Ellipsis in a Labelled Deduction System

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Abstract

Using the LDS_{NL} model of utterance interpretation being developed by Gabbay and Kempson (cf. [17, 29, 30]), this paper demonstrates how the dynamics of the proof process adopted explains configurational restrictions imposed on the interpretation of elliptical fragments. The blurring of traditional semantic and syntactic dichotomies in the LDS_{NL} proof-theoretic reconstruction of interpretation successfully provides a basis for predicting the array of variation displayed by different elliptical forms. The logic adopted is a composite system of a type logic nested within a database logic. Two resource-sensitive sub-types of Conditional Introduction form the basis for explaining the ellipsis data. The result is a demonstration of how the simple device of adding labels to an inference system can provide a useful tool not only at the meta-logic level of comparing alternative logic and grammar formalisms, but also at the level of explaining natural language data.

1 Ellipsis: the puzzle

Ellipsis phenomena as in (1) pose a particular challenge under assumptions of current linguistic orthodoxy:

(1) John wants to visit Mary in hospital.
Sue too (i)
Sue does too (ii)
Sue wants to too (iii)

They provide evidence on the one hand for a purely semantic/pragmatic explanation of how interpretation is assigned to the simple fragmentary string (cf. Dalrymple *et al.* [12], Prüst *et al.* [41]), and contrarily on the other hand for a configurationally-based syntactic explanation requiring the assignment of richer structure to the string than is visible (cf. Lappin [33], Fiengo and May [14]). Pragmatically, they constitute an extreme case of context-dependency of natural-language interpretation, with various forms, all of which require reconstruction by the hearer of some salient contextually provided one place predicate as part of the process of interpretation. Moreover the interpretation of elliptical fragments may depend exclusively on the way in which the hearer builds up such a one-place predicate as interpretation, for a fragment may be ambiguous despite lack of any ambiguity in its antecedent. In (2) for example a single interpretation of the first conjunct (with *his* fixed as picking out 'John'), is paired with possible interpretations of the second conjunct either as 'Harry admires John's mother' or as 'Harry admires Harry's mother':

(2) John admires his mother, and so does Harry.

However, despite semantic/pragmatic similarity between different elliptical forms, distinct forms nevertheless display different potential for interpretation. First there is a subject restriction, applicable only to VP ellipsis as in (1ii) and (1iii). Thus the so-called bare argument ellipsis form in (1i) (Reinhart [43]) can be used to mean either that Sue wants to visit Mary in hospital, or that John wants to visit Sue in hospital. (1ii) and (1iii), "VP ellipsis", can only mean the first of these. Secondly, both forms of ellipsis are sensitive to restrictions on their interpretation analogous to restrictions on wh-gap construal, but in different ways. Parallelling the acceptability of (3)

(3) Who$_i$ did John deny that Bill had interviewed e_i?

bare argument ellipsis allows reconstruction across clausal boundaries, giving rise to an interpretation of the fragment in (4) as 'Mary did not deny that she had taken the icecream':

(4) Mary denied that she had taken the cakes. But not the icecream.

Again parallelling wh-gap construal and the unacceptability of (5):

(5) $*$Who$_i$ did John go out with a woman who is studying e_i?

the fragment in (6) precludes the construction of an interpretation which would involve reconstructing the fragment across the relative clause boundary of the antecedent sentence as 'John is also going out with a woman who is studying Racine':

(6) John is going out with a woman who is studying Palestrina. Racine too.

(7), similarly, allows no reconstruction across the relative clause boundary[1]

(7) They are interviewing the man who Bill assaulted. But not Harry.

The apparent "subjacency" effect does not extend to wh-islands or sentential subjects. Unlike the unacceptability of (8)–(9)

(8) $*$Who do you know why e_i stole from the shop?
(9) $*$Who was that John doted on e_i clear?

(10) and (11) fully license reconstruction of the fragment across the intervening clausal boundary:

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[1] The data appear to vary according as the inferential effect of the fragment varies. Fragments as additions such as these preclude reconstruction across a relative clause boundary. Corrections and fragment wh questions do not (Deirdre Wilson and Robin Cooper pc)

(i) I've been befriending the man who stole diamonds from Harrods. Sorry rubies.

(ii) "I'm giving 200,000 ecus to the institution that obtains the most money from a European foundation." "Which foundation?"

I return to these data later.

(10) I know why Bill stole from the shop. But not Sam.

(11) That John doted on Mary was clear. And Sue too.

This bifurcation of subjacency effects, some carried over to ellipsis, others not, does not extend to VP ellipsis. To the contrary, though VP-ellipsis reconstruction might seem not to provide the environment for testing such subjacency effects since it only allows an interpretation in which the subject of the elliptical VP is reconstructed as the subject of the recovered predicate, with no possibility of reconstructing it into some subordinate position, there are subjacency effects none-the-less in antecedent-contained VP ellipsis such as (12)–(15), and these exactly parallel wh-gap dependencies:

(12) John interviewed everyone that Bill said Sue did.

(13) *John interviewed everyone that I know the man who did.

(14) *John interviewed everyone that I know why John did.

(15) *John interviewed everyone who that Bill had was clear.

There thus appear to be complex syntactic limitations on the reconstruction of elliptical expressions which a purely interpretive reconstruction would have no means of explaining. However, explaining these phenomena in terms of complex syntactic structure intrinsic to the elliptical expression involves analysing the elliptical form under an interpretation, and this leads to multiple formal ambiguity not only of the elliptical fragment but also in the unambiguous antecedent from which its interpretation is derived (cf. Fiengo and May [14]). In consequence such a solution does not reconstruct the semantic/pragmatic observation that ellipsis involves a mapping from some weak specification of content onto some more fully specified interpretation relative to the context in which it occurs.

In this paper I adopt the LDS_{NL} strategy (Gabbay and Kempson [17]) of defining subject proof-theoretically through a control label and particularised form of $\rightarrow$ Elimination and, with a correspondingly distinct subtype of $\rightarrow$ Introduction, analyse the different forms of ellipsis in terms of two types of $\rightarrow$ Introduction. This simple proof-theoretic distinction is, I shall claim, sufficient when set within the general framework of LDS_{NL} both to capture the diverse configurational constraints on the interpretation process and nevertheless to retain the semantic/pragmatic insight that the linguistic input underdetermines the proposition which is its assigned content. In particular, the use of a logic more stringent than a simple typed logic provides just the additional restrictiveness needed.

1.1 LDS_{NL}: a summary

The point of departure for all explanations within the LDS_{NL} framework is the following pair of informal observations, and I impose as a minimum criterion of success on any account of elliptical fragments that it reflect these.

(i) Utterance interpretation is a left-right reasoning process in which, by the information encoded with each word in sequence, the hearer progressively builds a structure which she takes to correspond to the interpretation intended by the speaker.

(ii) The input to interpretation provided by words underdetermines the content attributed to them in context, and as part of the interpretation process, the hearer has to make choices for all under-determined aspects.

It is this inferential activity of utterance interpretation which the $\mathrm{LDS_{NL}}$ system purports to model. The claim of Gabbay and Kempson [17] and Kempson [28, 29, 30] is that this inferential task is a goal-driven task of labelled natural deduction. Summarising, we assume the task for the hearer is to establish the proposition expressed by the words the speaker has used, a formula of logical type $\mathbf{t}$ whose content is to be established through steps of inference, in part deduction over the logical type-specifications of the provided words (as in other parsing as deduction frameworks—Pereira [38, 39], König [31], Moortgat [36], Hepple [22], Morrill *et al.* [37]). Some of the words provide a labelled formula (= 'declarative unit'), the word itself being the label, the formula being the logical type specification associated with that word. Some provide annotations on those labelled formulae imposing an order on their application (in particular the concept of subject is expressed as an ordering on the premises that one differentiated premise be used last in a chain of deductions leading to $\alpha : \mathbf{t}$.). Others provide instructions on the requisite proof configuration to be built e.g. *wh* expressions, which dictate the building of an independent database linked to its host only through unification of a term of the labelling algebra in each database[2]. Yet others impose extra choices, as in anaphora and, as we shall see, ellipsis. The overall task is to build a labelled proof configuration using instructions as they are given by the words in sequence once and once only with a goal of deriving a formula $\alpha : \mathbf{t}$ for each clause, and ultimately for the composite whole, where α is some complex expression of the labelling algebra . The effect of the labels is not only to project semantic information but also (i) to impose extra restrictions on allowable type inferences within a database, and (ii) to express relations between individual databases.

The logical system within which this deductive task is set is composite. First there is the logic whereby individual databases are established, a type-logical system with inference defined over labelled formulae in which the formula is a logical type, and the label is a pair (c_1, c_2) in which c_1 is an expression of a predicate algebra, c_2 is some control feature. The two rules of the $\rightarrow$ Logic are Modus Ponens and $\rightarrow$ Introduction.

[2] Initial *Wh* expressions are analysed as a goal specification on the database whose construction they initiate, requiring that at some unspecified point in that database an assumption of the form $\mathbf{u}_{\mathrm{wh}} : \mathbf{e}$ be constructed, $\mathbf{u}_{\mathrm{wh}}$ a metavariable. This predicts the three properties characteristic of such expressions—their invisibility for purposes of anaphoric dependence from this position, the need for an associated empty position at which the information they project is assumed, and the transfer of this information down through the proof configuration to this point. Cf. Kempson [28].

I Conditional Elimination ($\rightarrow$ Elim) with function μ and compatibility φ

$$\frac{\begin{array}{l}\alpha : P \rightarrow Q \\ \\ \beta : P \\ \varphi(\alpha, \beta)\end{array}}{\mu(\alpha, \beta : Q)}$$

II Conditional Introduction. $\rightarrow$ Intro

To Prove $P \rightarrow Q$ with label α

Assume	β: P with new label β
	β is arbitrary in $\{x \mid \varphi(\alpha, x)\}$
	$\vdots$
	Show $\gamma(\beta) : Q$

EXIT if there exists a unique α such that $\mu(\alpha, \beta) = \gamma(\beta)$
$\alpha : P \rightarrow Q$

In this system μ is taken to be functional application. The converse labelling operation in $\rightarrow$ Introduction is λ-abstraction, with $\alpha = \lambda x.\gamma(x)$. (These values of μ and α reflect Curry–Howard isomorphism between the lambda calculus and types as formulae—Curry [10], Howard [23], Gabbay and de Queiroz [16]). The effect of each step of inference is that structure builds up in incrementally in the labels. φ corresponds to additional restrictions on that process which might be imposed. Such restrictions give rise to sub-types of Modus Ponens. e.g.

III $\rightarrow_{\mathsf{S}}$ Elimination ($\rightarrow_{\mathsf{S}}$ Elim):

$$\frac{(w, \mathsf{S}) : A, \ (w', 0) : A \rightarrow \mathbf{t}}{(w'(w), 0) : \mathbf{t}}$$

IV $\rightarrow_{\mathsf{S}}$ Introduction ($\rightarrow_{\mathsf{S}}$ Intro):

To derive $A \rightarrow_{\mathsf{S}} \mathbf{t}$ with label γ

Assume $(w, \mathsf{S}) : A$ with new label (w, S)
$w' : A \rightarrow_{\mathsf{S}} \mathbf{t}$
$w'(w) : \mathbf{t}$

$\gamma = \lambda x.w'(x) : A \rightarrow_{\mathsf{S}} \mathbf{t}$

It is this sub-type of Modus Ponens and of $\rightarrow$ Introduction which are the particularised inference rules associated with the concept of subject. (Which premise it is that bears the annotation S = 'use last' is identified by inflection.). The two sub-types of $\rightarrow$Introduction are used solely for ellipsis. The restriction that all information projected by the words must be used once and once only is also expressed as a global restriction φ.

