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CROSSOVER SITUATIONS*

Situation semantics as conceived in Kratzer (1989) has been shown to be a valuable companion to the *e-type pronoun* analysis of donkey sentences (Heim 1990, and recently refined in Elbourne 2001b), and more generally *binding out of DP* (BOOD; Tomioka 1999; Buring 2001). The present paper proposes a fully compositional version of such a theory, which is designed to capture instances of crossover in BOOD.

1. INTRODUCTION

In this paper I develop a compositional account of *binding out of DP* (BOOD; sometimes called *indirect binding*) which uses e-type pronouns and situation semantics. The paper proceeds as follows: I show how surprising cases of binding from inside DP (possessors and postnominal PPs) can be handled by analyzing the bound pronouns as e-type pronouns. The crossover facts observed in these and similar constructions then follow as special cases of the standard crossover facts (section 3), and can be accounted for by e.g. a treatment that restricts variable binding to higher arguments (exemplified in section 2). I then show how well-known shortcomings of such analyses can be remedied by invoking situations, as done in Heim (1990), which I integrate into the specific syntax-semantics mapping developed previously (section 4). This, finally, opens up the possibility of asking whether the binding of situation variables itself is subject to crossover, a question answered in the affirmative in section 5, where I argue, following Elbourne (2001a), that certain dependent DPs need to be analyzed as containing bound situation variables, but no bound individual variables, and yet show crossover effects. The resulting treatment also remedies certain inadequacies of the simple e-type analysis of BOOD regarding VP ellipsis, and sheds light on some surprising facts about apparently antecedent-less bound DPs.

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2. AN ARGUMENT-BASED ACCOUNT OF PRONOUN BINDING AND CROSSOVER

An influential idea in generative grammar is that pronoun binding, or bound-variable anaphora, as it is sometimes called, always involves an argument slot binding (into) a lower coargument. Crossover, on this view, is simply a consequence of the fact that the element that has ‘crossed over’ does not occupy an argument slot, and is hence incapable of binding variables (see e.g. the discussion and references in Bach and Partee 1980, 1984). A very simple and natural implementation of this idea has been proposed by P. Jacobson (see Jacobson 1999, 2000 and the references therein) within a variable-free categorial grammar. In the transformational literature, Tanya Reinhart, in Reinhart (1983) and other works, has presented what I take to be an elegant characterization of the Weak Crossover (WCO) generalization along these lines, which I will take as my point of departure:

- (1) *Reinhart’s Generalization:*
Pronoun binding can only take place from a c-commanding A-position.

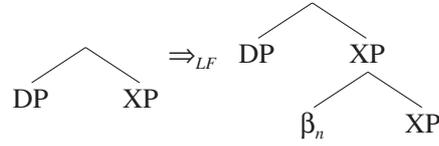
The crucial qualification here is ‘from an A-position’, which excludes binding from a position derived by *wh*-movement or quantifier raising. In the following, I will refer to this generalization as the *a-command* requirement on pronoun binding (where *a-command* = *c-command* from an A-position).

For the purpose of the discussion, I will implement this generalization in the following way: We introduce a *binding operator* β_n , which can be optionally adjoined at LF.¹ This operator signals that the DP immediately c-commanding it binds any free occurrence of a pronoun indexed *n* within its c-command domain.²

¹ Friends of surface indexing may also think of this rule as transferring an index from the DP to a binder, similar to Heim and Kratzer (1998)’s treatment of movement.

² Throughout this paper I will use *x* for individual variables (type *e*), *G* for generalized quantifiers ($\langle\langle e, t \rangle\rangle$), *R* for relations ($\langle\langle e, \langle t \rangle \rangle\rangle$), *p* for propositions (*t*), *G* for generalized quantifiers ($\langle\langle et, t \rangle\rangle$), *s* for situations, *T* as a variable over types, and Greek letters for variables of flexible type. Where necessary, variables will be subscripted to distinguish them.

(2) a. pronoun binding (optional):



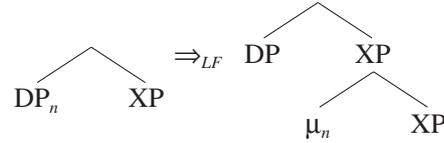
where n is an index, and DP occupies an A-position

b. $\llbracket \beta_n \text{ XP} \rrbracket^{w, g} = \lambda x. \llbracket \text{XP} \rrbracket^{w, g[n \rightarrow x]}(x)$

Given the (fairly standard) interpretation of the binding operator in (2b) (essentially the *derived VP rule* of Partee 1975, Sag 1976, a.m.o.) and the explicit stipulation that it can only be adjoined next to an A-position, we capture Reinhart's a-command requirement (1).

Almost, that is, for we need to ensure that no other mechanism can bind a pronoun from an \bar{A} -position, the most obvious candidate being the rule that interprets operator-trace dependencies. For the sake of concreteness I will do this by formally distinguishing a *trace binding operator* μ_n (mnemonic for 'movement'; this is Heim and Kratzer's (1998, p. 186) Predicate Abstraction rule):

(3) a. trace binding (obligatory):

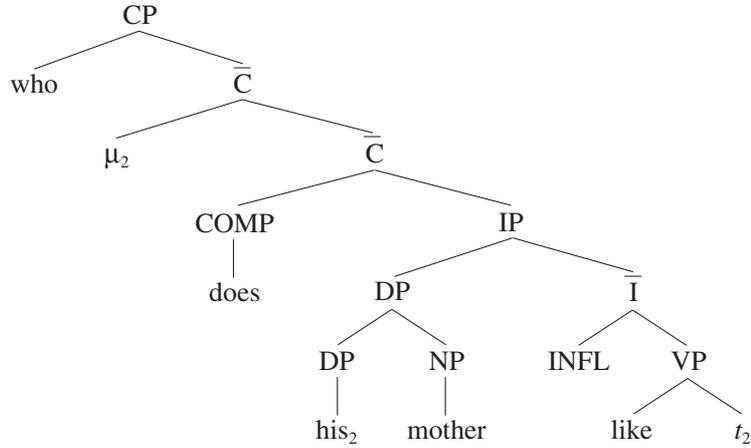


where n is a movement index

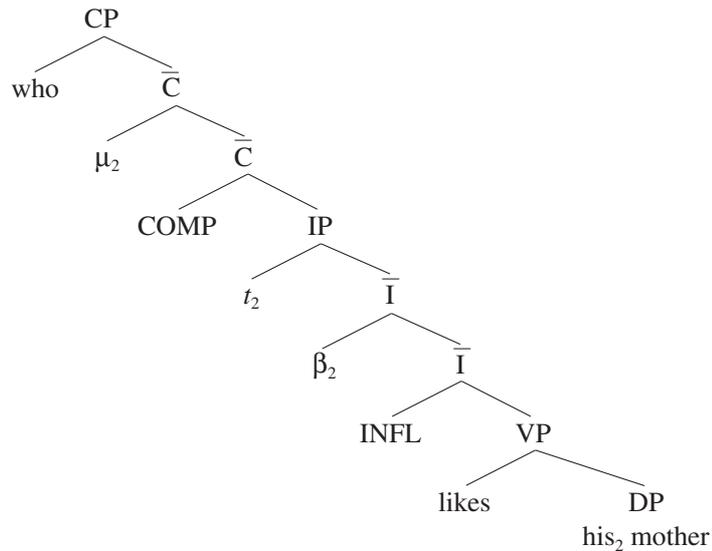
b. $\llbracket \mu_n \text{ XP} \rrbracket^{w, g} = \lambda x. \llbracket \text{XP} \rrbracket^{w, g[t_n \rightarrow x]}$

Note that crucially, the assignment function g has a sorted domain: indices, as found on pronouns, versus indexed traces; that way it is possible that $g(t_n) \neq g(n)$, and accordingly $\llbracket t_n \rrbracket^{w, g} \neq \llbracket \text{pron}_n \rrbracket^{w, g}$, for a given integer n . The standard WCO contrast between, say, (4) and (5) is thus captured via the full LFs given below:

- (4) Who
- ₂
- does his
- ₂
- mother like t
- ₂
- ?



- (5) Who
- ₂
- t
- ₂
- likes his
- ₂
- mother?



Structure (4), despite the coindexing, does *not* yield a bound interpretation for the pronoun *his*₂, because μ_2 binds traces only; *his*₂ is interpreted as a free variable. For *his*₂ in (4) to be bound, a β_2 operator would have to be inserted; but adjunction of β_2 to \bar{C} is not permitted, since SpecC is an \bar{A} -position.

In contrast to that, (5) has *his*₂ semantically dependent on *who*, because the *trace* of *who* binds it via the adjoined β_2 . This adjunction is licit, since the trace occupies an A-position. (If you believe that *who* in (5) hasn't

moved at all, the analysis gets even simpler; I just wanted to illustrate how a moved item can bind via its trace position in general.)

To put the gist of this treatment as a slogan: \bar{A} -dependencies and pronoun-binding dependencies are strictly distinct.³ This is diametrically opposed to treatments as diverse as Montague (1974) and Heim and Kratzer (1998, ch. 5), in which pronoun binding is taken as a side effect of \bar{A} -trace binding, but in keeping with the papers alluded to at the very beginning of this section. Independent of the specific implementation offered in this section, the present paper can be seen as an exploration of how this general line of analysis can be made to account for certain examples that are known to challenge it.

It bears mentioning that an implementation of WCO that restricts pronoun binding to (higher) argument positions, including the one given here, is extremely local, in the following semi-technical sense: It merely regulates whether one object – here: the β prefix – can be combined with another α – here: $\bar{I}/\bar{C}/VP$ – by looking at the properties of α itself (whether it is an argument-taking expression). It crucially doesn't look 'into' α , in particular not at the potential bindee and its configuration relative to β (in fact no reference to chains or indices is made at all). This kind of locality sets the present proposal, together with the conceptually similar one in Jacobson (1999) (where pronoun binding is a semantic operation on predicates), apart from the more common indexing or linking based approaches (Chomsky 1976; Higginbotham 1983; Koopman and Sportiche 1983; Safir 1984, to name just a few). I submit that locality is a desirable property, since it resonates well with the idea, endorsed in Categorical Grammar and more recently in certain 'minimalist' versions of the Principles & Parameters Theory, that the internal structure of constituents, once they have been constructed, is opaque to further grammatical operations, and that, accordingly, there can't be 'filters' on complete representations.

