Across-the-board binding meets verb second

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0. INTRODUCTION

The examples below indicate that English does not allow across-the-board binding:

(1) Every student likes, but every professor hates, Mary

(2) *Every student likes, but every professor hates, himself
'Every student$_i$ likes himself$_i$, but every professor$_j$ hates himself$_j$'

(3) *Every student likes, but every professor hates, his neighbors
'Every student$_i$ likes his$_i$ neighbors but every professor$_j$ hates his$_j$ neighbors'

Chierchia and Jacobson (1985) observe the same phenomenon in connection with Super Equi constructions (their (36)-(37)):

(4) ✱ That losing the race would upset everyone so much surprised Sam and amazed John
'That Sam's losing the race would upset everyone so much surprised Sam and that John's losing the race would upset everyone so much amazed John'

They comment, "The presence of *Sam* in ST[ORE] of one conjuct and of *John* in the ST of the other would yield a Coordinate Structure Constraint violation. Moreover, there is only one variable here in subject position, and so, it of course could not be bound twice."

If this kind of explanation were correct, ATB binding should be invariably bad across languages. However, the word-by-word translations of (2) and (3) are perfect in Dutch and rather good in German:*

(5) Elke student mag, maar elke professor haat, zichzelf

(6) Elke student mag, maar elke professor haat, zijn buren

(7) ?Jeder Student mag, aber jeder Professor hasst, sichselbst

(8) ?Jeder Student mag, aber jeder Professor hasst, seine Nachbarn

In looking for an alternative explanation, the question arises whether the contrast between English and Dutch/German is due to some binding theoretic parameter. In this paper I will argue that it is not. Rather, it is related to the one obvious difference between the above sentences, namely, that in Dutch/German we have verb second (V-2) and in English we do not. The analysis will be given in terms of combinatory grammar, a theory that derives this result without any specific stipulation.

The paper is organized as follows. §1 reviews the fundamental assumptions concerning the form of grammar. §2 spells out the basic claims about binding. §3 shows that the ungrammaticality of (2)-(3) in English follows from these. §3 makes the first move towards an explanation of the grammaticality of the Dutch and German cases via an obvious route, Toba Batak. §5 discusses a proposal concerning verb fronting, and shows that it predicts the correct possibilities for ATB binding.

1. COMBINATORY CATEGORIAL GRAMMAR

All versions of categorial grammar are characterized by the assumption that heads are interpreted as functions, wherefore their combination with an argument is interpreted as functional application:

(9) Notation:
- a. λx[...x...] denotes a function which ranges over *x*-type things and whose value for every argument *a* is defined by replacing each occurrence of *x* in [...] by *a*. I.e., λx[...x...](a)=[...a...].
- b. Both A/ B and A\ B are categories of functors that take expressions of category B to expressions of category A. A/ B expects its argument B from the right, and A\ B, from the left. I.e., A / B.B=A and B.A\ B=A.

(10)

John 'j'	likes 'λxλy[like(x)(y)]'	Mary 'm'	
NP	(S\NP)/NP	NP	
			apply
	S\NP 'λy[like(m)(y)]'		
			apply
	S 'like(m)(j)'		

The simplest extension of this grammar to extraction structures is very similar to the trace-theoretic treatment. The derivation below is modelled after early 'Seventies style Montague Grammar:

(11) who 'λf?x[fx]' John 'j' likes 'λxλy[like(x)(y)]' t 'z'
S'/S' NP (S\NP)/NP NP

---ap
S\NP 'λy[like(z)(y)]'

---ap
S 'like(z)(y)'

---λ
S' 'λz[like(z)(y)]'

---ap
S' 'λf?x[fx](λz[like(z)(j)])'= '?x[like(x)(j)]'

Likes here applies to the designated variable *t*. *t* must disappear from well-formed sentences, and it does so if it gets bound. Its binding involves two steps. First, the open sentence *like(z)(j)* is turned into the property of being liked by John by lambda-abstraction. Second, the quantifier *who* applies to the property and yields *?x[like(x)(j)]*. Given the close similarity of this treatment to that of any "trace-theoretic" grammar, it is easy to imagine how the pertinent well-formedness problems and their solutions carry over.