Labels are allowed to be both simple and complex—indeed whole databases may act as labels. The rules I and II are generalised to allow for such cases, via the addition of the concept of 'metadeclarative unit'. A meta-declarative unit is a database of premises Δ that uniquely proves some conclusion $\alpha : A$ where A is the type of Δ and α is its label. {Joan:**e**, smokes:$\mathbf{e} \rightarrow \mathbf{t}$} is a metadeclarative unit: so too is {Joan:**e**}. Modus Ponens applies to a pair of metadeclarative units as follows:

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$$\frac{\Delta_i : A,\ \Delta_j : A \rightarrow B}{s(t) : B} \quad \varphi(\Delta_i, \Delta_j) \qquad \text{where} \quad \begin{array}{l} \Delta_i \vdash t : A \\ \Delta_j \vdash s : A \rightarrow B \end{array}$$

This formulation allows Modus Ponens to be used equally in the two types of case: {believe:$\mathbf{e} \rightarrow (\mathbf{e} \rightarrow \mathbf{t})$, Mary:**e**} and {believe:$\mathbf{t} \rightarrow (\mathbf{e} \rightarrow \mathbf{t})$, {Mary: **e**, smoke:$\mathbf{e} \rightarrow \mathbf{t}$}: **t**}. In like manner $\rightarrow$Introduction is generalised:

VI To Prove $A \rightarrow B$ with label s

Assume	$\Delta_i : A$
	$\vdots$
	$\Delta_j : B$

$$\begin{array}{ll} \Delta_i & \vdash t : A \\ \Delta_j & \vdash \mu(\beta, t) : B \end{array}$$

EXIT if $s = \lambda.\mu(\beta, x)$
$s : A \rightarrow B$

To reconstruct the possible underdeterminacy of content provided by natural-language input, we define a set of abstract variables which act as metavariables. Such abstract variables are defined by special rules of interpretation mapping them onto sets of expressions (rather than onto sets of individuals). Such variables are assigned as the lexical specification of pronominal elements. Natural language quantification is also realised through such metavariables. Adapting the pattern of predicate-logic reasoning with quantified formulae to this proof-theoretic perspective on natural-language interpretation, determiners map directly onto restricted variables of distinguished sorts—*every* onto free variables, indefinites onto dependent variables, and so on. We wish however to model aspects of under-determinacy in the interpretation of determiners, and accordingly assume that this mapping is in two steps. The lexical specification of a determiner provides a metavariable for each determiner, these metavariables ranging over different sorts of logical expression, that projected by *every* ranging over free variables[3], the indefinite article *a* over dependent variables (cf. p. 498), *the* (like pronouns) ranging over all logical expressions of type **e**, and so on. For each such metavariable, the second step is to choose the appropriate logical expression, a choice which is trivial in the case of *every*, but involves a nontrivial choice from other labels in the case of pronouns, the definite article and, as I shall argue later, the indefinite article also. *Wh* expressions also project a metavariable as label to a formula, but indirectly through the license to construct such an assumption (cf. fn.2). The result is a system projected via lexical type-assignments which are invariably of the lowest type, all determiners projecting a metavariable of type **e**.[4]

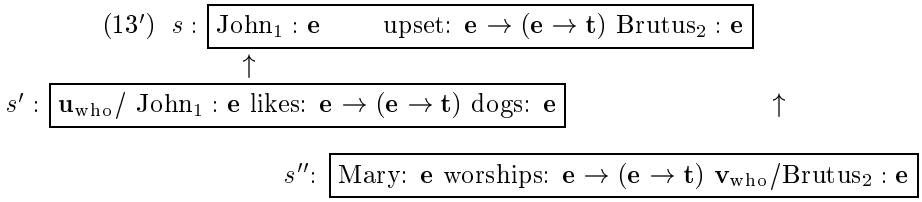
[3] Such variables are free only within the database (= proof domain) within which they are introduced, and are not therefore available for anaphoric dependence across clausal boundaries unless two clauses in sequence are treated as a single proof domain. cf. fn. 6.

[4] Composition of functions as in categorial grammar applications such as Steedman [46], Jacobson [24], could not be used as this would involve over-riding the ordering restriction on the indicated subject premise that it be used last.

In addition to the →Logic there is a logical system defining licensed relations between independently generated databases as units, expressing relations (e.g. temporal) holding between labels of those databases, or between labels within those databases such as LINK, etc. This system is defined exclusively through the labels and is not reduced to the type-theoretic system internal to individual databases. LINK is a relation between a pair of databases Δ, Δ' in which the label of some declarative unit in $\Delta', t' : \mathbf{B}$, is unified with a label in Δ also labelling type $\mathbf{B}, t'' : \mathbf{B}$. This relation is exemplified by relative clause constructions, as in (13) which we might display graphically as in (13′):

(13) John, who likes dogs, upset Brutus, who Mary worships.

(13′)



By definition:
LINK($\Delta(t_i : A)$, $\Delta'(\mathbf{u}_{\mathrm{wh}} : A)$, $\mathbf{u}_{\mathrm{wh}}/t_i$) = For database Δ containing at least 1 occurrence of $t_i : A$, Δ' a discrete database containing at least 1 occurrence of $\mathbf{u}_{\mathrm{wh}} : A$ in which $\mathbf{u}_{\mathrm{wh}}$ is a place-holding meta-variable,
t_i unifies with $\mathbf{u}_{\mathrm{wh}}$, t_i as the most general unifier replacing all occurrences of $\mathbf{u}_{\mathrm{wh}}$

(The restriction that there be a unique host $t_i : A$ and a unique assumption licensed by the presence of the *wh* expression is a consequence of the general restriction that words project information to be used uniquely.)

The rule of inference associated with LINK determines that the effect of creating such a linked database is to provide an additional restriction on some unifying variable:

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$$\frac{\Delta \vdash (\mathbf{c}_i, \varphi(\mathbf{c}_i)) : \mathbf{e},\ \Delta' \vdash \psi(\mathbf{v}) : \mathbf{t}}{(\mathbf{c}_i, \varphi(\mathbf{c}_i)\ \&\ R_{\Delta'}(\mathbf{c}_i)) : \mathbf{e}}$$

provided that

$$\mathrm{LINK}(\Delta((\mathbf{c}_i, \varphi(\mathbf{c}_i)) : \mathbf{e}),\ \Delta'(\mathbf{v} : \mathbf{e}),\ \mathbf{v}/(\mathbf{c}_i, \varphi(\mathbf{c}_i)))$$

where $R_{\Delta'}(\mathbf{c}_i)$ is intended to be $\psi(\mathbf{c}_i)$

We thereby generate $s_i : \{\mathrm{Jo} : \mathbf{e},\ \mathrm{like}{:}\mathbf{e} \rightarrow (\mathbf{e} \rightarrow \mathbf{t}), (\mathbf{x},\ \mathrm{student}(\mathbf{x})\ \&\ \mathrm{clever}(\mathbf{x})) : \mathbf{e}\}$ from *Jo likes every student who is clever* via $s_i : \{\mathrm{Jo} : \mathbf{e},\ \mathrm{like} : \mathbf{e} \rightarrow (\mathbf{e} \rightarrow \mathbf{t}), (\mathbf{x},\ \mathrm{student}(\mathbf{x})) : \mathbf{e}\}$, $s_j : \{\mathbf{u}_{\mathrm{wh}}/(\mathbf{x},\ \mathrm{student}(\mathbf{x})) : \mathbf{e},\ \mathrm{clever} : \mathbf{e} \rightarrow \mathbf{t}\}$, $\mathrm{LINK}(s_i((\mathbf{x},\ \mathrm{student}(\mathbf{x})) : \mathbf{e}),\ s_j(\mathbf{u}_{\mathrm{wh}} : \mathbf{e}), \mathbf{u}_{\mathrm{wh}}/(\mathbf{x},\ \mathrm{student}(\mathbf{x})))$. Additional rules need to be defined for other relations between databases: concatenation, disjunction and the

relation of labelling (cf. fn.6). A sentence made of a sequence of words $\langle w_1, \ldots, w_n \rangle$ is wellformed if and only if there is at least one database from which a unique conclusion $\alpha : \mathbf{t}$ for type $\mathbf{t}$ and label α is derivable using all information as projected by the sequence $\langle w_1, \ldots, w_n \rangle$ once and once only. The logical system within which such conclusions are derived is composite, with a type-driven conditional logic nested in a logic framework for licensing linked labelled databases.

1.2 The construction process and island constraints

To generate such labelled databases, there is a construction algorithm driven by lexical specifications which incrementally builds proof trees from the linear sequence of words on a left to right basis. Successor functions are defined for a node-to-node mapping distinguished according to the function of the entry at that node. M is the node corresponding to the point of departure, with successor functions as follows: an n-function for building a database-node, a d-function for building a node for a declarative unit, a d_* function for building a node which is the result of a step of inference, a g-node for a goal specification, an L-function for building a node for a label, an F-function for building a node for a formula. The result is nodes described as 'nM' = 'the node for a database at the source node m', 'Ld^inM' = 'the node for the label to the ith entry in the database at node nM', etc. Using these successor functions, lexical specifications are defined, dictating modification to the current proof configuration. These specifications encode restrictions on the order of entries within the database, allowing the type logic to be a simple conditional logic which does not reflect left-right order of premises. With this incremental building of proof structure, syntactic constraints are predicted without extra machinery, or additional operators, through restrictions that emerge from the incremental process of establishing the proof which the words dictate. One example is the restriction of no *wh*-gap dependency into relative clauses. This is predicted from two assumptions. On the one hand, the assumption that *wh*-initial expressions project goal specifications on a single database drives the search for a point at which the assumption $\mathbf{u}_{\mathrm{wh}} : \mathbf{e}$ corresponding to the gap can be constructed. On the other hand, composite databases are assumed to be projected by relations defined between them, such as LINK, which are not defined in the type-logical system. These two assumptions combine together to guarantee that a gap for a *wh*-expression cannot be constructed across a relative clause boundary, because the target imposed by the *wh* expression determines that the proof domain within which the corresponding gap assumption must be constructed is the database on which the target is imposed and not any other:[5]

(16) $*$John has reviewed that book which$_i$ Bill dislikes everyone who read e_i

[5] I display here the node annotations associated with the construction algorithm. Since the importance of this algorithm lies in providing a format for defining lexical input to the incremental process of building these proof structures, which is not the principle concern of this paper, I shall suppress these annotations where appropriate. They are not in any case elements of the labelling algebra.

(16′)

LnM	s_0	
gnM		GOAL $\vdash \mathbf{s}_0, \alpha : \mathbf{t}$
d^1nM	John, S : **e**	
d^2nM	reviewed : **e** → (**e** → **t**)	
d^3nM	$\mathbf{m}_i$, book($\mathbf{m}_i$) : **e**	

$nd^3nM = \alpha'$

$L\alpha'$	s_1	
$g\alpha'$		GOAL $s_1(\mathbf{y}_{\text{wh}} : \mathbf{e}) \vdash \beta(\mathbf{y}_{\text{wh}}) : \mathbf{t}$
		LINK($s_0((\mathbf{m}_i, \text{book}(\mathbf{m}_i)) : \mathbf{e})$,
		$s_1(\mathbf{y}_{\text{wh}} : \mathbf{e})$,
		$\mathbf{y}_{\text{wh}}/(\mathbf{m}_i, \text{book}(\mathbf{m}_i))$)
$d^1\alpha'$	Bill, S : **e**	
$d^2\alpha'$	dislikes : **e** → (**e** → **t**)	
$d^3\alpha'$	**x**, human(**x**) : **e**	

$nd^3\alpha' = \alpha''$

$L\alpha''$	s_2	
$g\alpha''$		GOAL$s_2((\mathbf{z}_{\text{wh}}, \text{human}(\mathbf{z}_{\text{wh}})) : \mathbf{e}) \vdash \beta(\mathbf{z}_{\text{wh}}) : \mathbf{t}$
		LINK($s_1(\mathbf{x}, \text{human}(\mathbf{x}) : \mathbf{e})$,
		$s_2(\mathbf{z}_{\text{wh}} : \mathbf{e})$,
		$\mathbf{z}_{\text{wh}}/(\mathbf{x}, \text{human}(\mathbf{x}))$)
$d^1\alpha''$	$\mathbf{z}_{\text{wh}} : \mathbf{e}$	
$d^2\alpha''$	read : **e** → (**e** → **t**)	
$d^3\alpha''$	$\mathbf{y}_{\text{wh}} : \mathbf{e}$	

In (16′) for example, the parsing process, as induced by the relative *which* in s_1, imposes the need in s_1 to reach a conclusion of the form $\beta(\mathbf{y}_{\text{wh}}) : \mathbf{t}$ within that local reasoning task, $\mathbf{y}_{\text{wh}}$ linked to $\mathbf{m}_i$ ($\mathbf{m}_i$ a metavariable projected from the determiner *that*). This goal specification and the restriction that all information projected by the words be used cannot however both be fulfilled for what follows is the sequence *Bill, dislike*, and *everyone*, and the information projected by each of these words must be used. Moreover the construction of the assumption associated with the *wh* expression in s_1 cannot be constructed in s_2, because the goal specification associated with the *wh* is a goal imposed on databases defined within the → Logic and the relation of LINK between two databases is not defined within the → Logic system. By definition a reasoning task locally imposed on some database has to be fulfilled within that

database. Hence the ungrammaticality of (16), and the lack of dependency between a *wh* expression and a gap within a relative clause. This restriction does not apply to complement clauses because the databases projected from them are contained as a label in the database of the verb to which they are a complement.

