English without VPs

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The existence of a VP constituent in English has largely been taken for granted since the appearance of the rule S → NP + VP in early generative grammar, and tests for VP constituency form part of the canon of argumentation in most syntax textbooks.[1] In this paper we argue that the arguments for a syntactic VP constituent in English are individually flawed, and that the absence of valid arguments should be taken as evidence that clause structure in English is in fact flat. In the proposed analysis, the units affected by the operations traditionally used to justify VP constituency do not in general correspond to syntactic constituents, but rather emerge as units created by the logical form operations of predicate saturation and higher-order unification.

1. INTRODUCTION: A BRIEF HISTORY OF VP

The existence of a VP constituent consisting of a verb and its non-agent, i.e. "internal" complements was not an assumption of traditional English grammar. For example, Jespersen (1933) analyses basic clause structure in terms of subject, verb and (direct and indirect) objects, each of the same primary rank,[2] and this analysis is essentially preserved in post-war comprehensive grammars such as Quirk, Greenbaum, Leech & Svartvik (1972, 1985).

The origins of VP as a constituent can be traced rather to American structuralism. The initial motivation for VP is found in the immediate constituent analysis of Bloomfield (1933); while Bloomfield does not actually use the term "verb-phrase", he analyses *ran away* in *Poor John ran away* as a constituent on the grounds that *ran* alone can substitute for *ran away*. The category label VP however made its first explicit appearance in Chomsky (1957) with the introduction of the rewrite rule S → NP + VP. and the expansion of VP into obligatory Verb plus optional NP and PP complements.[3]

A number of developments then conspired to consolidate the presence of VP in mainstream syntactic theory. The first was the notion that grammatical relations should be defined in terms of structural positions, e.g. subject as daughter of S and object as daughter of VP (Chomsky 1965). The second was the discovery of subject-object asymmetries, for example in the binding of pronouns, which find a structural analysis in terms of asymmetric command relations (Langacker 1969). The third was the introduction of more complex rules, notably those proposed by Ross (1967/1986), which seem to make crucial reference to VP as a constituent. These include transformational rules such as VP-preposing, VP-ellipsis and VP pronominalisation (later more widely known as VP anaphora), and the basic coordination rule which *inter alia* forms coordinate VPs. Finally, there was the advent of X-bar theory (Chomsky 1970, Jackendoff 1977), in which VP forms a cornerstone of cross-category structural parallelism based on notions such as head, complement and specifier..

To a large extent, all of these initial motivations for VP have survived the ravages of time and recur in something close to their original form in modern syntactic theory. For reasons which will become clear, the preservation of VP holds particularly of syntactocentric as opposed to parallel architecture approaches (for this dichotomy see Jackendoff 2002). For a time, under the VP-internal subject hypothesis, VP was taken to include not only internal complements but also agent subjects as specifiers (see for example Baker, 1988). However even under the VP-internal subject hypothesis the object forms a V' constituent with the verb which is c-commanded by the subject. Following the take-up of Larson's (1988) proposal for a higher little v projection whose specifier position is occupied by agents, VP has again reverted to something like its original conception as a home for non-agent complements. With the abandonment of X-bar theory and the advent of bare phrase structure in the minimalist program (Chomsky 1995), the verb still merges first with its internal complement(s) to form a constituent which projects no further and can then (predictably) be labelled V^{max} or VP.,. Phenomena such as VP-preposing, VP-deletion, VP-anaphora and VP-coordination continue both to figure in the technical literature, and to play a formative role in most syntax textbooks, including introductions to minimalist theory, as canonical illustrations of arguments for constituent structure.

Nevertheless, there have been dissenting voices, both to the assumptions which underlie arguments for VP constituency, and to the postulation of VP constituency itself. First and foremost, in parallel architecture theories like Lexical Functional Grammar (Bresnan 2001), Role and Reference Grammar (van Valin 2005) and the tripartite model of Jackendoff (2002), grammatical relations .like subject and object are treated as belonging to a separate functional level of analysis and not as derivatives of constituent structure. It then immediately becomes possible to relate, in equal measure, the presence or absence of subject and object arguments to notions of functional coherence and completeness. For example, the fact that *eat* can occur transitively with an object and intransitively without, while *devour* only occurs transitively, can easily be stated without the assumption that verb and object form a VP. Bloomfield's original substitution argument, i.e that VP is a constituent because it can be substituted by V, thereby loses its force.

Secondly, it becomes possible to dispense with surface-syntactic command relations as an account of subject-object asymmetries. Bresnan (1998, 2001) for example argues that the same kinds of subject-object asymmetry in binding as occur in English recur in languages such as Malayalam where there is no independent evidence for VP constituency. Binding asymmetries can, depending on the individual language, be attributed to the thematic role hierarchy, the grammatical function hierarchy or linear precedence (or a combination of these), rather than to constituency. Van Valin (2005) likewise states binding asymmetries in functional terms: reflexive pronouns must not be higher on the privileged syntactic argument hierarchy than their antecedent; for English, this is Actor > Undergoer > Other. Similar ideas have also emerged in Combinatory Categorial Grammar (Steedman 1996), where following ideas of argument order in Montague grammar (Bach 1979, Dowty 1980) binding effects are linked to hierarchical ordering of arguments at the level of predicate-argument structure.[4]

Although parallel architecture theories can in principle dispense with VP, at least for the purposes of completeness and coherence, or as a *sine qua non* for an account of binding effects, they have in practice differed as to whether they continue to assume a VP in English. Jackendoff (2002), followed by Culicover & Jackendoff (2005), explicitly models English with a VP constituent, though VP itself is internally flat. Indeed, for Jackendoff, VP constituency appears to be universal, given that constructions are taken generally to follow X-bar theory as an "attractor" (a dynamic systems concept for stable patterns). In Lexical Functional Grammar it has long been argued that there are languages in which the classic constituency tests do not identify a VP constituent, for example Warlpiri (Simpson 1991), where the combination of verb and object cannot, unlike NPs or the verb alone, occur in clause-initial position,. For such languages, a flat clause structure is typically proposed. Nevertheless, the constituent structure of English is generally taken to be very similar to what is proposed in syntactocentric models, i.e the clause has a CP, IP, VP structure. The motivation for this appears to be the pull of the classic constituency tests: Bresnan (2001:17-18) for example has a discussion of VP-preposing in English, and in a very careful discussion of the validity of constituency tests in LFG, Dalrymple (2001, ch 4) explicitly uses this rule as evidence for VP-constituency.

In Combinatory Categorial Grammar (Steedman 1996), basic clauses with subject-verb-object structure have multiple surface parsings, In one parsing, the verb does indeed combine with the object first to form a VP constituent. In some sense, this is the basic parsing, since it employs the simple combinatory rule of functional application. However, also available via the more complex combinatory rule of functional composition is a structure in which the verb combines first with its subject, and only subsequently with its object. Such non-standard constituents are explicitly used in the derivation of complex syntactic structures, e.g. relative clause constructions in which the object is fronted, and are also linked directly to possible information-structure packaging of the sentence.

Only in Role and Reference Grammar (van Valin 2005) is VP constituency explicitly rejected, both universally and in English. The core of a clause is a flat structure consisting of a nucleus (typically a verb) and its various arguments. To the extent that VPs appear in this system, they are units which emerge at a separate level of information structure. So, in an analysis of VP ellipsis in English (section 7.1), van Valin argues that the ellipted material must be non-focal, and that its semantic representation is projected from a given parallel semantic representation (e.g. the semantic representation of the first coordinate in a coordinate structure).

Do we need then a VP constituent in English? The brief history of VP sketched above suggests first that there is a requirement to account for subject-object asymmetries in effects like binding. In syntactocentric theories in which grammatical relations and logical form are coupled directly to surface constituency, a VP constituent will automatically emerge as a consequence of this requirement. However, in parallel architecture theories in which grammatical relations are decoupled from surface constituency, asymmetries can in principle arise from grammatical relations hierarchies (as in Lexical Functional Grammar and Role and Reference Grammar). Even outside the parallel architecture theories, it is possible to decouple subject-object asymmetries from surface constituency by defining argument hierarchies at the level of predicate-argument structure (as in Combinatory Categorial Grammar).

What is left therefore is the requirement to account for classic phenomena such as VP ellipsis, VP anaphora, VP-preposing and VP coordination. Van Valin (2005) suggests that (at least some of) these operations utilise units defined at the level of information structure rather than syntactic constituents. Some aspects of the analysis proposed in this paper have affinities to this idea. Analogues of VP will emerge firstly from the logical operation of predicate saturation (at which point information-structure does not play a role) , but also from articulations of logical form permitted by the algorithm of higher-order unification. One of the functions of higher-order unification is precisely to provide partitions of sentence meaning of the kind required by information structure packaging.

Henceforth, for brevity, we will call our VP-less analysis of English the “flat English” analysis, though this should not be taken to imply that English should necessarily be analysed as lacking internal structure in other constructions. The basic proposal that we make concerning flat English is presented in section 2, Section 3 then deals in turn with the standard constituency tests for VP in English (VP-preposing, VP-ellipsis, VP-anaphora, and VP-coordination), making precise proposals for how each construction should be treated. We conclude in section 4 with a brief discussion of the consequences of the proposed analysis, in particular the consequences for notions of cross-categorial symmetry.

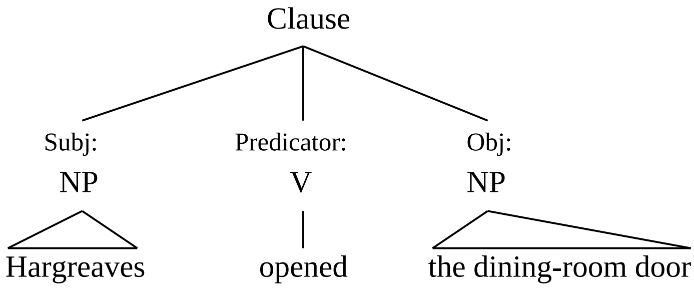
2. PRINCIPLES OF FLAT ENGLISH

In this section, we outline and illustrate the general principles of flat English. Section 2.1 describes the proposed flat syntactic structure of basic transitive clauses. Section 2.2 then provides for such structures a compositional translation into logical form which employs the operation of saturation. Saturation will allow a predicate to combine with its arguments in any order, composing logical units which correspond either to a verb combined with its object, or to a verb combined with its subject. Using the rule of relative clause formation, section 2.3 demonstrates the equal validity and utility of the logical unit formed in this manner from subject and verb. Section 2.4 then introduces higher-order unification, an algorithm for the subsequent manipulation of the basic logical forms derived from syntactic structures by the rules of compositional translation. Like saturation, but with greater degrees of freedom, higher-order unification permits the creation of useful logical units which do not correspond to syntactic constituents.

<u>2.1 Flat clause structure</u>

The syntactic structure we assume for a simple subject-verb-object clause in English is the flat structure in (1):

(1)



The notation used derives from Huddleston & Pullum et al. (2002) in that each node is simultaneously annotated with its category (e.g. NP) and function (e.g. Subj).[5] Grammatical relations are then functions associated with arguments, while predicator is a head function associated with the verbal predicate. Since grammatical relations are treated as constructs independent of the categories that bear them, this notation can readily be converted into that of any parallel architecture theory.

We take trees such as (1) to be licensed by well-formedness conditions on syntactic structure such as (2), where GR represents an arbitrary grammatical relation and X and Y are arbitrary syntactic categories:

(2) $[_{\text{Clause}}$ GR:X_n, ….. , GR:X_1, Predicator:Y]

The notation in (2) is to be interpreted as allowing a clause to consist in principle of a head (the predicator Y) and any number of categories *X* each of which bears a particular grammatical relation to the head. In (1), the GRs are subject and object, and *X* in each case is NP. It should be noted that (2) allows but does not require a clause to contain any of the indicated elements. In most cases, the obligatory presence of a given constituent will follow from semantic principles. For example, it will generally be impossible to derive a compositional semantic representation appropriate to a clause if no predicator is present. The co-occurrence restrictions between predicator and arguments will also follow to a large extent from the rules of logical composition to be outlined below. Wherever it is necessary however to indicate an obligatory condition on a particular rule, for example the obligatory presence of a given category, we do this by enclosing the condition in curly brackets following the constituent to which it applies. Thus, the syntactic requirement that a clause contain a verbal predicator would be notated as follows: *Clause{Predicator:V}*. When added to (2), this would result in the following rule: $[_{Clause}\ GR{:}X_n,\ \ldots\ , GR{:}X_1, Predicator{:}Y]\{Predicator{:}V\}$. Such a rule would force a clause to contain a predicator as a syntactic condition, and force that predicator to be a verb. In the end, this might well be too strong a constraint for English, given the existence of elliptical constructions in which predicators are omitted. We would prefer then a rule such as $[_{Clause}\ GR{:}X_n, \ldots\ldots , GR{:}X_1, Predicator{:}V]$, which states that if a clause contains a predicator, it must be a verb.

The well-formedness condition in (2) also in itself does not impose any ordering on the elements which make up the clause (the subscripts merely have an indexing function). We assume rather that ordering constraints will be imposed by a separate linear precedence rule of the type in (3):

(3) Subj > Predicator > Obj.

Here the symbol > is to be interpreted simply as “precedes”. Immediate precedence will be represented by >>. Thus from (3), it will follow that subjects precede predicators, and predicators in turn precede objects. This notation will sometimes be augmented by statements of the form *X<first>* or *X<last>*, meaning that the constituent X must be the first or last element respectively in its domain.

2.1 Saturation

The flat syntactic structure is linked to a logical form representation which we take to be a formula of a typed higher-order lambda calculus.[6] A transitive verb like *open* will translate simply into an expression of type <e,<e,t>>, i.e. an expression which combines with two entities in turn to yield a truth value. We will generally subscript the argument positions in such predicate types with the grammatical relation to which they are linked, viz: *open* will be of the type $<e_{OBJ},<e_{SUBJ},t>>$.[7] Thus, if desired, grammatical relations hierarchies can be defined by order of application at the level of predicate–argument structure.

Following the Montague tradition, we will generally treat noun phrases as expressions of the raised type <<e,t>,t>, i.e. property sets. This typing is necessary because noun phrases do not for the most part denote simple entities of type *e*. For example, while the noun phrase *Hargreaves* can easily be construed as denoting a particular individual, the noun phrase *nobody* cannot be construed in the same way. Rather, it will denote the set of properties that nobody has, and a sentence like *nobody laughed* will be interpreted as saying that laughing is one of these properties. The noun phrase *Hargreaves* can then be given a denotation of the same type, namely the set of properties that the individual Hargreaves has.

Simplified translations for the basic constituents in (1) are then given in (4):

(4)	ENGLISH EXPRESSION	TRANSLATION	TYPE
	open:	open'	$<e_{OBJ},<e_{SUBJ},t>>$
	Hargreaves:	$\lambda P \cdot P(hargreaves')$	$<<e,t>,t>$
	the dining room door:	$\lambda P \cdot P(drd')$	$<<e,t>,t>$

The lambda expressions $\lambda P \cdot P(hargreaves')$ and $\lambda P \cdot P(drd')$ denote respectively the sets of properties which the entities denoted by *hargreaves*' and *drd'* have. The simplification here lies in the fact that we are treating expressions such as *the dining room door* as unanalysed wholes. In a full treatment, they should of course have a translation which is formed compositionally from the translations of the individual constituents.

It is well-known that, given a typing of this kind, the arguments cannot combine directly with the predicate by simple functional application: the predicate is looking for arguments which are entities, but this type is too simple to be a type which can generally be associated with the translations of the NPs. There are several solutions to this problem, but the one which fits naturally with the flat structures proposed here is to combine the predicate with its arguments by an operation of saturation (**Sat**).[8] The translation of the class of syntactic structures defined by (2), with a verb as predicator, will then be given by (5)

(5) $[_{Clause}\ GR{:}X_n, \ldots, GR{:}X_1, Predicator{:}V]$

$\mathbf{Sat}(X_n', \ldots(\mathbf{Sat}(X_1', V'))$

It should be noted first of all that **Sat** combines the translation of the verb with the translation of each argument in turn. However, since the syntactic representation is unordered, the arguments can in principle be selected for combination in any order.[9]

Thus, in the translation of a tree like (1), the verb *open* can indeed combine first by **Sat** with its object NP to yield a new predicate of type $<e_{SUBJ}, t>$. This new predicate has the form on the left-hand side of the equivalence in (6a), where the variables *x* and *y* represent the subject and object positions of *open* respectively.[10] This simplifies straightforwardly to the expression on the right-hand side by lambda conversion.[11] Subsequent saturation of the new predicate by the subject NP then yields the translation of the clause as given in (6b). This in turn simplifies by lambda conversion to (6c):

(6) a. $\lambda x \cdot \lambda P \cdot P(drd')(\lambda y \cdot open'(x, y)) = \lambda x \cdot open'(x, drd)$

b. $\lambda P \cdot P(hargreaves')$**$(\lambda x \cdot open'(x, drd'))$**

c. $open'(hargreaves', drd')$

With this order of saturation, we form a logical constituent, highlighted in bold in (6b), which is the analogue in logical form of a syntactic VP consisting of verb plus object.

