Catalan Clitics

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Les clitiques du catalan

RÉSUMÉ

Après une introduction à la grammaire catégorielle en ce qui concerne la structure basique de phrase, on offre un traitement du concord entre sujet et verbe parmi un formalisme qui comprend des types de logique de prediqués. Cet appareil théorique est alors appliqué à l'analyse des clitiques pour laquelle on se sert de l'opération de "lifting". Des phénomènes tels que le doublage de clitique et le pro-drop de sujet sont traités dans le formalisme de la logique catégorielle. On rend compte du fait que la cliticisation se produit dans la domaine de la phrase en faisant référance aux domaines d'intensionalité temporelle, lesquelles permetten d'exprimer ce que les clitiques peuvent franchir des verbes infinitivals.

ABSTRACT

After a brief introduction to categorial grammar in relation to basic sentence structure, subject-verb agreement is implemented within the formalism with predicate-logical types. The apparatus is then applied to an analysis of clitics in terms of lifting. Phenomena such as clitic doubling and subject pro drop are treated in the general formalism of categorial logic. The clause-locality of cliticisation is captured by reference to temporally intensional domains in relation to which clitic-climbing over infinitival verbs is characterised.

CATEGORIAL GRAMMAR

Let us regard a language as a system associating symbols and meanings; a model of a language will be built out of prosodic and semantic objects. A sign is a prosodic object/semantic object pair; a type is a set of signs. An (indexed) language model is a set of types (indexed by a set of type formulas), intended to match the association between symbols and meanings in various categories of the language observed. Prosodic and semantic objects are designated structurally by prosodic and semantic forms. An assignment is a prosodic form/semantic form/type formula triple. A formal language model is a set of assignments. A formal language model will be specified by a formal grammar, most simply a set of initial assignments (a lexicon) and a set of rules of formation under which the initial assignments are to be closed to generate the formal language model.

In categorial grammar, certain categories (names, statements, ...) are regarded as corresponding to signs which are primarily meaningful (or: complete). These categories are represented by basic types (N, S, ...). Further categories are identified as follows: if an expression prefixes itself to expressions of signs in category *B* to form expressions of signs in category *A*, then that expression is of category *A*/*B* with semantics the function from the semantics of signs in category *B* to the semantics of the signs in category *A* that it forms on prefixation; likewise, if an expression suffixes itself to expressions of signs in category *B* to form expressions of signs in category *A*, then that expression is of category *B**A* with semantics the function from the semantics of signs in category *B* to the semantics of the signs in category *A* that it forms on suffixation.

This scheme describes an inhabitation of basic types by signs inducing an inhabitation of all types generated by the directional division type constructors. Alternatively, we may regard it as setting the conditions for a particular indexed language model to be legitimate. Corresponding to this interpretation of types, a statement that a given operation applies to some given set of types to yield an inhabitant of a given further type may be valid, or may not be. Thus we may consider a calculus of types designed to capture exactly those formation statements which are valid. The theorems of such a calculus (the valid statements) are the rules of formation.

Calculi differ depending on the algebraic properties of the notion of combination (product) on which prefixation and suffixation (division) are based. Lambek (1961) gives the non-associative case, and Lambek (1958) the associative one. This paper by and large employs the latter:

(1)

$$x : A \Rightarrow x : A \quad [\mathrm{id}] \qquad \frac{\Gamma \Rightarrow \alpha : A \qquad \Delta(x : A) \Rightarrow \beta : B}{\Delta(\Gamma) \Rightarrow \beta[x \leftarrow \alpha]}[\mathrm{Cut}]$$

$$\frac{\Gamma \Rightarrow \gamma : A/B \qquad \Delta \Rightarrow \beta : B}{\Gamma\, \Delta \Rightarrow (\gamma\, \beta) : A}[/E] \qquad \frac{\Delta \Rightarrow \beta : B \qquad \Gamma \Rightarrow \gamma : B\backslash A}{\Delta\, \Gamma \Rightarrow (\gamma\, \beta) : A}[\backslash E]$$

$$\frac{\Gamma\, y : B \Rightarrow \alpha : A}{\Gamma \Rightarrow (\lambda y \alpha) : A/B}[/I] \qquad \frac{y : B \quad \Gamma \Rightarrow \alpha : A}{\Gamma \Rightarrow (\lambda y \alpha) : B\backslash A}[\backslash I]$$

The statements of formation generated by this formal system consist of a sequence of antecedent semantic assignments to variables, and a consequent assignment to a semantic term; the prosodics of the consequent is left implicit, being the left-to-right concatenation of the antecedent prosodics. The semantic terms are interpreted as terms of the lambda calculus, satisfying beta-reduction:

(2) $((\lambda x \alpha)\ \beta) = \alpha[x \leftarrow \beta]$

Derivations are presented in (3) and (4).

(3)

```
El Joan     pensa     que   el Pere    parla      de   la Maria
----------- ------------ -------- --------- ------------ ------- -----------
     N     (N\S)/CP CP/S      N     (N\S)/Nd  Nd/N     N
                                                 -------------/E
                                                       Nd
                                         ---------------------/E
                                                 N\S
                                   ---------------------\E
                                              S
                         -----------------------/E
                                   CP
           ----------------------------/E
                     N\S
     -------------------------\E
               S
```

(4)

```
    vol         donar      aquest  llibre
------------ ------------- ----------- ------- ----1
(N\S)/VP (VP/Na)/N   N/CN     CN     Na
                           --------------/E
                                  N
            -----------------------/E
                    VP/Na
                      -----------------------------/E
                                  VP
--------------------------------------/E
                N\S
            -----------/I1
            (N\S)/Na
```

PREDICATE-LOGICAL TYPES

Pure ‘propositional’ categorial grammar assumes unstructured atomic type formulas. This means that no relation between atomic types is expressed other than whether or not they are identical. Linguistic applications however demand a classificatory scheme which, for example, can indicate identity of major features despite difference of minor features in order that generalisations on the basis of major features can be captured. The straightforward generalisation of the formalism is to allow atomic type formulas to be Prolog-like first-order predicate-logical structures composed of feature constants, feature functions and type predicates, with feature variables being implicitly universally quantified at the outer level of a type formula. Then valid type inferences may be implemented by performing rules of inference with matching and unification on feature terms (see Morrill 1990a for this quantificational perspective on the role of unification).