3. THE E-TYPE ANALYSIS OF BOOD

We will now show that the crossover account developed in the previous section correctly carries over to cases of *binding out of DP* (BOOD) such as donkey anaphora, genitive binding, and inverse linking.

³ Maybe there is a more principled reason why binding from an \bar{A} -position cannot bind pronouns, namely that the traces of \bar{A} -movement are of a semantic type other than e , so that no binding of an individual variable can occur as a 'side effect' of \bar{A} -trace binding (as has been suggested recently in Ruys 2000). This would avoid the stipulated restriction on β -adjunction to \bar{A} -positions. I will not speculate on this further, but everything that follows is compatible with such a refinement.

3.1. *Donkey Sentences and Donkey Crossover*

Donkey sentences like (6) have been analyzed using *e-type* pronouns (Chierchia 1995; Evans 1980; Heim 1990; Neale 1990, a.o.), as well as *unselective binding* (Heim 1982). We will now briefly show that the e-type analysis naturally fits with the account of crossover given above (the same is presumably true for unselective binding approaches, though a considerable amount of detail needs to be filled in):⁴

- (6) Every farmer who owns a donkey beats it.

According to the e-type analysis, the pronoun *it* in (6) is interpreted as ‘the donkey he owns’, which yields a reading in which the referent of *it* co-varies with farmers, as desired. Let us implement it by analyzing the configuration (7a) via the LF in (7b), which gets an interpretation equivalent to (7c) through contextual assignment of the ‘donkey of’ function to the variable *R* (this adopts the treatment of paycheck pronouns in Cooper (1979) and Heim and Kratzer (1998)):

- (7) a. Every farmer who owns a donkey beats it.
 b. [every farmer who owns a donkey] [β_2 [beats [THE $R(x_2)$]]]
 c. *every farmer who owns a donkey* beats **the donkey he owns**

Individual variables like x_2 are assigned the syntactic category of pronouns, i.e. $\llbracket x_n \rrbracket^{w,g} = g(n)$, which means they can get bound by β but not μ . Crucially, the only object language variable that is bound in (7) is x_2 , and it is bound by the subject DP *every farmer who owns a donkey*, not the embedded DP *a donkey*. We will henceforth speak of the embedded DP that *appears* to be binding the pronoun (here, *a donkey*) as the *antecedent*, and the DP containing it that is the *actual binder* (here, *every farmer who owns a donkey*) as its *container DP*. So, the container DP – the actual binder – α -commands the (variable within the) e-type pronoun, which means this binding conforms to Reinhart’s generalization; the sentence is thus correctly predicted to be acceptable.

It is well known from the literature that e-type pronouns – or rather: the bound variables within them – are sensitive to crossover (cf. the discussion of paycheck sentences and Bach-Peters sentences in Jacobson 1977, 2000). In the present context, this manifests itself in cases of ‘donkey

⁴ In what follows I will indiscriminately use the term e-type pronoun to refer to what have been called in the literature ‘donkey pronouns’, ‘pronouns of laziness’, and ‘paycheck pronouns’. Historically, the latter two stand for strict repetitions of their antecedent, while the former expands to a description which has to be “distilled” from the clause containing the antecedent.

crossover', as discussed in Chierchia (1995), Haïk (1984), Reinhart (1987), among others (italics in the examples indicate anaphoric dependencies; asterisks regard that reading only):

- (8) a. **Her* mother visited every knight who courted *a lady*.
 (not with *her* = 'the lady he courted'; Reinhart 1987, p. 150)
 b. **Its* lawyer sued every farmer who beat *a donkey*.
 (not with *it* = 'the donkey he beat')

A possible LF for (8b) is given in (9):

- (9) [every farmer who beat a donkey] (* β_2) μ_9 [[[THE **R/donkey beaten by** x_2]'s lawyer] sued t_9]

Here, as in (7b) above, the e-type pronoun *it* is expanded as **the R/donkey beaten by** x_2 . Crucially, however, the moved (quantifier-raised) object DP here can only bind its own trace (via μ), but not the variable x_2 (via μ) from its derived position. Therefore, a co-variant reading of *it/the donkey he beats* is out.⁵

The generalization that follows from this treatment is that a pronoun can co-vary as a donkey pronoun only if the container DP of the donkey antecedent (here, *every farmer who owns a donkey*) a-commands the pronoun. This generalization has been observed in the literature and implemented in the form of various stipulations on admissible indexings at LF (Haïk 1984; Reinhart 1987, a.o.). It follows directly, and without any further constraints on indexing, from the theory advanced in section 2.

3.2. Embedded Quantifier Binding

Other cases of binding out of DP, too, fall into place under the proposed analysis. Thus, if we follow a brief suggestion in Bach and Partee (1980, 1984) to treat cases of *genitive binding* as involving e-type pronouns, the correct crossover pattern is immediately derived. Under this analysis, (10) has (10a) as its LF, and receives the interpretation (10b):

⁵ The same effect can be seen with overt crossover, though the details would take us too far afield here. The relevant contrast is between the examples in (i):

- (i) a. How many farmers who own *a donkey* beat *it*? (ok with *it* = 'the donkey they own')
 b. *How many farmers who beat *a donkey* did *its* lawyer sue later? (not with *it* = 'the donkey they own')

- (10) *Every boy's mother like him.*
 a. [every boy's mother] β_3 likes [**the R/son of x_3**]
 b. *every boy's mother* likes **her son**

Note again that the container DP *every boy's mother*, rather than the embedded antecedent *every boy*, does the binding here, and it does so from an A-position. As predicted, this binding is impossible if the DP containing *every boy* has to cross over the pronoun in order to bind it, i.e. would have to bind from an \bar{A} -position:

- (11) a. **His* friends like *every boy's* mother. (*his* can't co-vary with boys/months)
 b. [every boy's mother] ($*\beta_4$) μ_2 [[[**the R/son of x_4**]'s friends] like t_2]

Extending beyond what is found in the literature, the approach also carries over to *inverse linking*, which shows the same crossover pattern:

- (12) a. Somebody from every city hates its climate.
 LF: [somebody from every city] [β_8 [hates **the R x_8 /city $they_8$ are from**]'s climate
 b. **Its* climate is hated by everybody in *some city*.
 LF: [everybody in some city] [$*\beta_8$] μ_6 [[[**the R x_8 /city $they_8$ are from**]'s climate is hated by t_6]

Since the e-type approach to inverse linking and genitive binding has never been explored in the literature, I provide a more complete derivation for these examples in the appendix. Note for the moment that, once again, the variable x_8 is bound by the container DP *somebody from every city*, i.e. it ranges over people, not cities. That DP is in an A-position in (12a), but in an \bar{A} -position in (12b). Hence, pronoun binding is impossible in the latter case.

The e-type account of genitive binding and inverse linking thus directly derives the crossover pattern. Although this pattern has been observed in the literature, where it has been christened *secondary weak crossover*, known attempts to implement it in the grammar are either empirically inadequate (May 1988; Hornstein 1995), as I intend to show in a separate paper, or have the status of mere additional stipulations regarding indexing or linking (Higginbotham 1980a, b, 1983, 1987; Reinhart 1987; Safir 1984). The bottom line is that the fact that the possibility of co-variation with a quantified DP (*every city*) should depend on the position of a DP containing it (*somebody from every city*) is simply completely unexpected if you assume that co-variation is a direct consequence of variable binding by *every city*.

On the e-type view, on the other hand, the container DP *is* the binder, and the correlation between weak crossover and secondary weak crossover is explained immediately.

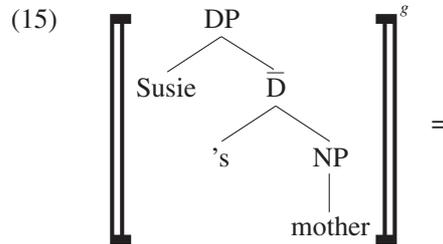
3.2.1. Appendix: Getting the DP Meanings Right

As said above, the analysis above assumes the following meaning for the subject DPs:

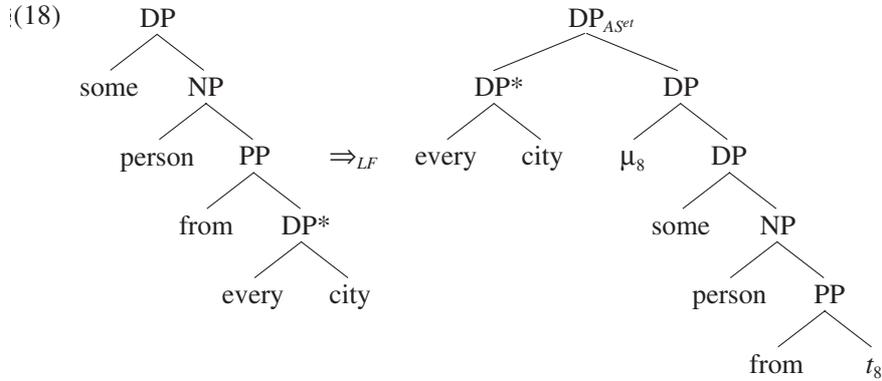
- (13) a. $\llbracket \text{every boy's mother} \rrbracket^g = \lambda P.$ for every boy x , the unique mother y of x has P
- b. $\llbracket \text{somebody from every city} \rrbracket^g = \lambda P.$ for every city x , there is some person y from x such that y has P

It is orthogonal to the analysis of crossover how these meanings are derived, but for concreteness we will assume the following: X 's *mother* is interpreted as 'the mother of X ', i.e. genitive 's denotes a function that maps a relation, $\llbracket \text{mother} \rrbracket^{w, g}$, and an individual, the possessor, onto a generalized quantifier. This gives us a straightforward interpretation for simple cases like *Susie's mother*:

- (14) a. $\llbracket \text{mother} \rrbracket^g = \lambda x \lambda y. y$ is a mother of x
- b. $\llbracket 's \rrbracket^g = \lambda R \lambda y \lambda P.$ there is an x , x is the only element such that $R(y)(x)$ and $P(x)$



- a. $[\lambda R \lambda y \lambda P.$ there is an x , x is the only element such that $R(y)(x)$ and $P(x)$] $(\lambda x \lambda y. y$ is a mother of $x)$ (Susie)
- b. $= [\lambda y \lambda P.$ there is an x , x is the only element such that $[\lambda x \lambda y. y$ is a mother of $x](y)(x)$ and $P(x)]$ (Susie)
- c. $= [\lambda y \lambda P.$ there is an x , x is the only element such that x is a mother of y and $P(x)]$ (Susie)
- d. $= \lambda P.$ there is an x , x is the only element such that x is a mother of Susie and $P(x)$



