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Chapter X: Ellipsis in Dynamic Syntax

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1.1 Ellipsis: a window on context?

1.1.1 Introduction: overview

In this chapter we argue that all forms of ellipsis directly parallel other forms of context-dependency, e.g., anaphora, and provide direct evidence for the concept of context on which human interaction through natural-language (NL) depends. The preliminary manoeuvre is to set out how, in failing to give due recognition to the incremental and interactive nature of NL processing, standard accounts have entered a stalemate situation in which no unitary account of ellipsis seems possible. In contrast, we believe, the Dynamic Syntax modelling we propose next presents ellipsis as a test case for the view that each NL constitutes a set of mechanisms for interaction, with "syntax" comprising a set of procedures for incrementally constructing or linearising representations of content relative to an evolving context.

1.1.2 Ellipsis: the problem

Ellipsis is a dramatic demonstration of the systemic dependency on context that NLs, like all other cognitive processes (see e.g. Millikan 2004), display. In elliptical structures, content can, in some sense, be reused from the context without the utterance of an expression, an overt signal, associated uniquely with that particular content. In some cases, a rather general type of expression provides the trigger for such recovery:

(1) I asked the woman who had been hand-gliding how long she had been *doing so*, and she asked me how long I *had*.

In (1) we have first the expression *doing so*, naturally interpreted as invoking the conceptual representation of a durative action, 'hand-gliding'. This is a case of so-called, *VP-anaphora*. Then the elliptical *had*, a case called *VP-ellipsis*, is interpreted as that same action taking place in the past, 'had been hand-gliding,' this time attributed to the speaker. In employing such general expressions to express context-dependent content, ellipsis construal behaves in many respects like pronominal anaphora, the other canonical type of NL context-dependency. Its antecedent can either occur in the same sentence, as in (1), or in some previous sentence, as in (2):

(2) The woman who had been hand-gliding told me she was always scared. I told *her* I *was* too.

Like pronominal anaphora, ellipsis allows cataphoric construals:

(3) Without meaning to, I badly upset Mary.

(4) Behind them, disguising her desire, one catches a poignant glimpse of the youthful, shaved-headed Cather. As it did me, work rescued Willa Cather. [example from Fisher-Wirth 1995 also mentioned in Miller 2013]

Indexical construals are also available, without any linguistic antecedent:

(5) Mother to child reaching for saucepan: *Don't*

The challenge ellipsis poses, as with anaphora, is whether a unified explanation in terms of updates to and from context, whether the linguistic or non-linguistic context, can be given. Even though intuitive, this idea has seemed a chimera in theoretical linguistics because of the various processes and constraints that have been claimed to affect the recoverability of meaning for elliptical structures and their particular licensing in each NL. As current linguistic models institute the separation of syntax, semantics, and pragmatics, the result has been that *ellipsis* seems just a folk term for a set of heterogeneous phenomena, allowing only an itemisation of different ellipsis types, merely stipulating constraints within the grammar to express the requisite restrictions.

1.1.3 Recoverability and licensing via identity of linguistic structure: syntactic accounts

The usual cases of ellipsis characterised in the syntactic literature are taken to involve deletion or copying under identity with some previously encountered structure. In trying to identify the properties of such structures, a huge range of different types of ellipsis have been distinctly labelled. Some of them merely label the form of interpretation they require when occurring in a particular context as, e.g., in (6)-(9) below where the various fragments, although displaying unitary properties, have received distinct treatments (see e.g. Ginzburg 2012, cf Culicover & Jackendoff 2005; Gregoromichelaki *et al.* 2011):

(i) Stripping / Bare Argument Ellipsis
- (6) A to C: We found your phone on Monday.
  A/B to C: On the table.
- (7) A: I know I saw my phone somewhere on Monday.
  A/B: On the table?

(ii) Fragment Answers
- (8) A Where did you last see your phone?
  B: On the table.

(iii) Completions
- (9) A: Should I put it back on the shelf, or ...
  B: on the table.

As (6)-(9) show, even a single form of fragment may serve in more than one of these categories, so large-scale ambiguity threatens. The same problem arises in cases where specialised expressions serve as indications for the form of antecedent required: verb phrase ellipsis has been divided into VP-ellipsis (VPE) (10), Pseudo-gapping ((11), (4)), Antecedent-Contained Ellipsis (ACE)(12), and Predicate Phrase Ellipsis (13)(see e.g. Craenenbroek & Merchant 2013):

(10) John was struggling at school as much as Mary was.

(11) John was reading to his nieces more than he was to his own children.

(12) Mary was reading every paper that John wasn't.

(13) Ben said that he wasn't at John's retirement party, though he was.

Problems of recoverability have arisen for all these phenomena: each can display the *strict* vs *sloppy* ambiguity that is characteristic of a number of ellipsis reconstructions. The strict interpretation involves attributing the same predicate to the new subject while the sloppy reading reflects the PATTERN of the antecedent's construal at the ellipsis site but, with the new subject, yielding a distinct content:

(14) A: John deceived his wife. B: Peter did too.

(15) John will have to explain how he deceived his wife to the police and Peter will to the court officials.

(16) (Context: John touches his nose with his tongue. He turns to Julian:) John: Now you do it. [Julian does it and then Arash does it] Eleni to Ruth: Look, Arash too! [example adapted from Dalrymple 2005]

Syntactic analyses of this phenomenon involve positing multiple syntactic structures for the ANTECEDENT as well as at the ellipsis site, even though the antecedent itself has only one actual interpretation, in order to sustain an approach to ellipsis as deletion of structure under identity with its antecedent (see Kempson *et al.* to appear for discussion). However, this is a more general phenomenon: pattern-copying for the conceptualisation of some previous set of actions can occur without any linguistic antecedent, as in (16). Moreover, this pattern is also common in the case of pronominal anaphora, in the phenomenon of so-called *paycheck pronouns* (Karttunen, 1969):

(17) John spent *his paycheck* on food but Peter spent *it* on clothes.

A further problem for such accounts is the fact that recoverability of an interpretation for the elliptical element can be achieved without the presence of an identical linguistic antecedent in the discourse (parallel to the cases of *bridging inferences* (Clark, 1977) for recovering antecedents in pronominal anaphora):

(18) I wish I could *bring you good news*, but today I am *not*!
(BBC National Weather, 5 February 2014, 6.20am)

(19) I disagree with the writer who says funeral services should be *government-controlled*. The funeral for my husband was just what I wanted and I paid a fair price, far less than I had expected to pay. But the hospitals and doctors should be. (Brown Corpus, cited in Hardt 2003)

1.1.3.1 Recoverability mechanisms and restrictions

The motivation for syntactic accounts, nonetheless, is the reported varying sensibility of ellipsis to island constraints (Ross, 1967), widely taken to be diagnostic of a syntactic phenomenon (see Merchant (this volume), and Kempson *et al.* to appear for discussion):

(20) John had interviewed every politician [who Bill had ~~interviewed~~].

(21) *John interviewed a journalist [who Mary turned away everyone [who Bill had ~~interviewed~~]].

The observance of such restrictions has been seen as sui-generis to NL and has therefore justified the assumption of a separate cognitive domain underpinning NL grammar, distinguished both from non-linguistic behaviour and, even, linguistic processing. As a theoretical consequence, this stance leads to a further explosion of ambiguity. For any grammar-related sentence-internal type of ellipsis postulated we are led to a bifurcation, despite the same elliptical form, into two distinct phenomena: those which fall within the remit of the grammar, and those which are defined as some "discourse" phenomenon, whose explication has to be part of a broader performance mechanism (see Hankamer & Sag 1976; Webber 1978; Hardt 1993). The insistence on this bifurcation separating grammar from discourse phenomena ultimately leads to the claim that some perfectly acceptable ellipsis data (see e.g. (18), (19)) constitute, in fact, speech errors. Since those data are not amenable to syntactic treatment, in order to sustain the claim that the grammar requires syntactic matching between antecedent and the ellipsis site, those sentences are characterised as ungrammatical but ultimately acceptable via the intervention of "performance" mechanisms (Frazier & Clifton, 2006). Until recently, the same stance was taken with respect to fragments occurring in dialogue, as in (6)-(9), where the lack of syntactic triggers and suitable matching antecedents resulted in their rejection as degenerate sentences with their licensing delegated to "performance".

1.1.4 Semantic accounts: recoverability with no underlying structure

It might seem that resolution to such issues could come from the attempt to construct a semantic alternative account of how an antecedent is constructed without presupposing an underlying syntactic structure for the ellipsis site beyond the pronounced element (if one appears on the surface). Dalrymple *et al.* 1991 take the antecedent of VP-ellipsis as input to a semantically-defined operation which derives an abstract (via higher-order unification) in order to create a predicate to combine with the subject of the elliptical clause. However, the problem that remains for such purely semantic accounts is either how to account for syntactic licensing restrictions like island-constraints (see e.g. (20)-(21)), or having to grant that there are islands for morphosyntactic restrictions which remain beyond the restrictions expressible within a strictly semantic account. For example, consider fragments without overt indications of the ellipsis site. Stainton 2006 argues convincingly that speech acts can be performed by employing such fragments with neither a syntactic nor a semantic linguistic antecedent:

(22) A: Covent Garden?
B: Right at the lights, and halfway up the hill

(23) (cook to assistant): Flour.