In precluding *wh*-gap dependencies into relative clauses as a consequence of the composite nature of the logic framework, the analysis might seem to face difficulties with counter-examples such as:

(17) The Mercedes is the car which I know someone who will rent

(18) Theories we need someone who works on are DRT and Categorial grammar

These examples are somewhat peripheral in English, but there is parametric variation across languages as to the acceptability of such structures which suggests that a preclusion of *wh*-gap dependencies into relative clauses in virtue of the logical system is too strong. However, within this proof-theoretic perspective such exceptions can be given a principled explanation, preserving the logical restriction. The examples in (17)–(18) involve either an indefinite or definite determiner as head, and this is observed across all languages which systematically license such exceptions. In such languages, of which the Scandinavian languages are a well-known example (cf. Maling and Zaenen [35]), *wh*-gap dependency is not unrestricted: as reported by Maling and Zaenen, a particular form of interpretation is required, with the head determiner of the gap-containing relative clause being in some sense functionally dependent on the gap. This phenomenon seems to present a puzzling interaction between semantic properties of the head determiner and what is otherwise a language-invariant structural restriction. The phenomenon, which carries over to ellipsis, can however be explained in terms of the semantic analysis required for indefinites, given a proof-theoretic perspective. The LDS_{NL} framework, building on the assumption that databases like all other inferential units have an assigned label, defines indefinite expressions as dependent names, dependent on either some preceding label paired with type **e**, or on some previously constructed database label. The particular choice of dependency is an anaphoric choice analogous to pronominals, with indefinites projected from the lexicon as a metavariable ranging over dependent names. This analysis projects two possible interpretations for sentences such as *Every student read a book* without requiring movement of the expression projected by a book to any higher position. We might represent the two interpretations informally as:

$(s_1, s_1, < s_{\text{NOW}}\ \text{read}(f(x))(x)) : \mathbf{t}$	for x a free variable ranging over students $f(x)$, $f(s_1)$ dependent variables ranging over books s_1 a unit of time preceding the time of utterance
$(s_1, s_1 < s_{\text{NOW}}\ \text{read}(f(s_1))(x)) : \mathbf{t}$	

Unlike the discourse referents of Discourse Representation Theory (Kamp and Reyle [25]), these dependent names are always existential in force, being constructed relative

to either some world- time index or some other variable[6]. (The dependency to be defined is broader than that standardly associated with skolem functions, in being a dependency which may yield 'wide-scope' existential effects in the semantics.) Once having introduced such dependent names, the potential for mapping onto a dependent name will automatically extend to definite NPs, because, being anaphoric, they can choose as value any label paired with type **e**.

This analysis of indefinites enables us to explain the apparent exceptions to the restriction debarring *wh*-gap dependencies into relative clauses. A language may license constructions of the type displayed in (15)–(16) as wellformed if the name lexically projected by the determiner heading the clause containing the gap can be identified as being dependent on that constructed gap assumption in its own relative clause. Consequent upon such identification, a representation of that assumption will be contained not only within the database projected from this relative clause but also, as part of a name, within the database initiated by the initial *wh*, and from this position its occurrence in that name will satisfy the target set by the initial *wh* expression without violating the dynamics of the proof discipline. (Formally what is required is a definition of the $\rightarrow$ Logic system to incorporate within the labelling algebra the process of substitution whereby such anaphoric elements are identified: cf. Meyer-Viol this volume for a definition of a predicate logic which would provide the requisite algebra). The required procedure, schematically, for the construal of (17) is (17′):

[6]The difference in availability for anaphoric dependence between the free variables projected from *every* and these names across antecedent and consequent of a conditional depends on the analysis of conditional sentences as '$(s_i : \Delta_m) : \Delta_n$', '$s_i : \Delta_m$' projected from the antecedent, 'Δ_n' projected from the consequent. The lack of availability of some variable x free in Δ_m for anaphoric dependency is because $s_i : \Delta_m$ is itself a complete proof domain and any variable x is free only within that proof domain. Hence $*$*If every student*$_i$ *saw me, I ignored him*$_i$. Conversely, *Every student*$_i$ *ignored me, if he*$_i$ *saw me* is acceptable, because the database without its label as projected by the consequent requires its label to complete its proof domain, so an instance of a variable introduced in the database projected from the consequent may have a subsequent instance in the database projected from the following antecedent. The freer availability of some dependent name $c(s_i)$ constructed either in Δ_m or in Δ_n for the purposes of anaphoric dependence in Δ_n, as displayed by *If a student*$_i$ *saw John, he*$_i$ *ignored him, A student*$_i$ *ignored me, if he*$_i$ *saw me*, turns on the fact that Δ_m and Δ_n have as a point of commonality the label s_i on which the name constructed from the indefinite depends.

(17′)

	s_1	GOAL $\vdash \alpha : \mathbf{t}$
1	Mercedes : $\mathbf{e}$	
2	is : $\mathbf{e} \rightarrow (\mathbf{e} \rightarrow \mathbf{t})$	
3	$\mathbf{v}_{\text{the}}, \text{car}(\mathbf{v}_{\text{the}}) : \mathbf{e}$	
		↑
4	s_2	GOAL $\vdash \beta(\mathbf{x}_{\text{wh}}) : \mathbf{t}$ LINK($s_1(\mathbf{v}_{\text{the}}, \text{car}(\mathbf{v}_{\text{the}}) : \mathbf{e})$, $s_2(\mathbf{x}_{\text{wh}} : \mathbf{e})$, $\mathbf{x}_{\text{wh}}/(\mathbf{v}_{\text{the}}, \text{car}(\mathbf{v}_{\text{the}}))$)
5	I : $\mathbf{e}$	
6	know : $\mathbf{e} \rightarrow (\mathbf{e} \rightarrow \mathbf{t})$	
7	$(\mathbf{u}_{\text{dependent}}, \text{person}(\mathbf{u}_{\text{dependent}})) : \mathbf{e}$	
13	$(\mathbf{u}_{\text{dependent}}, \text{person}(\mathbf{u}_{\text{dependent}})$ & $\text{rent}(\mathbf{x}_{\text{wh}}/\mathbf{v}_{\text{the}}, \text{car}(\mathbf{v}_{\text{the}}))(\mathbf{u}_{\text{dependent}}, \text{person}(\mathbf{u}_{\text{dependent}}))) : \mathbf{e}$	
14	$\text{CHOOSE}(\mathbf{u}_{\text{dependent}}, \text{person}(\mathbf{u}_{\text{dependent}})) =$ $f_{\text{RENT}}(\mathbf{x}_{\text{wh}}/(\mathbf{v}_{\text{the}}\text{car}(\mathbf{v}_{\text{the}})))$	
		↑
8	s_3	GOAL $\vdash \beta'(\mathbf{y}_{\text{wh}}) : \mathbf{t}$ LINK($s_2(\mathbf{u}_{\text{dependent}}, \text{person}(\mathbf{u}_{\text{dependent}}) : \mathbf{e})$, $s_3(\mathbf{y}_{\text{wh}} : \mathbf{e})$, $\mathbf{y}_{\text{wh}}/(\mathbf{u}_{\text{dependent}}, \text{person}(\mathbf{u}_{\text{dependent}}))$)
9	$(\mathbf{y}_{\text{wh}}/\mathbf{u}_{\text{dependent}}, \text{person}(\mathbf{u}_{\text{dependent}})) : \mathbf{e}$	
10	rent : $\mathbf{e} \rightarrow (\mathbf{e} \rightarrow \mathbf{t})$	
11	$(\mathbf{x}_{\text{wh}}/\mathbf{v}_{\text{the}}, \text{car}(\mathbf{v}_{\text{the}})) : \mathbf{e}$	
12	$\text{rent}(\mathbf{x}_{\text{wh}}/\mathbf{v}_{\text{the}}\text{car}(\mathbf{v}_{\text{the}}))(\mathbf{y}_{\text{wh}}/\mathbf{u}_{\text{dependent}}, \text{person}(\mathbf{u}_{\text{dependent}})) : \mathbf{t}$	

The critical step is at step 14, for it is at this point that having established the complex predicate 'person($\mathbf{u}_{\text{dependent}}$) & rent($\mathbf{x}_{\text{wh}}/\mathbf{v}_{\text{the}}$car($\mathbf{v}_{\text{the}}$))($\mathbf{u}_{\text{dependent}}$,person($\mathbf{u}_{\text{dependent}}$))', the dependent variable instantiating $\mathbf{u}_{\text{dependent}}$ projected by the indefinite article is identified as the name 'the one who will rent the car', a name whose form—'$f_{\text{RENT}}(\mathbf{x}_{\text{wh}}/(\mathbf{v}_{\text{the}}$,car($\mathbf{v}_{\text{the}}$)))'—reflects the construction of the LINKed database s_3 which projects this information. Moreover this name critically contains as a subpart the representation '$\mathbf{x}_{\text{wh}}/(\mathbf{v}_{\text{the}}$,car($\mathbf{v}_{\text{the}}$))' specified in the goal for s_2. If this is the

strategy the hearer chooses in interpreting (17), this name (with its representation of the label '$\mathbf{x}_{\mathrm{wh}}/(\mathbf{v}_{\mathrm{the}},\mathrm{car}(\mathbf{v}_{\mathrm{the}}))'$ will be in the proof domain s_2 which has a target that some conclusion be derived using '$\mathbf{x}_{\mathrm{wh}}/(\mathbf{v}_{\mathrm{the}}, \mathrm{car}(\mathbf{v}_{\mathrm{the}}))$'. Given the presence of the words *I, know*, and *someone*, this strategy is indeed the only way of meeting the goal specification imposed on s_2 at step 4. The target specification imposed by the presence of the first relative pronoun in such sentences will therefore be satisfied as long as the language in question allows this form of indirect satisfaction of that target specification—through a process analogous to anaphora resolution. It is this which is the source of the parametric variation, not variation according as the language does or does not constitute a counterexample of the general logic discipline. English in general does not allow such indirect satisfaction of the requirement to construct the necessary assumption: the presence of the 'gap' assumption licensed by the *wh* expression must be projected by construction only with no morphological form corresponding to the gap itself as trigger[7]. In the Scandinavian languages, in contrast, the pronominal system is freely used for the construction of the gap assumption initiated by the *wh* expression: Swedish and Norwegian, as Maling and Zaenen report, have resumptive pronouns which function as gaps and which in relative clauses display all the properties of gaps. Given the analysis of indefinites as requiring anaphoric resolution like pronominals, we would predict that indefinites, like pronominals, would also interact with *wh*-gap dependencies, allowing the name to be identified as dependent on the gap assumption, the languages thereby licensing apparent island violations relative to the construal of the indefinite as itself a function on the gap. The particular form of construal with the head determiner dependent on the gap within the modifying relative will in fact be essential to the wellformedness of any such *wh*-gap dependency across a relative clause boundary, for it is only if it is so identified that the goal specification imposed by the initial *wh* is met within the requisite proof domain. This corresponds exactly to the restriction on interpretation reported by Maling and Zaenen—(19)–(20) are Swedish, (21)–(22) are Norwegian:

(19) De blommorna känner jag en man some säljer.
These flowers know I a man that sells
These flowers, I know a man who sells.

(20) $*$ Lisa talar jag med den poiken some kysst (henne)
Lisa talked I with the boy who kissed (her)
Lisa, I talked with the boy who kissed (her)

(21) Mary finner vi aldri den gutten some kan hamle opp med
Mary find we never the boy who can handle
Mary, we never found the boy who can handle

(22) $*$Mary har vi endelig funnet den gutten som kan hamle opp med
Mary have we finally found the boy who can handle
Mary, we finally found the boy who can handle

[7] These structures are licensed only under very special circumstances. The *wh* expression must be construed referentially through some independent assertion of identity, and despite such identification, the sentences retain the flavour of a rescue strategy for an ill-formed structure. In these cases, such an identification pragmatically made as the most salient dependent name to choose will in fact be the only possible choice if the restriction imposed by the goal specification is to be met, for otherwise it will fail to be satisfied altogether. Hence the rescue strategy flavour.

(19) and (21) are acceptable because an interpretation is available with the determiner head of the relative clause construed as dependent on the gap inside the relative. (20) and (22) are not because the definite article is construed as picking out a fixed entity, and so does not provide the necessary dependent name which would satisfy the *wh*-imposed target.

The variation across languages with respect to *wh*-gap dependency is thus not a variation in the overall logical system, but rather variation in the stringency of the target specification assigned by the initial *wh* expression—expressed as the composition of functions β in the goal specification $\beta(\mathbf{u}_{\mathrm{wh}}) : \mathbf{t}$. Families of languages are defined according as the language has a more or less strict requirement on how that target specification is met. Some languages, e.g. English, impose the requirement upon a given local database that $\mathbf{u}_{\mathrm{wh}} : \mathbf{e}$ be constructed as an assumption which is to combine with other premises by steps of Modus Ponens to yield $\beta(\mathbf{u}_{\mathrm{wh}}) : \mathbf{t}$. Other languages, e.g. Swedish/Norwegian, allow this target to be met through any of the operations available in this local domain—by constructed assumption, or by anaphoric choice, equally. The result is an account of the restriction precluding *wh*-gap dependency into relative clauses that licenses parametric variation within limits strictly set by the logic discipline. What has made it possible is the proof-theoretic mode of presentation, for it is the analysis of indefinites as names explicitly recording the source of their dependent construal that makes apparent why it is the indefinite and definite determiners as heads that provide the exceptions to an otherwise strongly universal constraint[8].

2 Bare argument fragments as substitution in an $\mathrm{LDS}_{\mathrm{NL}}$ Framework

It is this proof-theoretic presentation of content which provides the basis of ellipsis interpretation. Ellipsis, recall, falls into the sub-types of bare argument ellipsis and VP ellipsis. The former I shall claim involves a substitution process founded on Introduction reflecting exactly the properties of this rule as it applies within the composite logic system. (23), displaying bare argument ellipsis, has three possible interpretations of the fragment:

(23) Joan insisted that Sue visit Bill in hospital. And Mary too.

