanation of why such uses of pronouns are marked when optional only carries the force it does because it preserves the analysis of the pronoun unchanged. The pronoun itself remains as a regular lexical item, duly decorating some terminal node in a tree through the imposed "bottom" restriction (see chapter 1). This is so whether or not the form carried over is complex. However, from the perspective of the copy mechanism as projected either by the English relative pronoun or by the resumptively used pronoun in Arabic and in English, any such complexity is irrelevant. The substitution is simply that of a formula. There is no internal structural complexity at the site of the copy, as opposed to German - what is copied is just a *Formula* decoration on a terminal node in the linked tree.

### 3.2.3 Romance Languages, resumptive pronouns and locality

Let's sum up what we have got so far. We have relativising elements that are fixed anaphoric devices, introducing either simple metavariables or terms with internal structure, and relativising elements that are systematically weaker, imposing only the requirement of such an anaphoric device. We have also seen variation as to whether there is any imposed locality constraint. In English the provision of the required copy is achieved by applying *Adjunction and decorating that unfixed node by actions of the relative pronoun. This sequence of actions determines that the copy imposed by the LINK transition will be provided within a single tree (and not across a further LINK relation). In Arabic to the contrary, there was no restriction whatever in where the copy of the formula decorating the head should be provided. The issue of whether or not the relativising element is pronominal-like or not is however logically independent of the question of what locality restriction there might be. So what we might now expect as a further point of cross-linguistic variation is the possibility of a language that has a relativiser which like Arabic fails to provide a copy, but which, English-like, imposes a locality restriction on where the pronominal-provided copy should be established. This brings us to Romanian.

The Romance languages, like the Semitic languages, vary as to whether resumptive pronouns are required. On the one hand, there is Italian, which is like English in not requiring the use of a pronoun in establishing relative clause construals, and dispreferring their use.[11] On the other hand, there is Romanian, which patterns exactly like Arabic, except that there is an island restriction constraining the availability of such resumptively used pronouns. Resumptive pronouns, which always take the phonologically-reduced clitic form

[10] Whether such projected meta-variable-containing formulae should, in the Arabic case, be taken to be defined with a separate lexical entry for the suffix as part of the characterisation of their phonological host is not an question we address here. Our sole concern is whether the resumptive use of such expressions needs to be distinguished in terms of its tree-update actions from regular discourse use of a pronoun as fixed in context.

[11] Cinque 1996 reports that resumptive use of pronouns is precluded in standard Italian. However he notes in a footnote that they are used in very informal speech, a comment reported anecdotally by Spanish and Portuguese informants also.

but are otherwise perfectly regular pronouns, are required in all nonsubject positions; but, in addition, the copy of the head required in the process of relative clause construal must be provided within a single tree. Given that the pattern displayed by Arabic arises in virtue of a relatively loose modal requirement imposed on the top node of the newly introduced LINKed structure, it is straightforward to define a modal requirement with a more stringent locality condition. We simply replace the Arabic form of restriction for a copy of the head formula $Fo(\alpha)$, $?\langle D\rangle(Fo(\alpha))$, with the restriction $?\langle\downarrow_*\rangle(Fo(\alpha))$, a modality which is idential to that in the rule as defined for English.

Such a restriction is motivated for Romanian relative clauses as introduced by the particle *care*, with its accompanying *pa*, a structure in which, as in Arabic, resumptive pronouns are obligatory in all non-subject positions.[12]

| (3.12) | *băiatul* | *pe* | *care* | *l-* | *am* | *văzut* |
|---|---|---|---|---|---|---|
| | the boy | pe | which | him | have$_{1.SING}$ | seen |

'the boy that I saw' [Romanian]

| (3.13) | * *băiatul* | *pe* | *care* | *am* | *văzut* |
|---|---|---|---|---|---|
| | the boy | pe | which | have$_{1.SING}$ | seen |

'the boy that I saw'

The only difference from Arabic is that such resumptive pronouns are required to occur locally to the complementiser *care* in the sense that they project a copy of the head formula in the same LINKed tree that the complementiser initiates. So (3.14), unlike (3.4) is ungrammatical:

| (3.14) | * *Omul* | *pe* | *care* | *cunosc* | *femeia* | *care* | *l-a* | *întîlnit* |
|---|---|---|---|---|---|---|---|---|
| | the man$_j$ | pe | which$_j$ | (I) know | the woman$_i$ | which$_i$ | him$_j$ have | met $e_j$ |

'the man who I know the woman who met him'

The preverbal position of the clitic is not what is at issue right at this juncture - it is the inability for the clitic to have its value established by an antecedent in any structure other than the one currently under construction.

In the mean time, the significance of the difference between Arabic and Romanian, and how easy it is to express in Dynamic Syntax terms, shouldn't go unnoticed. The variation is simply an expected variation in the particular form of modality associated with the requirement of the realisation of the provision of the second copy of the head from which the linked structure is built. This is in contrast to the difficulty of capturing this "strong-island" sensitivity in movement terms. The restriction of a long-distance dependency so that

[12] Romanian and Italian both have more than one relative pronoun, one of which demands a gap. These can be distinguished according to whether they project an annotation for an unfixed node, possibly like German as an internally structure term of type $e$, or merely a (modal) requirement for the required copy, lexically distinguishing two variants, unlike Hebrew in which a single morphological form has two divergent uses. Udo Klein informs us (personal communication) that it is *pe* which induces the locality constraint. What we would expect in both these languages is that strong pronouns can be acceptably used if stressed, as in English and Arabic, but this remains to be established. (We do not give an explicit lexical definition of *care* here as there is the issue to sort out as to what information the required particle *pe* projects. The function of this particle is poorly understood, apparently occurring in all structures for which there is a putative linked structure analysis.)

it is precluded across a relative clause boundary is taken to be definitive of a movement analysis; but in these examples, embarrassingly, there is a pronoun present, so there is no apparent indication of movement with a self-evident gap. There are only two ways to provide an analysis compatible with these data that preserves the movement analysis, neither of which are entirely satisfactory. One is to posit an entirely unrelated form of pronoun, a morphological realisation of trace, or some equivalent. This is the resumption analysis. The other, possibly co-occurring with such a resumption analysis, is to posit an alternative structure which, despite the diagnostics of movement is, by analysis, not reducible to a movement analysis.[13] The advantage of the present analysis is that by expressing discontinuity effects, pronoun construal, and the emergence of fixed tree structure all in terms of constraints on tree growth as expressed through the tree modalities, there is an expected basis for variation.

### 3.2.4 Resumptive Pronouns in English

English also has resumptive pronouns, and these appear not quite to fit in. They can be used as a marker of the position relative to which a *wh* expression has to be construed (i.e. as marking the "gap", hence "resumptive"), but though common are "substandard" (cf. Chomsky 1977, 1982; Sells 1984; Engdahl 1985; Safir 1986; Shlonsky 1992; Erteschik-Shir 1992):[14]

(3.15) I had some other point which I can't remember what it is.

(3.16) I have three people that I don't know how they are in other classes.

(3.17) He did a lot of things in high school in the 50s that if kids did them now....

There is, however, a lack of consensus as to how to treat such examples. In (3.15) and (3.16), the pronoun construed as resumptive occurs in the subject position of a *wh* question embedded within the relative clause, and in (3.17) it occurs in the object position of the antecedent of a conditional. As these are *wh* islands, extraction is marginal, but rescuable by the use of a pronoun, as noted above, as a "last resort" operation to save what would otherwise be irredeemable utterances, giving rise to the assumption that pronouns may be used resumptively only when *wh*-movement is not licit.[15]

Examples such as the following, however, are not widely discussed, yet are produced by native speakers:

(3.18) She got a couch at Sears that it was on sale.

(3.19) He's a professor that nobody liked him.

(3.20) ... who I was going to have lunch with him....

(3.21) ...Newton, Mass., where it's been pretty cold there

[13] See Aoun and Li 2003, who posit both movement and base-generation analyses for a range of related phenomena.

[14] The discussion in this section is taken from Cann, Kapaln and Kempson 2004 and the data were collected by Tami Kaplan between 1995 and 2001.

[15] Other analyses bear similar characteristics. Erteschik-Shir (1992), for instance, argues for these as "distance resumptives" which are not syntactically derived but spelled out at PF as a result of processing constraints due to the distance between the trace and its antecedent.

(3.22) This is the person that I told her about quitting my dissertation.

These cases all have corresponding constructions with gaps which are fully grammatical, and preferred by native speakers if asked directly:

(3.18') She got a couch at Sears that e was on sale.

(3.19') He's a professor that nobody liked e.

(3.20') ...who I was going to have lunch with e...

(3.21') ...Newton, Mass., where it's been pretty cold e this afternoon.

(3.22') This is the person that I told about quitting my dissertation.

The pronouns used resumptively in these examples occur in a variety of positions within the relative clause: subject (3.18), object (3.19), indirect object (3.22'), oblique (3.20), and locative (3.21), so one cannot argue for their existence based on idiosyncrasies in grammatical function. Moreover, though some of them can be interpreted either as restrictive or nonrestrictive (3.18), – (3.20), this is by no means true of all, as witness (3.21') which is only nonrestrictive, and (3.22'), which is only construed as restrictive.[16]

Erteschik-Shir's account (1992: 93-94) for cases like these as "coordinate resumptives" is problematic. She proposes that these resumptively construed pronouns are derived from coordinate structures when the relative clause involved could be considered to be a focus, i.e. providing "new" information. However, note that while this could work in (3.18) and (3.21) – indeed in all cases where the relative is naturally construed as nonrestrictive:

(3.18") She got a couch at Sears and it was on sale.

(3.21") ...Newton, Mass., and it's been pretty cold there this afternoon.

we still find cases like (3.19) where the relative clause is not a potential focus, so (3.19") is definitely odd:

(3.19") He is a professor and nobody liked him.

And in (3.22'), whose natural interpretation is restrictive, the conjunction analogue is clearly not equivalent:

(3.22") This is the person and I told him about quitting my dissertation.

In sum, then, resumptive pronouns appear to be available in English for a wide variety of speakers with no obvious differentiating characteristics.

The resumptive pronoun serves in all these cases to identify the role of the nominal as copied by the *wh* relativizer into the structure projected by the relative clause. This function can be provided by all pronouns, unlike the function of a pronoun as expletive, a property which has to be specifically defined for individual pronouns (eg *it* in English):

(3.23) It is likely that I am wrong.

[16] Fabb 1990 (inter alia) reports that the relativiser *that* cannot occur with nonrestrictive construals, but (3.18) and (3.19) arguably can have interpretations in which they are interpreted as two separate assertions, hence with the relative construed nonrestrictively.

The question posed by these resumptive pronoun data is their status. Are speakers of English licensed to provide sentences of this sort, or are they irregular in some way, having to be processed by general reasoning devices that enable a hearer to set aside constraints which their regular system imposes? Alternatively, are they licensed but dispreferred? And if so, what does this mean? In particular, why is such a strategy dispreferred in one language but a standard way of forming relative clauses in another language?

What is notable about previously proposed analyses is that the phenomenon of resumptive pronouns is treated as entirely separate from regular anaphoric processes, thus multiplying the different forms of analysis for what is morphologically a regular pronoun. Of analyses that address the problem in any detail, Chao and Sells 1983 (see also: Sells 1984) analyse such pronouns, not as regular gap-filling constructions that are A' bound by some operator, but as a discrete E-type pronouns, following the E-type form of analysis first introduced by Evans 1980 for cross-sentential anaphora as in (3.24):

(3.24) Three men entered. They were laughing.

But this analysis fails to account for those cases for which a restrictive interpretation is available, for which, as our analysis will in due course bring out, an E-type form of interpretation is not definable.

The immediate significance of our process-oriented account of what is elsewhere called strong crossover (Postal 1972, Chomsky 1981, etc.) is that we are led to expect that English pronouns used with resumptive construal in relative clauses will be wellformed in all positions:[17]

(3.25) ...those little potato things that you put 'em in the oven...

(3.26) There are people who I've had lots of ups and downs in my friendships with them.

(3.27) One of my cats had a litter that they were extremely wild.

(3.28) He's over Marshall county where flooding is a concern there.

(3.29) I have three people that I don't know how they are in other classes.

(3.30) ...he builds this house, which it's called Pandemonium....

In all cases, once an unfixed node has, through the relative pronoun, been provided with a copy of the head formula, it can be merged with a node which the pronoun decorates. In so doing it will provide a value for the metavariable projected by the pronoun, but crucially without violating the 'bottom restriction', $[\downarrow]\bot$, that ensures that a node is terminal in a tree. In this way, the model anticipates as wellformed the resumptive use of pronouns in English relatives, even though pronouns in English retain the property of contentive nouns in that they only decorate terminal nodes. This is because it is only the *formula* of the head that is copied by the relative pronoun and not any associated structure. Thus, *who* may project a node decorated as

[17] See Kempson et al 2001 for a detailed analysis of crossover phenomena, integrating what are otherwise said to be various different forms of crossover (Lasnik and Stowell 1992).

$\{\langle\uparrow_*\rangle Tn(n), Ty(e), Fo(John), ?\exists\mathbf{x}.Tn(\mathbf{x})\}$ which can Merge with a node decorated by a pronoun, e.g. $\{Tn(a), Ty(e), Fo(\mathbf{U}), ?\exists\mathbf{x}.Fo(\mathbf{x}), [\downarrow]\bot\}$ because the Merge process causes no growth of the tree below node $Tn(a)$.

English pronouns, therefore, lack the possibility of merging with structures of arbitrary complexity.[18] In particular, in *wh* questions, and in quantificational structures,where no linked structure analysis is available (see Kempson and Meyer-Viol 1999, Kempson et al 2001 for an account of topic structures in terms of a pair of linked trees) resumptive use of pronouns is debarred:[19]

(3.31) *Which book did John read it?

(3.32) *Every book, John read it.

As Figure 3.2 displays, these facts are as we would expect on the assumption that, in English, the pronoun remains a regular lexical item decorating a terminal node in the tree. For in order for the node projected by the pronoun to be unified with the node projected from *which book*, there would have to be no restriction on the decorations projected by the pronoun that the node it decorates be a terminal node in some tree. Should *Merge* apply in the process of interpreting (3.31), the formula would be replaced by the node dominating the pair of Determiner node and nominal node, and it is this that the terminal node restriction precludes.[20] By contrast, in relative clause construal, all that is

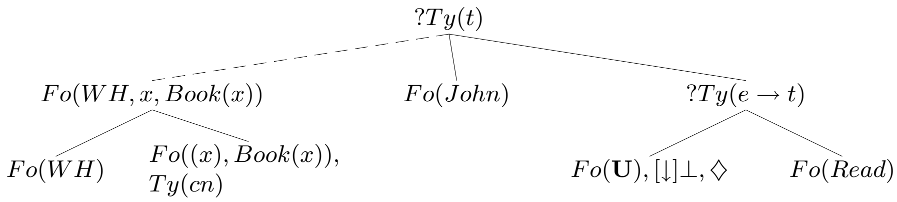



Figure 3.2: Resumptive pronouns in questions

copied over in the introduction of a LINKed structure is the formula projected by the head, and not its internal structure. So, in relative clause construal, the terminal node restriction constraining possible construal of the pronoun is not violated. Hence the acceptability of resumptive pronouns in English relative clauses, but not in all long-distance dependency structures, specifically not in *wh*-questions (unlike their Arabic analogue which allows this (see Demirdache 1991)).[21]

The analysis of resumptive pronouns offered here thus treats such pronouns *in English* as a regular pronoun: it projects a metavariable which is updated by

[18] Arguably the expletive *it* should be defined in these terms (see: Cann 2003).

[19] Sells 1984 reports the existence of (i), for which we would have to allow that NPs of the form *which of X* sequences in English can decorate an independent linked structure:
(i) Which of the linguists do you think that if Mary marries him, then everyone wll be happy.
But on the basis that (3.31) seems to be not wellformed, we resist this move as a general strategy.

[20] This analysis requires that *wh* question words such as *who* project a complex structure of the form:$[_e WH[_{cn} x, person(x)]]$. This structure reflects both their semantics and the status of *wh* words in questions as a type of indefinite, not needing a substituend within an individual interpretation process.

[21] We leave questions of Pied-Piping on one side here, partly because of space and partly because our dataset contains no examples of resumptive pronouns used with Pied-Piped relative phrases.

some term as made available in context. There is no need to posit any ambiguity in the lexical specification of the pronoun itself: indeed, given the DS account of quantification, the contrary Chao and Sells 1983 analysis of resumptive pronouns, which invokes an E-type form of construal for an assumed discrete form of pronoun, cannot be sustained.

In order to project an E-type form of interpretation, there must be a specified quantificational term to provide the type of antecedent for the pronoun to give rise to this form of interpretation. The pronoun antecedent relation is invariably cross-clausal, as the term to be selected as antecedent is only made available the final step in some interpretation for a propositional formula, providing as it does for each term in that structure a restrictor which reflects the relative scope of all quantifying terms in that structure. For example, in the canonical case of an E-type form of anaphoric construal, the pronoun can indeed be identified with some term witnessing the truth of the preceding sentence as interpreted, for it takes as antecedent the term $(\epsilon, x, Man(x) \wedge Enter(x))$ constructed from the first sentence,[22] which then has the new predicate *Smoke* applied to it:

(3.33) A man enters. He is smoking.

A pronoun in a relative clause which is nonrestrictively construed can, in like manner, identify as its antecedent the head of the relative, since, in virtue of the LINK transition being defined from some top node of a noun-phrase projection, a term is made available as input to the construal of the relative clause sequence. However, in restrictive forms of relative-clause construal, no such term can be available with which to identify a pronoun within the relative clause sequence, as the restrictor for which the relative clause acts as input is under construction at the point at which the pronoun is processed. Any attempt to retain an E-type form of analysis by defining some means of delaying the construal of the pronoun would not only violate compositionality, but would be circular, for the value of the metavariable projected from the lexical specification of the pronoun has by an E-type form of analysis to reflect the full content of the containing relative clause but the interpretation to be assigned to this clause turns in part on the value assigned to this metavariable.[23]

In the present analysis of such resumptive use of pronouns within a restrictively construed relative, no such problem arises. A fixed node decorated with a metavariable (as lexically projected from a pronoun) within the construction of some LINKed structure is, in principle, compatible with there being an unfixed node already introduced into that structure that is decorated with a fixed formula value of the same type. Furthermore, nothing prevents the merging of that node (decorated by actions of the relative pronoun with a copy of the variable projected by the noun which is head of the relative) and the fixed node decorated by the pronoun. Indeed, such an update resolves in one step the different forms of underspecification up to that point associated with the two nodes in question. Furthermore, since in relative clauses the formula value decorating that initially unfixed node in the emergent LINKed structure does so in virtue of a formula-copying device (and not in virtue of any internal structure it may have getting copied over from one tree to the next), there is no conflict

[22]In the DS account, the term results from the scope evaluation algorithm applying to logical-form scope-statement pairs.

[23]It is notable that no formal analysis is provided in Chao and Sells 1983.

with the restriction projected by the pronoun that the formula value assigned as its interpretation be a terminal node in the tree. Hence, the wellformedness of resumptive relative pronouns in English, either under a nonrestrictive or restrictive form of construal.