However, despite Stainton's claims to the contrary (Stainton, 2005), morphosyntactic licensing restrictions hold even for such cases of purely pragmatic ellipsis (as argued by Gregoromichelaki *et al.* 2011, 2013a). This is more evident in morphologically rich languages where the morphosyntactic requirements of the relevant NL need to be respected even when there is no LINGUISTIC antecedent for the fragment:

(24)
Context: A and B enter a room and see a woman lying on the floor:
A to B: Schnell, den Arzt /*der Arzt [German]
Quick, the doctor$_{ACC}$ /*the doctor$_{NOM}$ [command]

These licensing constraints have also been demonstrated for many types of fragmental utterances with (partial) linguistic antecedents that perform diverse types of speech act in dialogue. For example, a fragment clarification request has to bear an appropriate case specification, as if the frame in which the fragment is construed had been fully explicit. B's fragmentary clarification *Esi?* in (25) below has to be expressed with the appropriate case, nominative, and not accusative, since the pronoun is construed as the subject (see also Ginzburg 2012; Schlangen 2003, to appear):

(25) A: Tin ida [Modern Greek]
'I-saw her'
B: Esi? / *Esena?
You$_{2ndPersNom}$? / *You$_{2ndPersAcc}$?
'YOU (saw her)?'

These licensing restrictions are robustly displayed across case-rich languages. A purely semantic account of ellipsis as in Dalrymple *et al.* (1991) will fail to extend to these phenomena, as such morphosyntactic restrictions are not reducible to constraints on semantic (denotational) contents under standard assumptions.

1.1.5 Structural licensing without syntax? – the case of dialogue

As a result of such concerns and having acknowledged the widening chasm between what standard grammars provide as a basis for modelling ellipsis and the richness of data to be explained, the challenge of defining a grammar framework applicable to dialogue is taken up by Ginzburg and colleagues (HPSG$_{TTR}$, see Ginzburg 2012 among others). The model they propose includes licensing constraints spanning speech-act, semantic, syntactic, morpho-syntactic, phonological, and other attributes expressed as separate sub-modules within a HPSG grammar under a unifying TTR-based representation (Ginzburg, 2012; Sag *et al.*, this volume). However, despite covering a far broader remit of data (as e.g. in (22)-(23), (25)), the HPSG$_{TTR}$ grammar retains a conservative formulation as regards its sententialist/propositional grounding for syntax/semantics. All types of fragment, e.g. NPs (DPs) or PPs as in (7)-(9) and (22)-(25), are taken to project directly sentential categories with verbal heads and require a mapping to a (quasi)-propositional construal. To achieve appropriate licensing on this basis, each fragment is assigned a particular construction with its own speech-act, semantic, morpho-syntactic, and phonological constraints. As a result, ambiguity is posited wherever there is a distinguishable string-interpretation pairing. But this assumption now prevents the licensing of many genuine cases of "pragmatic" ellipsis in dialogue (Gregoromichelaki, 2012). This is because, as (26) below displays, all the fragment constructions postulated – clarifications, corrections etc. – can occur without linguistic antecedents and, at the same time, displaying all the morpho-syntactic licensing restrictions evoked to justify handling such constructions in the grammar:

(26) [Context: A is contemplating the space under the mirror while re-arranging the furniture and B brings her a chair]
A to B: tin karekla tis mamas? / *i karekla tis mamas?
the$_{ACC}$ chair$_{ACC}$ of mum's? / *the$_{NOM}$ chair$_{NOM}$ of mum's?
(Ise treli?) (Are you crazy?)
[clarification] [Modern Greek][example from Gregoromichelaki 2012]

The problem for the HPSG$_{TTR}$ account is that the rules licensing semantic update through moves such as clarifications handle such constructions only when an UTTERANCE event (characterised by a "locutionary proposition" with full phonological/syntactic specifications) is "pending" in the context. As a result, cases such as (26), where no such linguistic antecedent is available, cannot be accounted for with the mechanisms postulated for clarifications such as in (25). It is notable that such non-linguistic bases for fragment construal parallel both the VP-ellipsis cases in (5), and cases of anaphora where a pronoun, with appropriate grammatical specifications, can be used freely without a linguistic antecedent. Such parallels are not straightforwardly expressible in any account where various forms of licensing are reflected in distinguished syntactic/semantic/pragmatic specifications and distinct representations that necessarily output some sentence/proposition pair as the result of grammatical licensing.

1.1.6 Ellipsis as completability

There is a further hurdle, which all sententialist perspectives face. This is how to model the most prevalent pattern of ellipsis displayed in dialogue. In conversation, individuals can join in on the setting out of information, making their own contribution to its emergent content and direction:

(27) A: We're going to..
B: Burbage to see Auntie Ann
C: with the dogs?
B: if you look after them
C: in her garden?
A: unless it rains.

On the view of fragments as incomplete sentences, (27) would be made up of six elliptical sentences mapping to propositions, each separately intended by the speaker to be conveyed to the hearer. But in such conversations, no one contributor to the exchange that emerges need have had in mind the structure in which the event emerges as the resulting structure. This can be seen in (27) in the complex conditional involving *if* and *unless* and below, in what have been termed *hostile completions* (Gregoromichelaki *et al.*, 2011), an evolving speech act that transforms while it is being produced:

(28) A: What this shows is that
B: you are completely wrong.

This switch of roles can take place at any point in an emergent structure (Gregoromichelaki *et al.*, 2011; Howes *et al.*, 2011), sometimes so early on that no abstraction over some previous proposition will yield the right interpretation:

(29) A: I had to go back to the hospital for a follow-up appointment. The doctor
B: Chorlton?
A: Mhm. He said I had a shadow on my lungs.

This suggests that the characterisations of ellipsis we have outlined so far should be cast in a new perspective, seeing such phenomena as part of the rich potential for action-coordination during human interaction. Under this perspective, linguistic structures, interpretations and pragmatic effects –even illocutionary acts– all evolve, often within the span of an emergent single construction. Linguistic licensing of phenomena is just a subcase of such coordination effects (Gregoromichelaki, 2013b) and recoverability depends on much more than specifically linguistic structure (as in (26) earlier). As a result of this perspective, we can now see across the array of what we might call *compound utterances* (Howes *et al.*, 2011), that any dependency that any linguist has ever sought to articulate grammar-internally may be distributed across more than one speaker (as well as without any linguistic antecedent). Preposition-complement dependencies, (30), reflexive- antecedent dependencies, (31), quantifier-pronoun dependencies, negative-polarity dependencies, and quantifier-tense construal, (32), can all be distributed across more than one speaker:

(30) Joe: We were having an automobile discussion ....
Henry: discussing the psychological motives for
Mel: drag racing in the streets.
[Sacks 1992: 144-145 Lectures on conversation]

(31) (smoke coming from kitchen, B emerging) A: Did you burn
B: myself? No fortunately not.

(32) A: Has every player handed in
B: his registration form?
A: or any other documents?

In these cases, what is demonstrably required for successful use of fragments is NOT provision of words to complete some sentential string (contra Poesio & Rieser 2010) because, as (31) demonstrates, being a grammatical string when its two split parts are spliced together is not a necessary condition on well-formedness. Rather, the goal of the task is to allow a successful build-up of INTERPRETATION from the provided sequence.

These data cannot be dismissed as mere disfluencies. Firstly, if these data are to be excluded, not a single syntactic or semantic generalisation to be expressed will be matched with the complete set of data where licensing is required. Secondly, such dependencies form part and parcel of what the language-acquiring child is exposed to, a form of interaction which, as the Old MacDonald rhyme shows, they are capable of achieving quite early:

(33) Carer: Old McDonald had a farm... On that farm he had a
Child: cow.

(34) [addressing class of new nursery intake] Teacher: Your name is
Child: Mary
Teacher: And your name is
Child: Tommy.

On the other hand, endlessly inventing constructions or syntactic types is not going to address this problem as the split can occur at any point, so this move would lead to an explosion of constructions. Instead, it is the sentence-based licensing, on which previous accounts of ellipsis have rested, that is exposed as over-restrictive by dialogue data.

As the concept of "evolving context" implies then, the characterisation of these data needs to make reference to the dynamics of real-time processing expressed in a vocabulary that allows input from non-linguistic cognitive domains at a subsentential level. This is debarred in grammars that maintain the "autonomy of syntax" hypothesis, which disallows explanations in performance-related terms of incremental update. Moreover, as ALL syntactic/semantic dependencies can be split between speakers, licensing of such fragments requires the intervention of grammar, and cannot just be relegated to performance/pragmatics. What is critical is NOT completing some antecedently but only imperfectly realised string but adding to what has been provided to create some possible interpretation as output from the parts severally contributed.

So, in our view, what is needed is a grammar formalism modelling participant coordination in context and including:

- a set of mechanisms for inducing recovery of content from both linguistic and non-linguistic sources
- a modelling of word-by-word incremental licensing
- a model of context as recording all inputs, including the words, structures and procedures that induce that incremental development of content.

Dynamic Syntax is a formalism that incorporates these features and, hence, not only captures, but predicts the dialogue data wholly naturally. And, as we shall see, it is with this shift of perspective that ellipsis becomes less of a mystery, being characterisable in an integrated way despite the massive variability of interpretations.