Consider for instance the first conjugation as exemplified by the transitive verb *trobar*:

(5) jo trobo nosaltres trobem
tu trobes vosaltres trobeu
ell, ella troba ells, elles troben

The value for agreement on the subject is constrained by the verb; there is no constraint on the object:

(6) trobo - **find** := (N(1(sg))\S)/N(_)
trobes - **find** := (N(2(sg))\S)/N(_)
troba - **find** := (N(3(sg))\S)/N(_)
trobem - **find** := (N(1(pl))\S)/N(_)
trobeu - **find** := (N(2(pl))\S)/N(_)
troben - **find** := (N(3(pl))\S)/N(_)

Proper names are categorized as follows.

(7) el Joan - **john** := N(3(sg))
la Maria - **mary** := N(3(sg))

Then derivation may proceed as illustrated in (8).

```
(8)  El Joan      troba              la Maria
     ----------- ---------------------- -----------
     N(3(sg)) (N(3(sg))\S)/N(_) N(3(sg))
                    --------------------------------/E
                          N(3(sg))\S
     -------------------------------------\E
                       S
```

The derivation induces a semantic term indicating how the semantics of the compound expression generated by the derivation is composed out of the semantics of the words from which it is formed. The semantic term assigned by the derivation above is (9a). On substitution of the lexical semantics this becomes (9b).

(9) a. $((x_{\text{troba}}\ x_{\text{la Maria}})\ x_{\text{El Joan}})$
b. ((**find mary**) **john**)

Similarly the lexical assignments in (10) induce the derivation in (11).

(10) escriu - **write** := (N(3(sg))\S)/N_a(_)
a - (λxx) := $N_a(a)/N(a)$

```
(11) El Joan      escriu              a             la Maria
     ----------- ----------------------- ------------- -----------
     N(3(sg)) (N(3(sg))\S)/Na(_) Na(a)/N(a) N(3(sg))
                                        -------------------------/E
                                              Na(3(sg))
                    -------------------------------------------/E
                               N(3(sg))\S
     ------------------------------------------\E
                        S
```

Since the semantics of the preposition is taken to be the identity function, substitution of the lexical semantics into the semantic term (12a) yields (12b) on simplification.

(12) a. $((x_{\text{escriu}}\ (x_{\text{a}}\ x_{\text{la Maria}}))\ x_{\text{El Joan}})$

b. ((**write mary**) **john**)

SUBJECT AND OBJECT PRONOUNS: LIFTING

A featural approach might be taken to the constraints imposed by case as well as to those imposed by agreement. Here however we follow Lambek (1958) in encoding case by ‘type-raising’ or *lifting*; subject and object pronouns will be treated uniformly in this manner. The lexical type assignments for subject pronouns are as follows:

(13)	jo	- (λ*x*(*x* 1(sg)))	:= S/(N(1(sg))\S)
	tu	- (λ*x*(*x* 2(sg)))	:= S/(N(2(sg))\S)
	ell	- (λ*x*(*x* 3(sgm)))	:= S/(N(3(sg))\S)
	ella	- (λ*x*(*x* 3(sgf)))	:= S/(N(3(sg))\S)
	nosaltres	- (λ*x*(*x* 1(pl)))	:= S/(N(1(pl))\S)
	vosaltres	- (λ*x*(*x* 2(pl)))	:= S/(N(2(pl))\S)
	ells	- (λ*x*(*x* 3(plm)))	:= S/(N(3(pl))\S)
	elles	- (λ*x*(*x* 3(plf)))	:= S/(N(3(pl))\S)

In the following derivation the subject now combines with its verb phrase as a functor rather than as an argument; the semantics for lifting is given by lambda abstraction in the same way as for lifting of proper names in Montague's fragments.

(14)
```
        Jo                 trobo          la Maria
------------------- --------------------- -----------
S/(N(1(sg))\S) (N(1(sg))\S)/N(_) N(3(sg))
                    ---------------------------------/E
                              N(1(sg))\S
-------------------------------------------/E
                    S
```
The semantics is as shown in (15).

(15) a. $(x_{\text{Jo}}\ (x_{\text{trobo}}\ x_{\text{la Maria}}))$

b. ((**find mary**) 1(sg))

Since N(3(sg)) ⇒ S/(N(3(sg))\S) is a rule of formation, a proper name can adopt the subject pronoun type and so occur anywhere the pronoun can. However, since the reverse of the rule is invalid, a subject pronoun will not necessarily be able to occur everywhere that a proper name can; thus in particular the following is not generated as a sentence.

(16) *El Joan troba jo.

Clitics, such as accusitive object pronouns, precede their verb if it is finite (they follow their verb if it is infinite) rather than follow it like their lexically full counterparts; the lifted type they are assigned accords with this placement:

(17) la - (λ*x*(*x* 3(sgf))) := (N(*a*)\S)/((N(*a*)\S)/N(3(sg)))
el - (λ*x*(*x* 3(sgm))) := (N(*a*)\S)/((N(*a*)\S)/N(3(sg)))
les - (λ*x*(*x* 3(plf))) := (N(*a*)\S)/((N(*a*)\S)/N(3(pl)))
els - (λ*x*(*x* 3(sgm))) := (N(*a*)\S)/((N(*a*)\S)/N(3(pl)))

Then there are derivations such as (18) with semantics as in (19).