Informally, what the hearer does when faced with the minimal amount of information presented by a fragment is to use information she already has on-line to construct the requisite interpretation, analogous to anaphoric resolution. An entire preceding database is duly used to reconstruct an interpretation, substituting the fragment in place of some selected premise in the antecedent database. The result is the three interpretations

(23i) Mary insisted that Sue visit Bill in hospital.

[8] Many questions remain about the reconstruction of scope phenomena, but the range of available answers is principled (cf. Section 3.1 and fn. 26).

(23ii) Joan insisted that Mary visit Bill in hospital.

(23iii) Joan insisted that Sue visit Mary in hospital.

Not all accounts model this as a phenomenon of ellipsis. Dalrymple *et al.* [12] however rightly emphasise[9] that the phenomenon of ellipsis involves abstraction from some independently available source. They define predicate ellipsis in terms of higher order unification between some suitably created λ abstract on the antecedent conjunct and a predicate variable with which the presented elliptical expression can combine. Equivalently, these simple cases can be modelled as first order unification involving λ abstraction on the antecedent database with application of the result by Modus Ponens to the newly presented premise projected by the fragment (an analysis independently proposed by Prüst *et al.* [41] for VP ellipsis):

[9] From the observation that *I put everything away in the cupboard but the cake* is not equivalent to the inconsistent *I put everything away in the cupboard but I didn't put the cake away in the cupboard*, Reinhart [43] argues that bare argument ellipsis is not a phenomenon of ellipsis at all. She posits an analysis in terms of phrasal coordination, positing extraction of the correllated item (here *everything*) to create phrasal conjunction of the two correlated items at LF, the extraction process itself being used to explain the parallelism with *wh*-gap dependency. A subsequent semantic process of quantifying in guarantees that the conjoined unit is interpreted as though back in the original position of the correlated item. This analysis might be appropriate for *except phrases* and *but NP* phrases (cf. Lappin [34] for arguments that it is not), but it is not appropriate for the principal bare argument ellipsis cases. Such an analysis would predict the wellformedness of *Bill met. And Lucy too.* on the basis of *Bill and Lucy met*, and the equivalence of *Jo plays duets. Lucy too.* with *Jo and Lucy play duets.* It also predicts that the limits on interpretation for these fragments should correspond exactly to the *wh*-gap dependency on which their analysis is modelled. But though the construal of fragments appears to be sensitive to relative clause and some adjunct-clause boundaries, it is insensitive to boundaries caused by the existence of an initial *wh* in the complement clause ('*wh*-islands') as in (i) or the boundary created by clauses in subject position as in (iii):

(i) ?$*$What$_i$ do you wonder why Mary is taking e_i?

(ii) I am wondering why Mary took Prozac. And Lofepramine too

(iii) $*$What$_i$ is dancing in e_i fun?

(iv) Dancing in the rain is fun, but not the snow.

Whatever similarity there is between ellipsis construal and *wh*-gap dependencies, it cannot be analysed as involving the very same process.

(23′)

s_1	Joan, S : **e**	GOAL α : **t**
	insist : **t** → (**e** → **t**)	
s_2	Sue, S : **e**	GOAL α : **t**
	visit : **e** → (**e** → **t**)	
	Bill : **e**	
	visit (Bill) : **e** → **t**	
	visit (Bill)(Sue) : **t**	
	insist(visit(Bill)(Sue) : **e** → **t**	
	insist(visit(Bill)(Sue))(Joan) : **t**	

s_3	Mary : **e**	GOAL α : **t**
s_1	Joan, S : **e**	GOAL α : **t**
	insist : **t** → (**e** → **t**)	
s_2	Sue, S : **e**	GOAL α : **t**
	visit : **e** → (**e** → **t**)	
	Bill : **e**	
	visit(Bill) : **e** → **t**	
	visit(Sue)(Bill) : **t**	
	insist(visit(Bill)(Sue) : **e** → **t**	
	insist(visit(Bill)(Sue))(Joan) : **t**	
	λx[insist(visit(x)(Sue))(Joan)] : **e** → **t**	
	insist(visit(Mary)(Sue))(Joan) : **t**	

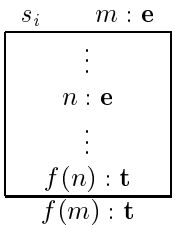
(23′) corresponds to interpretation (23iii). This analysis reflects the process of building the interpretation directly, the proof-theoretic mode of presentation preserving all structural aspects of that interpretation process, from some weakly specified input to a projection of propositional content[10]. Each one of the set of steps needed to derive insist(visit(Bill)(Sue))(Joan):**t** in s_1 is a step of Modus Ponens given our

[10]It might seem that →Introduction is not applicable here since Bill:e is not an assumption with which any database is opened. However, given annotations such as S = 'use last' on premises, the order of application of the premises is fully determined by the labelling algebra. From a proof-theoretic point of view, order in the database is accordingly irrelevant.

general form of Modus Ponens applying to metadeclarative units and carrying up in the labelling algebra only the predicate logic expressions of that algebra. Any one of the premises Joan:**e**, Sue:**e**, Bill:**e** can accordingly be removed from the database s_1 as a local box exit rule, and by a step of Modus Ponens be replaced by Mary:**e**, predicting the ambiguity of (23) directly. We predict directly the diversity open to fragment interpretation[11].

The separation of $\rightarrow$ Introduction and application of the result to the premise projected by the elliptical expression in (21′) is artificial, and I proceed to define a process of substitution for ellipsis construal through the concept of metadeclarative unit. For the simple case, for some fragment $m : \mathbf{e}$ we shall have a database with at least one assumption also of type $\mathbf{e}, n : \mathbf{e}$, and a process manipulating that database by substitution of the premise $n : \mathbf{e}$ by the premise $m : \mathbf{e}$

VIII



I retain the process as a Box-exit device like $\rightarrow$ Intro, a process whereby one premise can be withdrawn, another substituted in its place (cf. fn.10 on the irrelevance of order in the database). The process has however to be defined for the more complex case, as the label m may be composite as in (24)–(25):

(24) Jo had to decide that the dog should go, on behalf of his mother who was sick. And that the house should be sold too.

(25) Jo insisted on deciding swiftly that the dog should go. But not that the house should be sold.

The rule we require is IX, a substitution process defined to apply to any minor premise $\Delta_k : A$, where A is simple, but Δ_k is a metadeclarative unit of arbitrary complexity. The rule is a conflation of the generalised Modus-Ponens and Introduction rules V and VI:

[11] This analysis will correctly predict that pronouns construed as dependent on the item being substituted will be reconstrued in the elliptical fragment as in (i)
(i) Jo$_i$ worries that he$_i$'s sick. Bill too
It makes no allowance for readings in which only some instances of the substituend are removed:
(i) Jo told his mother that he was sick. Bill too.
(i) allows an interpretation in which the fragment is construed as 'Bill told John's mother that Bill was sick'. Since these mixed readings arise only with pronominal-containing definite NPs, I reconstruct them via the modelling of the referential/attributive distinction associated with definites. cf. fn.23.

IX

$$\dfrac{\Delta_j : B \quad \boxed{\begin{array}{c}\Delta_i : B \\ \vdots \\ \Delta : \mathbf{t}\end{array}}}{\mu(\alpha, y) : \mathbf{t}}$$

where $\Delta \vdash \mu(\alpha, x) : \mathbf{t}$.

$$\begin{array}{lll}\Delta_i & \vdash & x : B \text{ and } B \text{ is an elementary type} \\ \Delta_j & \vdash & y : B\end{array}$$

$\Delta_j : B$ corresponds to the fragment with y the label of the formula projected from it simple or composite. $\Delta_i : B$ is the assumption which is to be withdrawn. $\Delta : \mathbf{t}$ is the conclusion established from the antecedent clause by steps of Modus Ponens from $\Delta_i : B$ and other premises. $\mu(\alpha, y) : \mathbf{t}$ is the new conclusion. The rule applies just as the simpler forms of $\rightarrow$ Intro II, VI—directly a box- exiting and substitution process for a database whose conclusion depends on a sequence of steps of $\rightarrow$ Elim.[12]

2.1 Bare argument fragments: deriving the syntactic restrictions

The analysis of bare argument ellipsis has so far been shown to successfully account for data equally characterisable by the first-order unification account of Prüst et al and the higher order unification account of Dalrymple et al. The difference has been only that the natural deduction perspective provides a procedural basis to the explanation, preserving all elements of structure through the incremental record provided by the labels. However, we now see the empirical advantage of the proof-theoretic form of explanation. Configurational restrictions on the interpretation process can be explained in terms of the proof discipline without invocation of externally imposed syntactic principles (unlike the semantic unification accounts). In particular, the lack of reconstruction across a relative clause boundary follows directly. Like the target specification induced by *wh*, the presentation of a fragment also imposes a requirement on some local reasoning task: the substitution to be made must be substitution to a particular local database. As with *wh* dependencies, the relative-clause island phenomenon follows from the local nature of this requirement. The interpretation of (26) licenses the substitution of *Mary* for the *woman who likes Bill* or for *Joan*, but not for *Bill*.

(26) The woman who likes Bill visited Joan. And Mary too.

[12] Notice that though this process is reducible to a step of $\rightarrow$ Intro plus a step of $\rightarrow$ Elim, it is strictly a construction process, used solely to create structure for the projection from some minor premise $\alpha : \mathbf{e}$ onto some requisite conclusion of the form $\beta(\alpha) : \mathbf{t}$. Following Sperber and Wilson [45] we restrict the use of $\rightarrow$ Intro so that it has this function exclusively. Such a restriction is necessary, for without it, the rules would predict 'like(Jo)(Mary):**t**' to be derivable as an interpretation for the string *Sue likes Mary. Joan* by injudicious application of $\rightarrow$ Intro to an intermediate conclusion 'like(Mary)(Sue):**t**'. Worse, an infinite loop of such applications would be available. A consequence of this restriction is that we preclude type-lifting, a move which forces an account of determiners in terms of a direct mapping onto arbitrary names.

(26′) presents the reconstruction of the interpretation of the fragment up to the point at which a choice has to be made as to which premise Mary:**e** is to be substituted in place of:

(26′)

s_1	GOAL $\vdash \mathbf{s}_i, \alpha : \mathbf{t}$
Mary : **e**	
s_2	GOAL $\vdash s_i, \alpha : \mathbf{t}$
$(\mathbf{u}_{\text{the}},\ \text{woman}(\mathbf{u}_{\text{the}})), \mathsf{S} : \mathbf{e}$	
$(\mathbf{u}_{\text{the}},\ \text{woman}(\mathbf{u}_{\text{the}})\ \&\ \text{like (Bill)}(\mathbf{u}_{\text{the}})), \mathsf{S} : \mathbf{e}$	
visit : $\mathbf{e} \rightarrow (\mathbf{e} \rightarrow \mathbf{t})$	
Joan : **e**	
visit(Joan) : $\mathbf{e} \rightarrow \mathbf{t}$	
visit(Joan)($\mathbf{u}_{\text{the}}$, woman ($\mathbf{u}_{\text{the}}$) & like(Bill($\mathbf{u}_{\text{the}}$)) : **t**	
	↑
s_3	GOAL $\vdash \beta(\mathbf{v}_{\text{wh}}) : \mathbf{t}$
	LINK($s_2((\mathbf{u}_{\text{the}}, \text{woman}(\mathbf{u}_{\text{the}})) : \mathbf{e})$,
	$s_3(\mathbf{v}_{\text{wh}} : \mathbf{e})$,
	$\mathbf{v}_{\text{wh}}/(\mathbf{u}_{\text{the}}, \text{woman}(\mathbf{u}_{\text{the}}))$)
$(\mathbf{v}_{\text{wh}}/\mathbf{u}_{\text{the}}, \text{woman}(\mathbf{u}_{\text{the}})), \mathsf{S} : \mathbf{e}$	
like : $\mathbf{e} \rightarrow (\mathbf{e} \rightarrow \mathbf{t})$	
Bill : **e**	
like(Bill) : $\mathbf{e} \rightarrow \mathbf{t}$	
like(Bill)($\mathbf{v}_{\text{wh}}/\mathbf{u}_{\text{the}}, \text{woman}(\mathbf{u}_{\text{the}})$) : **t**	

In (26′) the database s_1 contains both the fragment and the full database s_2 projected from the previous sentence. In s_2 the occurrence of *Bill* may not be selected as the point of substitution for Mary:**e**. The required restriction follows from the form of $\rightarrow$ Intro (hence substitution). Consider the problem posed by trying to remove the name *Bill* from s_2 by a step of $\rightarrow$ Intro. $\rightarrow$ Intro by definition licenses the removal of an assumption α : **e** from some database Δ_i if the creation of that assumption has led by $\rightarrow$Elim step(s) in Δ_i to some conclusion $\beta(\alpha)$: **t**. But the presence of *Bill* in s_2 is not the result of any step of reasoning derivable by the local $\rightarrow$ logic. To the contrary, it critically involved a step of the global discipline correlating databases, a step which is not characterised within the $\rightarrow$ Logic. Indeed Bill:**e** is not a premise of s_2 at all. It is a label contained in s_2 in virtue of an operation defined solely through the labelling algebra for two independent databases with no alteration to the premise structure of

the host database. But a local logic contained within some global logic framework is by definition blind to any steps of that global discipline. $\rightarrow$ Intro will accordingly not be able to apply to the output of any process unless it is a process licensed within the local $\rightarrow$ Logic. An element in some database as the result of any LINK operation will not therefore be able to provide the basis for interpreting a fragment by this process of substitution.[13] [14]

As with *wh*-gap dependencies, substitution is possible into relative clauses if the determiner head which provides the point of linkage between the two databases is construed as dependent on the item being replaced, (27) allowing as one possible interpretation of its fragment (27′):

(27) I have had a student who studied Mongolian. But not Abkhaz.