1.2 Dynamic Syntax

Dynamic Syntax (DS) is a formalism based on the psycholinguistically-inspired action-based modelling of NL string-interpretation mappings in context. NL syntax is reconceptualised, not as a level of representation, but, instead, as a set of licensing actions for inducing or linearising semantic content, incrementally, on a word-by-word basis. As both parsing and production are defined as incremental and operating in tandem, the modelling of compound utterances emerges as an immediate consequence. Similarly, parsing and production exploit context which, in DS, is modelled intuitively as a record of all the actions and outcomes of incremental NL processing. Accordingly, context records not merely partial structures, as these are incrementally built up, but also the mechanisms used in constructing them. This richness of context is at the heart of the DS account of ellipsis construal. Like the direct reflection of parsing-production dynamics in compound utterances, the availability of strict and sloppy interpretations for a whole range of ellipsis and anaphoric devices is a direct consequence of this recording of actions and resulting content: both actions and content, once used, become available for recall and reiteration. So a unified account of ellipsis emerges, as we shall see, from the dynamics of the mechanisms underpinning the language system.

1.2.1 NL string - semantic representation mappings

We now turn to the details of the DS formalism. Processing in DS is taken to involve either building (*parsing*) or linearising (*production*) a semantic tree whose nodes incrementally come to reflect the content of some utterance. In processing a propositional structure, the first step is always a one-node tree that does nothing more than state the goal of the interpretation to be achieved, namely, to derive a formula of appropriate propositional type (Fig. 1.1, above $\Downarrow$). This is indicated by the *requirement* $?Ty(t)$. The query symbol, ?, indicates that this is a goal not yet achieved. This single node tree is then incrementally enriched as word-by-word processing proceeds, eventually leading to a complete tree of propositional type (Fig. 1.1, below $\Downarrow$).

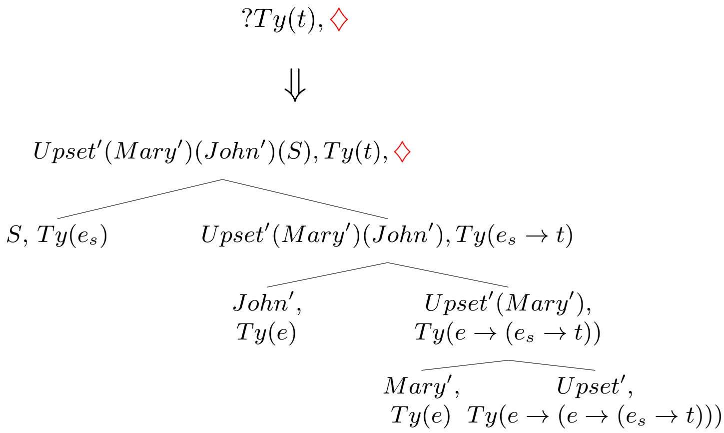

Figure 1.1. Processing *John upset Mary*

This result is achieved through a combination of grammatical actions put together with information from context. DS trees are invariably binary, reflecting functor-argument structure. By convention, the argument always appears on the left branch, and the functor on the right branch (a *pointer*, $\diamondsuit$, identifies the node under development). Each node in a complete tree is annotated, not with words, but with terms of a logical language (e.g. $Mary'$), and their type (e.g. $Ty(e)$). These logical terms are the sub-terms of the resulting propositional representation at the root node (see Fig. 1.1). The representation includes an event/situation argument S of type e_s, enabling tense/aspect construal as well as adjuncts (we suppress the details here, see Gregoromichelaki 2006; Cann 2011). Since this event/situation argument is a first-class citizen of the combinatorial structure, predicates are assigned types that reflect this: $Ty(e \to (e_s \to t))$ for combining with a subject first and then the situation argument, $Ty(e \to (e \to (e_s \to t))$ for an object, subject and situation etc.

1.2.2 Formalisation of tree-structure and incremental tree development

In order to talk explicitly about how such structures are constructed incrementally, trees are formally defined, together with a vocabulary for describing actions that induce the requisite tree development. Following Blackburn & Meyer-Viol (1994), DS adopts a (modal) logic with modalities that indicate what needs to be true at remote nodes or future developments of the tree for processing to be successful. There is the relation 'daughter' $\langle\downarrow\rangle$: $\langle\downarrow\rangle\alpha$ holds at a node if α holds at its daughter (with variants $\langle\downarrow_0\rangle$ and $\langle\downarrow_1\rangle$ for argument and functor daughters respectively). There is its inverse $\langle\uparrow\rangle\alpha$ which holds at a node if α holds at its mother, with argument, $\langle\uparrow_0\rangle$, and functor, $\langle\uparrow_1\rangle$, variants. A grammar then is defined as a set of *Actions* which are procedures for building/linearising trees. Actions are constructed via a procedural vocabulary that defines packages (macros) of actions like $\texttt{make}(X)$ for creating new nodes, $\texttt{go}(X)$ for moving the pointer, and $\texttt{put}(Y)$ for annotating nodes, where X and Y are tree relations and node-annotations (labels) respectively. Defined using this basic procedural vocabulary, *computational actions* are generally available macros for processing without any lexical trigger. For example, they introduce tree relations; they perform movement of the pointer $\diamondsuit$ around some partial tree under construction; they remove requirements once they are satisfied; and they perform beta-reduction operations when possible. *Lexical actions* are also macros achieving tree developments of the same type but contributed to the process by the lexicon of each particular NL.

1.2.3 Partial trees: requirements for completion

The mechanism driving forward NL processing is that of initial underspecification and its gradual resolution. Under the DS modelling of underspecification, there are various types. There is underspecification of content, which is arguably the most familiar from the wealth of literature on anaphora, to which we return in due course, where the output of semantic processing has to be enriched from context. But there is also underspecification of type of tree or node to be built, and even underspecification of the relation of a node to others in the tree. All these aspects of underspecification are expressed through the introduction of a *requirement*, $?X$, for some annotation X. These requirements express constraints on how the subsequent processing steps must progress. Such requirements apply to all types of annotation: there are type requirements, $?Ty(t)$, $?Ty(e)$, $?Ty(e \rightarrow (e_s \rightarrow t))$ etc; treenode requirements, $?\exists x.Tn(x)$ (associated with underspecified tree-relations in need of update); formula requirements $?\exists x.Fo(x)$ for any expression which, though typed, is only a placeholder for a content to be provided later from context; and requirements imposing semantic constraints, for example, $?\langle\uparrow_0\rangle Ty(e \rightarrow (e_s \rightarrow t))$, which defines the contribution of *accusative* case-marking as a requirement that a node so annotated be immediately dominated by a node of predicate type (as in the sister of the node carrying the *Upset'* annotation in Figure 1.1). In each case, these requirements drive the subsequent tree-construction process: unless they are eventually satisfied, processing will be unsuccessful.

1.2.4 Structural Underspecification

"Syntax" in the DS model is just the subset of actions that deals with the unfolding of tree structure via the twin concepts of structural underspecification and update. This is implemented via the definition of computational actions that include procedures inducing initially underspecified structural relations (*unfixed nodes*). These are defined using the Kleene star operator, *, and come with an associated requirement for future provision of a fixed tree-relation, i.e. a fixed tree-node address: $?\exists x.Tn(x)$. For example, $\langle\uparrow_*\rangle Tn(a)$ can appear on a node indicating that there is at least one future development in which the node with address a bears a sequence of zero or more mother, $\uparrow$, relations to the present node.

Word-order variation in various NLs can be treated via this means of unfixed nodes. In Figure (1.2), we can see how such structure-inducing computational actions feed NL-particular lexical actions, so that in combination the word-order properties of each particular NL are derived. For example, the SVO articulation of English, or scrambling in other languages, exploits a localised variant of unfixed nodes (*locally-unfixed nodes*). In Figure (1.2), step(i), an unfixed node is induced, initially describable merely as one of a set of argument nodes within some local predicate-argument structure. This is expressed as $?\langle\uparrow_0\rangle\langle\uparrow^1_*\rangle Tn(a)$, which, in words, indicates that the node so annotated must be eventually fixed as an argument node within the (sub-)tree whose root is $Tn(a)$. Now the word *John* can be processed, which annotates the unfixed node with the conceptual content associated with the context-particular individual John ($John'$).