## 3.3 Towards a left periphery typology

It has been standardly recognised over a long period that long-distance dependency effects can be modelled either as a correlation between two discrete positions in a tree through a process such as movement (or feature-passing), or through a process of anaphoric linkage (see Ross 1975). There are, that is, languages with the left-dislocated expression paired with 'a gap' and displaying island restrictions, this being assumed to involve a purely structural process:

(3.34) Mary, John thinks Tom had upset.

(3.35) *Mary, I dislike the man that married.

There are also languages/structures that display pairing of the left-dislocated expression with a pronoun with no such island restrictions (3.36)-(3.37), allowing mismatch of the peripheral expression and a case-marked pronoun (3.38).[24] These have been assumed to be induced as independent base-generated structures, linked to each other solely through anaphoric processes:

(3.36) *Il-kita:b da, 'inta tkallimt ma9a l-walad 'illi katab 9aley-h.*
the book this, you talked with the boy who wrote on it
[Egyptian Arabic]

'You talked with the boy who wrote on this book'

(3.37) As for Mary, I talked to the boy who said she had cheated.

(3.38) *I Maria, xtes gnorisa ton andra pu tin*
$\text{the}_{NOM}$ Maria yesterday $\text{met}_{1st.ps.sg}$ the man that $\text{her}_{ACC}$
*patreftike* [Greek]
married

' Mary, yesterday I met the man that married her'

What is less expected, given that way of looking at the dichotomy, are the various intermediate forms, involving some kind of interaction between establishing a long-distance dependency effect and resolving anaphoric underspecification, with apparent blurring of the distinctiveness in the two processes. There are left-peripheral constituents paired with a pronoun which display some but not all properties of movement - their properties include matching case-specification of left-peripheral noun phrase and doubled pronoun (3.39), sensitivity to strong island effects (3.40), general exclusion of quantified expressions (indefinites only, and with specific interpretation) (3.41), and realization with a sharp break of intonation following the left-peripheral expression:

[24]Nominative case in Greek is signalled by lack of case

(3.39) *Ton Petro, ton nostalgo poli.* [Greek]
The Peter$_{ACC}$, Cl$_{ACC}$ miss-1sg much
'I miss Peter a lot'

(3.40) **Tin Maria, xtes gnorisa ton andra pu*
The$_{ACC}$ Maria yesterday met$_{1st.ps.sing.}$ the man that
*tin patreftike.*
her$_{ACC}$ married
'Mary, yesterday I met the man that her married.'

(3.41) *A una secretaria que sabe hablar inglés, Pedro*
ACC one secretary that knows speak$INF$ English, Pedro
*la está buscando*
pro$_{Fem.ACC}$ is looking-for
'Pedro is looking for the secretary that speaks English'

This is the so-called Clitic Left Dislocation effect (Cinque 1990). There may even be variation between forms within a single language, as in Romanian: This language has one left-dislocation structure associated with one kind of morphological marker - no preposition but the presence of *-pe* - which is sensitive to strong-island constraints (3.42)-(3.43), and another - the complex form *cĭt despre* - for which there are no island restrictions(3.44):

(3.42) *Pe Maria am crezut ca ai intilnit-o*
pe Maria have$_{1st.sg}$ believed that have$_{2.sg}$ met$_{ACC.pron}$
[Romanian]
' Maria, I believed that you met.'

(3.43) **Pe Ion n-am ĭntĭlnit fata care l-a văzut anul*
pe John not-I-have met the girl which him-has seen year
*trecut.*
last.
'*The John, I have not met the girl who saw him last year.'

(3.44) *Cĭt despre Ion, n-am ĭntĭlnit fata care l-a*
As for John, not-I-have met the girl which him-has
*văzut ultima dată.*
seen the last time.
'As for John, I have not met the girl that she saw him last time.'

The echo of relative-clause restrictions is not a coincidence, and we return to this shortly.

These intermediate effects are problematic for movement accounts, as the paradigm at least leads one to expect a certain diagnostic set of effects associated with movement (strong island effects, no morphological realisation of the trace position, or if there is a pronoun marking that position, it is treated as some entity distinct from regular pronouns), and a complementary set of effects associated with base generation (no island sensitivity, presence of a pronoun). This range of variation is widespread. For example, Aissen 1992 has argued that the Mayan languages differ according to whether they have an external topic which is an independent structure, with pronominal duplication, separated by an intonational break, or have pronominal duplication and no such break and are subject to strong-island sensitivity despite the presence of the pronoun. Indeed, the difficulty in sustaining this dichotomy between movement and base generation is increasingly leading to analyses which depart from it (for a recent example, see Adger and Ramchand 2003).

### 3.3.1 Building linked structures at the left periphery

Turning to what DS would have to offer, we have the same two basic types of tool as in other frameworks – the characterisation of anaphora construal, and the characterisation of long-distance dependency effects. Indeed, at this juncture, it might seem that the two types of approach in the different frameworks are notational variants. The difference is that in DS the processes of anaphora construal and long-distance dependency construal are expressed in the same terms as each other, as variant forms of tree growth; and, just as in relative clause construal, this will turn out to give us a natural basis for defining different variations. Furthermore – a bonus which will have to wait until the following chapter – the story to be given here is only one half of a larger story, since the difference between right-periphery effects and left-periphery effects, which are not fully symmetrical, will fall out directly from the dynamics of how interpretation is built up in opening and closing stages of an interpretation process, something which is very far from being true in orthodox frameworks which allow no such expression of the dynamics of serial processing.[25]

#### 3.3.1.1 The topic-structure relative-clause parallelism

The first point to observe is that in having characterised relative pronoun construal as the construction of structures that are introduced as independent trees to be anaphorically paired, we can naturally express whatever parallelisms there may be between these and those topic-forming structures which involve essential use of anaphoric elements, by analysing those structures also as linked structures. This will be an immediate bonus for this analysis, since in many other approaches to relative clause formation, the relationship of relativiser to its remainder is that of an operator binding a gap as a logical operator might bind a variable, and the essential anaphoricity of the relationship between head and the relativising element is missed, with the natural extension to other left-dislocation structures not being brought out.[26]

In this connection, another point to notice is that though the concept of building linked structures has so far been restricted to inducing a new tree whose top node is duly decorated with a requirement $?Ty(t)$ from some node WITHIN a given partial structure, there is nothing in the concept of a LINK relation itself to determine the logical type of nodes can be related by such a transition. LINK is a tree relation, and can, in principle, be constructed between nodes of any type, at any level of embedding. So we can straightforwardly define a transition introducing a LINK relation between a tree with TOP node

[25]Indeed, in general, authors scrupulously avoid it. See Mahajan 1997 who, in commenting upon linearisation effects in Hindi word order variation, he describes the possibility of allowing pronominal binding to be sensitive to linearity as 'a rather dubious move.' We note in passing that the resumptive pronoun in the previous sentence occurred spontaneously, and was only picked up by the non-native-English-speaking author amongst us upon a late check.

[26]Though see Boeckx 2002.

type $e$ and some second structure of type $t$, duly imposing a requirement on that second structure that it contain an occurrence of the formula annotating the topnode of the first. Technically, since it is the type-$t$-requiring node which is the point of departure, it involves separating the introduction of the LINK relation from the imposition of a copy of a term from one structure on the development of the second. The first step is to introduce the linked structure from the root node without any imposition of a copy, since there is no term at this juncture to impose as a copy:

$$\langle L \rangle Tn(0), ?Ty(e), \diamondsuit \qquad Tn(0), ?Ty(t)$$

This tree display may not look much like tree-displays with which one is familiar, but that's because both trees have only one node! What is displayed here is a pair of trees, one with requirement $?Ty(t)$, from which a LINK transition is constructed (actually, an inverse Link transition) onto a node requiring $?Ty(e)$, so that the proposition-requiring tree will be in the end-result LINKed to this type-$e$-requiring tree-node. This newly introduced node with requirement $?Ty(e)$ is then decorated by the lexical actions given by the left-peripheral expression; and the pointer is then licensed to move back across the LINK relation, in so doing imposing a copy of the now established term on the subsequent development of the rootnode (see Appendix 1 for the detailed formulation of rules):

$$\langle L \rangle Tn(0), Fo(\alpha) \qquad Tn(0), ?Ty(t), ?\langle D \rangle Fo(\alpha)$$

Such a pair of trees can be used to model those structures in languages in which a left-peripheral NP, indicated to be separated from the following string by intonation, is associated with the presence in the following string of a coreferring pronoun:

(3.45) As for that friend of yours, I found him wandering round the supermarket.

Constructing a LINK transition, that is, is used to construct a tree as context for the subsequent construction of the tree dominated by the root node, s part of the overall information conveyed. Indeed, in English, the complex preposition *as for* arguably induces the building of such a LINK transition from the lexicon, without need of any independently defined computational action. However, the process is a very general one, so we presume that such a set of moves is licensed by general computational action.

This is a stipulation in so far as the rules need definition; but the concept of LINK itself as a tree relation associated with anaphorically driven sharing of terms carries over unchanged from the account of relative clause construal, with expectations of linguistic patterning that are immediately confirmed. First, since these structures have no analogue to a relative pronoun, their analysis as projecting linked trees would require the construal of the pronoun as identical to the interpretation assigned to the left-peripheral NP. This is because, given the modal form of requirement on the top node of the LINKed structure projected for interpreting the clause following that NP, together with the lack of any morphological expression analogous to an English relative pronoun, some pronoun MUST be interpreted as identical to the $Fo$ value projected by that NP in order to yield a wellformed result. This is confirmed immediately by English.

(3.46)-(3.47) are completely ungrammatical:

(3.46) *As for that friend of yours, I found wandering round the supermarket.

(3.47) *As for Mary, I like.

As in the case of Arabic relative clauses, this does not require any particular stipulation for the pronoun itself: it is a consequence of the interaction between requirements and the availability of placeholding devices subject to a pragmatic process of substitution. A general computational action which imposes a requirement for a copy will have the effect of determining that the only well-formed completions will be ones that get rid of this requirement, and without any analogue of a relative pronoun, this can ONLY be achieved by use of the regular anaphoric device of the language.

Secondly, we anticipate an asymmetry between those languages which have a full relative pronoun, which in relative clauses DOES provide that appropriate copy, and those languages which do not. Where the relativiser does not itself induce the required copy in the LINKed structure, as in languages such as Arabic and Romanian, the account so far provided leads us to expect parallelism between topic structures and relative clauses, both requiring a suitably construed pronoun in some position within that string, for neither have any expression encoding the requisite anaphoric link. In languages/structures in which a relative pronoun DOES secure the presence of the copy of the formula at an unfixed node within the introduced LINKed structure, there should be no such parallelism. This asymmetry is indeed reflected in the data. In both Arabic and Romanian (in relative structures using *care*), which we have already taken as illustrations of obligatory resumptive use of pronouns in relative pronouns, the two structures display parallel effects. In Arabic for example, a suitably construed pronoun is obligatory in all nonsubject positions, as it is in Romanian:

(3.48) *l-bint illi ali ʔabil-ha.* [Egyptian Arabic]
the girl that Ali met-her
'the girl who Ali met'

(3.49) *nadja, ali ʔabil-ha*
Nadia, Ali met her
'As for Nadia, Ali met her.'

(3.50) *baiatul pe care l-am vazut* [Romanian]
the boy pe which him-have$_{1.SING}$ seen
'the boy that I saw'

(3.51) *Ion l-am intilnit anul trecut.* [Romanian]
John him-have$_{1.SING}$ met year last
'John, him I met last year.'

Furthermore, Hebrew, as the mixed case, should, like Arabic, display parallelism between relative clauses and topic structures, and it does (compare (3.10)-(3.11) with (3.52)-(3.53):

(3.52) *shalom, ʔani xošev še ʔalav ʔamarta še sara katva*
Shalom, I think that about him you said that sara wrote
*šir* [Hebrew]
poem

'Shalom, I think that about him you said Sara wrote a poem.'

(3.53)

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| *shalom,* | *ʕalav* | *ʕani* | *xošev* | *še* | *ʕamarta* | *še* | *sara* | *katva* | *šir* |
| Shalom, | about him | I | think | that | you said | that | sara | wrote | poem |

'Shalom, about him I think you said Sara wrote a potem.'

In English to the contrary, with its anaphoric complementiser, it is only in topic structures that a suitably construed pronoun is required (as in (3.45)-(3.46) repeated here):

(3.45) As for that friend of yours, I found him wandering round the supermarket.

(3.46) *As for that friend of yours, I found wandering round the supermarket.

In relative clauses it is not, and is merely an option associated with markedness effects, as we have already seen:

(3.54) ?That friend of yours who I found him wandering round the supermarket seemed very upset.

So the exact parallelism of Hebrew and Arabic relative clauses and such topic structures is, as we would expect, not matched in English. This is the type of consequence signalled earlier, that is not naturally expressed by operator-variable forms of account, so a bonus for this account.

## 3.3.2 Overlapping analyses

What we now find is exactly the same kind of overlapping effects that we saw in the earlier relative clause forms of variation, but here with a new twist. We have two types of structure – paired linked structures, and one unfixed node introduced early on in developing a tree – both of which can be used as a basis for parsing left-peripheral structures; and both can be associated with variations that lead to the array of mixed effects which languages actually display.

### 3.3.2.1 Linked structures and Modality variations

On the one hand, pursuing the parallelism with relative clause construal, if we take a LINK transition as the point of departure for parsing a left peripheral expression, we will expect an array of locality variations associated with the antecedent-anaphor relation imposed by the LINK relation, just as with relative clause construal. So we can expect variation as to which modal operator $\langle \mathbf{x} \rangle$ defines the domain within which the constructed copy of the term must be found (i.e. $\mathbf{x}$ can range over $D\downarrow_*$, or maybe even $\downarrow$):

$$\langle L \rangle Tn(0), Fo(\alpha) \qquad Tn(0), ?Ty(t), ?\langle \mathbf{x} \rangle Fo(\alpha)$$

First there are the cases without locality constraints on where within the individual tree this requirement for a copy of the head is to be fulfilled. This is clearly met by the data which allow the left-peripheral expression to be interpreted as picking out the same entity as picked out by a pronoun, possibly inside a relative clause sequence:[27]

(3.44) *Cǐt despre Ion, n-am ǐntǐlnit fata care l-a*
As to John, not-I have met the girl which him she has
*văzut ultima dată.* [Romanian]
seen the last time.
'As for John, I have not met the girl that she saw him last time.'

Furthermore, on the assumption that case specifications indicate relative positioning in the resultant tree (see chapter 1), we expect an interaction with case-marking. That is, in languages which display morphological case, we expect, correctly, that in island-INsensitive environments, if a pronoun is used, there should be case mismatching, since the use of the pronoun can be taken as indicative of a LINK relation having been established between two separate structures, with only the node decorated by the pronoun meeting the requirement imposed by the case specification, and this pronoun meeting the requirement for a copy of the term constructed from the left-peripheral expression:[28]

(3.55) *I Maria xtes gnorisa ton andra pu tin pantreftike*
Maria$_{NOM}$ yesterday I met the man who her married
Greek
'As for Maria, yesterday I met the man who married her.'

(3.56) *Sue Johninu avale ishtammanu.* [Malayalam]
Sue, John$_{Dat}$ her$_{Acc}$ likes
'Sue, John likes.'

However, given the modal form of the requirement, there is every reason to expect variants of this form of constraint through selection of other modal operators from the range $\langle D\rangle, \langle\downarrow_*\rangle, \langle\downarrow_0\rangle$ – again just as in relative clause construal – thereby imposing more severe restrictions on where the copy is to be found in this second tree. The imposition of the requirement using the $\langle\downarrow_*\rangle$ operator, where the imposed structural restriction on the antecedent-anaphoric pairing mimics that of an unfixed node, corresponds directly to CLLD structures, which we see in all the Romance languages. Despite their strong-island sensitivity, these are obligatorily associated with an attendant pronoun in the second structure, and separated from the remainder of the string by a sharp intonational break:

(3.57) *El coche, Maria lo compró* [Spanish]
the car Maria it bought
'The car, Maria bought it'

Accounting for such strings in terms of paired linked structures would suggest that intonation is playing a role in indicating the separation of the structure to be projected from the first expression from the structure to be assigned to the remainder.

[27] This is in contrast to the restriction on relative clause sequences that the relative pronoun *care* cannot itself be correlated with a pronoun across such a boundary.

[28] In Greek and in Malayalam, as in many other languages, nominative case is associated with null morphological marking.

Such strings also display a further property, which is the specificity restriction already noted. In general quantified noun phrases cannot occur at the left periphery with pronoun doubling, with one exception – that of indefinite NPs. And these, if duplicated by a pronoun, must be interpreted as taking wide scope with respect to the remainder of the string, being interpreted quasi-referentially - (3.58) seems unacceptable, and (3.41) has to be interpreted as indicating that Pedro is looking for a particular individual:[29]

(3.58) *??Un coche, Maria lo compró.* [Spanish]
a car, Maria it bought.
A car Maria bought it.

(3.41) *A una secretaria que sabe hablar inglés, Pedro*
ACC one secretary that knows speak$INF$ English Pedro
*la está buscando*
pro$_{Fem.ACC}$ is looking-for
'Pedro is looking for a particular secretary that speaks English.'

(3.59) *Qualcuno, lo troveremo.* [Italian]
Someone, him we will find
Someone in particular, we will find him.

This property buttresses a linked-structure analysis, as, unlike all other quantified expressions, indefinites can be freely associated with an indefinitely extending scope potential across independent scope domains.[30] Analysing the indefinite as projecting an epsilon term, allowed to decorate the topnode of a linked structure inducing the requirement for a copy of that term in some paired emergent structure will provide the distribution expected. Only indefinites will be able to be associated with nodes identically decorated across a pair of independent structures. Non-indefinites require scope evaluation within an individual tree since, unlike indefinites, they have no lexically idiosyncratic mechanism to dictate any broader scope potential (see chapter 2). What this means is that if a language allows non-indefinite quantified expressions to be pronoun-doubled, i.e. to allow co-construal of the pronoun and the quantified expression, then this must be indication, contrarily, that the node which the pronoun has decorated is able to merge with the node which the quantifying expression has decorated, as such decorations must yield a single propositional domain within which the scope of the quantifying expression can be suitably defined. And this indeed is the property displayed in Spanish datives, a phenomenon we turn to shortly.[31]

[29]In many analyses, such indefinites are analysed indeed as names (Fodor and Sag 1982, and many thereafter: see references in chapter 2), but we have already seen reason to doubt any such analysis of indefinites.

[30]The extendability of the scope of indefinites can be shown by the way our scope evaluation algorithm defined earlier expands the following valid inference:

$\exists x, \psi(x) \wedge \phi(\epsilon, x, \psi(x))$
$\models \psi(\epsilon, x, \psi(x)) \wedge \phi(\epsilon, x, \psi(x)$
$\equiv$
$\psi(a) \wedge \phi(a)$
where
$a = \epsilon, x, \psi(x) \wedge \phi(x)$.

