On the processing of elliptical fragments: a Preliminary Report

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Abstract

This document surveys the problems posed by ellipsis data, some of them very wellknown, but as a set still posing very considerable challenges and, as a proof of concept of the insights expressible by Dynamic Syntax analyses, uses the intrinsic incrementality of the DS framework to capture structural and semantic properties of elliptical fragments in ways that are not available to more static analyses, solely reflecting output forms of content.

1 Ellipsis: The Challenge

Ellipsis (from the Greek: elleipsis, "omission") is a cover term for 'constructions that lack an element that is recoverable or inferrable from the context'. The conversational exchange in (1) illustrates the broad range of different ellipsis types : [1] An illustration of some of the different types is given in (1)

(1) A: John is using my apartment with Cyril on the 17th; and Tom my office on the 18th. Do you need either?
B. Your apartment please, for the night of the 19th.
A. Fine. Mary has also asked to, with Bill on the 20th, though I've no idea why. And Sue with Harry on the 21st, so please leave the place clean.

There is "gapping" (*Tom my office*, *Sue with Harry*), bare argument ellipsis ('stripping': *your apartment*, *for the night of the 19th*, *with Bill*, *on the 20th*; "subject+aux drop" (*Fine "*); "sluicing" *no idea why*,

[1] http://www.sil.org/linguistics/glossaryoflinguisticterms/WhatIsAnEllipticalConstruction.htm

VP ellipsis *asked to*, a nominal form of ellipsis (*either* in *Do you need either?*). All of these match the criteria for identifying an expression as elliptical, since all contribute to determining a very considerably richer structure that just what is provided by the words, and in each case what is supplied to this end is provided by the context within which the fragment is uttered.

Ellipsis is a paradoxical phenomenon, arising as it does in the ABSENCE of overt linguistic expressions to locally determine the requisite interpretation, yet manifestly relying on the PRESENCE of something contextually provided for determining the intended result. At first glance, the lack of overt expressions from which to compute such interpretation might seem uncontroversially not to be explicable as a syntactic phenomenon since there aren't the overt expressions from which to project the intended interpretation. To the contrary, however, there is ongoing dispute as to whether it has to be some covert syntactic structure that is presumed as input to the projection of these understandings. Within syntactic frameworks, indeed, VP ellipsis, sluicing, stripping, and gapping, are all identified as discrete phenomena manipulating a range of operations mapping some requisite full sentential source structure corresponding to interpretation onto the surface sequence, which is obtained by a late "PF" deletion process (Fiengo and May 1994, Merchant 2004, 2009, Chung et al 1995) Competing semantic accounts, at least for VP ellipsis and stripping, project the intended content from the surface sequence of expressions, without any such abstract syntactic level (Dalrymple et al 1991, Hardt 2008). There is an important restriction of remit on all such grammar-internal accounts. Given that the remit of grammar-based accounts of linguistic structure is the characterisation of all and only the wellformed sentences of the language and the pairing of these onto assignable interpretations, the remit of all these analyses extends only to those types of ellipsis which can be reconstructed as sentential in type for which a propositional structure/content is projected, given some antecedent linguistic string and the fragment itself.

This remit however sits awkwardly on the phenomenon of ellipsis as characterised above, as this characterisation is not restricted to constructions of particular type, as Culicover and Jackendoff (2005) note. Conversational dialogue for example involves widespread use of fragments in discourse in which participants provide expressions which wholly rely on what has been said just before to extend that expression, to acknowledge it, to revise it, etc, irrespective of whether or not the result projected from that fragment in that immediate context corresponds directly to a propositional content:

(2) A: I hear Harriet's been drinking again.
B: Scotch, every night.

(3) a: Could you fix me a drink?
B: In a minute.

(4) A: Let's get a pizza. B: Pepperoni?

(5) A: We're going to Marlborough
B: to see Granny?
A: if we have time.

(6) A: I'm afraid I burned the kitchen-ceiling.
B: Did you burn
A: myself? Fortunately not.

(7) A: Have you read ...
B: any of your new book? The preface.

(8) Gardener: I shall need the mattock.
Home-owner: The...
Gardener: mattock. For breaking up clods of earth.

(9) A. They X-rayed me, and took a urine sample, took a blood sample. Er, the doctor
B: Chorlton?
A: Chorlton, mhm, he examined me and said... [BNC]

(10) Daughter: Oh here dad, a good way to get those corners out
Dad: is to stick yer finger inside.
Daughter: well, that's one way (Lerner 1991)

(11) A: Most of the ones that we brought seem to have erm
B: survived
A: survived. Which I'm glad [BNC]

As (89)-(11) indicate, though some of these fragments are construable as adjuncts mapping (the previous) sentential sequence onto some distinct sentential content, for example (5), this is by no means necessary (see (9)); and the mapping may involve not so much extension of the previous sentential sequence, as modification of its subparts, yielding a new result (as in (4),(7), (10), (11)). Nonetheless, given the characterisation of ellipsis as arising when the context determines that the expression is omissible, these are uncontentiously subtypes of ellipsis.[2] Such data are problematic for standard analyses, as all conventional analyses are geared either to abstraction from an established PROPOSITIONAL content to yield a predicate abstract, or to syntactic analysis

[2]Culicover and Jackendoff 2005 observe a number of examples which they classify as non-sentential and therefore not at issue. These include vocatives, expletives, scores, and other idiomatic expressions. It is arguable that listing expressions, such as scores, are wellformed individual-denoting terms, and that a systematic part of any natural-language system is the license provided to such compound group-denoting terms. However we too leave these on side here.

of the fragment as a complete sentence, subject to late PF deletion of all but the fragment itself.

These "split utterances" have not to date been treated in any detail in the literature, except by the present authors, with the sole exception of Poesio and Rieser (2010), who analyse a sub-type of split utterance so-called *completions*. These are fragments that occur where the second participant is aiming to complete an utterance to match the intentions of their other interlocutor, as in (6)-(7) and (11); though even these may not involve the words the interlocutor being queried would choose. However, as this list of examples suggests, it is far from obvious that ellipsis types should be identified according to any such rhetorical function, as this may not be computable at the point of interchange between participants: see in particular 9), where the fragment occurs so early in the proposition under construction that the containing emergent rhetorical structure it is purportedly clarifying is not identifiable at all, at the point at which the request for clarification takes place. As all of (3-(11) demonstrate, fragmentary expressions can be used successfully in communication without necessary reference to the other participant's attitude or some intended overall content, each making some partial contribution to what turns out to be a propositional content contributed to by both parties. As (10) and (5) show, one participant may shift their intentions with respect to what is being communicated during the course of the exchange, as the daughter, replying in (10) explicitly acknowledges. Indeed, the attitude of either party may not be fully determinate. This phenomenon is not only challenging for syntactic or semantic accounts of ellipsis, but for pragmatic accounts of communication in general. All accounts to date have turned on presuming that successful communication involves successful transmission of some propositional content intended by the speaker, and giving rise to a certain speech-act effect (minimally question, assertion, command etc). Indeed following this broadly sententialist methodology, with some presumed fully determined albeit context-relative content, fragments have been seen as warranting discrete characterisations according as different speech-act effects are conveyed by their use (Ginzburg and Fernandez 2005, Purver 2004, Ginzburg and Cooper 2004). But what these fragments demonstrate – contributing at a sub-propositional level – is that the purported speech act achieved in the exchange may well not be determinatively fixed at the point of the contribution of the fragment to the utterance exchange. The effect is thus often open-ended, as to whether the contribution is a request for clarification, a proffered extension, an acknowledgement in virtue of providing an extension, etc. A methodology in which discrete construals are to be assigned discrete structures, each supposedly subject to varying constraints, appears to be enforcing ambiguity analyses.

2 VP Ellipsis

Amongst the ellipsis data modelled in the recent literature, VP ellipsis is arguably the most studied, having received a great deal of focus both by syntacticians and by semanticists. VP ellipsis involves expression of the VP only as a modal or auxiliary, often with *too* following:[3]

(12) Ann was sitting on her hands. Bill was too.

(13) Ann may have been sitting on her hands, and Bill may (have) too.

The emphasis in the literature has been on predicting the licensed interpretations from such sequences. Two major different interpretation types are: the so-called sloppy readings, in which the predicate constructable at the ellipsis site involves rebinding of all occurrences of the variable bound by the subject as arguably predominant in (12)-(13)) and their counterpart "strict" readings in which only the subject is rebound in the new environment predominant in (14):

(14) Ann presented her case yesterday because her barrister couldn't.

This characterisation of ellipsis as a rebinding of a predicate by a new subject, licensing the two forms of interpretation, strict and sloppy, is indeed the essence of the semantic characterisation of VP ellipsis. The algorithm takes as input the propositional content from some previous conjunct, abstracts over it with respect to at least the subject argument and, if more than that, over all occurrences of the variable bound by that subject term, and, for either result, applies the resulting predicate abstract to the newly presented subject of the second conjunct (Dalrymple et al 1991). There is some flexibility as to choice of antecedent content over whether adjuncts are taken to constitute a subpart of the domain over which predicate abstraction takes place (Dalrymple et al 1991, Shieber et al 1996), And VP anaphora and VP ellipsis alike are standardly not structurally restricted in this choice:

(15) John was worrying that the woman who had been trying to persuade Mary to leave school shouldn't have been.

(16) John was worrying about the woman who was trying to persuade Mary to leave school at 16. Unfortunately she wasn't successful and Mary didn't/ decided not to.

(15) involves an elliptical fragment to be construed at a subordinate level with that content taken from a relative within that same structure. In (16), the antecedent is in an embedded relative clause as in

[3]VP anaphora is a very near variant of VP ellipsis. The predicative form is introduced overtly with a tensed form of the auxiliary *do*,*be* followed by the proform *so* and sometimes *too* (or in the negative variant with *do* followed by *not*).

(15), but the ellipsis site is in a second conjunct of a matrix coordination. This availability of antecedent contents from arbitrary levels of embedding with license to project such content in combination with a fragment at any level of embedding is redolent of anaphora resolution. However some instances of VP ellipsis display sensitivity to constraints diagnostic of movement, hence argued to warrant the analysis of VP ellipsis as a phenomenon requiring analysis in which the interpretation is structurally represented (see Fiengo and May 1994, and others following). In particular, there is antecedent contained ellipsis (or equivalently named *Antecedent Contained Deletion*), which is displayed within a relative or comparative clause, themselves island-defining domains; but, critically, not allowing dependency of the ellipsis site on its apparent antecedent across a further relative clause boundary. Hence, though (17)-(18) are wellformed, (19) is not:

(17) John interviewed everyone Sue did.

(18) John interviewed everyone who Sue told her Mary hadn't.

(19) *John interviewed everyone who Sue ignored the assistant who had.

Analogously for comparatives:

(20) John bought more books than Sue had

(21) John had bought more books than I know Sue had

(22) *John had bought more books than I know another man who had.

With sensitivity to relative clause boundaries taken to be a reliable diagnostic of movement (following Ross' identification of the impossibility of extraction across such a boundary in 1967), the preclusion of any correlation between some construal site and a antecedent across a relative clause boundary is standardly taken to be indicative of movement, and hence diagnostic of a syntactic form of explanation for the phenomenon in question. Accordingly, movement analyses underpinning so-called Antecedent Contained Deletion case have duly been set up to secure such a prediction (Fiengo and May 1994, Larson and May 1990), the string resulting from such movement, along with whatever empty categories are contained within it, are said to be subject to subsequent PF deletion, a late process in the derivation.[4]

Whether this evidence is sufficient to determine that VP ellipsis be treated as a unitary phenomenon and invariably subject to explication as though a pairing of elliptical fragment and full sentence structure at all levels except the surface remains however a contentious matter, with syntacticians and semanticists bandying arguments between each

[4]See Fiengo and May 1994, Larson and May 1990 and many others following for details of such analyses.

other (Merchant, Hardt and others). And some have argued that the variation in ellipsis construal is so rich as to preclude a unitary account Ginzburg and Cooper 2004, Merchant 2004, 209). We turn, now, to consider these variants.

3 Bare Argument Ellipsis

Bare argument ellipsis is a phenomenon which bears many similarities to VP ellipsis. In particular, it is often presumed to be essentially identical to VP ellipsis in all but the subject restriction, an analysis which seems well motivated if the remit is restricted to those data for which a sentential form of construal is natural:

(23) John is hoping to visit Mary in hospital. Sue too

In Dalrymple et al and elsewhere, these are treated in parallel with VP ellipsis, and as predicted on such an account, they show similar sloppy and strict ambiguities, though they are notably not restricted to abstraction over the subject expression:

(24) Sue always checks her papers for typing errors. Mary too.

(25) Yesterday I had to hand Sue her end-of-contract notice. Mary too. They were not happy occasions. (sloppy interpretation natural abstracting over object: strict interpretation also available))

(26) Hospital nurse in charge of appointments:
I gave Mr Pinner a copy of his hospital letter. His wife too.
(strict interpretation natural: sloppy interpretations also possible despite gender mismatch).

However, the range of NP fragments is much broader, with many forms of fragment construal which are not amenable to a propositional-abstract style of explanation. as noted by Jackendoff and Culicover (2005). There are answers to *wh* questions, as in (27), which contains both a fragment answer to the present questions, and an extension of that:

(27) A: When is Robin coming?
B: On Tuesday. And with his dog.

