Projections for functional categories[*]

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1 Introduction

In this paper, we propose and motivate a distinct phrasal projection for all operator heads. Concomitantly, we reject the notion of adjunction as it is currently employed in the P&P (Principles and Parameters) framework.

We argue that the class of operator heads includes the standard functional heads, the so-called minor categories, and a number of phonologically but not semantically empty heads. These latter relate to coordination and to subordinating conjunction.

We will first argue on general and theoretical grounds against the standard adjunction structures and in favour of our proposal. We will then attempt to show by discussing particular examples that the proposal has descriptive and explanatory advantages. In particular, we offer new analyses of noun modifiers and predicate adjuncts.

2 Motivation

The necessity to reanalyse adjunction structures stems from the move towards syntax which is more semantically accountable. Uninterpretable syntax is useless. One principle which this perspective suggests is the following:

(1)   Principle I
        All structure, both syntactic and semantic, is head mediated.

More precisely, all structure is licensed and interpreted through selection by a head, within the maximal projection of the head, where selection includes both c-selection and s-selection. It follows immediately that there can be no adjunction of a maximal XP to any host: either X or some other head must mediate this process, within its own projection.

One compelling reason for the semantic part of principle I is that a head must have access to its arguments or operands in order that the Meaning Postulates or Inference Rules associated with the head can be stated over local and identifiable structures.[1] This necessitates, for instance, some version of the hypothesis that the subject is projected within the VP. We take it that similarly, all arguments or operands of a head must be projected within the maximal projection of the head.

The substantive or lexical heads, which we refer to as relational heads, are assumed to project according to standard X-bar theory. Note however that we are going to use VP to mean that projection of V where all the θ-roles are projected, but the external θ-role is not yet bound by an argument. Cormack (1989) used the notation

(2) $[_{VP}\, \theta\, [_{V'}\, V\, ..]]$

to indicate the availability of a θ-role. Thus VP will be a predicate (with type <e,t>), as it used to be, and so on for all the relational heads. In particular, NP within DP is a predicate, for instance. It is because of the pervasive importance of predicates within the grammar that we use this conservative notation.[2] The fully saturated projection of a relational head may be shown as XPmax.

All heads must s-select their arguments or operands. Theta theory as currently construed in P&P theory can accommodate this fact for relational heads, but it is inadequate for operator heads. Cormack (1989) argues that the most natural way of giving s-selection properties is by allocating a semantic type to each head, rather than by listing θ-roles. The basic types are <e> and <t>, for entities and propositions respectively: these are the types for the standard θ-roles.[3] The type for each head shows the type for each s-selection (in reverse hierarchical order i.e. external argument last), followed by the type for the mother category. For example, *hit* will have type <e,<e,t>>, and *think* will have the type <t,<e,t>>.

The type system extends naturally to operator categories, which do not assign θ-roles in the usual sense, but do require operands of specific types as we shall show below. For relational heads, the type of the mother is always <t>, because a saturated

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[1]Strictly speaking, we assume that inference is carried out over structures of the Language of Thought. Cormack (1989) argues that the types from Natural Language items carry over to the language of thought.

[2]See Williams (1980).

[3]We use only simple and ultimately of course inadequate extensional types here.

head represents a proposition, For operator heads, as we will see, this is not the case, and the entry for the type of the mother is informative.

3 Minor operator categories

We will consider first a number of minor categories which fairly clearly behave semantically as one- or two- place operators. We will find that the c- and s-selection properties of these heads differ from those of the relational heads, and that they cannot project in the same way as relational heads.

Consider *not*, for example. In logic, it is a one-place operator. Its basic s-selection type is $<t,t>$. A one-place operator like *former* however, in a phrase like *former king*, maps predicates into predicates, so it has at least apparently the type $<<e,t>,<e,t>>$. Similarly a two-place operator such as *if* or *and* has a meaning which demands that it have access to two operands of the type of propositions, so it has type $<t,<t,t>>$. We see here the canonic operator types - $<\alpha,\alpha>$ and $<\alpha,<\alpha,\alpha>>$: the output type matches the input type(s).

Although determiners are regarded as functional categories, rather than minor categories, it is useful to compare them with subordinators like *if*. Natural language binders are, like subordinators, also two-place operators (Barwise and Cooper 1981), but they bind θ-roles, so reducing the type complexity. Then a determiner like *every* needs two predicate operands of type $<e,t>$, returning a mother type $<t>$, and hence itself having the familiar type $<<e,t>,<<e,t>,t>>$. Here we have given the canonic, or lowest, type for each head. We will however argue shortly that, unlike relational heads, operators are polymorphic and hence vary in their type selection.

That an operator head must c-select its operands is clear for distributional reasons. We cannot have *former* selecting an adjective as its operand, or *if it rains* 'adjoined' to a noun. This is uncontroversial, though the necessity for an adjunct to select for its host is anomalous given the standard assumptions about adjuncts. What is controversial however is the mother category of the projection.

According to normal X-bar theory, and the argument so far, we would expect that for an operator head J, the operands all fell under JP, so the mother should be JP. (See Sportiche (1994)). But standard adjunction structures and formalisms like that of Categorial Grammar give as mother the category of one of the operands, the host. Indeed, this is the justification for regarding these heads as syntactic as well as semantic operators. The maximal projection of the operator is usually placed as sister, not mother, of the final operand, as in (3), (4) and (5). There are good grounds for the first of these moves, but not for the second.