[31]In the Romance languages, Greek and the Bantu languages, among others, clitic pronouns

So far, so good. We have itemised a basis from which to characterise the mixed status of Clitic Left Dislocation, using the assumption that the locality constraint within which the anaphoric link across a LINK transition may be established as a basis for variation. With this possibility of locality variation, one might expect further that if a language had morphological means of distinguishing more than one type of such structure, these might differentiate between different forms of locality constraint, and this is what we found in Romanian (3.44)-(3.43). In Romanian, there is the one generalised LINK transition which, like the corresponding transition in relative clause construal in Romanian, imposes a restriction that the shared term to be introduced must be constructed within the same tree as the LINKed structure (expressed using the $\langle \downarrow_* \rangle$); but there is also the richer lexical form involving *cǐt despre* ('as to'), which, like English *as for*, lexically induces a LINK transition with only the weakest form of locality constraint using the $\langle D \rangle$ operator that merely has the effect of imposing a requirement for the copy of the term in question during the construction process without any further structural restriction.

With the emergence of a locality constraint imposed on the anaphoric process associated with establishing the requisite pair of terms across a LINK relation, namely that the second copy occurs within the single tree which constitutes the linked structure, a clear overlap emerges between what are otherwise two discrete strategies, that of building paired linked trees, and that of building an unfixed node within a single structure. So there will be more than possible analysis for an individual string. And, as we turn to consider **Adjunction*, this is what we shall find.

#### 3.3.2.2 The Interaction of *Adjunction and anaphora

*Adjunction is, of course, the device *par excellence* for characterising left-periphery effects – it was defined to do just that. So with the availability of building an initial linked structure to be anaphorically twinned with the subsequently introduced structure, and with *Adjunction, we do indeed have two strategies available for building up interpretation of left-peripheral expressions. To complete the picture of the types of available variation, what we now bring back in to this account is the possibility of a pronoun losing its terminal node restriction (what we called "the bottom restriction" (chapter 1)). As we saw in chapter 1 in discussing crossover phenomena, a form of update for updating a node initially introduced as unfixed is by merging it with the node decorated by that pronoun itself, this update process itself providing the update both to the tree position for the hither-to unfixed node and to the initially projected metavariable provided by the pronoun, with the consequence, as figure 4.3 displays, that the process will have decorated a node which turns out not to be terminal in the resulting tree.[32] Pronouns, then, will vary as to whether or not such an

may occur either as prefixes (as a form of agreement), or as suffixes. The prefixal form requires a specific lexically induced action licensing the construction of an unfixed node which then merges with the (object/indirect-object) node projected by the actions of the verb, an action which in many languages is a freely available computational action, in particular in verb-final languages, a localised variant of *Adjunction (see chapter 6 of the extended Cann-Kempson ms).

[32]For convenience, we represent $Det'$ as a variable over variable-binding term operators, $Noun'$ as a variable over terms of type $e \rightarrow cn$, and $Verb'$ as a variable over terms of type $e \rightarrow (e \rightarrow t)$).

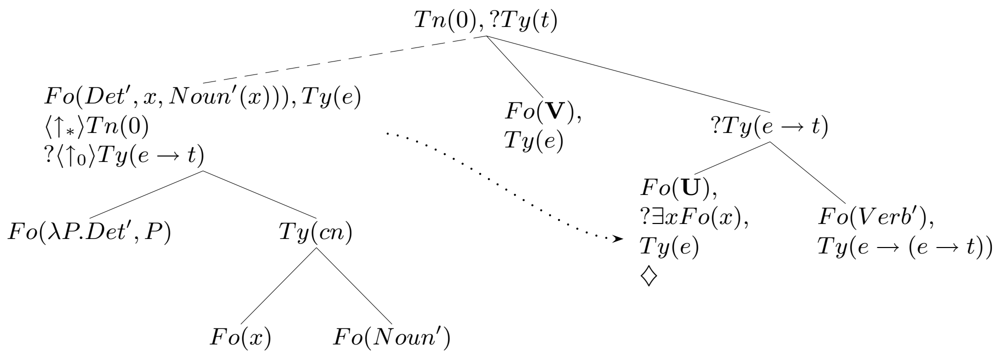



Figure 3.3: Licensing pronoun-merge interaction

application of *Adjunction is possible. If the pronoun retains its restriction, it will not allow such a process; retention of the terminal-node restriction is characteristic of English pronouns, and German also.[33] Remember, in passing, that resumptive construal of pronouns in English relative clauses did NOT provide evidence of any such loss of restriction as in those LINKed structures, it was only the formula value that was copied over into the LINKed structure, and not any ancillary structure (see Cann, Kaplan and Kempson 2004). If however – expletive-like – some pronoun has lost any such terminal node restriction, then unification of the node the pronoun decorates with any node introduced as unfixed in early stages of the parse process is licensed.

What this provides is a basis for characterising the data where a preposed nominal agrees with the case-marking of the pronoun that is construed as doubling it (repeated here):

(3.39) *Ton Petro, ton nostalgo poli.* [Greek]
The $\text{Peter}_{ACC}$, $\text{Cl}_{ACC}$ miss-1sg much
'I miss Peter a lot'

In these cases, the case specification imposing a requirement on what hierarchical position in the the initially unfixed node can ultimately establish is met upon unifying with the fixed node, once this is introduced. Furthermore, as we would expect, these cases need not display specificity effects. And Spanish, which unlike Greek does not have case morphology reflected on the noun phrase itself, certainly freely allows quantifiers with clitic doubling:[34]

(3.60) *A nadie le devolvió Maria su manuscrito* [Spanish]
To no-one $\text{CL}_{DAT}$ returned Maria his manuscript.
'To no-one did Maria return his manuscript'

[33] The only exceptions to this restriction on pronominal use are the expletives, for example the English expletive *it* (see chapter 4).

[34] The *à* displayed with the left peripheral expression in these examples is neutral between Accusative and Dative – so the dative case-marking in these examples is displayed solely by the pronoun.

(3.61) *A familias de pocos medios les ofrecieron queso y*
to families of small means to them offer$_{3pl}$ cheese and
*leche*
milk

To low-income families, they offered cheese and milk '.

We expect this to be so, and without restriction to a particular type of quantifying expression, as the process is simply one of tree update, which is a general computational action applying without restriction to particular sub-types of *Formula* expression. This property distinguishes the Spanish dative from the accusative clitic pronoun. Furthermore, unlike the other clitics, there is no necessity of any phonological break between the full noun phrase and the remainder of the clause, as we might expect.

#### 3.3.2.3 Processing ambiguities?

There is a consequence to such a shift however. If some pronoun in a language has lost its bottom restriction, then its presence in a string will no longer necessarily be indicative of the need to construct a pair of linked trees, since the node which it can decorates may nevertheless provide the input to a step of Merge unifying some unfixed node with the node just processed in parsing the pronoun. However, it won't debar the building of pairs of linked structures either: failing to have a bottom restriction, its distribution will simply be wider than those pronouns upon which such a restriction is imposed. But the effect is that either LINK or unfixed node analysis will lead to a well-formed result. This will give rise to a processing ambiguity without necessary semantic consequences. This, perhaps surprising, result appears however to be correct, in that it enables us to explain differences between dative and accusative doubling in Spanish.

In standard Spanish, the dative clitic pronoun, as we've already seen, can be used to duplicate ALL forms of NP, quantified and referential, allowing both an interpretation in which the doubled noun phrase is taken as some background to which the pronoun provides an anaphoric linke (with suitable use of intonation to buttress the separate structures to be constructed in the interpretation), and an interpretation in which the doubled noun phrase has no such distinctive role. But in this, it is alone. The object clitic in Spanish can only double referential noun phrases construed as independently fixed in the context, and so, arguably, requires an analysis as a pair of linked structures.[35] The object clitic in Standard Spanish is also reported always to require intonational indication of a break between the doubled noun phrase and what follows it. Indeed if no clitic is present in such structures, they must be interpreted nonspecifically, and hence by the analysis here as decorating an unfixed node. So (3.41) and (3.62) differ systematically in interpretation:

(3.41) *A una secretaria que sabe hablar inglés, Pedro*
ACC one secretary that knows speak$_{INF}$ English, Pedro
*la está buscando*
pro$_{Fem.ACC}$ is looking-for

'Pedro is looking for a specific secretary, who speaks English.'

[35] We return to the distribution of Spanish dative clitics and the distinction between clitic (weak) pronoun and strong pronoun in chapter 4.

(3.62) *A una secretaria que sabe hablar inglés, Pedro está*
ACC one secretary that knows speak$_{INF}$ English, Pedro is
*buscando*
looking-for

'Pedro is looking for some secretary that speaks English.'

To get this effect, and the asymmetry between dative noun phrases and the rest, we need an analysis which allows two strategies of construal for the one type of case, and one only for the remainder.[36]

Furthermore, we now expect the ambiguity of construal of subject pronouns in Spanish. Given the lack of morphological marking of case on the subject, and the pro-drop properties of the verb, projecting a full template of structure and a placeholder in subject position able to be identified contextually, we correctly anticipate ambiguity of construal as to whether the subject is construed as decorating an unfixed node or a linked structure.[37] The same methodological principle applies here. We don't need to say that in some sentences the agreement requires analysis as some form of indexical, in other cases an analysis as an agreement device. The account of verbs in pro-drop languages as decorating one or more argument nodes with a metavariable but with no bottom restriction gives just the flexibility we need.

Another expected variation would be a language in which a pro-drop property, with argument annotations provided by the agreement morphology has become replaced by use of clitics, with the clitic projecting exactly the same properties as the agreement morphology which it replaces, lacking any bottom restriction, and so sustaining a maximally broad distribution for the clitic. This is arguably the case with conversational French, which lost its pro-drop properties early on, which invariably doubles the subject NP with the presence of a clitic:[38]

(3.63) *Jean, il est malade* [French]
John he is sick

'John is sick.'

Indeed, what are described in current literature as two discrete processes - Hanging Topic Left Dislocation, and Clitic Left Dislocation - are argued by de Cat 2003 to be indistinguishable in modern conversational French, on this analysis exactly analogous to Spanish, except that in French the richness of decoration of the agreement morphology is taken over by the clitic.

So, with the use of two discrete forms of structure-building, both allowing variants which lead to overlapping effects, we expect the range of intermediate effects which the phenomena display. There is one pattern which, however, gives

[36]The Porteño Spanish accusative clitic appears to be moving in the same direction in that this intonational patterning of separation between it and its remainder has gone the way of the dative, and got dropped. However it retains a specificity restriction on all doubling of the clitic. See Suner 1988 and elsewhere.

[37]See Zubizarreta 1999 for arguments that in Spanish a lexical specified subject is invariably external to the clause.

[38]The same style of analysis arguably applies to the Northern Italian dialects, which share with French the property of being influenced by the neighbouring German-speaking Swiss, whose stumbling attempts in the Romance language would no doubt be insensitive to the subject pro-drop property, so that the Romance-language speakers would have to parse a great number of pronouns which seemed to them otiose.

us some difficulty. This is where a left-peripheral noun phrase is case-marked, requiring island-sensitive resolution of its position in the emergent structure – all as we would expect on an analysis as decorating an unfixed node, indeed requiring such an account in virtue of the case specification – but nevertheless precluding all quantified expressions expect those that can be interpreted as specific, an indication, which according to our account, contrarily indicates a LINK relation. Such distribution is observed of Greek accusative clitic pronouns, and too of Rio-Platense Spanish accusative clitics:[39]

(3.64)

| | | | | | | |
|---|---|---|---|---|---|---|
| *Mia* | *kokini* | *blouza* | *tin* | *psaxno* | *edo* | *ki* |
| a | red | bouse$_{FEM.ACC}$ | PRO$_{fem.3sg.acc}$ | look-for$_{1sg}$ | for | a |
| *ena* | *mina* | | | | | [Greek] |
| month | now | | | | | |

'I have been looking for a particular red blouse for a whole month now.'

How can we square this with our analysis, without weakening the diagnostics for the account of the other data? The first thing to note about these data, is that, in careful accounts of the Greek phenomenon, they are accompanied by a footnote pointing out that the data are not entirely clearcut, as in the subjunctive where an intensional context is being described, the pronoun may be obligatory without any indication of referentiality:[40]

(3.65)

| | | | | | | |
|---|---|---|---|---|---|---|
| *psachni* | *mia* | *fousta* | *pu* | *na* | *ti* | *thavmazoun* |
| looks-for$_{3.ps.sg}$ | a | skirt | that | SUBJ | it$_{CL.fem.ACC}$ | admire$_{3.ps.pl}$ |
| *oli* | | | | | | |
| all$_{NOM}$ | | | | | | |

'She is looking for a skirt that everyone will be jealous of'

(3.66)

| | | | | | | |
|---|---|---|---|---|---|---|
| **psachni* | *mia* | *fousta* | *pu* | *na* | *thavmazoun* | *oli* |
| looks-for$_{3.ps.sg}$ | a | skirt | that | SUBJ | admire$_{3.ps.pl}$ | all$_{NOM}$ |

'She is looking for a skirt that everyone will be jealous of'

Given that this example suggests that the phenomenon is not a clearcut reflection merely of structure, we prefer to advocate a pragmatic explanation, running off the presumption of an analysis using the unfixed node strategy. As we shall see in chapter 5, the task for a speaker of saying a pronoun requires identifiability of some term relative to the speaker's own context (and not, or not necessarily, involving any judgement about what the hearer has manifestly available).[41] Accordingly, even when the speaker may choose to describe some individual with the use of an indefinite expression, the choice of pronoun to pick out such an individual is natural as a warranty of the epsilon term presumed strictly to be the content of the proposition they are electing to convey. Presumption of such a term, relative to the speaker's own context, is a harmless enough move – despite the resulting lack of co-extensiveness of speaker's and hearer's context – as long as the clitic can be taken to license a step of Merge with the constructed epsilon term. The application of Merge between an unfixed

[39]The observation about Greek specificity effects is attributed to Philippaki-Warburton 1985, as the first to observe this. The example is taken from Alexopoulou and Kolliakou 2000.

[40]The same phenomenon is noted in passing for Hebrew in Sharvit 1998 while pursuing an analysis which is incompatible with such data.

[41]This turns out to be an important attribute of the dialogue model set out in chapter 5.

node decorated with an epsilon term and the node decorated by the pronoun will lead to a logical form that corresponds appropriately to the words uttered. Hence the resulting specificity effect is a consequence of an asymmetry between information the speaker may have available in their context and information that the hearer has.[42] The speaker can identify such an individual: the hearer can not. So, after all, we analyse Greek object pronouns in line with Spanish datives despite the supposed referentiality restriction, which the Spanish datives don't share.

## 3.4 Summary

Overall, this account of clitic-duplicated left-dislocation structures matches the more familiar base generation vs movement accounts in many respects, but it has the edge over them in that the intermediate cases emerge as expected variants, either from the interaction of independently motivated processes, or as expected variations along a locality spectrum. In particular, the various anaphoricity effects that are achieved do not need to be formalised with mechanisms distinct from regular processes.[43] The only difference between pronouns which do allow update by node-merging processes and those which do not, is in the loss of the terminal-node restriction. Strong pronouns invariably retain such a restriction, behaving in all respect as regular lexical items. Clitic pronouns may have lost this restriction, though by no means all have done so.[44] In all other respects, these pronouns function as regular anaphoric expressions, the loss of the restriction merely ensuring that they have a wider distribution. We summarise the distributions in tabular form, again noting the gap that nodes can't be decorated without having been constructed in relation to SOME tree. Again the characterisation is only partial in that there is no hint of how a LINK relation might be induced in the latter stages of the construal process, a right-periphery effect, a matter which we put right in chapter 4. And we have the same gap for the same reason – we haven't yet taken account at all of verb-final languages.

In developing this typology, there has been a singular lack of invocation of any primitive concepts of either topic or focus. We should now test out the extent to which the DS constructs can be used to reflect these informal notions. First, we turn to the concept of topic, which we take to constitute some minimal form of context relative to which the current update is presented. From the perspective of this framework, given that all parsing takes place in a context, we take the context to be some (minimal) sequence of partial trees immediately available to the parser, during the parse process. So the context, simply, is the point of departure for the current processing. However, the speaker is able to construct a point of departure as part of the utterance sequence, and in this lies the function of building a linked structure at the outset of an utterance - to create the context for the present utterance, either establishing anaphorically a relationship to the larger context, or to constitute a departure from it. And so it is that structures constructed as independent from the remainder, may be

[42]This situation is diachronically unstable, and a source for syntactic change.

[43]An account which purports to unify anaphora and long-distance dependency is that of Hornstein 199x, but with the opposite move of making anaphora resolution be defined as a form of movement.

[44]For discussion of the distinction between strong and clitic pronouns, see chapter 4.

| | Left-peripheral item provides Annotation on unfixed node | | Left-peripheral item decorates Linked node imposing Requirement within primary structure |
|---|---|---|---|
| Update locally restricted to individual tree | Pronoun updates no terminal node restriction<br>Greek/Spanish dative clitics French subject clitics | pronoun precluded, retaining terminal node restriction<br>German English Hebrew | Pronoun provides anaphoric link referential restriction<br>Greek/Romance object/dative clitics |
| Update Not Restricted to individual tree | | | Arabic Hebrew English |

Figure 3.4: Left-peripheral expressions

construed either as a backgrounding device, or as contrastive.

Second, there is the concept of focus, a slippery notion which some have argued is incoherent.[45] The other form of decision about the presentation of information within the time-linear dynamics of an utterance is the need to separate off some term from the remainder in order to allow it to serve as a specific form of update relative to some proposition to be taken as context – a canonical function served by **Adjunction*. However, as with the concept of topic, this separation of what is the new update may be achieved either within the construction itself, by the use of **Adjunction*, or within the general dialogue context. Question-answer pairs illustrate the use of context itself to provide the appropriate structure for which the presented utterance provides an update:

(3.67) Who annoyed his mother? John.

There is much more to be said here. All we can hope to have indicated is that there are grounds for being optimistic that, with the formal tools of building partial structures with an unfixed node, or paired linked structures, we have the basis for explaining topic and focus effects without having to invoke these concepts themselves as primitives in the explanation.[46] And, as we shall see when we turn to right-periphery phenomena, the same mechanisms of tree growth can be used to rather different effect in characterising the various devices of update in the latter stages of the interpretation process.

[45]See Buering 1997 who argues that it is no more than that which is left over once all expressions which match up with some term in context have been identified.

[46]See Kiaer in preparation for detailed exploration of this view.

# Chapter 4

# On the Right Periphery

## 4.1 Right Dislocation

In previous chapters, we have looked at a range of phenomena in the pre-verbal, or left-peripheral, domain of the clause. In particular, a range of constructions associated with topic and focus effects has been provided with analyses using concepts of unfixed nodes and LINK structures. In this chapter, we explore certain constructions on the less commonly studied right periphery (postverbal) domain. As we shall see, essentially the same concepts of *Adjunction and the building of linked structures used in analysing the left periphery can be used in analyses of right periphery phenomena. The result is a more unitary account of the two peripheral boundaries of the clause than is possible within Minimalism accounts or those based on Kayne (1994)'s antisymmetry thesis. However, as we shall also see, constructions on the left and right peripheries are not fully symmetrical and we will show how the time linear parsing approach of Dynamic Syntax provides an elegant and straightforward way of accounting for these.

