

On the origins of weak crossover. Some consequences of Dynamic Semantics *plus* Event Semantics

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Manuscript
January 21, 2019

“WCO may be described as a syntactic configuration in which pronouns cannot be interpreted as coconstrued with certain kinds of displaced or quantified antecedents. If it is correct to say that (a) the blocking of this coconstrual does not seem logically required, (b) the effect is syntactically conditioned, (c) the effect is widespread in the world’s languages, and (d) it does not appear to arise from instruction, then it is reasonable to assume that the WCO effect is a peculiar consequence of the human language capacity and a clue to the structure of that capacity” (Safir 2017)

1. Fragestellung

Weak Crossover (WCO) has been at the center of intense research for some 50 years (since at least Postal 1971)¹ and still constitutes largely a mystery. The present paper explores a novel explanation for it in terms of the dynamics of discourse. Textbook style cases of WCO typically have the following form:

(1) Canonical crossover cases:

- a. * Who₁ did [his₁ book make t₁ rich]
- b. [whose₁ book]₂ [t₂ made him₁ rich]
- c. * No author who₁ [his₁ book made t₁ rich] showed up
- d. No author [whose₁ book]₂ [t₂ made him₁ rich]] showed up
- e. i. Some manager interviewed every analyst
 - ii. every analyst_i [some manager interviewed t_i]
 - iii. his manager interviewed every analyst
 - iv. * every analyst_i [his_i manager interviewed t_i]

In (1a) and (1c) a wh-item is dislocated to the left periphery of a clause and in so doing it ‘crosses over’ a constituent that contains a pronoun. Such a pronoun cannot be interpreted as co-varying with (or bound by) the dislocated constituent. This contrasts with what happens in, e.g., (1b) and (1d)), where no crossing over occurs. WCO effects extend to non-wh dependencies (in particular, scope assignment for quantifiers) as illustrated in

¹ Another important early reference among many is Jacobson (1977).

(1e). It is easy to get an inverse scope reading for sentences (cf. 1e.i-ii). But in the very same configuration it is hard or impossible to get pronoun binding (as in 1e.iii-iv).²

Beyond the canonical cases, WCO has huge ramifications into many aspects of grammar. Consider for example the case of functional readings of *wh*-words (2a-b) or the distribution of list-readings in questions with quantifiers (2c-d):

- (2) a. Which person does no one ever have dinner with? His undertaker
 b. Which person has dinner with no one? * His undertaker
 c. Which extra guest did everyone bring along?
 John brought Sue, Mary brought Bill, ...
 d. Which person brought every guest? * John brought Sue, Mary brought Bill, ...

The impossibility of getting a functional answer in (2b) and a list reading in (2d) have been analyzed as cases of WCO.³ For example, the trace in (2a-b) can be argued to be a functional one, with the argument of the function understood as a null pronoun that has to be bound by a suitable antecedent. The binding of this covert pronoun turns out to be WCO-compliant in (2a) but not in (2b), whence the impossibility of a functional reading in the latter case. Our proposal will have consequences for many ramifications of CO effects, but we won't be able to pursue them all within a single paper, given how widespread they are.

While we won't be able to follow through all the consequences of our proposal, there is one class of WCO extensions that will play an important role in our argumentation, namely extensions to donkey anaphora. The following illustrates the relevant paradigm:

- (3) a. Every farmer who owns a donkey relies on its strength
 b. * its_j strength impresses every farmer who owns a donkey_j
 c. *[every farmer who owns a donkey_j]_i [its_j strength impresses t_i]
 d. Which farmer that owns a donkey_i relies on its_i strength?
 e. * Which farmer that owns a donkey_i does its_i strength impress t?

Non C-command anaphora such as the one illustrated in (3) has been widely studied and the two most prominent approaches to it are constituted by Dynamic Semantics and Situation Semantics (integrated by the view that pronouns are elliptical descriptions, i.e. the so called E-type approach to pronouns). The data in (3), originally due to J. Higginbotham (1980), show that donkey binding displays extremely strong WCO effects, which raises the following (additional) problem. Once the quantified object in (3b) is assigned scope (or overtly *wh*-moved as in (3d-e)) one gets structures that are isomorphic to the well-formed (3a) or (3d). It would appear that any theory that gets the indefinite *a donkey* to co-vary with the pronoun *it* in (3a) ought to yield the same in (3b-c). This constitutes a formidable unmet challenge for any approach to donkey anaphora I am familiar with, challenge that ought to be met and resolved on a par with the standard

² I do not believe that this is an artifact of the view that scope is movement. Any way of getting inverse scope for quantifiers is bound to give the option of binding pronouns as in (2.e).

³ Cf., e.g., Chierchia (1993), Dayal (2016, Chapter 4).

cases of WCO.⁴ We will make a case that the proposal developed here does precisely that.