However, this is not the only permitted logical articulation of the sentence. First of all, a further articulation can be obtained by saturating the subject position first. This results in the one-place predicate of type $<e_{OBJ}, t>$ given in (7a):

(7) a. $\lambda y \cdot \lambda P \cdot P(hargreaves')(\lambda x \cdot open'(x, y)) = \lambda y \cdot open'(hargreaves', y)$

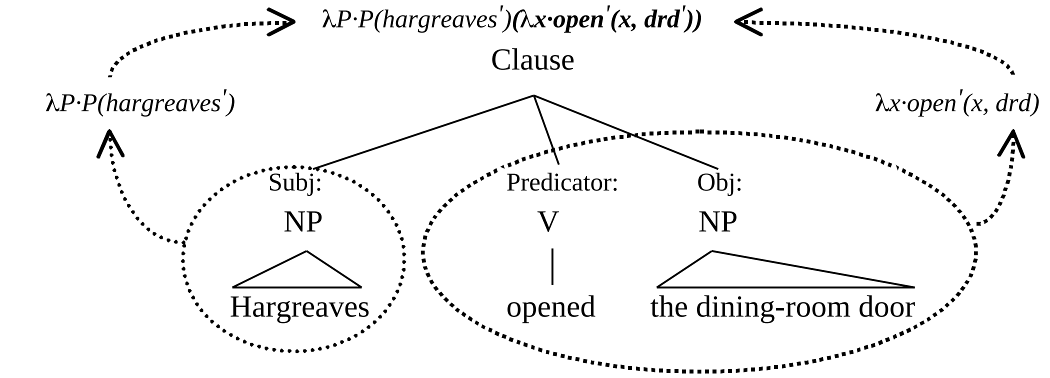
b. $\lambda P \cdot P(drd')$**$(\lambda y \cdot open'(hargreaves', y))$**

c. $open'(hargreaves', drd')$

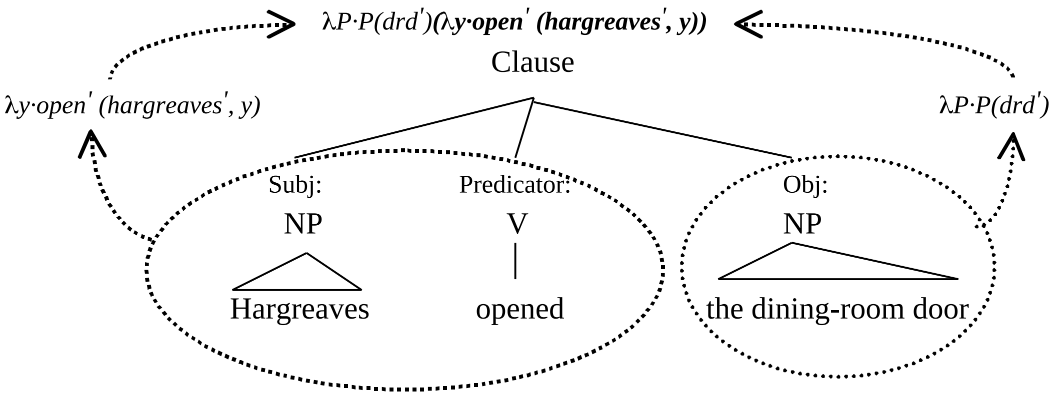
Subsequent saturation by the object NP the yields the translation of the clause given in (7b), where the logical unit formed by the composition of subject and verb is again highlighted in bold. This translation essentially says that the set of properties the dining room door has includes the property that Hargreaves opened it. The translation in (7b) simplifies to (7c), which is of course identical to (6c).

Thus saturation of the predicate in either order ultimately yields logically equivalent representations. The two alternatives are schematically summarised in (8):

(8) a.



b.



2.3 Relative clauses

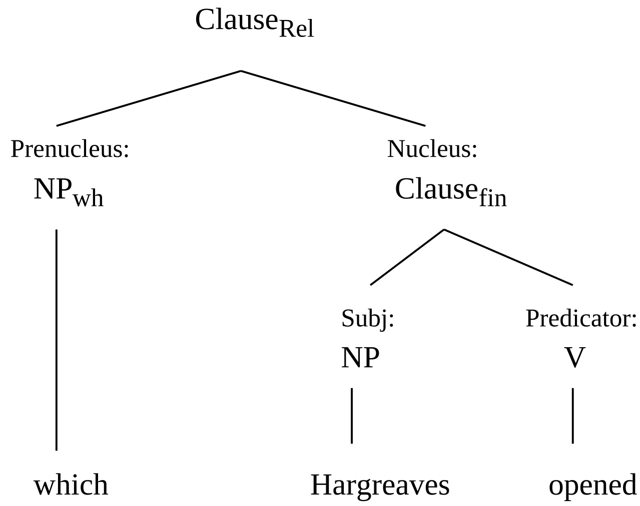
The logical units formed by saturation from verb+object and verb+subject have equal status. As pointed out by Steedman (1985), units like the ones in (7a) which compose a subject with a transitive verb may be utilised directly in the translation of more complex syntactic constructions in English. For example, the basic relative clause rule in flat English will be (9):[12]

(9) $[_{Clause_{Rel}}$ Prenucleus: NP_{wh} Nucleus: $Clause_{fin}]$

$\lambda P \cdot \lambda x \cdot [P(x) \quad NP_{wh}'(Clause_{fin}')(x)]$

In combination with the flat clause rule in (5), the syntactic part of (9) licenses a tree such as the one in (10). Recall that nothing in the syntactic part of (5) requires that a clause which contains the verb *open* must also contain an object:

(10)



The translation of the nucleus will follow from (5). Saturation of the subject place of *open*, as in (7a), yields the predicate $\lambda y{\cdot}open'\ (hargreaves',\ y)$. Given then a suitable translation for *which*, which we take to be $\lambda S{\cdot}\lambda z{\cdot}{\sim}person'(z) \wedge S(z)$, rule (9) will give (11a) as the translation of the relative clause.[13] This simplifies to (11b):

(11) a. $\lambda P{\cdot}\lambda x{\cdot}[P(x) \quad \lambda S{\cdot}\lambda z{\cdot}{\sim}person'(z) \quad S(z)]\mathbf{(\lambda y{\cdot}open'\ (hargreaves',\ y))}(x)$

b. $\lambda P{\cdot}\lambda x{\cdot}[P(x) \quad {\sim}person'\ (x) \quad open'\ (hargreaves',\ x)]$

Note in particular the bold expression in (10a), which is the direct translation of the (incomplete) clause *Hargreaves opened*.

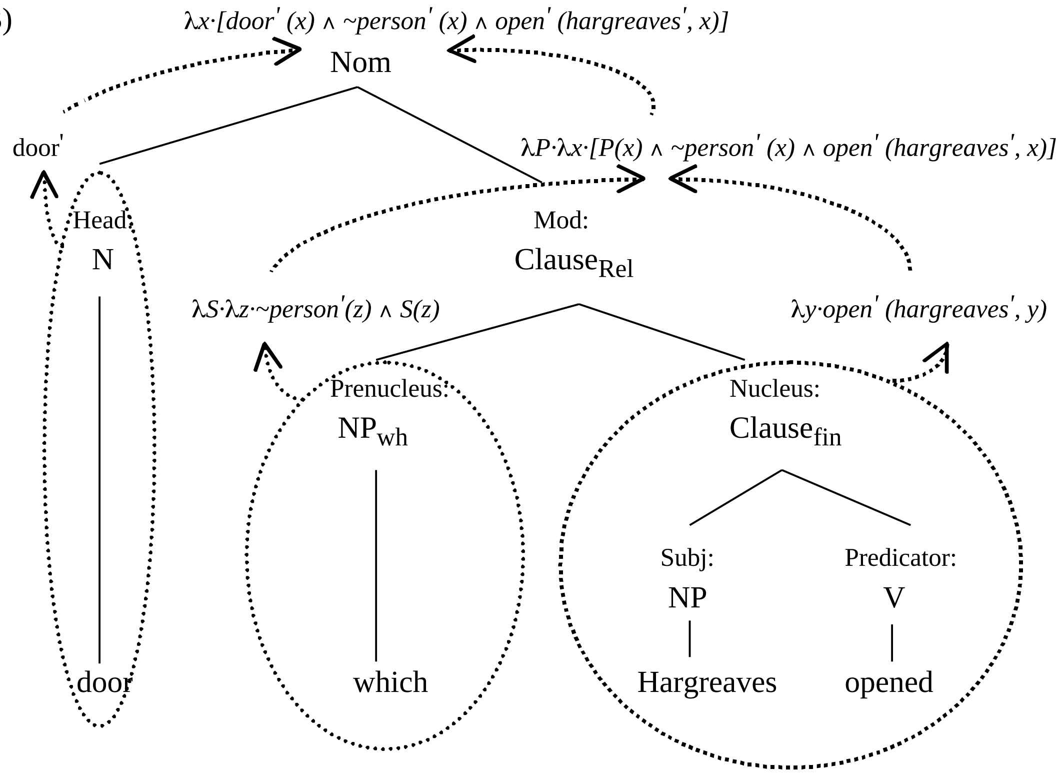
The translation of the relative clause in (11) will straightforwardly, by functional application, combine with the translation of a noun such as *door* to give (12a). Thus in turn simplifies to (12b), the translation of the expression *door which Hragreaves opened*:

(12) a. $\lambda P{\cdot}\lambda x{\cdot}[P(x) \quad {\sim}person'\ (x) \quad open'\ (hargreaves',\ x)](door')$

b. ${\cdot}\lambda x{\cdot}[door'\ (x) \quad {\sim}person'\ (x) \quad open'\ (hargreaves',\ x)]$

The contribution of the relative pronoun *which* is seen in the clause *~person' (x)*. Since a door is indeed not a person, there will be no incompatibility between the semantics of the noun *door* and the relative pronoun. The translation of the English nominal *door which Hargreaves opened* is schematically summarised in (13):

(13)



2.4 Higher-order unification

Different orders of saturation of a predicate, while useful, nevertheless do not appear to yield the full flexibility that is required of the level of logical form. The analysis of constructions involving ellipsis, and the representation of information structure, ultimately require more complex semantically equivalent articulations of basic logical forms. These will essentially be lambda equivalents of the basic logical forms, but will involve higher orders of type raising.

The approach we will adopt here is the higher-order unification approach of Dalrymple, Shieber & Pereira (1991) and Pulman (1997).[14] In this approach,. the algorithm which computes higher order equivalents of more basic forms is higher-order unification. Essentially, the higher-order unification algorithm can be thought of as providing solutions to equations of the form in (13), where $\alpha(\beta)$ is a logical expression whose order is higher than or equal to the order of γ:

(13) $\alpha(\beta) = \gamma$:

This effectively allows the information contained in γ: to be partitioned into two separate components α and β, where the application of α to β is equivalent to γ:. The manipulations which can be employed in solving such equations are generally less constrained than those involved in the derivation of compositional translations, and include in particular the free operation of functional composition and type-raising. While such operations may sometimes be employed in translation rules,, their use will be strictly limited to the syntactic constructions specified in those rules.

As an illustration of higher-order unification, consider the analysis of focus constructions in Pulman (1997). Building on the structured meaning approach of Krifka (1991), Pulman analyses focus constructions by taking α to be background information and β to be focal information. Consider then the exchange in (14):

(14) a. Did Hargreaves open the dining-room door?
b. No, he opened THE WINDOW.

Narrow focus on *THE WINDOW* in (14b) will, in Pulman's account, require articulation of the logical form into the format ***B(F),*** where ***B*** = background and ***F*** = focus.[15] Since, taking the contextual information into account, ***F*** = *λP·P(window')*, this articulation will emerge from solving the equation in (15):

(15) $\mathbf{B}(\lambda P \cdot P(window')) = open'\,(hargreaves', window')$

The solution is (16a), where the variable *T* is of the higher order type <<e,t>,t>, the general type of NP translations:

(16) $\mathbf{B} = \lambda T \cdot T(\lambda y\ open(hargreaves, y))$

With this value for ***B***, it is easy to check that ***B(F)*** indeed simplifies by lambda conversion to the basic expression *open' (hargreaves', window')*. The partition however articulates as background information the set of NP denotations whose property set includes the property of being opened by Hargreaves.

One of the main attractions of higher-order unification, as Pulman (1997) points out, is that it liberates logical-form partitions of this kind from too direct a connection to surface constituency.[16] It is then relatively straightforward to account for a variety of more complex cases such as discontinuous multiple foci, or foci within syntactic islands. Consider for example (17a), with focus on *Hargreaves*. The background information here will be representable by the higher-order expression in (17b):

(17) a. Clouseau examined the door which HARGREAVES opened.

b. $\mathbf{B} = \lambda T \cdot T(\lambda x \cdot examine'(clouseau', \iota y \cdot (door'(y) \quad {\sim}person'(y) \quad open'(x,y)))$

However, it does not seem at all plausible that this logical expression should correspond to a surface constituent, given that relative clauses are islands for extraction constructions. Compare the noun phrase in (18), where an attempt is made to relativize into the subject position within the relative clause.headed by *opened*:

(18) *the butler $[_{Clause_{Rel}}$ who Clouseau examined the door $[_{Clause_{Rel}}$ which opened]]

It is beyond the scope of this paper to give a full account of island constraints. However, the possibility arises within the present framework that strong constraints might in general emerge directly at the stage of compositional translation into logical form. The more flexible manipulations of higher order unification will then not come into play until after a basic logical form has been derived.[17]

In the particular case represented by (18), the translation of an expression such as **the butler who Clouseau examined the door which opened* will become incoherent at the point where an attempt is made to compose the translation of *which*, which requires as argument a predicate of type <e,t>. and the unsaturated predicate *open′*, which is of type <e, <e,t>>. The incompatibility between *which* and the unsaturated predicate ultimately derives from the translation of *which*, namely $\lambda S \cdot \lambda z \cdot {\sim}person(z) \wedge S(z)$. This contains a coordination of two propositions. If *open'* is unsaturated and of type <e,<e,t>>, then $S(z)$ will illegitimately have to be of type <e,t>. An expression of this type cannot be coordinated with the proposition ${\sim}person'(z)$, which is of type <t>. In zero and *that* relative clauses, a similar typing incompatibility will arise between the coordinates $P(x)$ and *Clause'(x)* in the relative clause translation itself. The island status of relative clauses is thus ultimately traceable in this analysis to the typing incompatibilities which underlie the island status of coordinate structures.

3. CLASSIC VP CONSTITUENCY TESTS

In this section, we examine the constructions which form the basis for the classic constituency tests supposedly justifying VP constituency in English. These are preposing (section 3.1), ellipsis (section 3.2), anaphora (section 3.3), and coordination (section 3.4). The principles of flat English provide two mechanisms for creating logical units corresponding to verb+object, namely saturation at the stage of compositional translation, and higher-order unification. Both of these mechanisms will be utilized in the analysis of these constructions.

3.1 Preposing

In flat English, the rule of “VP-preposing” will take a subjectless clause and displace it to initial position, stranding an emphatic finite auxiliary verb, or a finite auxiliary verb followed by emphatic *not*, as in (19).[18]

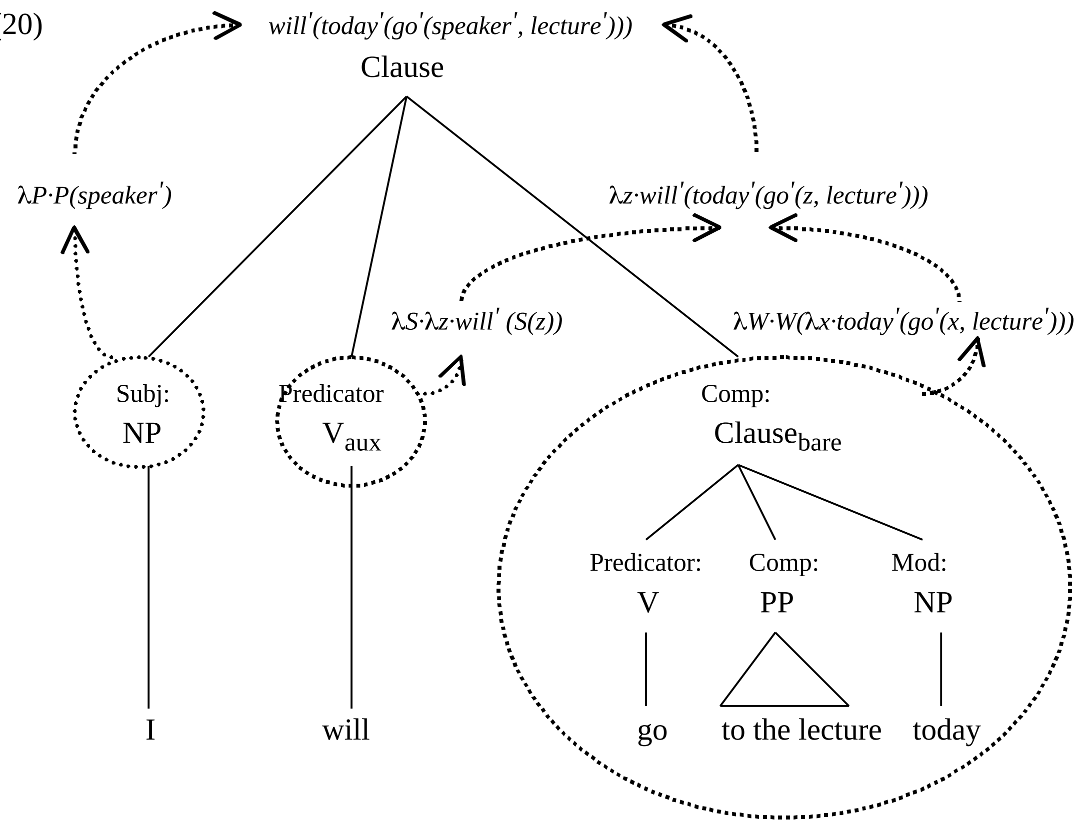
(19) a. My tutor said I should work harder and go to the lecture today, and go to the lecture today I WILL.
b. My tutor said I should work harder and go to the lecture today, but go to the lecture today I will definitely NOT.

Even in an analysis which has VPs, an indication that we are dealing here with a clause rather than merely a VP is the possible presence of clause-level temporal adverbials like *today*.

The function of this construction is clearly to articulate the sentence structurally in such a way that “polarity” or “verum” focus (focus on the truth or falsity, of a proposition) is indicated by the final element of the matrix clause.[19] In English the indication of verum focus appears to be restricted to finite auxiliary verbs and the negative adverb *not*, hence the requirement that the final element in the matrix clause be either an emphatic auxiliary or *not*. The displaced clause is then itself non-focal, and must have a strong formal connection with the preceding context.[20] It should be noted however that the structural articulation of the construction does not correspond absolutely to the information-structure articulation: the subject (and in more complex examples further material) also belongs to the background. This partial non-correspondence must ultimately follow from the structural requirement that the matrix clause contain an overt subject. In the present framework, we can naturally model it by associating the compositional translation with the syntactic articulation, and allowing the background-focus articulation to emerge from higher-order unification.