We cannot, of course, explore the whole range of right periphery phenomena here. In particular, we do not provide accounts of true afterthought and other elliptical constructions. Such fragments display rather different properties from those generally discussed in this book, as they do not appear on the left periphery (4.1b) and involve a non-monotonic process of re-using processed structure, as illustrated in (4.1a) where only part of the content of the preceding utterance is used to derive *Harry was not having a good time*, not *I was relieved that Harry was not having a good time.*

(4.1) a. I was relieved to see that everyone was having a good time. Except Harry/ But not Harry.

b. *Except Harry/But not Harry. I was relieved to see that everyone was having a good time.

The constructions we do analyse all involve pronominal elements, either explicitly as in *Pronoun Doubling* (4.2) and *Sentential Extraposition* (4.3) or covertly as in *Subject Inversion* (4.4) and (we shall argue) *Right Node Raising* (4.5).

(4.2) a. He talks too fast, the new secretary.

b. *Lo conosco, Giovanni.* [Italian]
Him I know Giovanni.
'I know him, Giovanni.'

(4.3) a. It is surprising that the Principal left so soon.
b. I have proved it to my satisfaction that the analysis is watertight

(4.4) a. *Ha telefonato Beatrice.* [Italian]
has telephoned Beatrice
'Beatrice has telephoned.'

b. *E' arrivato uno studente.*
Is arrived one student.
'A student has arrived.'

(4.5) a. Mary wrote, and I reviewed, several papers on resumptive pronouns.
b. Every overseas student could answer, but most home students couldn't even understand, some questions on formal semantics.

The question of whether the tools of Dynamic Syntax can capture the near, but not perfect, symmetries between right and left periphery effects is a nontrivial one. In movement accounts, the close correspondence between c-command explanations and explanations based on linear order of left-periphery phenomena threatens to break down in addressing those on the right-periphery. The correspondence can only be re-established by positing an array of movment processes and a number of additional projections whose sole motivation is to sustain a c-command analysis in the face of apparent counter-evidence (see Mohanan 1997, Cecchetto 1998, for example). If the DS approach is to be shown to be superior to movement analyses, the theory must be able to account for the common properties of left and right dislocation phenomena in the same terms. It is to a demonstration of the theory's ability to achieve just this that we now turn.[1]

## 4.2 Linked structures and Recapitulation effects

The primary attribute of right-periphery phenomena is that they occur as part of the process of completing the decoration on a tree structure already set; and at this point, the monotonic compositionality of the tree construction process imposes tight constraints on how the tree must be compiled. The concept of wellformedness turns on the availability of a derivation which yields a complete logical form using all the words, with no requirements outstanding. The building of such logical forms involves two phrases: (i) setting out the structure, (ii) compiling up decorations on nonterminal nodes of that structure. We have so far seen how there may be a considerable amount of leeway in lexical actions in what pointer movements from node to node are possible in how such structure is set out. For example, the sequence of actions of a verb allows the pointer to go to some local topnode, add a decoration there of some tense specification and

[1]The discussion and analyses in this chapter are based on Cann et al. (2003a), Cann et al. (2003b) and Cann, Kempson and Otsuka (2003). We are grateful to Masayuki Otsuka and David Swinburne for their help in developing the ideas presented here.

return to the predicate-requiring node, which constituted the point of departure. However, to preserve the monotonicity of accumulating content of the tree, once some structure is set and its terminal nodes decorated in a way that satisfies all their requirements, there must be strict movement of the pointer during the evaluation stage in which rules of completion and evaluation apply to determine how some total tree is successfully decorated. In particular, once some mother node is decorated on the basis of these rules, there can be no return to any of its daughter nodes, as the addition of any further decorations on these nodes would lead to having to modify the decorations on the mother node in the light of any such changes, as this would be incompatible with the monotonicity of the tree growth process, which is the centrepin of the concept of tree growth. We now see this constraint applying in a number of different ways.

The first case we take up in the light of this is a recapitulation effect. All languages permit a pronoun to double some NP on the right periphery of the clause, the effect being a backgrounding of the postposed constituent, sometimes described as a "background topic" (see Herring 1994).

(4.6) a. I think you should realise that it's an impossible topic, right dislocation.

b. He's not very good, that new administrator.

It is even possible in some languages for the right peripheral noun phrase to be an emphatic pronoun, see (4.7).

(4.7) I'm not happy, me.

In these structures, an anaphoric expression is necessarily identified as co-referential with the formula annotating the right-peripheral structure, which is itself optional and definite (4.8). Since it re-identifies the same element identified in the main clause by the pronoun, we may refer to the right peripheral expression as a recapitulation.

(4.8) a. She's a fool, my mother.

b. She's a fool.

c. *She's a fool, my brother.

d. ??She's a fool, a woman I saw yesterday.

This construction may be considered to be the analogue of Hanging Topic constructions on the left periphery. In left-dislocation structures, we postulated the construction of a LINK relation between a node of type $e$, projected for the analysis of an initial noun phrase, and a node requiring type $t$, the main proposition. The recapitulation case is naturally interpreted in DS analogously, but inversely, with a transition from the rootnode of the propositional tree to some following structure requiring type $e$. The term decorating this LINKed tree is required to be identical to some subterm of the just constructed propositional structure, which must itself provide a complete formula of type $t$. We thus have the construction rule in (4.9) which licenses the transition shown in Figure 4.1.[2]

[2]Note the use of the external underspecified modality $\uparrow_*$. This indicates that the node decorated by $Fo(\alpha)$ is dominated by node $Tn(0)$ but at a fixed position.

(4.9)

$$\frac{\{\ldots,\{Tn(0),\ldots Ty(t),Fo(\phi),\ldots,\{\uparrow_* Tn(0),Tn(n),Ty(e),Fo(\alpha)\},\ldots,\Diamond\}\}}{\begin{array}{c}\{\ldots,\{Tn(0),\ldots Ty(t),Fo(\phi),\ldots,\{\uparrow_* Tn(0),Tn(n),Ty(e),Fo(\alpha)\},\ldots\}\ldots\}\\ \{\langle L^{-1}\rangle Tn(n),?Ty(e),?Fo(\alpha),\Diamond\}\end{array}}$$

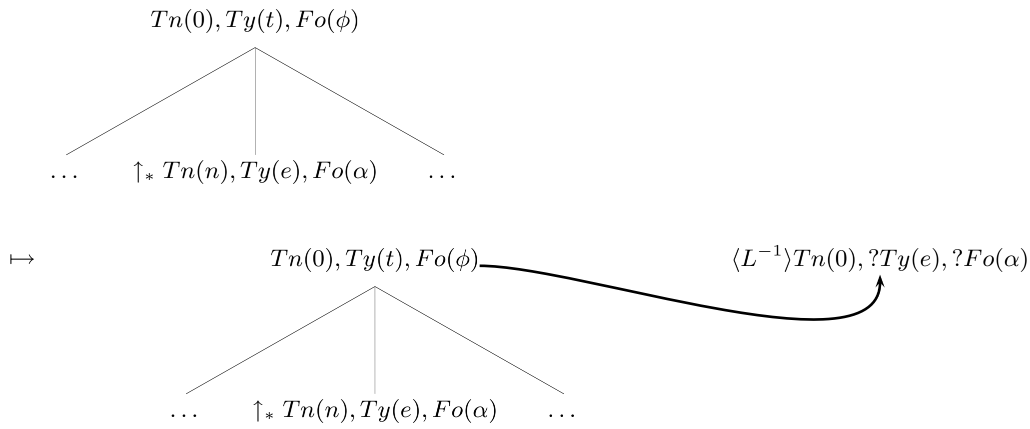



Figure 4.1: Licensing Recapitulation

The fact that this rule projects from a completed tree of type $t$ accounts directly for optionality (4.8b) while the requirement imposed on the LINK structure accounts for co-referentiality (4.8a,c). The restriction of these right dislocated expressions to referring expressions (4.8d) follows from the fact that the pronoun in the preceding clause cannot be truly cataphoric. This is precluded by the constraint that a mother node cannot be completed and eliminated unless both daughters carry no outstanding requirements. Since a pronoun projects a metavariable with its associated formula requirement, the propositional tree cannot be completed until substitution has occurred. It is the assigned value derived from substitution that is carried across as a requirement on the development of the LINKed structure. This can then only be satisfied by some referential term which itself identifies the same value in context (i.e. a proper name or a definite noun phrase). Thus, in parsing (4.2a) *He talks too fast, the new secretary*, the metavariable projected by the pronoun is substituted in context with the term picking out the new secretary, some individual named *Bill*, which is carried across the LINK relation as a requirement to be satisfied by the formula value of the postverbal definite NP.

A bonus for this analysis, in contrast to the problematic apparent violation of principle C which these data pose for binding theory accounts, is the naturalness with which it reflects the fact that a right dislocation structure with this type of construal, like the analogous left dislocation structure, is a root structure phenomenon, unavailable within the confines of an individual tree.[3]

Despite the mirror-image of Hanging Topic Left Dislocation that this analysis presents, there is nevertheless an asymmetry between right and left periphery

[3]The naturalness of this explanation is in sharp contrast to the setting aside of these data by Cechetto 1998 as problematic for all.

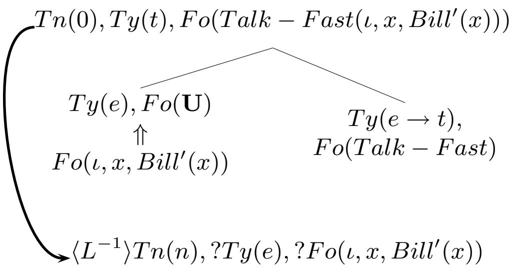



Figure 4.2: Parsing *He talks too fast..* in (4.2a)

effects, which is a consequence of the dynamics of left-right processing. A left peripheral expression that is used to introduce a linked structure projected at the outset (as a topic) cannot rely for its interpretation on any information projected by the following clausal sequence. However the projection of a pronoun within the subsequent clausal string can, indeed must, take the preceding linked structure as its context.

(4.10) *Giovanni$_i$*, *l$_{i/*j}$'apprezzavamo.* [Italian]
Giovanni him, we appreciate
'Giovanni, we appreciate him.'

With a right-peripheral NP 'topic', however, the pronoun in the clausal sequence must be interpreted relative to the context in which it is processed to establish a logical form; and the right-peripheral NP then must be interpreted as referring to the same individual in order to assure that there is a shared term in the two structures. Hence the invariably reported reminder effect in such pronoun doubling structures (see Heyting 1994, Kural 1997). The backgrounding topic effect in this framework emerges as an immediate consequence of the analysis. There is nothing in the process displayed in Figure 5.1 (and the corresponding rule in (4.9)) stopping the right dislocated expression from being a pronoun. Examples can be found at least in dialects of British English, as in (4.11):[4]

(4.11) He's a pain, him.
We don't start teaching next week, us.

In both these cases, acceptability depends on there being inferential effects derivable from the recapitulation of a term through a second pronoun. In (4.11) the effect in context is usually of (potential) contrastive focus. So in (4.11a), the contrast might be with other people who are not pains while the spontaneously produced example in (4.11b) indicated possible contrast with the hearer (i.e. the hearer might be starting teaching in the following week).

[4]The second of these examples was spontaneously uttered by the first author in a telephone conversation with the second

A further consequence of the rule in (4.9) is that it freely allows recapitulation of a full noun phrase within the main clause. Such examples generally, however, show various degrees of unacceptability. Recapitulation of quantified noun phrases is completely unacceptable (4.12a,b) and, without intonational cues, recapitulation of proper nouns is very marginal (4.12c).

(4.12) a. *Most students liked John's lectures, most students.

b. ??A tv presenter visited my garden, a tv presenter.

c. ???Jane likes my book, Jane.

However, independent constraints determine the range of wellformedness effects we find. Recall that quantifying expressions, or rather their accompanying noun, introduce a new variable; and the scope of the constructed term has to be determined in the most local propositional domain. In (4.12a), therefore, the scopes of the quantified expressions in the right peripheral domain cannot be resolved and so the outstanding requirement (to determine a scope relation) ensures the ungrammaticality of these strings. There is a somewhat different effect with indefinites, since in this case, as with names, repetition simply seems to be otiose. As we saw in chapter 4, indefinites can be successively asserted of a given individual, as in apposition structures such as *A friend of mine, a famous opera singer, is coming to stay*, a phenomenon due to the scope-extending properties of indefinites. Thus, despite the double projection of the quantifying expression, such a process would be applicable, licensing a wellformed interpretation of the string: note that (4.12b) becomes fully acceptable if the repeated indefinite is replaced by a distinct indefinite:

(4.13) A TV presenter visited my garden, a well-known garden journalist.

The unacceptability of (4.12b-c) is thus merely due to lack of informativeness, and can, unlike repeated quantifying expressions, be improved by use of contrastive stress, yielding a focus effect, as in (4.14a):[5]

(4.14) a. Harry came to my party, HARRY!

b. A tv presenter visited my garden, a TV presenter.

This is a balancing of parsing effort with added inferential effect that Relevance-theoretic assumptions would lead one to expect. However, this amelioration of the effects of repetition by construing it to be for contrastive purposes is not available with non-indefinite quantifiying expressions, as we would expect:

(4.15) *Most students liked John's lectures, MOST STUDENTS.

## 4.3 Late *Adjunction

Having seen how a right peripheral expression can be analysed using the same LINK analysis as for Hanging Topic constructions at the left periphery, we now

[5]It is notable that in English, such repetitions may occur in such examples as (i)-(ii) with the combination of NP plus auxiliary at the right periphery acting as a backgrounding device:
(i) He's always a pain, he is.
(ii) He always says nice things, Donovan does.
We take up the anaphoric properties of expressions occurring at verbs such as *be* in chapter 8.

turn to an exploration of the applicability of using some form of *Adjunction at a late stage in a parse to analyse some right peripheral expression. It might seem that this could not be motivated in Dynamic Syntax, since the later stages of processing a string do not provide the same sort of underspecification so manifestly provided at the left periphery. Once some structure has been introduced, and all its terminal nodes decorated, it would appear that there could be no node introduced later into the structure whose position was underspecified. Such a view is forced in frameworks which do not allow for left/right asymmetry, yet such a conclusion would be too hasty. Indeed it would entail that left and right periphery processes are radically asymmetric, when it is precisely their symmetry that is more commonly observed (see, e.g., Steedman 2001 for whom the symmetry is definitional). In any case, we have left a margin of flexibility open through the analysis of anaphoric expressions as projecting metavariables as their formula value, leaving a requirement for a fixed formula value yet to be provided. Nothing forces substitution to apply at any point. Like all other rules SUBSTITUTION is optional, and with the provision of a type specification, COMPLETION can apply, and hence the parse process can proceed, leaving that requirement unfilled. Should substitution not have taken place as the pronoun is parsed, however, the pointer will have to return to that node at a later juncture if a successful derivation is to be achieved.

Consider, now, what the parse process involves in general terms. The progressive introduction of structure in a top-down, goal-directed way, introducing either unfixed nodes to be updated or a skeletal propositional structure, to which lexical actions provide further update for terminal and nonterminal nodes. The tree is then evaluated bottom-up by functional application applying only if all requirements on the daughter nodes are satisfied. Pointer movement does no more than reflect incremental development, moving first down the tree driven by computational and lexical actions, and then successively back up it driven by functional application over types to complete the tree. In the closing stages of interpreting a clausal string, once the requisite structure is introduced and all words are parsed, successive steps of evaluation then determine the values of nonterminal nodes on the tree whose value is not yet established.

There is nevertheless a potential role for *Adjunction even at this late stage. Consider the situation in which there is some node in the tree whose characterisation during the construction process has been partial, leaving some unfulfilled requirement. In such a situation, a late application of *Adjunction might be invoked to satisfy the outstanding requirement through Merge. This would be the case, for example, if a metavariable failed to get a fixed value through substitution from the context (all rules being optional). In such circumstances, while the node decorated by the metavariable is type-complete, it is still formula incomplete and there remains an outstanding requirement. Satisfying a type requirement allows the pointer to move on in the construction process, but the open formula requirement causes a problem in the tree evaluation process, as the mother node cannot be evaluated. Steps must therefore be taken to allow this requirement to be met in order to allow the tree to be completed. To accomplish this the pointer must be able to move back down to the relevant daughter node in order to further specify it. In such a situation, we have a scenario in which late application of *Adjunction can lead to a successful update of the tree, by creating an unfixed node whose formula annotations will provide the satisfaction of the oustanding requirement through the merge process.

In order to make this type of analysis more concrete we will explore a number of constructions in which the hypothetical situation sketched above occurs: a metavariable is projected by some pronominal element (overt or covert) but its content is only identified at some later stage of the parse.

### 4.3.1 Extraposition

We begin by looking at a construction in English which may not be obviously associated with the right periphery, but which involves a pronoun that allows a contentive expression to appear post-verbally: sentence extraposition. In this construction, the subject argument of a predicate is propositional and so we find clausal strings appearing pre-verbally as syntactic subject (4.16a). We also find the clausal expression in post-verbal position just in case there is an expletive pronoun before the verb (4.16b).

(4.16) a. That I am wrong is possible (but not likely).
b. It's possible that I am wrong (but it's not likely).

The pronoun *it* in (4.16b) is not 'referential', taking its value from the context in which the string is uttered, but expletive in that it takes its content from the postverbal expression.

In nonpro-drop languages such as the Germanic languages, lexicalised expletives are essential in this position. Without them, the parsing sequence breaks down and cannot proceed because the verb does not decorate its subject position with a metavariable, unlike Japanese (Chapter 6) and some of the Romance languages (see below). Thus, the string in (4.17) is simply unparsable as the pointer cannot move on from the subject node without lexical input.

(4.17) *Is likely that I am confused.

The function of an expletive use of a pronoun, accordingly, is to keep the parsing process alive: it first provides a metavariable as an interim value to some type requirement associated with one node and then moves the pointer on to another node. Because the pointer is moved on as part of the actions determined by parsing the expletive pronoun, no substitution can take place and an open formula requirement necessarily remains on the node decorated by the metavariable.

The (provisional) definition of these actions are shown in (4.18) which assumes that $Ty(t)$ can decorate a subject node, and that certain predicates project a formula of type $t \rightarrow t$.[6] Note the extra condition, $\langle\uparrow\rangle\bot$, which checks whether the current node is the topnode in a tree and aborts the parse if it is, thus preventing *it* from being the sole expression in a sentence.

(4.18) *It*

| | | |
|---|---|---|
| IF | $?Ty(t)$ | |
| THEN | IF | $\langle\uparrow\rangle\bot$ |
| | THEN | ABORT |
| | ELSE | $\mathtt{put}(Fo(\mathbf{U}), Ty(t), ?\exists x Fo(x))$, |
| | | $\mathtt{go}(\langle\uparrow_0\rangle\langle\downarrow_1\rangle)$ |
| ELSE | ABORT | |

[6] Noting the possibility of (i)-(ii), we do not provide any tense restriction on the propositional tree to be constructed in subject position:
(i) It's nice being drunk.
(ii) It would be nice to be drunk.

The effect of these lexical actions is to license the transition in Figure 4.3.