(27′) I have not had a student who studied Abkhaz.

And the reason is the same. A well-formed interpretation across the relative clause boundary is possible only if the name which the indefinite is taken to project is identified as dependent on the element being replaced, for it is this identification which guarantees that the element to be substituted is in a proof domain which licenses substitution by the newly presented premise. If no such dependency is constructed, substitution of the premise in an independent linked database is impossible, precluded by the limitations imposed by the logic discipline.(Again, Meyer-Viol's extended predicate logic with substitution operators defined gives the right results here.) As with *wh*-gap dependencies, all such reconstruction across relative-clause boundaries require this form of interpretation.[15]

The asymmetry between reconstruction across relative clause boundaries, and *wh*-islands and sentential subjects (cf. examples (6)–(11)) automatically follows. The property that *wh*-islands and sentential subjects share is that the supposed island is a minor premise of the major predicate (complement to predicates such as *wonder* in the former case, subject in the latter) and contained within the overall database. Substitution is accordingly correctly predicted to be freely available across these boundaries. This of course creates the puzzle of why there should be such restrictions on *wh*-gap

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[13] This analysis is very close to an analysis set within a Unification Grammar perspective Gardent [18]. However, in [18] the various restrictions each require a stipulated addition to the basic grammar, whereas here they follow directly from the dynamics of the proof process.

[14] The examples from fn.1 require a different form of analysis:

(i) I have had a friend who works at Selfridges visiting. Sorry Harrods.

(ii) 'I will give 3.000 ecus to anyone who has won a grant from a major European company.' 'Which European company?'

The correction cases as in (i) are arguably substitution of an element in the phonological string. Examples as in (ii), whose full reconstruction is ungrammatical, are inferentially requests for clarification, a request for an additional specification. In being a process of cooperation between speaker and hearer in establishing a single inferential structure, they are not like ellipses phenomena considered so far. In the cases in the text, the elliptical fragment is used as the basis for creating an entirely new discrete inference structure. It is in such cases that the logic discipline will debar substitution.

[15] Such interpretations are correctly predicted to be precluded if the relative clause is construed as nonrestrictive: in that case, by analysis, the value to be assigned the variable projected by the determiner is selected prior to the computation of the database and cannot therefore be identified as dependent on the gap. Thus, unlike (27), (i) disallows any interpretation of its fragment as (i′):

(i) I've had to fail a student, who is studying Mongolian. But not Abkhaz.

(i′) $\neq$ 'I have not had to fail a student who is studying Abkhaz'

Cf. Kempson [28] for an account of the distinction between restrictive and nonrestrictive relatives.

dependency, the sentential subject restriction in particular being a strong restriction observed in all languages. But the solution is to see these as restrictions on the incremental projection of database structure and not a consequence of the logic itself. The sentential subject restriction debars:

(28) Who$_i$ is that John likes e_i surprising?

a restriction which only appears with the database in subject position, not if it is postposed:

(29) Who$_i$ is it surprising that John likes e_i?

The problem in incrementally projecting structure for (28) is displayed by the first three steps of its interpretation. First the *wh* expression initiates a new database by imposing on it a goal specification. Second, the auxiliary provides a database label plus indication of a premise to be duly annotated as the subject. Thirdly, despite there being no single entry in that database, there is an instruction (projected by the complementiser *that*) to build a node for a new database. The effect of following this instruction will be that the first database is not a database—it has no premises in it. If we impose on the construction algorithm the intuitively correct restriction that at all stages the construction process must generate wellformed databases, the sentential subject restriction will duly follow.[16] Violation of such a restriction will notably not arise in ellipsis construal as there is no incremental process of database-building once the fragment itself is entered in the database—merely a step of substitution carried out on a wellformed and complete database. The *wh*-island restriction precluding $*$*Who does she wonder what Bill gave?* is much weaker and varies from one *wh* expression to another. This suggests that the restriction is associated with difficulties of goal stacking (and keeping such unfulfilled goals distinct) a difficulty which might be enhanced or ameliorated by the intrinsic content of the goals in question. As in the case of the sentential subject restriction, this difficulty would not arise in ellipsis construal as the process of substitution is defined over complete databases. With a subset of restrictions on *wh*-gap dependency independently explained, we have to hand an explanation of the idiosyncratic set of restrictions imposed on bare argument ellipsis, and its partial parallelism with *wh*-gap dependency without need of any assignment of complex structure as input to the process of interpretation.[17]

[16] The restriction will also correctly preclude $*$*That that she is clever is unclear is unfortunate.*

[17] Lappin [34] argues that bare argument ellipsis is not subject to configurational restrictions at all on the grounds that it is not subject to ANY subjacency restriction, even in the case of dependency across a relative clause boundary, citing as evidence:

(i) John enjoyed reading the articles which appeared in the New York Times last week, but not the Daily Telegraph.

(ii) John agreed to the request that he submit articles to the journal, but not book reviews.

It is noticeable that (i) contains a definite article as the relevant head determiner (allowing an analysis along the lines of (27)) and also that the adjunct *last week* can be applied as adjunct equally to the superordinate and subordinate clauses, in principle allowing a phrasal interpretation of the two noun phrases. Controlling for both these factors leads to noticeably reduced acceptability of the requisite interpretations as this analysis would predict:

(iii) I am enjoying reading most of the articles Alex submitted to the Times last week; and the Telegraph too/but not the Telegraph.

(iv) I shall insist on reading most articles that appeared in the Times last week; and the Telegraph too/but not the Telegraph.

(iii) and (iv) allow the construal of *the Telegraph* only as complement of *reading*: no construal across the relative clause boundary is possible.

The general pattern is that the interpretation of bare argument ellipsis forms involve a free substitution process restricted only by the dynamics of the proof system within which the substitution process is defined.

3 VP Ellipsis as conditional introduction ($\rightarrow_S$ introduction)

VP-ellipsis forms display a different range of variation, with a distinct set of available interpretations. As with bare argument ellipsis, the challenge is whether or not these restrictions indicate an analysis of the elliptical form in terms of complex assignment of structure prior to their interpretation. I shall argue that all that is required is manipulation of $\rightarrow_S$ Introduction.

VP ellipsis occurs in various guises—bare auxiliary, a simple infinitive marker, or the pro- verb form *do*:

(30) John has been seeing Mary and Bill has too.

(31) John is required to care for Mary but he isn't likely to

(32) John was interviewing a student who said she'd never been to America and when I said I had, he turned to me with relief.

There is some difference between these forms (as observed in Haik [20]), but the principle patterns are the same. Informally, whatever way the interpretation is assigned in the antecedent clause is carried over to the interpretation of the elliptical VP form. Thus in (30)–(32) all the properties of the antecedent VP are carried over to the elliptical form as interpretation.

The phenomenon has been analysed in syntactic, semantic, and pragmatic terms. From a perspective in which binding conditions restricting interpretation of anaphoric elements is part of syntax, this phenomenon is seen as requiring a syntactic explanation, with a matching between structure projected without terminal elements (the elliptical expression) and an antecedent clause, the binding principles applicable equally to the visible sequence of expressions and their invisible counterparts (Williams [50], Tancredi [47], Chomsky [7], Fiengo and May [14], Lappin [34]). Structures for elliptical expression and antecedent alike are for example projected for the interpretation of (33) in which the elliptical expression is equally construed with a reflexive interpretation:

(33) Joan washed herself and so did her mother.

However, as pointed out by Dalrymple *et al.*, this approach faces problems with this and all other cases where the invisible counterpart takes more than one form despite no ambiguity in the antecedent clause as there will have to be more than one

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Lappin's observation with respect to (ii) is correct, but does not affect the validity of the analysis here. (ii) provides an instance of *the fact that* construction. If, reflecting the meaning of these expressions, they are analysed as projecting the complement clause as a database label to a formula of type **e** (with *fact* projecting a predicate on that label), the puzzle is not why construal ellipsis licenses substitution into these databases which is correctly predicted but rather why *wh* gap dependencies are precluded. For the time being I leave this puzzle unresolved.

different assigned indexing for each interpretation. The consequence is a commitment to multiple formal ambiguity, not only for the elliptical element itself but for its antecedent, hence any string. Additional problems are caused by the evidence that it is not the invisible counterparts of the morphological elements themselves which occur in the elliptical form. This has to be so because as the non-reflexive interpretation of (33) shows, there is an interpretation in which the predicate must not get carried over as 'washed herself' but as 'washed Joan'. There are cases of disparity such as this with every type of NP—reflexive, pronominal, name, or negative polarity item. If for example the predicate in the first conjunct of (34) were matched by corresponding elements in the invisible structure of the elliptical VP form, the structure would be debarred by principle *C* which precludes a name from being co- indexed with any c-commanding pronominal:

(34) I insisted that Sue should be allowed to see John$_i$, and eventually he$_i$ agreed that she should.

Examples like these and many others indicate that whatever the matching process is, it is not defined over terminal elements; and in an analysis which so defines it, an auxiliary process of 'vehicle change' has to be defined to ensure that terminal elements are replaced with some suitable substituend.[18] Invocation of processes of 'vehicle change' strongly suggest that the properties associated with elliptical forms are not those of the terminal elements of the preceding string but rather their interpretation; and a commitment to multiple formal ambiguity is an immediate consequence of analysing any phenomenon whose intrinsic content is weaker than its context-dependent interpretations in terms of discrete forms of input corresponding to those interpretations.[19] Bearing in mind the initial minimum criterion of success I imposed, that cases of underdeterminacy of provided input should be directly modelled, I shall therefore set such syntactic analyses aside at least initially, assume with Dalrymple *et al.* and Prüst *et al.* that the phenomenon of ellipsis construal requires an analysis in terms of the interpretation assigned to the elliptical expression rather than to any structure assigned independently of that interpretation process, and seek to derive any extra restrictions on the choice of predicate from the process of recovering the intended interpretation.

From the perspective of discourse understanding, VP ellipsis is like bare argument ellipsis in providing an expression which enables the speaker to convey a whole proposition without explicitly presenting the predicate a second time. The predicate can be constructed from any antecedent irrespective of depth or type of embedding, as (30)–(32) demonstrate. In all straightforward VP ellipsis cases (modulo, that is, antecedent-contained ellipsis), the only restriction on interpretation is imposed by the fact that these forms invariably present a fragment annotated as subject, to which the constructed predicate must apply. The relative freedom with which such elliptical expressions may be reconstructed might be taken as evidence that the process of creating such an interpretation has no restrictions apart from the predicate having to

[18] In some cases, the structure of antecedent and elliptical element do not match either:
(i) We are told that handouts should be distributed at every class, but I often forget to.

[19] Cf the many discussions of this point in the literature in the early 1970s when such analyses were first mooted: Wilson [51], Kempson [26, 27], Atlas [1, 2].

involve abstraction with respect to the subject (in all other respects other than this like bare argument ellipsis). Simple examples suggest that this might be correct:

(35) John washed his socks and so did Bill

In interpreting (35) the hearer faces a choice: she may construe the predicate as 'washed John's socks' abstracting out from information projected from the first clause solely information with respect to the subject position, or she may construe the predicate as '$\lambda x.x$ washed x's socks' giving rise to the interpretation of the elliptical conjunct as 'Bill washed Bill's socks'. However, a simple one-place predicate substitution process involving abstraction with respect to the subject and one or more positions in some available predicate-argument structure (Wescoat [49]) will not suffice. The problem (first pointed out by Dahl [11] and discussed in detail in Gawron and Peters [19], Dalrymple *et al.* [12], Fiengo and May [14]), is posed by (36):

(36) John corrected his paper before the teacher did; and so did Bill

On the assumption that the subject must shift in interpretation but the co-referential pronoun need not, there is for a sentence such as (36) six possible interpretations for an interpretation of the first conjunct *John corrected his paper* as 'John corrected John's paper':

(i) J corrected J's paper before T corrected J's paper
B corrected J's paper before T corrected J's paper

(ii) J corrected J's paper before T corrected T's paper
B corrected B's paper before T corrected T's paper

(iii) J corrected J's paper before T corrected T's paper
B corrected J's paper before T corrected T's paper

(iv) J corrected J's paper before T corrected J's paper
B corrected B's paper before T corrected B's paper

(v) J corrected J's paper before T corrected J's paper
B corrected B's paper before T corrected J's paper

(vi) J corrected J's paper before T corrected J's paper
B corrected J's paper before T corrected B's paper

(B=Bill, J=John, T=teacher)

The problem is that of these six, only the first four are possible. (i) is the interpretation in which the pronoun in the first conjunct is consistently construed as fixed referentially and hence held constant; (ii) the interpretation in which it is consistently construed as a variable to be rebound by abstraction. (iii) and (iv) involve mixed cases in which the pronoun is first construed as a variable to be rebound and subsequently as fixed, or vice versa.[20] (v) and (vi) are precluded, a distribution which an unrestricted abstraction process (such as that of Dalrymple *et al.*) will not predict.