As answer to a question, according to one analysis of questions which presumes that answers to all questions are propositional in form, the reply *On Tuesday* simply constitutes a selection of one full propositional content 'Robin is coming on Tuesday' out of the set of possible answers.[5] Hence, as long as these fragments can be treated as presentations of separate sentences, the first fragment is amenable to standard

[5]On the Groenendijk and Stokhof analysis of questions (1982) and many others following them, the semantics of a question is given by defining the set of possible answers,

analysis, with the expression *on Tuesday* being taken as the argument to a function created by treating the *wh* term as itself providing a predicate abstract binding a temporal argument. But the second is more problematic, because it constitutes an extension of what the context provides, a phenomenon dubbed *sprouting* by Chung et al (1995), and Culicover and Jackendoff following them. In order to match the pattern demanded by the Dalrymple et al (1991) pattern of analysis for this second fragment, its antecedent clause would also have to have the corresponding commitative adjunct as a skeletal term, in order to provide the predicate abstract which can then combine with the comitative *with his dog* as argument to yield appropriate binding of the contained pronominal *his* by the subject. But this antecedent is itself the result of construing the first fragment. In consequence, it is not merely the two fragment construals which must display the adicity commensurate with the adicity induced by the second adjunct, but that of the question itself. This prediction is wholly contrary to what the question presented in (27) is taken to mean. An alternative suggestion might be to take the sequence *on Tuesday and with his dog* as a single constituent.[6] However, this yields the same problematic results. For on the Dalrymple et al assumption of the fragment leading to appropriate higher-order abstraction over an argument of the requisite type to create the appropriate predicate abstract, this in its turn would impose on the analysis of *when* a typing that simultaneously binds two variables to yield an appropriate projection of content for the supposedly composite fragment. But, as on the previous analysis, this wrongly predicts that the initial question is a question over a predicate with the adicity sufficient to match both NPs presented in the fragments. This problem is in principle open-ended, since adjuncts are freely addable in such fragments:

(28) A: When is Robin coming?
B: On Tuesday. With his dog. After work. Coming from Hatfield.

There are many further types of such extensions, where the abstract style of analysis is even less well suited, as Jackendoff and Culicover 2005 note (repeated here):

(**??**) A: I hear Harriet;s been drinking again.
B: Yeah, Scotch, every night.

(3) a: Could you fix me a drink?

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and on the assumption that all propositions have to be relative to some world-time index, the set of answers to the question includes different world-time pairs, which the answer narrows down.

[6]See Chaves 2006 for an analysis along these lines in expressing nonconstituent coordination within categorial grammar.

B: In a minute.

(4) A: Let's get a pizza. B: Pepperoni?

As in other ellipsis cases, these raise the question of whether ellipsis construal is a phenomenon to be reconstructed semantically – defined within the model-theoretic algebra by defining appropriate lambda terms as a reformulation of some just provided content, eg as first conjunct, to create appropriate input to compositional construal of the fragment – or syntactically, involving regular syntactic operations sensitive to constraints diagnostic of syntactic operations. Neither option is unproblematic. On both approaches, revision has to be made to the compositional projection as established from the previous utterance, hence in some sense breaking up and adapting the structure over which the content has been compositionally defined, in (**??**) by reclassifying the intransitive *drink* as a transitive, a classification generally presumed to be a homonym, separately lexically defined. Each of these examples involves some form of apposition by way of response, extending the content of what is provided in the immediate context.

Furthermore, as Jackendoff and Culicover note, in contra-distinction to the evidence of antecedent contained ellipsis, bare argument ellipsis seems, at least at first sight, to be INsensitive to island constraints, at least if one assumes that their reconstruction involves constructing the fragment initially at some source site and moving it to create the IP which with its containing trace is then to be deleted as a late PF deletion process. For fragments may occur that license construal which on such an account would necessitate movement that is otherwise debarred:

(29) A: What kind of Scotch does harriet drink? B: Single Malt.

(30) A: John has introduced me to a woman who speaks French
B: With an English accent?

(31) A: John met a guy who speaks a very unusual language.
B: Albanian. That's Giorgiou, visiting the department for 6 months.

(32) a: They persuaded Kennedy and some other senator to sponsor the legislation.
B: Yeah, Wilson.

What is notable about these examples is that, taken as a development of the structure just presented, they display all the hallmarks of apposition constructions, despite being split across more than one speaker. They can, that is, be reformulated as analogous structures within a single utterance (in the question/answer case with suitable reformulation of the question as the corresponding assertion):

(33) Harriet drinks a certain kind of Scotch, single malt.

(34) John met a woman who speaks French, with an English accent

(35) John met a woman who speaks French, and Bengali

(36) John met a guy who speaks a very unusual language, Albanian.

(37) They persuaded Kennedy and some other senator, Wilson, to sponsor the legislation.

This array of data and apparently incompatible restrictivenes or nonrestrictiveness might seem clear evidence that bare argument ellipsis is simply a heterogenouns phenomenon, as Ginzburg and Cooper 2004 vividly expressed it "fractally heterogeneous." Culicover and Jackendoff argue that what is needed is a mechanism of indirect licensing, which enables phrases to be assigned syntactic features without overt licensers in the local context. [7] However, there is a hidden asymmetry in the data, which has as yet gone unnoticed. The ACE data supposedly demonstrating complex NP sensitivity of VP ellipsis are environments in which the fragment accompanying the auxiliary triggering the interpretation at the ellipsis site has itself to be construed as initiating a subject within a new propositional domain, in virtue of the relative complementiser which immediately precedes it. It is indeed the presence of this relative pronoun which initiates this island-sensitivity. Contrarily, the bare argument ellipsis data taken by Culicover and Jackendoff to display island INsensitivity is where the fragment extends some other propositional domain, already set out, and directly locally extendable by the fragment itself. As they correctly argue, A'movement of the fragment from out of this covert structure so that its remainder can be an empty IP site that can be deleted, would conflict with the extractability from these sites in the regular case.

They present as confirmation of this, the free availability of multiple fragments, as already itemised:

(38) A: I hear Harriet's been drinking again.
B: Yea, Scotch at the weekend.

On the Merchant movement based account, such instances would apparently involve multiple A' movement. Yet not only is such overt multiple A' movement impossible in English, so they observe, and furthermore the natural ordering with object preceding the adjunct specification in (38) is the reverse of what one would expect in multiple A' movement if permitted:

[7] Culicover and Jackendoff take some care to explore this notion, noting its anaphoric properties, but they provide no formal specification, noting that it is a function which may impose an array of morpho-syntactic, syntactic and selectional properties, following a broadly psycholinguistic processing perspective.

(39) ??At the weekend, Scotch, Harriet has been drinking.

(40) ??Scotch, at the weekend, Harriet has been drinking.

Such orderings as these are notably less felicitous than the end-placed sequences, where as (42)-(43) demonstrate weight considerations play a role:

(41) Harriet has been drinking Scotch at the weekend.

(42) ?Harriet has been drinking at the weekend, Scotch.

(43) Harriet has been drinking at the weekend that wonderful stack of 1920 port.

So whatever underpins these phenomena, they do not provide evidence of directly parallelling movement-based processes.

There are yet further examples noted by Stainton 2006 which demand indexical construal, with no linguistically provided antecedent:

(44) A (looking out of the window): Well, what I think we should be doing for our next project is.... Ooh, an osprey. Sorry it's gone now. It looks in flight a bit like a massive gull.

(45) Waitress: Another cup of tea, sir?

What these several examples suggest is that bare argument expressions may be subject to different forms of construal, depending on the context, and the question then is whether this necessarily grants the conclusion that no unitary basis for explanation is available. Jackendoff and Culicover take the first steps towards answering this pessimistic conclusion by noting the direct echoes in these process of ellipsis construal of an anaphoricity relation in such an array of elliptical sources, which they seek to reflect with reference to a function in which "the interpretation is constructed by reference to the antecedent", though, without further formulation, this is left by them as a challenge yet to be addressed.[8] But as we shall see, it is this insight indeed which DS seeks to express.

4 Gapping

Of all the ellipsis phenomena, gapping is the one generally agreed to be syntactic in nature, with what has been taken to be a stringent requirement on occurring only in root clauses, subject to a sisterhood restriction, and in the majority of cases merely the elision of the verb (or verbal complex). However, Jackendoff and Culicover present data that cast doubt on any such tight constraint, as indicated by the following:

[8] They refer to Ginzburg and Cooper 2004 for putative such formulation.

(46) Leslie wants to wake up in the morning and find herself able to speak French. And Susie German.

(47) Leslie thinks that everyone pays attention to you when you speak French And Susie German.

(48) Leslie thinks that Mercedes are cool. And Tom Ferraris.

(49) Leslie thinks that Mercedes are cool. And Ferraris, Tom.

(50) Robin knows lots of reasons why cats make good pets And Tom dogs.

(51) Leslie thinks that Tom should sell his scooter once he's got rid of the Mercedes, and Harry the Landrover.

However, it would be a mistake to conclude from these data that gapping is unrestricted, as there are limits on what is possible. Though bare argument ellipsis allows fragments to be construed freely into any argument position, even in relative clauses, gapping does not. The clue to the appropriate structures comes from the two types of structure that predominate. These are subject expressions, as above, or temporal or locative adjuncts:

(52) On Sundays, John plays tennis, and on Mondays, golf.

(53) On W'day Robin will leave the telephone in the kitchen and on Thursday in the living room

(54) On Sundays, Robin speaks French to Bill, and on Mondays, Leslie.

(55) On Sundays, John plays tennis, and on Mondays, Tom, golf.

What these two types of gapping structure have in common is that the initial member of the pair of the constituents provides secure indication of a left edge of some novel predicate-argument structure. Locative/temporal expressions do this in virtue of expanding some event term, an account to whcih we return; subject expressions do this in virtue of the overwhelming heuristic that human NPs are as a default construed as as subject, in English this occurring in some very early position immediately preceding the verb. On the other hand, interpretations in which the first expression in a pair of such NP-sequences is identified as not making any such indication salient strongly resist construal as a gapping sequence:

(56) Everyone pays attention to YOU if you speak FRENCH and to MARY GERMAN

(57) *Tom should sell his SCOOTER once he's got rid of the MERCEDES, and the BIKE, the LANDROVER

Thus in (56), there is no interpretation that everyone pays attention to you if you speak French and that everyone pays attention to Mary if she speaks German.[9] Similar data are:

(58) John told the judge the Council was suing his daughter over money issues, and the doctor his wife

(59) John told the judge his daughter was suing the Council over money issues, and the doctor his wife

(58) allows interpretations in which the doctor is suing his wife (John's, the judge's or his own), or on the other hand in which the doctor tells his wife the Council is suing his daughter (John's, the judge's or his own). However it precludes completely any interpretation of the NP paired sequence as 'John told the doctor that the Council are suing his wife' (for any value of wife). Analogously, (59) precludes any interpretation in which John tells the doctor that his wife is suing the Council. In both cases the only possible interpretations are essentially local, either with the doctor and his wife as co-arguments of suing or, with the doctor and his wife co-arguments of telling.

Culicover and Jackendoff analyse gapping as Multiple Bare Argument Ellipsis, but this doesn't capture this restrictiveness, or the asymmetry there is between the two paired expressions: to the contrary, they are analysed identically. The first NP cannot be in a relative clause, yet the second can; the first cannot even at all easily be in a subordinate clause, which the second freely can. Moreover, on their analysis, to sustain their simple syntax program in which the strings themselves match the surface sequence wherever possible, the gapped constituent, to which they do not provide a fixed constituency, is an adjunct to the single antecedent clause, and is not a sentential string in its own right. They take as evidence of this the availability of modal and negation operators ranging over both the full clause, in which these are overtly contained, and the gapped sequence:

(60) Can John talk to Jim, and Sue Mary?

(61) John speaks French better than Leslie German.

(62) Robin doesn't speak French, let alone Leslie German

(63) John can't eat steak or Mary (eat) spam

(64) Not every girl ate a green banana and her mother a ripe one.

(65) Harriet drinks scotch as well as gin.

(66) Too many Irish setters are named Kelly and German shepherds Fritz.

[9] For some speakers, there is a possible interpretation of (56) as 'Everyone pays attention to you if you speak French and German' with the parenthetical caveat that German is what you speak to Mary; but this interpretation doesn't involve a gapping source.

But this leaves them with the difficulty of identifying what constituent type the gapped sequence is, to which they have no answer, merely pointing that upon classical constituence labelling neither IP nor VP will do. For their own analysis, Culicover and Jackendoff propose an indirect licensing method of construal, in like manner to their account of bare argument construal, for which in either case formal details are not provided. Moreover, they analyse the subsequent term as yielding a possible multiple adjunct, for which no tree is added, and even the constituent, which may be a composite sequence of argument plus adjuncts, is not given a determinative constituent categorisation. So in effect, no analysis of gapping is offered, despite the fascinating observations.