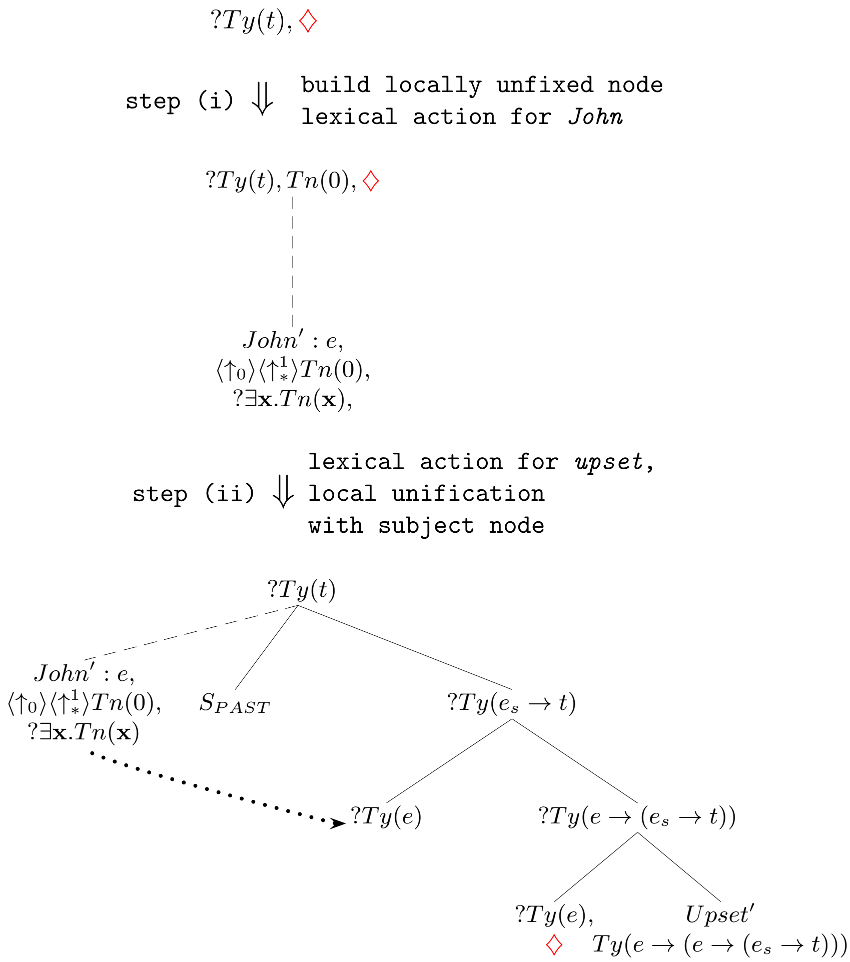

Figure 1.2. Unfolding structure for *John upset...*

We then process the word *upset* (step ii). In the lexicon, this is defined to induce a full template of predicate and argument relations as well as requiring that the existing locally unfixed node be fixed as its subject (see Fig. 1.3).

The sequence of underspecified structural relations and their update is also used in the processing of *long-distance dependencies*. For example, in cases like *Mary, John upset*, processing starts with application of a computational action which introduces, from the initial root-node annotated with $?Ty(t)$, a node whose relation to that top node is wholly *underspecified* except for the requirement that it is within the general emergent tree, i.e. defined as $\langle\uparrow_*\rangle Tn(0)$. This enables the word *Mary* to be taken to annotate this node, see step (i) of Fig. 1.4. Immediately following the construction of this unfixed node, the sequence of steps indicated in Figure (1.2) can take place. As a result, the new structure created now provides the environment which allows unification of the unfixed node annotated by $Mary'$ to take place, as indicated as step (iv) in Fig (1.4), the intermediate steps (ii) and (iii) being those set out in Fig (1.2). This resolution will be driven by the co-presence of, on the one hand, the requirement for a fixed tree node position $?\exists x.Tn(x)$ on that unfixed node, and, on the other hand, the requirement on the object node for a term of $Ty(e)$. Unification of the unfixed node at this juncture will simultaneously satisfy these two requirements.

upset

IF $?Ty(t), Tn(n), \langle\downarrow_*^1\rangle\langle\downarrow_0\rangle[Fo(\alpha), Ty(e)]$ } checking pointer position and for presence of locally-unfixed node

THEN $\texttt{go}(\langle\downarrow_*^1\rangle\langle\downarrow_0\rangle);$
$\texttt{put}(?\langle\uparrow_0\uparrow_1\rangle Tn(n)); \texttt{go}(\langle\uparrow_0\rangle\langle\uparrow_*^1\rangle)$ } determining unfixed node as subject

$\texttt{make}(\langle\downarrow_0\rangle) : \texttt{go}(\langle\downarrow_0\rangle);$
$\texttt{put}(Ty(e_s), Fo(U_{PAST}), ?\exists x Fo(x)); \texttt{go}(\langle\uparrow_0\rangle)$ } introducing situation argument

$\texttt{make}(\langle\downarrow_1\rangle); \texttt{go}(\langle\downarrow_1\rangle); \texttt{put}(?Ty(e_s \rightarrow t))$
$\texttt{make}(\langle\downarrow_0\rangle); \texttt{go}(\langle\downarrow_0\rangle); \texttt{put}(Fo(\alpha), Ty(e)); \texttt{go}(\langle\uparrow_0\rangle));$ } introducing subject node

$\texttt{make}(\langle\downarrow_1\rangle); \texttt{go}(\langle\downarrow_1\rangle);$
$\texttt{put}(?Ty(e \rightarrow (e_s \rightarrow t))); \texttt{make}(\langle\downarrow_1\rangle); \texttt{go}(\langle\downarrow_1\rangle);$
$\texttt{put}(Fo(\text{Upset'}), Ty(e \rightarrow (e \rightarrow (e_s \rightarrow t))))$ } introducing predicate node and content $Upset'$

$\texttt{go}(\langle\uparrow_1\rangle); \texttt{make}(\langle\downarrow_0\rangle); \texttt{go}(\langle\downarrow_0\rangle); \texttt{put}(?Ty(e))$ } creating object node and moving pointer to await lexical input

ELSE `Abort`

Figure 1.3. Lexical action for *upset*

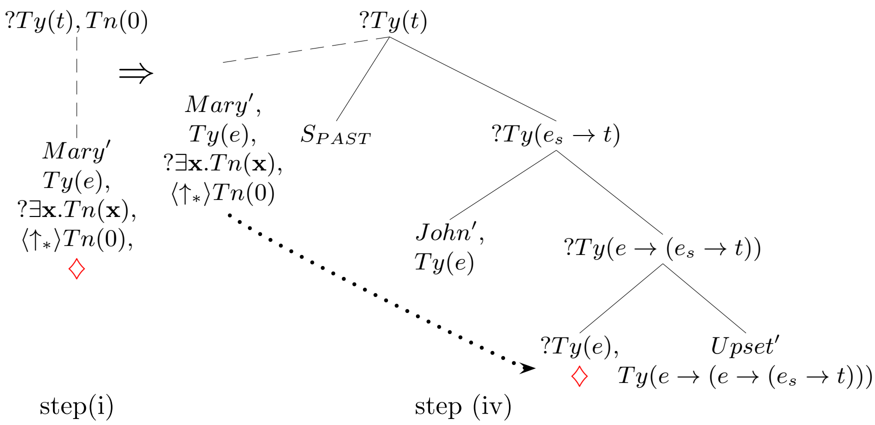

Figure 1.4. Parsing *Mary, John upset*

In the closing stages, there are invariably general computational actions of modalised beta-reduction which compile up the content of all nonterminal nodes to finally yield the complete tree as shown in Fig. (1.1).

1.2.5 Linking trees through term sharing

In order to reflect the full array of NL compound structures (e.g. adjuncts), DS employs a license to build paired trees, so-called LINKed trees. These are associated through the sharing of some term. This sharing is established through, for example, specialised anaphoric devices such as relative pronouns. Consider the structure, in Figure 1.5, derived by processing the string *John, who smokes, left* (omitting details of tense specification). The arrow linking the two trees depicts the so-called LINK relation. The tree whose node is pointed by the arrow is the LINKed tree (read $\langle L^{-1}\rangle$ as 'linked to'). Such LINKed trees, provide opportunities mid-sentence for NL processing to shift temporarily to a distinct structure for purposes of elaboration, expansion, explanation etc. of terms in the main structure. And this can happen either within a single propositional turn, giving structures like relative clauses, Hanging Topic Left Dislocation, clausal and phrasal adjuncts, etc., or across speakers where the effects include clarifications, confirmations, continuations, etc (see e.g. Gargett *et al.* 2008). Accordingly, LINKed trees provide an appropriately weak form of correlation between structures needed for modelling *sluicing* (see e.g. Merchant 2001), amongst other structures which may not be sensitive to island constraints.

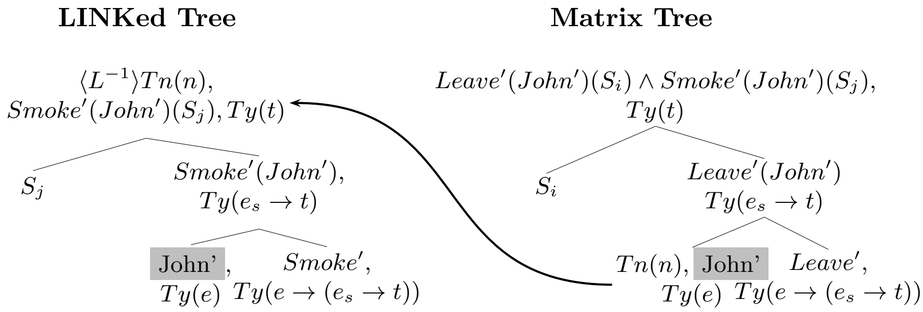

Figure 1.5. Result of parsing *John, who smokes, left*

This articulation of compound structures as independent LINKed trees, when put in combination with mechanisms that induce structure only within an individual tree, is indeed what provides a natural basis for expressing *island constraints*; and, as we shall see below in section 1.3.2.2, this means that modelling of the appropriate restrictions on antecedent-contained ellipsis emerges for free.