(3)   [$_{NP}$ [$_{AP}$ former] [$_{NP}$ king]]

(4)   I said, [$_{IP}$ [$_{CP}$ if he comes] [$_{IP}$ I will leave]]

(5)   [$_{IP}$ [$_{DP}$ every dog] [barks]]

Consider again one place operators *not, former* and so on. Selection would be needlessly complicated if the mother did not bear the category of the host, for instance if [*former king*] were not an NP, or if [*not unhappy*] were not an adjective. What is more, optionality of the operator fails to be predicted. The same is true of the ordinary binary operators: it is necessary that in (4), the mother category of the complement is an IP. But we have argued above that the mother must be a projection of the operator category. For say [*former king*], we appear to need both trees (6a) and (6b).

     Our solution to this conflict is that the mother node must bear two categories: the host category and JP, where J is the operator. The phrase is doubly-headed, where one head is the operator, and the other the head of the host. Since it is the host category which we are accustomed to, we show this as usual, with the projection of the operator category as a feature.[4] This feature is then potentially visible for syntactic purposes, and we will show below that it has its uses. Thus the examples in (3), (4), and (5) will appear rather as in (6c), (7a) and (7b). (We take it that *if* in (7a) has category C, but nothing hinges on that).

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(6)   a.     AP              b.     NP           c.     NP[AP]

            A     NP              A     NP              A        NP

(7)   a.     IP[CP] <t>           b.     IP[DP] <t>

          IP[C']                      NP[D']

          C      IP      IP          D      NP      IP
                <t>     <t>                <e,t>   <e,t>
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[4]This proposal was put forward in Cormack 1989. If categories are bundles of features, as is frequently assumed, then the distinction between ordinary and feature categories is spurious. However, pace Chomsky (1994 p.10), it is likely that all that is needed in the simpler cases is for the mother to bear the union of the categorial features of the relational head and any operator head(s). For example, instead of NP[AP], for *former king*, we could have [+N,-V, AP], where the A of AP is necessarily an operator head, and outside the <+/-N,+/-V> system. More structure may be required for more complex cases.

Note that C in (7a) is an 'adjunct' head, where D in 7(b) is a binding operator. The analysis of binders as in (7b) is in effect a reanalysis of the notion of 'specifier'; this is the subject of another paper in preparation.[5]

4 Polymorphism

Let us now look more closely at selection by these operator categories. Typically, operator categories exhibit polymorphism with respect to variable c-selection, both by category and by level, with a parallel type shift of the s-selection types. Let us reconsider *not*. *Not* is canonically a type $<t,t>$ operator. However, in constituent negation it may select for AP, DP, or PP, necessitating a type $<<e,t>,<e,t>>$.

(8)   I consider John [not [$_{AP}$ unhappy]]

(9)   I consider John [not [$_{DP}$ a fool]][6]

(10)   I consider John [not [$_{PP}$ in need of help]]

Moreover, in

(11)   [Not every] dog bites

not selects for D (in particular D of the canonic binding type $<<e,t>,<<e,t>,t>>$) and outputs the same type. So we have *not* selecting for more than one type of category (here AP, DP, PP) and more than one level (here D and DP). In parallel with the categorial changes, the semantic type selection of this lexical item and the meaning of the head must shift. It is this type-shifting in particular which characterises the polymorphism of operators, as contrasted with the simple variation in c-selection, with constant type, which a relational head may show. However, as we have already pointed out, the basic meaning of *not* is represented in the type $<t,t>$. All the other 'meanings' of *not* are in some sense derivative. That is, we assume that there is just one set of Meaning Postulates and related Inference Rules relating to the basic meaning; these together with the application of some general type shifting and

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[5]Those who have persisted in using NP for the old noun phrase, rather than DP, will observe partial vindication. It might be best to adopt Radford's (1993) notation DNP as an abbreviation for our constituent NP[D'].

[6]The noun phrase here is a predicate, not a binder.

meaning-shifting operations or some general processes will enable the hearer to make the appropriate inferences. We presume that such a process is available as a part of UG or the interpretive system.

The polymorphism of two-place operators can be established in a similar fashion. The connective *and* is notoriously promiscuous in its operands: it can conjoin not only clauses, as we expect from its canonic type, but at least NPs, Ns, Ds, Cs, Advs, as well as unmatched categories like AP and PP. The polymorphism is discussed by Sag *et al.* (1985), and Keenan and Faltz (1985); the variation is usually subsumed under the name of 'generalised conjunction' (Gazdar (1980).

(12)   every $[_{NP} [_{N0}$ [aunt and uncle]] of mine]

(13)   a child $[[_{NP}$ hungry] and $[_{PP}$ in a bad temper]

An asymmetric logical connective like *if*, with the canonic type $<t,<t,t>>$, has a somewhat more restricted range of syntactic possibilities. In

(14)   I know that [if it rains, I shall get wet]

(15)   John must be here, if his car is still here

we have the expected clausal operands and output. But this is not the only possibility. Consider, for instance,

(16)   You have to refix [each slate]$_i$[if it$_i$ is loose]

Given the quantifier-pronoun dependency, the *if* clause must be within the scope of the object noun-phrase (see Stroik (1990) for argumentation relating to other adverbial phrases). Thus it can only be attached to V^0, which we will assume to have moved subsequently leftwards across the object, to AGRo, mimicking a Larsonian analysis (see the tree in (63), for instance).