Let us begin by considering the analysis of the basic auxiliary construction, without displacement and without verum focus. The proposed structure of *I will go to the lecture today*, and its compositional translation, are schematically represented in (20):

(20)



It should be noted first that we assume, following Ross (1969) and Pullum & Wilson (1977) a catenative analysis for auxiliary constructions in which auxiliaries, like catenative verbs, head their own clauses and take subjectless clausal. The arguments in favour of this position are succinctly given in Huddleston (2002: 1209-1220). Essentially, there are no syntactic properties which can ultimately distinguish auxiliaries from catenatives. For example, the distinction between control and raising verbs crosscuts the distinction between auxiliaries and catenatives. Also, auxiliary constructions, just like catenative ones, allow independent negation of the matrix and subordinate clause, and independent time-reference.

In (20), both the matrix clause and the subordinate clause are individually flat. Nothing essentially new is required to derive a compositional translation for the matrix clause: the auxiliary can combine by saturation first with its complement clause (as shown), or first with its subject. Some additional mechanisms will however be needed in the derivation of the subordinate clause. Firstly. the flat clause rule (5) will have to be augmented to allow for the incorporation of adverbial modifiers such as *today*.[21] Secondly, the basic translation of *go to the lecture today*, which is *λx·today′(go′(x, lecture′))* and is of type $<e_{SUBJ},t>$, has to be raised to the type

$<<<e_{SUBJ},t>, t>,t>$ in order to be able to combine by saturation with the predicator *will* of the matrix clause. We assume that this type-raising operation applies generally to all subordinate clauses, and follows from rule (21):[22]

(21) $Clause_{sub}$ $\lambda w \cdot w(Clause')$
(where the variable *w* is of type $<\alpha,t>$ for Clause' of type α)

When applied to the basic translation of the bare infinitival subordinate clause *go to the lecture today*, this yields $\lambda W \cdot W(\lambda x \cdot today'(go'(x, lecture')))$, where the variable W is of type $<<e_{SUBJ},t>, t>$:

In the matrix clause of (20), saturation will now allow the predicator *will* to combine with its bare complement clause. On the assumption that *will* is a raising verb, its translation will be $\lambda S \cdot \lambda x \cdot will'(S(x))$. This translation is of type $<<e_{SUBJ},t>, <e_{SUBJ},t>>$. i.e. it is a predicate which combines first with a subjectless clause and then a subject. The logical predicate *will′*, as opposed to the translation of *will*, is however of type $<t,t>$, i.e. it has no subject argument. This translation ensures that the subject of *will* is not interpreted as the subject argument of *will′*, but rather as the subject of the subordinate clause.[23] The saturation of the predicator *will* by the bare subordinate clause thus yields (22):

(22) $\textbf{Sat}(\lambda S \cdot \lambda z \cdot will'(S(z)), \lambda W \cdot W(\lambda x \cdot today'(go'(x, lecture'))))$
$= \lambda z \cdot will'(today'(go'(z, lecture')))$

And this combines, again by saturation, with the translation of the subject to give (23):

(23) $\textbf{Sat}(\lambda P \cdot P(speaker'), \lambda z \cdot will'(today'(go'(z, lecture'))))$
$= will'(today'(go'(speaker', lecture')))$

The next move is to account for the same sentence with verum focus but without displacement, as in (24):

(24) I WILL go to the lecture today.

Since verum focus is lexically linked either to an emphatic finite auxiliary or emphatic *not*, we should account for this in the corresponding lexical entries. For a concrete implementation, let us assume, following Höhle (1992), that polarity is indicated in the semantic representation by a truth predicate *VERUM* which takes a proposition *p* as argument: positive polarity is represented by *VERUM(p)* and negative polarity either by

~VERUM(p), or equivalently *VERUM(~p)*. If the translation of a non-emphatic auxiliary *Aux* is *Aux'*, the translation of the corresponding emphatic auxiliary will then have the general form in (25a).[24] For the translation of $will_{emph}$ this results in (25b).

(25) a. Aux_{emph} λS·λx·VERUM(Aux'(S)(x))
b. $will_{emph}$ λS·λx·VERUM(will'(S(x))

The full simplified translation of (24) is then (26):

(26) VERUM(will'(today'(go'(speaker', lecture'))))

The information-structure purpose of the *VERUM* predicate is to induce a background-focus partition ***B(F)*** where ***F*** = *VERUM*. The equation (27a) which results can be solved by higher-order unification, and this solution is given in (27b):

(27) a. **B**(VERUM) = VERUM(will'(today'(go'(speaker', lecture'))))
b. **λO·O(will'(today'(go'(speaker', lecture'))))**(VERUM)

The logical unit corresponding to the background, here in bold, is obtained fairly trivially by type-raising the expression *will'(today'(go'(speaker', lecture')))* to type <<t,t>,t>.

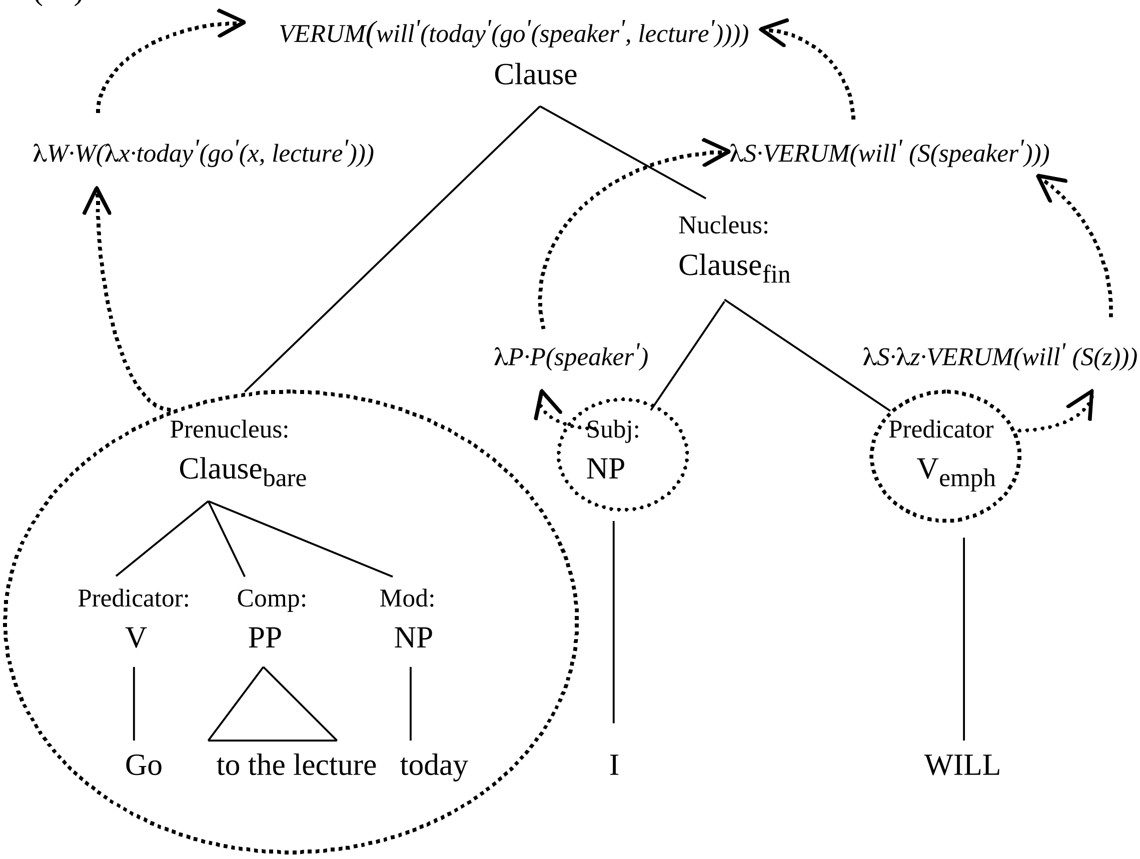
It is now relatively straightforward to derive the preposing construction in (19). The rule which gives the syntactic structure and compositional translation will be (28):

(28) $[_{Clause}$ Prenucleus: $Clause_{bare}$ Nucleus: $Clause_{fin}$\{X_{emph}<last>\}]
$Clause_{bare}$' ($Clause_{fin}$')

The syntactic part of this rule treats the preposed clause as a prenucleus, and requires that it be a bare clause, i.e. a bare infinitival clause, a gerund-participial clause, or a past-participial clause. This syntactic requirement blocks, in particular, a preposed to-infinitival clause: **Nobody wanted me to go to Paris, but* [*to go to Paris*] *I WAS*. The nucleus clause which follows must be finite, and contain an emphatic category as its final constituent, i.e. an emphatic finite auxiliary or emphatic *not*. Since emphatic *not* is only compatible with finite auxiliaries, the last verb in the nucleus is in both cases constrained to be a finite auxiliary, and this in turn will, through the typing requirements of the semantic part of the rule, force the prenucleus to be a subjectless clause.[25]

The semantic part of the rule is itself maximally simple: it just applies the translation of the prenucleus to the translation of the nucleus. Note then that the main semantic difference between the basic construction with verum focus in (26) and the preposing version, as schematically represented in (29), is in the manner of combination. The subordinate clause has exactly the same translation in both constructions. However, while it combines by saturation of the predicate in the basic construction, in the preposing construction the method of combination is functional application:

(29)



In the derivation of (29), then, the subject *I* and emphatic *will* are combined by saturation, yielding a translation of I WILL which includes the *VERUM* predicate. To this is then applied the translation of *go to the lecture today*, highlighted in bold in (30a). The translation in (30a) simplifies to (30b), which is of course identical to (26), the translation of the basic construction:

(30) a. $\mathbf{\lambda W \cdot W(\lambda x \cdot today'(go'(x, lecture')))}(\lambda S \cdot VERUM(will' (S(speaker'))))$

b. $VERUM(will'(today'(go'(speaker', lecture'))))$

Higher-order unification can then apply, exactly as in (27) to focus the verum predicate.

To conclude this analysis of the preposing construction, we note that it has been considered, ever since Ross (1967/1986:241-142), to involve an unbounded dependency and to be subject to standard syntactic island constraints. Consider then the examples in (30), where (30b) violates the complex NP constraint through the attempt to prepose a constituent which is contained within a relative clause:

(30); a. My tutor said I should work harder and go to the lecture today, and <u>go to the lecture today</u> **I think I WILL**.

b. *My tutor said everyone should work harder and go to the lecture today, and <u>go to the lecture today</u> **I think I know a student who WILL**.

As it stands, both (30) and (30b) conform to the syntactic part of rule (28): the finite clause is headed by the finite verb *think*, and the last element in the subordinate clause is an emphatic auxiliary. In order to derive the long-distance dependency in (30a), however, the constituent *I think I WILL* must be able to receive a compositional translation of the form in (31).

(31) $\lambda S \cdot think'(speaker', VERUM(will' (S(speaker'))))$

This is, as it stands, blocked, since the subordinate clause *I WILL* is incomplete. Its (unraised) type is $<e_{SUBJ},t>, t>$ rather than simply <t>, i.e. it is missing a subjectless clause, and as such it will be of the wrong type to saturate the complement clause place of the verb *think*, which is of type $<t, <e_{SUBJ},t>>$. This should be considered a desirable result, since unbounded dependencies are not universal, and in order to permit them, we have to invoke additional mechanisms.

What is needed is an extension of **Sat** (call it **Sat***) which allows certain types of incomplete constituent to saturate (bridge) predicates, forming a new predicate which is similarly incomplete.[26] **Sat*** will bear a relation to **Sat** which is analogous to the relationship between functional application and functional composition. Since however we do not permit functional composition as a general operation in the derivation of compositional translations, this will have the further interesting consequence that unbounded dependencies are forced to pass through chains of predicate-argument structures of an appropriate type, rather than through adjuncts. The general island status of adjuncts therefore falls out automatically.

In the case at hand, we allow the translation of *I WILL*, appropriately raised as a subordinate clause to type <<< e_{SUBJ},.t>,t>,t> , to saturate, by **Sat*** , the bridge predicate *think′*:[27]

(32) **Sat***(think′, λZ Z(λS·VERUM(will′ (S(speaker′))))
= λx·λS·think′(x,VERUM(will′ (S(speaker′))))

This is the translation of *think I WILL*. Normal saturation of the subject position of this new predicate by the translation of *I* yields (31), as desired. In the translation of (30a), we then apply the translation of *go to the lecture today* to (31), giving (33a). This simplifies straightforwardly to (33b):

(33) a.. **λW·W(λx·today′(go′(x,lecture′)))**(λS·think′(speaker′,VERUM(will′ (S(speaker′)))))
b. think′(speaker′,VERUM(will′(today′(go′(speaker′,lecture′)

On the other hand, the relative clause in (30b) remains an island and this example is blocked for the same reason as (18).

3.2. Ellipsis

There appear to be at least two distinct rules involving ellipsis of subjectless subordinate clauses in English (Stirling & Huddleston 2002). Rule (i), "auxiliary verb stranding" , is the one usually invoked as an argument for VP constituency, and is the main focus of this section (in 3.2.1). However, the analysis proposed here for auxiliary verb stranding straightforwardly extends to rule (ii): "ellipsis of complements of lexical verbs and adjectives", otherwise known as "null complement anaphora". We therefore briefly discuss this construction (section 3.2.2). Also used as an argument for VP constituency is ellipsis of subjectless subordinate clauses following infinitival *to* (section 3.2.3). For reasons that will become clear, this latter case is probably better assimilated to rule (ii) rather than rule (i).

3.2.1 Auxiliary verb stranding

Auxiliary verb stranding permits ellipsis of material following an auxiliary verb. Four basic cases are illustrated in (34):[28]

(34) a. I don’t want to go to the lecture today, but I will Ø.
b. I don’t want to go to the lecture tomorrow, but I will Ø today.
c. I’m not on the committee at the moment, but I will be Ø.
d. I was planning to go to the lecture, but in the end I will probably not Ø.

In the first three examples. ellipsis immediately follows an auxiliary verb: modal *will* in (34a) and (34b), and locative *be* in (34c). Example (34c) also shows that the auxiliary need not be finite. In (34a), the ellipted material corresponds not only to the verb *go* and its complement *to the lecture*, but also to the adverbial modifier *today*. Under an analysis in which the ellipted material must correspond to a syntactic VP, this would seem to imply that *today*, more plausibly a clause-level adverbial of time, is part of the VP. However in (34b) we see that the ellipted material can consist just of the verb and its complement: the adverbials *tomorrow* and *today* seem in this case not to be part of the VP. There is an obvious contradiction here under the VP analysis unless such clause-level adverbials are allowed to be both part of VP and outside it (not a particularly happy conclusion). Example (34c) shows that the ellipted material is not necessarily verbal: in this case it corresponds to the *PP on the committee*. Finally, in (34d), ellipsis does not immediately follow the auxiliary, but does immediately follow the negative adverb *not*. In such examples, material such as the adverb *probably* can intervene between the necessarily finite auxiliary and negation.

In flat English, the apparent contradiction between (34a) and (34b) evaporates. The ellipted material in (34a) has a logical form which does indeed correspond to a constituent, but this constituent is a subjectless clause rather than a VP. The requisite logical form is simply $\lambda x \cdot today'(go'(x, lecture'))$. The ellipted material in (34b) does not correspond to a constituent, but does correspond to a unit of logical form, namely $\lambda x \cdot go'(x, lecture')$. In the general case, therefore, we claim that the ellipted material in this construction must have a well-formed logical form, but the logical form does not necessarily correspond to a constituent.

Strong independent evidence that the ellipsis site in auxiliary verb stranding does not generally correspond to a constituent comes from “pseudo-gapping” (Levin 1986), where material is retained which is itself a complement (or a complement within a complement) of the ellipted head:

(35) a. A. Will you [$_{Clause}$ <u>fix</u> the computer <u>this afternoon</u>]?
B. No, but I will [$_{Clause}$ Ø the TV].
b. A. Do you [$_{Clause}$ <u>have</u> [$_{NP}$ a good picture <u>of John</u>]]?
B. No, but I do [$_{Clause}$ Ø of his sister].

In the flat English analysis of (35a), *fix the computer this afternoon* is a subjectless clause with three subconstituents: *fix*, *the computer*, and *this afternoon*. The ellipsis in this case is of the logical unit corresponding to *fix this afternoon*. In (35b), ellipsis is of the logical unit corresponding to *have a good picture*, but *a good picture* is syntactically a subconstituent of the NP *a good picture of his sister*.

Ellipsis also seems to pick out multiple syntactic units in examples like (36):

(36) Peter thinks I would rather [$_{\text{Clause}}$ date Jill], but I wouldn't Ø.

The evidence of other constructions indicates that *rather* is an adverb belonging to the matrix clause.[29] For example, there exists a parallel construction involving a finite subordinate clause, viz. *I would rather that he date Jill*, in which the adverb clearly does not belong within the subordinate clause. Compare the ungrammatical **I would that rather he date Jill.* Also, preposing fronts the subordinate clause beginning with the non-finite verb: *…and* [*date Jill*] *I would rather not*. Compare the ungrammatical **… and* [*rather date Jill*] *I would*. Flat English therefore requires that it be possible to form a logical unit corresponding to *rather date Jill*, even though *rather date Jill* is not a constituent.

As a final observation, we note that it has also long been known that, even when the ellipsis site does correspond to a constituent which would classically be analysed as a VP, this same constituent does not necessarily exist as a syntactic VP in the antecedent:

(37) a. A. She walks and she chews gum. (Nash-Webber & Sag 1978)
B. Jerry does Ø too, but not at the same time.
b. Kim doesn't have any money, but I do Ø.

In (37a), ellipsis appears, under the VP analysis, to have to be of a coordinate VP *walks and chews gum*, but for the antecedent we have instead a clause-level coordination. In (37b), the antecedent contains a polarity item which would not be acceptable in the second coordinate: **I have any money*.