This phrase marker receives the desired interpretation: the movement binder μ_8 triggers abstraction over an individual variable, which makes the middle DP segment denote the same kind of function as *'s mother* above, which then combines with the adjoined QDP by argument saturation:

- (19) a. $\llbracket \text{some person from } t_8 \rrbracket^g = \lambda P. \text{there is an } x, x \text{ is a person and from } g(t_8) \text{ and } P(x)$
 b. $\llbracket \mu_8[\text{some person from } t_8] \rrbracket^g = \lambda x_1 \lambda P. \text{there is an } x_2, x_2 \text{ is a person and from } x_1 \text{ and } P(x_2)$
 c. $\llbracket \text{every city} \rrbracket^g = \lambda P. \text{for every city } x, P(x)$
 d. $\llbracket [\text{every city } \mu_8[\text{some person from } t_8]]_{DP_{ASet}} \rrbracket^g =$
 $\lambda P_1. [\lambda P_2. \text{for every city } x_4, P_2(x_4)] (\lambda x_3. [\lambda x_1 \lambda P_3. \text{there is an } x_2, x_2$
 $\text{is a person and from } x_1 \text{ and } P_3(x_2)] (x_3)(P_1))$
 $= \lambda P_1. \text{for every city } x_4, \text{there is an } x_2, x_2 \text{ is a person and from } x_4 \text{ and } P_1(x_2))$

Note in closing that this analysis circumvents a certain embarrassment about the very *semantics* of these constructions, in which a quantifier appears to bind a variable that is not contained in its sister (if you assume that *somebody from every city* and *every boy's mother* form constituents at LF; May 1985, 1988, a.o.), or only so after a movement that is otherwise highly unlikely and problematic (if you assume that *every city* and *every boy* are adjoined to S at LF; May 1977; Hornstein 1995; see Larson 1987; May 1985; Heim and Kratzer 1998; Barker 2001 for arguments against this movement). On the present account, the subject DP remains a constituent at LF and denotes an ordinary generalized quantifier.

3.3. *Other Cases of Binding out of DP*

E-type analyses have been proposed for other BOOD constructions in the literature, notably by Tomioka (1997, 1999), who offers an analysis of sloppy identity without c-command in VP ellipsis ((20a)) and of focus co-variation without c-command ((20b)) that involves the use of e-type pronouns (strike-out marks elided material):

- (20) a. The policeman who arrested John read him his rights, but [the policeman who arrested *Bill*] didn't ~~read him his rights~~.
 b. It was only established that [the policeman who arrested *JOHN*] read *him* his rights.

Both types of examples receive the correct interpretation if *him* is expanded to *the R/person arrested by him* at LF, and the container DPs (bracketed in (20a) and (20b)) do the binding. While the compositional details of this construction are beyond the scope of the present paper,⁷ we note that both these constructions show WCO effects as well:

- (21) a.*It was only established that *her* mother threatened every policeman who arrested *MARY*.
 b.*The policeman who arrested her today read Sue her rights. The one who did ~~arrest her~~ yesterday, read *MARY* her rights.

The star in both cases regards the indicated co-varying interpretation (where *her* = *Mary*). In both cases, the container DP fails to a-command the pronoun, explaining the unavailability of this reading.

The concludes the first part of this paper. We have shown that an e-type analysis of BOOD, in particular genitive binding and inverse linking, handles some of the most notorious counterexamples against the a-command account of crossover, and in fact provides additional evidence for it. In the second part, we will show that this picture doesn't change under a semantically more complex, empirically more adequate account of e-type pronouns, which involves situations.

Note that the essential features of the account so far will carry over to any semantically refined version of the e-type approach, provided that this refined version still involves individual-variable binding of the sort used so far. The reason we bother about the details nonetheless is that arguably, *not* all cases of BOOD involve individual-variable binding, as we will

⁷ . . . and may very well involve significant complications for the situation-based theory to be put forward in the following sections (cf. the discussion in Elbourne 2001a, sec. 7.2+3)

see. The refinement of the theory we are about to present captures crossover effects in these cases nonetheless, and moreover repairs some general inadequacies of the e-type approach (in VP ellipsis contexts).

In what follows, I will restrict my attention to donkey sentences, since these have received the most attention in the literature, and embedded quantifier binding (genitive binding and inverse linking), which hasn't been analyzed using e-type pronouns at all.

4. ENTER SITUATION SEMANTICS

As is well known at least since the discussion in Heim (1982), the e-type analysis of donkey sentences in its simple form is haunted by what has come to be known as the *uniqueness problem*. In a nutshell, the problem is this: Given that the bound pronoun is analyzed as essentially a function from individuals to individuals, it follows that it will not be defined if no such functional mapping exists. Sentences like (22) from Rooth (1987) are predicted to be either false or undefined if there are mothers that have more than one son:

- (22) No mother with a teenage son will lend him the car on the weekend.

But this result is counterintuitive. We clearly judge these sentences to be true just in case no boy, whether he has a brother or not, gets to ride the family car on weekends. The exact same problem shows up in cases of genitive binding, inverse linking, focus constructions, and VP-ellipsis. The following examples should be self-explanatory:

- (23) a. *Every boy's* mother likes *him*.
 b. Some ally of *every country* betrayed *it*.
 c. It was only established that the guy who married *APPOLONIA* was a bigamist and attempted to steal *her* money.
 d. *Every boy's* father likes *him*, and *every boy's* grandfather does, too.

In all these cases, the intuitions are clear: There should be as many different cases as there are individuals that meet the scope of the quantifier with the wider scope, i.e. one per boy, country, wife, or (grand)son.⁸

⁸ Note incidentally that (23b) also argues against an analysis of *it* as a numberless pronoun that denotes the sum of elements standing in the pertinent relation, as suggested in Neale (1990); that would wrongly yield a reading according to which every country *x* has some ally that betrayed *all of x's allies*. To be sure, Neale doesn't intend his analysis for these cases, but if we want to pursue a unified analysis, they become relevant.

4.1. *Adding Situations to the E-Type Analysis*

Heim (1990), elaborating on Berman (1987), provides a situation semantics version of a paycheck account to donkey sentences which avoids the uniqueness problem. Simplifying considerably, she lets the container DP in donkey sentences, say *every man who owns a donkey*, quantify over an individual and a situation, here: minimal situations of a farmer and a donkey he owns. *Every farmer who owns a donkey beats it* is thus, to a first approximation, interpreted as ‘Every minimal situation containing a farmer and a donkey owned by him is (or can be extended to) one in which he beats the unique donkey he owns in that situation’.

Paul Elbourne, in a series of recent papers (Elbourne 2000a, b, 2001b) elaborates on Heim’s proposal, pointing out among other things that the description ‘the unique donkey he owns in that situation’ above can simply be replaced by ‘the unique donkey in that situation’, given that we are talking about minimal farmer+donkey-he-owns situations anyway. Put in different terms, Elbourne observes that the three variants in (24) are judged to have the same truth conditions (though they differ in their degree of naturalness):

- (24) Every farmer who owns a donkey beats $\left. \begin{array}{l} \text{it} \\ \text{the donkey} \\ \text{the donkey he owns} \end{array} \right\}$

He suggests that if we assume the plain definite *the donkey* rather than the definite with a bound pronoun in it to be the LF representation for the e-type pronoun, we can formulate a simple condition on the occurrence of e-type pronouns, namely: the presence of an antecedent with identical descriptive content (or, put syntactically, identity of NPs). This not only provides a simple rule to retrieve the content of an e-type pronoun, it also naturally and correctly limits the occurrence of e-type pronouns to environments in which there is a suitable NP ‘antecedent’.⁹

For example, it has been observed that we can have an e-type interpretation for *it* in *Everyone who has a guitar should bring it* but not in *Every guitarist should bring it*: predicting this difference has been dubbed the ‘problem of the formal link’ (Kadmon 1987; Heim 1990). According to Elbourne, the generalization is simply that we need to interpret *it* as ‘the

⁹ This then turns the e-type analysis almost back into a pronoun of laziness (or, paycheck) analysis, since now the pronoun *is* taken to simply go proxy for a literal repetition of a preceding constituent, though this constituent is taken to be an NP, not – as in Geach’s original discussion (e.g. Geach 1962) – a DP (cf. note 4 above).

guitar’, which is possible only if an NP *guitar* exists in the linguistic context.

The question I want to address now is if and how such a situation-semantic analysis of donkey sentences, and BOOD more in general, is still compatible with the story about crossover told in the previous part of this paper. More precisely, we can ask the two questions: Can the individual-binding mechanism used be carried over to a semantics with situations? And do we need to add additional mechanisms to regulate situation binding? I will provide a formalism in which both questions receive a positive answer, and in which, moreover, the binding of situation variables in general is treated in complete parallelism to that of individual variables.

Neither Heim (1990) nor Elbourne (2001b) concern themselves with the compositional interpretation of these examples. That is, they leave open the question what the denotation of the CDP is in isolation, by what exact rules it combines with the rest of the sentence, and how situation variables are indexed and bound. Since all these questions will ultimately become relevant to the analysis of (secondary) crossover, let us try to answer them at the outset. The implementation I will suggest differs in its net results from the existing proposals, in a way that is, I think, advantageous. The following should therefore not be read as a literal exegesis of Heim’s or Elbourne’s proposals.

4.2. *Situations and Types*

As a first step, we need to add a set S of situations to our ontology, together with a partial ordering \leq , meaning ‘part of’. A subset of the set S of situations is the set of worlds, i.e. those situations which are not proper parts of other situations. Each situation s is part of exactly one world (namely $\iota s' \in S[s \leq s' \text{ and } \forall s'' \in S, \text{ if } s' \leq s'', \text{ then } s' = s'']$), which we notate as w_s (‘the world of s ’, cf. Kratzer 1989).

Our semantic types will remain standard, but the domain of type t is now $\{0, 1\}^S$, i.e. a sentence denotes (the characteristic function of) a set of situations (called a *proposition*), a VP denotes a function from individuals and situations to truth values (e.g., $VP'(x)(s) = 1$ iff x beats the unique donkey in s), and so forth. Accordingly, we don’t need a world index on the interpretation function, which is then plan $\llbracket \cdot \rrbracket^s$. I will write, e.g., $\lambda x \lambda s$. . . to name a function of type $\langle et \rangle$, and similarly for other types ending in t , and I will freely refer to functions as sets, e.g. speak of a VP denotation as a set of individual+situation pairs.