(17)   V$_0$[CP]

                 V$_0$ IP[C']

                      C   IP

Here, in (17), we have *if* selecting for a type <t> IP as its first operand as usual, but then for V^0 of type <e,<e,t>> as its second operand, the host. The type of the maximal projection [CP] of *if* matches that of the host, i.e. <e,<e,t>>. The type and meaning of *if* itself will shift to accommodate the non-canonic selection.

Polymorphism relating to projections of D will not be discussed here[7], but we emphasise that polymorphism with respect to category and type selection is the norm with operator heads.[8]

5 Functional categories as operators

The unmarked assumption will be that all non-relational heads, including the standard functional heads such as D, C, T and AGR as well as the minor categories, should be seen as operator heads. Let us consider the consequences of adopting that assumption. One immediate result will be that their occurrence will be in principle optional: they will occur obligatorily only if they are selected for, or if some principle of UG forces their presence. This hypothesis warrants more exploration than we can undertake here. We have work in hand on optional AGR, and on D and DP, (based in part on Cormack (1989), and exploiting structures based on (7b) above). We can do no more here than to indicate what sorts of effects we would obtain by postulating that C and I are operator heads.

Recall that a relational head X typically selects arguments of type <e> or <t>, with output type <t>. C and I (i.e. T) select for projections of type <t> and return type <t> as output, so they could be relational. However, an operator head has type <α,α>, and C and I will have type <t,t>; so they may equally well be operators. We wish to suggest that these heads are indeed operators.[9] Then we would have not the standard (18), but (19):

(18) $[_{CP}$ [C $[_{IP}$ $[_{DP}$ D $[_{NP}$...]]   [I $[_{VP}$ V ...]]]]]

(19) $[_{VP[IP][DP][CP]}$ C $[_{VP[DP][IP]}$ $[_{NP[D']}$ D $[_{NP}$...]] $[_{VP[IP]}$I $[_{VP}$ V ...]]]]]

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[7]See Emms (1990) on polymorphism within a Lambek Calculus framework.

[8]Polymorphism is discussed by Rothstein (1991), whose concerns are much the same as ours, but whose conclusions are somewhat different.

[9]The semantic status of C and I is far from clear. It is possible that one or both will be binders, if we move out of the simplistic <e> and <t> system of types].

If this is correct, then a head that selects for say CP in fact selects for VP[CP]. Clearly then this would need to be a selection distinct from that for VP alone, and so the feature [CP] would need to be visible.

With this possibility in mind consider (20) from Payne (1993):

(20)   They require that he be there by noon.

There is a problem if *require* selects simply CP[*that*]: the subjunctive is not demanded. However, if the structure is as in (19), we may naturally select for VP[IP][CP], as in (21), so the problem disappears.

(21)   *require*: ___VP   [IP]   [CP]
                           [subjunctive]   [*that*]

Rather more significantly, if a matrix verb selects clausal complements by selecting VP together with the appropriate functional projections, then we may take it that VP is L-marked. This means that extraction from VP is licensed directly, without any manoeuvres such as adjunction of an intermediate trace to VP.[10]

We also derive a direct characterisation of an extended projection. The extended projection of a particular V consists exactly of all the projections of V, some of which are ornamented with operator features. Thus in (19) above, C falls within the extended projection of V. Similarly, the extended projection of N will include D, as can be seen from (7b) above.

The ambivalence of a <t,t> type as between operator or relation can be exploited to explain the limits in a particular instance of an extended projection. Picallo (1990) shows that a clitic in Catalan can climb over modals, but not over *semblar* ('seem'), as in the examples (22) and (23).

(22)   En Joan es$_i$ deu [afaitar t$_i$]
       Joan may shave himself   (epistemic reading)

(23)   *En Joan es semblar [fidel t$_i$]
       Joan seems loyal to himself

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[10]Sportiche (1994) discusses the elimination of adjunction derived from movement.

Roberts (1993) claims that clitics can climb within the extended projection of their selecting heads.[11] Picallo argues that on the epistemic reading, modals are generated under I, so it is plausible that they are all operators. Under this assumption, if there is a modal, as in (24), the projection of the head which selects the clitic is extended. Contrariwise, if *semblar* is (as usual) a relational head, then the projection will not be extended, as we see in (25), accounting neatly for the contrast noted by Picallo.

(24) $[_{VP[IP]} [_{VP[I']}[_{I_{modal}} \text{deu}][_{VP} ...cl]]]]$

(25) $[_{VP} [_V \text{semblar} [_{AP}... cl]]]$

6 Modification: $-conjunction

We move on now to consider structures where a phonologically but not semantically empty operator head should arguably be invoked. In some cases, the argument is from simplicity, and in others, because Principle I would be violated without such a head . It turns out that there is a range of such structures, which we discuss in the next few sections. We return first to nominal modifiers.