The general solution to all of the complex issues connected with auxiliary verb stranding, namely that the ellipted material must be recoverable from the logical form of the antecedent rather than its syntax, has long been clear (see for example Sag 1976, Miller 1992).[30] Higher order unification (Dalrymple et al 1991, Pulman 1997) provides a natural framework in which to instantiate this insight, and in the division of labour between compositional translation and higher order unification proposed here, also makes the prediction that ellipsis, unlike preposing, will not generally be subject to island constraints. As example (38) shows, this prediction seems to be correct:

(38) A. Do you $[_{Clause}$ know someone $[_{Clause_{Rel}}$ who can fix the car]]?

B. No, but I do $[_{Clause}$ Ø the TV.]

The ellipsis site in (38B) requires the construction of a logical form corresponding to *know someone who can fix*. This logical form cannot be derived compositionally because of the island status of relative clauses, but higher order unification can be allowed to generate it. At the very least, any perceived deviance in (38B) is of a different order to the gross violations seen in extraction constructions involving relative clause islands.

The rule we propose for auxiliary verb stranding then takes the following form:

(39)
$$[_{\text{Clause}}\ <_{\text{Comp}} \text{XP} >]\{\text{Predicator:}V_{\text{aux}}{*}\ (\left\{ \begin{array}{l} >>\text{Comp} \\ \\ >\ \textit{not} \end{array} \right\})<\text{last}>\}$$

$$\mathbf{E}(\text{XP}'\bullet\text{Clause}')$$

The syntactic part of this rule is necessarily complex, but should be construed as a special case of the basic clause rule.[31] The first set of conditions is imposed by the part of the rule in curly brackets. The basic requirement here will be that the rule apply solely to clauses whose predicator is an auxiliary verb, including positive declarative forms of the non-emphatic auxiliary *do*. The category V_{aux}* is thus distinguished from the category V_{aux} by the inclusion of these forms of *do*, which are thereby constrained, unlike the emphatic, interrogative or negative forms, to occur solely in elliptical constructions. There is then an ordering requirement that the auxiliary either itself occur last, or optionally be followed by a single final constituent. This single final constituent may itself either be a complement (we take *Comp* here to subsume both clausal and phrasal complement types), in which case the auxiliary must immediately precede the complement. Or the final constituent may be the negative adverb *not*, in which case the auxiliary may be separated from *not* by intervening material such as other adverbs.

A final condition, imposed by the expression in angled brackets in the main part of the rule, is that the clause may contain a complement which itself contains a unique maximal phrase. Note that *Comp* itself is contained within the representation of the clause and is therefore permitted but not required by this condition to be present. If *Comp* is in fact missing we will have an incomplete clause in which either the auxiliary or the adverb *not*, by the linear precedence conditions, must be last. This covers the basic examples in which there is ellipsis of the whole of the complement of the auxiliary verb, whether this be a subjectless clause as in (34a) and (34d), or a PP as in (34c). It also covers examples like (36) where the antecedent includes adverbs like *rather*. The adverb must be included in the ellipsis, since otherwise the auxiliary would not be last. However, if *Comp* is present, the notation <$_{\text{Comp}}$ XP> rather than <Comp:XP> requires that XP itself not fulfil the *Comp* function. In this case, *Comp* must contain a unique XP but will otherwise be incomplete. Since heads are not maximal categories, at least the head of *Comp* (and possibly more material) will then be missing. This covers the pseudo-gapping cases in (35) and (38), as well as the cases in which an adverbial is preserved like *today* in (34b). Where the auxiliary itself is not the last element in the clause, the linear precedence condition requires it to be penultimate and to be followed immediately by the incomplete *Comp*. The purpose of the angled brackets is simply to indicate that the interpretation of *Comp* is excluded from the general rule for interpreting the clause, i.e. the interpretation of the rest of the clause proceeds normally by saturation for arguments, and functional application or functional composition for adjuncts.

We can now turn to the interpretation, in which ellipsis is represented in logical form by a functor ***E*** which applies to the product of the interpretation of XP and the interpretation of the Clause (excluding XP). In the event that there is no XP, the interpretation reduces simply to $\boldsymbol{E}(Clause')$. When XP is present, it is equivalent to $\boldsymbol{E}(XP')(Clause')$. The meaning of ***E***, essentially following Pulman's (1997) formulation, is given by the conditional equivalence in (40):

(40) $\mathbf{E}(\mathrm{XP}' \bullet \mathrm{Clause}') \Leftrightarrow \mathrm{F}(\mathrm{XP}' \bullet \mathrm{Clause}')$

if

antecedent(C)

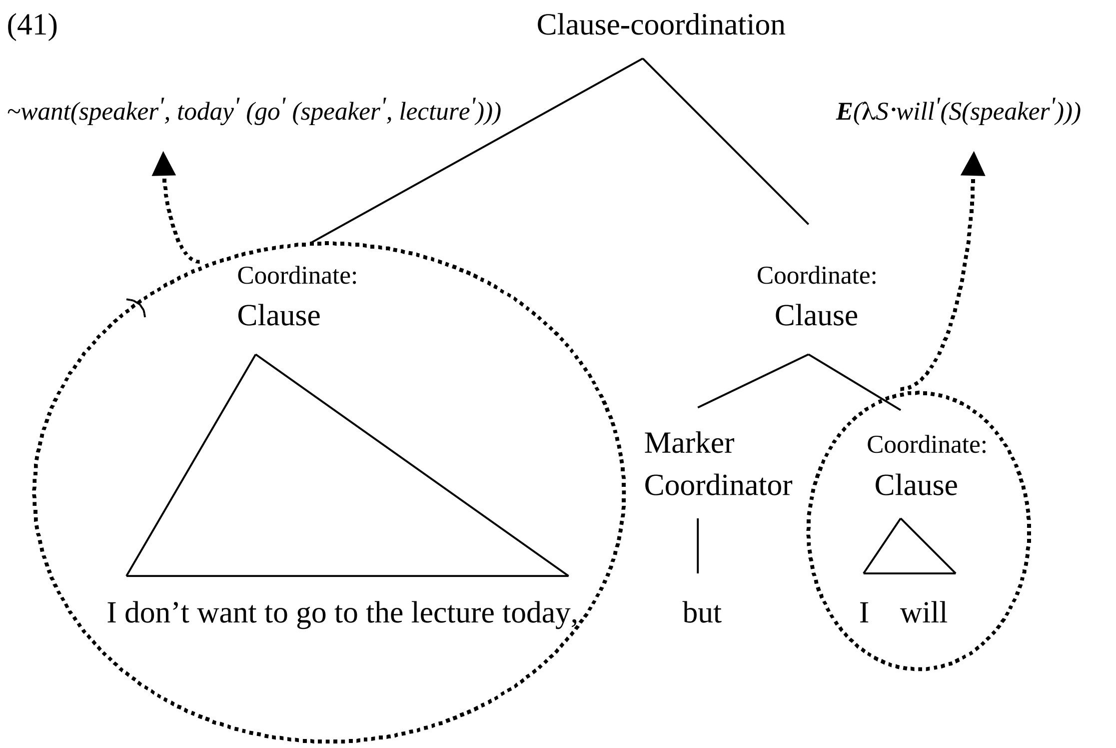
& $\mathrm{F}(\mathrm{A}_1 \bullet \mathrm{A}_2) = \mathrm{C}$

& parallel($\mathrm{A}_1 \bullet \mathrm{A}_2$, $\mathrm{XP}' \bullet \mathrm{Clause}'$)

By higher order unification, we therefore have to find an expression *C* which serves as an antecedent. This antecedent will in canonical cases be extractable from the linguistic context in that it is an expression derivable by compositional translation from contextually available material, or is a logical equivalent of such an expression.[32] The antecedent must then be partitioned into the form $F(A_1 \bullet A_2)$ where $A_1 \bullet A_2$ is parallel to $XP' \bullet Clause'$. We take this parallelism requirement to include at least the requirement that A_1 be of the same type as XP' and that A_2 be of the same type as $Clause'$.[33] If we can find such an antecedent, then $\boldsymbol{E} = F$.

Consider then a basic example such as (34a): *I don't want to go to the lecture today, but I will.* The schematic representation of (34a) and the translation of the individual coordinates is given in (41).[34] Here the contribution of the coordinator *but* is not relevant to the purpose at hand, and is omitted:

(41)



Since the auxiliary *will* is final in its clause, the interpretation of this clause is given by rule (39) and is ***E****(Clause′)*. *Clause′* represents the compositional translation of *I will*, viz. λ*S·will′(S(speaker′))*. and is of type $<<e_{SUBJ},t>, t>$. It is then necessary to compute ***E*** by looking for a suitable antecedent *C*. The antecedent in this case is simply the translation of the first coordinate, as given in (42):

(42) C = ~want′(speaker′, today′ (go′ (speaker′, lecture′)))
= **λW·W(λx·today′(go′(x, lecture′)))**(λS ~want(speaker′, S(speaker′)))

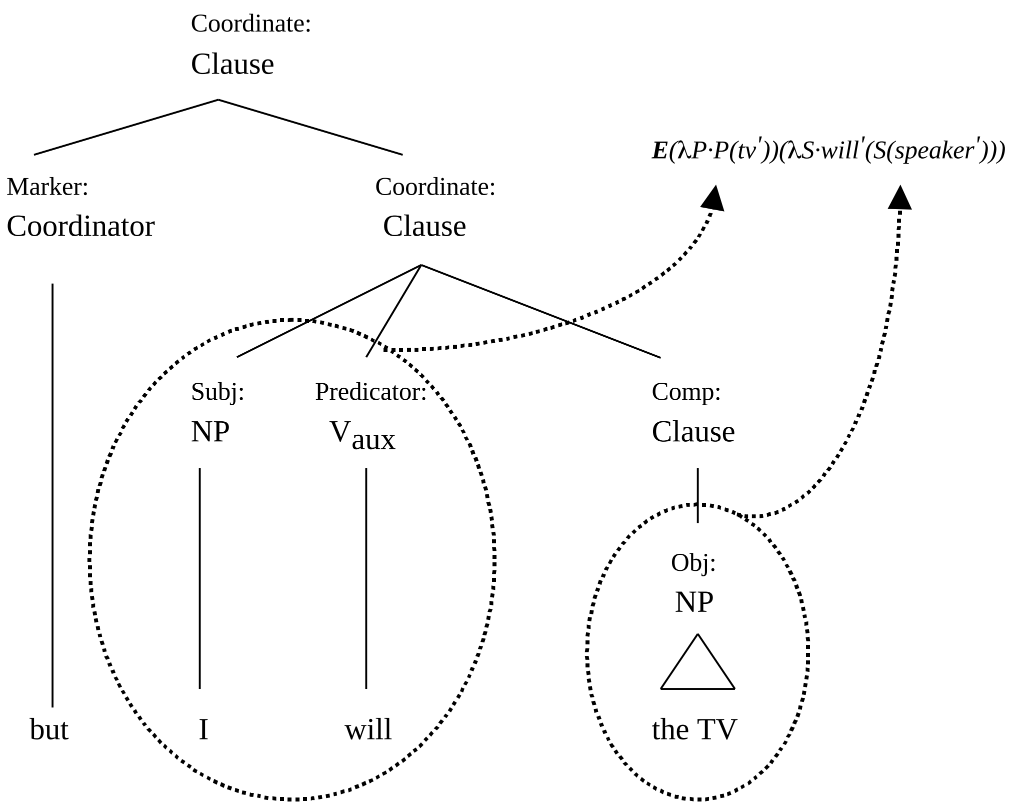
Here the first line is the basic translation of the first coordinate, while the second line is derived by higher order unification in such a way as to satisfy the conditional equivalence in (40). In particular, the expression λ*S ~want′(speaker′, S(speaker′))* is of the same type as λ*S will′(S(speaker′))*, satisfying the parallelism requirement. Thus ***E*** is given by the bold expression in (42), and the full interpretation of the second coordinate can be computed as in (43):

(43)

$$\mathbf{E}(\lambda S\cdot will'(S(speaker')))$$
$$= \boldsymbol{\lambda W\cdot W(\lambda x\cdot today'(go'(x, lecture')))}(\lambda S\cdot will'(S(speaker')))$$
$$= will'(today'(go'(speaker', lecture')))$$

The solution to the pseudo-gapping cases follows straightforwardly. Taking (35a) as an example, viz. *A. Will you fix the computer this afternoon? B. No, but I will the TV*, the structure of B’s reply is given by (44).

(44)



In (44) we have an incomplete *Comp* containing just a single object NP. The predicator *will* immediately precedes this NP, so the translation of the coordinate is given by (40), viz. $\boldsymbol{E}(NP'\bullet Clause') = \boldsymbol{E}(\lambda P\cdot P(tv'))(\lambda S\cdot will'(S(speaker')))$. The types of NP′ and Clause′ are respectively $<<e_{OBJ},t>, t>$ and $<<e_{SUBJ},t>, t>$. The antecedent in this case is contained in A’s question, and is given in (45):

(45) C = will′(this-afternoon′(fix′(addressee′,computer′)))

= **λT·λW·W(λx·T(λy·this-afternoon′(fix′(x,y))))**(λP·P(computer′))

(λS will′(S(addressee′)))

Here again the second line is derived by higher order unification in such a way as to satisfy the conditional equivalence in (40). In particular, the expression *λP·P(computer′)* is of the same type as *λP·P(tv′)*, and the expression *λS will′(S(addressee′))* is of the same type as *λS will′(S(speaker′))*. Accordingly, ***E*** is given by the bold expression in (45) and the full interpretation of (44) can be computed as follows:

(46) **E**(NP′• Clause′)

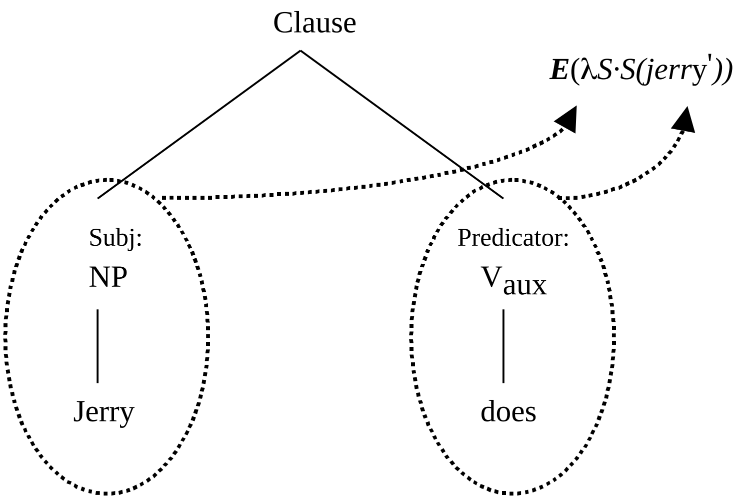
= **λT·λW·W(λx·T(λy·this-afternoon′(fix′(x,y))))**(λP·P(tv′))

(λS·will′(S(speaker′)))

= will′(this-afternoon′(fix′(speaker′,tv′)))

As a final illustration of this approach, consider the split antecedent in (37), viz. *A. She walks and she chews gum. B. Jerry does too, but not at the same time*. Assuming that the auxiliary *do* is a semantically vacuous raising predicate translated by *λS·λx·S(x)*, the relevant part of B's response can be schematically represented as in (47):[35]

(47)



Note that the existence of *do*-support in such examples follows directly from the formulation of rule (39): elliptical interpretations are possible if a clause contains an auxiliary as predicator, and the only auxiliary with a semantically vacuous interpretation is *do*. The translation of *Jerry does* simplifies to $\boldsymbol{E}(\lambda S\cdot S(jerry'))$, where $\lambda S\cdot S(jerry')$ is of type $<<e_{SUBJ},t>, t>$.

The antecedent in this example is given in (48):

(48) C = $walk'(she_i')\quad chew'(she_i', gum')$

$= \boldsymbol{\lambda W\cdot W(\lambda x\cdot walk'(x) \wedge chew'(x, gum'))}(\lambda S\cdot S(she_i'))$

As before, higher order unification produces a logical equivalent which satisfies the conditional equivalence in (40). The expression $\lambda S\cdot S(she_i')$ is an exact parallel to $\lambda S\cdot S(jerry')$, so $\boldsymbol{E} = \lambda W\cdot W(\lambda x\cdot walk'(x) \wedge chew'(x, gum'))$, and the full interpretation of (47) can be computed as follows:

(49) $\mathbf{E}(Clause')$

$= \boldsymbol{\lambda W\cdot W(\lambda x\cdot walk'(x) \wedge chew'(x, gum'))}(\lambda S\cdot S(jerry'))$

$= \lambda x\cdot walk'(x)\quad chew'(x, gum')(jerry')$

$= walk'(jerry')\quad chew'(jerry', gum')$

The key to this example lies in the logical equivalence of the translations of *she walks and she chews gum* and *she walks and chews gum*, though it should be noted that a syntactic expression of the latter kind is never actually employed in the computation.

3.2.2 Ellipsis of complements of lexical heads

Ellipsis of subjectless complement clauses after non-auxiliary heads is restricted to a relatively small number of lexical items, e.g. *try* but not *attempt*, *make* but not *require*: [36]

(50) a. A. Are you going to finish the assignment?
B. I'm going to try/*attempt Ø.

b. A. Why do you drink so much every evening?
B, My friends make/*require me Ø.

Verbs like *try* which are directly followed by the ellipsis site include some verbs in the semantic field of agreement (*agree*, *promise*, *volunteer*, *refuse*) and some aspectual verbs (*begin*, *continue*, *start*, *stop*). Verbs like *make* where ellipsis occurs after the object NP are *beg*, *force*, *let* and *stop*, and verbs of perception like *hear* and *see*. The construction is also available to some adjectives, e.g. *keen. willing*, *reluctant*. Since there is widespread agreement that complements of lexical heads should be analysed as subjectless clauses rather than VPs, this ellipsis construction is not generally used as an argument for VP constituency. We briefly analyse it since, as stated above, it has essentially the same properties as ellipsis following infinitival *to*.