A DP (type $\langle et, t \rangle$) then denotes a function from $\langle et \rangle$ type functions to t type functions, which means a function from sets of situation+individual

pairs to propositions. Consider a simple example, together with the truth conditions we want to assign it:¹⁰

- (25) a. every man sleeps
 b. For every x , s_b such that s_b is a minimal situation of x being a man, there is an extended situation s_e , $s_b \leq s_e$ such that x sleeps in s_e .

Note that we need to distinguish two situations here, which are called s_b and s_e , mnemonic for ‘base situation’ and ‘extended situation’, in (25). The base situation relates to the restriction of the quantifier; in (25), base situations are minimal situations that contain a man and absolutely nothing else. Since such a situation contains no sleeping, we need to extend the base situations when it comes to evaluating the consequent.

Assuming that an intransitive V denotes a simple set of situations as in (26a), we therefore introduce into the syntactic representation an operator \leq , which adjoins to VP and whose denotation, to a first approximation, is (26b):¹¹

- (26) a. $\llbracket \text{sleeps} \rrbracket^g = \lambda x \lambda s. x \text{ sleeps in } s$
 b. $\llbracket \leq \rrbracket^g = \lambda P \lambda x \lambda s_b. \text{there is an } s_e, s_b \leq s_e, \text{ and } P(x)(s_e)$

$[_{VP} \leq [_{VP} \text{ sleeps}]]$ no longer maps an individual x onto the set of situations in which x sleeps, but onto the set of situations that can be *extended* to one in which x does, (27a), which then combines with the subject as in (27b) and (27c):

- (27) a. $\llbracket [_{VP} \leq [_{VP} \text{ sleeps}]] \rrbracket^g = \lambda x \lambda s_b. \text{there is an } s_e, s_b \leq s_e, \text{ and } x \text{ sleeps in } s_e$
 b. $\llbracket \text{every man} \rrbracket^g = \lambda P \lambda s. \text{for all } x, s_b \text{ such that } s_b \text{ is a minimal situation of } x \text{ being a man, } P(x)(s_b)$
 c. $\llbracket \text{every man } [_{VP} \leq \text{sleeps}] \rrbracket^g = (25b)$

Before going on, let us ask: Couldn’t we avoid \leq in the syntax and assume instead of (27a) and (27b) that VP denotes (26a) and the DP denotes something like (28), yielding the same net effect?

¹⁰ The technical use of the term ‘situation’ might be confusing at first, since it is intuitively unclear what, e.g., a minimal situation of being a man would look like. As I lack the space to go into the foundations of situation semantics here, I have to refer the reader to Kratzer (1989) and the references therein.

¹¹ Note that \leq in the metalanguage, the mereological part-of relation, is not identical to, nor the interpretation of, \leq in the object language.

- (28) $\llbracket \text{every man} \rrbracket^s = \lambda P \lambda s. \text{ for all } x, s_b \text{ such that } s_b \leq s \text{ is a minimal situation of } x \text{ being a man, there is an extended situation } s_e, s_b \leq s_e \text{ such that } P(x)(s_e)$

For simple examples this doesn't make any difference. But for the donkey examples it does. Recall that the correct truth conditions for these examples in a situation s go like (29):

- (29) For every x, s_b such that $s_b \leq s$ is a minimal situation of x owning a donkey, there is an extended situation $s_e, s_b \leq s_e$ such that x beats in s_e the unique donkey x owns in s_b .

Note that within the core VP meaning (underlined), there are two different situation variables, s_e and s_b , both of which, according to (28), would be introduced by the DP meaning. Accordingly, the DP can't be interpreted as in (28). Rather, it would have to take as its argument a function from a situation and an individual to propositions, and the VP would, consequently, have to denote a function of that kind, something like (30) (this kind of function doesn't have a type in our system):

- (30) $\llbracket \text{beats the donkey he owns} \rrbracket^s = \lambda x \lambda s_b \lambda s_e. x \text{ beats in } s_e \text{ the unique donkey } x \text{ owns in } s_b.$

The alternative introduced first doesn't have to assume this. All denotations remain standard (standard, that is, under the new type–domain assignment). This is an argument from simplicity: If we can assume that DPs and VPs have a standard denotation, we should happily do so, and not have to worry about when and why DPs and VPs come to acquire more complex, essentially ternary, meanings.¹²

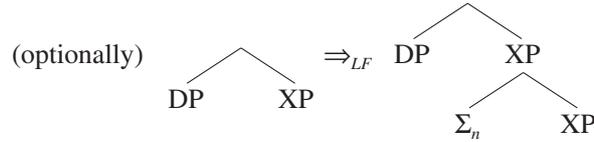
Below, we will present a second, empirical argument: We will show that, descriptively, a DP within the predicate can never be indexed s_e . This can be modeled rather naturally by assuming that only s_b , but not s_e , is introduced by a DP.

¹² Similar consideration apply to approaches on which the argument to DP denotes a function from assignment functions to $\langle e, t \rangle$ -type meanings; though technically, on such an approach, the DP can bind any number of variables (situation or individual) within its complement while maintaining one and the same type, it effectively relegates the task of semantic types – to 'traffic rule' semantic composition – to a theory of indexing. (Note that in principle, any constituent could be made to denote a function from assignments to propositions on the account, since these can cash out as effectively n -ary place relations for any n .) Such an approach is not only semantically more cumbersome, it is diametrically opposed to the project underlying the present paper: to minimize the role of indexing procedures in the grammar and keep grammatical rules local.

4.3. *The Meaning of The Donkey and It*

Turning now to the DPs, these will have an additional situation index, which, like an index on an ordinary pronoun, can be bound or free. We will write these as situation indices $\sigma_0, \dots, \sigma_n$ on determiners, and signal binding of this situation variable by a s(ituation)-binder prefix Σ_n ; this will be referred to as *s(ituation) binding*, as opposed to *i(ndividual) binding*:

(31) a. *Situation binding (preliminary):*



where n is any index

$$\text{b. } \llbracket \Sigma_n \text{ XP} \rrbracket^g = \lambda x \lambda s. \llbracket \text{XP} \rrbracket^{g[\sigma_n \rightarrow s]}(x)(s)$$

The domain of assignment functions is extended to contain a special set of variables, $\sigma_1, \dots, \sigma_n$, which are mapped onto situations; i.e. for all n , $g(\sigma_n) \in S$. To a first approximation, the meaning of *the*, as seen in overt definite DPs, as well as e-type pronouns at LF, is (32); the two different readings for a donkey sentence are represented in (33):

$$(32) \quad \llbracket \text{the}_{\sigma_n} \rrbracket^g = \lambda P_1 \lambda P_2 \lambda s. P_2(\text{the unique } x \text{ such that } P_1(x)(g(\sigma_n)))(s)$$

- (33) Every boy who grew up with a donkey $\Sigma_3[\leq]$ will like
- a. $\llbracket \text{the}_{\sigma_3} \text{ donkey/animal} \rrbracket$ (s-bound reading)
 - b. $\llbracket \text{the}_{\sigma_4} \text{ donkey/animal} \rrbracket$ (anaphoric/free reading)

An s-bound definite as in (33a) represents the run-of-the-mill donkey sentence, in which the donkey co-varies with boys (or rather: boy+donkey situations). A definite with a free s-variable as in (33b) represents an anaphoric, unbound reading, on which the donkey is the unique donkey in a contextually given situation $g(\sigma_4)$ and doesn't co-vary with boys.¹³ Such a reading is for example plausible in a context where we wonder whether the boys in the summer camp will like the donkey I just bought.

This account then lets even unbound definites as in (33b) refer, anaphorically if you will, to a unique donkey in a particular situation (here: $g(\sigma_4)$), rather than an absolutely unique donkey. I don't see any reason to exclude this, given the well-known fact that unbound definites don't have to refer

¹³ That is, in this representation, Σ_3 binds vacuously.

to absolutely unique individuals, and in fact rarely do.¹⁴ But we also want to have non-anaphoric, non-bound definites, i.e. ones that do refer to the unique N in the world. For this purpose we introduce a special subscript σ_0 , such that *the* _{σ_0} is interpreted relative to w_s . This index will show up on *truly unique*, non-anaphoric or *absolute definites*, such as *the goddess of beauty* or *the tallest mountain on earth*.

In introducing situation indices on DPs, we have forgone a different, equally obvious option, namely to say that definites are ‘automatically’ evaluated at the local situation index, which will be the bound index in the scope of a situation quantifier and the matrix index otherwise. DPs would then be like, say, verbs, which also don’t bear any specific situation index, but get automatically interpreted relative to the local index. The following meaning for *the* would accomplish this effect:

$$(34) \quad \llbracket \text{the} \rrbracket^g = \lambda P_1 \lambda P_2 \lambda s. P_2 (\text{the unique } x \text{ such that } P_1(x)(s))(s)$$

I think, however, that there are reasons to disprefer this option. For one thing, bound definites and anaphoric/absolute definites can occur in the same structural domain, e.g. *the donkey* (bound) and *the market* (anaphoric) in (35):

$$(35) \quad \text{Every farmer who owns a donkey brings the donkey to the market.}$$

LF: [every . . .] Σ_1 [brings [the _{σ_1} donkey] to [the _{σ_2} market]]

Since both definites are within the scope of *every farmer who owns a donkey*, it is hard to see how they could be interpreted with respect to different situations if interpreted as in (34), whereas indexing represents this straight-forwardly, as shown in the LF in (35). To pursue this argument is tricky, however, since a certain amount of ambiguity can probably be derived by scoping the DP at LF (e.g., moving *the market* above the subject DP). While I believe that the rather great flexibility of DPs to choose their situation index makes a scoping approach unpromising, I will therefore not pursue this argument any further.

¹⁴ Perhaps the technique of indexing definites to contextually given situations can even be extended to offer a general account of anaphoric definites in terms of anaphoric situations, while maintaining a general uniqueness semantics for definite DPs, or, put differently, offer an alternative way of encoding domain restriction effects, by saying that *the donkey* refers to the unique donkey in a specific, anaphorically given situation, rather than the unique donkey out of a specific, anaphorically given set of individuals (it is, however, fully compatible with the idea that *in addition*, the common noun denotation which the determiner combines with can be contextually restricted). I will leave the exploration of this possibility for further research.