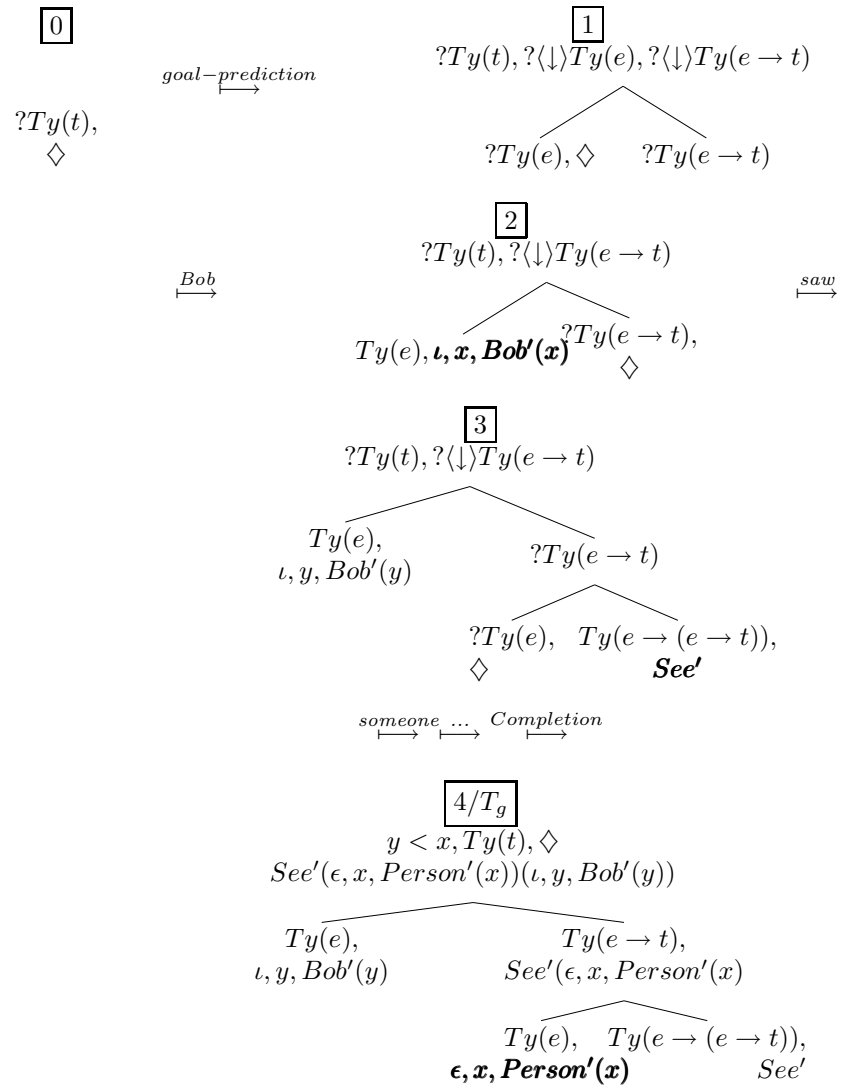
The challenge is how to express the partial restrictiveness there is on gapping constructions, and whether it is no more than a performance-dictated restriction of requisite salience.

5 Dynamic Syntax

In response to the challenge that such data provide, we turn to Dynamic Syntax (DS) to consider whether forms of correlation between parsing and generation, as they take place in dialogue, can provide a basis for modelling recovery of interpretation in communicative exchanges without reliance on recognition of specific intentional contents. DS is a procedure-oriented framework modelling sequential processing. As is displayed in (68) by way of illustration, the build up of interpretation for (67) is monotonic and strictly word-by-word incremental:

(67) Bob saw someone

(68)



As (68) graphically displays, the DS system provides mechanisms that enable the hearer to anticipate and therefore allow incremental word-by-word build-up of representations of content paired with some word string. Amongst such anticipatory steps are the construction by anticipation of a subject-predicate schema (with requirements for a subject and predicate imposed at the very first step, and their immediate construction at the second).[10] Such a frame then makes possible the iden-

[10]In this display we assume for simplicity that the subject node is introduced as fixed by a computational action (following Kempson et al 2001, Cann et al 2005). See Cann

tification of the subject as some individual named Bob, via processing of *Bob* as the word triggering that identification, and then successive steps of identifying predicate and its internal argument to be paired with verb and object noun-phrase respectively. These updates then provide input to the compilation by labelled type-deduction of a propositional representation of content. This then as a final step is subject to an algorithm of evaluation determining how some assigned scope dependency choices are reflected in the constructed names (here the formula $S < x$ indicates that the existential term binding the variable x is taken as dependent on the event-term S (see Gregoromichelaki 2011, Cann 2011). The mechanisms for tree growth and evaluation are identically available to speakers, hence in generation. The only essential difference in speech is that the modelling of a speaker's actions for tree-growth update involve a so-called "goal tree" (tree 4 in (68) relative to which all intermediate construction steps have to be checked for commensurability, a checking step for which there may be no analogue in parsing (see section 3.2).

The notion of incrementality in DS is closely related to another of its features, the *goal-directedness* of BOTH parsing and generation. At each stage of processing, *structural predictions* are triggered that could fulfill the goals compatible with the input, in an underspecified manner. Representations of the conceptual structure of messages are given as binary trees, formally encoded with the tree logic *LOFT* [**?**]. LOFT is a modal logic with operators $\langle\uparrow\rangle, \langle\downarrow\rangle$ $\langle\uparrow_*\rangle, \langle\downarrow_*\rangle$ to define the relations of immediate and iterative domination, and to indicate node locations. What is novel about such trees is, on the one hand, that though they constitute a form of syntax, they are not inhabited by words of the language – they constitute structures inhabited by (lambda binding) formulae in the epsilon calculus, the selected semantic representation language. Yet the mechanisms that define such progressive tree construction constitute the sole concept of natural-language syntax which the DS grammar provides. The system is goal-directed; and trees are constructed, by starting (in the context-independent case) from a radically underspecified goal, the *axiom* (the leftmost minimal tree in the illustration provided by (68), and proceeding through *monotonic updates* of partial or *structurally underspecified* trees until some tree is constructed from an input string in which all imposed goals and subgoals are met. Every node in a complete tree bears annotations (these to include semantic formulae and their type information); and these are projected onto the tree during the course of the construction process.

Crucial for expressing the goal-directedness are *requirements*, i.e. unrealized but expected node/tree specifications, indicated by '?' in front of annotations. As the axiom and its immediate subsequent up-

2011 for a more articulated view, which we take up here in due course.

date tree development in (68) indicate, requirements may also take a modal form, e.g. the constraint $?\langle\downarrow\rangle Ty(e \rightarrow t)$, which is a constraint that the daughter be a formula of predicate type. Requirements are essential to the tree-growth dynamics. All requirements must be satisfied if the construction process is to lead to a successful outcome, and, as indicated by the requirement for the predicate imposed at step 2 in (68), these may not be satisfied until substantially later than the point at which they are imposed.[11]

Updates are carried out by means of applying both *computational* and *lexical actions*, which introduce and update nodes, and move the pointer. *Computational actions* govern general tree-constructional processes in a broadly top-down process, but whose top-down effect is matched by lexical specifications which, equally, induce tree-growth, providing decorations for nodes, in many cases also inducing the construction of further nodes. In the update from 2 to 3 in (68), for example, the set of lexical actions for the word *see* is applied, yielding the predicate subtree and its annotations. Subsequent computational actions involve progressive labelled type-deduction decorating non-terminal nodes in the tree strictly bottom-up until the goal defined in the axiom is reached. Indeed all actions, computational and lexical, are defined in the same tree-growth vocabulary, so there is free intercalation of the various types of process. A core notion is that of structural underspecification, allowing the construction of what are termed "unfixed" nodes, those in a relation of being dominated by some higher node, in a relation $\langle\uparrow_*\rangle Tn(a)$, without any more specific relation, though with a requirement for update.[12] There is also a local variant of this, reflecting a temporarily unfixed node whose update has to be within a given single local domain (that of constructing an individual predicate-argument structure). Thus *partial trees* grow incrementally, driven by procedures associated with particular words as they are encountered while conforming to top-down modal requirements on later development.

Central to the framework is the modelling of quantification as a process of term construction, using the *epsilon calculus* as the basic formula language (the epsilon calculus is the formal language that employs arbitrary-name terms in predicate logic natural-deduction proofs). All terms are of type e: *epsilon terms*, as illustrated by $(\epsilon, x, Consultant'(x))$. This term constitutes an arbitrary witness of the existentially quantified formula $\exists x.Consultant'(x)$, by definition:

[11]The pointer, $\Diamond$, indicates the 'current node' in processing, namely the one to be processed next, a constraint which governs word order.

[12]This is closely related to the concept adopted by some psycholinguists under the appellation of *connectedness* (Sturt and Crocker 1996): an encountered word always gets 'connected' to a larger, predicted, tree.

$\psi(\epsilon, x, \psi(x)) \equiv \exists x \psi(x)$
Notice how this equivalence yields the effect that an epsilon term invariably reflects its containing environment (for the predicate ψ in the accompanying restrictor is a duplicate of the containing predicate). A notable bonus of this choice of logical system is the tight correspondence it allows between DP-internal syntax (as characterised in other frameworks) and such representations of content, an area of natural-language syntax standardly taken to involve mismatch between syntactic and semantic requirements. The substructure of such terms involves the sub-types $cn \rightarrow e$ for the quantifying determiners, cn for the restrictor specification itself, and a second node with a type e for the individual-variable induced by the lexical action associated with nouns.[13] In particular, dependencies between such terms – their relative scope inter-relations – have to be expressed as part of the restrictor of the term itself. The construction of such terms is induced by actions which incrementally, in part lexically, specify and collect up scope constraints of the form $x < y$ (to be understood as the term with variable y is dependent on the term with variable x).[14] A final step yields the evaluation that specifies the resulting richness of the terms themselves within the restrictor as required in the equivalence: thus *A consultant arrived* is assigned a propositional formula

$$Arrived'(\epsilon, x, Consultant'(x))$$

which is evaluated as

$$Consultant'(a) \wedge Arrived'(a)$$

where

$$a = (\epsilon, x, Consultant'(x) \wedge Arrived'(x))$$

The overall dynamics is thus one of growth in names as well as in structure (see Kempson et al 2001).

More radical underspecification of formulae at intermediate stages, equally associated with a process of growth, is lexically licensed, for example by pronouns, which act as simple place-holders for some possibly subsequent identification. These are defined as projecting a metavariable (notated as $\mathbf{U}, \mathbf{V}$ etc) as a place-holder for some value to be assigned, with an associated type specification, for pronouns $Ty(e)$, for

[13] The discrete type cn is eliminable, but we leave this on one side here.

[14] For example, indefinites project epsilon terms subject to the constraint that they are invariably dependent on either another quantifying expression or a term within the temporal specification (not here provided); names, as iota terms (eg $\iota, x, Bob'(x)$), are, in contrast, taken to be epsilon terms of widest scope. Once the propositional formula is compiled up with the terms projected by the linguistic expressions, the propositional formula is subject to an evaluation algorithm determining the form of these dependencies, as spelled out within the restrictor specification of the individual terms.

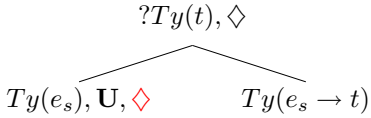
VP anaphora of predicate type. These invariably occur with an associated requirement for a fixed formula value (of the form $?\exists \mathbf{x} Fo(\mathbf{x})$), making such provision of a value essential to a successful outcome. Metavariables are substituted by other terms available in the context as part of the construction process, subject to locality restrictions differentiating pronouns and reflexives (Cannn et al 2005).

The distinctive flavour of DS lies in its reflection of the granularity of the parsing process defined. Pronouns provide one such case. Given the type specification but lack of formula value in the processing of a pronoun, the value for such metavariables may be established later in the construction process, in particular at the point when the pointer is returned to that node immediately prior to determining the value of the mother node, as for example in expletive use of pronouns. These are parsed as projecting a metavariable whose value is established only subsequent to the construction of their sister predicate, at which point the parse process may return to the preliminarily decorated node for further construction from that node:

(69) It is likely that Geoff is wrong

Indeed, given the delay in provision of a fixed value for that metavariable , this node must be further expanded if the outstanding requirement for some fixed value is to be met. This possibility of delayed development of structure is tightly restricted by the parsing dynamics. Such open specifications cannot be delayed more than locally, for the trees that result are defined as having compositionality of content defined over the resulting tree, with the consequence that no such delayed assignment can remain outstanding beyond the projection of formula value for two such sister nodes.

This flexibility of growth of interpretation either from context or from the construction process, is combined with the use of epsilon terms to provide an account of how auxiliaries contribute to the progressive projection of an event term reflecting the propositional content relative to the flow of time. Expanding the minimal opening tree as displayed in (68), we take the opening axiom statement of any proposition construction process to project the following partial tree (e_s is a sortally restricted type, ranging over event types):



This tree provides the basis which enables both adjuncts and auxiliaries to contribute to the build up of the event depicted. In particular auxiliaries are taken both to add constraints on the emergent event term, and, furthermore, to unfold the emergent structure so that a predicate node is introduced with a predicate-holding metavariable together with a subject node constrained through agreement speci-

fications. The projection for English of this place-holding predicate metavariable then licenses the substitution of that metavariable either from context, as in VP ellipsis - it is an idiosyncracy of English that VP construals can be projected from bare auxiliaries - or from the subsequent development of what in other frameworks is the VP, exactly analogous to expletive pronouns.[15] Overall all, then, running through every aspect and every parameter of the construction process out of which a decorated structure emerges with no requirements remaining is the projection of underspecified, partially decorated structures and the dynamics of their subsequent update.