One obvious difference between ellipsis of complements of lexical heads and auxiliary verb stranding is that the former does not permit pseudo-gapping:

(51) *I’m not going to fix the car , but I’ll try Ø the TV.

Also, since the negative adverb *not* can only follow finite auxiliary verbs, no possibility exists of ellipsis following *not* in the same clause. The syntactic part of the rule for ellipsis of complements of lexical heads therefore simply needs to state that that ellipsis either immediately follows the lexical item in question, or an object thereof :

(52) $\text{Clause}\{\Pi(<<\text{Obj})<\text{last}>\}$

$\mathbf{E}_{<<t,\ t>,\ t>}\ (\text{Clause}')$

Here, we take Π to represent the somewhat arbitrary set of lexical items which permit ellipsis, so the rule will apply to all clauses in which one of these lexical items, possibly immediately followed by its object, is last. The semantic part of the rule will then allow an elliptical interpretation following the principles established in the previous section (see rule 40). The typing condition on ***E***, namely that it be restricted to type $<<t, t>, t>$, constrains the elliptical material to have a logical form corresponding to a complement clause.

3.2.3 Ellipsis after infinitival *to*

Ellipsis after infinitival *to* is illustrated in (53):

(53) A. Are you going to the lecture today?
B. a, I wasn’t intending to Ø.
b. *I wasn’t intending Ø.

The possibility of ellipsis after infinitival *to* compensates to a large extent for the impossibility of ellipsis following the vast majority of lexical heads which take infinitival complement clauses: compare (53B/a) and (53B/b).

In VP-based analyses, infinitival *to* is frequently analysed as a head in complementary distribution with finite auxiliary verbs which take a VP complement, but functioning as a marker of non-finiteness. In line with this analysis, infinitival *to* is then often itself treated as an unusual member of the auxiliary verb category, in which case VP-ellipsis following *to* can be assimilated to the rule governing ellipsis following auxiliary verbs (for a detailed defence of this idea, see Pullum 1982). However, despite its initial attractiveness, there are grounds for doubting whether this treatment of infinitival *to* is fully correct. Firstly, the notion of complementary distribution between finite auxiliaries and infinitival *to* straightforwardly collapses in examples like *they were to leave the same evening*, or *we ought to leave soon* (for those speakers for whom *ought* has auxiliary properties). In flat English, of course, or any catenative analysis of auxiliaries, these examples simply involve auxiliaries taking *to*-infinitival rather than bare complement clauses. However, more importantly from the current perspective, ellipsis after infinitival *to* shares a key distinguishing property of ellipsis after lexical heads, namely the ungrammaticality of pseudo-gapping (Stirling & Huddleston 2002:1516):

(54) A. Are you going to fix the car?
B. *No, but I intend to Ø the TV.

The simplest solution is to assimilate ellipsis after infinitival *to* to ellipsis following lexical heads. All that needs to be done is to add infinitival *to* to the set of lexical items under Π in rule (52). Since *to* does not take an object argument, it will be constrained by this rule to be the last element in its clause.[37]

The inclusion of infinitival *to* in the rule for ellipsis following lexical heads now raises the intriguing possibility that the initial idea that *to* should be analysed as an unusual auxiliary verb might be replaced by an analysis in which *to* is treated as an unusual lexical verb, lacking therefore the English-specific grammatical properties of the auxiliary verb category. As a non-finite verb form, infinitival *to* would of course lack the negation, inversion and emphasis properties (the so-called operator properties) of finite auxiliaries regardless of whether it was analysed as an auxiliary or a lexical verb. In particular, the impossibility of a following negation in ellipsis, as in (55B), would follow directly from the non-finiteness of *to*:

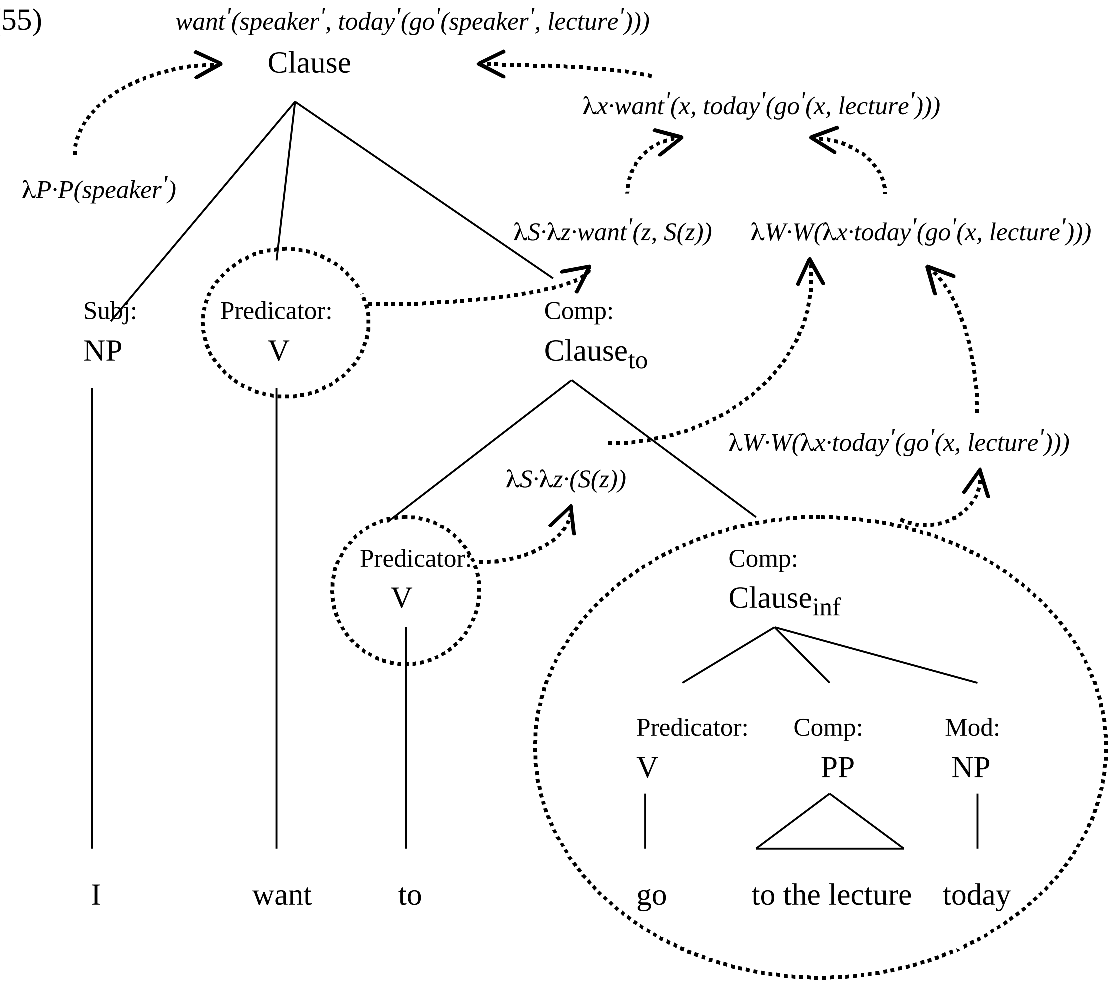
(55) A. Are you going to fix the car?
B. *To not Ø would get me into deep trouble with the law.

No non-finite verb, whether lexical or auxiliary, can be negated in the same clause by a following *not*. However the pseudo-gapping property is distinctive. Infinitival *to* possesses, as we have seen, this ellipsis property of a subset of verbal heads rather than either finite or non-finite auxiliaries.

Under the lexical verb analysis, then, infinitival *to* would be a verb which heads its own non-finite clause and takes a subjectless bare infinitival clause as complement.

The appropriate structure in flat English for a typical clause with a *to*-infinitival complement is given in (55):

(55)



In this analysis, it will noted, *to* itself is assigned the translation $\lambda S \cdot \lambda z \cdot (S(z))$ of type $\langle\langle e_{SUBJ}, t\rangle_{inf}, \langle e_{SUBJ}, t\rangle\rangle_{to}$. It thus combines with a subjectless bare infinitival clause to yield a subjectless *to*-infinitival clause, but contributes nothing semantically.[38] The closest parallel in the verbal system would then be the non-finite form of *do* in elliptical examples such as (56), characteristic of certain varieties of British English:

(56) A. Do they like pasta?
B. They may do Ø.

In such examples, *do* has a history of being analysed variously as an auxiliary (Pullum & Wilson 1977, Baker 1984, Miller 2002) or a lexical verb (Gazdar, Pullum & Sag 1982). It automatically lacks the operator properties of finite *do*, in particular the possibility of a following negation, and therefore presents problems of categorisation similar to those of infinitival *to*. However, as Miller (2002) observes, there are two key properties which link non-finite *do* to the finite auxiliary *do*, Firstly, it can occur in environments where the ellipted material is headed by a purely stative predicate (A. *Does Mary have a mortgage?* B. *She may do Ø*), and secondly it occurs in pseudo-gapping constructions like (56):[39]

(56) The hapless mother threw up her eyes to heaven, and uttered a shriek so unlike the voice of a human being, that the eagle which soared in middle air *answered* it as she would have **done** the call of her mate. (Scott, Chronicles of Canongate)

Non-finite *do* will therefore in our analysis be assimilated to finite auxiliary *do*. Of the two non-finite verb forms with vacuous translations, therefore, *do* is an auxiliary and infinitival *to* is not.

Possible objections to the analysis of *to* as a lexical verb are that (a) unlike other lexical verbs it has a vacuous semantic translation; (b) unlike other lexical verbs it can sometimes be freely and optionally omitted (e.g. *All I did was* (*to*) *ask a question*); (c) unlike other lexical verbs it cannot head a main clause.[40] Probably the most serious of these is the first, since we do not expect a lexical verb to be vacuous. However, note that we have understood the term “lexical” here to imply simply that the form lacks the grammatical properties of auxiliary verbs in English. The correspondence between auxiliary status and denotation is well-known to be imperfect. For example *have* in *have to* has the semantics of a modal, but is grammatically lexical in the intended sense. So is *get* in the *get* passive. We might expect vacuity to be associated with auxiliary status, as it is with dummy *do*, but there is arguably no reason why it has to be. The second objection essentially falls with the first: if any lexical head can be freely omitted, we would expect it to be a vacuous one. As far as the final objection is concerned, Aarts (2004) notes that infinitival *to* can head main clauses in signs giving instructions such *as All visitors to report to reception*.

Admittedly, then, infinitival *to* is a very unusual lexical verb. But the advantages of treating it this way are (a) no need for a separate account of its behaviour with respect to negation (like all non-finite verb forms it will be negated by preceding *not*); (b) generalisation of Π in rule (52) to include only lexical heads.; (c) predicted absence of pseudo-gapping;

3.3 Anaphora

There are two main constructions to consider here: (i) *do so*, and (ii) *do* plus other referentially dependent expressions, e.g. *it, that, this, what, which, the same, something else, likewise*.[41] These both involve lexical rather than auxiliary forms of the verb *do*. However, there are significant differences between the two constructions, for instance in the fact that the antecedent in the *do so* construction is restricted to stative predicates, while the antecedent in the *do it* etc. construction must be agentive. In both cases we will treat the construction compositionally, assigning a translation separately to the two varieties of *do* and to the referentially dependent expressions. The contextual interpretation of the referentially dependent expression will be computed by higher order unification, in a manner similar to ellipsis. In no case therefore is a syntactic VP required.

3.3.1 *Do so*

The pro-form *do so* is often taken as a pro-VP. Some basic examples are given in (57):

(57) a. If Hargreaves <u>signs the petition</u>, I will do so too.
b. If Hargreaves <u>signs the petition today</u>, I will do so too.
c. If Hargreaves <u>signs the petition</u> today, I will do so tomorrow.
d. If Hargreaves <u>donates $500 to the hospital</u>, I will do so too.
e. *If Hargreaves <u>donates $500</u> to the hospital, I will do so to the church..

In example (57a), the interpretation of *do so* straightforwardly seems to correspond to that of verb+object. In (57b) and (57c), we see the same issue as with ellipsis: the adverbial *today* can be either part of the interpretation, or excluded from it. On the other hand, the contrast between (57d) and (57e) shows that both complements of a ditransitive verb must be included. Examples like (57e) in particular are used to justify the claim that *do so* substitutes for a full VP, and not a subconstituent thereof.

The *do so* construction shares some features of the ellipsis construction discussed in section 3.2. In particular, examples like (58), parallel to (37), show that the interpretation of *do so* must be recovered from the logical form of the antecedent rather than a syntactic VP:

(58) A. She walks and she chews gum.
B. Jerry does so too, but not at the same time.

This suggests a similar analysis in which higher-order unification creates an appropriate logical form for (58B) on the basis of the logical equivalence *of she walks and she chews gum* with *she walks and chews gum*.

Nevertheless, there are well-known and significant syntactic and semantic differences between *do so* and the auxiliary forms of *do* which make it impossible simply to assimilate *do so* to the ellipsis rule for *do* and other auxiliaries. The crucial differences are shown in (59):

(59) a. Hargreaves usually <u>announces dinner</u>, but today he can't do so.
b. Hargreaves usually <u>announces dinner</u>, but today he was reluctant to do so.
c. *I <u>like pizzas</u>, and Mary does so too.
e. *I don't intend to <u>fix</u> the car, but I will do so the TV.
f. *Mary <u>went</u> to Paris, and I did so to Berlin.
g. Mary <u>spoke</u> to Peter <u>about the problems</u>, and I did so to Kim.

Example (59a) illustrates the fact that *do* in *do so* lacks the NICE properties of auxiliaries (in this particular example it is itself negated by *do*-support). However, as a standard lexical verb, at least from a formal point of view, it has all the regular non-finite forms. This means that it can occur in a number of environments where auxiliary *do* is at best marginal, as after infinitival *to* in (59b). Even for speakers who have non-finite forms of auxiliary *do*, these essentially only occur as complements of auxiliary verbs.[42] On the other hand, *do so* is semantically more restricted than auxiliary *do*. Example (59c) shows that it is not compatible with an antecedent which denotes a state (compare *I like pizzas, and Mary does Ø too*, with ellipsis). From examples (59d) and (59d) it can be seen that *do so* also does not generally permit pseudo-gapping. However, as Miller (1992) points out, examples like (59e) with PPs which denote certain types of affected argument show a much greater degree of acceptability. In (59e), the predicate *spoke to* can be thought of as semantically similar to *admonish*. Another predicate which appears to work well is *complain to*, e.g. *I'm going to complain to my MP about this, and you should do so to yours*. The range of predicates which allow this construction is clearly somewhat restricted, and needs further investigation. For expository purposes, however, we will continue to use the term "affected" to cover the argument types which are permitted. Patient NP arguments are clearly excluded, as are pure goal and recipient PP arguments.

The rule we propose for *do so* therefore has close affinities to the ellipsis rule as instantiated by auxiliary *do*, but will differ from it in relevant ways: First of all, we distinguish the *do* in *do so* from other varieties of the verb *do* by the feature *so*, i.e the *do* in *do so* will be do_{so} rather than simply do_{lex}. The proform *so* itself resists pigeon-holing into any other category, so we will simply assume that it forms a category on its own which belongs to the variable type τ. It is then possible to assign the type $<\tau_{SO},<e_{SUBJ},,t>>$ to the verb do_{so} itself, giving this the same vacuous translation as auxiliary *do*, viz. $\lambda S \cdot \lambda z \cdot (S(z))$. The full rule is then given in (60).

(60) $[_{Clause}$ <Comp:*so*, Affected:PP>]{Predicator: do_{so}}
so' (PP'•Clause')

As with the ellipsis rule, this rule can be thought of as a special case of the general clause rule applying to clauses whose predicator is do_{so}.[43] The typing of do_{so} will enforce the requirement that do_{so} has *so* itself as a complement. However, any non-subject complement other than an affected PP will be excluded since such a complement will not be able to saturate the predicate. Affected PPs are likewise destined to fail to saturate the predicate, but as a special case are nevertheless assigned a translation by the rule.

It is then up to higher order unification to produce an interpretation for the proform *so*. This interpretation, represented as ***so'*** in the rule, will be obtained by exactly the same procedure as the interpretation of ellipsis in the ellipsis rule, namely by solving the conditional equivalence in (61):

(61) **so**' (PP'• Clause') ⇔ F(PP*o*• Clause')
if
antecedent(C)
& DYNAMIC(C)
& $F(A_1 \bullet A_2) = C$
& parallel($A_1 \bullet A_2$, PP'• Clause')

It will be noted that the conditional equivalence in this case imposes the additional requirement that the antecedent be dynamic, thus excluding examples like (59c).

In a basic example like (59a), there is no affected PP and the interpretation will be given straightforwardly by ***so'****(Clause')*. In this case, since *today*, *he* and *can't* belong to the matrix clause, the interpretation of *Clause'* is simply the translation of do_{so}, i.e. *λS·λz·(S(z))*. The antecedent, corresponding to *announces dinner*, can be extracted from the translation of the first coordinate and is given in (62):

(62) C = λx·announce'(x, dinner')
= **λY·Y(λx·announce'(x, drnner'))**(λS λz (S(z)))

The second line is derived by higher order unification in such a way as to satisfy the conditional equivalence in (61). In particular, the expression *λS λz (S(z))* for A_2 is identical to the translation of do_{so} and therefore automatically satisfies the requirement that A_2 and *Clause′* be parallel. Thus ***so′*** = *F* is given by the bold expression in (62), and the interpretation of the expression *do so* in the second coordinate can be computed as in (63):

(63) $\mathbf{so'}\ (\lambda S\ \lambda z\ (S(z)))$
$= \boldsymbol{\lambda Y \cdot Y(\lambda x \cdot announce'(x, drnner'))}(\lambda S\ \lambda z\ (S(z)))$
$= \lambda z \cdot announce'(z, dinner')$

This interpretation of *do so* can now function as an argument of the auxiliary *can't*, ultimately yielding *today′(~can′(hargreaves′,announce′(hargreaves′,dinner′)))* as the full simplified translation of the second coordinate.