(18)
```
El Joan     la                                  troba
----------- ----------------------------------- ----------------------
N(3(sg)) (N(a)\S)/((N(a)\S)/N(3(sg))) (N(3(sg))\S)/N(_)
              -------------------------------------------------------/E
                               N(3(sg))\S
---------------------------------------------\E
                     S
```

(19) a. $((x_{\mathrm{la}}\ x_{\mathrm{troba}})\ x_{\mathrm{El\ Joan}})$
b. ((**find** 3(sgf)) **john**)

Since N(3(sg)) ⇒ S/(S/N(3(sg))) is not a rule of formation, a proper name cannot adopt this pronoun type and word orders such as *El Joan la Maria troba*, 'John finds Mary', are not generated as sentences.

CLITICS

This section surveys the various kinds of clitic form in Catalan over and above those of the previous section (see e.g. Fabra 1956). The clitic functions described pertain to the València dialect.

The reflexive clitic *es*, apart from its use with ergatives (*el vidre es trenca*, 'the glass breaks'), inherently reflexives (*El Joan s'equivoca*, 'John is wrong'), and impersonals (*es venen pisas*, 'flats are sold'), signifies reflexivisation of a verb with respect to its third person subject:

(20) a. El Joan renta les tasses.
'John washes the cups'
b. El Joan es renta.
'John washes himself'
c. *(Jo) es rento

(21) renta - **wash** :=
(N(3(sg))\S)/N(_)
es - (λ*x*(λ*y*((*x y*) *y*))) :=
(N(3(*n*))\S)/((N(3(*n*))\S)/N(3(*n*)))

Derivation and semantics is as follows.

(22)
```
                 es                            renta
----------------------------------------- ---------------------
(N(3(n))\S)/((N(3(n))\S)/N(3(n))) (N(3(sg))\S)/N(_)
----------------------------------------------------------------/E
                         N(3(sg(_)))\S
```

(23) a. $(x_{\mathrm{es}}\ x_{\mathrm{renta}})$
b. (λ*y*((**wash** *y*) *y*))

The clitic *en* is associated with a variety of functions (see e.g. Bartra 1987), amongst which is the satisfaction of a verb or noun *de* nominal complement requirement:

(24) a. El Joan parla d'aquest llibre.
'John talks about this book'
b. El Joan en parla.
'John talks about it'

(25) a. El Joan llegeix la introducctió d'aquest llibre.
'John reads the introduction of this book'
b. El Joan en llegeix la introducctió.
'John reads its introduction'

(26) en - **of-it** := (N(*a*)\S)/((N(*a*)\S)/N_d(3(_)))

Note that in (25b) the clitic attaches to a verb which is not the head of the complement position that the clitic binds: clitics are not limited to satisfying just the valency of their verb.

(27)

```
                en                        llegeix          la introductió
------------------------------------ ---------------------- --------------------- -----------1
(N(a)\S)/((N(a)\S)/N_d(3(_))) (N(3(sg))\S)/N(_) N(3(_))/N_d(3(_)) N_d(3(_))
                                                                 --------------------------------/E
                                                                           N(3(_))
                                         ------------------------------------------/E
                                                   N(3(sg))\S
                                                  ----------------------------/I1
                                                  (N(3(sg))\S)/N_d(3(_))
------------------------------------------------------------------------------/E
                              N(3(sg))\S
```

The clitic *hi* may perform locative adverbial modification, and *ho*, sentential complementation.

(28) a. El Joan vagi a la biblioteca.
John goes to the library
b. El Joan hi vagi.
'John goes there'

(29) a. El Joan pensa que la Maria canta.
'John thinks that Mary sings'
b. El Joan ho pensa.
'John thinks so'

(30) hi - **there** := (N(*a*)\S)/((N(*a*)\S)))
ho - **so** := (N(*a*)\S)/((N(*a*)\S)/CP))

The second person clitics *et* (sg) and *us* (pl) can satisfy either a direct object or indirect object valency (dative clitics can also fulfill an 'ethic' role expressing someone to whom an act is beneficient; this aspect is not included here).

(31) a. El Joan et renta.
'John washes you(sg)'
b. El Joan t' escriu.
'John writes to you(sg)'

(32) a. El Joan us rento.
'John washes you(pl)'
b. El Joan us escriu.
'John writes to you(pl)'

The first person *em*(sg) and *ens*(pl) behave likewise.

(33) a. El Joan em renta.
'John washes me'
b. El Joan m' escriu.
'John writes to me'

(34) a. El Joan ens renta
'John washes us'
b. El Joan ens escriu.
'John writes to us'

In order to capture the polymorphism exhibited here a conjunctive type-constructor & is used (see Morrill 1990a). Note that the same semantics is given to cover the cases where the clitic binds direct and indirect object positions.