In addition to the construction of individual predicate-argument tree-structures, complex structures are obtained through pairing of such simple structures. A general tree-adjunction operation licenses the construction of so-called *linked* trees, pairs of trees sharing information in the form of a shared term, each such tree a then subdomain in which labelled type-deduction takes place as in the simple structures. What gives this projection of adjunct structures its idiosyncratically DS flavour is that in the construction of such trees, at any arbitrary stage of development, some partial tree may constitute the context for the subsequent parsing of the following string, from which the resulting updated tree then becomes the context for whatever next steps follow in the construction process.

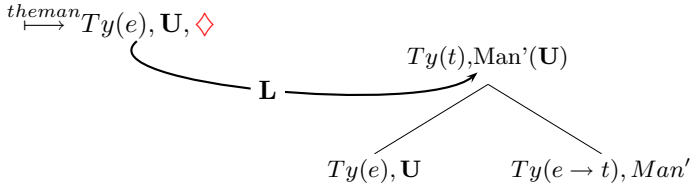
The construction processes determining and then updating such *linked* partial tree representations are used to model a range of phenomena. Relative clauses constitute the canonical case (Kempson et al 2001, Cann et al 2005). Some node decorated with a type e term becomes the context for the projection of a linked structure, which when completed allows the pointer to return to that initial type e term, now enriched by the incorporation of information constructed upon such a linked (adjunct) tree. Each such linked tree is indeed evaluated as contributing an additional predicate on the term at the node in the host tree from which the transition was constructed, leading to compound specifications, conjunctive in form. One immediate application for this concept of a locally independent but linked tree – correlated with the tree to which they are linked solely through the shared term – is to provide the basis for defining island structures. The LINK transition is defined as not being that of a daughter, so these substructures are not a sub-part of the locally defined tree to which they are linked.

The mechanism inducing such paired quasi-independent trees has more general application. For example, in taking definite NPs to be

[15] A consequence of this expansion of the axiom statement is a characterisation of syntactic subject as initially locally unfixed, its position in the tree subsequent determined by the morphological form of the verb. We do not pursue this here: see Cann 2011 for full details.

anaphoric, we define the definite article as introducing a metavariable as a partial term, inducing also construction of a LINK transition to allow the construction of a tree providing possibly complex information as a constraint ("presupposition") on the value to be substituted for the constructed partial term:[16]

(70) The man

(71) 

The structure on the subject node above is abbreviated as: $Ty(e), \mathbf{U}_{Man'(\mathbf{U})}$. More generally, this provides a basis for modelling presupposition effects.

Prepositional phrases too are analysed as involving linked trees, the preposition constituting a predicate attributed to whatever is the term decorating the node of the host structure from which the link transition is constructed. In the case of locational/temporal adjuncts, this provides the basis for analysing these as providing modified attributes of the emergent event term, either at some initial point in the parse process, developing attributes on the basis of the place-holding metavariable presented in the axiom statement, or at later stages when the event term is very much more richly specified.

Such *linked* trees and their development set the scene for a general characterisation of context, since in these construction cases, it is partial trees which constitute the context for some next update. *Context* in DS is defined as the storage of *parse states*, i.e., the storing of partial tree, word sequence parsed to date, plus the actions used in building up the partial tree. Formally, a parse state P is defined as a set of triples $\langle T, W, A\rangle$, where: T is a (possibly partial) tree; W is the associated sequence of words; A is the associated sequence of lexical and computational actions. At any point in the parsing process, the context $\mathcal{C}$ for a particular partial tree T in the set P can be taken to consist of: a set of triples $P' = \{\ldots, \langle T_i, W_i, A_i\rangle, \ldots\}$ resulting from the previous sentence(s); and the triple $\langle T, W, A\rangle$ itself, the subtree currently being processed. Anaphora and ellipsis construal generally involve re-use of formulae, structures, and actions from the set $\mathcal{C}$. All fragments illustrated above are processed by means of either extending the current tree, or by constructing LINKed structures with transfer of information among them so that one tree provides the context for another. Such

[16] We ignore issues here as to whether such minimal adjunct trees involve an independent event term.

fragments are licensed as wellformed by the grammar only relative to such contexts (Cannn et al 2007).

6 Parsing/generation coordination

This overall architecture allows a dialogue model in which generation and parsing function in parallel, following exactly the same procedure in the same order. Returning to (68), we now pick out the generation steps involved in producing *Bob saw Mary*, notated as steps 0 to 4. As indicated earlier, generation of this utterance follows precisely the same actions and trees from left to right as in parsing, with the one additional filter, that the complete tree is available as a *goal tree* from the start (hence the labelling of the complete tree as T_g). The intuition this reflects is that the eventual message, in this simple context-independent case at least, is known in advanced by the speaker; and determines the choices to be made. What generation involves, in addition to parse steps, is reference to T_g to check whether each intended generation step (1, 2, 3, 4) is consistent with it. A *subsumption* check is carried out as to whether the current parse tree is monotonically extendible to T_g.[17] The trees 1-3 are licensed because, for each of these, the subsumption relation to T_g is maintained. Each time then the generator applies a lexical action, it is licensed to produce the word that carries that action only under successful subsumption check: at step 3, for example, the generator processes the lexical action which results in the annotation See', and upon success and subsumption of T_g license to generate the word *see* ensues (see Purver et al 2006).

For processing split utterances, two more consequences are pertinent. First, there is nothing to prevent speakers initially having only a partial structure to convey, i.e. T_g may be a *partial* tree: this is unproblematic, as all that is required by the formalism is monotonicity of tree growth, and the subsumption check is equally well defined over partial trees. Second, the goal tree T_g may change during generation of an utterance, as long as this change involves monotonic extension; and continuations/reformulations/extensions across speakers are straightforwardly modelled in DS by appending a LINKed structure annotated with added material to be conveyed (preserving monotonicity) as in single speaker utterances:

(72) A friend is arriving, with my brother, maybe with a new partner.

[17] In fact, with both parsing and generation being context-dependent, the goal tree for the speaker need only be at least subsumed by the parse step under construction, and in all nonfinal steps in the generation process nontrivially.

Such a model under which the speaker and hearer essentially follow the same sets of actions, each incrementally updating their semantic representations, allows the hearer to mirror the same series of partial trees as the producer, albeit not knowing in advance the content of the unspecified nodes. Furthermore, not only can the same sets of actions be used for both processes, but also a large part of the parsing and generation algorithms is shared. In particular, the processing actions of both parsing and production involve the same progressive growth of partial tree representations, this being the only concept of "syntax" in the DS model. Even the concept of *goal tree*, T_g, may be shared between speaker and hearer, in so far as the hearer may have richer expectations relative to which the speaker's input is processed, as in the processing of a clarification question. Conversely, the speaker may have only a partial tree as T_g, relative to which they are seeking clarification.

6.1 Split utterances in Dynamic Syntax

Split utterances follow as an immediate consequence of these assumptions. For dialogues (3)-(11), A reaches a partial tree of what she has uttered through successive updates, while B as the hearer, follows the same updates to reach the same representation of what he has heard: they both apply the same tree-construction mechanism which is none other than their effectively shared grammar.[18] This provides B with the ability at any stage to become the speaker, interrupting to continue A's utterance, repair, ask for clarification, reformulate, or provide a correction, as and when necessary. According to DS assumptions, repeating or extending a constituent of A's utterance by B is licensed only if B, the hearer now turned speaker, entertains a message to be conveyed (a new T_g) that matches or extends in a monotonic fashion the parse tree of what he has heard. This message (tree) may of course be partial, as in (9), where B is adding a clarificational LINKed structure to a still-partially parsed antecedent, or it may complete the tree in some unexpected way as in ((4),(7), (10), (11)).

Importantly, in DS, both A and B can now re-use the already constructed (partial) parse tree in their immediate context as a point from which to begin parsing and generation, rather than having to rebuild an entirely novel tree or subtree. By way of illustration, we take a simplified variant of (6):

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

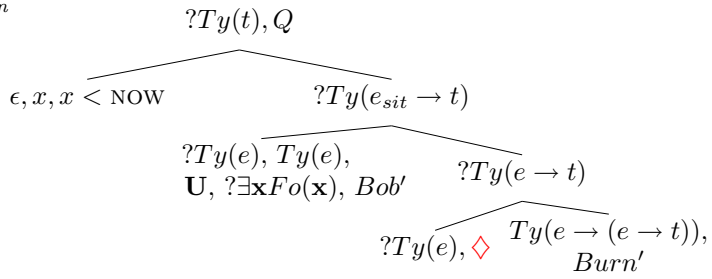
Here, of course, the reconstruction of the string as **Did you burn my-*

[18] A completely identical grammar is, of course, an idealisation but one that is harmless for current purposes.

self? is unacceptable (at least with a reflexive reading of *myself*), illustrating the problem of purely syntactic accounts of split utterances. But under DS assumptions, with representations only of informational content, not of putative structure over strings of words, the switch of person is entirely straightforward. Consider the partial tree induced by parsing A's utterance *Did you burn* which involves a substitution of the metavariable projected by *you* with the name of the interlocutor/parser:[19]

Mary/Bob Context:

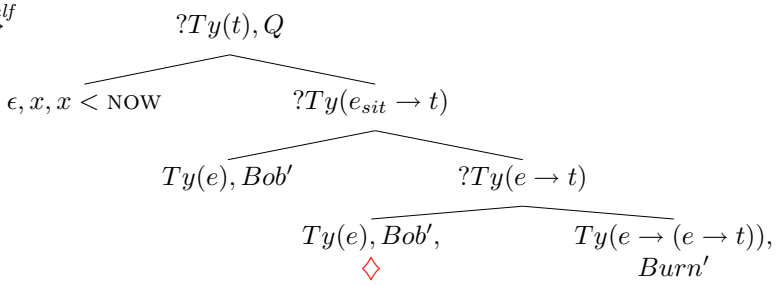
- *Did you burn* $\longmapsto$



At this point, Bob can complete the utterance with the reflexive as what such an expression does, by definition, is copy a formula from a local co-argument node onto the current node, just in case that formula satisfies the conditions set by the person and number of the uttered reflexive, in this case that it names the current speaker:

Bob: myself?

- *myself* $\longmapsto$



- *myself*

IF	CO-ARGUMENT$(x) \wedge Speaker'(x)$
THEN	`Substitute`$(\mathbf{U}, x)$
ELSE	ABORT

[19]The feature Q on a decorated node is not taken to have a fixed speech-act content: given the range of acts achievable by interrogative structures (as diverse as *yes-no* questions, *wh* questions, tag questions, exclamatives, etc.) we take interrogative forms to encode a direction by the speaker to the hearer for a particular type of coordination, here notated simply as Q.

Hence the absence of "syntactic" level of representation distinct from that of such semantic representations – put together with the fact that lexical constraints are taken instead as procedural, context-dependent instructions for update – allows the direct successful integration of such fragments through the grammatical mechanisms themselves, rather than necessitating their analysis as sentential ellipsis.

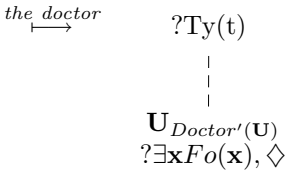
Further, to illustrate how DS can sidestep the problems posed by abstraction accounts of ellipsis, we take a simplified version of (9):

(74) A: The doctor

B: Chorlton?

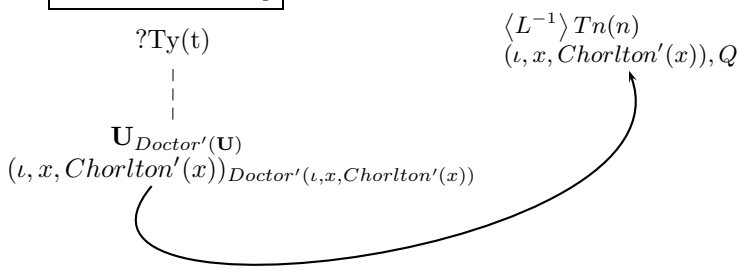
After processing *the doctor*, at that early point in the utterance, its role in the ensuing structure unknown, both A and B can be seen as sharing a context comprising a partial tree as follows:

(75) A's/B's context:



At the next stage of processing, let's assume that B fails to find a secure substitution for the metavariable **U** on the subject, thus being forced to request clarification if the requirement is to be satisfied. Notice that at this point A and B's contexts will diverge since A presumably knows who he's referring to, i.e. has a substituend for the metavariable introduced by the definite description. Now B's goal tree for his request for clarification is:

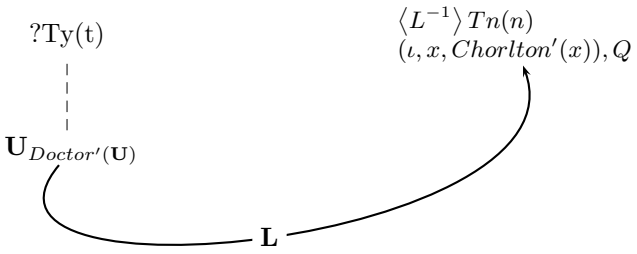
(76) B's GOAL-TREE T_g



The LINK transition to accommodate an additional property (that they are named *Chorlton*) attributed to the individual in question takes the partial tree in (75) as its context. In this context, with the pointer at the subject node, the building of a LINK relation is licensed and this

is duly constructed. Now by uttering the word *Chorlton?* a new tree can be constructed for B which indeed subsumes the goal tree of (76):

(77)



Now regular anaphoric substitution allows the metavariable **U** to be instantiated by the term $(\iota, x, Chorlton'(x))$. The result of this process will be exactly the tree in (76) and speaker and hearer context trees will be identical at this point. As illustrated here, the most recent (partial) parse tree constitutes the most immediately available local "antecedent" for fragment resolution; hence no separate computation or definition of *salience* or speaker intention by the hearer is necessary for such incremental fragment construal. As in P&R, the mechanism is exactly that of apposition, the building of a LINKed structure, in this case the result of that transition in its turn being used to provide a value for the metavariable place-holder associated with the definite article.