The version of categorial grammar I will use does *not* adopt this treatment of gaps. To put it aphoristically, it works on the assumption that the distribution of empty categories can be best explained if we assume they are not there. Instead, the empirical generalizations concerning their distribution, which are expressed in GB-type grammars in the form of constraints, are turned into constructive procedures that directly generate the well-formed structures containing only overt material.

The crucial step in achieving this result is to eliminate the binding of free variables by operators (cf. lambda). We can do this, and thus concatenate *John* and *likes* to get the interpretation λz*[like(z)(j)]* directly, if we introduce a richer variety of functional operations into grammar. Below I spell out one plausible way to handle (11). The operations type-lifting and composition will be useful in the coming discussion:

(12) Lifting: Facilitates function-argument structure reversal by turning *a* into a function over functions that range over *a*'s. I.e., A → B\ (B/A), B/(B\ A), resulting in λf[fa]. Lexical lifting may also use parallel slashes.

(13) Composition: If the domain of function f contains the range of function g, their composition λx*[f(g(x))]* maps g's domain to f's range directly. I.e., A/ B.B/C=A/C and B/C.A\ B=A/C for English.

(14)

who 'λf?x[fx]'	John 'j'	likes 'λxλy[like(x)(y)]'	
S'/(S/NP)	NP	(S\NP)/NP	
	----------lift		
	S/(S\NP) 'λf[fj]'		
	----------	----------comp	
	S/NP	'λx[like(x)(j)]'	
----------	----------	----------apply	
S'		'?x[like(x)(j)]'	

The logical coherence and viability of this enterprise is guaranteed by the fact that there is a branch of mathematical logic that differs from the lambda calculus in precisely the same way as our grammar differs from theories with traces. This is combinatory logic, which has the same potential expressive power as the lambda calculus but uses functional operations (like lifting and composition etc.), as opposed to abstraction and bound variables, to achieve it. These operations are called combinators, and the grammar implementing this logic is combinatory (categorial) grammar. See Steedman (1987, 1988) for further details.

2. BINDING IN COMBINATORY GRAMMAR

The interesting question now is how we can develop a restrictive theory of grammar on the basis of combinatory logic, i.e., by letting the spirit and techniques of this logic delimit our analytical options. One test case may be the treatment of binding. Notice that combinatory logic does not just allow us to treat specifically extraction structures without bound variables for gaps; it has no bound variables at all. Hence, the question arises what the theory has to say about anaphors. These are overt items which are commonly assumed to start out with a "wrong" free variable interpretation, to be "put right" by a binding mechanism in syntax.

The crucial observation is that anaphors can be "right" from the beginning if they are assigned a so-called *duplicator* interpretation in the lexicon: *λgλv[g(v)(v)]*. A duplicator eats a two-place function g, cf. *λyλz[like(y)(z)]*, and turns it into a one-place function by identifying its arguments, cf. *λv[like(v)(v)]*. The lexical category of *herself* is like a lifted category but it is assigned to the item directly, matching its meaning. (From now on, I will use the ad hoc labels NOM and ACC, instead of plain NP, to make categories more transparent.)

(15)

Everyone	likes	herself	
'λf∀x[fx]'	'λyλz[like(y)(z)]'	'λgλv[g(v)(v)]'	
S/(S\NOM)	(S\NOM)/ACC	(S\NOM)\((S\NOM)/ACC)	
			apply
		S\NOM 'λv[like(v)(v)]'	
			apply
S '∀x[like(x)(x)]'			

This proposal is developed in detail in Szabolcsi (1989a,b). It is shown, among other things, that by following the lead of combinatory logic we practically derive Reinhart's (1983) theory. Note, therefore, that bound pronouns are assimilated to reflexives.

3. ATB BINDING: ENGLISH

With these assumption in mind we are ready to tackle the problem of across-the-board binding in English. Recall the contrast between (1), viz., (16) and (2)-(3), viz., (17):

(16) Every student likes, and every professor hates, Mary

(17) *Every student likes, and every professor hates, himself/ his neighbors

If we try to derive these sentences using the rules of the game just established, it becomes clear that the contrast is predicted.