(35) ens - ($\lambda x(x$ 1(pl))) := (N(*a*)\S)/((N(*a*)\S)/(N(2(sg))&N_a(2(sg))))

The rules for the type-constructor are as follows:

(36)
$$\frac{\Gamma \Rightarrow \alpha : B \qquad \Gamma \Rightarrow \alpha_1 : C}{\Gamma \Rightarrow \alpha : B\&C}\,[\&I],\ \alpha = \alpha_1$$

$$\frac{\Gamma \Rightarrow \gamma : A\&B}{\Gamma \Rightarrow \gamma : A}\,[\&E_a] \qquad \frac{\Gamma \Rightarrow \gamma : A\&B}{\Gamma \Rightarrow \gamma : B}\,[\&E_b]$$

The derivations in (37) and (38) illustrate how both a transitive verb and a prepositional verb inhabit the argument type of *ens.*

(37)

ens renta
-- ----------------------- -----------------------1
(N(*a*)\S)/((N(*a*)\S)/(N(1(pl))&N_a(1(pl)))) (N(3(sg))\S)/N(_) N(1(pl))&N_a(1(pl))
----------------------&E_a
N(1(pl))
---------------------------------------/E
N(3(sg))\S
---/I1
(N(3(sg))\S)/(N(1(pl))&N_a(1(pl)))
--/E
N(3(sg))\S

(38)

```
                    ens                                    escriu
--------------------------------------------------- ------------------------ -----------------------1
(N(a)\S)/((N(a)\S)/(N(1(pl))&Na(1(pl)))) (N(3(sg))\S)/Na(_) N(1(pl))&Na(1(pl))
                                                                   ---------------------&Eb
                                                                        Na(1(pl))
                                                      ------------------------------------/E
                                                                N(3(sg))\S
                                                       ---------------------------------------/I1
                                                      (N(3(sg))\S)/(N(1(pl))&Na(1(pl)))
-----------------------------------------------------------------------------------------------/E
                                        N(3(sg))\S
```

The clitics *li* and *els* bind third person dative objects with which they optionally co-occur; in the event of such clitic doubling there must be agreement of number.

(39) a. El Joan li/*els escriu a la noia

b. El Joan *li/els escriu a les noies

In order to capture such possibilities intersection may again be used, but it is necessary for the semantics to be different depending on whether it is to be taken from a realised complement, or just the agreement features of the clitic.

(40) li - $(\lambda x((x\ 3(sg)), x))$:=
$((N(a)\backslash S) \wedge ((N(a)\backslash S)/N_a(3(sg))))/((N(a)\backslash S)/N_a(3(sg)))$

els - $(\lambda x((x\ 3(pl)), x))$:=
$((N(a)\backslash S) \wedge ((N(a)\backslash S)/N_a(3(pl))))/((N(a)\backslash S)/N_a(3(pl)))$

The rules of use and proof for this semantically potent conjunction are semantically interpreted in terms of pairing and projection; the earlier, semantically impotent, conjunction was semantically interpreted by just identity.

(41)
$$\frac{\Gamma \Rightarrow \alpha : B \qquad \Gamma \Rightarrow \alpha_1 : C}{\Gamma \Rightarrow (\alpha, \alpha_1) : B \wedge C}[\wedge I],$$

$$\frac{\Gamma \Rightarrow \gamma : A \wedge B}{\Gamma \Rightarrow (\pi_1 \gamma) : A}[\wedge E_a] \qquad \frac{\Gamma \Rightarrow \gamma : A \wedge B}{\Gamma \Rightarrow (\pi_2 \gamma) : B}[\wedge E_b]$$

The reduction laws for pairing and projection are given in (42).

(42) $(\pi_1(\alpha, \beta)) = \alpha$

$(\pi_2(\alpha, \beta)) = \beta$

Clitic doubling and non-clitic doubling derivations are as follows.

(43)

els escriu

$((N(a)\backslash S)\wedge((N(a)\backslash S)/N_a(3(pl))))/((N(a)\backslash S)/N_a(3(pl)))$ $(N(3(sg))\backslash S)/N_a(\_)$

---/E

$(N(3(sg)))\backslash S)\wedge((N(3(sg)))\backslash S)/N_a(3(pl)))$

---$\wedge E_b$

$(N(3(sg)))\backslash S)/N_a(3(pl))$

(44) $(\pi_2(x_{els}\ x_{escric}))$

write

(45)

els escriu

$((N(a)\backslash S)\wedge((N(a)\backslash S)/N_a(3(pl))))/((N(a)\backslash S)/N_a(3(pl)))$ $(N(3(sg))\backslash S)/N_a(\_)$

---/E

$(N(3(sg)))\backslash S)\wedge((N(3(sg)))\backslash S)/N_a(3(pl)))$

---$\wedge E_a$

$N(3(sg))\backslash S$

(46) $(\pi_1(x_{els}\ x_{escriu}))$

(**write** 3(sg))

The first and second person clitics may also double with a realised prepositional phrase; the object of the co-occuring complement will be an agreeing reflexive such as *a mi* (*mateix*) (‘myself’). This could be treated in a similar manner to the doubling of third person datives, though we do not pursue this here; that the non-third person cases carry always an emphatic force may suggest some distinction.

SUBJECT PRO-DROP

Main and embedded sentences of Catalan exhibit subject pro-drop, by which subjects are omitted; they are interpreted according to principles of agreement.

(47) a. Canto.
‘I sing’
b. El Joan pensa que canto.
‘John thinks that I sing’

In order to treat this we will employ explicit and semantically potent existential feature quantification, semantically interpreted by pairing and projection, like conjunction (see Morrill 1990a). The rules of inference for the existential type constructor are as follows.

(48) $\Gamma \Rightarrow \alpha : A[v \leftarrow F]$
$$\frac{\Gamma \Rightarrow \alpha : A[v \leftarrow F]}{\Gamma \Rightarrow (F, \alpha) : \exists vA}\exists I$$

$$\frac{\Gamma \Rightarrow \gamma : \exists vA \qquad \Delta(x : A[v \leftarrow (\pi_1\gamma)]) \Rightarrow \beta : B}{\Delta(\Gamma) \Rightarrow \beta[x \leftarrow (\pi_2\gamma)] : B}\exists L$$

Consider *que*. In order to allow its complement sentence to be without a subject it may have type CP/(∃*a*(N(*a*)\S)) where the embedded sentence is missing a nominal at its left edge with some agreement. The semantics is to take the existential type argument and apply the verbal meaning (second projection) to the agreement value (first projection): $(\lambda x((\pi_2 x)\ (\pi_1 x)))$.