So far, the modifiers such as *former* and *very* are plausibly operators. However, this is very much less plausible for the heads of post-modifiers like those in (26) to (29),

(26)   no [boy [riding a bike]]

(27)   a [man [without a drink and furious]]

(28)   no [child [covered with mud]]

(29)   each [dog [with a collar]]

where the modifiers have the natural category of predicates, with relational heads. Since we are rejecting standard adjunction structures as being semantically and syntactically inadequate, there has to be some other solution. The principle that all structure is head mediated dictates that we produce a head, which we call $, to

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[11]Roberts extends Grimshaw's (1991) concept of an extended projection; we have not yet seen this ms.

mediate the combination of the NP and its modifier. Intuitively, these modifiers combine with the NP denotation by set-intersection or generalised conjunction. $ is, then, a type-shifted conjunction operator, and produces what Higginbotham (1985) calls role identification on its two operands. It is, of course, phonologically empty, but this is by no means uncommon for conjunction operators (see Payne (1985)). Let us assume for the moment that $ is head initial with respect to both its operands; then instead of (30) we have (31) and so on:

(30) `[`$_{NP}$ `[`$_{NP}$ boy   `[`$_{XP}$ riding a bike]]]

(31) `[`$_{NP[\$P]}$ `[`$_{NP[\$']}$ $ `[`$_{NP}$ boy]] `[`$_{XP}$ riding a bike]]]

For restrictive relative clauses, the only overt head which could connect the clause to the NP is the *Wh* operator. However, this is a binding operator on the IP. For this reason, it seems unlikely that it should in addition have an NP operand which it does not bind; so we assume that as with the other post modifiers, we have $ as a mediating operator. The *Wh* operator then has the semantics of the lambda operator, so that the CP has the predicate type <e,t> as required. We will then have structures like

(32) `[`$_{NP[\$P]}$ `[`$_{NP[\$']}$ $ `[`$_{NP}$ boy]] `[`$_{CP}$ who is riding a bike]]

$ is a subordinating operator; it replaces the subordinating device of adjunction, and is equivalent in syntactic effects to the standard subordinators such as *if*. For example, *Wh* extraction from the host is licensed, whereas extraction from the non-host operand is not (see section 9.2). It is not subordinating conjunction which is surprising, but rather the existence and properties of coordinating conjunction. Our analysis of coordinating conjunction, discussed briefly in section 9.1 below, is parasitic on subordinating conjunction.

The use of $-conjunction avoids the less desirable alternatives offered by Categorial Grammar. The standard Categorial Grammar approach type-lifts a modifier such as PP or relative clause CP so that it can take the host as its operand. Alternatives, such as that offered by Barry and Pickering (1990), type-lift the host so as to accommodate an arbitrary number of modifiers as operands. The use of $-conjunction by contrast maintains the operands at their primary type, and their heads at the simplest type (in line with Partee and Rooth (1982)).

7 Prenominal adjectives

Some prenominal adjectives, such as *former*, or *fake*, are plausibly operators, and fall under the discussion of section 3. However, in this section, we will argue, contra Montague (1974) and others, but in line with Higginbotham (1985) that not all prenominal adjectives should be treated this way.[12]

7.1 Premodifying intersective adjectives

Consider an ordinary adjective like *furious*, which is intersective. Conceptually, we expect it to have the type of a predicate. One possibility, again assuming that $ is head-initial, would be to have

(33) $[_{NP[\$P]} [_{AP[\$']} \$ [_{AP} \cdot\cdot]] [_{NP} \cdot\cdot]]$

alongside (34) for postmodifiers:

(34) $[_{NP[\$P]} [_{NP[\$']} \$ [_{NP} \cdot\cdot]] [_{XP} \cdot\cdot]]$

But this is not an explanatory solution. Suppose instead what we have is movement of the A from the postmodifying AP position in (34) into the phonologically empty $-head. Then

(35)   the big cat

has the structure shown in (36):

(36) $[_{NP[\$P]} [_{\$} big_k [_{NP[\$']} cat] [_{AP} t_k]]]$

This is clearly a more satisfactory solution, provided that the proper conditions for movement are met.

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[12]Higginbotham of course does not think that any adjectives should be treated as operators, because he claims that all arguments have to be saturated - in our terms, of type <e> or <t>.

7.2 Conditions on movement

There are three things we need to consider in order that the movement be legitimate:

a.   the syntactic licensing (i.e. kind of movement and absence of barriers);
b.   the semantics of the movement;
c.   what triggers movement.

We consider only the first two here, in sections 7.3, and 7.4. The conditions dictating whether an adjective head occurs pre- or post- nominally are complex, depending at least on phonological, and stylistic, and pragmatic considerations; and these conditions vary from one language to another.[13]

7.3 syntax

Head-to-head movement is familiar. The question is, how A can move to $ over an apparently intervening NP whose head N is nearer to $ than is A? In answer to this we make what seems to be a natural stipulation relating to the projection of a two-place operator:

(37)   Principle II Extension to c-command:
        If an operator is in its base position, it c-commands both its operands.

Now consider N and A in (38).

(38) $[_{NP[\$P]} [_{NP[\$']} \$ [_{NP} N..]] [_{AP} A..]]$

Since $ selects NP and AP as its operands, it c-commands N and A by the extension in II above. Since neither of N and A c-commands the other,[14] then neither intervenes between the other and $. The movement of A to $ is now possible: it moves to the nearest c-commanding position. It is equally possible for N to move to $, if $ will host that category.

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[13]See for example Giorgi and Longobardi (1989) for some discussion of these issues in Italian.