Consider (16) first. On the assumption that we must do with just overt material, and that we can coordinate like categories, the structure will be as follows (recall (14)):

(18)

Every student likes	and	every professor hates	Mary
comp		comp	
S/ACC		S/ACC	ACC
	S/ACC		
	S		ap

Consider a reflexive in the place of *Mary*, however. The crucial ingredient in our treatment of reflexives was that they are interpreted as duplicators. This interpretation and the corresponding category (S \ NOM)\ ((S \ NOM)/ACC) entail that the reflexive must be able to combine with the verb and the subject separately, one after the other. If those items have, for some reason, already

combined with each other, the reflexive has no way to relate to them. But this is precisely the situation in our examples since the gap-free account of right node raising forces subject and verb to compose:

(19) Every student likes ... himself

---comp

'λyVx[student(x) → like(y)(x)]' 'λfλz[f(z)(z)]'

S/ACC (S\NOM)\((S\NOM)/ACC)

---*

Given that bound pronouns are assimilated to reflexives in this theory, the ungrammaticality of *his neighbors* also follows.

Prior to proceeding to Dutch, let us examine this proposal more closely. It is worth emphasizing that the ungrammaticality of (17) is not directly tied to coordination. It derives from the fact that the subject and the verb already combined when the reflexive enters the picture; coordination is relevant only insofar as it forced them to. So, are there other cases when subject and verb provably form a constituent?

4. VSO BINDING: TOBA BATAK

Keenan (1987) argues, using data from Schachter (1984), that in Toba Batak VS can be a constituent. Toba Batak verbs have the prefixes *mang* or *di*. In the former case the sentence is VOS, and in the latter, VSO:

(20) Mang-ida si Torus si Ria
-see art Torus art Ria
'Ria sees Torus', *'Torus sees Ria'

(21) Di-ida si Torus si Ria
-see art Torus art Ria
'Torus saw Ria', *'Ria saw Torus'

Regardless of the choice of the prefix, the postverbal NP in Toba forms a syntactic constituent with the verb. Adverbials may not intervene between them; only the second NP can be extracted, pronominalized or deleted; phonology treats the postverbal NP as the final element of the predicate etc. On the other hand, Toba reflexives are always subject oriented objects, and not vice versa. The crucial case is of course *di*:

(22) a. [Di-ida si Torus] dirina b. *[Di-ida dirina] si Torus
-see art Torus self -see self art Torus
'Torus saw himself'

Given that this reflexive asymmetrically c-commands the subject, Keenan concludes that binding is not contingent on the configurational factors binding theory tends to single out.

Is this conclusion inescapable? How can the grammaticality of (22a) be reconciled with the ungrammaticality of (17) in the combinatory theory? There is in fact one way to go. Suppose that the semantic type and syntactic category of *mang*-verbs differ from those of *di*-verbs. While the former are like verbs in English, the latter will be as below:

(23) Di-ida 'λxλk[k(saw)(x)]' si Torus 't' dirina 'λfλx[f(x)(x)]'
(S/((S/NOM)\(S/NOM)/ACC)))/NOM NOM (S/NOM)\(S/NOM)/ACC)
---------- ap
S/((S/NOM)\(S/NOM)/ACC))
---------- ap
S 'λk[k(saw)(t)](λfλx[f(x)(x)])'='saw(t)(t)'

Mang-ida and *di-ida* now differ in two respects. One is that *mang-ida* takes its object first and its subject second, while *di-ida* takes them in the reverse order. The far more important difference is that *di-ida* is assumed to subcategorize for an object with a (S/ NP)\ ((S/ NP)/ NP), rather than a simple NP, category. This is a category which is lexically assigned to reflexives in view of their duplicator meaning, and which simple noun phrases acquire by lifting in syntax. As (23) shows, in this case VS does not end up with a category that the reflexive cannot relate to, but rather has a category that the reflexive can be an argument of. As is indicated above, this actually yields the correct semantic result.

Now, this treatment of Toba Batak may seem like patchwork. Consideration of Dutch and German will show it is not.