(49)

```
        que                 trobo           la Maria
--------------------- --------------------- -----------
CP/(∃a(N(a)\S)) (N(1(sg))\S)/N(_) N(3(sg))
                         ---------------------------------/E
                                  N(1(sg))\S
                                  -------------∃I
                                  ∃a(N(a)\S)
---------------------------------------------/E
                     CP
```

(50) $(x_{\text{que}}\ (1(\text{sg}),\ (x_{\text{trobo}}\ x_{\text{la Maria}})))$
((**find mary**) 1(sg))

To allow in addition an embedded sentence to be complete, a semantically potent disjunction will be used:

(51)
$$\frac{\Gamma \Rightarrow \alpha : A}{\Gamma \Rightarrow (\mathrm{i}\alpha) : A \vee B}[\vee I_a] \qquad \frac{\Gamma \Rightarrow \beta : B}{\Gamma \Rightarrow (\mathrm{j}\beta) : A \vee B}[\vee I_b]$$

$$\frac{\Gamma(x : A) \Rightarrow \gamma : C \qquad \Gamma(y : B) \Rightarrow \gamma_1 : C}{\Gamma(w : A \vee B) \Rightarrow (w \rightarrow x.\ \gamma;\ y.\ \gamma_1) : C}[\vee E]$$

The semantic interpretation is given in terms of a programming case statement: in the case that input is tagged i, substitute in the first branch; in the case j, in the second branch.

(52) $((\mathrm{i}\alpha) \rightarrow x.\ \gamma;\ y.\ \gamma_1) = \gamma[x \leftarrow \alpha]$
$((\mathrm{j}\alpha) \rightarrow x.\ \gamma;\ y.\ \gamma_1) = \gamma_1[y \leftarrow \alpha]$

(53) que - $(\lambda x(x \rightarrow y.\ ((\pi_2 y)\ (\pi_1 y));\ z.\ z))$:= CP/((∃*a*(N(*a*)\S))∨S)

Since subject pro-drop is also permitted in main clauses, where there is no embedding element to license the omission, it is proposed to admit a simple generalisation of the formalism:

(54) Main Clause Types

> Rather than a single distinguished sentence type, there is a parameter of grammar specifying a finite set of main clause type formulas.

Such a parameter (which in a categorial grammar of the kind envisaged here will be the only one other than the lexicon) would be employed in relation to main clause phenomena such as topicalisation, and V2. Thus in English, the main clause types will include NP·(S/NP), PP·(S/PP), etc. where · is the product. Then a main clause may consist of a topicalised maximal projection followed by a sentence lacking that constituent. An appropriate semantic term should be assigned to each main clause type formula showing how semantics in these pragmatically significant types is mapped into the logical value in the actual (truth-valued) sentence domain. In the case of Catalan main clause subject pro-drop there is the following:

(55) $\exists a(N(a)\backslash S) \Rightarrow ((\pi_2 x)\ (\pi_1 x))$

For alternative presentations of subject pro drop, in terms of lexical lifting of nominals, as well as for unificational cliticisation, see Beaven (1990) and Sanfilippo (1990).

MEDIAL CLITICISATION

The types used so far command a rather too limited control over word order. They form a logic emphasising immediate adjacency in resource order, but are not suited to partial ordering constraints allowing limited permutation. In Morrill, *et al.* (1990) and Barry *et al.* (1991) a structural modality for permutation is proposed, drawing inspiration from the use of structural modalities in linear logic to govern resource transformations by structural rules. This machinary will be applied to allow non-peripheral cliticisation such as that in (56) which the earlier types are unable to generate.

(56) La dono a la Maria.
‘I give it to Mary’

The categorization of *donar* is as illustrated in (57).

(57) dono - **give** := $((N(1(sg))\backslash S)/N_a(\_))/N(\_)$

Clitics are to now receive types such as (58) seeking a verb phrase missing a permutable nominal. The logic of permutation is presented in (59).

(58) la - $(\lambda x(x\ \ 3(sgf)))$:= $(N(a)\backslash S)/((N(a)\backslash S)/(HN(3(sg))))$

(59)

$$\frac{\Gamma \Rightarrow \alpha : HA}{\Gamma \Rightarrow \alpha : A}[HE] \qquad \frac{H\Gamma \Rightarrow \alpha : A}{H\Gamma \Rightarrow \alpha : HA}[HI]$$

$$\frac{\Gamma\ x : A\ \ y : B\ \ \Delta \Rightarrow \gamma : C}{\Gamma\ y : B\ \ x : A\ \ \Delta \Rightarrow \gamma : C}[HP],\ A \text{ or } B \text{ is } HD$$

The word order in (56) is now derived as follows:

(60)

```
                 la                                  dono            a la M.
-------------------------------------------- ---------------------------------- -------- ---------------1
(N(a)\S)/((N(a)\S))/(HN(3(sg)))) ((N(1(sg))\S)/Na(_))/N(_) Na(_)  HN(3(sg))
                                                                  -----------------HP
                                                                   HN(3(sg))  Na(_)
                                                                  -----------HE
                                                                     N(3(sg))
                                             ---------------------------------------------/E
                                                 (N(1(sg))\S)/Na(_)
                                                   --------------------------------------------/E
                                                          N(1(sg))\S
                                                      ---------------------------------/I1
                                                      (N(1(sg))\S)/(HN(3(sg)))
---------------------------------------------------------------------------------------------------/E
                                      N(1(sg))\S
```

CLITIC ORDER

Clitics are subject to a rigid ordering according to their form; for instance, second and third person clitics must be ordered with respect to one another:

(61) a. Us les dono.
'I give them to you (pl)'
b. *Les us dono.