A second argument is more conceptual in nature. A meaning along the lines of (35) yields *non-persistent* propositions. For example, a simple sentence like *The donkey is paranoid* would denote the following proposition:

- (36) λs . there is an x which is the unique donkey in s and x is paranoid in s

This set will contain all situations which contain a paranoid donkey and possibly other things, *but not a second donkey*. In a world w which has two donkeys, one or both of which are paranoid, (36) will contain a number of situations $s \leq w$, but not w itself (or any situation s' , $s \leq s' \leq w$ which contains more than one donkey). Such a proposition is called *non-persistent* (a persistent proposition is one that contains for every situation s in it also all s' for which $s \leq s'$).¹⁵

Kratzer (1989) argues that persistence is a desirable property for propositions to have, and that quantifier meanings should be construed so as to yield persistent propositions. Transposing her proposal for *every* to the case of *the* would mean to replace *the unique donkey in s* in (36) by *the unique donkey in w_s* , where w_s is the maximal situation (= the world) of which s is a part. This, however, cannot be the hard-wired meaning for *the*, for it makes every definite an absolute one, in our terminology, excluding bound and anaphoric uses. Giving DPs a bindable situation index, as proposed here, lets us have the cake and eat it, too. The index *can* be bound by a Σ , be indexed to a contextually given situation, or be indexed σ_0 , in which case we achieve Kratzer's absolute uniqueness. In either case, the resulting proposition will be persistent.

The third argument for indexing DPs for situations is empirical, and relates directly to BOOD. If a definite/e-type pronoun can always be interpreted at the local index, there should be a scoping on which it is embedded under the situation extension operator. This effect is irrelevant for true donkey sentences; *Every man who owns a donkey beats it* could, under the alternative, index-less theory using (34), be represented by either LF in (37):

¹⁵ It is not clear to me whether Heim or Elbourne allow such propositions. The question is whether e-type pronouns, on Heim's account, can even occur unbound, and whether the actual definite determiner shares the relevant properties with the definite determiner in e-type pronouns, on Elbourne's account. At least the latter seems reasonable, given the near-complete parallelism between e-type pronouns and definite DPs that Elbourne points out. In that sense, these approaches might then yield, or rather, allow for, non-persistent propositions as well.

- (37) a. every man who owns a donkey [[the donkey] [\leq [beats t]]]
 b. every man who owns a donkey [\leq [beats [the donkey]]]

Construal (37a) is interpreted identical to a bound construal: *the donkey* is interpreted relative to the base situation, introduced by the subject. (37b) is structurally different – *the donkey* is interpreted relative to the extended situation – but arguably yields the same truth conditions, due to the following conspiracy: the extended situation s_e must contain a unique donkey (uniqueness requirement of the definite DP), but it must also be an extension of the base situation, which already contained a donkey; therefore, the unique donkey in s_e must be the same as the donkey in s_b (cf. the argument in Elbourne 2001a, p. 260f).

Nonetheless, admitting LFs like (37b) opens Pandora’s box, as it were, for other cases. Consider (38):

- (38) a. Every man in Athens worships the goddess.
 b. LF: every man in Athens [$_{VP^*} \leq$ [$_{VP}$ worships the goddess]]

If we interpret *the goddess* at the local evaluation index, the lower VP will denote (39a), and the upper VP* (39b):

- (39) a. $\lambda x \lambda s_e. x$ worships in s_e the unique goddess in s_e
 b. $\lambda x \lambda s_b. \text{there is a situation } s_e, s_b \leq s_e \text{ such that } x \text{ worships in } s_e$
 the unique goddess in s_e

Suppose now that every man in Athens worships two or more goddesses, but there is no goddess worshipped by every man. In such a situation, (38) is actually predicted to be true, since for each base situation s_b that contains just a man it is possible to find (at least) one extended situation $s_e, s_b \leq s_e$ containing that man and a goddess he worships. Since that goddess is unique *in that extended situation*, the truth conditions for the sentence are fulfilled. The sentence is thus predicted to mean more or less the same as *Every man in Athens worships some goddess*.

This result of course clashes with our intuitions, according to which (38) can only be interpreted to mean that every man worships one and the same goddess, who is unique relative to some situation that doesn’t co-vary with men (say the goddess of beauty). This intuitively available reading can (more or less, ignoring issues of absolute uniqueness and persistence discussed above) be derived assuming (34) by scoping *the goddess* above *every man in Athens*, but it would remain rather mysterious why this scoping is obligatory in a case like (38) while it is not in true donkey sentences like (37b).

On the present proposal, the intuitively available reading is readily

represented by the LF in (40a) below. Alongside it, there is a bound representation, (40b), which we can safely ignore, however; it is inevitably false because the base situation introduced by *every man in Athens* doesn't contain any goddesses whatsoever.

- (40) a. every man in Athens [\leq [worships [the $_{\sigma_{0/2}}$ goddess]]]
 b. #every man in Athens [Σ_2 [\leq [worships [the $_{\sigma_2}$ goddess]]]]

Still, the incriminated reading on which (38) essentially means 'Every man in Athens worships some goddess' can be represented in our system, too, namely by LF (41):

- (41) every man in Athens [\leq [Σ_2 [worships [the $_{\sigma_2}$ goddess]]]]

Here the definite is s-bound to the extended situation, rather than the base situation, yielding the same truth conditions as (38b) above. But we can block this reading syntactically without much ado, by requiring that the Σ -prefix must be next to a DP, not something else. This is a stipulation, but a very local one, which is easy to formulate. We will return to the question whether it follows from a more general syntactic condition on Σ -placement below. For the moment we just stipulate that nothing must intervene between Σ and the binder DP.¹⁶ Note that this is possible because we opted above to have only one of the two situations, the base situation, introduced by the quantificational DP, while the other one is introduced by \leq . S-Binding a DP to the extended situation would have been much harder to rule out had we adopted the alternative to have both situations introduced by the DP; in this sense, the fact that representations like (41) should and can be ruled out in this fashion provides a further argument a favor of assigning the meanings we did above.

It should be noted that the unwanted reading of (38) can also be derived in Heim's (1990) framework (or Elbourne's (2001a), which is identical in this respect). To block it, a stipulation that prohibits DPs from being indexed to the extended situation (in our terms) would be needed. Since Heim discusses neither the details of the indexing procedure nor the interpretation of DPs that are not s-bound, it is moot to speculate about the detail of such a convention. Suffice it to say that the present account, even with the stipulated restriction on Σ -placement, is local in precisely the same way that our account of crossover in section 2 is: It doesn't regard the

¹⁶ A more general version of this constraint will have to address cases in which DPs are bound by non-nominal elements such as conditional clauses, adverbials, tenses, etc. I have to leave this issue for future research (cf. also Percus 2000).

coindexing of two elements in a phrase marker, but simply the possibility of locally inserting a binder.

Before closing this section, we need to add one more complication. In our meaning for the definite determiner in (32), repeated here, we simply interpreted the restriction relative to the situation $g(\sigma_n)$:

$$(42) \quad \llbracket \text{the}_{\sigma_n} \rrbracket^g = \lambda P_1 \lambda P_2 \lambda s. P_2(\text{the unique } x \text{ such that } P_1(x)(g(\sigma_n))(s))$$

Note, however, that $g(\sigma_n)$ is a particular situation, which is part of one particular world. Accordingly, *the* _{σ_1} *man sings* will denote the set of situations s in which the unique man in $g(\sigma_1)$ sings, which means that for most such s , $g(\sigma_1)$ isn't even a part of s . This raises various problems familiar in counterpart semantics which we need not go into here. Intuitively, what we want the sentence to denote is the set of all situations s such that the unique man in *that part of s which is a counterpart to $g(\sigma_1)$* sings in s . We will therefore have to replace $g(\sigma_n)$ with the more cumbersome $G_s^g(\sigma_n)$, to be read as 'that situation in s which is a counter-part of $g(\sigma_n)$ ':¹⁷

$$(43) \quad \llbracket \text{the}_{\sigma_n} \rrbracket^g = \lambda P_1 \lambda P_2 \lambda s. P_2(\text{the unique } x \text{ such that } P_1(x)(G_s^g(\sigma_n))(s))$$

Technically crucial though it is, the reader can ignore this complication for the remainder of this paper and simply think of $G_s^g(\sigma_n)$ as 'the situation σ_n '.

5. SITUATION CROSSOVER

5.1. Restricting S-Binding to A-Positions

We now have all the pieces together to represent situation binding in donkey sentences and their kin, and derive their meanings compositionally. A standard case is represented as in (44):

¹⁷ We define:

- (i) a. For all s_1 , $cpc(s_1)$ = the set of all counterparts to s_1 .
- b. For all s_1, s_2 , $cp(s_1)(s_2)$ = the $s \in cpc(s_1)$ such that $s \leq w_{s_2}$.
- c. For all assignment functions g , variables σ_n , and situations, s_1 , $G_{s_1}^g(\sigma_n) =$
 - 1) w_{s_1} if $n = 0$
 - 2) $cp(g(\sigma_n))(s_1)$ otherwise.

Note that this also takes formal care of our convention that $\llbracket \text{Det}_{\sigma_n} \rrbracket^g \dots (s)$ is always relativized to w_s .

- (44) Every man who owns a donkey beats it.
- a. LF (traditional):
[every man who owns a donkey [Σ_3 [β_2 [\leq [beats **the _{σ_3} donkey owned by x_2]]]]]]**
 - b. λs . for every x that is a man in w_s , any minimal situation $s' \leq s$ in which there is a donkey x owns is a situation which can be extended to a situation s'' in which x beats the unique donkey x owns in s' .
 - c. LF (Elbournesk):
[every man who owns a donkey [Σ_3 [\leq [beats **the _{σ_3} donkey]]]]]**
 - d. λs . for every x that is a man in w_s , any minimal situation $s' \leq s$ in which there is a donkey x owns is a situation which can be extended to a situation s'' in which x beats the unique donkey in s' .