7 VP and Bare Argument Ellipsis: a DS account

We now have in place all we need to survey the DS perspective on ellipsis, taking in turn VP ellipsis, Bare argument ellipsis (stripping), and gapping.

7.1 VP ellipsis

First we formulate the parallelism observable between VP ellipsis and VP anaphora, where the fragment serves as a trigger to build up some propositional content. As we saw earlier, if the satellite expression is construed as initiating an independent proposition for which the immediate context provides a value, then it gives rise to both sloppy and strict interpretations using, content and actions being made available exactly as with VP anaphora. VP ellipsis is identical to VP anaphora except that it involves just a bare auxiliary and no other verbal anaphoric device involving *do*:

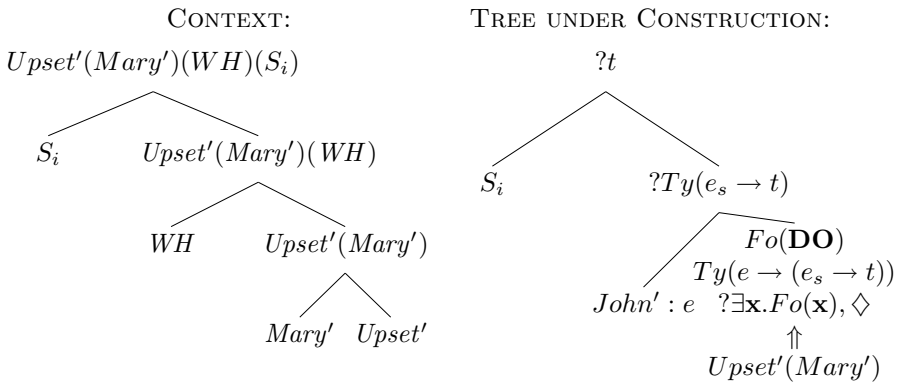
(78) Bill will help his students, John will too.

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

Here the explicit anaphoricity of the English auxiliary comes into play, licensing the identification to the value to be provided by one of two strategies, as with VP anaphora. First, the value of the predicate can be identified as the choice of some preceding predicate, leading to the strict interpretation whereby John also helps Bill's students:[20]

(80) A: Who upset Mary?
B: John did.

Parsing *John did*:



This account incidentally involves the commitment that indexical interpretations of VP-ellipsis are available, contrary to what was claimed by Hankamer and Sag (1976). This is because meta-variables in DS by definition can be provided values from contextually provided representations of content, whether or not these are constructed by processing linguistic input; for example, such representations might be constructed by processing other aspects of the cognitive environment such as visual signals. Consider the case of a mother and teenage son standing at the shore's edge looking at the size of the waves, with the mother deciding how best to dissuade her son from surfing. A mere command 'Don't go now' would surely risk the very action she is hoping to dissuade him from. A much less confrontation-risking comment might take the form:

(81) I wouldn't if I were you. There are severe rip tides round here.

All that is required for the success of this utterance, on this view, is that the context for utterance interpretation can be presumed to contain representations of predicate-argument content inferrable by reasoning

[20] We give here the minimal characterisation of names,for simplicity.

over information culled from any form of processing, in this case information provided by anxiously scanning the shore-line. Incidentally, all such cases are problematic for the higher-order unification account of ellipsis, which presumes on some source conjunct whose content provides an appropriate abstract which can be taken as the content of the elliptical verb phrase. In cases like the above, there may be no such antecedent available; and it is far from obvious in what sense the action of scanning the shore-line can be said to lead to some propositional content to provide input to the requisite abstraction process.

Secondly, however there are construals of VP ellipsis where parallelism between the antecedent site and its antecedent is in some sense preserved, but the interpretation itself is not identical. For this type of interpretation , the DS perspective, in which actions for interpretation-buildup are first class citizens, is to take the value of the predicate as established by reiterating some sequence of actions from that context for their re-use. In other words, the syntactic process used to construct a preceding tree may be re-run at the ellipsis site to provide possibilities for certain changes in the information conveyed by the elliptical expression vis-a-vis the contextually provided input allowing the sloppy ellipsis construal. In these cases, we want to be able to reflect the way in which linguistic input is in some sense re-used to yield a modified interpretation but without having to commit the account to literal re-use of the words themselves:

(82) A: Who hurt himself?
B: John did.

Informally, the DS processing for the question in (82) involves the following actions after parsing of the subject *who*: constructing a two-place predicate as indicated by the verb; the construction of an object argument; and then, because this object contains a reflexive pronoun, it is obligatorily identified with the argument provided as subject. Now, if we assume that these actions themselves 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. When it comes to processing the elliptical *did* in the answer, this sequence of actions which is recorded in the context can be invoked and re-run, as *did* contributes a metavariable whose required substitution from context gives license to do exactly that. Re-applying these very same actions in the new tree whose subject node has been decorated by the expression *John* of the elliptical fragment then gives rise to the construal of the answer as involving a re-binding of the object argument to the provided new subject. The effect achieved is the same as the higher-order unification account 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 to the elliptical element *did* or the subject

John. All that has to be assumed is that the metavariable contributed by the anaphoric *did* can be updated by some suitable selection of some action-sequence taken from the context.

As with strict construals of VP ellipsis, we take the trigger for context search of actions to be triggered by the auxiliary, with its context-search instruction of a presented metavariable. The specific choice made is determined system-externally by eg relevance constraints, exactly as with overt anaphora, the result a unification of the content projected by the newly presented subject to the elliptical VP and the actions recovered from context.

In order to formalise this approach, we need two things. The first is an equivalent to the SUBSTITUTION rule that allows us to provide fully specified values for metavariables by re-use of actions, rather than by re-use of semantic formulae. This we term REGENERATION:

REGENERATION	**IF**	$Ty(X), ?\exists x.Fo(x)$,
		$\langle T, W, A\rangle \in \mathcal{C}$,
		$\langle a_i, \ldots, a_{i+n}\rangle \sqsubseteq A$,
		$a_i = \langle$**IF** ϕ_1 , **THEN** ϕ_2 , **ELSE** ABORT$\rangle$,
		$?Ty(X) \in \phi_1$,
	THEN	$\mathtt{do}(\langle a_i, \ldots, a_{i+n}\rangle)$
	ELSE	ABORT

Simply stated, the rule of REGENERATION enables the parser (and generator) to take a sequence of actions from context and re-use them, provided that they were triggered by the same type-requirement as is imposed on the node currently under development.[21] Any such re-use of actions from context will be successful if and only if the result of applying these actions in the new context is suitable, i.e. yields an output in which all requirements are now satisfied, or which the actions of any immediately subsequent lexical expression can take as input to eventually lead to a complete tree.[22] This rule merely allows any sequence of actions to be re-used, given an appropriate type matching, without constraint on the end-point of the sequence.[23]

[21] We use the $\sqsubseteq$ symbol to represent the subsequence relation.

[22] As phrased here, this rule can only be triggered by the presence of a metavariable with an unsatisfied requirement for a fixed value (just as with SUBSTITUTION). It may, however, be that the rule should be generalised to any $?Ty(X)$ triggering context. This will allow gapping examples to be handled straightforwardly without the need for any extra machinery. Although this may seem to open the floodgates for arbitrary generation of semantic structure, the use of such a procedure will be constrained by both context and prosody. We will leave this possibility aside for now.

[23] This characterisation will also apply directly to pseudo-gapping, as the actions of parsing the verb *interviewed* in the first conjunct in (i) can be used to extend the tree to provide the appropriate structure for parsing the final noun phrase *Mandela*:
(i) John interviewed Clinton, and I did Mandela.

The second addition is a variant of SUBSTITUTION which, analogously, recovers actions rather than a formula value. Recall that, once having checked the appropriate pre-conditions for there to be some $Fo(Y)$ in a tree in context, the actions defined by SUBSTITUTION were simply to decorate the current node with the value of Y so found, in (78) this being $\texttt{put}(Fo(John'))$. Re-using this action in a new context will make no difference to the result – the formula $Fo(John')$ will be added. The problem posed by sloppy cases is that this is not what we want: we need pronouns to be resolved differently when their actions are re-run as part of an elliptical reconstruction process. We therefore define an alternative LOCAL-SUBSTITUTION rule, one that reflects the saving of actions by checking the modal tree relation between the current node and a putative antecedent:

LOCAL-SUBSTITUTION	**IF**	$Ty(X), ?\exists x.Fo(x),$ $\langle Y\rangle Ty(X), Fo(\alpha)$	
	THEN	**IF**	$\uparrow_0\uparrow_*^1\downarrow_0 Ty(X), Fo(\alpha)$
		THEN	ABORT
		ELSE	$\texttt{put}(Fo(\alpha))$
	ELSE	ABORT	

In this definition, X is a placeholder for a type as before, but Y is now a placeholder which ranges over the possible tree modalities $\{\uparrow, \downarrow, \ldots\}$: its value will be the modality describing the relative tree relation between the current node and the antecedent. As such modal relations can only hold between nodes in the same overall tree, this restricts this rule to antecedents along a tree-definable path. When the action is saved in context, X and Y must become fixed with the appropriate values (as with the semantic formula placeholder in SUBSTITUTION before). However, we now take α to be a rule-language metavariable which persists in context, rather than becoming fixed with the value it takes on first application (we will indicate this by use of Greek letters from now on). Re-application of this rule in a new context will therefore force the same type and relative tree address of the antecedent, but not the same semantic formula label.

With these formulations, we can provide a sloppy analysis of (83), repeated here:

(83) John worried about his sister, and Tom did too.

In the first sentence, given that *his* and its antecedent *John* are in the same tree, the parser can use the LOCAL-SUBSTITUTION rule to provide a value, instantiating the value for the modality $\langle Y\rangle$, as a path from the determiner-internal pronoun to the subject node; in this case, $\langle\uparrow_0\uparrow_0\uparrow_1\downarrow_0\rangle$. The relevant actions used are therefore as follows (slightly

abbreviated):[24]

a_i *(worry about)*	**IF**	$?Ty(e \rightarrow t)$	
	THEN	$\texttt{make}(\langle\downarrow_1\rangle); \texttt{go}(\langle\downarrow_1\rangle); \texttt{put}(Ty(e \rightarrow (e \rightarrow t)));$	
		$\texttt{put}(Fo(Worry\text{-}about')); \texttt{go}(\langle\uparrow_1\rangle);$	
		$\texttt{make}(\langle\downarrow_0\rangle); \texttt{go}(\langle\downarrow_0\rangle); \texttt{put}(?Ty(e))$	
	ELSE	ABORT	
a_{i+1} *(his)*	**IF**	$?Ty(e)$	
	THEN	$\texttt{make}(\langle\downarrow_1\rangle); \texttt{go}(\langle\downarrow_1\rangle);$	
		$\texttt{put}(\lambda P.\epsilon, P); \texttt{go}(\langle\uparrow_1\rangle);$	
		$\texttt{make}(\langle\downarrow_0\rangle\langle\downarrow_0\rangle); \texttt{go}(\langle\downarrow_0\rangle\langle\downarrow_0\rangle); \texttt{put}(Fo(\mathbf{U}));$	
		$\texttt{put}(?\exists x.Fo(x)); \texttt{put}(Ty(e)); \texttt{go}(\langle\uparrow_0\rangle);$	
		$\texttt{make}(\downarrow_1\downarrow_0); \texttt{go}(\downarrow_1\downarrow_0); \texttt{freshput}(\mathbf{x});$	
		$\texttt{go}(\langle\uparrow_0\rangle); \texttt{make}(\langle\downarrow_1\rangle); \texttt{go}(\langle\downarrow_1\rangle);$	
	ELSE	ABORT	
...	...		
a_{i+j} *(*Loc-Subst*)*	**IF**	$Ty(X = e), ?\exists x.Fo(x),$	
		$\langle\uparrow_0\uparrow_0\uparrow_1\downarrow_0\rangle(Ty(e), Fo(\alpha))$	
		(succeeds with $\alpha = John'$)	
	THEN	**IF**	$\uparrow_0\uparrow_*^1\downarrow_0 Ty(e), Fo(\alpha)$
		THEN	ABORT
		ELSE	$\texttt{put}(Fo(\alpha))$
	ELSE	ABORT	

The action a_i for *worry about* introduces a predicate node $Worry\text{-}about'$, also introducing its argument node with a requirement for an object $Ty(e)$ term; the actions for *his* build an epsilon-term subtree, including a metavariable **U** which is required to be given a fixed formula; the Local-Substitution computational action resolved that metavariable. In this first application, the only available and consistent $Ty(e)$ antecedent node in the current partial tree is that for the subject, which

[24] We take *his* to project the combination of an epsilon operator introducing a two place predicate, of whose arguments, the higher is a metavariable of type e, the lower, the variable that the operator binds. The characterisation of *his* simplistically conflates the pronominal sub-entry and the sub-entry for the genitive, a conflation which leaves the pointer at not strictly the right node. In a stricter specification, in which the contained noun-phrase expression is analysed as parsed as a node locally unfixed to the $Ty(e)$-requiring node, subsequently resolved to yield a structure identical to that of *mother of him*, this problem doesn't arise. But we leave such complications aside here. We also suppress here the event term and the need to determine the role of the initial NP as semantic subject, taking this to have been determined by computational action (following Cann et al 2005): nothing turns on this simplification. See Cann et al 2005 for justification of the construction of locally unfixed nodes, and Cann 2011 for full articulation of the interplay between the subject expression, auxiliary specifications, and the morphological form of the verb.

is at $\langle\uparrow_0\uparrow_0\uparrow_1\downarrow_0\rangle$ from the current node; the formula $John'$ is therefore copied from there. The actions for *mother* (not shown) then provide the required predicate to complete the epsilon term.