1.2.5.1 Epsilon terms

Though in this chapter we place very little emphasis on quantification, we note that NPs (DPs) in DS contribute content in the form of arbitrary names, *epsilon terms*, defined to denote a witness of type e, and with scope variation expressed via statements of term-dependency (see Kempson *et al.* 2001; Cann *et al.* 2005).[1] So processing a DP like *every student* will result in expanding the tree with a subtree with top-node content the term $\tau, x, Student'(x)$ of type e. The interpretation of such a term induces universal force via a choice function that selects an arbitrary witness based on the content of the whole containing sentence. The subtree will contain minimally a fresh variable and an appropriate lambda-abstract needed to create the full term. A DP like *a student* will result in a term $\epsilon, x, Student'(x)$ with existential reading.

This analysis applies also to tense/aspect/modality construals, with such elements providing constraints onto a propositional structure with an associated event term ($S_{i,j,...}$) denoting an arbitrary witness of the event depicted (see Gregoromichelaki 2006; Cann 2011).

1.3 Ellipsis in Dynamic Syntax

We now turn to underspecification of content, its realisation in elliptical forms, and their construal relative to context.

1.3.1 Context in DS: three basic mechanisms for recovery of content at the ellipsis site

The concept of context appropriate for a processing-directed account is substantially richer than is expressible in either model-theoretic accounts or semantically-blind syntactic accounts. On this view, *Context* is a dynamic, multi-modally induced record of (a) words; (b) conceptual content notated as tree structures; and (c) the sequence of steps in building the emergent trees – a sequence of partial trees, and the actions that effect the transitions between them (for the finer articulation of semantic parameters in context see Purver *et al.* 2010; Gregoromichelaki & Kempson 2014, to appear). More specifically, this unfolding of

[1] Proper names will be shown here in the abbreviated form $John'$, $Bill'$ etc., presuming them to be shorthand for appropriate expanded, context-dependent terms.

options is represented in Sato (2011); Purver *et al.* (2011); Eshghi *et al.* (2012) as a Directed Acyclic Graph (context DAG) where each node represents the current (partial) tree and each edge in the graph records the action taken (see Fig. (1.13)). *Context of a partial tree* is then the path back to the root of this graph; and actions, as well as conceptual content on the trees, are recoverable for re-iteration/re-use in creating new construals. As a result, there are three basic mechanisms by which the ellipsis site, being an underspecified element awaiting resolution, interacts dynamically with the context DAG for content recovery:

(a) Re-use of content (semantic formulae) from some (partial) tree on the context DAG.
(b) Re-use of sequences of actions from the DAG (sequences of DAG edges).
(c) Direct re-use of structure, i.e. extension of some (partial) tree in context.

1.3.2 Content underspecification and recoverability through copying or action-replay

Initial content underspecification is characteristic of both pronominal and elliptical expressions (e.g. VP-Ellipsis/VP-anaphora), as in these cases there is an explicit trigger for content recovery - e.g. a pronoun or an auxiliary in English. Anaphoric expressions can be of various types, with the common feature of introducing on the tree a temporary content place-holder (a *metavariable* in DS terms) of the appropriate type (e.g. term, $Ty(e)$, predicate $Ty(e \rightarrow (e_s \rightarrow t))$, etc.). These license construals either from the linguistic or extra-linguistic context, recall (1), (2) and (5) at the outset of this paper, or cataphoric identification from within the construction process (see (3)-(4) above). In DS notation, pronouns introduce a formula metavariable ($Fo(\mathbf{U})$) of type e with the accompanying requirement for replacement by an appropriate logical term: $?\exists x Fo(x)$. For reflexives and anaphors, it is straightforward in DS to identify the requisite concepts of locality constraining antecedenthood since all lexical and computational actions are defined in the same procedural vocabulary. All arguments local to a given predicate are identifiable as meeting the characterisation: $\langle\uparrow_0\rangle\langle\uparrow^1_*\rangle Tn(a)$ (i.e. $Tn(a)$ is up one argument-relation plus a possibly empty sequence of function-path relations from the node so characterised). Reflexive anaphors can then be characterised as projecting the action specified in Fig. (1.6), reflecting a restriction to antecedents as only "co-argument" terms; and, conversely, pronominals exclude as antecedent any formula at a node standing in such a local relation.[2]

$$\begin{array}{lll} \text{IF} & ?Ty(e), Fo(\alpha) & \\ \text{THEN} & \text{IF} & \langle\uparrow_0\rangle\langle\uparrow^1_*\rangle\langle\downarrow_0\rangle Fo(\alpha) \\ & \text{THEN} & \texttt{put}(Fo(\alpha), Ty(e))\,. \\ & \text{ELSE} & \texttt{Abort} \\ \text{ELSE} & \texttt{Abort} & \end{array}$$

Figure 1.6. Action for reflexive anaphors

Similarly, *wh*-pronouns contribute a metavariable (**WH**), specifically defined as awaiting substitution by a term in some future utterance.

An ellipsis site is treated similarly as inducing a place-holding metavariable, with an accompanying requirement $?\exists x.Fo(x)$ for recovering from context some appropriate input: either (a) content from some tree in context, or (b) a sequence of actions in context to be re-iterated at the ellipsis site. The two mechanisms are implemented through the pair of computational actions, *Substitution* and *Regeneration*.[3] Fig. 1.7 displays the substitution process (a) for the pronominal and (b) the elliptical expression in (35).

(35) A: John upsets Mary.
B: Bill annoys her. / B: BILL does

Fig. 1.8 then displays the regeneration process of an ellipsis site for cases like B's answer in (36):

[2] See Gregoromichelaki 2006, 2013a for a reformulation of Binding Theory in DS terms.
[3] For formal definitions, see Kempson *et al.* to appear.

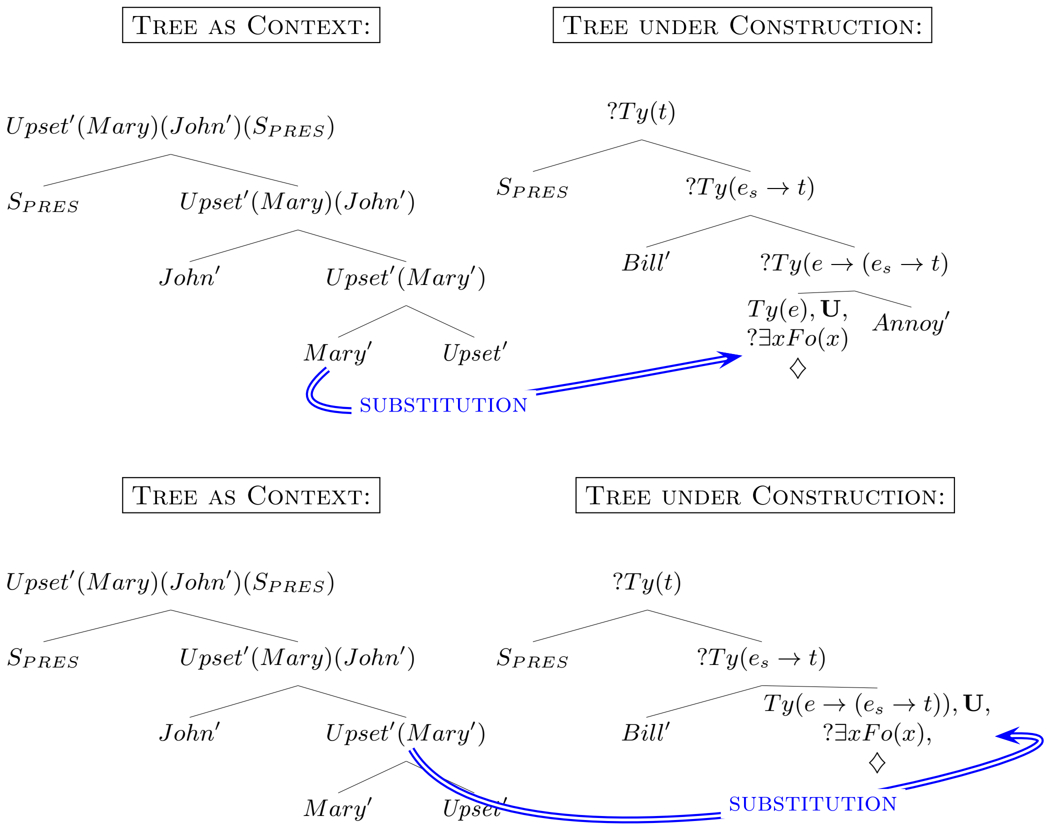

Figure 1.7. Substitution from context at the ellipsis site of (35): anaphora and VP-Ellipsis

(36) A: Who upset himself?
B: John did.

This is achieved by re-using the actions involved in constructing the question to flesh out the predicate-ellipsis form of the answer. The DS processing for the question in (36) involves the following actions after parsing of the subject *who* (omitting tense details for clarity): constructing a predicate as indicated by the verb; construction of an object argument; and then, because this object contains a reflexive pronoun, obligatorily identifying its value with that of the subject. Now, if these actions are stored as a sequence in context, they will then be accessible in that sequence for re-use in the next stages of the parse. Re-applying these very same actions on the new tree at the site of the elliptical fragment is triggered by the use of the auxiliary *did*. With $John'$ now annotating the subject node, this then leads to the construal of the answer as involving a re-binding of the object (the reflexive pronoun) argument to the provided new subject ('John'). The effect achieved is the same as the higher-order unification account of Dalrymple *et al.* (1991) but without anything beyond what has already been used for the processing of the previous linguistic input and, consequently, without any need to assign some distinct type of expression to the elliptical element *did* or the subject *John*. All that has to be assumed is that the metavariable **U** contributed by the anaphoric *did* can be updated by an action-sequence taken from the context, identifying this process as anaphoric in kind.