Note that the intended co-variation is achieved under either the ‘classical’ assumption that e-type pronouns contain i-variables (in addition to s-variables; LF (44a)) or a modified proposal à la Elbourne, under which they only contain s-variables (LF (44c)). Turning to crossover now, an LF for the illicit case in (8a), repeated here, would look as in (45):

- (45) a.**Her* mother visited every knight who courted *a lady*.
b.*[every knight who courted a lady] Σ_8 [β_5 [μ_4 [\leq [[[**the _{σ_8} lady courted by x_5]**’s mother] visited t_4]]]]]

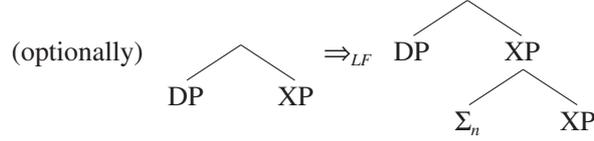
This representation is ill-formed for the reasons discussed in sections 2 and 3: The i-binder prefix β is adjoined in an \bar{A} -position. This answers the first of the two questions we set out to answer: We still derive the crossover effects in the situation-infused framework. Let us then address the second question: Should there be a crossover restriction on s-binding, too? There has to be, if we assume that e-type pronouns do not, or at least need not always, contain an i-variable. In that case, (45a) has a second LF that looks like (46):

- (46) [every knight who courted a lady] Σ_8 [μ_4 [\leq [[[**the _{σ_8} lady]**’s mother] visited t_4]]]]]

Note that this LF doesn’t involve a β , i.e. no i-binding, and is therefore not excluded by the A-binding requirement. Yet, it has the same interpretation as the LF in (45a), for the reasons pointed out in Elbourne (2001a), discussed in section 4 above. Thus, if Elbourne’s analysis is correct, that is, if e-type pronouns without i-variables exist, then a constraint on Σ -

adjunction, parallel to that on β -adjunction, is called for to rule out (46). Anticipating the discussion in the next section, I assume that this is indeed the case, and therefore formulate the rule for s-binding as in (47):

(47) a. *Situation binding (final)*:



where n is an index, and DP occupies an A-position

b. $\llbracket \Sigma_n \text{ XP} \rrbracket^g = \lambda x \lambda s. \llbracket \text{XP} \rrbracket^{g[\sigma_n \rightarrow s]}(x)(s)$ ¹⁸

Note that (47) also more or less naturally encompasses our earlier requirement that Σ cannot be adjoined underneath \leq , since this configuration doesn't match the structural description in (47a). Arguably, there is an intuition behind this, too: that Σ and β are DP-related elements, while \leq is not, though a formal exploration of this intuition is beyond the scope of this paper.

This concludes our account of crossover. (47), together with (2) from section 2, excludes any dependence of an e-type pronoun on a DP in \bar{A} -position.

5.2. Dependent Definites

Our argument for restricting s-binding to A-positions rests on the premise, inherited from Elbourne (2001a), that e-type pronouns without i-variables exist. In the remainder of this section I will review and present evidence that this is correct. More in general, it will be shown that there are definite descriptions at LF which are co-variant with a DP antecedent, but don't contain i-variables.

A first example of this kind that might come to mind are dependent definites, i.e. sentences in which we have an overt plain definite description instead of an e-type pronoun:

- (48) a. Every farmer who owns a donkey beats the donkey.
b. **The donkey's* attorney sued every farmer who beat *a donkey*.

- (49) a. *Every boy's* mother likes *the boy*.
b. **The boy's* mother likes *every boy's* girlfriend.

¹⁸ A flexible-types version of this rule is needed for some later examples. Its definition is as follows: $\llbracket \Sigma_n \text{ XP} \rrbracket^g = \lambda G. SB(\lambda s \llbracket \text{XP} \rrbracket^{g[\sigma_n \rightarrow s]})(G)$, where $SB(\psi)(G) = i) G(\lambda x \lambda s. \psi(s)(x)(s) = 1)$ if $\psi \in D_{er}^s$, otherwise ii) $\lambda \phi. S(\lambda s \lambda x. \psi(s)(x)(\phi))(G)$ if $\psi \in D_{T_1, T_2}$, with $\phi \in D_{T_1}$.

- (50) a. Some person from *every city* likes *the city*.
 b.*Some person from *the city* likes *every city's* beaches.

As shown above, these definites show clear crossover effects. While the subject-object examples might sound somewhat artificial and strained, the object-subject examples are certainly worse.

As we would expect, given the present analysis, dependent definites do not only occur with embedded quantifiers as antecedents, but can also be directly c-commanded by their antecedent, provided that they do not thereby violate Principle C of the binding theory:

- (51) a. *Most modern cars* let *the driver* adjust *the mirrors* from *the inside*.
 b. *Some movies* are so long that you have forgotten *the title* by the time they end.

In these cases, too, a crossover effect can be seen, as in the following examples from Chierchia (1995, p. 226):

- (52) (Every young author will have a new book at the fair.)
 a. *Every author* will personally present *the book* to the critics.
 b.**The book* will make *every author* rich.

While (52a) can be understood with the definite being s-bound by the subject DP (*the book* = ‘this book’), no analogous reading is possible in (52b); it can only be understood to talk about one specific, contextually given book.

It should be clear that all these judgments are correctly predicted if we assume (47): that binding the definite involves s-binding, and that s-binding can only take place from an A-position. However, they could alternatively be predicted by assuming that all these dependent definites include a covert individual variable, which is responsible for the co-variation. That is, *the book* is *his book* at LF, *the donkey* is really *the donkey he owns*, and *the city* has an afterlife as *the city they are from* (cf. the proposal in Chierchia 1995, p. 225ff).

In order to conclude from these examples that it is a restriction on s-binding (rather than i-binding) that incurs the crossover effect, then, we have to find a way of showing that these examples do *not* involve hidden individual variables, but just the elements we see at the surface.

5.3. Plain Definites and Skolem Definites

To rephrase the issue, we need to find a way to determine what the correct LF-representation for the three DP types in (53) is:

- (53) a. it
 b. the donkey
 c. the donkey he owns

In the context of our discussion, there are two options for the LF-representation, and correspondingly, the interpretation, of the first two DP types: They could be represented as definite DPs containing a pronoun, essentially as (53c), and be interpreted, effectively, as skolem functions (since they'd map an individual or a value assignment to the pronoun, and a situation to an individual, say, people to the donkey they own), or they could be represented as definites without a pronoun, essentially as (53b), and be interpreted as individual concepts, i.e. functions from situations to individuals. Let us call these options *skolem descriptions* and *pure descriptions*, respectively.

A view under which all the crossover effects with donkey pronouns and definite descriptions are ultimately traced to hidden individual variables within these, then, is committed to the view that (53a) through (53c) alike are skolem descriptions at LF. We will show that this is incorrect; rather, plain definites as in (53b) are pure descriptions at LF, definites with pronouns in them are skolem descriptions, and donkey pronouns are plain definites if their antecedent NP is a plain NP like *(a) donkey*, and are skolem definites only if their antecedent NP contains a pronoun, as in the case of *the donkey he owns* or *his donkey*. Or, put snazzily, everything is what it is at the surface, except a donkey pronoun, which is what its antecedent is at the surface.

If this is correct, then since donkey pronouns, plain dependent definites, and definites with a pronoun in them show crossover effects alike, crossover must pertain to situation binding and individual binding the same.

To preview the argument in a nutshell, pure descriptions (*the donkey*) have more stringent requirements on their binders than skolem descriptions (*the donkey he owns*): a binder for the former must introduce a base situation that contains a donkey, while a binder for the latter need not. Put differently, whenever a DP does not yield a co-varying reading, we can *ceteris paribus* conclude that it must be a pure description at LF. (The following examples directly build on Elbourne's (2001a) arguments for his proposal to represent donkey pronouns as pure descriptions, rather than skolem descriptions; his examples and judgments are indicated by 'E'.)

As a first step, observe that plain definites and definites containing a pronoun behave markedly different from one another if they serve as the

antecedents in VP ellipsis; while definites containing pronouns allow sloppy identity readings, plain definites don't.¹⁹

- (54) a. In this town, every farmer who owns a donkey beats the donkey he owns, and the priest does, too. (strict/sloppy; E:44a/b)
 b. In this town, every farmer who owns a donkey beats the donkey, and the priest does, too. (strict/?*sloppy)

The priest in (54b) doesn't beat his own donkey, but either the same one poor donkey every donkey-owning farmer beats (strict identity, with *the donkey* being scopally independent) or the donkey of every farmer (a sort of across-the-board reading, the derivation of which need not concern us here). This is different in (54a), which allows for the priest beating his very own donkey – a run-of-the-mill case of sloppy identity.

The contrast in (54) alone suggests that plain definites and definites containing pronouns should not be the same beasts at LF. Moreover, situation theory accounts for their different behavior, assuming that plain definites are plain descriptions at LF, while definites containing pronouns are skolem descriptions. The former need to be s-bound to co-vary, which is possible only if the s-binder introduces a base situation big enough to contain to donkey. Since *the priest* does not introduce such a situation, the unavailability of a co-varying (= sloppy) interpretation in the second conjunct of (54b) is explained:

- (55) the priest
 a. $\Sigma_1[\leq [\text{beats the}_{\sigma_1} \text{ donkey}]]$ ($g(\sigma_1)$ doesn't contain a donkey)
 b. $\leq [\text{beats the}_{\sigma_{0/2}} \text{ donkey}]$ (*the donkey* anaphoric/absolute)
 c. $\beta_1[\leq [\text{beats the}_{\sigma_{0/2}} \text{ donkey he}_1 \text{ owns}]]$ (DP i-bound)

Skolem descriptions like (55c), on the other hand, can co-vary by virtue of i-binding. They will then denote, for every assignment x to the pronoun *he*, the unique donkey x owns in either a contextually given situation or the world. Hence, co-variation with the priest is possible in (54a).

It is worth emphasizing this latter point. While a skolem description contains two bindable variables, one a situation, the other an individual, it can co-vary on account of only the i-variable being bound, with the s-variable indexed to a bigger situation. That bigger situation, say in (54a), may contain any number of donkeys, as long as it contains a unique donkey owned by the farmer/priest. It is only pure descriptions that need to achieve co-variation and uniqueness by virtue of the s-variable alone, which explains

¹⁹ As Elbourne (2001a) shows, all these data can be replicated with down-stressing instead of ellipsis; I leave the down-stressing examples out in the interest of space.

their demand for a custom-tailored base situation containing one and only one donkey.