The second (elliptical) sentence is initially parsed as before, with the lexical actions of *did* projecting a metavariable. Now, REGENERATION allows us to retrieve the actions shown above. Clearly, when these actions are re-applied in the new context of the elliptical utterance, an identical structure will be built modulo the fact that the LOCAL-SUBSTITUTION action will now pick up the local antecedent Tom' in the current partial tree, as this now decorates the node related to the current node by the modality $\langle\uparrow_0\uparrow_0\uparrow_1\downarrow_0\rangle$. We thus obtain the sloppy reading. [25]

Positing two substitution processes is, interestingly, not equivalent to a specification of lexical ambiguity in the pronominal or elliptical expressions themselves. Metavariables projected by pronouns are simply place-holders to be provided a value. However, just as in parsing, there is more than one strategy for providing such a value; tracing paths through nodes in a tree is one strategy provided the tree itself remains available in context.[26][27]

7.1.1 Antecedent-contained ellipsis

Antecedent-contained ellipsis is a form of VP ellipsis, in which, as before, the actions are chosen from the context, this time that being the primary structure to which the relative clause appends a LINKed structure, but with the additional factor that whatever actions are

[25] This characterisation forces an exactly parallel tree relation between the regenerated pronoun and its antecedent in the two sentences. This could be weakened to allow for non-identical structure, but we take any lack of parallelism to seriously jeopardise the availability of sloppy readings, as in (i), and therefore we do not make that move here:
(i) The teacher who spoke to Bill about his problems reported them to the head, and the man who Sue tells me had spoken to Tom did too. Note also that versions with subject-auxiliary inversion *"and so did Tom"* require the lexical actions of the auxiliary to provide an underspecified subject node; we skip this refinement here, but see Cann et al 2005.

[26] One might view the distinction between the two forms of SUBSTITUTION as the parser's pragmatic choice of whether to take the (strict) choice of substituend as critical, or the (sloppy) local node relation (an option not even available if the substituend is taken from a tree which is not part of the current tree, as no such relation can be defined). We take the two separate rule specifications as simply making this choice explicit.

[27] We assume, without full analysis, that presuppositional constraints on pronoun resolution (gender and speaker/addressee identity) are taken not to persist into context, in order to allow the LOCAL-SUBSTITUTION actions for resolving *his* and *my* in (i)-(ii) below to be re-run, picking up on the different parallel antecedents even though they do not fit the initial gender or speaker-identity requirements:
(i) A : John left his socks in the washing machine. B: Susan did too.
(ii) A: I left my socks in the washing machine. B: I did too.

selected from that context must also be commensurate with what has to be processed given the overt form of words presented for interpreting the ellipsis site presented within the relative clause. This structure has been discussed in detail elsewhere (Cann et al 2005). Here suffice it to say that the apparent island observing effects are preserved in the characterisation of relative clauses as LINKed structures, because the relative pronoun itself within that adjunct structure, in virtue of its left-peripheral position, imposes the requirement that the node which it decorates, initially only unfixed, has to be updated within the domain given by that LINKed tree (rather than across both it and that in which its head is contained). Hence the effect of the island-sensitivity, itself a consequence of the presence of the relative pronoun initiating the interpretation process inducing the LINKed structure.

7.2 Bare Argument ellipsis

The pattern of analysis adopted for VP ellipsis extends to bare argument ellipsis where these are subject to direct propositional construal, dubbed "stripping"(a term from Ross 1967), except that because there is no relative pronoun (complementiser), there is no island sensitivity, and because there is no restriction to the predicate to be selected having to involve applicability to any presented subject, there is a considerably greater range of interpretations:

(84) John wants Mary to visit Sue in hospital. Tom too.

Furthermore, there is lack of island sensitivity, as noted by Culicover and Jackendoff 2005:

(85) John wants to read all the articles that appeared in the Times last week. And the Telegraph too.

In (85) for example, the fragment allows construal as 'John wants to read all the articles on golf that appeared in the Times last week, and John wants to read all the articles that appeared in the Telegraph last week' (though this is by no means the only construal). Such lack of island-sensitivity of bare argument ellipsis suggests, in DS terms, an anaphoric linkage from within the primary structure to some structurally independent term already constructed rather than update of an unfixed node whose construction within the emergent structure would, to the contrary, induce island effects. This is straightforwardly modellable via one of the proposition-opening strategies which the DS system makes available, namely that of inducing the building of a *LINKed* structure whose top node to be decorated by a type-*e* expression, with the imposed requirement of the primary structure having to emerge as containing the requisite shared term definitive of LINKed structures. This is a strategy independently defined for so-called Hanging Topic constructions which familiarly do not display island sensitiv-

ity, and so is available for the processing of such isolate NP expressions without more ado. All we need is to presume that the processing of such expressions with immediate follow-on provided by *too* constitutes a trigger for the construction of such a sequence of opening steps. This would have the effect of treating the fragment expression as though a left-peripheral expression, even though itself a fragment, with all the actions to create the structure to be taken to be a development making use of the term constructed from what is otherwise within the structure, being taken from the immediately preceding context. As with VP ellipsis, this involves the re-use of actions used in the building up of content for the antecedent structure but in this bare argument case, in the reconstruction of the fragment, there has to be replacement of one such term with that presented by the fragment itself:[28]

(86) *A:* John interviewed Mary in hospital.
B: Bill too.

There is then the issue of choosing which term of the antecedent structure to use as the source from which the action sequence is to be selected.[29]

To achieve this effect, we again appeal to the concept of re-using actions from context; and, as with VP ellipsis, presume on a variant of REGENERATION. First, the fragment *Bill* is parsed, decorating an unfixed node of type e. A metavariable, this time of type t, is then projected by the lexical actions of *too*, whenever a complete propositional

[28]This process has been dubbed 'stripping' (see Chung et al: 1995).

[29]We take the constraint of immediately preceding to be a relevance-induced matter, on the grounds that ignoring some immediately previous set of actions would involve setting them aside in favour of some other choice, and other things being equal such a choice would itself involve effort and so be dispreferred. These circumstances however arise in scenarios where for example the speaker is having two conversations in tandem, literally interspersed in time, but with their disjointness of topic enabling the participants to retrieve which context the proffered fragment has to be construed relative to (as in conversations between parents with co-present young offspring). So whatever locality is imposed on the choice of actions to be selected, is not a strictly time-linear matter.

formula has not already been constructed:[30]

too

IF	$Ty(t)$,	
THEN	1	
ELSE	**IF**	$?Ty(t)$,
	THEN	$\texttt{put}(Ty(t))$;
		$\texttt{put}(Fo(\mathbf{U}))$;
		$\texttt{put}(?\exists x.Fo(x))$;
		REGENERATION;
		IF $Tn(0), Ty(t)$ **THEN** 1 **ELSE** ABORT
	ELSE	ABORT

In contrast to other similar anaphoric specifications, note that *too* enforces the completion of a propositional end result at the top node. This excludes the partial use of actions licensing strings after *too* has been parsed:[31]

(87) *I persuaded Harry to visit Mary in hospital; and Bill too Sue.

This metavariable now licenses the use of REGENERATION to re-run actions to construct a complete $Ty(t)$ formula. However, in order to allow the substitution of one of the terms within the sequence of selected actions to be re-run, we require an alternative version, allowing a compatible section of the contextual action sequence to be replaced by a meta-variable that then gets duly updated as the only means of securing the consequence of having set in train the initial step of building a LINKed structure, which was to impose on the primary emergent structure the requirement of the construction of a second token-identical occurrence of whatever term decorates the node inhabiting the topnode of the LINKed structure, and then, having made this replacement, leave that node at this point to continue with whatever further action steps form part of the selected antecedent action-sequence. In the action-sequence specification that follows: [32]

- $a_i \ldots a_m$ is the sequence in context (from the first conjunct) that builds from the current type requirement $?Ty(X)$ (e.g. $?Ty(e \rightarrow t)$) to a complete $Ty(t)$ (although we're not checking that, just assuming that if we don't run all the way to a complete t type we won't parse successfully anyway)

[30] Other triggers are stressed *and* (see Cann et al 2004 on *and* and Right Node Raising). We ignore here the fully inferential use of *too* as in *John tends to watch home movies all day and Sue is a layabout too.*

[31] This characterisation also correctly precludes the use of *too* in pseudo-gapping:
(i) John interviewed Clinton, and Bill did too Mandela .

[32] Use of this strategy is not restricted to *too*; we take it to be a generally available alternative, licensing examples such as:
(ii) Sue persuaded Harry to visit his mother in hospital, but not Tom.

- $a_j \ldots a_{k-1}$ is the subsequence of that which builds a node (with possible daughters etc) of a complete type $Ty(Y)$ which will probably be $Ty(e)$ - i.e. the subsequence which corresponded to what in the first conjunct is the sequence of actions yielding that term for which the fragment constitutes a replacement in the now emergent tree. This does not get re-run here - instead, we put in a metavariable of type Y.
- We assume that the actions now record in context which node an atomic action applies at - so we have e.g. $put(Ty(e))@Tn(a)$ to say that we put $Ty(e)$ at node a. This is how we can check that a_j starts a sequence with a relevant requirement $?Ty(Y)$ and a_{k-1} finishes it by putting $Ty(Y)$ at the very same node. N^1_X etc are supposed to be rule-level metavariables, just like X and Y
- $a_k \ldots a_m$ is the remainder of the action sequence which needs then to be re-run to set out at least all the construction steps needed to establish the follow-on (propositional) type X.
- As the final step in the sequence of actions defined by this composite action, we secure the return of the pointer to the node with the metavariable, so that this can be updated by being identified with the term decorating the LINKed structure, and so fulfil the requirement initially imposed:[33]

[33]This step is strictly unnecessary for bare argument ellipsis, though defined for implementation purposes, since it will be a consequence in all successful derivations. Either the pointer fails to return to the node decorated with a metavariable altogether, so no output structure will get compiled; or it succeeds in returning to that node and if it so returns, the needed step of Substitution can only be one which duly selects as its update the term occupying the LINKed structure, this being the only way of satisfying the LINK-imposed requirement.

REGENERATION'	**IF**	$?Ty(X)$
		$\langle T, W, A\rangle \in \mathcal{C}$,
		$\langle a_i, \ldots, a_j, \ldots a_k, \ldots, a_m\rangle \sqsubseteq A$,
		$a_i = \langle$**IF** ϕ_1 , **THEN** ϕ_2 , **ELSE** ABORT$\rangle$,
		$?Ty(X)@Tn(N^1_X) \in \phi_1$,
		$a_j = \langle$**IF** θ_1 , **THEN** θ_2 , **ELSE** ABORT$\rangle$,
		$?Ty(Y)@Tn(N^1_Y) \in \theta_1$,
		$a_{k-1} = \langle$**IF** ξ_1 , **THEN** ξ_2 , **ELSE** ABORT$\rangle$,
		$put(Ty(Y))@Tn(N^1_Y) \in \xi_2$,
	THEN	$\mathtt{do}(\langle a_i, \ldots, a_{j-1}\rangle)$,
		$put(Ty(Y))@Tn(N^2_Y)$
		$put(Fo(META))@Tn(N^2_Y)$
		$\mathtt{do}(\langle a_k, \ldots, a_m\rangle)$,
		$go(Tn(N^2_Y))$
	ELSE	ABORT

In (86), there are two possible structural points at which the sequence can be broken and the requisite construction of a metavariable be carried out: either when the pointer is at the subject node or when it is at the object node (repeated here):

(84) John wants Mary to visit Sue in hospital. Tom too.