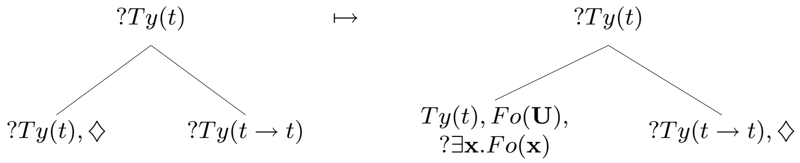



Figure 4.3: Parsing *it*

Once the predicate node is decorated, the pointer moves to the mother node in order to complete the propositional type requirement. However, because the subject node still carries an unsatisfied formula requirement no evaluation can proceed; and the pointer must move back down to the subject daughter in order to complete the requirements on this node. Since the node is type-complete, however, it looks as if the parse is doomed to failure. But it is at this point that a variant of *Adjunction, which we dub "Late *Adjunction", can apply to provide an open type requirement allowing the parse of new material to take place.

Unlike the versions of *Adjunction discussed in earlier chapters, Late *Adjunction projects an unfixed node with a requirement for the same type as the node from it is projected. Since no further direct development of the fixed node is possible, this version of *Adjunction thus defines directly the structural context to which Merge applies, i.e. the unfixed node and the fixed node from which it is projected. We define this rule in (4.19) and show the effects from some arbitrary node in Figure 4.4.[7]

(4.19) *Late*Adjunction*

$$\frac{\{Tn(n), \ldots, \{\uparrow_* Tn(n), Tn(a), \ldots, Ty(X), \Diamond\}, \ldots\}}{\{Tn(n), \ldots, \{\uparrow_* Tn(n), Tn(a), \ldots, Ty(X)\}, \quad \{\langle\uparrow_*\rangle Tn(a), ?Ty(X), \Diamond\}, \ldots\}}$$

This is the only form the rule could take, on the assumption that downward unfolding rules have provided a complete skeletal propositional structure; as it is only a development of one of these already introduced nodes which remains to be completed.

Applying Late*Adjunction to the subject node in a parse of *It is possible* yields the configuration in Figure 4.5.[8] This permits the parse of the post-verbal string and the completion of the unfixed propositional tree immediately feeds an application of Merge, as shown in Figure 4.6, which yields a complete subject node and a final formula value $Fo(Possible(Wrong(Ronnie)))$ as desired.

This analysis has the bonus of providing a much tighter restriction on late applications of adjunction characteristic of all rightward dependencies, encapsulating the Right Roof Constraint.[9] The application of Late*Adjunction can

[7]Note the use of the dominance relation $\uparrow_*$. This is the external 'dominated by' relation which refers to fixed mother-daughter relations. Hence, the node from which the unfixed node is projected must itself be fixed.

[8]Ignoring the contribution of the copula, including tense. See Chapter 8.

[9]The term is due to Ross 1967, who first observed the phenomenon. As we shall see, Right Node Raising, though an apparent exception to the Right Roof Constraint, in the event, is subject to it also.

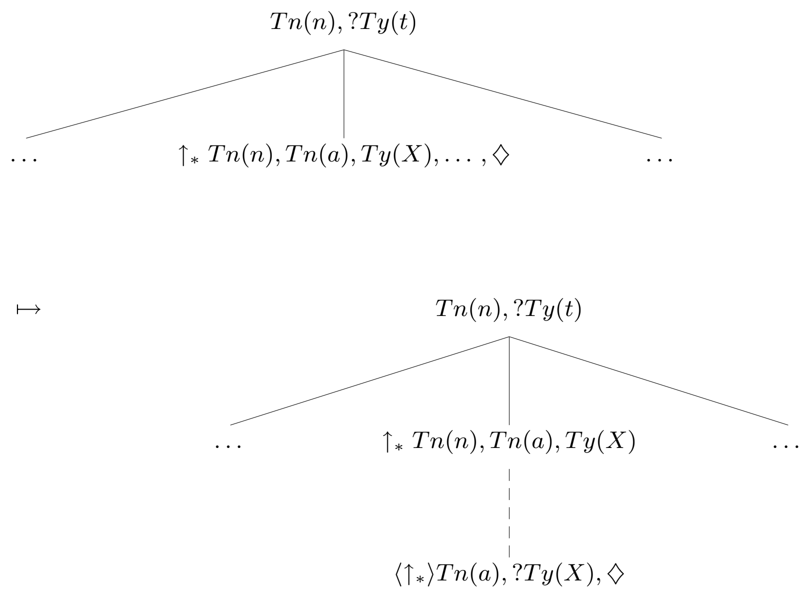



Figure 4.4: Late*Adjunction

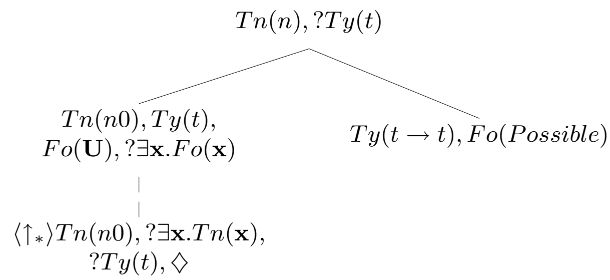



Figure 4.5: Parsing *It is possible*

only arise in a context in which one of two daughter nodes lacks a Formula value, so no successful annotation of the mother node is as yet possible. The string (4.20a) will never emerge as wellformed, as the projection of an annotation for the embedded subject cannot be successfully achieved without some later addition of a node providing the necessary update for the metavariable projected by the expletive pronoun *it*. (4.20b), on the other hand, is fully wellformed, precisely because such a value is provided prior to the construction of the main predicate.

(4.20) a. *That it is certain is unfortunate that I am wrong.

b. That it is certain that I am wrong is unfortunate.

Note further that the effect of parsing the expletive pronoun in moving the pointer straight to a sister node means that examples like (4.21a) are precluded, given the lexical definition of the expletive. The predicate must be established

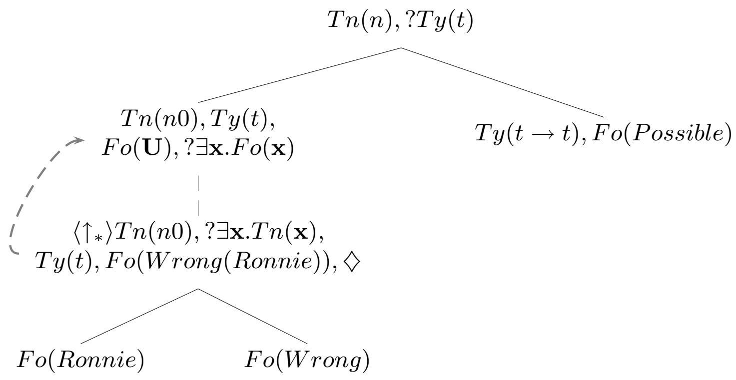



Figure 4.6: Parsing *It is possible that I am wrong*

before the pointer can return to the subject node.[10] At the same time, left dislocation of a clause is awkward, if not ungrammatical, in the presence of the expletive (4.21b). Here, the fixing of the adjoined tree should occur as soon as the pointer is on the subject node (see chapter 2) which prevents the parsing of the expletive.

(4.21) a. *It that I'm wrong is possible.

b. ??That I am wrong, it is possible.

An important thing to notice at this point is that for Merge to successfully take place in Figure 4.6 the node decorated by the expletive pronoun must not project a terminal-node restriction, $[\downarrow]\bot$. This is because any node initially decorated by a pronoun whose final formula value is only successfully provided by a step of Late*Adjunction and subsequent Merge will, in the end result, be a nonterminal node. Indeed, we take the lack of this restriction to be a definitive property of expletive expressions of all kinds. Despite the fact that Late*Adjunction and subsequent Merge only lead to a successful outcome if the formula which decorates the node which is input to Late*Adjunction contains a metavariable, no special provision needs to be made to reflect this. This is a consequence of the fact that conflicting formula values on a single node lead to ill-formedness, unless one of those values is a metavariable. Hence, the restriction follows without stipulation from the definition of well-formedness for a node.

We return to a further discussion of expletive expressions in English in Chapter 8, but for now what we have established is that the analysis of expletive pronouns may require a late application of *Adjunction to determine their content.

### 4.3.2 Subject Inversion

Certain languages do not use lexical expletive pronouns in cases of extraposition and such languages also do not require overt referential subject pronouns, either,

[10] As a lexical restriction, however, this might be subject to cross-linguistic variation; and Oystein Nilssen reports to us that the analogue of (4.20a) is well-formed in Norwegian.

as illustrated in the Italian examples in (4.22).

(4.22) a. *Sembra che Giovanni ha telefonato Maria.*
seems that Giovanni has phoned Maria
It seems that Giovanni phoned Maria.

b. *Ha telefonato Maria.*
has phoned Maria
S/he phoned Maria.

Such subject pro-drop languages also permit the inversion of a subject to the end of the clause (in simple clauses) as exemplified by the examples in (4.4) repeated below.

(4.4) a. *Ha telefonato Beatrice.* [Italian]
has telephoned Beatrice
'Beatrice has telephoned.'

b. *E' arrivato uno studente.*
Is arrived one student.
'A student has arrived.'

Given that an overt subject expression is optional in Italian and similar languages, parsing the verb must construct a subject node which is decorated by a metavariable, exactly as though a pronoun were present. This is unlike English where subject nodes are constructed by general transition rules and are initially decorated only with a type requirement. It is, furthermore, unlike Japanese in that it is only the subject node which the verb annotates with a metavariable: non-subject argument nodes are specified as open type requirement, as in English. Recall from chapter 2 that a finite verb form like *parla* 's/he speaks' (transitive) is associated with a set of actions like those in in (4.23) (ignoring tense and agreement information).

(4.23) *parla*

| | |
|---|---|
| IF | $?Ty(t)$ |
| THEN | $\mathtt{make}(\langle\downarrow_0\rangle), \mathtt{go}(\langle\downarrow_0\rangle), \mathtt{put}(Ty(e), Fo(\mathbf{U}), ?\exists\mathbf{x}.Fo(\mathbf{x}))$ |
| | $\mathtt{go}(\langle\uparrow_0\rangle), \mathtt{make}(\langle\downarrow_1\rangle), \mathtt{go}(\langle\downarrow_1\rangle), \mathtt{put}(?Ty(e \to t))$ |
| | $\mathtt{make}(\langle\downarrow_1\rangle), \mathtt{go}(\langle\downarrow_1\rangle), \mathtt{put}(Ty(e \to e \to t), Fo(Parl), [\downarrow]\bot)$ |
| | $\mathtt{go}(\langle\uparrow_1\rangle), \mathtt{make}(\langle\downarrow_0\rangle), \mathtt{go}(\langle\downarrow_0\rangle), \mathtt{put}(?Ty(e))$ |
| ELSE | ABORT |

The effect of this macro of actions triggered by processing the verb is that the pointer will not return to the subject node until the entire verb-phrase sequence has been processed, as illustrated in Figure 4.7.

At this point, substitution could occur from context[11] or Late*Adjunction may be used to further develop the node within the string. The effect of this is shown by the structure derived from the parse of *Parla inglese Giovanni* 'Giovanni speaks English' in Figure 4.8.

[11] As it may with expletive *it*:
(i) Kim thinks that the Vice Principal is insane. It's possible.

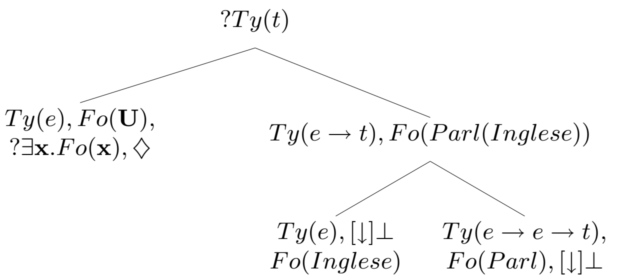



Figure 4.7: Parsing *Parla inglese*

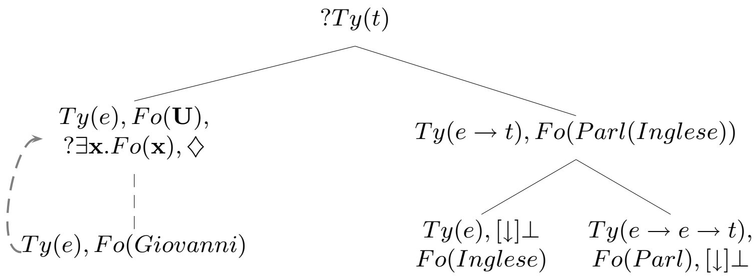



Figure 4.8: Parsing *Parla inglese Giovanni*

### 4.3.3 Clitics in Porteno Spanish

This account of pro drop structures, and expletive pronouns, as decorating nodes with metavariables, but without a bottom restriction, gets confirmation from the fact that a natural explanation of the clitic doubling puzzle of (Porteno) Spanish datives at the right periphery emerges from the analysis. In Porteno Spanish, as in other dialects, full NPs in postverbal position can be doubled by a preverbal clitic (4.24).

(4.24) a. *(Les) ofrecieron queso y leche a familias de pocos medios.*
to them offer$_{3pl}$ cheese and milk to families of small means
'They offered cheese and milk to low-income families.'

b. *(La) oian a Paca.*
Her listen$_{3pl}$ to Paca
'They listened to Paca.'

As Suñer (1988) observes, this clitic doubling in Porteno Spanish affects accusative and dative pronouns, but not in the same way. The optional doubling by a clitic of some following full dative-marked NP imposes no restriction on the NP in question (notice the nonspecific construal of the right-peripheral NP in (4.24a)). Doubling of an accusative noun phrase, on the other hand, imposes a restriction on the right peripheral NP, that it be restricted to a referential construal.

We have already seen in chapter 3 that there is reason to analyse the Spanish dative clitic as having lost its bottom restriction, in this sense becoming expletive. This analysis now comes into its own, as it leads us to expect these facts. In this chapter we have seen that a pronoun may be interpreted as indexical with a following NP interpreted as coreferential with that contextually assigned value, a distribution we have analysed as involving a LINK relation between two structures, the second decorated with a node of of type $e$. In English, because pronouns retain their bottom restriction, they can only be recapitulated by referential noun phrases through the construction of a such structure, and the Spanish accusative clitic too. And because this is a domain in which quantified NPs cannot be used to provide a wellformed result, only definite NPS are acceptable here.

The dative clitic, on the other hand, is not so restricted and can double a quantified noun phrase. Under such a use, the right peripheral noun phrase could not be analysed in terms of a LINK projection. Instead, to accommodate doubling of a quantified expression with a clitic, the clitic needs to be analysed as able to be updated by some unfixed node derived through application of Late *Adjunction. Schematically, the situations with respect to the two clitics are shown in figures 4.9 and 4.10 which relate to the parsing of the sentences in (4.24b) and (4.24a), respectively.[12]

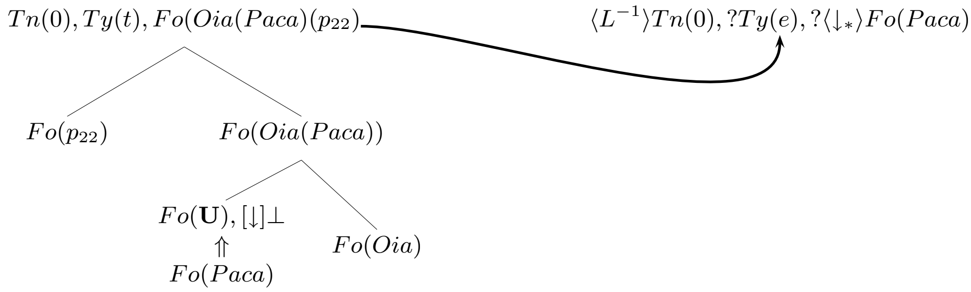



Figure 4.9: Parsing the accusative clitic

The co-occurrence of the dative pronoun with a subsequent quantified expression is expected: once *Adjunction and Merge have taken place, the introduced quantified term will be able to enter a scope statement into the set of scope statements associated with interpreting the resulting logical form in a completely regular way.

There is a further puzzling fact concerning the Porteno Spanish clitics: when a strong pronoun is used instead of a full form of NP, clitic doubling becomes obligatory, as shown by the dative examples in (4.25) and the accusative ones in 4.27).

(4.25) *Le* *hablaron* *a* *ella.*
to her spoke$_{3pl.}$ to her
'They spoke to her'.

(4.26) *Hablaron* *a* *ella.*
spoke$_{3pl.}$ to her

[12] $p_{22}$ is some arbitrary constant picking out an individual identified from a term in context..

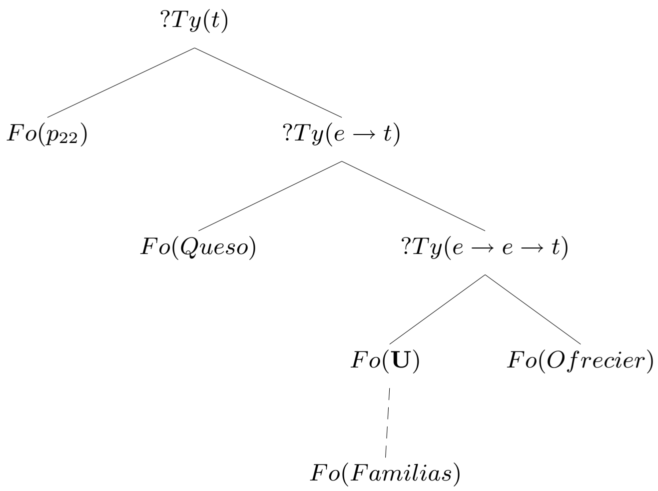



Figure 4.10: Parsing the dative clitic in the presence of a quantifying expression

'They spoke to her'

(4.27) *La llamaron a ella.*
her $call_{3pl.}$ her
' They called her'

(4.28) **Llamaron a ella.*
$call_{3pl}$ her ]
'They called her'

These data may seem bizarre as they show that the weak clitics may appear without the buttressing effect of a pronoun or full noun phrase, while the strong pronouns need the help of a clitic when they appear in the apparently normal postverbal position. However, there is an alternative way of looking at these data. Suppose we assume that it is not full pronouns or noun phrases which provide the decoration of the fixed argument nodes in tree structures, as we find in English, but clitics. Clitics in Spanish we have defined as decorating the requisite predicate-internal argument node, doing so from a preverbal position by lexically defining the introduction and decoration of a (locally) unfixed node that merges with the argument node provided by the actions of the verb.[13] This will have the effect of ensuring no regular noun phrase occurs in that string position, as such a node will be introduced only by the lexical actions particular to these clitics. All we have to stipulate of the strong pronouns, then, is that they are restricted to decorating nodes in a tree structure that are in some sense non-canonical (i.e. either at a node LINKed to the primary structure or at an

[13]We do not provide an account of the requisite actions here. As we shall see in chapter 6, there is evidence of a localised variant of *Adjunction which in Latin, as in Japanese, applied freely for all noun phrases including the demonstratives *ipsa*, *ille*, from which the clitics are known to have derived. The action defined by the clitics is arguably a calcified reflex of what was a general process in the language from which these structures have evolved.

unfixed node within it). This is ensured by the set of actions in (4.29), because the trigger $\uparrow \top$ that induces the abort action holds of any *fixed* node within a tree except for the topnode, by virtue of the external modality (referring only to determinate tree positions) and the supremum which is true of any decorated node.[14]

| | | | | |
|---|---|---|---|---|
| (4.29) *ella* | IF | $?Ty(e)$ | | |
| | THEN | IF | $\uparrow \top$ | |
| | | THEN | ABORT | |
| | | ELSE | $\mathtt{put}(Fo(\mathbf{U}), Ty(e), ?\exists x Fo(x))$ | |
| | ELSE | ABORT | | |

Accusative and dative clitic doubling with strong pronouns thus turns out to be obligatory because Spanish is only subject (and not object) pro-drop. Hence, by virtue of the actions in (4.29), the strong pronoun (in the dialects which display such obligatory doubling) never decorates the fixed argument position in the emergent tree directly and relies on the clitic to do so.