[20] Cases such as (ii) and (iii) are problematic for any account of ellipsis which depends on ambiguity of the source sentence as between dependent and referential modes of interpretation (Reinhart [42], Gawron and Peters [19], Fiengo and May [14]). To account for facts such as these Fiengo and May propose a theory of dependency discrete

With the differentiation between two types of $\rightarrow$ Elimination, a natural solution is available. Corresponding to the splitting of $\rightarrow$ Elimination into a general case and a particular case, there is the second form of $\rightarrow$ Introduction $\rightarrow_{\mathsf{S}}$Intro ('S' being the annotation 'use last' associated with the subject):

IV $\rightarrow_{\mathsf{S}}$ Introduction:
To derive $A \rightarrow_{\mathsf{S}} \mathbf{t}$ with label γ

Assume $(\alpha, \mathsf{S}) : A$	with new label α, S
$\beta : A \rightarrow_{\mathsf{S}} \mathbf{t}$	
$\beta(\alpha) : \mathbf{t}$	

$\gamma = \lambda x \,.\, \beta(x) : A \rightarrow_{\mathsf{S}} \mathbf{t}$

$\rightarrow_{\mathsf{S}}$ Intro will license a box-exit process in which assumptions made with respect to the minor premise $(\alpha, \mathsf{S}) : \mathbf{e}$ which led by one step of $\rightarrow_{\mathsf{S}}$ Elim to $\beta(\alpha) : \mathbf{t}$ are abstracted out. The result is a labelled premise of type $\mathbf{e} \rightarrow \mathbf{t}$ with a predicate as label requiring a premise annotated as subject with which to combine. Given a conventional construal of λ, this form of predicate will close off all occurrences of α used in obtaining $\beta(\alpha) : \mathbf{t}$. This will give us part of the VP ellipsis phenomenon—across the board abstraction.

In $\mathrm{LDS_{NL}}$: terms, elliptical VP forms project a database structure containing an expression annotated to be used last and a database label determining how the database is to be construed in a flow of time. All they lack is a one-place predicate:

$$\psi : \mathbf{e} \rightarrow_{\mathsf{S}} \mathbf{t}$$

The phenomenon is as with pronouns a case of under-determinacy, the value of the label ψ to be chosen on the basis of what is independently available. Intuitively, there are two procedures which the hearer might follow to provide such a label . One is to take some previous database, remove all assumptions about its subject by $\rightarrow_{\mathsf{S}}$ Intro, and use the resulting predicate as the basis for interpretation. The other is to identify the new predicate as having the same label as the predicate in some previous database (exactly as pronominal construal). Applied to (37), the first strategy will yield (37').[21][22]

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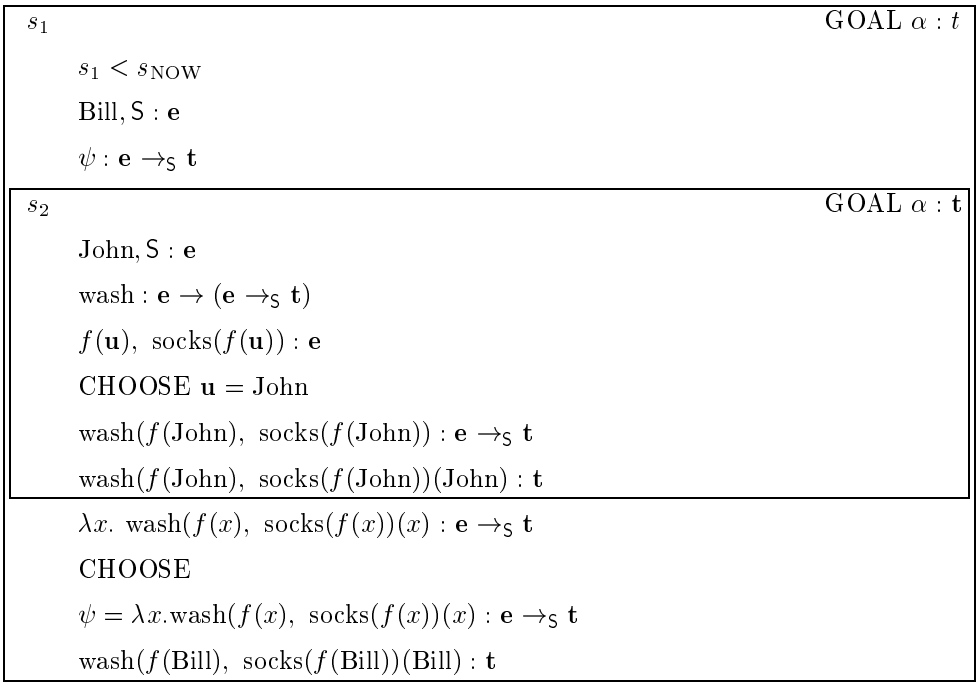
from binding theory which distinguishes α-occurrences and β-occurrences of an index according to whether the index is established referentially (= α-occurrence) or as a dependency on some other index (= β-occurrence). They define a matching relation between antecedent string with assigned structure and set of indices and the elliptical form with invisible assigned structure and set of indices called 'an i-copy', which does not involve semantic identity but requires matching of α- and β-occurrences of indices. This concept guarantees the carrying over of bound-variable construals of pronouns (normally β-occurrences) to some following elliptical form without necessary semantic identity. This concept of i-copy defined in terms of matching of terminal elements and assigned structure allows up to a certain defined limit of morphological and structural variation (cf. fn.32). The theory thus provides an index-relative concept of identity which is distinct from either a semantically or a structurally defined concept of identity. Their analysis assigns a peripheral, marked status to both (iii) and (v) equally, said to require subordination of the second conjunct to the first.

[21] The representation of the genitive is schematic at best, but the approximation is harmless.

[22] To distinguish the interpretation of *John washed his socks and so did Bill* and *John washed John's socks and so did Bill* we shall need to add to the label projected by a name a record of when it was introduced into the database, keeping track of discrete introductions of the same name in much the same way as keeping variables discrete. Some following pronoun may then be identified as John_i for some i, and λ-abstraction will be sensitive to a distinction between John_i, John_j. This phenomenon is entirely general, all premises requiring an index of occurrence. Such indices have in general been suppressed simply for ease of exegesis.

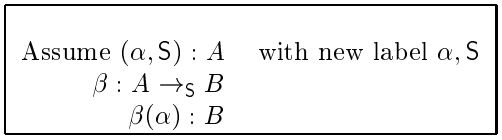
(37) John washed his socks and so did Bill

(37′)



The unambiguous first conjunct is re-used to create by abstraction an interpretation for the elliptical form and hence create the so-called 'bound-variable' interpretation. The second strategy involves simply choosing the label of type $\mathbf{e} \rightarrow_{\text{S}} \mathbf{t}$ that is available in the database from that first conjunct, to wit 'wash(f(John), socks(f(John)))'. Formally this process of direct identification can be seen as a variant of $\rightarrow$ Introduction, here withdrawing only the premise $(\alpha, \text{S}) : \mathbf{e}$ and not any other occurrences of α. We might refer to this as $\rightarrow_{\text{S},1}$ Intro, manipulating a more sensitive abstraction operator λ_1:

VII $\rightarrow_{\text{S},1}$ Introduction ($\rightarrow_{\text{S},1}$Intro)
To derive $A \rightarrow_{\text{S},1} B$
Open a new box s_i



$\lambda_1 x[\beta(x)] : A \rightarrow_{\text{S},1} B$

where λ_1 is to be understood as abstracting only the occurrence of α which is annotated with the feature S. The result is a one-place predicate in which the only remaining argument needed to create a proposition must be construed as subject.

With these two processes of interpretation for a single form of ellipsis, we immediately predict the four possible interpretations of (36). The interpretation of (36) involves an identification process for the temporal adverbial using either $\rightarrow_{\mathsf{S}}$Intro or $\rightarrow_{\mathsf{S},1}$ Intro and a second process also using either of these two rules. (i) involves two uses of $\rightarrow_{\mathsf{S},1}$ Intro. (ii) involves two uses of $\rightarrow_{\mathsf{S}}$ Intro. (iii) involves the use of $\rightarrow_{\mathsf{S},1}$ Intro followed by application of $\rightarrow_{\mathsf{S}}$ Intro, (iv) the converse. There is no independent interpretation of the adjunct in the interpretation of the second conjunct, for each $\rightarrow_{\mathsf{S}}$ Introduction process takes the conclusion of some established database and abstracts the subject from it, and no mixed cases are allowed other than those licensed by the application of these two processes. In particular, no abstraction is allowed other than either across-the-board abstraction or from subject position alone; and (v) and (vi) are precluded.[23] The choice of a resource label S for defining the concept of subject has had the happy consequence of predicting the right restricted set of interpretations.[24]

3.1 VP ellipsis and syntactic restrictions

The major restrictions on VP ellipsis purporting to show its syntactic basis also follow from this account, in particular the observed subjacency effects.[25] The significance of these data is that it is these which provide the principal evidence (Haik [20],

[23] Mixed cases which are not covered by these rules arise with definite NPs containing pronominals:
(i) John said his mother was worried about him and so did Fred.
(i) allows an interpretation in which Fred is reported as having said that John's mother was worried about Fred. These cases are covered by the independent necessity of treating definite NPs as having interpretations in which they are rigidly referential expressions, effectively names, the predicate 'his mother' in the first conjunct of (i) used to set up a name which uniquely picks out John's mother (the traditional referential/attributive distinction of Donnellan [13]). If the hearer inferentially makes this additional step, subsequent abstraction will not affect this name. What this account correctly predicts is that pronouns, having no such predicative content, will never be subject to this additional step of interpretation, and so the possibility of interpreting the second conjunct of (i) as 'Fred said that Fred's mother was worried about John' is precluded (contrary to the Fiengo and May [14] account).

[24] Examples due to Dahl 1972 such as *John thinks he's clever; so does Bill though Bill's wife does not* (with an interpretation in which Bill thinks that he Bill is clever though his wife does not think that he is clever) pose no problem of principle for this account, predicting as it does that interpretations are projected from the previous database by one or other form of abstraction. All that is required in this case is a shift from one type of abstraction to the other, a shift which given relevance considerations would predict to be somewhat more marked than merely repeating the strategy used in establishing an interpretation for the second conjunct. The concept of relevance I am here presuming on is that of Sperber and Wilson [45], who define a principle of relevance as the presumption that hearers will invariably interpret utterances by engaging in the least cognitive effort for the intended interpretation. The preclusion of an interpretation in which Bill's wife does not think that John is clever is also predicted on relevance grounds. Relevance considerations, given the Sperber and Wilson definition, dictate that the only possible interpretation for some under-determined element is the interpretation which is the most salient (evaluating competing interpretations itself involves cognitive effort, and is debarred). Given the sequence of conjuncts explicitly presented, with the third presented as subordinate to the second, the only available interpretation of the third is that which is established by using the interpretation assigned to the second. That these preferences are due exclusively to salience considerations is confirmed by examples such as *John thinks he's been maligned. So, incidentally, does Bill. However John's wife doesn't, so they will be taking no action.* With the use of *incidentally* explicitly marking the second conjunct as not of primary importance, the interpretation of the second elliptical VP from the first conjunct becomes available as predicted.

[25] Examples with expletive subjects are observed by Lappin to be problematic for standard semantic accounts of VP anaphora—e.g. Dalrymple *et al.* [12], Hardt [21], such as *It's obvious that John's right even if John doesn't think that it is.* However if we assign *obvious* the type $\mathbf{e} \rightarrow \mathbf{t}$ as expected, allow expletive subjects to project a label for the type $\mathbf{e}$ which is empty other than a 'use last' annotation, and assume that the immediately follow ing database has no assigned type, the only possible resolution will be for that following database to be taken to provide the missing label for the premise preceding *obvious*, it will then duly be identified as 'John's right' and the elliptical VP by direct identification will be construed as 'obvious'. An account very similar to the present one is Prüst *et al.*,

Lappin [33]) that an account of VP ellipsis has to be in terms of syntactic structure. Thus sensitivity to *fact that* constructions (39), *wh*-islands (40), and relative clause constructions (41) all appear to be displayed by antecedent-contained VP ellipsis, and suggest that the elliptical forms must be analysed as containing occurrences of the *wh* gap in order that the strings can be debarred in terms of the presence of some illicit gap in structures where it is not licensed:

(38) John read every book which Bill said Sue had.

(39) ∗John read every book which Bill believes the claim that Sue had.

(40) ∗John read every book which Bill wondered why he had.

(41) ∗John's book discusses every book which Bill recommended the book which also did.