There are also constraints on co-occurence, but no upper bound on the number of clitics that may occur in a sequence, other than simultaneous satisfaction of their individual conditions of use, e.g. Solà (1973:56) presents the following.

(62) se te me li n'hi posarà tres

In the València dialect, the possibilities are limited to the following, where at most one clitic from each class may appear, and clitics occur in the left-to-right order of some traversal from root to leaf.

```
(63)                                                              → ho
        es → et|us → em|ens → li|els → el|la|els|les → en
                                                                  → hi
```

In prescribed Catalan the ordering is as follows (taken from Mascaró 1986:138):

```
(64)                           → els → el|la|els|les              → ho
        es → et|us → em|ens                              → en
                                      → li                        → hi
```

The graph is now re-entrant. Relative to the València dialect, *li* is unable to co-occur with any member of the gendered accusitive class. The Barcelona dialect possibilities are circumscribed by the following.

(65) → ho
es → et|us → em|ens → el|la|els|les → en → hi
→ li

The prescribed and Barcelona clitics differ from the València in function as well as order. In the course of presentation some indications will be made in the direction of capturing alternative orderings, but note that these remarks fall well short of addressing the alternative systems properly. There are many more subtleties.

We treat clitic order by means of a feature on sententials for clitisisation class (cf. Baschung *et al*. 1987): a whole number which encodes increasing cliticisation reactivity with increasing value. For space and clarity, clitic class feature structures are notated $\mathbb{1}$, $\mathbb{2}$, $\mathbb{3}$, … and $\boldsymbol{\mathbb{1}}$, $\boldsymbol{\mathbb{2}}$, … for 1, 2, 3, … and not less than 1, not less than 2, …; these stand for s(0), s(s(0)), s(s(s(0))), … and s(_), s(s(_)), ….

(66) es := (N(3(*n*))\S(0))/((N(3(*n*))\S($\boldsymbol{\mathbb{1}}$))/(HN(3(*n*))))

(67) et := (N(*a*)\S($\mathbb{1}$))/((N(*a*)\S($\boldsymbol{\mathbb{2}}$))/(HN(2(sg))))

us := (N(*a*)\S($\mathbb{1}$))/((N(*a*)\S($\boldsymbol{\mathbb{2}}$))/(HN(2(pl))))

(68) em := (N(*a*)\S($\mathbb{2}$))/((N(*a*)\S($\boldsymbol{\mathbb{3}}$))/(HN(1(sg))))

ens := (N(*a*)\S($\mathbb{2}$))/((N(*a*)\S($\boldsymbol{\mathbb{3}}$))/(HN(1(pl))))

(69) li := (N(*a*)\S($\mathbb{3}$))/((N(*a*)\S($\boldsymbol{\mathbb{4}}$))/(HN_a(3(sg))))

els := (N(*a*)\S($\mathbb{3}$))/((N(*a*)\S($\boldsymbol{\mathbb{4}}$))/(HN_a(3(pl))))

(70) el := (N(*a*)\S($\mathbb{4}$))/((N(*a*)\S($\boldsymbol{\mathbb{5}}$))/(HN(3(sg))))

la := (N(*a*)\S($\mathbb{4}$))/((N(*a*)\S($\boldsymbol{\mathbb{5}}$))/(HN(3(sg))))

els := (N(*a*)\S($\mathbb{4}$))/((N(*a*)\S($\boldsymbol{\mathbb{5}}$))/(HN(3(pl))))

les := (N(*a*)\S($\mathbb{4}$))/((N(*a*)\S($\boldsymbol{\mathbb{5}}$))/(HN(3(pl))))

(71) en := (N(*a*)\S($\mathbb{5}$))/((N(*a*)\S($\boldsymbol{\mathbb{6}}$))/(HN_d(3(_))))

(72) hi := (N(*a*)\S($\mathbb{6}$))/(N(*a*)\S($\boldsymbol{\mathbb{7}}$))

(73) ho := (N(*a*)\S($\mathbb{6}$))/((N(*a*)\S($\boldsymbol{\mathbb{7}}$))/(HCP))

For prescribed Catalan, the assignment to *li* in (69) becomes the following:

(74) li := (N(*a*)\S($\mathbb{3}$))/((N(*a*)\S($\boldsymbol{\mathbb{5}}$))/(HN_a(3(sg))))

Likewise, for the Barcelona dialect ordering the entries for *li* and *ho* should become:

(75) li := (N(*a*)\S($\mathbb{3}$))/((N(*a*)\S($\boldsymbol{\mathbb{7}}$))/(HN_a(3(sg))))

ho := (N(*a*)\S($\mathbb{3}$))/((N(*a*)\S($\boldsymbol{\mathbb{7}}$))/(HCP))

And the clitic *els* now belongs to one class only. For a rationale of the Barcelona system see Gavarró (1990).

BLOCKING PREPOSITION STRANDING

Stranding of prepositions in Catalan is ungrammatical.

(76) a. *Ens escrius a.
'You(sg) write to us'

b. *Ens parles de
'You(sg) talk about us'

The types presented so far allow such overgeneration. Following Morrill (1990c) and Oehrle and Zhang (1989), island constraints will be captured by incorporating division duals to a non-associative product. Lambek (1961) presents the non-associative calculus (77); the division operators are written here as angles directed from domain to range.