5. V-2 AND ATB BINDING

In §1 I noted that there is an obvious difference between the superficially word-by-word identical clauses in English and Dutch/German: the fact that in English the verb in second position is in its original position, whereas in Dutch/German it moved there. This is of course a rather rough statement, and certainly much more needs to be said about the subtleties of V-2. I assume, however, that even sophisticated accounts will maintain this global typological difference and therefore the essence of the story remains tenable.

An account of V-2 in the combinatory theory has been proposed by Hepple (1988). Rather than going into full detail, I only lay out the proposal for the relevant case.

Dutch V's start out with a (S\ NOM)\ ACC category that reflects embedded order. Matrix order is derived by verb fronting. The "fronting category" of verbs, just like that of WH-phrases, is a parallel slashed lifted category, cf. (12) and (14). It is defined in (24) and utilized in (25):

(24) Lifted (fronting) transitive verbs: X/(X/((S\NOM)\ACC)). With X=S\NOM, this is (S\NOM)/((S\NOM)/((S\NOM)\ACC)).

(25)
Jan	mag	Marie	
NOM	(S\NOM)/((S\NOM)/((S\NOM)\ACC))	ACC	
		----------	lift
		(S\NOM)/((S\NOM)\ACC)	
	----------	----------	ap
	S\NOM		
----------	----------	----------	ap
	S		

But, lo and behold, this fronting category of Dutch transitives is semantically (i.e., except for order) exactly the same as the category we assigned to *di*-verbs in Toba Batak. Let us consider this coincidence from both directions.

On one hand, this verb is able to compose with the subject to yield a category that the reflexive can combine with. The semantics works the same as in (23):

(26)
Elke student	mag	zichzelf
S/(S\NOM)	(S\NOM)/((S\NOM)/((S\NOM)\ACC))	(S\NOM)\((S\NOM)\ACC)
----------	----------	comp
S/(S\NOM)\((S\NOM)\ACC)		
----------	----------	ap
S		

Naturally, *elke student mag maar elke professor haat* will also have the same category S/(S\ NOM)\ ((S\ NOM)\ ACC), hence the ATB cases in Dutch are predicted to be perfect.

On the other hand, we may look back to Toba Batak and ask if the treatment of *di*-verbs makes any more sense now than it seemed to at the end of the last section. But of course it does: it has been argued in the literature that VSO order is in fact derived by verb fronting. If that is correct, and if fronting categories are a lifted kind of categories in general, then it is perfectly

natural for Toba Batak *di*-verbs to have the category as in (23). Not for the sake of reflexives; for the sake of VSO.

All in all, the precise statement of the generalization is as follows. Given that reflexives are interpreted as duplicators, they have two ways to participate in well-formed sentences. One is to apply to the verb and to the subject one after the other. Another is to have subject and verb form a constituent of a category that may apply to the reflexive. If the latter is available, VSO binding and [SV&SV]O binding are in principle possible. Now, if a language has basic SVO or VSO order, i.e., if the category of transitive verbs participating in that order is unlifted, then the subject and the verb form a constituent of category S\|ACC, and the reflexive (as opposed to a simple name, for instance) has no way to combine. If, however, the verb is fronted and fronting itself necessitates that the verb be lifted over S\|NOM, then we get just the right category, and hence predict an empirical correlation with ATB and VSO binding.

At this point, the alert reader may note that if lifting is a free syntactic operation, verbs in English may also undergo (order-preserving) lifting. Does this not ruin the story? I believe it does not. The fact is, ATB binding in English is marginal compared to what we find in Dutch, but it is not plainly out. This judgement may arise precisely under the circumstances we are dealing with here. Namely, there is a logical possibility to derive the desired reading, but it "requires unusual gymnastics" in the sense that this logical possibility is otherwise not exploited in the syntax of English.

NOTE

* The contrast between English and German/Dutch was first pointed out to me by Arnim von Stechow and Johan van Benthem. For further data and discussion, I wish to thank Elisabet Engdahl, Kai von Fintel, Mark Hepple, Jack Hoeksema, Polly Jacobson, Renate Raffelsiefen, Shi Zhang, and Frans Zwarts. Unfortunately, an analysis of Chinese and Swedish, as well as a discussion of parallel cases with infinitives in the place of reflexives go beyond the scope of this squib.

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