In the previous example, the key step in the computation is essentially trivial: it just type-raises the translation of *announce dinner* and applies it to the (vacuous) translation of *do*. In examples with affected PPs such as (59g), *Mary spoke to Peter about the problems, and I did so to Kim*, the computation will necessarily be more complex. The antecedent in this case will be the translation of the first coordinate *Mary spoke to Kim about the problems*. If we take *spoke* in this example to be of the augmented type $<e_{Theme:about},<e_{Affected:to,}<e_{SUBJ},t>>>$, then the antecedent will have the logical form in (64):

(64) C = $speak'(mary',peter',problems')$
$= \boldsymbol{\lambda T \cdot \lambda W \cdot W(\lambda x \cdot T(\lambda y \cdot (speak'(x,y,problems'))))}(\lambda P \cdot P(peter'))$
$(\lambda S \cdot S(mary'))$

Here again the second line is derived by higher order unification in such a way as to satisfy the conditional equivalence in (61). There are obvious affinities here to the pseudo-gapping partition in example (45). In this case, the expression $\lambda P \cdot P(peter')$ is of the same type as $\lambda P \cdot P(kim')$, and the expression $\lambda S \cdot S(mary')$ is of the same type as $\lambda S \cdot S(speaker')$, the translation of *I did*$_{so}$,. Accordingly, ***so′*** is given by the bold expression in (64) and the full interpretation of the second coordinate in (59g) can be computed as follows:

(65) $\mathbf{so'}\ (PP' \bullet Clause')$
$= \boldsymbol{\lambda T \cdot \lambda W \cdot W(\lambda x \cdot T(\lambda y \cdot (speak'(x,y,problems'))))}(\lambda P \cdot P(kim'))$
$(\lambda S \cdot S(speaker'))$
$= speak'(speaker',kim',problems')$

3.3.2 General agentive *do*

Following Stirling & Huddleston (2002:1532), we take the verb *do* in construction with anaphoric expressions, e.g. *it*, *that*, *this*, *what*, *which*, *the same*, *something else* and *likewise*, to be the general agentive verb *do*$_{ga}$. This is clearly distinct from the light verb *do* in constructions such as *do a somersault*, and the ordinary lexical verb *do* in *Didn't she do well?* The former alternates with other light verbs such as *make* in *make a comment* or *take* in *take a nap* (contrast **do a comment*. **do a nap*), while the latter can be simply intransitive.

Some basic examples of *do*$_{ga}$.are given in (66):

(66)
- a. Hargreaves translated the message, but he didn't do it very well.
- b. It's traditional to go away in August, but we're not doing that this year.
- c. Kim smiled at me, and then Pat did the same
- d. A. What are you going to do? B. Ask him to leave.
- e. Hargreaves was supposed to serve dinner, but he did something else.
- f. Hargreaves did something unspeakable.

Example (66a), with negation by auxiliary *do*, shows that *do*$_{ga}$ itself is lexical. In the first three examples, the anaphoric expressions *it*, *that* and *the same* appear to correspond to a traditional VP., as does the response in the interrogative example with *what* in (66d). The expression *something else* in (66e) is likewise anaphoric, but in this case of course the interpretation of the anaphor must differ from that of the antecedent.[44] In (66f) the complement of *do*$_{ga}$ is a non-anaphoric noun phrase headed by *something*. Nevertheless, even in this example there is a clear intuition that what Hargreaves did, for instance rudely interrupt the flow of conversation at dinner, can be represented by an expression of type $<e_{SUBJ},t>$,.

In an echo of the *do so* construction, one striking property of *do*$_{ga}$ is that it can combine with a *to* PP representing a patient argument:

(67)
- a. Hargreaves may have insulted you, but you shouldn't do the same to him.
- b. A. What did they do to you? B. Give me an injection.
- c. They were supposed just to service the car, but I think they did something else to it as well.
- d. Hargreaves did something unspeakable to me.
- e. *Hargreaves did a nasty deed to me.

Unlike in the *do so* construction, though, the *to* PP can regularly correspond to an NP object in the antecedent. Indeed, since there is no *wh*-word in the verb category in English, examples like (67b) represent the standard way of forming a question to which the response is of type $<e_{SUBJ},t>$. The contrast between (67d), with do_{ga}, and (67e), with the ordinary lexical verb *do*, further shows that this kind of PP is proper to the do_{ga} construction.

Since, as can be seen in examples (66f) and (67d), the do_{ga} construction is not exclusively anaphoric, a somewhat different treatment is required than for ellipsis or *do so*. In particular, we will wish to encompass the full range of NP object types that are permitted n the construction, and also to reflect the regular correspondence between the patient PP argument of do_{ga} and an NP object in the antecedent.

First of all, it seems that the permitted NP objects of do_{ga} are precisely those kinds of NP to which we might ascribe variable typing. An NP like *something* can be, as we have had it before, of type $<<e,t>,t>$, denoting the property set of an entity. For example, the translation of *something* is then $\lambda P \cdot \exists x[P(x)]$ in a simple formulation using the existential quantifier. But we could also allow for *something* to be of type $<<<e_{SUBJ},,t>,t>,t>$. In this case its translation would be $\lambda W \cdot \exists S[W(S)]$, where S is of type $<e_{SUBJ},,t>$ corresponding to a subjectless clause. Or more generally it can be of type $<<\tau,t>,t>$, with translation $\lambda w_1 \cdot \exists\ w_2[w_1(w_2)]$, where w_1 is of type $<\tau,t>$ and w_2 is of type τ . The actual type assigned will then match the requirements of the predicate. So in the simple case where do_{ga} does not have a PP argument, it will be a control verb of type $<<e_{Agent},t>_{NP},,<e_{Agent},t>>$ with an agentive subject and the translation $\lambda S \cdot \lambda x \cdot do'(x,S(x))$. The only NPs with the typing required to saturate the $<e_{Agent},t>_{NP}$ argument position of do_{ga} will be precisely the variable-typed NPs we have seen, i.e. anaphors, interrogatives and NPs headed by expressions like *something.* Saturating $\lambda S \cdot \lambda x \cdot do'(x,S(x))$ with the appropriate translation of *something,* viz. $\lambda W \cdot \exists S[W(S)]$, will result in $\lambda x \cdot \exists S[do'(x,S(x))]$. For this to yield a true proposition, there must then be something of type $<e_{Agent},t>$ that x did.

Other examples proceed in a similar fashion, The translation of *something else* can be $\lambda W \cdot \exists S[W(S) \& \sim(S=\boldsymbol{Ana})]$, where ***Ana*** will be equivalent to some contextually given antecedent of the same type as *S*. Other anaphors will have translations such as $\lambda W \cdot W(\boldsymbol{it}')$, $\lambda W \cdot W(\boldsymbol{this}')$, and $\lambda W \cdot W(\boldsymbol{that}')$.. In each case, letting ***Ana*** stand in general for any anaphoric expression, the interpretation of the anaphor will be given by a conditional equivalence such as (68):

(68) **Ana** $\Leftrightarrow$ F
if ANTECEDENT(F)
& …….. (any further conditions depending on the anaphor)

Further conditions may for example be those associated with the distinction between deictic and non-deictic anaphors. It is beyond the scope of this paper to pursue these distinctions here, but we note that the conditional equivalence yields an interpretation for the generality of anaphoric expressions independently of their occurrence in the do_{ga} construction. By contrast, the interpretation of *so* in the *do so* construction is unique to this construction, and *so* cannot be substituted by any other analogous expression.

When do_{ga} is accompanied by a PP argument, it will be a control verb of the more complex type $<e_{to},<<e_{Patient},<e_{Agent},t>>_{NP},<e_{Agent},t>>>$. The corresponding translation will then be $\lambda y\cdot\lambda U\cdot\lambda x\cdot do'(x,U(x,y))$, and the appropriate type of the variable NP argument will be $<<<e_{Patient},<e_{Agent},t>>,t>,t>$. For example, for the translation of *something* we would have $\lambda V\cdot\exists U[V(U)]$, where U ranges over two-place relations with agent and patient arguments, and for the translation of *it* we would have $\lambda V\ V(\boldsymbol{it'})$, where $\boldsymbol{it'}$ must be equated to such a relation extracted from the context. The fact that the PP argument of do_{ga} is to be interpreted as the patient argument in such a relation will therefore emerge directly from the lexical translation of the do_{ga} predicator. However which relation it actually is will be determined by the context.

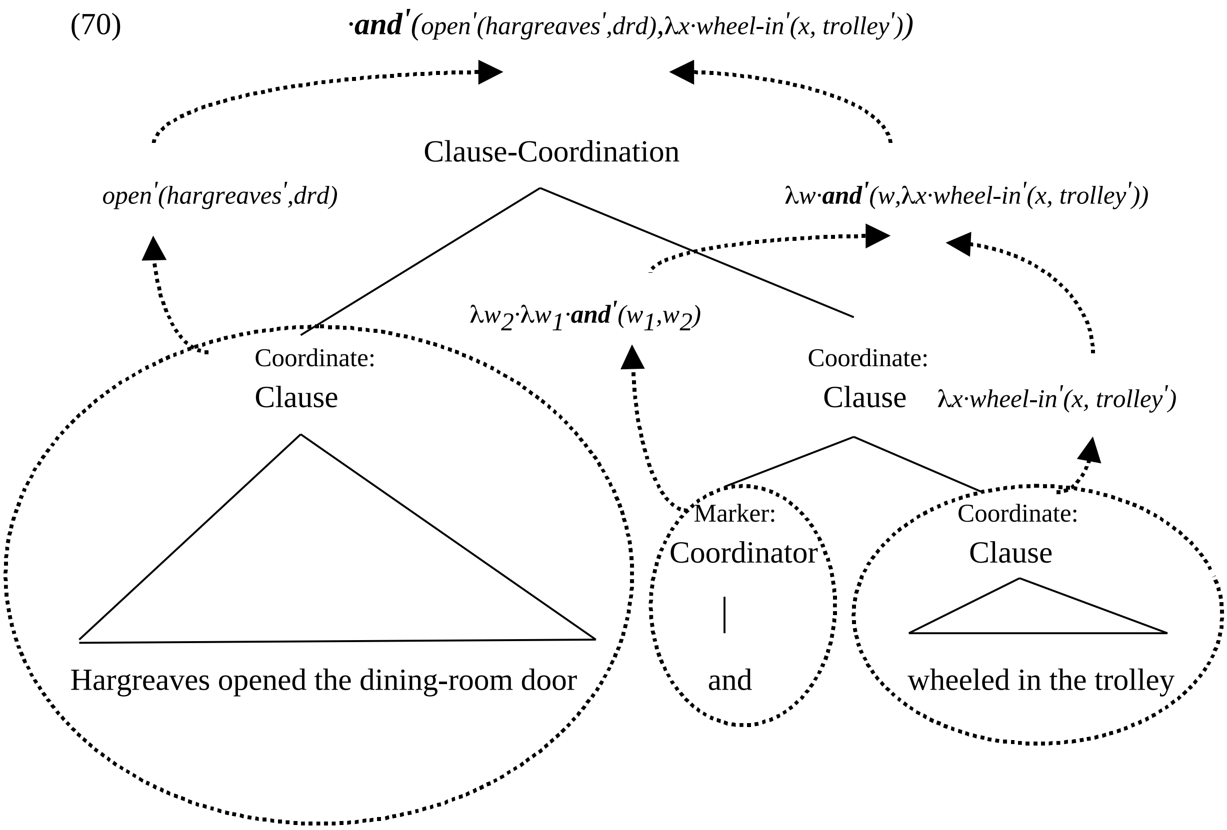
3.4. Coordination

One more structural argument which has been used to argue for VP constituency in English is coordination. On the face of it, two main clause verb+object structures can be coordinated in sentences like (69):

(69) Hargreaves opened the dining-room door and wheeled in the trolley .

Many authors have taken this sharing of a subject as strong evidence for VP constituency. However, coordination is notoriously problematic as a test for constituency, and an alternative which has long existed in the literature (at least since van Oirsouw 1987) is to take sentences like (69) as involving coordination of clauses, with a missing subject in the second clause. In flat English, the structure assigned to (69) would then have to be that in (70):

(70)



The translation is derived by compositional translation rules, to which we return shortly, and this translation will ultimately allow for an appropriate interpretation to be given to the missing subject argument of the second coordinate.

In English, there are no obvious clues (apart of course from the presence or absence of the subject) which distinguish clauses with overt subjects from clauses without. However, we know of at least one language where such clues are indeed available and the evidence seems to point towards the clause-level solution for what might appear to be VP coordination. In Roshani (an Eastern Iranian language belonging to the Pamir group), clause patterns differ according to whether the subject is expressed by a full NP or not. In transitive clauses, a subject clitic must be present when a clause lacks a full NP subject, but is obligatorily omitted when one is present:[45]

(71)	a.	mas	uf	qiwt
		we.OBL	them.OBL	call.PAST
		'we called them.'		

b.	uf=am	qiwt	
	them.OBL=1.PL.TRANS	call	
c.	*mas=am	uf	qiwt
	we.OBL=1.PL.TRANS	them.OBL	call

In (22i), the subject is expressed by a full pronoun *mÇ‰*. When *mÇ‰* is omitted, the clitic =*um* is obligatorily attached to the first clausal constituent, in this case the object. The clitic cannot be used when the subject is present, as in (71a). In intransitive clauses, on the other hand, the clitic is always required.

Now in coordinations with like subjects, if the second coordinate is transitive, it behaves as if it lacked an overt subject:

(72)	[mas=am	sat	]	xo	[uf=am	qiwt].
	we.ABS=1.PL.INTRANS	go.PAST.PL		and	them.OBL=1.PL.TRANS	call.PAST
	'We went and called them.'					

This would not be expected on a coordinate VP analysis, since both VPs would then have an overt shared subject. It is however totally predictable if the second coordinate is analysed as a subjectless clause.

The correctness of the clause-level analysis is reinforced by the behaviour of the first coordinate. Transitive clauses in Roshani differ from intransitive ones not only by the behaviour of the subject clitic, but also by the case of the subject: in transitive clauses it is oblique, but in intransitive clauses it is absolute. In a coordination with a transitive first clause and an intransitive second clause, an overt subject is oblique and the clitic is obligatorily omitted:

(73)	[uf	curuken	bilen	zuxt]	xo	[tar	kor=an	tayd]
	those.OBL	man.PL	spade.Pl	take.PAST	and	to	work=3PL	leave.PAST.M.PL
	'Those men took the spades and left for work.'							

The first coordinate always behaves like a full clause, containing an overt subject if there is one, and the second coordinate always behaves like a reduced clause with no overt subject.

The Roshani data show that a clause-level analysis for coordinations like (69) is the only plausible solution in some languages. From a universal perspective, flat clause structure predicts either that coordinations like (69) will be permitted, in which case one clause will have the properties of a full clause and the other will have the properties of a subjectless clause, or that they will not be permitted at all. Parallelism considerations, for example a mismatch between the case required by the overt subject and the case required by the covert subject, might in principle serve as a blocking factor, even though obviously this does not occur in Roshani. What is not expected is any syntactic behaviour of the overt subject which leads us to believe it to be somehow external to the clause with which it is in construction, for example a resolution rule in which the subject does not assume the case required by that clause.

Returning now to the coordination rules for English, we propose that the coordinator *and* translates as $\lambda w_2 \cdot \lambda w_1 \cdot \mathbf{and'}(w_1, w_2)$, where w_1 and w_2 are as usual variables of any type. Coordinators can then, in principle, coordinate any two expressions, though a parallelism condition will subsequently be imposed which determines whether an interpretation can eventually be achieved. Two syntactic rules are then required, one which forms the second coordinate by marking it with *and*, and a second which forms a coordination by combining the second coordinate with the first:

(74) a. $[_{\text{Coordinate:Y}}$ Marker:Coordinator Coordinate:Y]
Coordinator'(Y')

b. $[_{\text{X/Y-Coordination}}$ Coordinate:X Coordinate:Y]
Y'(X')

The syntactic rules therefore permit an X/Y-coordination to consist of two coordinates which in principle can belong to any two different categories X and Y. For simplicity, when X and Y are like categories, we can simply refer to the output of rule (74b) as an X-Coordination. A coordination of two clauses is therefore simply, as in (41) and (70), a Clause-Coordination. As shown already in (70), the compositional translation of (69) is then (75):

(75) $\lambda w_2 \cdot \lambda w_1 \cdot \mathbf{and'}(w_1, w_2)(\lambda x \cdot \text{wheel-in}'(x, \text{trolley}'))(\text{open}'(\text{hargreaves}', \text{drd}))$
$= \mathbf{and'}(\text{open}'(\text{hargreaves}', \text{drd}), \lambda x \cdot \text{wheel-in}'(x, \text{trolley}'))$

We now again invoke higher-order unification to compute the available interpretations of expressions which contain **and'**. These interpretations will be given by the conditional equivalence in (76):

(76) $\mathbf{and'}(X', Y') \Leftrightarrow F(H \quad Y')$ or $F(H) \quad F(Y')$
if
$F(H) = X'$

&parallel(H,Y')

The operator $\wedge$ should be taken as a Boolean connective ("and"; similarly $\vee$ = "or") which can in principle join any two expressions which belong to the same semantic type (Keenan & Faltz 1985). The parallelism condition then requires minimally that H and Y' be of the same semantic type, so that the expressions $H \wedge Y'$ and F(H) F(Y') will both be well-formed. Whether an interpretation is ultimately available for **and'**(X',Y') therefore depends on the possibility of computing suitable values for *F* and *H*.