1.3.2.1 Strict/Sloppy ambiguities as a result of content recovery

This duality of mechanisms for content recovery at the ellipsis site (copied content vs. action reiteration) provides a way of capturing the strict/sloppy ambiguity observed in several forms of ellipsis: either

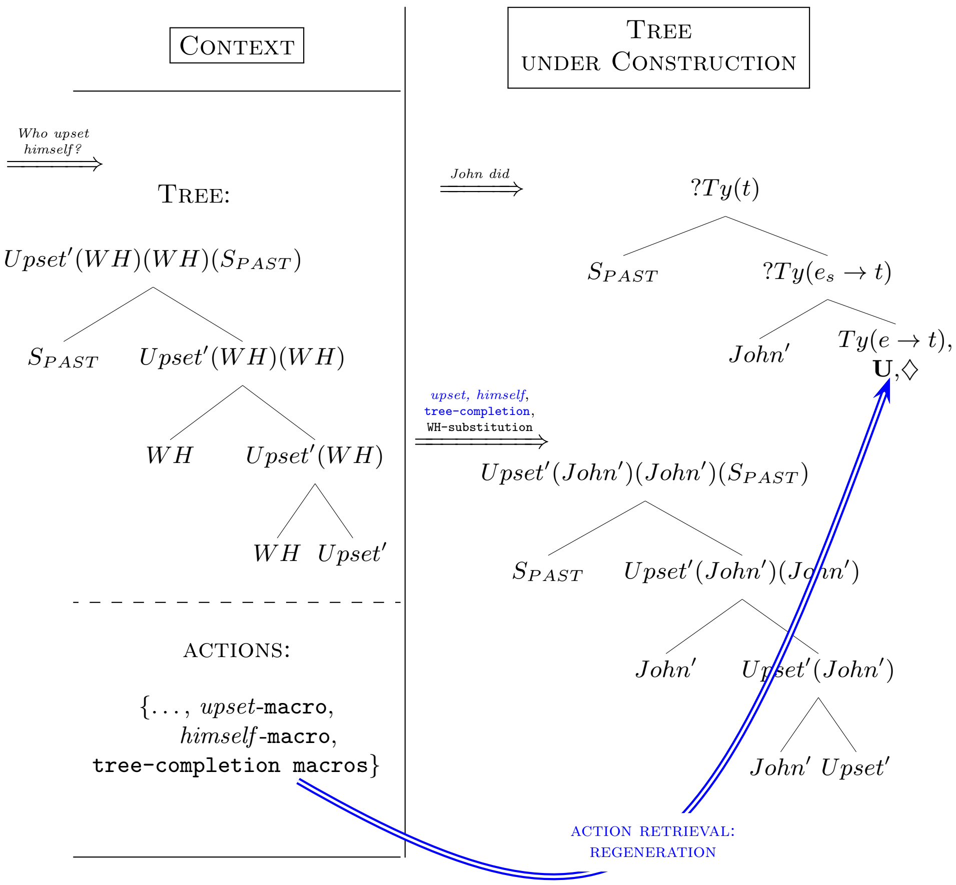

Figure 1.8. Action replay from context at the ellipsis site

content specifications or sequence-of-action specifications can be reiterated, the one preserving some previous construal, the other preserving only the PATTERN of construal. For strict interpretations, it is the representation of content which is copied over directly as providing a value for the ellipsis site. For sloppy interpretations, it is a sequence of actions selected from the antecedent site that can be reiterated at the ellipsis site to provide the appropriate interpretation, parallel to the interpretation of the antecedent but discrete:

(37) Bill will help his students, though whether John will, is less clear.

This gives precisely the right basis for the ambiguity. In (37), a strict construal $\lambda x.Help'(Students'(of - Bill'))(x)$, 'help Bill's students', is carried over as the fixed predicate content to be predicated of the subject $John'$. In contrast, a sloppy interpretation involves the sequence of actions associated with processing $help + his + students$ in the first conjunct re-applied to the new subject $John'$.

The same type of analysis applies to two subcases of anaphora – co-referential and so-called *lazy pronouns*, with the concept of parallelism of interpretation applying in that domain too. Coreferential construals constitute a replication of some antecedently-constructed content of individual type e; lazy construals involve recovery of actions to be re-run at the site indicated by the pronoun to yield some requisite term that is distinct from that picked out by the antecedent:

(38) John came into the room. He looked very sick. [*He* is resolved by replicating the content $John'$]

(39) John always keeps his keys in the same place. Michael just dumps *them* down when he comes in, so is always losing them. [*them* resolved by rerunning actions corresponding to *his keys* in the previous clause]

1.3.2.2 Syntactic licensing: island restrictions

The advantage of presuming that actions for building up representations of content are amongst what is retrievable from context is also that suitable subsequences of these actions can constitute the basis for construals of VP-ellipsis where syntactic dependencies have to be reconstructed at the ellipsis site as we saw earlier in (36). Another type of syntactic restriction is also capturable through the characterisation of compound structures as independent LINKed trees (as explained in section 1.2.5). In DS, this is what provides a natural basis for expressing so-called *island* restrictions: due to its very definition, an unfixed node cannot be resolved across a LINK relation. This is because its address specification, $\langle\uparrow_*\rangle Tn(a)$, would not be satisfied in such a case, given that the steps linking this node to $Tn(a)$ would necessarily include an intervening LINK relation (L), not just steps over mother relations as specified by $\langle\uparrow_*\rangle$ (see Kempson *et al.* 2001; Cann *et al.* 2005).

With this perspective on structural constraints, the parallel restriction on *antecedent-contained ellipsis* emerges unproblematically:

(40) John interviewed every student [who Bill already had].

(41) *John interviewed every student [who Bill ignored a teacher [who already had]].

Simplifying for reasons of space here, in these cases the DP is minimally made up of a determiner (*every*), a nominal (*student*) and a relative pronoun (*who*) initiating a relative clause which contains the ellipsis site (*had*). This relative clause is expected to provide an added restrictor to the variable bound inside the epsilon term $\tau, x, Student'(x)$ contributed by the DP. The DP word-sequence has to be processed along with the usual principles governing the processing of relative clauses. First, processing the determiner phrase *every student* involves constructing an abstract $(\lambda y.\tau, y, Student'(y))$ that will result in binding a variable x introduced by the noun *student*.[4] Second, a LINKed tree is constructed from the node occupied by x with the requirement to include this variable as one of the arguments of this new LINKed tree in order to furnish it with further restrictions. Because relative pronouns in English appear as left-dislocated elements, an unfixed node is introduced initiating the building of this LINKed tree in order to process the relative pronoun, *who*, which later needs to be interpreted as the object of the verb inside the relative. Processing the relative pronoun then annotates this unfixed node with a second copy of the variable x. It is then the underspecified domination relation associated with the unfixed node, $(\langle\uparrow_*\rangle Tn(a))$, which independently imposes the constraint that its position must be resolved within the domain of a single tree. As a result, this then precludes the possibility that this unfixed node could be unified as the argument of a further LINKed tree as, by definition, there are no dominance relations holding across LINKed structures (Fig. 1.9):

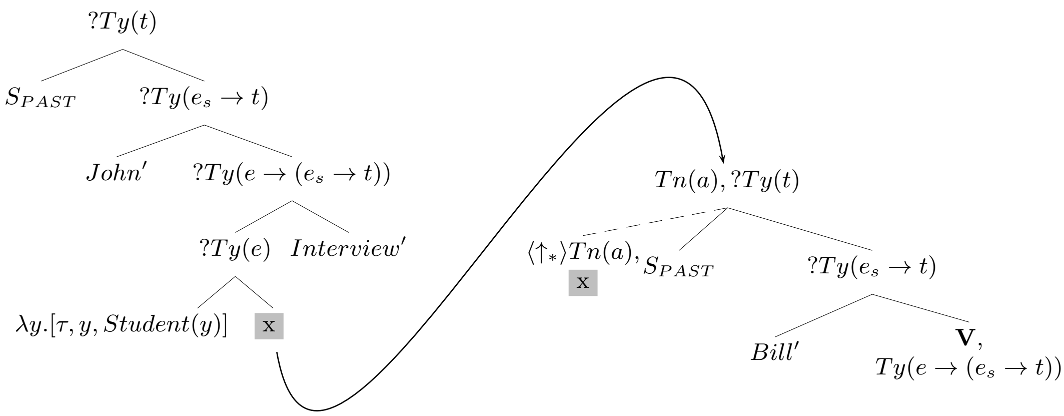

Figure 1.9. Successful processing of *John interviewed every student who Bill had*

[4] We are simplifying as regards the details of quantificational subtrees for reasons of brevity.