The restriction of strong pronouns to unfixed nodes and LINKed structures as encoded in the lexical characterisation of *ella* is a stipulation; but this is nothing more than a codification of their exceptional pragmatic properties (conveying more than just the anaphoric construal conveyed by the clitic form of pronoun, such as focus or background topic effects). It is thus a direct reflex of its communicativve function, encoded as a particular, distinct form of anaphoric expression.

We have now seen that the concepts of formula underspecification, LINKed structures and positional underspecification do operate in the analysis of right peripheral effects, as well as those on the left. They allow analyses to be given of apparently quite disparate constructions such as pronoun doubling, sentence extraposition, subject postposing and clitic doubling. The fact that the same concepts apply to both the left and right peripheries provide striking support for the form of grammar proposed in this book, while the time-linearity of the parsing process accounts nicely for observed asymmetries between the two peripheries. A particular bonus is the explanation of the Right Roof Constraint as a consequence of compositionality of the tree growth process: in other frameworks, this restriction remains a mystery - able to be expressed by some form of stipulation, but not subject to a principled explanation.

## 4.4 Summary.

In this chapter, we have provided an account of a number of right peripheral constructions, largely focussing on English data. Pronoun Doubling (Recapitulation) constructions have been analyzed as involving a LINK transition from a completed $Ty(t)$ to a type $e$ tree, an analysis of which the backgrounding topic construal is a consequence. *It* Extraposition and Subject Inversion have been analyzed in terms of a right unfixed node whose resulting formula replaces the metavariable projected by the subject anaphoric expression, and the obligatory

[14] We ignore the gender specification here and the prepositional marker *a* which we assume to be a kind of case-marker that does not project its own structure.

clitic doubling of Spanish has been analyzed in terms of the potential availability of both LINK transitions and the late construction of an unfixed node. Finally, Right Node Raising has been modelled using a combination of building LINKed structures and unfixed nodes.

Almost all these data are intransigent for most frameworks. Rightward movement in Kayne-style accounts has been modelled as involving Topic and Focus projections below the VP projection, in addition to the higher Topic and Focus projections, an account which is little more than a description of the data with a great deal of movement machinery. Right Node Raising has long been recognized as problematic for movement explanations, as, more recently, has the particular restrictions on Porteno Spanish. Pronoun Doubling, with its requirement of coreference is often, simply, set aside. So far as we know, no current analyses of these data can offer principled explanations of the various asymmetries set out, in Right Node Raising, and elsewhere. In Dynamic Syntax terms however, the systematic variation between left- and right-periphery effects, and the asymmetries in Right Node Raising in particular, can be naturally expressed; and, as a bonus, the analyses offered, in each case, reflect functional explanations of the data.

# Chapter 5

# General Perspectives

## 5.1 Well-formedness in a Non-encapsulated System

A major difference between this and other systems is that the system is not encapsulated: at any point, there may be interaction with context-relative processes such as substitution which are defined over terms in the context, hence ranging over more than the constructs which the construction process itself provides. With the formal recognition of the wide-spread nature of this interaction, we need now to be more precise about what it means to have defined grammar-internal operations that interact with context-dependent processes that are in some sense external to the grammar formalism, and how a concept of well-formedness can be defined, despite the lack of encapsulation. As a preliminary to this, we need to be more explicit about the concept of context itself.

### 5.1.1 Defining Context

Recapitulating what we have been presuming throughout the book, the context, to put it at its most neutral, constitutes the point of departure for whatever is the current task. Given our Fodorian stance of a language of thought ($\mathcal{LOT}$), here the epsilon calculus,[1] this point of departure is some formula or formulae of the epsilon calculus. Since any such representation of content can be represented in a tree format, we say that a context is made up of a sequence of labelled trees, including, minimally, the (partial) tree which constitutes the input to the task to hand. Even at the beginning of a parsing task, then, the context will consist of some non-empty sequence of labelled trees. So we might provisionally say:
$C = \langle T_1, ....T_n, T\rangle$ where each of $T_1....T_n$ is an arbitrary, complete, propositional tree, and $T$ is some partial pointed tree under construction. An important property of this characterisation is that the concept of context itself is language-general. The context is solely made up of $\mathcal{LOT}$ objects, and not natural-language expressions. It does NOT comprise strings, prosodies, or anything external to the interlocutor. However we do not impose a type restriction; so these context trees may at least range over trees decorated at their rootnode with type $t$, $e$, $(e \rightarrow t)$, or $(e \rightarrow (e \rightarrow t))$ formulae.

[1]To keep things simple, we have assumed a single $\mathcal{LOT}$.

This concept, ranging over both information that may be independent of the immediate parsing task and information constructed during the parse task, is sufficient to cover the concept of context required for the major types of pronoun resolution. For example, it covers both intra-sentential and inter-sentential anaphora, because both the partial tree under construction and the structure obtained by parsing the previous utterance can be taken as part of the context on which the string under construal is interpreted:[2]

(5.1) John said he was upset.

(5.2) John left. He was upset.

It applies equally to linked structures, where the tree may not be of type $t$, but of type $e$:[3]

(5.3) As for John, he was upset.

(5.4) If John left, he was upset.

It will apply in the projection of such linked structures, irrespective of whether the propositional structure is processed first, or subsequently. In either case, it is that which is processed first which constitutes the context for the building of the LINK transition and the construction of the copy. This was the basis of the account of Japanese head-internal relatives:

(5.5) *John-ga* *sanko-no* *ringo-o* *muita-no-o* *tabeta.*
John$_{NOM}$ three$_{GEN}$ apple$_{ACC}$ peeled$_{NOMIN,ACC}$ ate
'John ate the three apples which he peeled.'

It was also the basis of the account of right-dislocation effects such as:

(5.6) She talks too fast, that woman from Islington.

It covers intra-sentential and inter-sentential anaphora for quantified expressions, with the terms under construction freely able to act as terms to be substituted by the anaphoric process, as long as a scope statement has been entered into the structure, so that the construction of the term itself is complete (see chapter 3):

(5.7) A man left. He was upset.

(5.8) Two men left. They were upset.

(5.9) Every parrot sang a song, which it didn't understand.

[2]In principle, the characterisation is neutral enough to allow for system-external inferences, given that any expression of the language of inference can be expressed as a tree. It is wellknown that there is a feeding relation from general steps of inference onto tree structures, since anaphora resolution may involved bridging cross-reference effects:
(i) I fainted outside the hospital. They operated rightaway.
(ii) The wedding pair looked miserable. He had just come from a hospital appointment, and she had been fretting that he would be late.
However, at the current stage of development, there are no mechanisms for expressing these, as the feeding relation necessary between decorations on tree-nodes, general forms of inference, and the process of tree growth, remains to be defined.

[3]See Gregoromichelaki in preparation, where an account of conditionals is developed in which the antecedent of a conditional is taken to project a linked structure providing the restriction on a world variable.

With the characterisation of context as a SEQUENCE of possibly partial trees, it might appear that there is a left-right asymmetry in context construction, which would not apply to cases where the context may not literally always be on the left of update being carried out, as in cases of Right-Node Raising:

(5.10) John ignored, but Bill consoled, the woman from Birmingham.

In these, what is imposed as a requirement on the development of the second structure is a copy of the metavariable used to decorate a node in the first structure, itself not yet completed. With the right-peripheral expression then decorating an unfixed node that provides a value for that copy of the metavariable in the second structure, enabling it to be completed, the second structure happens to be completed before the first structure is completed. Despite this, the concept of context remains time-linear, remaining that of a sequence of trees minimally including the tree resulting from the task just completed.

There is however one type of anaphora resolution which is not so far covered by our concept of context – the "sloppy" uses of pronouns (see Karttunen 1980). This case requires an extension to include an online lexicon, which, anticipating the discussion of dialogue, we might call the "dialogue lexicon".

(5.11) John keeps his receipts very systematically, but Tom just throws them into a drawer.

For these sloppy uses of pronouns, the pronoun is interpreted as having as antecedent some term which carries the information that it itself contains an metavariable. The value assigned to the pronoun in parsing the second conjunct then determines that the copied metavariable is then fixed relative to the context of interpreting that second conjunct. What we need to be able to recover to express this form of context is the lexical actions that the first pronoun induces, and not simply the resulting value assigned to it in the parsing of that first conjunct. In fact, in (5.11), we shall need the sequence of actions given by *his* followed by those given by *receipts*. But we have not so far allowed reference to lexical actions as part of the context.

While a lot more needs to be said about such an extension, we nevertheless take this preliminary consideration as indicative that the concept of context for the purposes of the construction process has not only to contain sequences of representations of content, but also sequences of actions, as implemented in the parsing process. This however doesn't disturb the concept of context as needing to be defined over $\mathcal{LOT}$ constructs, for these actions are all defined as updates in a tree-growth process. Context, as now revised, is a record of what information has been constructed to date, and how it has been presented.

### 5.1.2 Context and Wellformedness

In returning now to the relationship between context and the operations of the grammar, we are envisaging the grammar formalism as a set of constraints on tree development, a process that takes place relative to context.[4] As just set out, this is some sequence of (partial) trees and, for at least some concepts of context, a sequence of lexically provided macros of tree-update actions.

[4]This section involved extensive discussion with Matthew Purver, which led to implementation of a fully context-dependent system (as part of ESRC grant 00xx). See Purver and Kempson 2004 for a report of these results.

#### 5.1.2.1 Substrings of a language

Preliminary to exploring the relationship between context and wellformedness, it is important to note that the grammar formalism itself provides a basis for determining what are licensed SUB-strings of the language, quite independent of any utterance context. All licensed strings are updates from one partial tree to another, using computational, lexical and pragmatic actions following the sequence of words. So (5.12)-(5.14) are wellformed bits of English, albeit essentially incomplete:

(5.12) is a man

(5.13) Wendy is thinking of

(5.14) reviewing a chapter on those

These strings all provide mappings from some appropriately defined partial tree to an output partial tree; and the sequence of words provides the appropriate lexical update actions that make such a tree update process possible. So, relative to some partial tree as context, they can contribute as a sub-part of a wellformed sequence of words. This characterisation of a wellformed sub-string already distinguishes these from impossible strings:

(5.15) Man the died.

(5.16) Died man.

(5.17) is the often man.

In (5.15), computational actions of the system do not provide the appropriate trigger for parsing *man*; and the lexical actions induced by the parsing of *man* do not provide as output the appropriate node specification for parsing of *the*. So there is no partial tree with a pointer at an appropriate node to provide appropriate input for the parsing of *died*. A similar basis underpins the lack of wellformedness of (5.16)-(5.17). No general discourse-based concept of context is needed to distinguish such strings such as (5.15)-(5.17) from (5.12)-(5.14): all that is required is the mapping from one partial tree to another.

#### 5.1.2.2 Utterance Wellformedness

The next step is to define what it means to be a wellformed OUTPUT of the grammar formalism itself. What we take to be a complete parsing process using a natural-language grammar is the use of a sequence of words to construct a propositional form of type $t$. These have a special status in the larger general cognitive system as, with inference as a core activity of that containing system, it is well-formed formulae which must be constructed in order to feed appropriate inference actions, necessary for the retrieving of information. The required output we have so far defined is a tree with a rootnode decorated with a propositional formula of type $t$, without requirements on any node (see also Kempson et al 2001). An uttered string is, then, wellformed if there is a mapping defined over the sequence of words such that a COMPLETE tree representing a propositional formula of type $t$ is derivable using computational, lexical and pragmatic actions, with no requirements outstanding on any node. To tighten up this constraint of no requirements, we have sought to retain a strict reflection of compositionality in the application of Elimination. This is subject to the constraint that no mother node can have *Formula* decorations attributed at that node unless all requirements on the daughter nodes are complete.

#### 5.1.2.3 Wellformedness and dependence on fixed contexts

This strict interpretation of the relationship between requirements and wellformedness is a reasonable point of departure, but it is under-informative, in that it fails to express any concept of context-dependence. We now wish to explore what it means to say of a string that it is wellformed with respect to some contexts, but not others; and we get there by defining wellformedness with respect to some fixed context and then generalising.

As it turns out, the only objects that we can properly describe in terms of grammaticality in the generative sense are the representation trees that are the output of the parsing process, the expressions of the epsilon calculus as our language of thought ($\mathcal{LOT}$). These constitute a language which is fully describable given the set of construction rules, conditions on declarative units, and some lexicon acting as a filter on output. A formal definition of this language can be stated without reference to context or anything external to the cognitive system. This is as we would expect, as all underspecification is resolved during the construction process, and a tree all of whose nodes are decorated with such *LOT* formulae has no requirements outstanding.

For wellformedness of natural-language strings on the other hand - here illustrated by English - we might start by defining well-formedness as before, except that this time there is reference to a context $\mathcal{C}$. Wellformedness is defined in terms of a mapping from the string AND SOME CONTEXT to some well-formed representation tree in the *LOT* language such that no outstanding requirements remain:

A string $\phi$ is well-formed in language $\alpha$ if and only if in context $\mathcal{C}$ there is a parse $\mathcal{P}$ such that $\mathcal{P}(\mathcal{C}, \phi) = \mathcal{T}$ where $\mathcal{T}$ is a well-formed tree in $LOT_\alpha$ that has no outstanding requirements, and $LOT_\alpha$ is the *LOT*-language of language $\alpha$ (i.e. with predicates standing in one to one correspondence with $\alpha$).[5]

This concept of wellformedness preserves the unification of the concept of anaphora. Consider the sentences in (5.18)-(5.19) as a sequence:

(5.18) John came in.

(5.19) He sat down.

The well-formedness of each of these strings can be established as follows. We begin with a null context (an impossibility but a simplifying assumption) and derive the context $\{\mathcal{T}_1\}$ consisting solely of the tree derived from parsing the string in (5.18). This forms the input context to the parsing of (5.19):[6]

(5.20) $\{\mathcal{T}_1\} \mapsto \{\mathcal{T}_1, \mathcal{T}_{?\mathrm{Ty(t)}}\} \mapsto \{\mathcal{T}_1, \mathcal{T}_{\mathrm{he}}\}$

[5]This is a simplification, given the construction of ad-hoc context-dependent concepts, as already noted, but we leave this on one side (see Carston 2002).

[6]$\mathcal{T}_\mathcal{X}$ is a diagrammatic shorthand for a partial pointed tree, where $X$ indicates how far the parse has proceeded through the string from which $\mathcal{T}$ is being constructed.

Substitution operates to replace the metavariable projected by the pronoun from *this* context to give: $\{\mathcal{T}_1, \mathcal{T}_{\text{John}}\}$. Parsing the rest of string derives the context $\{\mathcal{T}_1, \mathcal{T}_2\}$ in which both trees are complete and so (5.19) can be considered well-formed relative to having parsed (5.18).

For a text like (5.21,5.22) in which the anaphor identifies its substituend internally, the reasoning goes analogously.

(5.21) I saw John yesterday.

(5.22) Janet thinks she's pregnant.

We begin with the null context again and progressively induce some context $\{\mathcal{T}_3\}$ through the parse of the string in (5.21). We then progress through the parse of the second string incrementally building up the context: $\{\mathcal{T}_3, \mathcal{T}_{\text{Janet thinks she}}\}$. At this point the only suitable substituend is derived internally to the current tree being developed to give $\{\mathcal{T}_1, \mathcal{T}_{\text{Janet thinks Janet}}\}$. The rest of the string is parsed to give a context $\{\mathcal{T}_1, \mathcal{T}_4\}$ in which both trees are complete. (5.21) is thus well-formed as a string. Notice that for this characterisation of wellformedness to hold, the string must be complete, and a fully specified interpretation assigned; hence at the juncture of its evaluation, the tree $\mathcal{T}$ which constitutes its interpretation is itself part of the derived context.

It is important at this juncture to bear in mind that we aren't really here dealing with *strings* but *utterances.* Utterances being concrete things (spoken or written tokens) necessarily appear in a context - a context that is updated continually as the utterance progresses (since the act of uttering some string necessarily changes the context). From the hearer's perspective, therefore, the incremental parse of an utterance incrementally updates the context within which the utterance is interpreted. The output tree of the parse of an uttered string must then be part of the context with respect to which the well-formedness of that utterance is evaluated. This is essential to preserve the dynamic spirit of the parsing underpinnings which the system provides, and the unitary concept of anaphora.

#### 5.1.2.4 Wellformedness with respect to arbitrary context

Making explicit the fact that the utterance itself is a function from context to context, we now define a concept of wellformedness which makes reference to both the input and the output of such a composite update process: a string constitutes a well-formed utterance if it licenses a transition from one (tree-complete) context to another.

(5.23) A string $\phi$ of language $\mathcal{L}$ is well-formed just in case:

$$\mathcal{C} \ \overrightarrow{\phi}_{\mathcal{L},\mathcal{C},\mathcal{P}} \ \mathcal{C}' \cup \mathcal{T}_\phi$$

where $\mathcal{C}, \mathcal{C}'$ are tree-complete contexts[7]; $\overrightarrow{\phi}$ is the transition from $\mathcal{C}$ to $\mathcal{C}' \cup \mathcal{T}_\phi$ licensed by a parse of $\phi$ using computational, lexical and pragmatic actions of $\mathcal{L}$; and $\mathcal{T}_\phi$ is complete.

In other words, a string is well-formed just in case the parsing of it using rules of the system gives rise to a (tree-complete) update as the output context.

[7] I.e. a sets of trees, $\mathcal{T}$, such that $\forall \mathcal{T} \in \mathcal{C}$, $\mathcal{T}$ is complete.

On this characterisation we would not be saying that *she is pregnant* is a wellformed utterance relative to the context provided by the parsing of the incomplete sentence *Jane thinks that*, even though the parsing of this substring provides the context structure whereby the metavariable provided by *she* is identified, for *she is pregnant* is a substring of *Jane thinks that she is pregnant*. Wellformedness of complete strings is a property of utterances relative to a particular kind of context - where the trees are complete. This restriction to complete trees correctly yields the result that right-node raising conjuncts cannot be uttered in isolation, but only as a pair of linked structures, taken together against some other proposition(s) as context:

(5.24) A: John likes
B: And Bill dislikes, that doctor from Washington.

A's utterance, and B's utterance are not wellformed as complete utterances, even though they are wellformed as substrings. In A's utterance, the result is not a complete tree. In B's utterance, the context upon which its interpretation depends is not a complete tree. (5.24) is only interpretable as a collaborative utterance, as we would expect (see section 9.4.3 for discussion of such shared utterances). Similarly in the phenomenon of mixed utterances:

(5.25) A: I'm worrying about..
B: your chapter on the..
A: Split-Identity puzzle.