In the remainder of this section it may be useful to go over desiderata one might want a theory of WCO to satisfy. To do so, let us briefly review the main current approaches to WCO, sketched in (4):

(4) Approaches to WCO:

- a. Reinhart (1983):
A pronoun *pro* can be bound by (/covary with) an antecedent XP
iff XP (or its trace, if XP is quantificational) is in a A position that C-commands *pro*. (= XP must C-commands *pro* before A'-movement, if any).
- b. Koopman and Sportiche (1983):
Bijectivity : An XP in an A' position can bind one and only one element.
- c. Safir (1984):
Parallelism on Operator-Binding: If a single quantifier binds more than one syntactic variable, then either (i) or (ii):
 - i. Both syntactic variables are pronouns.
 - ii. Both syntactic variables are traces.

What is striking about all of these proposals is that they are formally fairly complex, more so than other constraints on binding like, say, the Binding Theory. Moreover, all the constraints in (4) are construction specific and close to being just a restatement of the generalizations in (1)-(3). It would obviously be desirable to derive CO effects relying solely on independently justifiable principles and constraints.

A related issue has to do with what one might call 'functional grounding'. Again, the Binding Theory (along the classical lines of Chomsky 1981) provides us with a useful comparison. Principles A and B of the Binding Theory have a fairly natural 'functional' grounding: Reflexive morphology on a pronoun encodes the need for a local antecedent. It is natural then to try to relate to this the fact that non reflexive pronouns *cannot* be locally bound.⁵ WCO constraints, on the other hand, do not appear to have a clear functional grounding. Maybe such a thing simply does not exist in the case of WCO. Or we are missing something. Everything else being equal, one might prefer a theory of WCO that has a natural functional grounding over one that doesn't.

The third desideratum concerns the well-known, and pretty formidable empirical challenges that all of the approaches in (4) face. In particular, the following phenomena have been repeatedly pointed out in the literature as problematic for any current approach:

⁴ Chierchia (1995) discusses donkey crossover at some length but winds up simply having to stipulate that the dynamics is disactivated at scope sites (i.e. Quantifier Raising has a static semantics).

⁵ See, e.g., Schlenker (2005), Marty (2017) for takes on the BT directly relevant to the present approach.

(5) Empirical issues with canonical WCO constraints:*a. Donkey anaphora*

- i. If a farmer₁ buys a donkey₂, he₁ trains it₂
- i. Every farmer that buys a donkey₁ trains it₁

b. Inverse linking

- iv. The mayor of no city₁ despises it₁/its₁ population

c. Possessor binding

- v. Every first year student₁'s advisor tries to help him₁ or her₁ through the initial rough phase

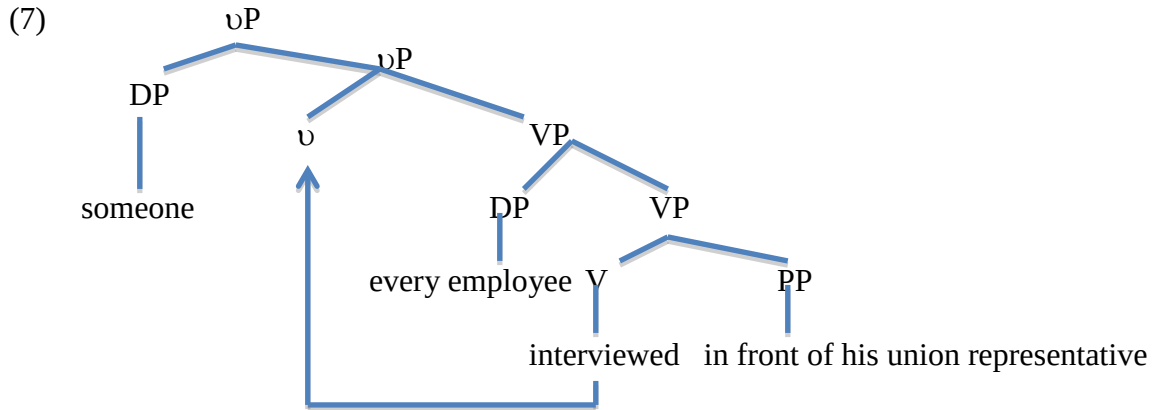
d. Binding into adjuncts

- vi. I spend an inordinate amount of time time with every first year student₁ in order to afford him₁ or her₁ a smooth entrance into our program

All of these familiar phenomena are known to be *prima facie* incompatible with the C-command condition on pronoun binding, or with bijectivity, or with parallelism. It is worth focusing, in particular, on the case of binding from the object position into adjuncts, i.e. (5d). Its problematic nature can be best appreciated by considering the paradigm in (6):

(6) a. Someone interviewed every new employee**b. His manager interviewed every new employee****c. Someone interviewed every new employee in presence of his union representative**

We already pointed out that while it is easy to construe (6a) with the object having wide scope over the subject, it is hard or impossible to get the object to bind a pronoun embedded in the subject position as in (6b). However, it is perfectly natural for a quantifier in object position to bind into a higher adjunct as in (6c), regardless of whether the object is construed with wide or narrow scope with respect to the object. The problem here is the asymmetry between the subject vs. the adjuncts: both are higher than the object, and yet the object can easily bind into adjuncts, but hardly so into the subject. This situation has led some researchers (e.g. Larson 1988, Pesetsky 2004) to invoke 'cascading' structures / VP-shells such as (7):



The idea here is that adjuncts, no matter how high they wind up at spell out, are generated as sisters to the verb, which is subsequently head raised leftwards, as indicated by the arrow in (7). In their base position, adjuncts are C-commanded by the object, which supposedly explains why binding by objects into adjuncts is possible. However, this generalization of the VP-shell approach faces many issues. For one thing, approaches based on bijectivity or parallelism still face a problem here, for structures like (7) wind up with an operator binding two (non parallel) positions. Moreover, adjuncts pattern very differently from arguments when it comes to, e.g., extraction, something that is problematic for the take in (7). In conclusion, it seems desirable to try to understand binding into adjuncts in a way that retains a more standard approach to adjunction.