Now, in coming to resolve the metavariable **V** which the ellipsis site *had* inside the relative clause has contributed, a sequence of actions from the context has to be retrieved that will result in a subtree of $Ty(e \to (e_s \to t))$. But now the choice of which sequence to select is constrained: the selected sequence that will resolve the ellipsis has to conform to the already mentioned independent restriction on unfixed nodes imposed on the partial tree already constructed from the relative pronoun. Hence the variable x can only appear in the local tree and cannot cross further to another LINKed one. This explains the island sensitivity yielding ungrammaticality in (41) where this constraint cannot be satisfied (Fig. 1.10):

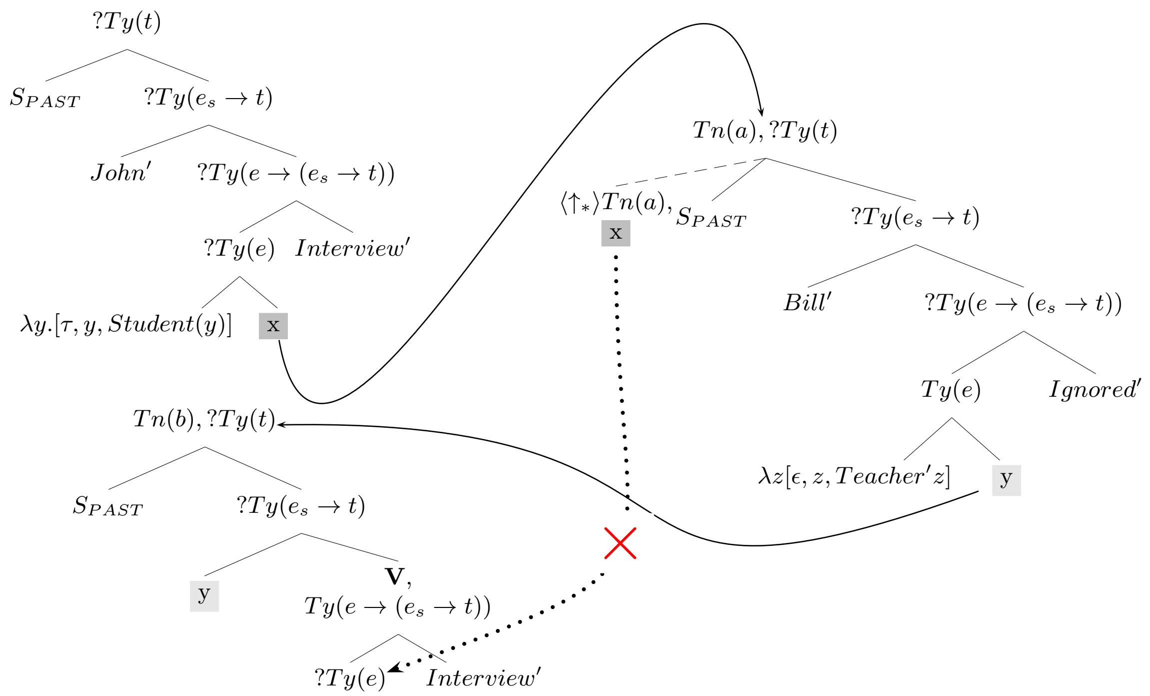

Figure 1.10. Ungrammaticality of (41) as impossibility to unify unfixed node with object of *interview* in second relative clause

Notice the significance of this result. In other frameworks, island constraints would be articulated within the component of syntax, independent of any interpretation considerations, hence not expected to interact with ellipsis construal. In DS, however, with syntax defined in terms of update of representations of content, such restrictions, modelled as constraints on tree development, are directly predicted to also constrain ellipsis. This is because ellipsis is also modelled as a process of contextual development and is therefore required to conform to any restrictions applying independently to such processes.

1.3.3 Fragments: recoverability and licensing

1.3.3.1 Structural underspecification and recoverability of content for fragments

This method of processing by enriching the extant context applies equally to fragments: if uttered alone without prior sentential context to provide a structure needed for completion, fragments can be processed as occupying such a structurally underspecified node. For example, *Mary* in (42) can be uttered in isolation in a context where actions are available for repeated application from context, as in the *bare argument ellipsis* case:

(42) Sue, John upset. Mary too.

Here *Mary too* is interpreted as 'John upset Mary' via a sequence of actions in which $Mary'$ is taken to annotate an unfixed node, later unified to become the internal argument of $Upset'$, exactly following actions used in interpreting the preceding string, a form of priming. So the projection of an unfixed node, like the underspecification of anaphora, can be resolved either subsequently in the construction process, familiarly known as long-distance dependency but on this perspective analogous to cataphoric or *expletive pronoun* resolution (see earlier (3) and (4)), or as in (42) by reiteration of actions from some previous utterance, analogous to cross-utterance and *paycheck anaphora* resolution (see earlier (17)).

Completing the parallelism between unfixed-node structures, anaphora and ellipsis as different forms of underspecification in utterance understanding, the resolution of an unfixed node can also be resolved indexically. Of these, the most striking instances are children's one-word utterances at early stages of language acquisition where they rely on their interlocutor to construct some open structure into which their presented fragment can be incorporated. One real example is the following child utterance to the mother which occurred the day after an event shared by father and son:

(43) Eliot (pointing across the canal to empty mooring): Daddy
Alex: That's right dear. You were here with Daddy yesterday, clearing out the boat.

Eliot here relies on his mother to construct a predicate sufficient to complete the very partial structure from the words he offers as an initial opener.

Thus, from this perspective, use of fragments in co-constructed utterances (see e.g. (30)-(32)) isn't merely an optional economy measure, it is an essential vehicle for coordination, which is crucially exploited during both language acquisition and mutual language-adjustment among participants in human interactions. Furthermore, the expressibility of the parallelism among anaphora, ellipsis, and what might otherwise seem the wholly unrelated phenomenon of long-distance dependencies is a surprising, hence robust, confirmation of the interactive and dynamic perspective on syntax.

1.3.3.2 Licensing fragments: articulating morphosyntactic licensing constraints

Concerning the licensing of such fragments in languages with rich morphology (see earlier (24), (26)), as we said earlier, all such morphological restrictions are expressed in DS via modal requirements expressing future developments. For example, *accusative case* marking, as in (26), introduces the requirement: $?\langle\uparrow_0\rangle Ty(e \rightarrow (e_s \rightarrow t))$, as a restriction that a node so annotated be immediately dominated by a node of predicate type in a conceptual structure (see, e.g., the sister node of $Upset'$ in Fig. 1.1). And since DS trees do not represent specifically linguistic content, such conceptual structures can ensue either by NL processing, via input from other modalities, or ad hoc inference so that the content of the fragment can be legitimately integrated in all such cases, without needing the recovery of a sentence that has not been uttered.

Similarly for other fragments that require a specialised environment to be processed in. As we saw earlier, pronominals provide underspecified content. And so too do *wh*-pronouns, with their specialised metavariable requiring instantiation external to the tree under construction, and reflexives, with their restriction on local provision of an antecedent (see earlier (1.6)). Combining this with a view of fragments as able to further develop an already present structure in context allows for *short-answers* (see, e.g., (8) earlier) to be processed unproblematically according to various licensing constraints, for example, in combination with binding restrictions (see Fig 1.11 for illustration):

(44) Q: Who did John upset?
Ans: Himself.

So morpho-syntactic constraints on ellipsis, which are amongst those most problematic for semantic accounts, are here resolved by the collapse of the distinction between syntactic and semantic representations and the reformulation of "syntactic" restrictions in dynamic-semantics terms, as constraints on the context of occurrence.

1.3.4 Compound utterances

Like short-answers, compound-utterances exploit the same mechanism of direct extension of some partial tree in context. And it emerges that this is what is needed to characterise not only the vast seemingly

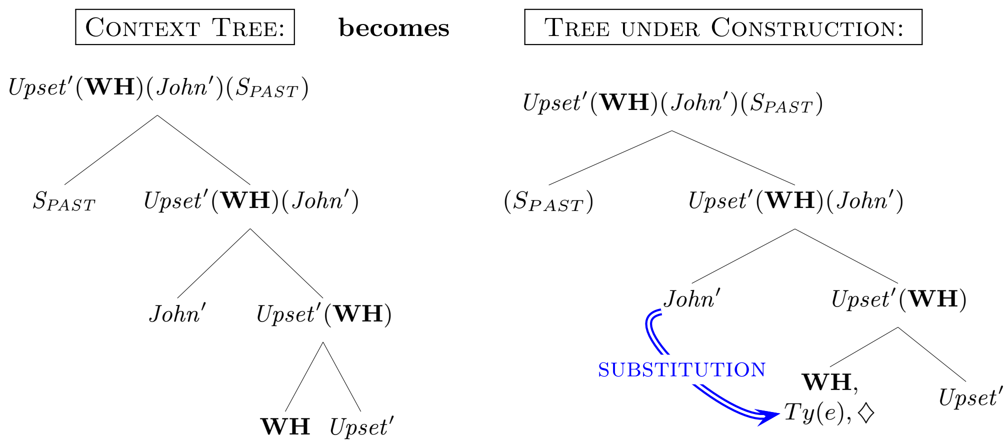

Figure 1.11. A short answer with binding restrictions

heterogeneous array of compound utterance data, but also fragment types identified as *sluicing*, *reprise clarifications*, *corrections* etc. (see also Kempson *et al.* 2007; Gargett *et al.* 2009; Gregoromichelaki *et al.* 2009). For modelling all these, we need to consider the tight coupling of parsing and production as articulated in DS. Given that the grammar is common to both, production as well as parsing involves tree construction. The only additional assumption underpinning production is that at every step of such processing there must be some richer tree, a so-called *goal tree*, which the tree-under-construction must *subsume*, i.e., the partial tree that is being developed must be extendible into that goal tree by following the licensed actions of the system (Purver & Kempson, 2004). To put this informally, whereas parsers have to follow what the speaker offers them, speakers have to have at least some partial idea of what they are going to be communicating at the next step. Otherwise, the dynamics of the two activities is shared so each processor simulates the actions of the other (Gregoromichelaki *et al.*, 2013b). Shift of roles from parsing to production and vice versa are accordingly predicted to be wholly unproblematic (Gregoromichelaki *et al.*, 2011; Howes *et al.*, 2011). Due to the modelled incrementality of processing, two properties of the NL production (generation) mechanism are pertinent for compound utterances. First, there is nothing to prevent speakers initially having only a partial structure to convey, i.e., the goal tree may be a PARTIAL tree, perhaps only one step ahead from what is being voiced. This is unproblematic, as the subsumption check with the goal tree is equally well defined over partial trees.[5] Secondly, via use of requirements, the DS grammar implements a notion of *predictivity*, i.e. the parser is defined simultaneously as a producer, constantly generating predictions as to what will follow next.