Though each sub-string of this exchange involves a wellformed sequence of actions licensing an update from partial tree to partial tree, none of these utterances as an individual action is itself a complete wellformed utterance, since they all involve incomplete trees; and, as in this case, they may not add up to a single uttered string, even though a single proposition is constructed as a result. This result is important as, without it, we risk failing to provide a sufficiently rich concept of wellformedness, since collaborative construction of utterances may not, as here, respect constituent boundaries at the change-over between speaker/hearer roles.

Once having made this shift to a concept of wellformedness explicitly in terms of context update, we could in principle drop the idea that strings are well-formed with respect to specific contexts, retaining only:

A string is well-formed just in case there is *some* context where the parse of that string gives rise to an updated context that contains only complete trees including the one derived from the parse of (an utterance of) the string.

Given that a context is some (possibly) null set of trees we can then refine this notion to say that a string $\phi$ is well-formed in language $L$ just in case there is a (possibly null) (complete) tree $\mathcal{T}$ in the (I-)language of $L$[8] such that the context $\{\mathcal{T}, \mathcal{T}_\phi\}$ is derivable through a parse of $\phi$ and $\mathcal{T}_\phi$ is complete. This would mean that *Janet thinks she is pregnant* is well-formed (since the transition $\emptyset \mapsto \{\mathcal{T}_{\text{Janet thinks she is pregnant}}\}$ is licensed through the parse of the string), while *He was in tears* is well-formed because $\{\mathcal{T}_{\text{John came in}}\} \mapsto \{\mathcal{T}_{\text{he was in tears}}\}$ is licensed.

[8]Defined as the set of trees determined by the set of construction rules plus the lexicon of $L$.

#### 5.1.2.5 On Felicitous Use

The question, then, is whether, having defined this existential notion of wellformedness with respect to some context, we need to retain the richer concept of wellformedness with respect to some fixed context. We think that we do. We wish to express the distinction between (5.27) and (5.26):

(5.26) John upset Mary. He ignored her.

(5.27) A book fell. *He ignored her.

The utterance of the string *He ignored her* with respect to a context obtained from having parsed *John upset Mary* is wellformed. In contrast, the utterance of the second string in (5.27) is not wellformed with respect to the context provided by having just parsed *A book fell*, WITH NO FURTHER EXPANSION OF THAT CONTEXT. The step of expanding the minimal context which would be necessary to determine the acceptability of *He ignore her* in the context of an utterance of *A book fell* is often taken as trivial, but on the characterisation of wellformedness for context-string pairs provided here, this sidewards move would have the effect of substituting the pair under characterisation with a different pair of objects. It is no coincidence that this concept of wellformedness with respect to a fixed context is exactly that of felicitous utterance, as put forward by Heim 1982 (and the very similar concept of proper DRS of Kamp and Reyle).[9] Indeed, given the claimed conflation of syntactic structure and level of semantic representation that we are putting forward, the concepts of wellformedness and felicitous use are bound to come together.

Given the characterisation of wellformedness in terms of context update, gapping and pseudo-gapping cases emerge as incomplete strings - of the same status as relative clauses:

(5.28) John ignored Mary, who he had upset.

(5.29) John ignored Mary. And Bill Sue.

(5.30) John ignored Mary. And Bill did Sue.

In all of (5.28)-(5.30), the substring at the right periphery is not a wellformed utterance in its own right, but only as a subpart of the overall structure obtained from constructing a logical form from the pair of linked trees. This is because retrieval of lexical actions, as part of the context, is not part of the characterisation of context-update whereby utterances are defined as wellformed. Utterances by definition are said to be a function from one COMPLETE context to another: this precludes retrieval of lexical actions, since these constitute PARTIAL trees. Hence the result that fragments are not utterances in their own right. Such elliptical fragments would, nevertheless, be part of the partial tree under construction obtained from the parsing of the compound of the first and second conjuncts, as long as we define such gapping constructions as inducing a LINK transition,

[9] Heim notes, with regret, that her concept of felicitous use can only be defined over whole sequences of utterances, given her rule of existential closure over a discourse as a whole. We are grateful to Eleni Gregoromichelaki for reminding us of this discussion and the concept of proper DRS.

hence the second of a pair of linked trees.[10] On this view then, relative clauses and gapping structures are of the same status, both *And Bill Tom* and *who I like* requiring the presence of a host primary structure with which they can form a subpart of a wellformed utterance.

It follows from this that gapping constructions as answer in question-answer pairs only constitute a well-formed utterance AS PART OF THAT PAIR. This may seem disappointing, given that many answers to questions do not take this incomplete form. A question may be replied to either by an elliptical form (as in (5.31), or as a full form of utterance (as in (5.32)):

(5.31) Who interviewed whom?
John, Mary. And Tom, Sue.

(5.32) Who interviewed whom?
John interviewed Mary, Tom interviewed Sue.

In fact, other types of question-answer pairs form an even tighter unit, the answer having to be seen as an extension of one individual structure:

(5.33) Who does everyone admire? Their mother.

To model the way in which such so-called functional questions can yield a well-formed result, with appropriate binding of the pronominal by the quantifier in the question, the account to be provided has to posit the construction of an unfixed node by Late*Adjunction, as this would make available the incomplete tau term as possible antecedent, leading to the requisite single logical form with binding of the term from *his mother* as part of the nuclear scope of the quantifying term. This heterogeneous account of question-answer pairs may seem a surprising result, but it is not implausible. Question-answer pairs, from this perspective, span the full range of structures, able to be presented either as separate utterances, or as a pair of linked trees, or as a single tree which is an extension of what has just been parsed – exactly analogous, that is, to any other sequence of utterances.

### 5.1.3 Acceptability

We have proposed in Chapter 3 an account of resumptive pronouns in English that is permissive with respect to the data, but this poses the question as to why native speakers often judge sentence with resumptive pronouns to be less acceptable than their gapped counterparts. Our answer turns on the presumption that all anaphora construal is a unitary pragmatic process, but pragmatic considerations will influence acceptability. If we adopt Relevance Theory assumptions, we would expect that all aspects of utterance interpretation not determined by rule will be constrained by a balancing of cognitive effort with some degree of cognitive effect (see Sperber and Wilson 1995). On this basis, any unnecessary morphological processing (parsing or production) will be avoided unless its use in some way benefits the interpretation process - either to

[10]It is notable in this connection, that such gapping constructions are not generally acceptable without some form of conjunction, unless part of a listing construction:
(i) John interviewed Sue. ??Tom Harry/And Tom Harry/though not Tom Harry.
(ii) John interviewed Sue, Tom Harry, Mary Anna-Marie, and Max Harold.

secure additional pragmatic effects, or to ensure processing success that might otherwise be judged to be at risk. And this is exactly what we find.

On the one hand, resumptive use of pronouns in English becomes fully acceptable if the resumptive pronoun is stressed, and interpreted as inducing a contrastive interpretation:

(5.34) That friend of Mary's, who HE had to be the one to admit that we had low teaching loads, was roundly condemned.

(5.35) That friend of Mary's, who even HE admits he needs a holiday, was nevertheless at the conference.

In these examples, it is only the use of a stressed resumptive pronoun that allows focus on the subject of the relative clause (stressing *who* has no such effect). Hence, there is sufficient pragmatic effect for the examples to be acceptable in an otherwise null (or unspecified) context.[11]

On the other hand, resumptive use of pronouns is invariably judged to be more acceptable when they occur in an embedded structure:

(5.36) I had some other point which I can't remember what it is.

(5.37) That friend of yours who Sue noticed that he was looking unwell has been taken off to hospital.

3.18' She got a couch at Sears that her brother told her he was sure it was on sale even though it wasn't.

Examples of this latter type show that acceptability improves just in case the resumptive either saves an otherwise potentially unacceptable string or that simply identifies a 'gap site' that is not local to a dislocated expression. These cases are thus explicable in terms of ease of processing rather than pragmatic effect.

However, the resumptive use of pronouns is judged not to be acceptable where there is no apparent justification of either type:

(3.18) ?She got a couch at Sears that it was on sale.

(3.19) ?He's a professor that nobody liked him.

Yet even these occurred in conversation, as did other comparable data:

(3.30) He builds this house, which it's called Pandemonium,....

(3.25) Those little potato things that you put 'em in the oven.

Given such examples, we would, given a relevance theoretic perspective, expect acceptability to improve in context. For example, the string in (5.38) occurred as part of a discussion of child actors and what they get up to on stage. The

[11]Stressing the pronoun in strong crossover examples such as (2.3) notably does not allow the pronoun to be construed as *John* (2.3') while it is possible if the following gap is replaced by a resumptive pronoun as in (2.4'):
(2.3') John, who I'm certain HE said would be at home, is in the surgery.
(2.4') John, who I'm certain HE said he would be at home, is in the surgery.
Thus pragmatic considerations notably do not over-ride system-internal construction processes.

pragmatic effect of the pronoun here appears to have been to emphasise the agentivity of the children and the example was perfectly natural within that context.

(5.38) I've had children that they've come in and ... (BBC Radio 3 21/07/2002)

In the other examples recorded above, we expect acceptability also to be affected by further specifying the context. (3.30) and (3.25) both (for example) improve when you extend the context:

(3.30") He builds this house, which it's called Pandemonium, and rightly so!

(3.25") Those little potato things that you put 'em in the oven and when you take them out again, they've turned into mush.

That this analysis is on the right track is suggested by other phenomena such as the parallel use of definite noun phrases as resumptive, a phenomenon which is widespread cross-linguistically:[12]

(5.39) That friend of yours, who the idiot had to be the one to admit that our teaching loads were low, was roundly condemned.

(5.40) John, who Sue tells me the poor dear is suffering dreadfully from overwork, is still at the office.

From a relevance-theoretic perspective, the use of definite noun phrases as resumptive can always be justified on the grounds that the very addition of the predicative content of the nominal accompanying the definite article ensures additional inferential effects can be derived from this addition, thus justifying the additional processing cost of parsing the determiner-noun configuration. It is notable that this resumptive use of definite noun phrases is expected in this framework, given independent justification of an analysis in which definite noun phrases are analyzed as a type of anaphoric expression (see Kempson et al 2001, ch.1).[13]

This suggests that indeed pragmatic relevance constraints play a role in determining acceptability. Prosodic cues may be used to provide additional contrastive effects improving acceptability where there is no processing difficulty in establishing the requisite anaphoric construal. In the absence of any such special intonational effects, acceptability may be determined by the increased ease of retrieval of the requisite form of anaphoric construal when the structure under construction reaches a certain level of complexity. Otherwise, acceptability may be improved by embedding the examples within richer contexts which induce other pragmatic effects.

Through all this exploration of different concepts of wellformedness, one property has remained constant. The concept of wellformedness does not express appropriacy of uttering one sentence after another: there is no attempt to express what is an appropriate answer to a question, or what is a cohesive sequence of dialogue. We are concerned solely to articulate what is intrinsic to

[12]Since the Kaplan collection was restricted to resumptive pronoun use, the collection did not contain epithet use of definite noun phrases.

[13]In all other frameworks, this use of definite noun phrases is problematic, requiring an analysis in terms other than the regular binding mechanism.

ability in a language, independent of any such constraints. It is in this respect that the framework is NOT providing a model of pragmatics. Accordingly, the concept of wellformedness is expressed solely in terms of being able to derive a complete propositional formula, with no requirements outstanding. Despite its context-dependence, it does not incorporate any implementation of pragmatic constraints, nor any reflection of such constraints.

#### 5.1.3.1 Wellformedness with respect to all contexts

We now have a set of concepts of wellformedness. We can express wellformedness with respect to a fixed context. We can express wellformedness with respect to some arbitrary context. And we can express a concept of utterance wellformedness with respect to all contexts. This last characterisation picks out a heterogeneous set:[14]

(5.41) No man is mortal.

(5.42) A woman likes mustard though it makes her hot.

(5.43) If John is a teacher, he will have a degree.

(5.44) As for John, he is sick

These are either sentences in which no specific context is required, or they are sentences in which the context required for the latter part of the string is provided by the first part. However, it does not follow that in being wellformed with respect to all contexts that such strings are displaying no element of context-dependence. To the contrary, every uttered string displays some element of context-dependence - minimally that of the context of the act of utterance. Even conditional sentences, whose antecedent *if*-marked clause presents a recursively complex specification of some context relative to which the consequent is to be evaluated, have to be evaluated relative to the index of the world/time of utterance, albeit while constructing some alternative index of evaluation.[15]

Conversely, a sentence is ungrammatical with respect to all contexts if there is no context relative to which a string is derivable. These provide a basis for characterising the classic cases of ungrammaticality. This includes sentences whose substrings are not licensed sequences of actions:

(5.45) The a very sat down.

(5.46) A will do.

(5.47) A woman will a sick fainted.

But it also includes sentences which contain sub-strings that constitute licensed sequences of actions, but with no overall resulting ouput logical form:

(5.48) Which man did you interview the man from London?

(5.49) The man from London emerged that he is sick.

[14]It would even exclude *It is raining*, since this has to be evaluated with respect to some current, contextually fixed index of evaluation.

[15]See Gregoromichelaki in preparation, to whom this observation is due.

(5.50) The man John saw whom is outside.

In each of these, some requirement on either computational or lexical action fails to be satisfied; the appropriate update cannot take place; and the result is a failure to derive an output tree with all requirements satisfied. So no logical form is derived to yield a context update from any one context to another.

Thus the decision to define a concept of what it means for an utterance to be wellformed relative to some fixed context has led to a richer overall account of wellformedness for natural languages.

## 5.2 Grammars and Parsers

Interesting though such characterisation of wellformedness might be, it is essentially epiphenomenal. Wellformedness plays no direct part in the characterisation of either parsing or production. In particular, it is not the case that the objects that the grammar defines as wellformed constitutes the input to any application of the formalism in parsing or production. But, put like this, two further questions can be delayed no longer. What, then, is the relation between the grammar formalism as so presented and its application in a model of parsing as part of an account of performance itself? And, following on from that, what is the relation between parsing and production?[16]

Given that we have been committed to the view that there is no articulation within the grammar formalism of how individual choices are made between alternative strategies, we are faced with the consequence that a model of the grammar formalism is a proper subpart of a model of the parsing mechanism. Minimally, we will need some reconstruction of a filter, say reflecting relevance-theory assumptions.[17]

While this remains an avenue for future research of which we can do no more than give a hint, we can get a sense of what the problem and its resolution should be. In the opening stages of any parse, and from then on, the choices available to hearer multiply. Even in parsing some first constituent, say *that receptionist*, from what we have set out in previous chapters, the parser has at least three alternatives, to parse the noun phrase as decorating as fixed subject node, as in *That receptionist distrusts me*,[18] to parse it as some unfixed node to be updated to a fixed position later, as in *That receptionist, I distrust*, or to parse it as decorating the topnode of some structure, to be treated as linked to what is constructed as some remainder, as in *That receptionist, I distrust her*. Because there is no lexical basis for differentiating the choices to be made at this first step, it might look as though we have to posit the construction not just of one, but at least three structures in tandem, progressively decorating each one of them until such time later in the parse at which all but one of them will

[16]The contents of this section have evolved over a number of years through extensive discussions with Wilfried Meyer-Viol, Masayuki Otsuka, and Matthew Purver; and is work still under development (see in particular Otsuka in preparation).

[17]See Dekker and van Rooy 2000 for a remodelling of the Levinson Q and I implicatures (see Levinson 2002) as strategies in a decision-resolution game-theoretic model which at all stages determines which out of the presented alternatives is to be selected within the space provided by the grammar architecture. As van Rooy 2003 notes, the formulation of these strategies correspond broadly with considerations of cognitive effect and cognitive effort, along relevance-theoretic lines.

[18]Here we set aside phonological focus.

have been rejected as putative candidates by some filtering process yet to be formally modelled. Unless the window in which parallel structures are sustained is very small, it looks as though we will have a gap opening up between parsing on-line and the grammar formalism which threatens to undermine the central claim of the theory. But it turns out that contributory factors determine swiftly the selection to be made, for the implementation of pragmatic constraints is not applied to the output of what is provided by the grammar (as in other frameworks), but at each step in the construction process as provided by the system.

Consider the difference in uttering *that receptionist* as subject and as a displaced object. These are immediately distinguished by intonation: if an unfixed node is to be built – as in *That receptionist, I distrust* there will be a marked intonational effect distributed across the entire expression indicating, at the very least, that the structure to be built isn't a canonical strategy. Moreover, intonation is a para-linguistic feature, distributed right across a constituent and identifiable from the outset of the parse. By contrast an utterance of *That receptionist distrusts me* with neutral intonation will induce the canonical strategy (for English) of Introduction and Prediction. Consider also the difference between uttering *that receptionist* to be construed as subject, and uttering *that receptionist* to be construed as decorating a structure related to the remainder only through anaphora (*That receptionist, I distrust her*). These are the so-called Hanging Topic Left Dislocation Structures, invariably reported as requiring a distinctive intonation pattern. Whether the intonation itself is sufficient to distinguish the effect of building an unfixed node from that of building and decorating a linked structure is surely uncertain, but this isn't necessary, given that all utterances are interpreted relative to context. The hallmark of unfixed nodes is that they are constructed in order to provide some UPDATE to what may be independently identifiable as in context, a distinctiveness from the remaining structure to be constructed which their assigned intonation buttresses.[19] The characteristic use of sentence-initial linked structures, on the other hand, is to provide the CONTEXT relative to which what follows is the update. The relation of these two to the context in which they are uttered is not the same. Hence the combination of intonation and their distinct relation to how they add to their context is sufficient to determine that, even at the first step in constructing a representation of content, the hearer has either one, or maximally two alternative strategies to construct. And with each next presented word, it can be expected that this choice of alternatives will get narrowed down to the limit.[20] The claim we are making, then, is that the choice mechanism, however it is formalised, does not apply to the OUTPUT of the grammar. Indeed, the output of the grammar is the output of the parser also. Rather, it applies to each individual action of tree growth licensed by the grammar. It has to be granted, however, that the challenge of modelling any such choice mechanism

[19]See Kiaer in preparation where this account of topic and focus is substantiated in detail. She argues there that intonation plays a critical role in enabling a fully incremental account of Korean.

[20]Of course it might be argued that what this disjunction of strategies shows is that we have the wrong analysis and that we should have provided a more integrated account with but a single input specification. One alternative would be to analyse verbs in all languages as projecting a propositional template, differing only in the decorations on their attendant argument nodes, thereby reducing the number of alternative strategies by one..

within Dynamic Syntax remains entirely to be done.[21]

## 5.3 Dialogue as a window on production

The next question is the relation between parsing and production. Why is it that parsing is the more basic of the two language-based activities, and not the inverse mapping from conceptual representation onto linearised string? Indeed, in what sense is it more basic – how can an underlying system of linguistic knowledge be non-neutral between the various activities to which language is put? According to standard methodologies, it simply makes no sense to articulate one activity as primary, the others all having to be defined in terms of it. From that perspective, indeed, this question isn't specially interesting since the assumptions made don't suggest answers – the matter is purely contingent. The two activities might turn out to be correlated, but only indirectly, through the neutral and statically defined intermediary that they share.