(77)
$$\frac{\Gamma \Rightarrow \gamma : A < B \qquad \Delta \Rightarrow \beta : B}{[\Gamma\ \ \Delta] \Rightarrow (\gamma\,\beta) : A}[<E] \qquad \frac{\Delta \Rightarrow \beta : B \qquad \Gamma \Rightarrow \gamma : B < A}{[\Delta\ \ \Gamma] \Rightarrow (\gamma\,\beta) : A}[>E]$$

$$\frac{[\Gamma\ \ y : B\,] \Rightarrow \alpha : A}{\Gamma \Rightarrow (\lambda y \alpha) : A < B}[<I] \qquad \frac{[y : B\ \ \Gamma] \Rightarrow \alpha : A}{\Gamma \Rightarrow (\lambda y \alpha) : B > A}[>I]$$

While the associative calculus adhers to a list structure on resources, the non-associative one adhers to a binary tree structure. When the systems are mixed, sequents become partially bracketed (*n*+2-ary trees) and non-associative inference is conditioned on the requisit bracketing (resource structure). The effect of the following non-associative assignments is to block clitics binding into the bracketed domain induced by prepositions: (79) is not a theorem, so a prepositional verb and a preposition do not form a member of a clitic's transitive verb argument type.

(78) a - $(\lambda x x)$:= $N_a(a) < N(a)$

de - $(\lambda x x)$:= $N_a(a) < N(a)$

(79) $(N(3(sg))\backslash S)/N_a(\_)\ N_a(a_1) < N(a_1) \Rightarrow (N(a)\backslash S))/N(3(sg))$

The use of non-associativity here is meant to carry a commitment to prosodic interpretation, rather than to be an ad hoc device. The idea is that partially bracketed structures designate constraints on prosodic constituency: necessary prosodic constituents. The treatment of prepositions as non-associative functors portrays prepositional phrases as obligatory prosodic constituents, and the effect of blocking stranding is derivative on this. In general the prediction is that domains which are necessarily prosodic constituents are islands to extraction, but this will not be the only constraint, and additional apparatus may allow more penetrative binders than the clitics.

CLAUSE-LOCALITY

Although a clitic does not necessarily bind an immediate argument of the verb to which it attaches, the position it binds must be local to its clause:

(80) a. Penso que el Joan troba la Maria.

b. *La penso que el Joan troba.

The grammar as it stands does not capture this clause-locality. The strategy of the previous section is not applicable since while preposition-stranding is to be blocked for all constructions, clauses are not ceilings for phenomena other than cliticisation such as relativisation. Following Morrill (1990b) we will read the relevant information on locality off the type system by including in it encoding of intensional semantic domains, in particular temporal domains. The unary temporally intensional type-constructor < is associated with semantic operations of intensionalisation and extensionalisation with respect to time indices; these satisfy ‘down-up’ cancellation:

(81) $(\downarrow(\uparrow\alpha)) = \alpha$

In general the lexical semantics of words are now functions from time points to extensional denotations at those time points.

(82) troba - **find** := <**(**(N(3(sg))\S)/N(_))

Taking proper names to be rigid designators, their lexical semantics will be constant functions, mapping time points into the same individual.

(83) el Joan - ($\uparrow$**john**) := <N(3(sg))

The rules of inference are given in (84) and the derivation in (85) has the semantics (86).

(84)
$$\frac{\Gamma \Rightarrow \alpha : {<}A}{\Gamma \Rightarrow (\downarrow\alpha) : A}[{<}E] \qquad \frac{{<}\Gamma \Rightarrow \alpha : A}{{<}\Gamma \Rightarrow (\uparrow\alpha) : {<}A}[{<}I]$$

(85)
```
 El Joan          troba            la Maria
-------------- ----------------------------- --------------
<N(3(sg)) <((N(3(sg))\S)/N(_)) <N(3(sg))
                 ------------------------<E -------------<E
                   (N(3(sg))\S)/N(_)      N(3(sg))
-----------<E  ------------------------------------------/E
 N(3(sg))                 N(3(sg))\S
 ------------------------------------------\E
                    S
                    ---<I
                    <S
```

(86) a. $(\uparrow(((\downarrow x_{\text{troba}})\ (\downarrow x_{\text{la Maria}}))\ (\downarrow x_{\text{El Joan}})))$

b. ($\uparrow$((($\downarrow$**find**) **mary**) **john**))

The [<I] in (85) is permitted since the derivation’s components are of the form <*A*. Thus the sentence can adapt to the argument type of the intensional context creating element *que.*

(87) penso - **think** := <((N(1(sg))\S)/CP)
que - (↑(λ*xx*)) := <(CP/(<S))

However, with the type assignment (88), a clitic will not bind into a temporal domain since its argument must take an element of type N(3(sg)) to form a verb phrase: an expression *penso que el Joan troba* requires an intensional type like <N(3(sg)).

(88) la - (↑(λ*x*(*x* 3(sg)))) := <((N(*a*)\S)/((N(*a*)\S)/N(3(sg)))

CLITIC CLIMBING

Although control verbs require for semantic interpretation the intensions of their verb phrase complements across worlds, these are untensed and do not form temporal domains.

(89) puc := <((N(1(sg))\S)/VP)
llegir := <(VP/N(_))

A word order like (90b) is prevented by assignments as in (89) since a prefix clitic is a functor over N(_)\S and not VP. The clitic climbing (90d) is expected, since there is no intervening tense inflected domain.

(90) a. Puc llegir aquest llibre.
‘I am able to read this book’
b. *Puc-lo llegir.
c. Puc llegir-lo.
d. El puc llegir.

Clitic climbing may extend across more than one verb:

(91) a. Vull poder llegir aquest llibre.
‘I want to be able to read this book’
b. El vull poder llegir

However, some verbs, such as *decidir*, cannot receive themselves clitics that have climbed (92d), and block climbing to superordinate verbs (93b).

(92) a. Decideixo llegir aquest llibre.
‘I decide to read this book’
b. *Decideixo-lo llegir.
c. Decideixo llegir-lo.
d. *El decideixo llegir.