. In the former case, it is the sequence of actions associated with parsing *John* that is replaced by the action constructing a new Metavariable; in the latter, those associated with parsing *Mary*. In both these cases, the replacement of that antecedent term by the metavariable by applying REGENERATION' enables the context-provided re-running of actions to proceed without further interruption, hence as a single uninterrupted sequence, save for the intermediate construction of the metavariable. The further step of Substitution selecting some value as enrichment of that metavariable does not need to take place at this point, as with anaphoric processes generally. There will always be a point in the sequence of actions at which the pointer returns to the mother of the node in question in order that the node decorated with the metavariable and its sister are scanned for evaluation (to secure some formula value at the mother node as part of the process of evaluating the tree as a whole) this being at the relatively late process of tree compilation where the structure has been fully set out and is midway through being evaluated on a bottom-up basis for establishing compositionality of content - a fully algorithmic process once all the parts have been constructed. The significance of anaphoric devices is that the place-holding metavariable allows the construction process to proceed, so that the construal can be fixed either from context already established, or from terms later in the evaluation process (presented

as following the anaphoric device). This pattern is indeed characteristic of anaphora resolution wherever such resolution is triggered by expletive pronouns and agreement devices, as witness all so-called pronoun-doubling, all expletive cases, and all agreement where associated with pro-drop phenomena (Gregoromichelaki 2010, Cann et al 2005) At such a relatively late stage, substitution of the metavariable with the term decorating the LINKed structure node constructed initially can take place, using that term as the content-providing term, successful second use of the term providing content to the anaphoric device being a prerequisite of all successful completions involving pairs of linked structures. All steps subsequent to any such substitution step are automatic steps of evaluation of the tree and need no triggering of context-provided actions. This same pattern will apply to all more complex cases, where more structural positions for substitution may be available.

At this juncture, there is an advantage in having presumed that the fact that ellipsis construal involves apparent binding of some pronominal within the ellipsis site by a term within some preceding term is a consequence of parsing the words in the fragment, and not a consequence of individuation of any particular argument node in the tracing of a path by Local-Substitution. For now, by Regeneration and Local-Substitution, we can correctly anticipate the availability of sloppy readings from non-subject positions:

(88) I gave John comments on his paper, and Mary too.

Moreover, given that the tree node identifiers in the rule specification are themselves variables over tree transitions, and furthermore that the localised variant of substitution for anaphoric expressions within any such re-play action sequence is restricted to taking as antecedents only those terms which decorate a node in some tree relation to the metavariable, the restriction of value for that metavariable from within the action sequence is secured.

7.2.1 Bare arguments as local tree-growth add-ons

In all these characterisations presented so far, the construction of interpretation for the fragment has been constructed on the assumption that some propositional form can be constructed by what is provided by the actions stored in context, with suitable adjustment allowing its reapplication. The fragment is thus by presumption sufficient to induce an entire propositional structure from just the fragment itself. These indeed constitute the canonical form of ellipsis, recognised by linguists as "stripping"; and, on the present analysis, there is the immediate bonus of a basis for explicating the parallelism central to these forms of ellipsis. Nonetheless, as we have already seen, fragments of this type

can only be one part of the story. Fragments, by definition, are partial specifications of content, and given that all expressions by definition are updates to partial specifications of context, the DS anticipation is that in principle any arbitrary type of structure can constitute a context for a fragment; and not merely structures of propositional type. Accordingly, we expect that a natural role for a fragment is indeed to provide an extension of what someone else has provided, either by interrupting them, or by providing licit extensions to terms their interlocutor has completed. It is this latter which constitutes the other major type of bare argument ellipsis expression identified by Culicover and Jackendoff. By assumption, this process is essentially local, so no antecedent selection is involved. The seamlessness of such extensions follows directly from the DS assumptions that both parsing and generation make use of identical mechanisms of tree construction, for, relative to this assumption, we anticipate the freedom with which fragments can adopt some subtree under development from their conversational partner, sequentially extending that:

(89) A: I hear Harriet's been drinking again.
B: Yeah, Scotch, at the weekend.

Moreover, there is sensitivity to context to a fine level of granularity. *yeah* itself is a propositional anaphor, hence identifiable as some propositional construct from the immediate context, a choice which is sensitive to a whole range of pragmatic issues, such as the implausibility of identifying the proposition to be given as agreement with A's hearing that Harriet's been drinking, as compared to confirming that Harriet has indeed been drinking. As with VP anaphora, the choice is open to carry over either the interpretation itself as a finished product, or the actions which lead to that content, and with selection of actions, the respondent B can then take the actions determining the construal of the string *Harriet has been drinking* as the basis for what it is B is agreeing with; and the addition of *Scotch at the weekend* is a seamless add-on provided by B as speaker to the sequence of actions already selected for that construal. All we need for this particular case, with *drink* able to be used apparently intransitively as well as transitively is to assume that in the semantic representation, there is invariably a representation of some object, albeit a mere epsilon term, with the word *Scotch* then providing an appositional extension of that. The add-on of *at the weekend* then provides an analogous development of the event term, just as it would as an end-placed adjunct to an independent sentence. A similar account would be provided to the *Culicover and Jackendoff* example of *Yeah, probably Scotch*. For their own otherwise very similar account, resting as it does in anaphoricity, the string is given a flat tripartite analysis, and only as it were passed to the pragmatic device to interpret relative to context with that se-

quence analysed as a flat whole. On the account developed here, the account is a step-wise processing, with each word in turn providing update actions to be carried out in the order presented.

This account now has an immediate bonus. The challenge of bare argument ellipsis is why it could fail to be island sensitive, given that antecedent contained ellipsis is island sensitive. The answer to the challenge is now to make use of the liberating abandonment of the assumption that all ellipsis construal involves projecting the fragment itself as leading directly to some propositional content, given suitable selection of some context-provided abstract. The island sensitivity arose, recall, because these data appear to violate what are otherwise standard constraints on movement. on the assumption that elliptical fragments following the pattern of other ellipsis data, involved movement from some full sentential source site across to the left periphery in order to create an appropriate constituent containing the whole of the remainder string which would then be subject to PF deletion. Critical examples are:

(90) John has introduced me to a woman who speaks French
B with an English Accent?

(91) John met a guy who speaks a very unusual language.
B Albanian. That's Giorgiou

On this latter analysis, these fragments need not treated as processed relative to a full propositional content as context, from which some structure/actions need to be selected. Rather, they are processed relative to a partial structure, to which the actions presented by the fragment have to apply as input – in exactly the manner of a split utterance. Thus, as indicated in section by the observation of parallelism with apposition structures as in monologue, such fragments would be seen as yielding an extended term as part of some single propositional structure-building process. Thus they form part of the core data, constructed by direct projection of structure across the two participants, exactly as would be predicated to be felicitious by DS assumptions. The DS account thus correctly predicts that such data are seamlessly acceptable, and wholly unproblematic in the parsing process that they instigate.

Thus in bare argument ellipsis, we have some data redolent of VP ellipsis, involving anaphoric choice from some (independently provided) context and some data redolent of the incrementality of immediate tree construction as carried out in some sense collaboratively across participants in a dialogue. On this view, we would expect asymmetries between two such processes of ellipsis construal, as in the one case the fragment expression is being used as an initiator of a novel emergent propositional structure, relying on anaphorically establishable dependencies, whereas in the other case, the fragment is being as an update

to a partial structure in arbitrary stages of content construction between the outset imposition of a propositional type requirement and final satisfaction of that requirement, in the latter case but not the former, so its role within that process is defined relatively to an essentially local context.

8 Gapping

With gapping, we have the mirror image of VP ellipsis,for it is not the skeletal auxiliary which triggers the re-use of context in some way, but the expressions themselves. In some sense to be made precise, it is these that control the way the interpretation is built up from the context. What we now see is that the intrinsic incrementality of the DS perspective enables us to capture the range of facts remarkably naturally. What we propose is that the pair of expressions is indeed identified in the construal process with the first expression identifying what initiates the choice of actions to be selected from context; the second expression then determines the course of that action sequence, in particular where it ends.

Recall that the challenge that gapping presents is the partial restrictiveness: it is not the case that just any old pair of terms from the antecedent structure can be taken as the basis for some process of substitution in the building up of the 'gapping' site. The only types of expression that can occur as the term preceding the construal derived from context are those that can be interpreted entirely straightforwardly given the regular strategies in the initial steps of proposition construction - the decoration of the already constructed event term, or the building of a node to be identified as subject, or indeed more peripherally the building of an unfixed node to be identified as later resolved by the reconstructed actions. So by far the commonest exemplars of gapping constructions are of two sorts, either a temporal adverbial, or an expression construed as subject. On the assumption that this is indeed the process involved, the second expression then determines that at some point in the construal process, some trigger provided in the actions sequence is used as input to the processing of the second expression, this being essential to the wellformedness of the sequence. This then identifies the endpoint of the action sequence as taken from context. All other expressions that follow this second member, are then construed in a wholly conventional manner as (adjunct) add-ons in the construal process. Nothing particular needs to be said for them, since all interpretation mechanisms are defined as taking some structured context as input, whether provided by the processing of overt NL expressions, or by the re-use of material from context. There is one slight wrinkle to this, that endpoints in any ac-

tion sequence can by a quite regular process be made to be extendable, giving the effect that there are cases of what is classified as gapping, but in which the second member of the pair is not apparently construed as some end-point in the construction of a propositional structure but, rather, something securely in the middle thereof.

8.1 Paired terms and action-sequence selection

The canonical cases of gapping, with simple clauses, constitute a pair of sisters as some skeletal conjunct to some previous conjunct on whose interpretation they depend, in particular lacking the verb, so that in the processing all that is presented is a pair of expressions interpreted as co-arguments, with a predicate to be recovered from the previous conjunct:

(92) John interviewed Mary, and Tom Harry.

However, as Culicover and Jackendoff point out, the remit of explanation is broader than that, since adjuncts can also constitute a first member of the n-tuple with one or more co-arguments following:

(93) On Monday John helped Mary with her project, and on Tuesday, Tom

(94) On Monday John criticised Mary, and on Tuesday, Tom, Sue.

And then there are the examples they noted which involve pairing across clausal boundaries:

(95) Mark thinks that we should get an apartment in Shanghai, Hugh a cottage in Wales.

(96) Leslie thinks that Mercedes are cool. And Tom Ferraris.

What these examples share despite the different structures across which the NPs are paired is that the first constituent of the pair in each case can be taken as decorating a node which can be built by what are available strategies in any case for the initial stages of constructing some emergent propositional structure – this recall was what distinguished the wellformed cases from the impossible construals indicated in 57)-(59). In both subject and adjunct construals, the first NP in the sequence is identified simply by regular and highly salient strategies opening up the interpretation process: if as a subject this will be via decorating an initially locally unfixed node with a routinised expectancy that this may be identifiable as subject; if as an adjunct by the building of a LINKed structure to the event term, itself introduced as part of the axiom. Both are independently available routinised heuristic strategies for the opening stages of any type-t-requiring imposed goal. The consequence is that in such gapping cases, out of the

pair of supposed gapped expressions, only one expression will necessitate a search within the context for some action sequence to license its construal, in these cases constituting an endpoint to the sequence of actions. However, the NP immediately before the ellipsis reconstruction site (the first member of the pair in a pair of "gapped" NPs) does have an additional role to play: it constitutes the point from which the action sequence is selected. In consequence, we have a pair of expressions in the fragment sequence whose construal is coordinated with a pair of terms in the preceding context.

The canonical instances of gapping are those with co-arguments, as in (92), for which the two subject expressions are twinned, the second as looking for some sequence of actions to be picked up from the context of actions immediately subsequent to the processing of its subject. Unlike VP ellipsis which determines the endpoint of the action sequence to select by its typing, the appropriate action sequence for gapping is that which successfully provides the trigger for the processing of the second expression, this itself determining the endpoint of the action sequence. In (92), with the subject expression taken to decorate a locally unfixed node and its fixed position determined by tense, the determination of the second NP as subject is part of the actions selected in re-running the actions from those locally identifying the subject expression as not yet fixed. And (95) demonstrates that the action sequence so selected does not imply any particular action sequence, in particular not one corresponding to a particular type. Rather with the first NP taken as subject, the actions for creating construal are from there reduplicated until the construction of the node to be decorated with the requirement $?Ty(e)$,which constitutes a trigger for the processing of the second NP, whose associated actions duly serve to satisfy this requirement.

Moreover, even where there are adjuncts and other modifiers following, these do not need to be seen as n-tuples of expressions within a gapping construction, as they can be invariably be analysed as providing the regular tree-update specifications they are defined to do:

(97) John wants to see a movie with Tom, and Sue a concert with her brother

(98) John has made arrangements to sell his car on e-bay, and Tom his piano by auction

(99) Robin speaks French on Tuesdays, and Leslie German on Thursdays, with her mother-in-law.

All that is required for these cases is to presume that with the subject expression being construed in a wholly regular way - as decorating a locally-adjoined unfixed node for which the verb provides the fixing as logical subject, and the presence of a second NP triggering a selection from context of the requisite action sequences determining the construction of a partial structure which it can be used to decorate,

the then subsequent construal of *by auction* can take place exactly as if the overt string *Tom has made arrangements to sell his piano* had preceded, for in both cases equally, the adjunct will serve to update whatever partial structure is thereby constructed in the two cases. Hence the construal of a construal of a gapped sequence with no special mechanisms needing to be articulated. Indeed, contrary to a movement analysis of gapping, one might expect that construal of sequences of actions could be across arbitrary nonconstituent sequences, such as in:

(100) John has plans which involve working at the Sunday Times; Mary, the Observer.

These are amongst cases which are highly problematic for movement accounts of gapping, as the structure in which the second NP is construed as being lodged, precludes movement from out of such a structure:

(101) *Which paper does John have plans which involve working at?

Under this account however, all that is required is that the first expression which is to be taken as in correspondence with the initial expression of the second conjunct – here the subject *Mary* – identifies where the sequence of actions is to be taken as starting; and the pairing of the alternants *the Sunday Times* and *The Observer* enables the identification of the appropriate term as provided by that second expression to constitute the juncture at which the context-selected sequence of actions terminates. The fact that this second fragment is not a structure that can be analysed in terms redolent of Left Dislocation is wholly irrelevant, according to the DS analyses, since fragment construal can be in terms of adding to some partial structure already available.