This distinction can be used as a probe to the LF representation of donkey pronouns. As Elbourne (2001a) observes, donkey pronouns don't allow for sloppy identity either:

- (56) In this town, every farmer who owns a donkey beats it, and the priest does too. (?*sloppy/strict; E:45/46b)

In other words, the donkey pronouns pattern with plain definites, rather than definites containing pronouns. Representing plain definites and donkey pronouns both as plain descriptions at LF accounts for this patterning, and its consequences for sloppy identity. The elided VP in (54b) and (56) is then represented as (57):

- (57) Σ_1 [\leq [beats the $_{\sigma_1}$ donkey]]

For this to be interpretable, the subject to this VP must introduce a donkey-laden base situation, which *the priest* patently doesn't.

Elbourne's particular theory also explains *why* the donkey pronoun in (56) exists at LF in the form of a plain description, rather than a skolem description: its antecedent NP is itself of the form *donkey*; it doesn't contain a pronoun. Since, on Elbourne's story, donkey pronouns involve NP deletion under identity, this means that the donkey pronoun itself will have a pronoun-less NP as its descriptive core at LF.

This predicts, of course, that an antecedent NP containing a pronoun can itself license a donkey pronoun that expands into a skolem description. This, come to think of it, is the case in classical paycheck sentences such as (58):

- (58) Mary gave her paycheck to the bank, while the priest gave *it* to the Church.

We can interpret *it* to be the priest's paycheck, provided we are ready to accommodate that the latter has a unique paycheck. If *it* were represented as *the paycheck*, this reading couldn't obtain, given that the base situation introduced by *the priest* contains no paycheck, just as little as it contains a donkey; in other words, an LF like (59a) wouldn't do the trick:

- (59) a.*the priest Σ_8 [\leq gave [**the $_{\sigma_8}$ paycheck**] to the bank]
 b. the priest β_8 [\leq gave [**the $_{\sigma_0}$ paycheck of his $_8$**] to the bank]

However, since in (58) the antecedent to the pronoun is *his paycheck*, the pronoun itself can be interpreted as a skolem description, roughly

thereby allow for s-binding of either a pure description or a donkey pronoun.²¹ This effect can be seen with EQB as well:

- (62) Every boy's cat scratched him, only Bosco didn't (sloppy ok: 'didn't scratch the boy who owns him')

Once again, cat Bosco, being the exception to the rule, can be accommodated to be one of 'every boy's cats', and therefore introduce a base situation containing *cat and caboodle*.

As an aside, note that the fact that (62) allows for a sloppy construal (parallel to (61) above) shows the insufficient generality of analyses in which the binding in basic cases like *Every boy's cat likes him* is accomplished by somehow i-binding *him*, directly or through some kind of unselective binding, to *every boy* (a method championed by all analyses I am aware of, except Bach and Partee (1980, 1984); e.g., May (1977, 1985, 1988), Higginbotham (1980b, 1983, 1987), Larson (1987), Reinhart (1987), Barker (1995), Hornstein (1995), Heim and Kratzer (1998)). It is therefore worthwhile to emphasize that examples without a structural binder can be rather productively constructed, once we understand the recipe:

- (63) a. Every boy's parents are supposed to buy him a dictionary, but many of them simply can't afford to/none of them can afford to.
 b. Most people's publishers tell them when a book is going to appear, but Routledge doesn't.
 c. Every boy's mother said she liked him. I didn't expect them to.
 d. (Child to father:) Everybody's dad supports them, but you don't.

End of aside.²²

²¹ Arguably the same is going on in the following examples, where the subject in the second conjunct of VPE overtly introduces a complex situation that can license s-binding of a pure description:

- (i) In this town, every farmer who owns a donkey beats it, and every priest who owns a donkey does too. (strict/sloppy; E:FN16:i)
 (ii) Every boy's cat recognized him, and every boy's dog did, too. (strict/sloppy: 'the boy' as co-variant)

These cases are less spectacular than those presented in the main text, though, because they are also analyzable via sloppy i-binding by *a donkey/every boy* under an unselective binding or binary binding approach.

²² The (im)possibility of sloppy identity should also be useful to shed light on the internal makeup of directly dependent definites of the kind in (51) and (52). Polly Jacobson (p.c.) offers the sentences in (i), based on Jacobson (1999), in which sloppy identity seems fine:

In this subsection, we have seen ample evidence that there are pure descriptions at LF, both as the spell-out of donkey pronouns and as the representation of simple definites. Therefore, we have to conclude that the crossover facts with simple definites and donkey pronouns in the standard cases must be accounted for by situation crossover. That is, the correct representations for the minimal pairs in (64)/(65) are as given underneath:

- (64) a. Every farmer who owns *a donkey* beats *it/the donkey*.
 LF: every farmer who owns a donkey Σ_7 [\leq beats the the $_{\sigma_7}$ donkey]
- b. **Its/The donkey's* lawyer sued every farmer who beat *a donkey*.
 LF: every farmer who beat a donkey $\mu'(*\Sigma_2)$ [the $_{\sigma_2}$ donkey's lawyer sued t_1]
- (65) a. *Every author* will present *the book*.
 LF: every author Σ_4 [will present the $_{\sigma_4}$ book]
- b. **The book* will make *every author* rich.
 LF: every author $\mu_8 (*\Sigma_6)$ [the $_{\sigma_{06}}$ book will make t_8 rich]

This concludes our argument for imposing a crossover condition on s-binding

6. EMBEDDED QUANTIFIER BINDING

In the previous section we have developed a compositional situation semantics for BOOD that accounts for crossover effects. In section 3 we have argued that BOOD encompasses more cases than just donkey sentences, in particularly genitive binding and inverse linking, which are jointly referred to as E(mbedded) Q(uantifier) B(inding). In this last section we will

-
- (i) a. Every young author will have a book at the fair. Every ambitious author will present the book to the critics, but lazy Bill won't.
 b. Everyone in Berkeley in the sixties put eucalyptus on the mantle. Bill still does.

Similar remarks apply to *local*-type expressions (P. Jacobson, p.c.; Mitchell 1986; Partee 1989):

- (ii) Every Red Sox fan watches the world series in a local bar. John does too.

It doesn't seem implausible to me to analyze these particular examples as cases of s-binding, parallel to (62) and (63); if cases like these in general don't show any pragmatic restrictions at all, however, this would suggest that *some* apparently plain DPs do contain i-variables after all, and that our snazzy slogan that "everything is what it is at the surface" is too simple-minded (as Jacobson, p.c., suspects). I leave this issue for further research.

give the details of the e-type analysis of EQB including situations, which is a straightforward extension of the techniques used in the previous section.

Our assumption in section 3 has been that a sentence like (10), repeated here, has the essential semantics in (66b):

- (66) a. *Every boy's mother likes him.*
 b. For every boy x , the mother of x has the following property:
 $\lambda y.y$ likes **the R/son-of** y .

Subject DP and VP under this analysis have the denotations $\lambda P.\text{for every boy } x, \text{ there is a } y, y \text{ is } x\text{'s unique mother, and } P(y)$ and $\lambda z.z \text{ likes the son of } z$, respectively.

We now need to add situations to that analysis. Under the situation analysis, the e-type pronoun is spelled out simply as **the boy**, with *the* s-bound by the subject DP. The interpretation for the predicate is straightforwardly derived from the following representation:

- (67) a. $\Sigma_1[\leq [\text{likes} [\mathbf{the}_{\sigma_1} \mathbf{boy}]]]$
 b. $\lambda x \lambda s_b$. there is a situation s_e , $s_b \leq s_e$ such that x likes in s_e the unique boy in s_b

The following would be a good denotation for the subject DP:

- (68) $\lambda P \lambda s$. for every boy x in w_s , there are y, s_b such that y is x 's unique mother, s_b is a minimal situation of y being x 's mother, and $P(y)(s_b)$

Together, the meanings in (68) and (67b) will derive the correct truth conditions. Note in particular that (68) introduces a minimal mother+son situation for each boy, which functions as the base situation for s-binding *the boy* in the predicate. To get this compositionally, we need to revise the denotation for the genitive 's and the definite article once more, so that they introduce their own quantification over situations:²³

- (69) a. $\llbracket \text{the} \rrbracket^g = \lambda P_1 \lambda P_2 \lambda s$. there are x, s' such that $\{x\} = \{x \mid P_1(x)(s)\}$,
 $\min(P_1(x))(s')$ and $P_2(x)(s')$ = THE
 b. $\llbracket 's \rrbracket^g = \lambda R \lambda x. \text{THE}(R(x))$

According to (69), t_1 's *mother VP*, or *the mother of t' VP*, denotes the set

²³ *min* is a function that maps any set of situations onto the minimal ones among them, i.e. for any $P \in \{0, 1\}^S$, $\min(S) = \{s' \in S \mid P(s')\}$, and for all s'' if $P(s'')$ and $s'' \leq s'$, then $s'' = s'$.

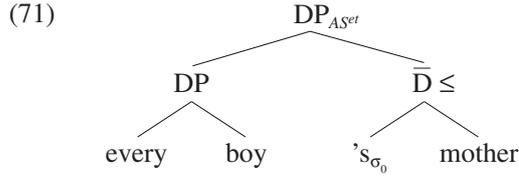
We don't explicitly require in (69a) that $s' \leq s$, given that x by definition must be part of s and s' , which can only be the case if $w_s = w_{s'}$.

of situations s such that there is an x which is the unique mother of $g(t_1)$ and at least one minimal situation of x being $g(t_1)$'s mother is in $\llbracket \text{VP} \rrbracket^s(x)$. If t' is the trace of *every boy*, i.e. if $g(t')$ ranges over boys, there will be a minimal mother+boy situation for each boy x , such that the mother loves the unique boy in that situation. This is precisely what we want.