To sum up, the main desiderata we would like a theory of WCO to meet are:

(8) A theory of WCO should:

- a. eschew WCO specific provisions
- b. provide some kind of functional grounding for CO phenomena
- c. avoid the empirical problems that current approaches face, like the asymmetry between binding into subjects vs. binding into adjuncts.

I think that dynamic semantics (DS) provides us with a framework that enables us to meet these goals. In essence, our main thesis is that WCO phenomena follow from the fact that pronouns can *only* pick up their reference from antecedents that are ‘accessible’ to them, where accessibility is determined by familiar semantic properties of propositional connectives. Of course, not any old version of DS enables us to derive how crossover effects come about by logic alone. But there are a number of assumptions that arguably constitute well-motivated moves in a dynamic setting and do enable us to provide, perhaps, an appealing way of deriving WCO. This, on the one hand, paves the way to an account of crossover that has explanatory and empirical advantages over existing alternatives. On the other hand, it constitutes new evidence in favor of a dynamic take.

2. Dynamic Semantics + Event Semantics

Typical cases of ‘discourse binding/donkey anaphora’ are of the following sort:

(9) Discourse binding/Donkey anaphora:

- a. An unfamiliar customer walked into the office. He wanted to know about our new program.
- b. Lately, each time an unfamiliar customer walked into the office, he wanted to know about our new program.
- c. If an unfamiliar customer walks into the office, he wants to know about our new program.

Example (9a) is prototypical. Examples (9b-c) show that this kind of antecedent-pronoun relation is not simply due to coreference, but must involve co-variance/binding. The problem is how to push the scope of a potential antecedent like *an unfamiliar customer* in (9) beyond its natural syntactic boundaries. The two main approaches to this issues appeal to logical forms like:

- (10) a. $\exists s [\text{walk-in}(s) \wedge \exists x (\text{new customer}(x) \wedge \text{theme}(s) = x) \wedge \text{the customer in } s \text{ wanted to know-etc.}]$
- b. $\exists s [\text{walk-in}(s) \wedge \exists x (\text{new customer}(x) \wedge \text{theme}(s) = x)] \wedge \text{the customer } y = x \text{ wanted to know-etc.}$

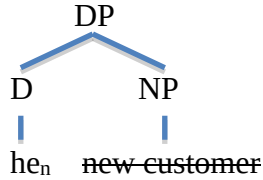
In Situation Semantics (SS)-approaches (cf., e.g. Elbourne 2005, 2010), the antecedent has its normal scope (namely the first clause). But the situation/eventuality variable associated with a clause can span beyond it, and pronouns in subsequent clauses can be construed as descriptions that depend on the situation index. In Dynamic Semantics (DS-) approaches, the *syntactic* scope of (all the) the existential quantifiers in the first clause is limited to the clause in which they originate. However, it is a *semantic* property of existential operators in general to activate ‘Discourse Referents’ (DRs); pronouns pick up accessible DRs from surrounding discourse in a quasi-indexical manner. Pronominal pick up can be done via descriptions that in cases like (10b) are trivial, while some other times wouldn’t be quite so trivial.⁶ So, the main difference between these two approaches doesn’t lie so much/at all in the way pronouns are interpreted, but in *how* potential antecedents are made accessible: a special property of situation variables in SS, a special property of existential operators in DS. Accordingly, I will adopt in what follows an Elbourne like syntax and semantics for pronouns. For example, the pronoun in (9) will be represented as in (11a) and interpreted as in (11c).

⁶ As is well known, cases where the descriptive content of a pronoun cannot be trivial include so-called paycheck pronouns like (i) and much more:

(i) Every candidate except John delivered his CV in person. John mailed it in.

Here, *it* is understood as ‘John’s CV’. It is also perhaps worth pointing out that on approaches like Elbourne (2005), trivial, non situation-dependent descriptions are used for C-command binding like:

(ii) Everyone here thinks he is a genius

- (11) a. 
- b. $\iota y [\text{new customer}(y) \wedge x_n = y]$
- c. $\iota y [\text{NP}(y) \wedge R(x_n)(y)]$

Pronouns are definite Ds with an anaphoric index. Their NP-sisters are elided under identity with some NP in their environment. The anaphoric index picks up its denotation from an accessible antecedent (a situation in SS, anything of type e in DS). The default interpretation for the relation R in (1b) is just identity (the *in*-relation in SS); the context may override the default by bringing to salience some more substantive descriptive content.