[14]We follow Rizzi (1990) here, who deletes the 'first branching node' phrase from Reinhart's (1976) definition of c-command.

As an example, let us look at some Rumanian data, taken from Cinque (1993). In Rumanian we have rather free movement of N or A to definite D as in (39) and (40):

(39)   frumos-ul   portret
       handsome-the   picture

(40)   portret-ul   frumos
       picture-the   handsome

There are exceptions to this free movement however. These involve a small class of adjectives which must always be pre-nominal. This class includes *biet* 'pitiable', for which (41) is acceptable, but (42) is not:

(41)   biet-ul   baiat
       pitiable-the   boy

(42)   * baiat-ul   biet
       boy-the   pitiable

We explain the distribution as follows: from Principle II, either N or A can move to $. Consider the schema in (43). We assume that $ can move to D because if D c-commands NP, then it c-commands NP[$P]; and since the mother of D and NP[$P] is NP[$P][D'], there cannot be any barrier intervening. So either N or A moves to $, and subsequently with $ to D, where the definite affix is attached or otherwise licensed, as in (39) and (40). However, there are two cases where N cannot move to D. If an adjective obligatorily moves to $, then movement of N will be blocked. We assume this is the correct account for *biet*. Alternatively, if the adjective is an operator on N, rather than $ adjoined, as shown schematically in (44), then A c-commands N, so the movement of N to D is blocked. This however does not seem to be the right explanation for the behaviour of *biet* 'pitiable', if it is intersective.

(43) $[_{NP[\$P][D']} D [_{NP[\$P]} [_{NP[\$']} \$ [_{NP} N ..]] [_{AP} A ..]]]$

(44) $[_{NP[\$P][D']} D [_{NP[AP]} [_{NP[A']} A [_{NP} N ..]]]]$

Note that under the analysis offered, the possibility of stacking will be predicted. Furthermore, if stacked postmodifying adjectives are moved to $, we get

the mirror image effect discussed for instance by Cinque (1993). The examples below are taken from Cinque; (46) is Indonesian and (47) and (48) are Italian.

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(45)   [[$beautiful] [[$big] [[$red] [NPball]    t]      t]        t]
```

```
(46)   [       $        [ $    [ $     [NPbola] mera] besar] tjantik]
                                       ball    red    big    beautiful
```

```
(47)   [       $    [   $   [NPmacchina] rossa] bellissima]
                            car          red    beautiful
```

```
(48)   [ [$ bella] [  $   [NPmacchina] rossa]        t     ]
```

Also, the moved A^0 need not be a single lexical item: it can have operators acting on it, giving

(49) $[_{A[AdvP]}$ very fine] wool[15]

(50) $[_{A[\&P][\alpha P]}$ old and shabby] clothes[16]

Further support for movement into an initial $ position is given by examples such as (51) to (53).

(51)   the first person to climb mount Everest

(52)   an easy man to please

(53)   a bigger cat than mine

There are three possibilities for such constructions:

    a.   the initial adjective is a two-place operator, with NP and XP as its operands:
$[_{NP[AP]}$ $[_{NP[A']}$ A $[_{NP} ..]] [_{XP} ..]]$

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[15]Sigurðsson (1993) takes advantage of the operator status of adverbs which modify adjectives.

[16]For [&P][αP], see below, section 9.1.

b.   the adjective is generated with XP as its complement in the pre-NP position, with subsequent extraposition of the infinitival phrase:

$$[[_{NP[\$P]} [_{AP[\$']} \$\ [_{AP} A [_X t]]] [_{NP} ..]][_{XP} ..]]$$

c.   the adjective is generated with XP as its complement in the post-NP position, with subsequent movement of the head A to $:

$$[_{NP[\$P]} [_{NP[\$']} [_\$ A_k [_{NP} ..]] [_{AP} [_A t_k [_{XP} ..]]]]$$

Since a complete AP may in fact occur post-nominally, as in (54),

(54)   a cat bigger than mine

we reject the first solution. Extraposition is a poorly understood phenomenon, and according to Kayne (1993) impossible. So let us reject the second solution as well. The third solution requires no additional stipulations: in fact, if the movement of the simple adjective is possible, it would be hard to prevent such movement, provided that the semantics permits it. We will see in section 7.4 that the semantics imposes restrictions on this kind of movement We take the existence of structures like those in (51) to (53) as evidence for the syntactic existence of the head $, because movement of A out of an adjunct can only be licensed by principle II, which presupposes some operator head.

There is in fact an alternative regarding the position of $ which is compatible with the arguments above.. Suppose that $ is medial, taking its first operand to the right, and its second to the left. Suppose in addition there is another operator head, say an AGR or a specialised head akin to & (see section 9.1 below), which is a one place operator selecting XP[$P] to its right. Now let any movement of a head into $ be followed by the movement of $ into this new head. Then all the same effects will be accounted for. This story has the merit of eliminating the otherwise unattested situation where the operator has its host category as the first, rather than the second, operand; $ would now select as does *if*. We will leave the question open, but continue to place $ is in the phrase initial position.

7.4 Semantics

In many cases of head to head movement, a relational head such as V moves into a position which carries no semantic content, such as AGR or root C. Here, we have a relational head moving into $ which does have semantic content, so semantics is an issue. There are precedents: movement into finite T is movement into a position with

semantic content (outside the simple <e>, <t> type system however), and there is movement of the auxiliary verb into a position carrying the semantic content of *if* , in sentences like

(55)   Were it *t* to rain, we would get wet

There are roughly two ways we can set up the semantics: the moved element is interpreted as if it were *in situ*, or its meaning is combined in some way with that of the $ into which it moves. Somewhat surprisingly, it seems that the latter is correct.
        Consider first

(56)   the first woman to walk on the moon

If we put the adjective *in situ*, we will have an interpretation where the referent is a woman and the first to walk on the moon. But the first to walk on the moon was a man; so something is wrong.
        Further evidence comes from the unacceptability of movement of the head adjective in various constructions. Consider the following examples:

(57)   an easy man to please *t*

(58)   * a ready cat to feed *t*

(59)   * a proud man of his achievements

If the adjective were interpreted *in situ*, then why should (57) and (58) differ in acceptability, since both leave remnant complements of the same kind? Why would (59) be ungrammatical?
        We claim that the movement is syntactically licensed in all cases, but in some, the structure is semantically anomalous, leading to unacceptability. We generate the semantic interpretation as follows. The meaning is derived from function composition of the adjective meaning with that of the $-conjunction. The meaning of the whole is then given by

(60) $(((A°\$)(NP)AP) \equiv A((\$(NP))AP)$ where AP is [*e* [CP]]

(where we have used italics instead of the prime notation to indicate the meanings of the constituents).

The illicit (58) is ruled out because meaning postulates will produce contradiction: it is not possible for something to be ready to be a cat, since that entails that it was immediately previously not a cat. The illicit (59) is ruled out because $-conjunction cannot apply to the two constituents left, an NP and a Case-marked noun phrase (the NP is a predicate, but the noun phrase is not).

That gives the correct account for cases where the adjective is transitive. For the cases where the adjective is intransitive, and gives a predicate directly (as in the examples such as *big cat* of section 7.1), what we need is different. In those cases, we need to combine the meanings of adjective and conjunction by applying the conjunction to the adjective meaning. The composite will then take the NP as its operand. The meaning of the whole is given by ((A))(NP), where italics is for meaning.

It has to be the case that these choices, and very possibly only these choices, are offered by UG, and that the applicability of one or the other is determined by the semantic types of the two heads. What is permitted for other semantic combinations of heads, such as the ones alluded to above, remains to be investigated.

8 Predicate adjuncts

8.1 Syntax

We now turn to the case of predicate adjuncts. Examples of this are given in (61) and (62).

(61)   John painted the box red.

(62)   John ate the meat raw.

Examples such as these have been analysed by Larson (1988b) as in figure (63).

(63)
```
                    V'