In a simple coordination in which X' and Y' are already of the same type, the computation trivially yields $H = X'$ with *F* as the identity function. So in this case ***and'****(X',Y')* is equivalent as required to $X' \wedge Y'$. In the case we are considering here, with *F= λP·P(hargreaves')* and *H= λx·open'(x,drd'),* so that *F(H) = open'(hargreaves',drd'),* we derive:

(77) **and'**(open'(hargreaves',drd'), λx·wheel-in'(x, trolley')) ⇔

a. λP·P(hargreaves')(λx·open'(x, drd') λx·wheel-in'(x, trolley'))

or b. λP·P(hargreaves')(λx·open'(x,drd'))
λP·P(hargreaves')(λx·wheel-in'(x, trolley'))

It will be noted that the conditional equivalence (76) allows two possible interpretations: the "wide-scope" interpretation of *F* in (77a) and the "narrow-scope" interpretation of *F* in (77b). In (77a), two expressions of type <e_{SUBJ},,t> are joined by the Boolean connective " ". The two properties of opening the dining room door and wheeling in the trolley can then directly be interpreted as properties of Hargreaves. On the other hand, in (77b) two separate propositions about Hargreaves are joined, namely that he opened the dining-room door and that he wheeled in the trolley. In this case, the two alternatives essentially amount to the same thing

It should be noted, however, that this formulation of the coordination rule marries naturally with analyses of the correspondences generally encountered in elliptical coordinations where the first (full) coordinate contains scope-bearing operators such as modals and negation (see in particular the analysis of gapping in Oehrle 1987:205).[46]

(79) a. Hargreaves can't [open the dining-room door and wheel in the trolley]

b. [Hargreaves can't open the dining-room door] and wheel in the trolley.

c. [Hargreaves can't open the dining-room door] and can't wheel in the trolley.

d. Hargreaves can't [open the dining-room door or wheel in the trolley].

In (79a), the structure we would assign is one in which two parallel subjectless clauses are coordinated as complements of a single negative auxiliary *can't*. There is only one interpretation in this case: for example, an appropriate context might be one in which it is too difficult for a single individual such as Hargreaves to do both things at the same time. In (79b), we have a structure with a first full coordinate *Hargreaves can't open the dining-room door* and a second subjectless coordinate *wheel in the trolley*. In this case, the conditional equivalence will partition *Hargreaves can't open the dining-room door* into $F = \lambda S \cdot {\sim}can'(hargreaves', S(hargreaves'))$ and $H = \lambda x \cdot open'(x, drd')$. The coordination rule in this case gives two possible interpretations:

(80) a. $\lambda S \cdot {\sim}can'(hargreaves', S(hargreaves'))(\lambda x \cdot open'(x, drd' \quad \lambda x \cdot wheel\text{-}in'(x, trolley'))$

b. $\lambda S \cdot {\sim}can'(hargreaves', S(hargreaves'))(\lambda x \cdot open'(x, drd'))$
$\lambda S \cdot {\sim}can'(hargreaves', S(hargreaves'))(\lambda x \cdot wheel\text{-}in'(x, trolley'))$

In contrast with (77a) and (77b), these two interpretations do not amount to the same thing. The wide-scope interpretation of can't represented in (80a) essentially corresponds to the interpretation in (79a), namely that there are two tasks that Hargreaves cannot simultaneously do, even though he may be able to carry out either of them individually. On the other hand, the narrow-scope interpretation represented in (80b) asserts simply that he can perform neither task. As Oehrle (1987:234-235) notes, the narrow-scope readings, which are semantically equivalent to coordinations of separate propositions, are facilitated by the association of a separate intonation phrase with each clause, while the wide-scope readings are facilitated by a single intonation phrase covering both clauses. The narrow-scope interpretation thus corresponds to the interpretation which is assigned to (79c), and is also logically equivalent by De Morgan's laws to (79d).

Not only therefore does the analysis of coordination not require the postulation of a syntactic VP, but the treatment of sentences such *as Hargreaves opened the dining-room door and wheeled in the trolley* as coordinations of a full first clause and a subjectless second clause reveals the parallels with the generality of coordination constructions with ellipsis in one coordinate.

4. CONCLUSION

In this paper, we have argued for a flat analysis of English clause structure in which there is no syntactic VP constituent. Wherever in the derivation of any individual sentence a unit appears which looks superficially like a VP, it turns out to be either syntactically a subjectless clause, as in "VP-preposing" and "VP-coordination", or to be a unit which is constructed solely at the level of logical form, as in "VP-ellipsis" and "VP-anaphora". In all varieties of "VP-ellipsis" and "VP-anaphora", it invariably turns out in the general formulation of the rule concerned that the logical unit corresponding to a supposed "VP" in fact belongs to one of several different semantic types which can in principle be constructed by the rule. The logical unit constructed does not even necessarily correspond to **any** syntactic constituent.

The general framework proposed in this paper for flat English involves a two-stage procedure for the construction of logical forms. Firstly, each syntactic rule is accompanied by a translation rule which compositionally gives a corresponding logical form. These logical forms may however themselves be the input to a further stage of higher-order unification which manipulates them in a variety of ways, either creating the partitions required by information structure, as in preposing, or identifying logical forms supplied by contextual antecedents, as in ellipsis, anaphora, and the coordination of unlike categories. One interesting consequence of this two-stage procedure is the possibility that island constraints might emerge directly from computations during the first stage, where logical translations are tied to syntactic form, while the computations of higher-order unification are freer and not island-sensitive. Although it is not the purpose of this paper to provide a full account of island constraints, we have given a number of specific examples which justify this conjecture.

The flat clause structure we have proposed for English does not entail that English generally lacks constituent structure. Indeed, in a number of specific rules we have explicitly assumed that such structure exists. For example, in clauses which contain displaced elements, we have assumed a prenucleus–nucleus structure in which the displaced element, e.g. a wh-phrase, combines with the clause form which it is displaced. Nevertheless, the flat structure of basic clauses has potentially interesting consequences for general theories of clause structure. The verb is now the immediate daughter and head of the clause, just as adjectives are the immediate daughter and head of adjective phrases and prepositions are the immediate daughter and head of prepositional phrases. Exactly the same principles might be applied to the argument and modifier structure of noun phrases, with no need, for example, to postulate the syntactic stacking of adjectives. We leave the feasibility of such an analysis for future investigation: the distinctive role of determiners raises a number of important issues. However, the question then arises whether there is any need in syntactic theory for any intervening nodes between lexical and phrasal levels of the single-bar type postulated in versions of X-bar theory.

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ENDNOTES

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1. This paper is a much-expanded version of a paper first presented at the DELS Conference, University of Manchester 2006. I am grateful to participants at this conference for comments on the early presentation.

2. For Jespersen, the relationship between verb and object is even taken to be "less intimate" than between verb and subject (see Jespersen, 1933: 108).

3. At this time (Chomsky, 1957), VP is taken to include an abstract tense node as well as modals and auxiliary verbs, i.e Verb → C(M)(have+en)(be+ing)(be+en), with the government relationship between these various elements handled by the famous affix-hopping rule. This analysis reflects the traditional English grammar analysis which treats auxiliaries and lexical verb as forming a verbal group within VP . While the idea of a verbal group was preserved in the tradition of the Quirk and Greenbaum grammars (see Biber 1999 for a relatively recent example), it has largely been abandoned elsewhere. Modals and auxiliaries are typically analysed either as heading higher functional projections within a single clause or, as in Huddleston & Pullum et al (2002), as independent catenative verbs taking clausal complements. We will henceforth take VP to mean a constituent containing just the lexical verb and its complements, though we will return to the issue of the structure of sentences containing auxiliaries in section 2 below.

4 .It is beyond the scope of this paper to give an account of binding in English. The point that is being made is simply that the accounts which have been given which are based on syntactic or semantic rank (with the possible involvement also of linear precedence) remove any necessity to postulate a VP constituent.

5. Huddleston & Pullum et al. (2002), henceforth *CGEL* (*The Cambridge Grammar of the English Language*), assume the existence of a VP constituent. Apart from this point, however, we generally adopt the *CGEL* analysis and terminology for the syntactic representation of English. Note in particular the function "predicator" for the lexical head of a clause. The term "predicate" (the typical function in *CGEL* of VPs) will in our system then be restricted to units at the semantic level of representation.

6. It is not the purpose of this paper to give a detailed justification for the formal semantic representations used. Rather, the intention is to show how an account based on well-understood formalisms such as the lambda calculus and higher order unification can obviate the need for a syntactic VP in English. Many formal details are therefore omitted, or relegated to footnotes. We have however aimed for a level of exposition which makes

the analysis both fully explicit and accessible. The formal representation is particularly indebted to Pulman (1997) and Winter (1997, 2001).

7. In an expression like *open' (x, y)*, therefore, where *open'* is of type $<e_{SUBJ},<e_{OBJ},t>>$ and *x* and *y* are of type e, we will say that *x* occupies the subject place in the predicate and *y* the object place. Types like $<e_{SUBJ},<e_{OBJ},t>>$ which contain more than purely semantic typing information will be called augmented types. Augmented types play a significant role in the linking of argument expressions to argument places (see the definition of saturation below). However, we also allow augmented types to be subscripted with category information. They can then be used to indicate arbitrary syntactic category restrictions on the combinatory possibilities of a given type. For example, we argue below that auxiliary verbs in English are of the type $<<e_{SUBJ}, t>, <e_{SUBJ},,t>>$, i.e. their first argument is a subjectless clause of type $<<e_{SUBJ},t>$, and the second argument is a subject of type *e*. This is the same general type as catenative verbs such as *want*, and we take it to be an arbitrary syntactic requirement that auxiliaries (for the most part) take bare infinitival clauses while catenatives (for the most part) do not. The augmented type of auxiliary verbs which take bare infinitival complements can then be represented as follows: $<<e_{SUBJ}, t>_{inf}, <e_{SUBJ},,t>>$. In general, any type can be subscripted with a function, a thematic role, a category, or any combination of these, as appropriate.

8. The general definition we will assume for **Sat** is as follows (see Nam 1991, Winter 1997 for discussion):

> If R is an n-place predicate, w_i is a variable of type α occupying the GR place in R, and X' is an expression of type $<<\beta,t>,t>$ (β not distinct from α) which translates X:GR, then **Sat**(X', R) forms the new n–1 place predicate R' given by:
>
> $R' = \lambda w_n\cdot\ldots\lambda w_{i+1}\cdot\lambda w_{i-1}\cdot\ldots\lambda w_1\cdot X' (\lambda w_i\cdot R(w_1, \ldots w_{i-1}, w_i, w_{i+1}\ldots,w_n))$.

The requirement that the type β be not distinct from the type α of the variable w_i is intended to allow for the possibility that X might be underspecified with respect to any function or category restrictions imposed by R. Thus a plain case NP of the general type $<<e,t>,t>$, rather than the augmented type $<<e_{SUBJ},,t>,t>$ or $<<e_{OBJ},,t>,t>$, can saturate either the subject or object place of a predicate belonging to type $<e_{OBJ},<e_{SUBJ},t>>$. The saturation of the two-place predicate *open* by its object NP *the dining room door* then directly results in the one-place predicate $\lambda w_1\cdot\lambda P\cdot P(drd')(\lambda w_2\cdot open' (w_1,w_2))$, where the variable w_2 occupies the object place of *open'*. This simplifies straightforwardly to $\lambda w_1 \cdot open'(w_1, drd')$. Note that the definition of saturation requires a match between the grammatical relation borne by a category and the place in the predicate which is saturated: any mismatch will result in either an unsaturated predicate or logical incoherence. This has essentially the same effect as the completeness and coherence conditions of Lexical Functional Grammar (Bresnan 2001: 63), or the completeness constraint of Role and Reference Grammar (van Valin 2005:129).

9. The relationship between the flat syntactic structure and the hierarchical logical form is thus similar to that between unordered f-structures and semantic representations in Lexical Functional Grammar. In the GLUE resource logic approach (Dalrymple 1999), semantic representations are formed by utilising f-structure resources (in any order) until all resources are consumed. The approach given here could easily be reformalized in this way. However, given a flat syntactic structure, flat f-structure becomes (in some respects) redundant: the mapping from syntax to logical form can be defined directly, with grammatical relations in effect serving as indices linking NPs to places in predicate-argument structure. The approach is also reminiscent of the multiple parsings available in Combinatory Categorial Grammar. Note however that in the system outlined here, the flat syntactic structure forms a separate level of representation.

10. The variables are: x_1, x_2, y_1, y_2, z_1, z_2 etc. (type <e>), *p* (type <*t*.>; *P*, *Q*, *S* (type <e,t>); *T*, *W* (type <<e,t>t>; U (type <e,<e,t>>); V (type <<e,<e,t>>,t>); *Y* (type <<e,t>,<e,t>>; *Z* (type <<<e,t>,t>,t>; *O* (type <t,t>). *R* is used as a metavariable over all predicate types and *w* as a metavariable over all variable types. Also, the symbol τ will function as a variable over types themselves. Subscripts will generally be omitted where no confusion will result. Constants and translations of syntactic categories follow the standard convention of being distinguished by primes, e.g. *hargreaves'* is an expression in the logic of type <e>, and NP' is the translation of NP.

11. Lambda conversion can be defined as follows:

> If *a* is a variable of type α, and Φ and *b* are expressions of type δ and α respectively, then $\lambda a \cdot \Phi(b) = \Phi'$, where Φ' (of type δ) results from substituting *b* for all occurrences of *a* in Φ.

Thus $\lambda P \cdot P(hargreaves')(sing')$, where *P* is a variable of type <e,t> and *sing'* is a constant of the same type, simplifies to *sing'(hargreaves')* by substituting *sing'* for *P* in *P(hargreaves')*. While $\lambda P \cdot P(hargreaves')(sing')$ essentially says that the set of properties

that Hargreaves has includes singing, *sing′(hargreaves′)* equivalently says that Hargreaves sings.
12. The terms prenucleus and nucleus, for the functions of the fronted wh-phrase and the body of the relative clause respectively, derive from *CGEL*. See *CGEL*, ch 12, for detailed discussion.
13. The essential semantic contribution of the relative pronoun *which* is then that the position relativized does not denote a person. An analogous translation can be given for *who*, viz. $\lambda S \cdot \lambda z \cdot person'(z) \wedge S(z)$. However, the case distinction between *who* and *whom* will impose a typing requirement on *S*: for example *whom* will require *S* to be of type $<e_{OBJ},t>$. In *that* relatives, the translation of *that* will be the vacuous $\lambda S \cdot \lambda z \cdot S(z)$, so that the translation of the relative clause is $\lambda P \cdot \lambda x \cdot P(x) \wedge that'(Clause')(x)$, and in zero relatives, the translation of the relative clause will simply be $\lambda P \cdot \lambda x \cdot P(x) \wedge (Clause')(x)$. In general, the relative clause rule imposes the requirement that the nucleus contain a “gap” at the level of logical form, i.e. that its translation be of type <e,t> rather than <t>.. If the nucleus is complete, i.e. its predicate is already fully saturated, the translation of the relative clause will simply be incoherent. An expression such as **which Hargreaves opened the window* will therefore be logically ill-formed. For an analogous analysis within the GLUE framework, see Dalrymple (2001, ch14).
14. The original formulation of higher-order unification is due to Huet (1975). Given arbitrarily high levels of type raising, higher-order unification is not deterministic (there will be multiple solutions to a given equation). It is also not decidable (i.e. there may not be a solution). In practice, however, this is unlikely to present a major computational problem: tractable subsets of higher-order unification exist and non-trivial solutions can be prioritised (see Pulman 1997, fn2 for discussion).
15. We use bold variables to represent logical expressions whose interpretations must be computed by higher-order unification. In addition to **B** (background) and **F** (focus), they include **E** (ellipsis), **so**', **it**' (proforms),, **that**', **this**' (deictics).
16. This is then a major point of difference with the flexible categorial grammar approach (Steedman 1996), where logical form is tied tightly to surface constituency.
17. An interesting comparison arises here with the approach of van Valin (2005). The partitions which derive from higher-order unification have affinities to the focus-structure projection in Role and Reference Grammar (though of course they are represented in a totally different manner). Note however that Role and Reference Grammar uses focus-structure partitions as the key to the analysis of extraction constructions. There is clearly a close and undisputed connection here, since extraction constructions typically exist for the primary purpose of syntactically reflecting information-structure partitions. Nevertheless, the fact that extraction constructions are subject to island constraints which

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information-structure partitions in general fail to observe suggests that there are at least some constraints on extraction which information structure alone may not account for.

18. We understand the term “auxiliary verb”, abbreviated as V_{aux}, in the grammatical sense of a verb which has the NICE properties in English. Finite forms of auxiliary verbs can then be termed “operators”. The term “lexical verb”, abbreviated as V_{lex}. will be used for all verbs which lack the NICE properties, regardless of their function.

19. The terms “polarity focus” and “verum focus” seem to originate with Gussenhoven (1984) and Höhle (1994) respectively.

20. There is an analogous construction which displaces complements of *be* belonging to non-clausal categories following stressed *not.* An example is: *The lecturer said this sentence would be easy to analyse, but a simple exercise it is definitely NOT.* This construction does not require the same formal correspondence between the displaced material and the preceding context, and we will not analyse it here. See Ward, Birner & Huddleston (2002: 1376-1381) for discussion.

21. The basic flat clause rule, when augmented to include adverbial modifiers, can take the following form:

$$[_{\text{Clause}}\ \text{Mod:}X_n,\ldots\ \text{Mod:}X_m,\ldots\text{Mod:}X:_k,\ \text{GR:}X_j,\ \ldots,\ \text{GR:}X_1,\ \text{Predicator :V}]$$
$$\ldots X_n'\ldots(\mathbf{Sat}(X_j',\ (\ \ldots X_m'\ldots(\mathbf{Sat}(X_1',\ (\ldots X_k'\ldots(V'))))))))$$

This is to be interpreted as allowing in principle any number of adverbial modifiers, and modification of any predicate type. A full treatment of adverbial modification would require complex additions to basic logical forms involving a detailed representation of event types and indexical information (see for example Ernst 2002). Here, for simplicity, we assume that modifiers in the first instance combine with the predicates they modify by functional application. The adverbial *today* is therefore taken to be basically a clause-level modifier whose translation will be *today’* of type <t,t>. However, in order to allow adverbials to combine with predicates whose argument positions are unsaturated, we must also permit combination by functional composition (**Comp**). In particular, if P is a predicate of type <e,t> and X is an adverbial of type <t,t>, then **Comp**(*X’*, *P’*) = $\lambda x\cdot X'(P(x))$. Thus *today’* can combine with $P = \lambda y\cdot go'(y, lecture')$ to give $\lambda x\cdot today'(\lambda y\cdot go'(y, lecture')(x))$. This simplifies to $\lambda x\cdot today'(\cdot go'(x, lecture'))$, the basic translation for the incomplete clause *go to the lecture today*. For the treatment of *today* as a deictic pronoun heading an NP see Payne & Huddleston (2002:.429).