The way in which an active DR is passed onto subsequent discourse within DS depends on the inherent semantic properties of connectives. In particular, all versions of DS and Discourse Representation Theory converge on the idea that the accessibility relation is the transitive closure of the following lexical properties of the Boolean connectives:⁷

(12) **Standard dynamics:**

- | | |
|--------------|---|
| a. [A and B] | i. A is ACCESSIBLE-TO B (but not viceversa) |
| | ii. B is accessible to whatever may follow B |
| b. [If A, B] | i. A is accessible to B (but not viceversa) |
| | ii. A, B are <i>not</i> accessible to what follows B |
| c. [not A] | Nothing in A is accessible to what follows A |
| d. [A or B] | A is not accessible to B, nor is B to A. Neither is accessible to what follows. |

These properties follow from the lexical semantics of Boolean operators (see Section 3 below, and the Appendix, for one implementation). The consequences of this view of accessibility for anaphora resolution can be illustrated along the following lines:

⁷ For Discourse Representation Theory (DRT) see, e.g., Kamp and Reyle (1993); for DS see, e.g., Gorenendijk and Stokhof (1991) or Chierchia (1995), among many others.

- (13) a.i. John brought in a cat_i and sat down. Mary fed it_i.
 ii. [[A and B] and C] A is ACCESSIBLE-TO C (it follows from (12a))
- b. i. If John brought in a cat_i, he then sat down. ?? Mary fed it_i.⁸
 ii. [[if A then B] and C] A is not ACCESSIBLE-TO C
 (it follows from (12b.ii))
- c. i. John didn't buy a new car_i. ?? He borrowed it_i from me.
 ii. [[Not A] and B] A is not ACCESSIBLE-TO B
- d. i. ?? Either John has a new car for us to borrow, or it_i is parked in that garage.
 ii. [A or B] A is not ACCESSIBLE-TO B

The deviant cases in (13) all involve unresolved anaphora, as the occurrences of *it_i* lack accessible antecedents.

A radical way of interpreting anaphora resolution for pronouns in DS is to assume that pronouns can *only* pick up antecedents in a quasi-indexical manner. Here is how, e.g., P. Dekker couches this view:

Pronouns are essentially indexical...devices to refer to contextually given entities...And when I say that a pronoun refers to a contextually given entity, I mean it relates to something that is 'given' at its point of occurrence...by an expression that literally occurs to the left of the pronoun's occurrence in a formula". (Dekker, 2012, p. 17).

If this is correct, it follows that pronouns can *never* be bound by a quantifier, for a quantifier scoped to an A'-position would *not* introduce a DM at that level.⁹ This radical interpretation of pronoun binding runs against the standard textbook way to achieve C-command binding, which is as in (14):

- (14) a. Every cat is proud of its_i whiskers
 b. Every cat_i [_{t_i} is proud of its_i whiskers]

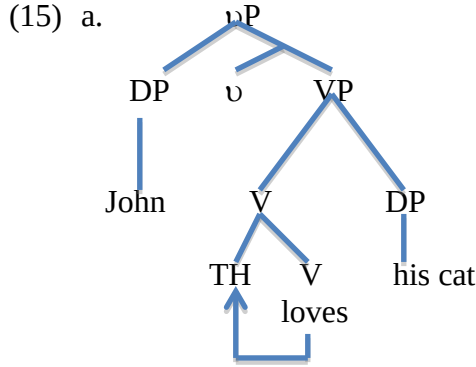
On the standard approach (cf., e.g. Heim and Kratzer 1998), pronouns carry an index, quantificational DPs get one when they are assigned scope. The index on the A'-moved subject in (14b) is interpreted as abstractor that simultaneously binds the trace and the pronoun. This approach is not available in the kind of dynamic framework envisioned by Dekker, because within the clause [_{t_i} is proud of its_i whiskers], no DR is introduced (for there is no existential operator), nor is a DR introduced by the raised quantifier. In this strong version of DS, pronoun binding can only come about through an antecedent activated by an existential operator and passed on through a suitable Boolean functor (like conjunction or a conditional).

If C-command pronoun binding does not work as standardly assumed, how does it come about? I think the answer lies in event-semantics. A pretty widespread stream of

⁸ This holds modulo 'Modal Subordination' phenomena. See Roberts (1987).

⁹ This contrasts with what is assumed in most dynamic frameworks where pronouns can be both bound by a C-commanding quantifier and pick up their antecedent through non C-commanding accessible antecedents. Cf., e.g., Groenendijk and Stokhof (1990) or Chierchia (1995).

event-semantics regards verbs as (unary) predicates of events; ‘arguments’ of verbs are fed via thematic role so that a clause winds up corresponding to a structurally determined series of conjunctions as in (15):¹⁰



b. i. $TH = \lambda P \lambda x \lambda e \exists u [u = x \wedge TH(e)(u) \wedge P(e)]$

ii. $v = \lambda P \lambda x \lambda e \exists u [u = x \wedge EX(e)(u) \wedge P(e)]$

c. $\exists s [\exists u [u = \text{John} \wedge EX(s)(\text{John})] \wedge \exists u' [u' = \text{his cat} \wedge TH(s)(u') \wedge \text{love}(s)]]$

I am assuming here that thematic roles are projected as applicative heads (like TH in (15), into which the lexical V incorporates in English) and/or other suitable functional heads (like little *v*, voice or what have you). But the details of this implementation are very negotiable. The important thing is that conditions like *John is the experiencer of s* vs. *his cat is the theme of s* come as conjuncts in a structurally determined order. And of course, it follows from the semantic properties of conjunction that the first/highest such conjunct will be accessible to the second/innermost one but not viceversa. Thus, a (novel) Discourse Referent introduced in the upper region would be accessible to a pronoun in the lower region, but not viceversa. We get back in a new way the old observation that anaphora follows the C-command chain. It does so because the structure of the clause is conjunctive, which enables us to pass on down the C-command chain accessible antecedents introduced in higher regions.