Alas, there is one last complication: If *the* as part of an e-type pronoun bears a situation index, so should *'s/the* as part of a possessive DP, and any other determiner, for that matter:

- (70) a. $\llbracket \text{the}_{\sigma_n} \rrbracket^s = \lambda P_1 \lambda P_2 \lambda s. \text{there are } x, s' \text{ such that } \{x\} = \{x \mid P_1(x)(G_s^s(\sigma_n))\}, \min(P_1(x))(s') \text{ and } P_2(x)(s') \quad \boxed{= \text{THE}^{s, \sigma_n}}$
 b. $\llbracket 's_{\sigma_n} \rrbracket^s = \lambda R \lambda x. \text{THE}^{s, \sigma_n}(R(x))$
 c. $\llbracket \text{every}_{\sigma_n} \rrbracket^s = \lambda P_1 \lambda P_2 \lambda s. \text{for all } x, s' \text{ such that } P_1(x)(G_s^s(\sigma_n)), \min(P_1(x))(s'), \text{ then } P_2(x)(s')$
 d. $\llbracket \text{some}_{\sigma_n} \rrbracket^s = \lambda P_1 \lambda P_2 \lambda s. \text{there are } x, s' \text{ such that } P_1(x)(G_s^s(\sigma_n)), \min(P_1(x))(s') \text{ and } P_2(x)(s')$

We are now in a position to derive the DP meaning every step of the way, starting with the LF in (71):²⁴



- a. $\llbracket \text{mother} \rrbracket^s = \lambda x_1 \lambda x_2 \lambda s. x_2 \text{ is } x_1 \text{'s mother in } s \quad \boxed{= \text{MOM}}$
 b. $\llbracket ['s_{\sigma_0} \text{ mother}] \rrbracket^s = \lambda x_1 \lambda P_2 \lambda s_1. \text{there are } x_2, s_2 \text{ such that } \{x_2\} = \{x_3 \mid \text{MOM}(x_1)(x_3)(G_{s_1}^s(\sigma_0))\}, \min(\text{MOM}(x_1)(x_2))(s_2) \text{ and } P_2(x_2)(s_2) = \lambda x_1 \lambda P_2 \lambda s_1. \text{there are } x_2, s_2 \text{ such that } \{x_2\} = \{x_3 \mid \text{MOM}(x_1)(x_3)(w_{s_1})\}, \min(\text{MOM}(x_1)(x_2))(s_2) \text{ and } P_2(x_2)(s_2)$

²⁴ I henceforth abbreviate $[\leq Z]$ as Z^{\leq} , parallel to the notation for argument saturation above, for the sake of brevity. (71b) still gives the semantics of the intermediary step.

The following definition, to replace (26b), allows situation extension to apply to categories of any type that ends in t :

- (i) Situation extension, flexible types version:
 $\llbracket Z^{\leq} \rrbracket^s = \text{XT}(\llbracket Z \rrbracket^s)$, where
 a. $\text{XT}(p) = \{s_1 \mid \text{there is a situation } s_2 \text{ such that } s_1 \leq s_2 \text{ and } s_2 \in p\}$ if p is in D_t , else
 b. $\text{XT}(p) = \lambda \phi. \text{XT}(p(\phi))$ if $p \in D_{(T_1, T_2)}$ (with ϕ a variable of type T_1)

- (73) $\llbracket S \rrbracket^g = [\lambda P_3 \lambda s_6.$ for all x_1, s_3 such that $BOY(x_1)(w_{s_6})$, if $\min(BOY(x_1))(s_3)$ then there are s_2, x_2 s.t. $\{x_2\} = \{x_3 \mid MOM(x_1)(x_3)(w_{s_3})\}$, $\min(MOM(x_1)(x_2))(s_2)$ and $P_3(x_2)(s_2)](\lambda x_6 \lambda s_1.$ there are x_4, s_5 such that $\{x_4\} = \{x_5 \mid BOY(x_5)(s_1)\}$, $\min(BOY(x_4))(s_5)$ and there is an $s_4, s_5 \leq s_4$ and x_6 likes x_4 in $s_4) = \lambda s_6.$ for all x_1, s_3 such that $BOY(x_1)(w_{s_6})$, if $\min(BOY(x_1))(s_3)$ then there are s_2, x_2 such that $\{x_2\} = \{x_3 \mid MOM(x_1)(x_3)(w_{s_3})\}$, $\min(MOM(x_1)(x_2))(s_2)$ and there are x_4, s_5 such that $\{x_4\} = \{x_5 \mid BOY(x_5)(s_2)\}$, $\min(BOY(x_4))(s_5)$, and there is an $s_4, s_5 \leq s_4$ and x_2 likes x_4 in s_4
- $\approx \{s_6 \mid$ for all x_1 , if x_1 is a boy in w_{s_6} then for every minimal situation s_3 of x_1 being a boy there are x_2, s_2 , such that x_2 is x_1 's (unique) mother in w_{s_3} , s_2 is a minimal situation of x_2 being x_1 's mother and can be extended to a situation s_5 such that there is an x_4 which is the unique boy in s_2 , s_5 is a minimal situation of x_4 being a boy and can be extended to a situation s_4 in which x_2 likes $x_4\}$ ²⁶

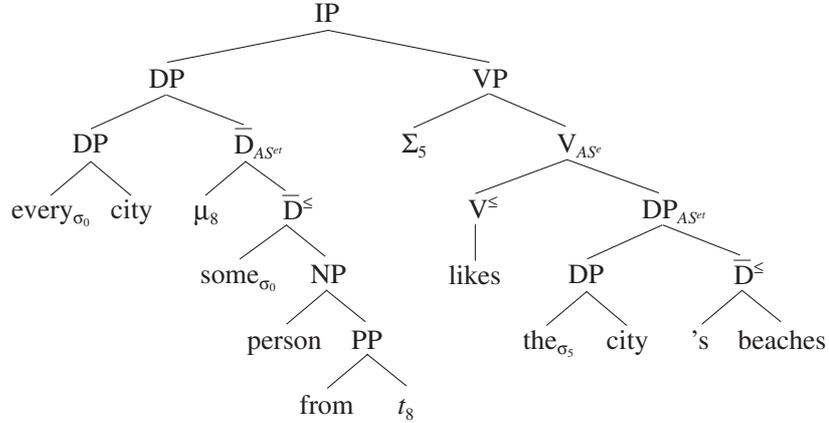
The analysis of the inverse linking cases doesn't bring anything new, except that the embedded QDP undergoes QR to get to its scope position:²⁷

²⁶ This implementation of the analysis hinges on the assumption that if x_1 is a boy, and s_2 is a minimal situation of x_2 being x_1 's mother, then s_2 is a situation that contains a boy. Sure enough s_2 contains x_1 , but does it 'contain' x_1 's boyhood? If the answer to this question is negative, the analysis presented in the main text cannot be maintained as is. One amendment I can think of is appeal to accommodation. Another one is to leave the restrictor of the wide-scope DP within the narrow-scope DP (i.e., by copying). I leave these issues for further research.

²⁷ Here, *every city* binds its trace through μ_8 . It couldn't s-bind or i-bind anything, given that it is in an \bar{A} -position. Thus bindings like the following are correctly ruled out:

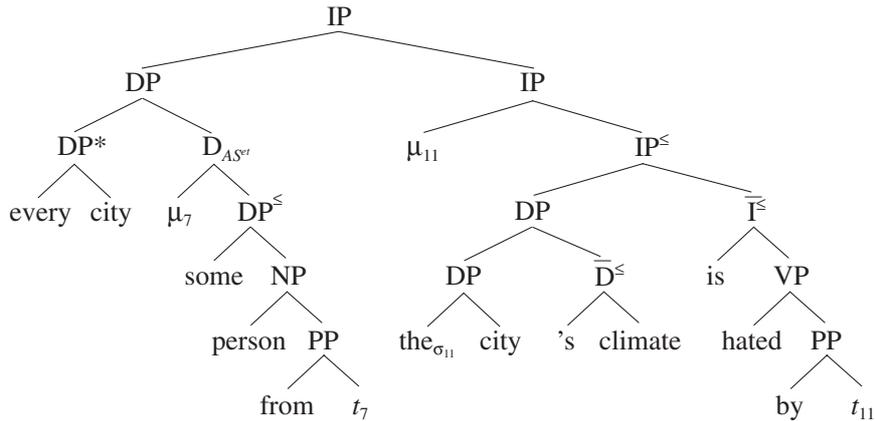
- (i) a. **its mayor's brother from every city* (trying to mean *every city's mayor's brother from that city*)
 b. **its enemies' destruction of every city* (trying to mean *every city's destruction by/through its enemies*)

(74) Some person from every city likes its beaches.



As for (secondary) weak crossover, as shown above, s-binding is possible only under a-command, which lead us to stipulate that Σ can be adjoined next to an A-position only. The secondary weak crossover effects follow from this, given that the apparent embedded quantifier binding is reanalyzed as s-binding by the subject DP. For example, the dependent reading indicated in (75) is ruled out because *some person from every city* lacks a position that a-commands *its climate*, making s-binding impossible. The closest we can get to binding *it* by *some person from every city* is the LF in (75) below, which fails to encode the intended reading: *the _{σ_{11}} city* refers to the unique city in $g(\sigma_{11})$, i.e. it is not s-dependent on *some person from every city*, nor could it be, given that the latter occupies an \bar{A} -position; the coindexing is thus semantically vacuous:

(75) * *Its climate is hated by some person in every city.*



7. CONCLUSION

The first part of this paper developed an account of standard crossover cases along the lines of Reinhart (1983), building on the idea that (non-resumptive) pronoun binding and trace binding are entirely separate phenomena of grammar. It was shown how this approach can extend to apparently problematic cases such as donkey crossover and secondary crossover, once an e-type approach to these phenomena is adopted. The result was a treatment which is significantly simpler and more local than any existing account, based on indexing or linking, of simple crossover (Chomsky 1976; Koopman and Sportiche 1983, a.o.) or secondary crossover (Higginbotham 1983; Reinhart 1987; Safir 1984, a.o.). This, I submit, not only argues in favor of this particular treatment of crossover, but also lends credibility to the uniform analysis of all BOOD phenomena, crucially including genitive binding and inverse linking, in terms of e-type pronouns.

The second part then went on to argue that the crossover phenomenon is not restricted to the binding of individual variables, but should extend to the binding of situation variables, as seen in the case of dependent definites and, indeed, most e-type pronouns in BOOD. A fully compositional semantics of these cases was provided, including a mechanism for situation binding which entirely parallels that proposed for individual binding, encompassing the parallel crossover behavior.

Certainly, the semantics provided are nerve-wrackingly complex. They owe their complexity, however, to entirely independent considerations: the proper treatment of situations across worlds, the compositional semantics of inverse scope, the proper treatment of e-type pronouns in general, etc., etc. The part concerning the very binding of situations is in fact rather simple. The complications arise with the proper and sufficiently detailed analysis of the various constructions we apply it to.

I thus submit that, given that we independently need analyses of all these things, it is actually a small step towards the unified situation-semantic e-type analysis of BOOD, including, for the first time, embedded quantifier binding. The present paper showed what a compositional treatment of these cases looks like, and demonstrated a fully local version of crossover, donkey crossover, and secondary crossover, i.e., one that doesn't involve any constraints on coindexing.

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