There are other cases, which though presumed by Culicover and Jackendoff to be amongst those classified as 'gapping' are arguably better analysed as a variant of bare argument ellipis. These are cases the first expression is construed as an initially placed adjunct, the second expression, in the event, construed as subject. In such a case, we suggest, with wholly regular construal of the initially placed adjunct, the following expression can be construed equally by wholly regular strategies identifying it as a putative subject. And what is then triggered is search in context for some appropriate predicate to complete it, which in such a case would be a strictly matching predicate as already available. So for example in (102), the decoration of the first of the "'gapped" pair *on Mondays* can take place directly as an adjunct to the independently constructed event term, by a LINK transition to a node hosting the predicate attributed to that event term $on'(Mondays)$:

(102) On Sundays, Robin speaks French to Bill, and on MOndays, Leslie.

This leaves just the one expression *Leslie*. On the supposition that the following expression can be analysed as a putative subject – a default assumption – all that is required is to identify the predicate available from the immediate context. It is notable in such cases, that the addition of *did* is wholly equivalent.

Unlike this analysis Culicover and Jackendoff argue that gapping is no more than a sequence of multiple applications of bare argument ellipsis, Culicover and Jackendoff argue that the existence of multiple foci is a matter of processing complexity as to how many focussed constituents are processible, with increasing degradation of acceptability with each additional fragment expression. However, this is not a mere matter of how many such expressions there are, as there is notable asymmetry between whether the preposed constituent is a temporal adjunct or not. Culicover and Jackendoff cite

(103) *With Yves, Robin speaks French on Tuesdays, and with Horst, Leslie German on Thursdays.

A notable improvement is (104) which differs from (103) only in that it is the adjunct which occurs first:

(104) On Tuesday, Robin speaks French with Louise, and on Thursdays Leslie German with Horst.

Thus, in virtue of being construable as a temporal adjunct, the processing of the first expression can be by immediate construction of a placeholder for an event term, as made available by the axiom itself (following Gregoromichelaki 2006); and the result is that the interpretation with this order is no greater a burden than a three-term gapping sequence. The only complexity involved in (104) as opposed to (102) is that the initial adjunct does not itself constitute the input to the running of the selected actions sequence, and this role is taken up by the immmediately following subject expression.

This effect of lack of additional complexity with additional postposed adverbial expressions occurs also in what might seem to be a three-term gapping sequence:

(105) On Tuesday Robin speaks French with Louise, and on Thursdays German with Horst.

In (8.1), the fragment contains a temporal adjunct initially, with an object and a postposed prepositional phrase. The effect is that what might seem to be three-way gapping is in fact a straightforward processing task, involving choice of action sequence to be replayed with only one substitution site to be selected, that replacing French with German. The initial adjunct of the second conjunct is processed as that, given its lexical content, so no substitution operations are required. The presence of the immediately following *German* triggers

the action sequence reconstructing subject and verb from the previous conjunct; but the following *with Horst* needs no such substitution mechanism. Like the first locative expression, it can be processed as any other adjunct would, merely as extending the event term so far constructed, as entirely standard for adjunct processing. Hence the ease with which this example is processed – no more complex than a single bare-argument to be elliptically construed.

It might seem, on the face of it, that however attractively functionally motivated such an account of gapping might be, it is nonetheless inadequate, as there are many cases where the second expression is construed not as some late-edge defining expression. Rather it acts as a substituend for some mid-point item in the construal of the structure under re-iteration. In (106), for example the term selected is the term constructed from *dogs*, duly replaced by a place-holding metavariable for subsequent substitution by the term constructed from *cats*:

(106) Robin knows a lot of reasons why dogs make good pets, and Leslie, cats.

Indeed, in an example such as this, the intermediate sequence of steps, crudely corresponding to 'knows a lot of reasons why...make good pets' is not a constituent at all, let alone one that is edge-determined. There is further significance to examples such as these, as on a movement analysis of gapping/bare-argument ellipsis, these would be predicted to be ungrammatical, movement out of a clausal adjunct being precluded from a covert presentation of such structure:

(107) *What kind of animal do you know a lot of reasons why make good pets?

(108) *Which newspaper does John have plans which involve working at?

But, at this point, the analysis given to the second term is no different from that of bare argument ellipsis, with the second term analysed as involving REGENERATION'. What is involved in reconstructiong actions for the construal of gapping is that the second term will trigger rerunning of the actions with one term identified as to be replaced by a metavariable. This intermediate step will then allow the action replay to resume without further interruption. It is only when the pointer returns to the metavariable-decorated node that the value for this will have to be provided. And ensuring this can either involve local construction of an unfixed node or a *linked* structure which can allow the processing by the second of the gap expressions to create the necessary provision of value for the constructed metavariable. But whichever of these strategies is selected will involve a construction step at a very late stage in the interpretation process; so the intuition that the second NP identifies the end edge of the sequence of actions to be culled

from context is directly preserved in the analysis.

8.2 Gapping: the formal account

These informal statements now need fleshing out. The formal statement presumes independent characterisation of the first expression, and solely expresses the requirement for identifying a suitable sequence of actions with reference to some sequence of actions from that point and some second expression, which serves to identify the end point of the sequence of actions constructing propositional structure. So in effect, all that is required specific to this gapping structure is an application pertinent also to Bare Argument Ellipsis. The only property idiosyncratic to REGENERATION' as it applies to Gapping is that for Gapping, the provision of value for the metavariable which REGENERATION' sets in place is provided by the processing of the second term of the gapping sequence. (and not by anaphora resolution from context). The only aspect of the re-running of actions particular to Gapping is then that the pointer must return to the node to be identified as decorated by the metavariable that remains to be developed in order for that node to be expanded to provide the site from which the second NP can be processed. The actions are exactly as before except for such return of the pointer to the node in question (and we repeat them here):

REGAPPERATION	**IF**	$?Ty(X)$
		$\langle T, W, A\rangle \in \mathcal{C}$,
		$\langle a_i, \ldots, a_j, \ldots a_k, \ldots, a_m\rangle \sqsubseteq A$,
		$a_i = \langle$**IF** ϕ_1 , **THEN** ϕ_2 , **ELSE** ABORT$\rangle$,
		$?Ty(X)@Tn(N^1_X) \in \phi_1$,
		$a_j = \langle$**IF** θ_1 , **THEN** θ_2 , **ELSE** ABORT$\rangle$,
		$?Ty(Y)@Tn(N^1_Y) \in \theta_1$,
		$a_{k-1} = \langle$**IF** ξ_1 , **THEN** ξ_2 , **ELSE** ABORT$\rangle$,
		$put(Ty(Y))@Tn(N^1_Y) \in \xi_2$,
	THEN	$\mathtt{do}(\langle a_i, \ldots, a_{j-1}\rangle)$,
		$put(Ty(Y))@Tn(N^2_Y)$
		$put(Fo(META))@Tn(N^2_Y)$
		$\mathtt{do}(\langle a_k, \ldots, a_m\rangle)$,
		$go(Tn(N^2_Y))$
	ELSE	ABORT

The development of this metavariable-decorated node can take place either by Late*Adjunction or by a LINK transition, enabling substitution of the constructed metavariable of type Y by the value to be provided by the second NP. The only subsequent steps in the compilation of a propositional value are thus whatever evaluation steps are necessary to derive a propositional formula of type t. Within the

ellipsis set of forms, this latter step is specific to Gapping, but the mechanism itself is wholly general and needs no special stipulation. This part of the construal process is simply the application of mechanisms independently available for processing metavariables within the construction process at some relatively late stage, as for example for expletive pronouns, as we have already seen.

So Gapping is merely a composite sequence of actions:
(i) the regularly available strategies for initiating an emergent proposition construction process for processing the first expression in the pair;
(ii) the use of an action-sequence copy process modulo construction of one intermediate place-holding metavariable as preparation for provision of a novel substituend
(iii) the presumption that constructed metavariables allow delay in expansion of structure until the point at which the pointer returns to the node so decorated during the bottom-up evaluation stage of construal, hence at a relatively late stage in some emergent propositional structure.
Hence the intuition that gapping involves using the first NP of the pair to identify the beginning of some attendant action-sequence selection and the second NP of the pair to identify the closing steps in that selection, thereby enabling the identification of which action-sequence to be successfully selected from context. Furthermore, this process is predicted to be available in virtue of all its sub-mechanisms being independently available, its relative complexity arising only because it is a compound interaction of such independent processes.

It might seem that the account provided, with its strict taking up of the action sequence of the previous conjunct would preclude the possibility of inverted ordering of the second stressed pair of NPs, providing evidence furthermore that the priming effect of strict matching achieved by reiteration of the way the interpretation is set up isn't the only basis for establishing interpretation:

(109) Leslie thinks that Mercedes are cool; and Ferraris, Tom.

However, given that the opening strategies in these second fragments comprise the regular initiating strategies, one such would be the application of *Adjunction, hence allowing the possibility that the initial expression be taken to decorate an unfixed node. This then allows the action sequence to be selected to be that of the subject predicate and complement selection. It is only at the processing of the subordinate subject that the formula *Ferraris* can duly be used, and the substitution of metavariable in the sequence of actions make this unification possible. And with this substituted metavariable in place, the full sequence of actions from the first conjunct can be carried out with just this intercalation. Only at the evaluation of the tree and the return of the pointer to the rootnode is it essential to compositionality that the

value for that matrix-subject metavariable be instantiated, and at this point, Merge can take place, duly providing the value for that node. The dynamics of the explanation is no more than that provided for the second term of a gapped pair in other constructions.

8.3 Pseudo-gapping

Finally we now have an explanation of why, and to what extent pseudo-gapping is like gapping:

(110) John will try to interview Obama, and Sue will Clinton.

Pseudo-gapping corresponds to gapping only with respect to those subcases in which the first term is identified as subject, as with the presence of the auxiliary, the first term of the pseudo-gapped sequence will have to be subject. This apart, the function of the auxiliary in projecting a predicate metavariable applies just as in regular auxiliary processing, triggering a selection from context of some suitable predicate. However, in the pseudo-gapping environments, this selection is further narrowed down by the presence of the following NP, which serves as the trigger for identification of which further term within that antecedent conjunct is to be replaced by its own content as substituend. But this is precisely the analysis of gapping, with subject expressions as the first term of the pair, modulo the lack of overt repetition of the auxiliary. Hence we predict the partial parallelism between gapping and pseudo-gapping, without any need to separately identify mechanisms specific to pseudo-gapping.

9 Ellipsis and the grammar/cognition interface

Running through all that we have set out has been the assumption that a grammar system is a set of strategies for online (and interactive) construal. This has yielded a very liberal system. Though such flexibility has psycholinguistic back-up (Ferreira and Dell 2000), it might then seem impossible to exclude anything, which would threaten the DS claim to constitute a grammar system. However, taking gapping as a case study, we see what new perspective the DS perspective provides on the objectives for grammar articulation. We have set out an explanation for the limits on gapping in terms of the first member of the pair having to be associated with opening steps in the construction of an emergent proposition, hence the identification within the context of where in such a proposition the action sequence to be selected is to be taken from; and we have identified the second member of the gapped pair with providing the means of identifying the closing steps of that

action sequence. Gapping has been said to be associated with matrix coordination, an observation we know to face counter-examples. Replacing any such restriction is the assumption that what is preserved across all examples is the claim that the gapping pair themselves trigger the search in the context for what can be used to interpret them. And for this to be achievable, the first expression must serve to identify the opening edge of the actions to be selected, the second NP the closing edge of such an action sequence. With the former it is the fact that the strategies triggering its construal are all strategies which are diagnostic of a newly emergent propositional structure which constrains the search for the appropriate action sequence from some most salient context, and with the latter, it is the stress assignment coordinating the second paired term with some expression in the antecedent conjunct, an intonational pairing which is characteristically marked for all gapping sequences. This quintessentially processing explanation raises interesting issues as to the boundary of what a grammar encodes, but this is a matter we explore in detail on another occasion. Nonetheless we note that language-specific idiosyncracies are in the main driven by routinisation of early pragmatic performance-driven choices which then over time come to be handed on with such regularity that they come to be part of the successful performance of any speaker of the language (Bouzouita 2008, Chatzikykiadis 2010, Cann and Kempson 2008, Chatzikyriakidis and Kempson forthcoming). Whether we choose to call this a competencist or performancist explanation seems to us to have reduced to a matter of taste, or sensitivity to academic sociology. Unless there are lexical specifications that turn on the itemisation of such structures as a definitive list, on the DS perspective, there will not be anything to determine the outcome of the debate. However, far from this in itself meaning that we have reduced the debate between protagonists to a merely terminological issue, we urge that the alternative is to grasp the nettle presented by language as a system in continual flux and view individual languages as composite collections of on the one hand absolute constraints on structural and content growth, on the other, heuristics for processing that come over time to be associated with individual lexical items, in combination with a mass of constraints imposed by ease of processing which, in being explicable in terms of general if nonabsolute constraints on processing cost, need no encoding as such within the grammar formalism because ever present in determining optimal usage of the language. The concept of I-language versus E-language (Chomsky 1984) is, we suggest, to be replaced by that of language as a complex set of constraints on optimal interaction with others in the co-manipulation of structures.

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