¿From the Dynamic Syntax perspective, things are quite different. Not only does the question force itself into the research arena; there is also indication of a set of answers which are possibly surprising: – production has also to involve establishing a possible parse for that is what the rules of grammar provide; it has to be an incremental task; and it also has to be context-dependent. The one major difference is that, unlike the blind and trusting parser, the producer has the foresight of knowing what they want to say, at least in part. So the producer starts with some (possibly partial) representation of content which guides the construction process. Otherwise, the two tasks go hand in hand.

This may seem a surprising twist; and to set this proposal in context, we need to see what relations there are between the roles of producer and parser. And for this we turn to dialogue.

### 5.3.1 Dialogue Data

Study of dialogue has been proposed by Pickering and Garrod 2004 as the major new challenge facing both linguistic and psycholinguistic theorising.

The most striking property of everyday dialogue is how easily we shift between the roles of producer and parser. We ask and answer questions in rapid succession:

(5.51) A: Who did you see?
B: I saw Mary.
A: Mary?
B: Yes, with Eliot.

We extend what the other person has said:

(5.52) A and B talking to C:
A: We are going to London.
B: Tomorrow. Because Mary wants to.

[21] Prototype implementations of Dynamic Syntax have been defined by Kibble and Purver (see Kibble, Meyer-Viol and Marten 1997, Otsuka and Purver 2002, Purver and Otsuka 2003, Purver and Kempson 2004), but, in all cases, these have focussed on testing the framework as a grammar formalism, setting aside the disambiguation challenge.

We may even interrupt, and finish each other's utterances:

(5.53) A: What shall I give...
B: Eliot? A toy.

As these data show, all such negotiated completions involve the assumption of a shared partial structure. Yet, our reliance on a concept of shared context isn't always successful, as what constitutes the context for the speaker may not always match that of their hearer :

(5.54) A (having come off the phone): I'm worried about him.
B: Who?
A: Jim. That was his supervisor.

At any such point, where the context turns out not to be shared by the hearer, the negotiation between speaker and hearer becomes momentarily explicit. In the more usual case, however, there is presumed identity of context, and it is on their own individually established context upon which speaker and hearer individually rely.

Further coordination between speaker and hearer roles is displayed by what Pickering and Garrod label 'alignment' between speakers. If one interlocutor has used a certain structure, word or choice of interpretation, then the respondent is much more likely to use the same structure as in (5.55), rather than a switch of structure as in (5.56):

(5.55) A: Who has Mary given the book?
B: She has given Tom the book

(5.56) A: Who has Mary given the book?
B: ??She has given the book to Tom.

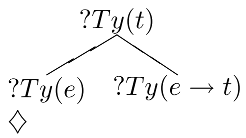
(5.57) A: Who was at the bank yesterday?
B: Sue was at the bank until lunchtime, and Harry stayed at the bank all afternoon.

So there is tight coordination between speaker and hearer activities at syntactic, semantic and lexical levels.

These informal observations about dialogue and the observed interplay between shifting speaker and hearer roles may seem obvious, even trivial; but, as Pickering and Garrod 2004 point out, dialogue presents a major hurdle for most theoretical frameworks. The separation of competence from performance, with the articulation of the former as the logically prior task, has meant that the data for linguistic modelling have been sentences taken in isolation; and the presumption has been that study of performance, whether processing or production, can only be couched in terms of how the principles encoded in such a cognitively neutral body of knowledge is put to use in the various language-related tasks the cognitive system may engage in. But, given this separation of the articulation of the system itself from considerations of these activities, the formal properties of the system itself provide no clue as to what such parsing and production systems might look like, other than dictating that they must make reference at various points to the system, with no reason to anticipate that these various applications might have anything to do with each other. Reflecting this, models of parsing and production have been quite generally studied in psycholinguistics as quite separate research enterprises with very little to do with each other.[22]

### 5.3.2 Production - The Dynamic Syntax Account

It might seem that Dynamic Syntax is in an even worse position than other frameworks for modelling production, since production so obviously isn't the same as parsing. To the contrary, production is in some sense surely the reverse activity? Where the goal of parsing is to progressively establish some logical form, the task for the producer has to be start from some assumed representation of content which, following Otsuka and Purver 2003, Purver and Otsuka 2003, we call the goal tree,[23] and select some string of words from which a parser can recreate that same representation of content. Certainly, what is needed is a mapping from a decorated tree (or more abstractly some logical representation) onto a linearised string from which the tree in question could be constructed by a parsing system. However, the surprise is that we can model this task using the very same rules, following possible parse routines, with the goal tree merely serving as the filter against which all possible actions by the generation system have to be matched, despite the fact that neither selection of words nor their order are uniquely correlated with a given content. All that is required in addition to the parse routine is that the choice of words to be selected by the generation device must meet the requirement that they progress the building of the goal tree. Reflecting these informal statements, we assume that in generation, the very same computational actions initiate the development of some tree, but this time, each update step has to meet the severe restriction of not merely being an enrichment as in parsing, but of being a precise form of enrichment – a sequence of progressive enrichments towards yielding a particular tree – the selected goal tree representing the interpretation to be conveyed.[24] Taking the very first set of update options for English, the producer takes the Axiom as a starting point and induces two daughter nodes (by the regular combination of Introduction and Prediction), the pointer then resting at the subject node awaiting development:




Trivially these steps create a partial tree that subsumes the goal in the sense

[22]Computational models of parsing and generation have explored the relationship between parsing and generation over a number of years (following Shieber 1988: see eg Neumann 1994), but nonetheless, with a direction-neutral grammar formalism, the two systems are defined as different applications of the shared grammar-formalism. One such difference lies in the fact that, while incremental parsing systems can be defined, generation systems remain head-driven (see Shieber et al 1990, Stone 1996, among others).

[23]A goal tree is a tree with all requirements on nodes satisfied, and with $Ty$ and $Fo$ decorations at each node.

[24]Section 9.4 is a relatively informal report of work on generation done in collaboration with Masayuki Otsuka and Matthew Purver. The suggestion for this design of a generation system relative to DS assumptions was suggested to Kempson, Otsuka and Purver by Matthew Stone (personal communication), and subsequently developed in Otsuka and Purver (see Otsuka and Purver 2002, Purver and Otsuka 2003). Both the details of the system and its implementation remain currently under development.

of being a partial tree that can lead by monotonic steps of enrichment to the selected goal tree, whatever that may be. We now assume that, with the next step in English being induced by lexical actions, the generation system has to initiate a search through the available lexicon for words that provide updates matching the goal tree. In principle, this means scanning all possible words, searching for some item which can provide an appropriate update to the partial tree so far constructed.[25] Seen overall, production involves a sequence of triples of partial string, partial tree, and complete tree. The first step comprises an empty string, the Axiom step, and the goal tree; the last step comprises some complete string, and two occurrences of the goal tree. All steps in between these two involve updating the previous partial tree, commensurate with the goal tree filter. For any update that passes the filter, the selected word can be uttered, or, in writing systems, added to the right edge of the output partial string. Even in a simple case such as uttering *John snores*, given a binary branching semantic structure, there is in principle two successive searches of the lexicon to find words that provide the appropriate update to the opening partial tree. And this is only the beginning, as for any one tree, there may be several linearisation strategies. Even in such a simple case as this, there are two, since the noun *John* could have been taken to decorate an unfixed node which then merges with the subject node once that is subsequently constructed. So, with two such parsing strategies, there would equally be at least two production strategies, against each of which appropriate searches of the lexicon have to be set up, even for this simple goal tree. This poses a substantial computational problem, particularly for a theory committed to the account being incremental.[26]

### 5.3.3 The context-sensitivity of production

The clue to solving the problem, we suggest, lies, as before, in modelling what goes on in real-time as closely as possible.[27] And production, on this account, is a proper subpart of a theory of performance, so we expect it to be restricted by whatever general cognitive constraints apply to processing in real time. In particular, we anticipate, correctly, that production choices are sensitive to whatever is provided by the immediate context.

To stick with our simple cases, recall how parsing a sequence such as (5.58) takes place:

(5.58) John ignored Mary. He upset her.

Having established a tree representation decorated with the formula *Fo(Ignore (Mary)(John))*, the task of parsing *He upset her* involves manipulating the process of Substitution to establish the value of the subject argument as $Fo(John)$ and the object argument as $Fo(Mary)$, given that particular minimal context. Recall that the constraint of minimising processing cost which is central to the

[25] If this can be found by the speaker, by assumption of a common language, it can be presumed also to be findable by the hearer, given the words as input.

[26] Very generally, generation systems are head-driven (see Shieber and Johnson 1994), Stone and Doran 1998, Stone et al 2001, contrary to recent psycholinguistic evidence (see Ferreira 1995, Branigan et al 2001, Pickering and Branigan 1999, Pickering and Garrod 2004).

[27] One suggested solution to this problem in Otsuka and Purver 2003, Purver and Otsuka 2003 involves restricting solutions to words representing terms that decorate terminal nodes in the tree, selected from the lexicon as a first pass. This account has the disadvantage of not being incremental, requiring a global search of the tree as a first step.

constraint of relevance posited by Sperber and Wilson 1985 was in response to Fodor's counsel of despair that no theory of the central cognitive system is possible, because of the complexity of the selection task, with unrestricted multitude of connections a reasoning agent can bring to bear in determining interpretation. But the producer of that same sentence also has as the immediate context the tree with topnode decorated with $Fo(Ignore(Mary)(John))$. The production of *He upset her* thus, analogously, allows choice of the word *he* on the basis that in the immediate context is an appropriate occurrence of $Fo(John)$ a copy of which, substituting the metavariable lexically associated with the actions of the pronoun, will indeed meet the subsumption requirement with the goal tree. The only difference between parsing and production is the subsumption requirement specific to production.[28]

Notice the immediate advantage of pronouns in language for the production task. The search in the lexicon is reduced to finding the pronoun. There doesn't have to be a search for a particular unique word, matching the term decorating the node in the tree. The pronoun will do just as well, as long as the context contains the term in question. Indeed, the pronoun itself, by definition, provides an update which relies on context for its determination. So, as long as pronouns are presumed themselves to be easily available as a lexical expression, their selection bypasses the general lexicon search, replacing it with search in the immediate context – a very much smaller and more tractable task.[29] And, given that in both parsing and production, the same tree is being constructed by both speaker and hearer, the selection of appropriate minimal context will be in general be taken from the sequence of trees both speaker and hearer know each other to have constructed, ie as discourse-anaphoric. No calculation of mutual manifestness, or hypothesis about the hearer's mental lexicon is needed to ensure this: it is a simple consequence of the fact that production follows the same process as parsing. Both involve the construction of tree representations of content: and presumed values of minimal context are thereby shared. Cases of pronouns which are unsuccessful in enabling their hearer to establish the appropriate term are when a speaker chooses a pronoun on the basis of his own minimal context, but this structure is not available to the hearer (as in (5.54)). So, as in the case of parsing, though in principle there is nondeterminism and a wide range of possibilities, in practice this is narrowed down to a single choice - or, where not, the threat of breakdown in communication is immediately opened

[28]In principle, the production of a pronoun, given its lexical specification as providing a meta-variable as $Fo$ value will trivially satisfy the subsumption constraint, apparently without any reflex of the parsing step whereby it might be interpreted. If this were the correct analysis, pronouns would not be good evidence of the context-dependency of natural-language production: to the contrary, pronouns would constitute a trivial production step, always licensed no matter what is being talked about. However the presence of the requirement $?\exists x Fo(x)$ in the lexical specification of the pronoun forces the provision of a value in the building up of a logical form in all well-formed strings containing a pronoun, hence also forcing the contextual provision of a value in production on the assumption that production steps incrementally match the corresponding parse steps.

[29]This account of pronoun generation will have as consequence that the utterance of a pronoun in the context of a preceding sentence containing two possible antecedents will be ambiguous, a problem which extends also to ellipsis. We take this to be correct. The process of substitution which provides interpretations of pronouns is taken to select a value out of some arbitrary minimal context, and where two antecedents are provided in any such context, two logical forms are derived and the resulting ambiguity has to be resolved by evaluation of inferential potential (mimimally passing a consistency check).

up.[30]

The context-dependent characterisation of the production of pronouns extends straightforwardly to the widespread occurrence of repetitions in dialogue, so-called lexical alignment, with one additional assumption. Suppose we take the context to contain not merely some sequence of partial trees, but with linguistic input, the lexical actions used in creating such structure. With this assumption, repetitions are immediately motivated. If in engaging in the task of searching for an appropriate word, the first search is through those actions that have so far been accessed, one will have a strategy which avoids full lexical search altogether. Repetitions aren't essential for the hearer, though assuming a dialogue lexicon helps reduce the hearer's lexicon search space. But for the producer, cutting down on lexical search is essential to the realisability of the task. Lexical repetition makes an important contribution to this, as long as we assume that lexical specifications, once used, themselves become part of the context. There is simply no need to access the dictionary if one's context provides an appropriate set of lexical actions.[31]

Syntactic alignment goes hand in hand with lexical and semantic alignment. A putative example of syntactic alignment is provided by a word such as *give*, since this is said to have discrete syntactic properties for a single semantic content - the subcategorisation either for a double object construction or for the indirect object construction. This turns out to be straightforwardly reflected in a DS analysis in virtue of the procedural nature of lexical content. All that is exceptional about a word such as *give* is that it has two closely related sequences of actions, which are reflected in two discrete lexical specifications. But this is all we need to account for such so-called syntactic alignment, given that it is the macro of update actions for a word which, once retrieved for parsing (or production), gets added to the context. For once either of these specifications gets selected, it is that pairing of word and update-specification that will get entered into the context lexicon, to be retrieved by the second occurrence of the word. As with instances of repetition, it is the stack of lexical actions that gets searched first to see whether there are items that can project the required subsumption relation to the goal tree; and in all cases, as long as one sub-case of the lexical specification is entered in that active lexicon, the other case will never need to be retrieved,[32] exactly analogous to the case of semantic alignment with ambiguous expressions. In sum, by collapsing what would in other systems be discrete syntactic/semantic/lexical levels, the multi-level nature of syntactic/semantic/lexical alignment is transformed into a single phenomenon.

Finally, and perhaps most significantly, given the problem it poses for other

[30]There is a notable asymmetry between nondeterminism in resolution of content and nondeterminism in resolution of structural update. Making a wrong choice in pronoun construal or ellipsis construal leads to immediate lack of communication. Making an unintended choice in structure build-up may lead only to relatively minor differences in pairing of context and current structure. It is notable that such flexibility is a source of syntactic change. See section 6.7.2.

[31]Though we don't take up ellipsis here, we note in passing that ellipsis may be analysed as re-use of lexical actions with only the trigger of the elliptical form, hence an expected alignment phenomenon (see Purver and Kempson 2004).

[32]Ferreira 1996 provides confirming evidence for preferring incremental accounts of production over threshold activation accounts in which putative strategies are simultaneously activated but progressively eliminated.

frameworks, we expect that utterances can be shared. Both in parsing and producing an utterance, a single tree is constructed. If before completion, the hearer can leap to the conclusion of what is being said, she can complete the partial tree she has up till then constructed as a parser, and so shift into being a producer where the task is to complete that tree against an already completed goal tree. Equally, the speaker can shift into being a parser, as she, too, has a partial construction of that tree. On this view, this is merely a shift from PROVIDING the input for updating some partial structure, to analysing some PROVIDED input with which to update that very same partial structure. There is no major shift from one performance mechanism to some entirely distinct mechanism. Unlike in other frameworks, the phenomenon of shared utterances is expected to be strikingly natural. Apart from the abduction step of anticipation made by the interrupting interlocutor, nothing new needs to be added.[33]

This alignment account of production pressures, with dove-tailing of parsing and production tasks, is directly in line with the way we were led (section 8.2.2.5) to analyse at least some answers to questions as an incomplete utterance, extending the structure provided by the question. Question-answer pairs, recall, were seen to range over pairs of structures which are independent of each other, and extensions of one single structure by some addition. With production seen as involving the construction of the very same structures as in parsing, such question-answer pairs simply form part of the incomplete utterance phenomenon, hence explicable in the same terms.[34] So, overall, dialogue patterns buttress the DS account of production as an incremental task following the pattern of parsing.

It is notable that this account (despite similarities with eg Clark 1996 in taking language use to be a collaborative activity) doesn't require the definition of either parsing or production in terms of having to construct higher-level hypotheses about the other interlocutor's belief system. The production steps simply follow a parse routine because this is the form of the grammar. The use of context by the speaker to identify the usability of a pronoun, and the widespread use of repetition occurs for the same reason as in parsing: it is because the task of production by the speaker is context-dependent - dependent, that is, on the speaker's own context. There is no necessary Gricean construction of what the other believes about what the speaker might believe, etc. This means that a child can become a language producer without engaging in any such higher-level hypotheses about the hearer's mental state, leaving these to emerge later in more sophisticated types of communication inducing indirect pragmatic effects.[35]

We can now see why parsing is basic, with production as the task defined in its terms. In a real sense, we have been setting out the evidence for this stance throughout this book. As we have seen, syntactic explanations have been transformed by the central assumption of a parser that information projected early

[33] Purver and Kempson 2004 provides a formal characterisation of these informal reflections and reports on an implementation of them.

[34] This DS account of production, implemented as reported in Purver and Kempson 2004 is notably confirmed by current research on production, both in outline and in detail: see Ferreira and colleagues, and Branigan and Pickering 2001, Pickering and Branigan 1999, 2001, Branigan et al 2004.

[35] As is widely known, such higher-order hypotheses don't emerge until about the age of 6 (see Tomasello 1999 for discussion). However, what the dialogue patterns suggest is that, even in adult language use, such higher-order hypotheses are are constructed only as required, and not invariably. This point is made in Pickering and Garrod 2004.

on in the projection of structure from the left-edge of a string projects some partial representation to be subsequently updated in interaction with whatever other general cognitive constraints may be operative. An immediate disadvantage of a production-based account of language, in which parsing is seen as the dependent activity (as suggested in Phillips 1996), would be the loss of this embedding relation within a general cognitive capacity for information processing. We would be defining a process that takes as input some rich notion of content, suitably represented, and for which some choice of output has to be selected whose content may be systematically weaker than the input specification, in contra-distinction to those other cognitive systems displaying underspecification of initially retrieved information and subsequent enrichment. Immediately, the entire concept of context dependence would return as an unsolved mystery - why should there be natural-language expressions whose content is systematically bleached as an intermediate step in the mapping onto the string itself. The puzzle of the imperfection of natural languages would also return. We would be back to the problem of why some term associated with a given position in a hierarchical semantic structure should ever occur at some left (or right) edge, from which its interpretation is not optimally projected. We would have to return to some equivalent of the movement account, with a heterogeneous listing of different types of anaphoric expression, different types of relative clause, and different left and right periphery effects. We would be back at our point of departure, with no reason to expect interaction of anaphoric and structural processes, no reason to expect production to be incremental, no reason to require its association with a self-monitoring device. On this view, as we've been seeing, these phenomena emerge as by-products of the adopted stance. So this book is the demonstration to the contrary that parsing is the basic mechanism, fulfilling our promise made in the opening chapter that this was to be the substance of the book.

# Chapter 6

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