It makes sense, in fact it is necessary from this perspective to assume that TH-roles activate DRs by associating with existential operators, as in (15b). This is NOT a logical necessity: one could easily write applicative heads without this feature. But things fall into place, if we do: higher applicative heads introduce DRs that pronouns within lower applicative heads can pick up quasi indexically exploiting accessibility (but not the other way around). Consider, from this perspective, a sentence like *everyone likes his cat*, (16a). It has a structure like (16b), fully parallel to (15):

(16) a. [everyone v_{EXP} TH loves his cat]

b. $\text{everyone}_i \exists s [\exists u [u = t_i \wedge EX(s)(u)] \wedge \exists v [v = \text{u's cat} \wedge TH(s)(v) \wedge \text{love}(s)]]$

¹⁰ An early discussion can be found in Higginbotham (1985); Kratzer (2003) constitutes an important contribution. For a recent take, cf. Champollion (2015), among many others.

Here, the EXP-role activates a DR (in boldface) that is passed onto the TH-role conjunct where it gets picked up quasi-indexically by the pronoun, as Dekker proposes. The quantifier undergoes scope assignment as in (16b) and binds *only* its own trace. Contrast this with the reverse:

- (17) a. [his owner $\cup_{\text{EXP}}$ TH loves every cat]
 b. everyone_i $\exists s[\exists u[\mathbf{u = his\ owner} \wedge \mathbf{EX(s)(u)}] \wedge \exists v [v = t_i \wedge \mathbf{TH(s)(v)} \wedge \mathbf{love(s)}]]$

Here the DM corresponding to the theme (in boldface) is NOT structurally accessible to the pronoun embedded in the experiencer region. Scoping the object cannot change that, if scoped quantifiers can only bind their own traces and do not introduce DRs. WCO falls into place.

The view just sketched resonates deeply with (and, in fact, was directly inspired to me by) an idea put forth in Büring (2004). He argues that there are two systems of indices: one for A'-binding, and one for A-binding. On the one hand, he adopts the standard view of scoping as movement but with a twist: that the binder associated with Quantifier Scoping binds only its own trace exactly as in (16)-(17). On the other hand, pronoun binding is dealt with in terms of a separate binder to be (optionally) inserted at A-positions as illustrated below:

- (18) a. Every cat_i [t_i O₃ likes its₃whiskers]
 b. Every cat $\lambda_i [t_i \lambda_3 [t_3 \text{ likes } t_3\text{'s whiskers}]]$

The operator O in (18a) links the A-position to the embedded pronoun (in a manner similar to how the Geach-rule works). Then the subject is assigned scope in the usual manner. The semantics for the LF in (18a) is schematically spelled out in (18b). Büring argues that this approach provides us with a way of deriving WCO effects:

- (19) a. Its whiskers bother every cat
 b. Every cat_i [its₃ whiskers bother t_i]
 c. * Every cat_i [its₃ whiskers O₃ bother t_i]
 d. * Every cat_i O₃ [its₃ whiskers bother t₃]

The canonical A'-binder in (19) can never 'see' pronouns. The O-operator in (19c) is correctly inserted in an A-position, but it is too low to bind the pronoun embedded within the subject. In (19d), on the other hand, the O-operator is high enough to link the pronoun within the subject to the object position, but it is not in an A-position. In sum, there is no way of getting the undesired binding. While this approach provides us with an interesting take on WCO, it remains unclear on Büring's approach where these two systems of indices come from. Büring suggests (quoting E. Ruys) that his proposal should be grounded in a semantic difference between traces and pronouns, but doesn't pursue this suggestion. It seems to me that DS + event semantics provides us with a way of pursuing Büring's suggestion and ground his double indexing idea in an independently needed semantic difference between traces and pronouns: traces are (standard) Tarskian

variables, pronouns have a quasi-indexical semantics and can pick up their antecedents only through accessible Discourse Referents.¹¹

Within DS + event semantics, there is, I think, independent evidence of at least two sorts in favor of the view that TH-positions must be associated with existential operators active for anaphora. The first has to do with contrasts like:

- (20) a. i. I just met John_i and liked him_i a lot
 ii. ?? I just met him_i and liked John_i a lot
- b. i. John believes that [the person who scratched his car]_i is one of his students and that he_i did it on purpose.
 ii. * John believes that he_i is one of his students and that [the person who scratched his car]_i did it on purpose.