Moreover the wellformed cases of antecedent-contained VP ellipsis as in (38) constitute the primary argument for the level of LF posing as they do an apparent problem of vicious circularity in the assignment of their interpretation given an s-structure characterisation (Haik [20], Fiengo and May [14], though cf. Lappin [33], Brody [4]). The $\mathrm{LDS_{NL}}$ account avoids this problem in virtue of the fact that the elliptical VP in the relative clause is interpreted from an independent linked database as part of the process of establishing the predicate within which it appears to be contained. The process of interpreting (38) in $\mathrm{LDS_{NL}}$ terms is displayed in (38′) (assuming an analysis in which determiners project onto variables, every onto a meta-variable $\mathbf{x}$ ranging over free variables $x, y, \ldots$). (38′) presents the interpretation up to the point immediately prior to the point at which some choice has to be made to complete the premise $\psi : \mathbf{e} \rightarrow_{\mathsf{S}} \mathbf{t}$:

who present a first-order unification account of VP ellipsis, but they explicitly advocate that this account applies exclusively to so-called discourse phenomena and leave on one side as subject to syntax-internal explanation all cases which involve structural restrictions on their interpretation such as bound-variable construals of pronominals and antecedent-contained VP ellipsis.

(38′)

LnM	s_1	
gnM		GOAL $\vdash s_1, \gamma : \mathbf{t}$
d^1nM	John, S : **e**	
d^2nM	read : **e** $\rightarrow$ (**e** $\rightarrow_{\mathsf{S}}$ **t**)	
d^3nM	**x**, book(**x**) : **e**	
$nd^3nM = \alpha$		$\uparrow$
$L\alpha$	s_2	
$g\alpha$		GOAL $s_2(\mathbf{u}_{\mathrm{wh}} : \mathbf{e}) \vdash \beta(\mathbf{u}_{\mathrm{wh}}) : \mathbf{t}$
		LINK $(s_1((\mathbf{x}, \mathrm{book}(\mathbf{x})) : \mathbf{e})$,
		$s_2(\mathbf{u}_{\mathrm{wh}} : \mathbf{e})$,
		$\mathbf{u}_{\mathrm{wh}}/(\mathbf{x}, \mathrm{book}(\mathbf{x}))$
$d^1\alpha$	Bill, S : **e**	
$d^2\alpha$	say : **t** $\rightarrow$ (**e** $\rightarrow_{\mathsf{S}}$ **t**)	
$d^3\alpha$	s_3 : **t**	
$nLd^3\alpha = \alpha'$		
$L\alpha'$	s_3	
$g\alpha'$		GOAL $s_3(\mathbf{u}_{\mathrm{wh}} : \mathbf{e}) \vdash \beta'(\mathbf{u}_{\mathrm{wh}}) : \mathbf{t}$
		LINK $(s_1((\mathbf{x}, \mathrm{book}(\mathbf{x})) : \mathbf{e})$,
		$s_3(\mathbf{u}_{\mathrm{wh}} : \mathbf{e})$,
		$\mathbf{u}_{\mathrm{wh}}/(\mathbf{x}, \mathrm{book}(\mathbf{x}))$
$d^1\alpha'$	Sue, S : **e**	
$d^2\alpha'$	ψ : **e** $\rightarrow_{\mathsf{S}}$ **t**	

The only predicate available which gives rise to a well-formed interpretation for ψ : **e** $\rightarrow_{\mathsf{S}}$ **t** is the database of premises {read:**e** $\rightarrow$ (**e** $\rightarrow_{\mathsf{S}}$ **t**), **x**, book(**x**) : **e**}, and this is what the hearer chooses. As a result of this choice, the conclusion 'say(read(**x**,book(**x**))(Sue))(Bill)' will duly be derived in s_2; the LINK target on s_2 will thus be satisfied; and the composite restriction 'book(**x**) & say(read(**x**,book(**x**))(Sue))(Bill)' entered in s_1 as the result of the LINK inference rule. The result here emerges from three factors: (i) linked databases are by definition independent of the host database to which they are linked; (ii) the elliptical form in this type of case is constructed as part of the process of building the linked database in question; (iii) the inference which leads to an added restriction on some variable which is induced by the linked database only applies after that database successfully leads to some conclusion α : **t**. In consequence of these, an interpretation can be projected from the structure directly projected from the string without threat of circularity. At the point $d^2\alpha'$ in

s_3 at which ψ is to be instantiated, the computation of the database to be linked in to d_3nM is not complete, so the restriction on the variable which that computation will provide is not yet entered into the database s_1. The hearer is therefore able to choose $\{\text{read:}\mathbf{e} \rightarrow (\mathbf{e} \rightarrow_S \mathbf{t}), (\mathbf{x}, \text{book}(\mathbf{x})) : \mathbf{e}\}$ from s_1 as providing a value for ψ, with the premise containing the variable $\mathbf{x}$ only bearing the restriction book($\mathbf{x}$), no associated restriction from the linked database yet being available. No circularity results from this process. Indeed this choice of predicate is essential in order both to fulfil the target specification imposed on s_2 (and s_3), and through the inference rule VII to derive the wellformed result of an additional occurrence of $\mathbf{x}$—'say(read($\mathbf{x}$, book($\mathbf{x}$))(Sue))(Bill)'—within the proof domain s_1 in which it was introduced. Hence the licit antecedent-contained VP anaphora in (38).[26]

The island-violating effect of VP reconstruction in (39)–(41) follows exactly as *wh*-gap binding with no VP ellipsis present, for the *wh* in all cases will project a goal specification and realisation of this specification will have to satisfy all the restrictions imposed by the goal-directed construction process exactly as in the general case. The following VP anaphor does not change the status of the already imposed target. In (41) for example, the database containing the elliptical VP form will never be computed because the database to which it should be linked is in violation of its own target (projected from *which Bill recommended the book*) and the database containing the elliptical form is independent of the database to which it should be linked and cannot constitute a domain for constructing the necessary assumption—all exactly as in island-violating cases with no ellipsis. A similar explanation is available in all the other cases. Whatever restriction debars the incremental projection of a *wh* expression followed by its gap will debar these cases, given the presence of the *wh* expression and the associated goal specification it projects. The interest of these cases of antecedent-contained ellipsis lies in the fact that the explanation turns on the assumption that the process of interpretation itself projects structure. It is this which has enabled an explanation of the structural restrictions on interpretation of elliptical forms without circularity and without abandoning the assumption that all forms of VP ellipsis have

[26] The scope effects arising from restrictions on the construal of free variables in elliptical constructions can be predicted from the twin assumptions (i) that proof domains are defined to be labelled databases, (ii) that determiners such as *every* project a variable free within one such proof domain. If the clause which contains the elliptical expression can serve to project a database as label to a database projected from its adjoining clause so that both antecedent database-structure and the structure projected by the elliptical expression are within the same proof domain, then a variable introduced in the adjoining clause will be carried over construed as the very same variable. Thus *John saw everyone when Bill did* is ambiguous because *when* clauses may act as label to the main clause and if they so act then the variable x projected by *everyone* will be held constant in the reconstructed elliptical predicate. If however the two clauses are taken as independent proof domains, the construction of the elliptical VP will be construed as a predicate with a free variable in that new proof domain and so be construed as separately quantified. This possibility is available for both strategies for ellipsis construal, hence the four-way ambiguity of *John explained his theory to everyone in the Department when Bill did.* By contrast, with the quantifier in the *when* clause and the elliptical form in the main clause, the quantifier in the predicate has to be construed as independently quantified—*When John interviewed everyone Bill did* is unambiguous. This is because the database acting as a label is itself a labelled database and hence a proof domain independent of the database it labels. The results parallel the asymmetry for pronominal dependence, cf. fn.6. In all cross-clausal relations—unless they project such a single proof domain—a variable in a predicate will be construed as requantified under ellipsis reconstruction and VP ellipsis construal across *and* and *because*, for example yields unambiguous results:

(i) John saw everyone and so did Bill

(ii) John interviewed everyone because Bill did.

$\lambda y.[\text{see}(x)(y)]$ is carried over from the first conjunct of (i), providing a variable free in the new database. Hence the effect of requantification. Again the data parallel the potential for anaphoric dependence across these clausal boundaries. This analysis will extend without modification to the examples which are problematic for the Dalrymple *et al.* account with a pronominal in the antecedent predicate that gets construed in the new database as a variable bound in that new domain: *Everyone in Sarah's class wants her to go out with him, but none of them think that she will.* Notice that the restriction on the variable is held constant, as this analysis would predict.

a simple intrinsic structure.[27]

An alternative account of antecedent-contained VP-ellipsis constructions avoids the threat of circularity by analysing cases such as (38)–(41) as lacking only a verb in the manner of pseudo- gapping. Pseudo-gapping is a process freely used in comparatives in which the verb or verb-sequence is replaced by the pro-verb *do*:

(42) John hid the brandy, and Sue did the chocolate.

(43) John hid the brandy more efficiently than Sue did the chocolate.

(44) John wants to see Peru and Harry does Brazil.

On this analysis the *wh* expression and its associated gap are generated independently in cases of antecedent-contained ellipsis such as (38), and the interpretation of the elliptical form involves reconstructing the remainder, to wit the verb. (This analysis has been proposed both in semantic terms by Cormack [9] and Jacobson [24] involving composition of functions, and in syntactic terms as s-structure reconstruction by Lappin [33, 34]). On these accounts, there is no circularity in examples such as (38) because the elliptical expression is not a VP in such cases but only a subpart of one. This account is clearly compatible with the present framework; and the phenomenon could be modelled in $\mathrm{LDS_{NL}}$ terms with the ellipsis being a remainder-constructing process of whatever type. However, the observed parallelism between pseudo-gapping and VP ellipsis is misleading. Pseudo-gapping is a restricted process, and is not allowed unless the predicate to be reconstructed is a sequence of adjacent verbs. Though (45) allows a reconstruction of the second conjunct as 'Sue will agree to

[27] Examples which are not covered by either the Dalrymple analysis or the present one are those in which the selected VP antecedent contains a pronoun construed as a name which is not subject of that antecedent clause, and this is carried over and interpreted in the elliptical form with the pronoun reidentified in its new domain (cf. Lappin [32], Hardt [21], Wescoat [49]):

(i) As for Bill, I greeted him with pleasure, but John, I didn't.

(ii) Bill admitted that Mary had bribed him and John admitted that Sue had.

(iii) The policeman who had arrested John failed to read him his rights and so did the policeman who arrested Bill.

These appear to involve reconstructions of meaning from the input meaning of the elements. Such reconstructions are not covered by the present analysis, but it does not preclude them either, given that the second strategy, here called $\rightarrow_{S,1}$ Introduction, involves a direct identification of some requisite predicate-label from some label already available. The analysis given here has relied on some relevance-defined concept of choosing the most salient database/most salient predicate from which to identify the appropriate φ for the elliptical predicate of type $\mathbf{e} \rightarrow \mathbf{t}$ (Sperber and Wilson [45]); and I have said nothing about what determines how the appropriate φ is chosen. In all cases of predicate construction where the information projected by some input sequence of words does not match that of its ultimate interpretation (e.g. sequences containing a pronoun), a predicate of the form $f(\mathbf{u}_{\mathrm{pro}}) : \mathbf{e} \rightarrow \mathbf{t}$ matching that interpretation modulo the interpretation of the pronoun itself will in principle be available from the lexical content of the clause. However, given the obligatory process of incrementally establishing an interpretation for a string, once an interpretation for a predicate is established it will always be more cognitively accessible for purposes of anaphoric dependence than any predicate constructed from the input forms of its constituent parts, and relevance considerations will dictate that an interpretation for a subsequent elliptical expression based on such input contents will not be available unless special directions are given to over-ride the greater salience of the established interpretation of that antecedent expression. The only way in which such predicates can be made properly accessible to the hearer without undue cognitive effort is either

(A) all interpretations of the completed antecedent cognitively salient predicate are precluded

(B) the speaker unambiguously signals to the hearer that it is the process of arriving at the interpretation of the antecedent that is to be used as the basis for recovering the interpretation of the elliptical form, rather than the resulting content.

(i) is a case of A, (ii) and (iii) a case of B. Notice the parallelism in word sequence in (ii) making prominent the use of the same sequence of strategies for assigning interpretation. If this focus on such parallelism is disturbed, the interpretation disappears. Cp. (iv) which does not allow an interpretation of the elided VP as 'had bribed Bill':

(iv) *John admitted that Sue had bribed him and Bill spoke to the woman who also had

complete her book', there is no interpretation of the second conjunct of (46) as 'my mother had promised me to talk to the Director':

(45) John will agree to complete his paper well before Sue will her book.

(46) John promised me to talk to the Dean quite as fervently as my mother had to the Director

For similar reasons, (47) only allows an interpretation of the second conjunct as non-elliptical, and (48) is illformed:

(47) Mary had made arrangements for the police to pick up the documents; and Sue had the money.

(48) ?∗Mary had made much more efficient arrangements for the police to pick up the documents than Sue had the money.

This restriction is not shared by either VP ellipsis in general, nor by antecedent-contained ellipsis in particular, as both (49) and (50) are fully acceptable:

(49) We discovered which documents Mary had made arrangements for the police to pick up; but we never discovered which documents Sue had.

(50) John had made arrangements for the inspectors to be shown the same rooms that Bill had.