          V               VP

          e       NP           V'
                  the
                  fish    V        AP

                          eat      raw
```

We follow Larson's analysis in spirit, but not in detail. That is, where Larson has (64), we have rather (65).

(64) $[_{V'} [_V e] [_{VP} [_{NP} \text{the fish}] [_{V'} [_V \text{eat}] [_{AP} \text{raw}]]]]$

(65) $[_{AGRoP} [_{AGR} e] [_{V'[DP]} [_{NP[D']} \text{the fish}] [_{V[\$P]} [\$ [_V \text{eat}]] [_{AP} \text{raw}]]]]$

The V is moved to some higher position, which we would take to be AGRo rather than a shell V. Larson has to treat the AP as a complement of V, licensed obscurely by an identification of θ-roles. To account for the 'heavy NP-shift' order in

(66)   John ate raw all the fish in the larder

he suggests that the V' is reanalysed as V^0, and that the upper rather than the lower V^0 may then move (giving 'light predicate raising'). If we assume rather that we have $-conjunction of the AP to the V^0, all is clear. The verb does not need a spurious complement AP; and the whole constituent has the category $V^0[\$P]$ without stipulation.

However, for the $-conjunction to be well formed, *raw* must c-select and s-select in the same way as *eat* does. This is simple, if the adjective is ergative. Sigurðsson (1989) has argued for Icelandic that all normal predicate adjectives, including transitive ones, are ergative; we assume the same for English. Certainly adjectives never assign an agentive role. We further assume that an ergative head selects an external role, but assigns a nil θ-role to it. The selections for *eat* and for *raw* then line up, with the s-selection as shown, licensing conjunction. This of course also gives the correct semantics.

(67)   `eat s-selection` $<e, \ <e,t>>$
                            $\theta_1 \quad \theta_2$

(68)   `raw` $<e, \ <e,t>>$
                            $\theta_1 \quad$ `nil`

Notice that we may have very similar structures with prepositions:

(69)   Mary threw the stone into the river

We may assume then that at least some transitive prepositions are also ergative, and that possibly all predicate prepositions are. For further examples of the use of the nil role with $ conjunction, see Cormack and Smith (this volume), on serial verbs.

8.2 Interpretation

In addition, the $-conjunction analysis will be able to account for the variation in interpretation that arise in these structures. Consider again the examples

(61)   John painted the box red.

(62)   John ate the meat raw.

In (61) we get a 'result' reading while in (62) we get a 'while' reading .
        Carston (1993) has a convincing account of the variation in the interpretation of conjoined sentences, as in (70) and (71):

(70)   John ate the meat, and the meat was raw   ('while')

(71)   John painted the box and the lid got stuck   ('result')

        The same account should carry over to the $-conjunction cases with object orientated predicate adjuncts.

9 Extraction and conjunction

9.1 Coordinating conjunction

Consider again a general two-place operator, such as *if*. One of its operands is the host; let us call the other, the adjunct. As is well known, extraction from the host is licensed, while extraction from the adjunct is not. Consider (72), where the first, adjunct, IP is to the right of *if*, and the second operand, the host IP, is to the left.[17]

(72)   The boss must have paid Lucy, if she has bought the food

(73)   Who must the boss have paid *t*, if she has bought the food

(74)   * What must the boss have paid Lucy, if she has bought *t*

---

[17]In this example, on the natural reading, the adjunct cannot be attached at the VP or V^0 level, because it is not inside the scope of the epistemic *must*.

The salient property of coordinate constructions of interest here is that extraction is not possible from either conjunct:[18]

(75)   * What did John eat *t* and drink orange juice?

(76)   * What did john eat sausages and drink *t* ?

If the coordinator is an operator head, as it must be, then we expect extraction to be possible from the host but not the adjunct. The solution we suggest is that there are two operator heads involved in coordination, and that each of them in turn designates one conjunct as opaque to extraction. The 'two heads' idea is not new: it was put forward by Gazdar *et al.* (1985) in order to account for other distributional facts, and is directly supported by the existence of pairs such as *both... and...*, *either...or* and so on. We denote the heads of such pairs generally as & and α, where in particular cases, one or other may be phonologically empty. Consider (77).

(77)   B[αP] [&P]   A[&P] [αP]

        A[&']   B[αP]   A[&P]   B[α']

    &   A   α   B   &   A   α   B

The idea is that the <&,α> pair has to be interpreted BOTH ways: that is, with & as two-place, selecting A and B[αP], where α is one-place; and with α as two-place, selecting B and A[&P], where & is one-place.[19] Coordination then involves a pair of structural descriptions. Under the first, the whole phrase can occur only if B is selected; under the second, the phrase can occur only if A is selected. Satisfying both these requirements gives the correct distribution of conjuncts. Similarly, under the first structural description, A is opaque, and under the second, B is opaque; so there cannot be extraction from either A or B.