In classical DRT definites are not taken to activate DMs, for the latter is a semantic property of existential operators. Yet in (20a-b) we see a reflex of accessibility that must clearly apply to definites. Sentence (20b), in particular, shows that this not an issue about reference per se, for the definite in (20b) may not be referential at all. If activating DRs is a property of TH-positions, the contrast in (20) immediately falls into place. The AG-role of *meet* introduces a DM that is passed on to the second conjunct; the EX-role of *like* is not in condition of introducing a DM accessible to the first conjunct.¹²

The second type of evidence has to do with bare plurals and contrasts like (21) (originally from Carlson 1977 – cf. also Chierchia 1998, Dayal 2004, among others):

- (21) a. A rabbit was repeatedly killed last summer.
 b. Rabbits were repeatedly killed last summer.

The subjects in (21a-b) are both construed existentially. However, the indefinite in (21a) must get wide scope with respect to the low quantificational adverb *repeatedly* (whence the pragmatic oddity of the sentence), while the subject of (21b) naturally takes narrow scope with respect to *repeatedly*. This has been taken to suggest that the existential force of bare plurals does not come from the bare plural itself, for otherwise bare plurals should behave just like indefinites with respect to scope. The existential force of bare plurals should rather be associated with the *position* they are merged into. On one implementation of this view, bare plurals are uniformly kind-denoting. Their existential force in episodic contexts comes from an operation on the verb, cf. e.g. Chierchia

¹¹ For the interpretation of traces, I follow Fox's (1999) trace convention. See also Sauerland (2004).

¹² Of course, when it comes to definites, and to proper names in particular, co-reference is an option. The relationship between binding and co-reference needs to be regulated on any approach to binding, regardless of the dynamics. One way of addressing it is in terms of Reinhart's (1983) 'Rule I,' which, everything else being equal, bans co-reference between an element A and another element B when A cannot bind B (or viceversa); cf. also Reinhart and Reuland (1993). But discussion of co-reference is clearly orthogonal to our present concerns.

(1998)’s Derived Kind Predication (DKP). DKP introduces an existential quantifier over instances of the kind, much like TH-roles do under the present hypothesis. Differently put, DKP can be eliminated under the view that TH-roles in general introduce an existential quantifier over individuals (where ordinary individuals have unique instances, while kinds are multiply instantiated). Under the present view, scoping the subject *rabbits* in (21b) above the adverb *repeatedly* would not be able to affect interpretation, for referential BPs are always semantically inert for scope. Notice, furthermore, that the existential quantification over instances conjectured here must be able of creating antecedents for anaphoric elements such as pronouns:

- (22) a. Cats were repeatedly chasing their own tails this morning in front of my house.
 b. $[_{TP} \text{ cats}_i \text{ were repeatedly } [_{VP} \text{ t}_i \exists\text{-AG}_3 [_{VP} \text{ chasing their}_3 \text{ tails }]]]$
 c. A cat was repeatedly chasing its own tails this morning in front of my house
 d. $[_{TP} \text{ a cat}_i \text{ was repeatedly } [_{VP} \text{ t}_i \exists\text{-AG}_3 [_{VP} \text{ chasing its}_3 \text{ tails }]]]$

The structure of (22a) is (22b). The kind denoting subject is interpreted (via λ -conversion) in its ‘first merge’ position, where the quantifier associated with $\exists$ introduces DRs over instances of the kind, which in turn duly antecede subsequent anaphoric elements. Note that the existential quantifier over instances of the kind is within the scope of the Q-adverb *repeatedly*, which yields the right interpretation. An analogous construal for, say, (22c) is impossible for the quantifier associated with *a cat* has no way of being scoped below the adverb *repeatedly*. Accordingly, (22c) cannot mean that it was repeatedly the case that a cat was chasing its tail, i.e. it cannot get a reading parallel to (22a).

Thus the view that TH-roles/positions introduce DRs via existential operators associated with them is not only a virtual conceptual necessity from the point of view of the quasi-indexical view of pronouns we are exploring here. It also seems to have independent empirical support from other important phenomena.

Summing up, the plan is to follow, in a way, Buring’s idea that quantifiers can bind only their own traces, but to replace his situation theoretic apparatus, with a dynamic semantics one. The switch to a dynamic setting is an attempt to find what Buring himself says is missing from his proposal: a reason for treating pronoun binding through a channel that is distinct from that of scope assignment. In a dynamic setting, as suggested by Dekker, it is natural to assimilate pronouns to quasi-indexicals that pick their antecedents only from accessible discourse markers (and can never be directly A’-bound). Event semantics does the rest: TH-roles (or TH-positions) are the natural locus for the activation of discourse markers, in a structurally determined manner. The basic cases of WCO fall then into place, in an arguably principled manner. In what follows, we put forth a version of dynamic semantics within which these ideas can be made fully explicit.

3. Which Dynamics?

There are many dynamic systems around. The one introduced here is a modification of Muskens (1996) (see also Champollion et. al 2018) and is also very close to Heim’s

(1982) File Change Semantics and to Dekker (1996). Of the many choice points ahead some are essential to our proposal and others a matter of execution. It won't be always easy to tell which is which, but I am going to try.