(93) a. Puc decidir llegir aquest llibre.
‘I am able to decide to read this book’
b. *El puc decidir llegir

We propose here to classify those verbs allowing climbing as inheriting the cliticisation feature of their complement, and those blocking it as instantiating cliticisablity to 0. Any blocking verb in a chain will prevent clitic climbing.

(94)	puc	:= <((N(1(sg))\S(*i*))/VP(*i*))
	poder	:= <(VP(*i*)/VP(*i*))
	decideixo	:= <((N(1(sg))\S(0))/VP(_))
	decidir	:= <(VP(0)/VP(_))

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APPENDIX

The treatments of the various aspects of cliticisation in Catalan addressed in this paper are integrated in the following lexical assignments. The grammar has been implemented in the parser-theorem prover of Morrill (1990c).

el Joan	- (↑**john**)	**:=** <N(3(sg))
la Maria	- (↑**mary**)	**:=** <N(3(sg))
trobar	- **find**	:= <(VP(7)/N(_))
trobo	- **find**	:= <((N(1(sg))\S(7))/N(_))
trobes	- **find**	:= <((N(2(sg))\S(7))/N(_))
troba	- **find**	:= <((N(3(sg))\S(7))/N(_))
trobem	- **find**	:= <((N(1(pl))\S(7))/N(_))
trobeu	- **find**	:= <((N(2(pl))\S(7))/N(_))
troben	- **find**	:= <((N(3(pl))\S(7))/N(_))
escriure	- **write**	:= <(VP(7)/N_a(_))
donar	- **give**	:= <((VP(7)/N_a(_))/N(_))
pensar	- **think**	:= <(VP(7)/CP)
poder	- **able**	:= <((VP(*i*))/VP(*i*))
decidir	- **decide**	:= <((VP(0))/VP(_))
a	- (↑(λ*xx*))	:= <(N_a(*a*)<N(*a*))
de	- (↑(λ*xx*))	:= <(N_d(*a*)<N(*a*))
que	- (↑(λ*x*(↑((↓*x*) → *y.* ((π_2*y*) (π_1*y*)); *z. z*))))	:= <(CP/(<((∃*a*(N(*a*)\S))∨S)))
jo	- (↑(λ*x*(*x* 1(sg))))	:= <(S(*i*)/(N(1(sg))\S(*i*)))
tu	- (↑(λ*x*(*x* 2(sg))))	:= <(S(*i*)/(N(2(sg))\S(*i*)))
ell	- (↑(λ*x*(*x* 3(sgm))))	:= <(S(*i*)/(N(3(sg))\S(*i*)))
ella	- (↑(λ*x*(*x* 3(sgf))))	:= <(S(*i*)/(N(3(sg))\S(*i*)))
nosaltres	- (↑(λ*x*(*x* 1(pl))))	:= <(S(*i*)/(N(1(pl))\S(*i*)))
vosaltres	- (↑(λ*x*(*x* 2(pl))))	:= <(S(*i*)/(N(2(pl))\S(*i*)))
ells	- (↑(λ*x*(*x* 3(plm))))	:= <(S(*i*)/(N(3(pl))\S(*i*)))

elles - (↑(λ*x*(*x* 3(plf)))) := <(S(*i*)/(N(3(pl))\S(*i*)))

es - (↑(λ*x*(λ*y*((*x* *y*) *y*)))) :=
<((N(3(*n*))\S(0))/((N(3(*n*))\S(1))/(HN(3(*n*)))))

et - (↑(λ*x*(*x* 2(sg)))) :=
<((N(*a*)\S(1))/((N(*a*)\S(2))/(H(N(2(sg))&N_a(2(sg))))))

us - (↑(λ*x*(*x* 2(pl)))) :=
<((N(*a*)\S(1))/((N(*a*)\S(2))/(H(N(2(pl))&N_a(2(pl))))))

em - (↑(λ*x*(*x* 1(sg)))) :=
<((N(*a*)\S(2))/((N(*a*)\S(3))/(H(N(1(sg))&N_a(1(sg))))))

ens - (↑(λ*x*(*x* 1(pl)))) :=
<((N(*a*)\S(2))/((N(*a*)\S(3))/(H(N(1(pl)))&N_a(1(pl)))))

li - (↑(λ*x*((*x* 3(sg)), *x*))) :=
<(((N(*a*)\S(3))∧((N(*a*)\S(3))/N_a(3(sg))))/((N(*a*)\S(4))/(HN_a(3(sg)))))

els - (↑(λ*x*((*x* 3(pl)), *x*))) :=
<(((N(*a*)\S(3))∧((N(*a*)\S(3))/N_a(3(sg))))/((N(*a*)\S(4))/(HN_a(3(pl)))))

el - (↑(λ*x*(*x* 3(sg)))) :=
<((N(*a*)\S(4))/((N(*a*)\S(5))/(HN(3(sg)))))

la - (↑(λ*x*(*x* 3(sg)))) :=
<((N(*a*)\S(4))/((N(*a*)\S(5))/(HN(3(sg)))))

els - (↑(λ*x*(*x* 3(pl)))) :=
<((N(*a*)\S(4))/((N(*a*)\S(5))/(HN(3(pl)))))

les - (↑(λ*x*(*x* 3(pl)))) :=
<((N(*a*)\S(4))/((N(*a*)\S(5))/(HN(3(pl)))))

en - **of-it** :=
<((N(*a*)\S(5))/((N(*a*)\S(6))/(HN_d(3(_)))))

hi - **there** :=
<((N(*a*)\S(6))/((N(*a*)\S(7))))

ho - **so** :=
<((N(*a*)\S(3))/((N(*a*)\S(6))/(HCP)))