The syntactic asymmetry of subordinating conjunction emerges from the fact that there is a single operator head, while the syntactic symmetry of coordination emerges form what is in effect simultaneous asymmetric subordination.

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[18]We have a paper in preparation on 'Conjunction and coordination' which offers more justification for the analysis indicated here.

[19]There are in fact two possible tree pairs which satisfy this description. We have chosen the one with the host as the second operand in each case.

There are well-known apparent exceptions to the impossibility of extraction from coordinate structures. Consider

(78)   Who did John kick and punch *t* ?

(79)   * What did John work and whistle *t* ?

(80)   What did John go and buy *t*?

That extraction in (78) is licensed can be accounted for if we have coordination at the V^0 level [$_{V0[\&P][\alpha P]}$ *kick and punch*]. The extracted noun phrase is simply the single complement of a complex V^0. This process replaces the notion of 'across the board' extraction from coordinate structures. The status of (79) follows from the fact that the unergative verb (type <e,t>) and the transitive verb (type <e,<e,t>>) cannot be conjoined at the V^0 level due to a mismatch in types. Only VP coordination is possible; and then extraction out of a conjunct is unlicensed. In the case of (80), if we have coordination of VPs, the extraction would be illicit. We may however have V_0 conjunction of an ergative and a transitive, if we again invoke nil roles. This time, we need the single θ-role to be assigned to the external argument, and the nil role to the internal one, so that the selection lines up thus:

(81)   *go*   <e, <e,t>>   *buy*   <e, <e,t>>
        θ_1 nil θ_2 θ_3

The situation as far as extraction is concerned is now entirely parallel to that of transitive-transitive coordination as in (78).

There is ample evidence from other languages that ergativity is what is crucial in allowing the extractions in examples such as (80). See in particular Josefsson (1991) on Scandinavian languages, and also Cormack and Smith (this volume) on Nupe, where the same phenomenon occurs with $ conjunction.

It should be noted that contrary to what was suggested in the discussion of section 3, the *if* of *if P, Q* , appears not to be an instance of a subordinating conjunct like $, but rather an instance of &. That is, the pair <*if, then*> is an instance of <&,α>, even where *then* is realised as phonologically null. We cannot extract from either clause in (82):

(82)   If Mary told John, (then) Bill told Sue.

(83)   * Who did if Mary told *t*, (then) Bill *v* tell Sue?

(84)   * Who did if Mary told John (then) Bill *v* tell *t*?

The α-operator status of *then* is confirmed by the existence of a polymorphic variant of '*if* IP1 (*then*) IP2', of the form '*if* IP1 (*then*) CP2' as in (85); at least, it is not obvious to what other category the item would belong.[20]

(85)   If Mary takes the car, (then) how will we get home?

Thus coordinated structures are apparently not confined to the symmetric logical operators, but extend to the asymmetric ones.

9.2 Subordinating conjunction

In this section, we consider an interesting case of apparent extraction from an adjunct observed and discussed by Borgonovo and Neeleman (1993). Consider examples like

(86)   What did John die whistling *t* ?

As Borgonovo and Neeleman note, this extraction from the *-ing* phrase is only possible if the tensed verb is ergative.

(87)   * What did John paint the room whistling *t* ?

(88)   * What did John work whistling *t* ?

Extraction from the tensed VP is however possible, as in

(89)   What did John paint *t* whistling Greensleeves?

The obvious conclusion for us is that what we have here is $ conjunction, at either the VP or V^0 level.[21]   For (89), we have a gap only in the tensed VP, so we need $

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[20]Notice that according to the schemas in (77) above, the whole will be parsed both as an IP and as a *wh* CP. The consequence is that it cannot be embedded, except as a quotation or semi-quotation.

[21]Borgonovo and Neeleman have a totally different account of the data. Theirs is motivated in part by sentences such as (i) *What did John hurt himself trying to fix t*. From this they infer that all the relevant structures are in some sense reflexive. For us, it has to be the case that *to hurt oneself* as opposed to the ordinary transitive *hurt* is ergative. This is not implausible given that in the former the subject role is an experiencer, but in the latter, an agent.

conjunction of VP and VP*ing*. Thus extraction is licensed, since it is from the host VP. In (86), since the gap is in the adjunct, let us suppose that we have $ conjunction at the V^0 level:[22]

(90)   What did John $[_{VP} [_{V0[\$P]} [\$ \text{ die whistling}]] [t]]$