Our basic types are going to be e, t, n ; n is the type of natural numbers; i.e. $D_n = \mathbb{N}$, the set of positive integers, which will be used to model Discourse Referents (DRs). Other types (e.g. worlds) can be readily added. Complex types are built as usual. We assume, also as usual, that we can quantify and abstract over variables of any type. An important type will be $\omega = \langle n, e \rangle$, the type of assignments/sequences. I will use boldface ω for the type $\langle n, e \rangle$ of assignments, and (un-bold) $\omega, \omega', \dots, v, v', \dots$ as variables of type ω . I assume that assignments may be partial. The type of sentences is going to be $T = \langle \omega, \langle \omega, t \rangle \rangle$, i.e., I follow Heim, Muskens, etc. in treating sentences as (Curried) relations between assignments (an input and an output assignment). Things of type T will be called 'Context Change Potentials' (CCPs) following Heim.

Basic predicates are represented in the usual way as $man_{\langle e, t \rangle}$ or $run_{\langle ev, t \rangle}$, where the latter is a property of events. Discourse referent introduction will be treated as a property-level operation, which adds to the n th coordinate of the input assignment a value chosen from the property's extension:

- (23) a. $[P_{\langle e, t \rangle}]_n = \lambda u [\lambda \omega \lambda \omega'. \omega =_{n/u} \omega' \wedge P(u)]$
 where $\omega =_{n/u} \omega'$ is an abbreviation of $\omega' = \omega \cup \langle n, u \rangle$, defined only if the input assignment is *undefined* for the n th-coordinate. Throughout, $\omega(n)$ is abbreviated as ω_n .
- b. Example: $[run_{\langle e, t \rangle}]_4 \Rightarrow \lambda e [\lambda \omega \lambda \omega'. \omega =_{4/e} \omega' \wedge run(e)]$

Something of type $\langle e, T \rangle$ can be viewed as a dynamic property. DR introduction is an operation (of type $\langle et, eT \rangle$) that adds to the n th coordinate of the input assignment some u which is a P , and is only defined for input assignments that do not assign a value to n . In other words, we are building Heim's 'Novelty Condition' into discourse referent introduction. The choice of properties as the locus for DR introduction (as opposed to sentences) is not essential, but it facilitates using TH-roles/positions for DR-introduction purposes. Properties (as well as CCPs) can undergo existential closure, which finalizes DR introduction:

- (24) a. There was running.
- b. $\exists [run]_4 \Rightarrow \exists e \lambda \omega \lambda \omega' [run]_4(e)(\omega)(\omega') = \lambda \omega \lambda \omega' \exists e [\omega =_{4/e} \omega' \wedge run(e)]$
- c. i. For any P or type $\langle e, T \rangle$, $\exists P = \lambda \omega \lambda \omega'. \exists e [P(e)(\omega)(\omega')]$
 ii. For any CCP ψ , where x occurs free in ψ , $\exists x \psi = \exists (\lambda x. \psi)$

A sentence like (24a) modifies the input assignment by adding to its 4th-position a running event. The arguments of verbs are fed via Th-roles that also introduce DRs:

$$(25) \text{ John } AG_2 \text{ runs}_4 \Rightarrow AG_2 ([run]_4) (j) = \lambda e. [AG(e)]_2(j) \wedge [run]_4(e) \text{ }^{13}$$

where $[AG(e)]_2(j) = \lambda \omega \lambda \omega' [\omega =_{2/j} \omega' \wedge AG(e)(j)]$

In primitive notation, (25) becomes:

$$(26) \lambda e. \underline{\lambda \omega \lambda \omega' [\omega =_{2/j} \omega' \wedge AG(e)(j)]} \wedge \underline{\lambda \omega \lambda \omega' [\omega =_{4/e} \omega' \wedge run(e)]}$$

The two underlined portions are the conjunction of two context change potentials, which in dynamic semantics is defined as composition of relations:

(27) Conjunction:

If ϕ, ψ are of type T, then

$$\phi \wedge \psi = \lambda \omega \lambda \omega'. \exists v [\phi(\omega)(v) \wedge \psi(v)(\omega')] \quad (= \text{Relation Composition})$$

Applying the definition of conjunction in (27) to (26), we get (28.i), which after existential closure, becomes (28ii):

$$(28) \text{ i. } \lambda e \lambda \omega \lambda \omega' \exists v [\omega =_{2/j} v \wedge AG(e)(j) \wedge v =_{4/e} \omega' \wedge run(e)]$$

$$\text{ ii. } \lambda \omega \lambda \omega' \exists e \exists v [\omega =_{2/j} v \wedge AG(e)(j) \wedge v =_{4/e} \omega' \wedge run(e)]$$

$$\text{ iii. } \lambda \omega \lambda \omega' \exists e [\omega =_{((2/j)/4/e)} \omega' \wedge AG(e)(j) \wedge run(e)]$$

where $\omega =_{((2/j)/4/e)} \omega'$ abbreviates $\omega' = ((\omega \cup \langle 2, j \rangle) \cup \langle 4, e \rangle)$

The context change potential in (28) is only defined for input assignments that are *undefined* on their 2nd and their 4th coordinates. The first conjunct modifies the input assignment ω by adding to it John as a value of coordinate 2 and specifying that John is the agent of some event e ; the result is a new assignment $v = \omega \cup \langle 2, \text{john} \rangle$. The second conjunct modifies further $v = \omega \cup \langle 2, \text{john} \rangle$, by adding e to the 4th coordinate and specifying that e must be a running. Formula (28ii) is equivalent to (28iii) and can accordingly be thus abbreviated, for enhanced readability. The bottom line is that the output assignment in (28) contains two active DRs over its 2nd and 4th coordinates, linked to John and to a running event of which John is the agent. These DRs are ready for pronominal pick by subsequent pronouns.