22. We assume a top-level division of subordinate clauses (abbreviated *sub*) into finite (*fin*) and non-finite (*non-fin*), with a further subdivision of non-finite into bare and *to*-

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infinitival (abbreviated *to*). For the status of *to* as a verb see section 3.1.3.. Bare subordinate clauses are of three types: infinitival (abbreviated *inf*), gerund-participial (*gp*), and past-participial (*pp*).

23., The translation of a control verb like *want* will have the same general type as the translation of *will*, namely $<<e_{SUBJ}, t>, <e_{SUBJ}, t>>$, but the logical predicate *want'* will be two-place with both subject and clausal arguments. Its translation will be $\lambda S\cdot\lambda x\cdot want'(x, S(x))$.

24. In rule (25a), *emph* is taken to be a grammatical feature distinguishing lexical items whose translations introduce the *verum* predicate. Since the *verum* predicate is associated at the information structure level with narrow focus, items marked with *emph* will trigger focal intonation. Rule (25a) works straightforwardly for positive polarity focus, and also correctly handles the translation of negative auxiliaries. However, there are scopal complications with negative auxiliaries as negation does not always introduce negative polarity focus. For example, the translation of non-emphatic *mustn't* will be $\lambda S\cdot\lambda x\cdot must'(\sim S(x))$, with the modal scoping over negation. The translation of $mustn't_{emph}$ will then correspondingly be $\lambda S\cdot\lambda x\cdot VERUM(must'(\sim S(x)))$, By contrast, the translation of *can't* will be $\lambda S\cdot\lambda x\cdot\sim can'(S(x))$, and the translation of $can't_{emph}$ correspondingly $\lambda S\cdot\lambda x\cdot VERUM(\sim can'(S(x)) = \lambda S\cdot\lambda x\cdot\sim VERUM(can'(S(x))$. These complications have consequences for the translations of *not* and not_{emph}. Positive finite auxiliaries must be divided into two categories Aux_1 (*must* type) and Aux_2 (*can* type). The translation of *not* composed with Aux_1 will be $\lambda S\cdot\lambda x\cdot Aux_1'(\lambda y\cdot\sim S(y))(x)$, while the translation of *not* composed with Aux_2 will be $\lambda S\cdot\lambda x\cdot\sim(Aux_2'(S)(x))$. The *verum* translations induced by not_{emph} will correspondingly be $\lambda S\cdot\lambda x\cdot VERUM(Aux_1'(\lambda y\cdot\sim S(y))(x))$ and $\lambda S\cdot\lambda x\cdot\sim VERUM(Aux_2'(S)(x))$. Syntactically, *not* can simply be included amongst the modifiers in the flat clause structure, with a linear precedence requirement that it follow the auxiliary and precede the complement clause. The translation rules ensure that *not* can only combine with finite auxiliaries, and not with other catenative verbs.

25. The auxiliary *will* has the augmented type $<<e_{SUBJ}, t>_{inf}, <e_{SUBJ},,t>>$. The constraint that the complement of *will* be a subjectless clause follows from the $<e_{SUBJ}, t>$ part of this typing, whereas the arbitrary syntactic requirement that the complement be a bare infinitival clause comes from the category annotation *inf*. Analogous annotations will handle the co-occurrence requirements of other auxiliaries. For example, the negative auxiliary *doesn't* will be of type $<<e_{SUBJ}, t>_{inf;lex}, <e_{SUBJ},,t>>$, and will thus be prevented from co-occurring with other auxiliaries. It is well-known however that the

preposing construction differs in an interesting manner from the basic construction, in that the perfect auxiliary *have* can co-occur with a bare infinitival clause in the prenucleus: *He said he would go to Paris, and go/gone to Paris he HAS.* This compares with the grossly ungrammatical **He HAS go to Paris*. It is tempting here to relate the difference to the different modes of combination involved. The saturation rule directly combines a predicate with its arguments and as defined requires unification of the function and category of the argument with any function or category specifications imposed by the place in the predicate which is saturated. If perfect *have* is of type $<<e_{SUBJ}, t>_{pp}, <e_{SUBJ}, t>>$, this will constrain the complement clause in the basic construction to be past-participial. On the other hand, the preposing construction involves functional application, and we can in principle define the category matching requirements here differently. This will require functional application **App** to be defined as follows:

> If *a* is an expression of type $<<\alpha,\delta>,\beta>$, and *b* is an expression of type $<<\gamma,\delta>$, where δ may be null, then **App**(*a*, *b*) forms an expression *a*(*b*) of type β iff (i) α is not distinct from γ, or (ii) $\alpha=<e_{SUBJ},,t>_{inf}$ and $\gamma=.<e_{SUBJ},,t>_{pp}$.

Clause (i) does the same job as the unification requirement in the definition of **Sat**, while clause (ii) is a statement of the permitted mismatch when an expression like $\lambda W\cdot W(\lambda x\cdot(go'(x, paris')))$ of type $<<<e_{SUBJ},t>_{inf}, t>, t>$ is applied to an expression like $\lambda S\cdot VERUM(have'(S(speaker'))$ of type $<<<e_{SUBJ},t>_{pp}, t>$. We will avoid this complication of functional application in the body of the paper.

26. A precise statement of the typing constraints on **Sat*** will ultimately depend on a full analysis of constructions involving islands. However, as a preliminary definition we propose the following:

> If R is an n-place predicate, w_i is a variable of type γ, $w_i(w_z)$ is an expression of type α occupying the GR place in R, and X' is an expression of type $<<<\gamma,\beta>,t>,t>$ (β not distinct from α) which translates X:GR, then **Sat***(X', R) forms the new predicate R' given by:
>
> $$R' = \lambda w_n\cdot\ldots\lambda w_{i+1}\cdot\lambda w_{i-1}\cdot\ldots\lambda w_1\cdot\lambda w_z\cdot X'(\lambda w_i\cdot R(w_1, \ldots w_{i-1}, w_i(w_z), w_{i+1}\ldots,w_n)).$$

Here γ, the type of w_i, represents the type of the extraction site, and constraints on w_i and w_i will play a fundamental role in determining what can be extracted from what. For example, if w_i is of type $<<e_{OBJ}, t>$ and w_i is correspondingly of type $<e_{OBJ},>$, it will be possible to extract an object NP from a complement clause which saturates a predicate place of type $<t>$. In the event that there is no extraction, the definition of **Sat*** collapses to that of **Sat**, so the translation of the basic clause rule (5) will employ **Sat*** in the general case.

27. In this example, the extraction site, represented by the variable w_i, is of type $<e_{SUBJ},t>$. Saturation and lambda conversion proceed as follows:

$$\begin{aligned}
&\textbf{Sat*}(\text{think}', \lambda Z\cdot Z(\lambda S\cdot \text{VERUM}(\text{will}'(S(\text{speaker}'))))\\
&= \lambda x\cdot\lambda w_i\cdot(\lambda Z\cdot Z(\lambda S\cdot \text{VERUM}(\text{will}'(S(\text{speaker}')))))(\lambda W\cdot \text{think}'(x,W(w_i)))\\
&= \lambda x\cdot\lambda w_i\cdot(\lambda W\cdot \text{think}'(x,(W(w_i))(\lambda S\cdot \text{VERUM}(\text{will}'(S(\text{speaker}'))))\\
&= \lambda x\cdot\lambda w_i\cdot \text{think}'(x, \lambda S\cdot \text{VERUM}(\text{will}'(S(\text{speaker}')))(\ w_i))\\
&= \lambda x\cdot\lambda w_i\cdot \text{think}'(x, \text{VERUM}(\text{will}'(w_i(\text{speaker}'))))
\end{aligned}$$

This expression, the translation of *think I WILL*, needs to combine with a subject argument for *think'*, and then a predication applied to the speaker.

28. The use of the symbol Ø in examples (34)-(38) and subsequently is intended merely as a device to indicate that an elliptical interpretation is required. It does not imply the existence of empty categories at a syntactic level.

29. The same argument might be applied to examples like *Peter thinks he'd better* [$_{\text{Clause}}$ *postpone the meeting*], *but he hadn't* Ø. However, *better* should probably be analysed as an (incipient) auxiliary verb rather than as an adverb (see Huddleston 2002a:113 for discussion). Auxiliary properties appear in non-standard forms such as %*You better not leave yet* and %*You'd better leave now, bettern't you.* And even in standard English ellipsis is permitted: *You'd better* Ø. In this case the analysis would be *Peter thinks he'd* [$_{\text{Clause}}$ *better* [$_{\text{Clause}}$ *postpone the meeting*]], *but he hadn't* Ø, and the ellipsis site corresponds to a subjectless clause.

30. See Culicover & Jackendoff (2005:296-298) for a discussion of recent attempts by Kehler (2000) and Kennedy (2003) to resurrect syntactic reconstruction of VPs in at least some cases of ellipsis. Kehler's argument rests on well-known examples like **Susan defended Bill$_i$, and he$_i$ did Ø too,* from Lappin (1993), in which a reconstructed VP *defended Bill* leads to the Condition C violation observed in **He$_i$ defended Bill$_i$*. Here, we concur with Culicover & Jackendoff that this argument is based on an unfounded assumption that the relevant aspects of such violations cannot themselves be stated at a non-syntactic level (for Culicover & Jackendoff they are stated at conceptual structure).

Kennedy’s argument rests on the contrast between (i) *Dogs*$_i$*, I understand* t_i*, but cats*$_k$*, I don’t* [~~*understand* t_k~~], and (ii) **Dogs*$_i$*, I understand* t_i*, but cats*$_k$*, I don’t know anyone who does* [~~*understand* t_k~~], with an island violation. Culicover & Jackendoff argue that these examples should be treated as topicalised versions of the pseudo-gapping construction rather than as instances of what they call VP ellipsis. The relevant part of the structure of (ii) would then be *cats*$_k$*, I don’t know anyone who does* [~~*understand*~~] t_k, the antecedent would simply be the verb *understand* and there would be no need for a recovered VP. However, we note that both Kennedy’s argument and Culicover & Jackendoff’s refutation of it rely on the postulation of an improperly bound syntactic trace. This is however unnecessary in the analysis proposed here. Rather, the ungrammaticality will emerge directly, without the postulation of traces, from the treatment of relative clause islands in section 2.4. The antecedent in (i) has to be the translation of *I understand*, the nucleus of the first coordinate, i.e. *λy·understand′(speaker′,y)*, This expression can be partitioned by higher-order unification into a suitable form $F(A_2)$, viz. ***λW·λy·W(λx·understand′(x,y))****(λS·S(speaker′)*, such that the interpretation of the elliptical coordinate is given by the parallel expression ***E****(Clause′)* = ***λW·λy·W(λx·understand′(x,y))****(λS·~S(speaker′)*, where *λS·~S(speaker′)* is the translation of *I don’t*. Simplification yields *λy·~understand′(speaker′,y)*, which corresponds to *I don’t understand*. On the other hand, the antecedent in (ii) would have to be simply the translation of *understand*. A potentially suitable partition $F(A_2)$ can indeed be calculated, viz. ***λY·λy·Y(λz·understand′(z,y))****(λS·λx·S(x))*, such that *F* = ***E*** and ***E****(Clause′)* = ***λY·λy·Y(λz·understand′(z,y))****(λS·λx·S(x))*, where *λS·λx·S(x)* is the translation of *does*. This simplifies appropriately to the expression *λy·λx·understand′(x,y)* for the translation of the elliptical clause which just consists of *does*. However, this expression has the type $<e_{OBJ},<e_{SUBJ},t>>$ and is therefore not of the correct type to combine with the translation of the relative pronoun *who*, which is looking for an argument of type $<e_{SUBJ},t>$.

31. An analogous rule will be required for ellipsis in interrogative clauses, This will take the same form, except that the predicator will be followed by a subject and belong to the category $V_{aux}**$ rather than V_{aux} or $V_{aux}*$. The set of auxiliary forms permitted in interrogatives differs in small ways both from V_{aux} or $V_{aux}*$, a well-known case being the existence of the form *aren’t* as a negative first-person singular form of *be*. $V_{aux}**$ will also naturally include all forms of dummy interrogative *do*.

32. There are also non-canonical cases. In the ellipsis rule (39) the antecedent can also be non-linguistic, e.g. *You shouldn’t Ø!* as a warning to a child just about to do something naughty. ***E*** must then be recovered by verbalising the action about to be performed. By

contrast, the antecedent in the interpretation of *so* in the *do so* rule (60) must be linguistic. We assume that these are variable conditions on ANTECEDENT which could be formalised in a more detailed account. However, self-evidently there is no syntactic VP available as an antecedent in the non-linguistic cases.

33. Aspectual parallelism clearly plays an important role here. If *Clause*′ contains a perfect or progressive auxiliary, then there is typically a degradation of acceptability if the A_2 component of the antecedent does not match this. Nevertheless examples without a match may work. Stirling & Huddleston (2002:1521) compare ?*Kim may be questioning our motives, but Pat hasn't Ø* with the considerably more acceptable *I'm sure Bob will tell her soon, but he hasn't Ø yet* (where the degree of parallelism is greater because of the time contrast). There are also very strong contraints when any forms of *be* or perfect *have* are to be included in the ellipsis. In this case, the stranded auxiliary in *Clause*′ must have a counterpart in A_2 which matches it exactly in function and augmented type. Thus, to take a further example from Stirling & Huddleston (2002:1521), *Kim was interrogated yesterday and is being Ø again today* is fine, but **Kim was interrogated yesterday and is Ø again today* is not. In our terms, the latter example does not contain a counterpart in the antecedent to the stranded progressive *is*. This constraint also seems to block the use of auxiliary *do* in examples like **I asked Kim to be quiet, but she didn't Ø*: In order to satisfy the parallelism requirement the antecedent would also have to contain auxiliary *do*, and this is incompatible with the following *be*..

34. The syntactic representation of coordinate structures here and in section 3.4 follows *CGEL* principles. For a detailed account see Huddleston, Payne & Peterson 2002.

35. We take adverbs like *too* to belong, like markers of coordination, to a higher level of clause structure. They thus do not interfere with the requirement that the auxiliary be last in order for an elliptical interpretation to be possible. *Too* can also follow a final XP in pseudo-gapping cases, e.g. A *Do you have a picture of Bill? B. Yes, and I do of his sister too.*

36. The construction also extends with some heads to the ellipsis of finite complement clauses and other complement categories. See Stirling & Huddleston (2002:1527-1529) for a comprehensive description. Since these cases are not relevant to the VP debate, we omit discussion of them here.

37. There are clearly further constraints on ellipsis following infinitival *to* which are not predicted by its inclusion in rule (52). For discussion, see Stirling & Huddleston (2002:1526). We can however provisionally relate these to the prosodic status of *to*. For example, it is impossible to have ellipsis when *to* initiates a subject clause: **I was going to fix the car, but to Ø would be far too expensive*. However, these kinds of examples are immediately improved by the inclusion of a preceding overt subject or *not*. Consider (a) *I*

was going to fix the car myself. For anyone else to Ø would be out of the question, and (b) *I was going to fix the car. Not to Ø would be out of the question*. Infinitival *to* can then plausibly be treated as a prosodically deficient element which must cliticise to a preceding or following phonological word, either an element within the same clause as in examples (a) and (b) above, or a preceding verb or adjective which takes an infinitival complement.

38. Note however that Duffley (1992) does attempt to assign a general meaning to infinitival *to* which essentially involves the separation in time of the event denoted by the complement clause. We do not take a stand on this issue here. If *to* does have a meaning, however, its logical representation in our system will be $\lambda S \cdot \lambda z \cdot to'(S(z))$ rather than just $\lambda S \cdot \lambda z \cdot (S(z))$. It will then semantically be a contentful raising predicate rather than simply a vacuous one.

39. This and a number of other attested examples are cited by Miller (2002). All attested examples seem to appear in comparative constructions. However, Miller also cites constructed examples in non-comparative environments which seem acceptable.

40. The latter two objections are taken from Huddleston (2002b:1186). Huddleston employs them as objections to the analysis of *to* as an auxiliary verb, but they apply *a fortiori* to the analysis of *to* as a lexical verb.

41. The expression *do likewise* may require slightly separate treatment in that *likewise* is an adverb rather than an NP complement of *do*. We take the verb *do* in *do likewise* to be a variety of general activity *do*, but it will need a distinct augmented type.

42. Contrast then (59b) *with *Hargreaves usually announces dinner, but today he was reluctant to do*. A similar contrast can be seen in *Hargreaves announced dinner, and in doing* *(*so*) *triggered the subsequent course of events*.

43. Huddleston & Stirling (2002:1530) point out that *do so* is excluded from certain clause types, in particular comparatives, tags and some types of response. These clause types will themselves be licensed by rules which require auxiliary stranding, thus preempting the *do so* construction.

44. For a detailed discussion of *else* anaphors see Culicover & Jackendoff (2005:ch11). Culicover & Jackendoff’s conclusion, namely that these (or indeed any other anaphoric expressions) cannot be interpreted at a syntactic level of representation, is clearly consistent with the hypothesis proposed here.

45. The Roshani data was collected on a field-trip to Tajikistan by the author.

46. The coordination rule (76) might naturally be extended to cover gapping by allowing Y' (and *H*) to be product types, e.g. $NP' \bullet NP'$., as in [$_{\text{Clause}}$ *Hargreaves opened the dining-room door*] *and Jeeves the window*. It is well beyond the scope of this paper to construct this extension. Howver, if possible, it would allow rule (76) to be the general

coordination rule covering *inter alia* coordinations of full clauses, coordinations of subjectless clauses, and coordinations of full and various types of elliptical clauses.