The extraction is then unproblematic. Notice that as with the examples in section 9.1, the ergative verb must assign its real role externally and the nil role internally.

    For (87) there cannot be V^0 conjunction because there are two distinct objects. In (88) V^0 conjunction is disallowed, because the tensed verb is unergative, so the types cannot be matched. In neither will VP conjunction permit extraction, since the gap would be in the adjunct category.

    One interesting consequence of this analysis of $-conjunction of the ergative verb as in (90) is that in essence it conforms to the paradigm of certain parasitic gap constructions, as can be seen by comparing the three examples below. Larson (1988b) also argues that these constructions are derived similarly.

(91)   Which articles did John $[_{VP} [_{V0[JP]} \text{file without reading}] t]$?[23]

(92)   Which article did you $[_{VP} [_{V0[JP]} \text{go to London without reading}] t]$?[24]

(93)   Which articles did John $[_{VP} [_{V0[\$P]} \text{ruin editing}] t]$?

It would follow from the approach we have been pursuing that (91) and (92) should be treated in the same way as (90) or (93), that is, by type shifting the two-place operator to accommodate its <e,<e,t>> operands. We envisage that it should be possible to construct an account of parasitic gap sentences along these lines.

10 Licensing and coordination

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[22]We could in fact postulate <&,α> conjunction here, but the lexicon and learning would then be complicated by the phonologically null α, where we otherwise have *and*. Also, as we see for (89), we must allow $ VP VP*ing*, so it seems natural that $ V V*ing* is also permitted. This leaves us without an explanation as to why we can have *John painted the box [t red]*, but not *John ruined the articles t editing*. Larson's explanation, of obligatory reanalysis, fails in the light of (93) below.

[23]Notice that, under this analysis, *without* is a two-place operator, similar to $ and <u>if</u> above.

[24](92) is taken from Steedman (1987), who similarly takes [file without reading] and so on to be constituents. The phrase *go to London* is still ergative, in the sense that it may have an internal nil argument. We put it at V^0 for convenience.

An interesting consequence of our hypothesis about coordination is that it makes a sharp distinction between two sorts of wellformedness conditions. On the one hand, licensing conditions, such as those imposed by c-selection, or conditions determining opacity with respect to extraction, apply by hypothesis to each of the coordinate structural descriptions. On the other hand, checking appears only to have to be done once. Consider example (94). Case will not be assigned to the object noun phrase trace under the structural description where *go* is the host, but the sentence is nevertheless grammatical.

(94)   What did John go and buy *t* ?

Of course, if both verbs assigned Case the example would still be grammatical, so the checking mechanism must allow for one or more legitimate Case assigners. The mechanism suggested in Chomsky (1993) would need to be amended to accommodate this situation.

Another instance of checking just once is provided by an example from Reinhart and Reuland (1993), quoted in Borgonovo and Neeleman (1993):

(95)   The queen invited both Max and herself to our party

There will be two structural descriptions associated with the coordinate structure, one involving *Max* as host, and one involving *herself* as host. We assume that it is just the latter which licenses the reflexive, because when *Max* is host, no projection of *herself* is a sister to *invited*. However, in this instance, the reflexive is not disallowed: checking is only positive.

11 Conclusions

This paper has been an examination of non-relational heads, in the light of the principle that all structure is head-mediated. We have argued for a distinct projection for operator categories. Operators are in principle optional, and usually polymorphic. We showed that minor categories, functional categories, and the $, & and α heads should be treated as operator categories, taking one or two operands. We differ from Rothstein (1991) and Sportiche (1994) in making no use of the notion of specifier, and having explicit double-headedness. It appears that the lexical entry for operator heads has to contain information relating to constituent order, and perhaps to the host/non-host distinction. We assume that there must be UG principles and language particular parameters to be found, which will constrain the amount of information required in

the lexical entry for each operator. There also need to be principles which determine the visibility for syntactic processes of operator projections.

We have been able here to do no more than indicate some of the consequences of this hypothesis about operator categories. There is plainly much more work to be done, but we hope we have shown that pursuing these ideas is explanatory of matters pertaining both to particular languages and to UG.

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