As a result, if, at some stage in the processing, an interlocutor has the ability to satisfy the projected requirements via their own resources, e.g., via lexical access or by extending the current tree with a LINKed tree, it is perfectly sanctioned by the grammar for them to take-over and continue extending the partial tree under construction in any direction they require. Consequently, DS is able to deal even with cases where, as we saw in (31), repeated modified here as (45), compound utterances can take forms which would be ungrammatical under standard assumptions *(*Did you burn myself?)*:

(45) Mary: Did you burn
Bob: myself? No.

Given that in DS only representations of semantic content are derived, not structures over strings of words, the switch of person mid-utterance is straightforward and leads to a wellformed result. Figure 1.12 displays the partial tree induced by processing Mary's utterance *Did you burn*, which involves a substitution of the metavariable projected by *you* with the term standing for the current addressee, Bob. At this point, Bob can complete the utterance with the reflexive. This is because a reflexive, by definition, just copies a formula from a local co-argument node onto the current node (see Fig. 1.6), just in case

[5] Cases where change in the goal tree occurs are modelled via backtracking along the context DAG, giving rise to overt repair (see Hough 2011).

that formula satisfies the person/number conditions of the expression, in this case, that it designates the CURRENT speaker.

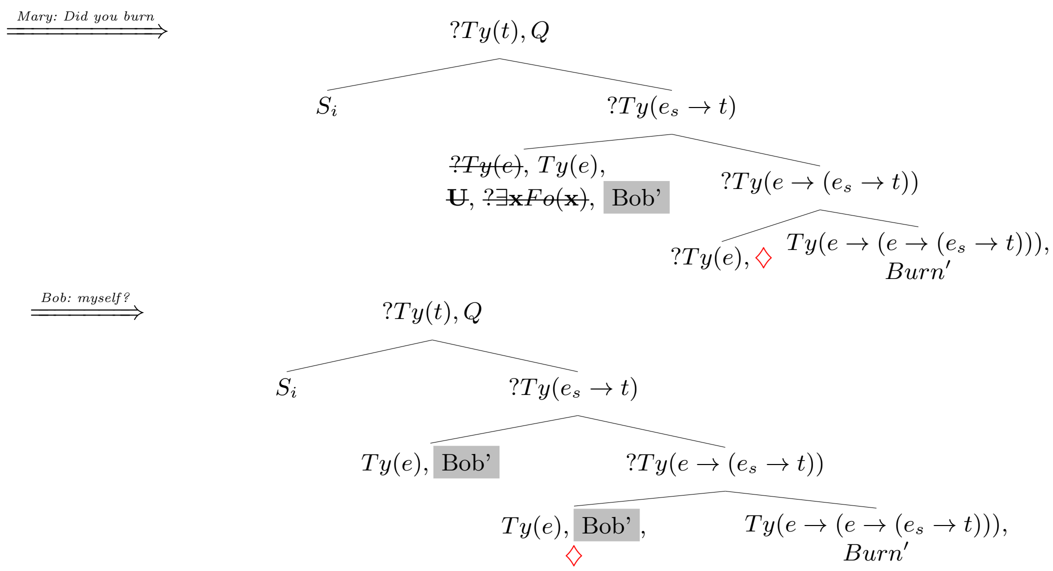

Figure 1.12. Incremental development of Mary's/Bob's context via processing words.

This illustration is only of the simplest type of compound utterance, but the point is entirely general. These seamlessly achieved shared utterances can apparently separate off any expression from the syntactic environment it needs for its wellformedness because both speaker and hearer incrementally mirror each other in applying the same mechanisms. Moreover, one and the same individual, whether as speaker or as hearer, will invariably have a grammatically-licensed partial structure on which to rely at the point of participant switch. It is notably the absence of a "syntactic" level of representation, distinct from that of semantic representations (put together with the fact that grammatical mechanisms and the lexicon are taken as procedural, context-dependent instructions for update), which allows the direct modelling of such fragments as genuine continuations rather than necessitating their analysis as sentential ellipsis. This phenomenon of speaker switch in the middle of a dependency under construction is a major challenge for sentence-based grammar frameworks and potential analyses of each part as fragmental with subsequent reconstruction misses the discourse significance of an interlocutor presenting their offering as a continuation/interruption/reformulation etc. (Gregoromichelaki *et al.* 2013b).

1.3.5 Mechanisms for interaction: repairs and self-repairs

Finally, there is a further consequence afforded by such a system. The incremental licensing of NL-strings and interpretations is an ideal background for modelling the processing of *repair* (see e.g. Schegloff 2007), and even a subclass of repair, *self-repair*, a pervasive phenomenon in dialogue (Shriberg, 1994). Given that the DS notion of context can be characterized as a DAG, the ellipsis protocols that make use of actions and formulae in context use a *backwards search*. This same backwards search mechanism can be used to resume parsing from appropriate points in the context in the face of syntactic disfluency in self-repair processing– see Hough 2011 and Hough & Purver 2012 for details. This approach models common types of self-repair phenomena such as short repeats (*I, I go to Paris*) and substitutions (*John likes, uh, loves Mary*), but it can also deal with the rarer phenomenon where ellipsis must operate within a repair structure. In the following example, ellipsis reconstruction must operate across an interruption point + a repair (the bracketing follows Shriberg 1994):

(46) Peter went [swimming with Susan, + {or rather,} surfing] yesterday

This is a *substitution repair* where the reparans *surfing* repairs the reparandum *swimming with Susan*. However, in one plausible interpretation, the speaker continues to describe an activity ‘with Susan’, and this requires elliptical resolution during the reparans phase and use of the structure in the reparandum. As a result, the committed status of the information ensuing from *with Susan* must be maintained whilst the content of the verb *swimming* is substituted by that of *surfing*. The action sequences triggered by *with Susan* therefore must be re-run, using Regeneration. Schematically this can be seen in Figure 1.13.

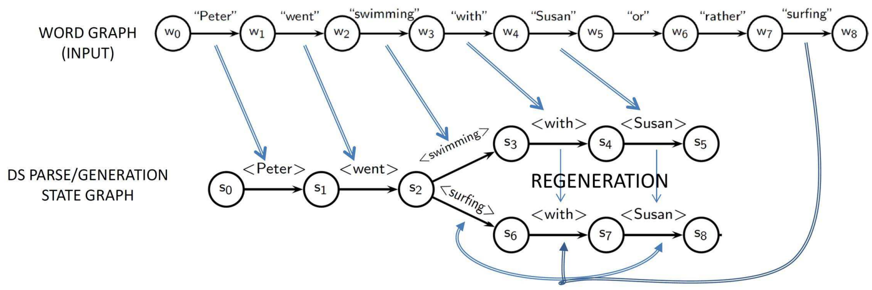

Figure 1.13. Incremental interpretation of self-repair by re-running of DS actions

It is the fact that actions are first-class citizens in the DS context that allows this straightforward integration of parsing and generation to enable the direct reflection of incremental dialogue-level interaction between agents. The only additional technology required here is a record of what has been repaired and what is doing the repairing action (Hough & Purver, 2012) to differentiate these phenomena from the other types of ellipsis described above.

1.4 Reflections

In this chapter, we have briefly shown how, by sustaining the abstractions and restrictedness of standard grammar formalisms, various accounts of ellipsis are unable to provide a unified picture of all the phenomena as endemic context-dependency. In our view, this is because the sententialist/propositionalist orientation of most approaches imposes a distorted view on the forms of explanations that can be provided, which enforces the characterisation of ellipsis in terms of arrays of multiple ambiguities. Instead, we have shown how, with a shift to a perspective in which grammars are grounded in the incrementality/predictivity of processing actions, a general feature of cognition (Pickering & Garrod 2009), a new perspective opens up. Through the direct linking of perception/understanding and action/production, NL mechanisms, defined here as stabilisation patterns of processing actions, can all be seen as grounded in their potential for achieving coordination during interaction with either other individuals or with the environment. As a further consequence, by modelling this type of coordination/“repair”, the continuous plasticity of the NL resources and mechanisms can be given formal expression so that learning and adjustments occurring even during a single instance of interaction are characterised as the expected consequences of a flexible, context-responsive and adaptive system.

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