Lappin [34] postulates a process of clause union on s-structure configurations to cover such cases as (44) but (45)–(49) remain problematic.[28]

Moreover there is independent evidence to prefer the more uniform analysis in which antecedent-contained ellipsis like all other forms of predicate ellipsis is a case of one-place predicate reconstruction. The two analyses differ over the status of the gap in the reconstructed interpretation of the elliptical VP in (38). According to the pseudo-gap form of analysis, the empty category satisfying the target specification imposed by the *wh* is projected directly from the *wh*. In the analysis proposed here, the assumption corresponding to the gap is projected as part of the one-place predicate instantiating the VP anaphor input. Parasitic gap constructions, in which a secondary gap is constructed in the presence of a single *wh* operator, provide a test-case for this difference:

(51) This is the book on pornography which John read before tearing up.

Parasitic gaps display the full range of subjacency effects (Chomsky [6]). They are standardly analysed as necessitating an empty operator, and in this framework will

[28] Lappin [34]cites examples of the form of (49) as evidence against a predication analysis (his own examples are *John saw Mary, who he liked and Bill, who he didn't*) on the basis that the variable associated with the *wh*-expression must be rebound in the new proof domain. On this analysis, with all quantifying determiners projecting variables, the data posed by such rebinding of the *wh* induced assumption are no different from *John saw everyone and so did Bill*, in which the predicate 'λx. say $(y)(x)$' is carried over to create the new database in which, equally, the variable y is free (cf. fn.26). The sole difficulty lies in the linkage, which has to be suppressed. Cf. fn.27.

require the postulation of a parasitic target specification imposing on its own domain a new task of constructing the requisite ancillary assumption:[29]

(52) *This is the book on pornography which John read before hearing about the decision that he shouldn't have read.

(53) *This is the book on pornography which John read before he saw the teacher who had said he shouldn't read.

(54) *This is the book on pornography which John read while wondering why his teacher had told him not to read.

Unlike *wh*-expressions, such operators have to be said to be optional in these environments because not all such adjuncts contain a parasitic gap. There is no goal-specifying element driving the interpretation of the clausal adjunct in (55)–(56):

(55) This is the book on physics Joan read while wondering why her teacher had been ignoring her.

(56) This is the book on physics Joan read before selling it to her friend.

With antecedent-contained VP ellipsis and parasitic gap constructions combined, we shall get a difference between the pseudo-gapping analysis and the $\mathrm{LDS}_{\mathrm{NL}}$ predicate-forming analysis. The pseudo-gapping verb-ellipsis form of analysis will predict exact parallelism between parasitic gaps in elliptical and non-elliptical forms, for even in the elliptical cases the parasitic gap operator will be needed to license the presence of the gap exactly as in more straightforward parasitic gap cases. All that is reconstructed as the construal of the elliptical form is the verb:

(57) This is the book that John read before discovering that Sue already had.

In all cases, then, in which the clause containing the elided form contains a construction across which *wh*-gap and parasitic gap dependencies are debarred, the interpretation should be debarred. The reconstruction of the elliptical form as a one-place predicate from some previous gap-containing predicate will not make this prediction. An elliptical VP can freely select as its value some salient gap-containing predicate irrespective of the structure intervening between that predicate and the point of interpreting the elliptical form, and this choice of value is predicted to lead to a well-formed interpretation as long as both the elliptical form and that gap-containing predicate are in the same proof domain. The construction of a parasitic gap by these means is predicted not to be sensitive to the same restrictions as parasitic gap constructions with no ellipsis because it will not have been induced by any goal-driven necessity—the only requirement is its occurrence within the appropriate proof domain. The issue turns on the contrast between (52)–(54) and (58)–(60):

[29] Cf. Postal [40] for data suggesting that an analysis in terms of control. Should this be the correct analysis (46)–(48) would be a consequence of a much more stringent restriction. Well-formed examples of parasitic gaps in tensed clauses would however be precluded:

(i) This is meat you must chop before you fry.

(ii) This is a book which if you can be bothered to read you will be impressed by.

(58) This is the book on pornography which John managed to read before hearing the teachers' decision that he

$$\left\{\begin{array}{l}\text{was not to be allowed to}\\ \text{they would all try and ensure that he did not.}\\ \text{they would all try and ensure that he shouldn't do so}\end{array}\right.$$

(59) This is the book on pornography which John read before he saw the teacher who had insisted that

$$\left\{\begin{array}{l}\text{he wasn't to.}\\ \text{he must not.}\\ \text{he mustn't do so.}\end{array}\right.$$

(60) This is the book on pornography which John read while wondering why his teacher had told him

$$\left\{\begin{array}{l}\text{not to.}\\ \text{that he must not.}\\ \text{that he mustn't do so.}\end{array}\right.$$

According to the $\mathrm{LDS_{NL}}$ analysis (52)–(54) are unlike (58)–(60) and unlike (39)–(41) because no initially imposed goal specification drives the interpretation process. Given the very much greater acceptability of (58)–(60) over (52)-(54), I take the present analysis as confirmed.[30] [31]

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[30] Lappin [33, 34] argues on the basis of (i)–(iii) that both parasitic gaps and elliptical VPs containing parasitic gaps are subject to an identical locality condition expressed by Contreras [8] as the restriction that the gap be 1-subjacent to the true gap (a restriction which he claims cannot be reduced to any semantic form of explanation):
(i) This is the performance which John attended in order to review.

(ii) $*$This is the performance which John attended after coming in order to review.

(iii) $*$This is the play which John saw before Bill went because he wanted to.
(iii) is ungrammatical on the interpretation in which the elided VP = 'John saw e'. However, even granting the need for a locality restriction on the gaps which are parasitic on a *wh* induced goal-specification, there is evidence that reconstructing a secondary gap in an elliptical VP form is not subject to this restriction, confirming the analysis of parasitic gaps in VP ellipsis suggested here:
(iv) $*$This is the play which$_i$ John wrote about e_i despite having gone to a concert in order to avoid having to write about e_i.

(v) This is the play which$_i$ John wrote about e_i despite having gone to a concert in order to avoid having to.

(vi) This is the play which$_i$ John wrote about e_i despite having gone to a concert in order to avoid having to write about it$_i$.

(vii) This is the memo$_i$ which John wrote e_i because Bill$_j$ left the office so that he$_j$ wouldn't have to e_i.

(viii) $*$This is the memo$_i$ which John wrote e_i because Bill$_j$ left the office so that he$_j$ wouldn't have to write e_i.

(ix) This is the memo$_i$ which John wrote e_i because Bill$_j$ left the office so that he$_j$ wouldn't have to write it$_i$.
According to this analysis, (v) and (vii) are like (vi) and (ix) in allowing an interpretation which is not driven by any imposed goal specification, and hence not subject to restrictions imposed by such specification. The distinction between (iii) and (v) and (vii) seems to be due to a contrast between *before* adjunct clauses and causal adjuncts. I have no explanation for this.

[31] Some speakers report a gradation in acceptability with the *do so* forms being markedly more acceptable than either the bare auxiliary or bare infinitive forms. Lappin [34] reports that most speakers record increased acceptability with parasitic gaps under ellipsis, but still a noticeable difference between these and the full pronominal form of *do so* anaphora, which is fully acceptable. The distinct lexical inputs of these different forms of VP ellipsis provide some basis for explaining this. *Do so* forms exactly parallel pronominal anaphora. The predicate form $\psi : \mathbf{e} \rightarrow \mathbf{t}$ is explicitly projected, and all that is required is instantiating the metavariable on the basis of independently accessible labels. The bare auxiliary and bare *to* forms however induce a skeletal structure which they themselves fail to fill. The *to* infinitive in particular induces the building of an incomplete database which it does not provide at all. Such incomplete forms tend to encourage the interpretation of the elliptical element via word strings from which to project the structure, hence inducing a genuine parasitic gap.

The overall advantage of using incrementally projected proof-theoretic structure as the basis for VP ellipsis interpretation has been two-fold. On the one hand, the analysis has greater structure than a model-theoretic semantic account and so is able to reconstruct configurational restrictions while retaining the insight that the elliptical VP is reconstructed from the interpretation of its antecedent. Furthermore, the use of resource labelling to define the concept of subject has had the immediate advantage of predicting a narrower range of interpretations for elliptical expressions than a free semantic process of abstraction. On the other hand the analysis, though closely allied to a syntactic reconstruction of ellipsis in its direct modelling of *wh* gaps as constructed premises, correctly reconstructs interpretation of VP ellipsis as matching the interpretation of anaphoric elements in the antecedent, not their morphological form. Unlike the syntax-based accounts of VP ellipsis, no ancillary 'vehicle change' process is required: the phenomenon is simply a reflex of the way in which structure as interpretation is built up. The analysis has, furthermore, an intrinsic dynamism not shared by s-structure reconstruction of the ellipsis phenomena which avoids the problem posed by antecedent-contained VP ellipsis. S-structure reconstruction of VP ellipsis is statically defined over the output of syntactic configuration-building process. Hence the circularity of reconstruction of antecedent-contained VP ellipsis. On this analysis, in which structures as interpretation are built up incrementally, VP ellipsis, like all underdetermined elements, is enriched on the basis of representations available at the point of its construal in the projection of content. The choice of value for the elliptical expression may therefore be a structure which is itself subject to further enrichment as in the cases threatening circularity, so the antecedent-contained cases can be seen as no more than a subcase of a unitary VP-ellipsis phenomenon. Finally, the analysis retains the insight that the input to interpretation of all elliptical expressions corresponds solely to that projected by the expression itself, an insight which all syntactic approaches signally fail to capture. No concept of formal ambiguity is invoked associated with syntactic assignment of indices. The different interpretations arise solely from the form and content of the provided input and the way in which choices are made during the process of interpretation.

4 VP Ellipsis: the general picture

Comparing VP—and bare-argument ellipsis, we have analysed both as projecting an input which under-determines the output interpretation very considerably, both such inputs requiring a structural process of interpretation. These structural processes of interpretation are both defined in terms of $\rightarrow$ Intro, the one a substitution process founded on $\rightarrow$ Intro, the other the process of $\rightarrow_S$ Intro. In being defined as a local box-exit rule, both are subject to locality conditions—neither allowing reconstruction into relative clauses.[32] Despite similarities in the process of their construction, the two processes nonetheless differ, and the differences between them are also predictable.

[32] Wescoat [49] claims that dependency into relative clauses in constructing the interpretation of fragments should not be precluded on the grounds that the analysis must reflect the parallelism between fragment and expressions of the type *the same goes for Bill*, and this latter form does allow reconstruction into relative clauses, as in the natural interpretation of *John dislikes every city which has an air pollution problem. The same goes for water pollution.* However arguably the parallelism is solely semantic, *the same* triggering a much freer one-place predicate construction process independent of the combinatorial restrictiveness imposed by the syntactic type system of types as formulae (cf. Rooth [44] who also argues that *the same* triggers a free process of predicate construction, not syntactically constrained).

They follow from the different forms that the elliptical element presents. From a concatenated database, the bare argument fragment presents merely a minor premise and therefore requires abduction of some total database structure into which the new premise is substituted. This reconstruction is confirmed by the required use of the word *too, and*, or *but not*, of which *but not* and *too* both encode the information that the sequence which they precede/follow is a concatenated database (note the unacceptability of $*$*John interviewed everyone who Bill did too*). An elliptical VP form, on the other hand, by itself presenting a database and some minimal structure, licenses a freer identification process but subject to greater stringency in the form of label to be constructed: the label must be associated with a major premise which can combine with a premise annotated with the S restriction that it be used last. Moreover, when the elliptical form combines with other forms such as *wh* expressions in antecedent-contained VP ellipsis, the range of available interpretations is exactly that predicted by the combination. The shift from a model-theoretic to a proof-theoretic construal gives exactly the richness of structure required, not just for the purpose of predicting the process of interpreting elliptical forms, but for predicting also varying configurational limits on such interpretation.

The assumptions definitive of the $\mathrm{LDS}_{\mathrm{NL}}$ framework have been central to this explanation. It was the composite form of label-plus-formula which enabled us to absorb semantic compilation into a syntactic process of interpretation, preserving semantic insights while enriching them with procedural information about how the truth-theoretic content is projected. It has been the greater richness of vocabulary made available by the complex of labelling algebra, type specification and the dynamics of the proof process, that has enabled us to retain the insight that fragment ellipsis, VP-ellipsis, intransitive verbs. and even *wh*-expressions, all constitute one-place predicates while nevertheless predicting their differences in associated structural properties. It is the proof discipline of the local conditional logic and the distinction between it and the global discipline in which it is embedded that have enabled us to explain the parallelism between *wh*-gap dependency and ellipsis, and the extent to which in bare argument ellipsis that parallelism is incomplete. It has been the use of resource labelling for control purposes which provided the basis of restrictions on the otherwise free process of substitution in VP ellipsis. It has been the system of proof construction from a mixed meta-language/object-language input, subject to progressive instantiation of metavariables, which provided the basis of the procedural account of ellipsis paralleling anaphora, modelling them all as instances of some underdetermined input with subsequent processes of enrichment of that input. So it is that in this framework we bring together the assignment of structure to a string, the provision of an associated interpretation, and the modelling of how the string is interpreted in context. All three are the incremental proof-theoretic projection of structure to a string on a left-right basis through the sequence of words.

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