The Logical Form of a sentence like (29a.i) below, which contains a pronoun, is (29a.ii). Pronouns are functions from assignments to specified projections, as in (29b). They combine with predicates via function composition, as in (29d):

¹³ Note that AG_2 is of type $\langle \langle ev, T \rangle, \langle u, \langle ev, T \rangle \rangle \rangle$, while $AG(j)$ is of type $\langle e, t \rangle$.

- (29) a. i. He is fast.
 ii. Logical Form of (i): $\exists \text{He}_2 \text{TH}_3 \text{ is } [\text{fast}]_1$
 b. $\text{he}_2 \Rightarrow \lambda\omega. \omega_2$
 c. $\text{TH}_3([\text{fast}]_1) = \lambda u \lambda s. \lambda \omega \lambda \omega' \exists v [\omega =_{3/u} v \wedge \text{TH}(s)(u) \wedge v =_{1/s} \omega' \wedge \text{fast}(s)]$
 d. $\exists [\text{TH}_3([\text{fast}]_1)(\lambda\omega. \omega_2)] =$
 $\lambda \omega \lambda \omega' \exists s \exists v [\omega =_{3/\omega_2} v \wedge \text{TH}(s)(\omega_2) \wedge v =_{1/s} \omega' \wedge \text{fast}(s)]$
 e. $\lambda \omega \lambda \omega' \exists s [\omega =_{1/s} \omega' \wedge \text{TH}(s)(\omega_2) \wedge \text{fast}(s)]$
 f. $P_{\langle e, T \rangle}(\lambda\omega. \omega_2) =_{\text{df}} \lambda v \lambda v'. P(\lambda\omega. \omega_2(v))(v)(v')^{14}$

The existential closure at the beginning of the Logical Form in (29a.ii) binds the state argument associated with *fast*. Inspection of (29d) reveals that any input assignment to *he₂ is fast* must be defined for the 2nd coordinate, for what (29d) does is link the input assignment ω (applied to its 2nd coordinate) to the theme argument of some state of being fast. It also adds a new discourse marker for the theme-argument of the state of being fast, however TH_3 is linked via functional application to ω_2 , and hence the addition of TH_3 is of no consequence for subsequent discourse, and I will often ignore it in what follows (abbreviating (29d) as (29e)). Pronouns, in other words, carry a ‘familiarity’ presupposition, in Heim’s sense.

Having defined the semantics of pronouns, pronominal pick up is now straightforward, again via function composition (which this time comes in via the definition of dynamic conjunction):

- (30) a. John runs. He is fast.
 b. $\text{John AG}_2 [\text{runs}]_4 \wedge \text{He}_2 \text{ is } [\text{fast}]_1$
 c. i. $\exists \text{John AG}_2 [\text{runs}]_4 = \lambda \omega \lambda \omega' \exists e [\omega =_{((2/j)/4/e)} \omega' \wedge \text{AG}(e)(j) \wedge \text{run}(e)]$
 ii. $\exists \text{He}_2 \text{ is } [\text{fast}]_1 = \lambda \omega \lambda \omega' \exists s [\omega =_{1/s} \omega' \wedge \text{TH}(s)(\omega_2) \wedge \text{fast}(s)]$
 d. $\lambda \omega \lambda \omega' \exists v \exists e [\omega =_{((2/j)/4/e)} v \wedge \text{AG}(j)(e) \wedge \text{run}(e) \wedge \exists s v =_{1/s} \omega' \wedge \text{TH}(v_2)(s) \wedge \text{fast}(s)]$

The discourse in (30a) has the schematic logical form in (30b). The content of the two conjuncts in (30b) are spelled out in (30c). In virtue of the definition of conjunction, (30b) is equivalent to (30d). To make things more readable, I will abbreviate formulas like (30d) with the following equivalent formula:

- (31) $\lambda \omega \lambda \omega' \exists e \exists s [\omega =_{(((2/j)/4/e)/1/s)} \omega' \wedge \text{AG}(j)(e) \wedge \text{run}(e) \wedge \text{TH}(j)(s) \wedge \text{fast}(s)]$

¹⁴ Use of function composition with pronouns is necessary to guarantee that the relevant assignment is linked to the input assignment of the predicate they combine with. In other words, we want to make sure we get (i) and not, e.g., (ii).

(i) $\lambda \omega \lambda \omega' \exists s \exists v [\text{TH}(\omega_2)(s) \wedge v =_{1/s} \omega' \wedge \text{fast}(s)]$ correct

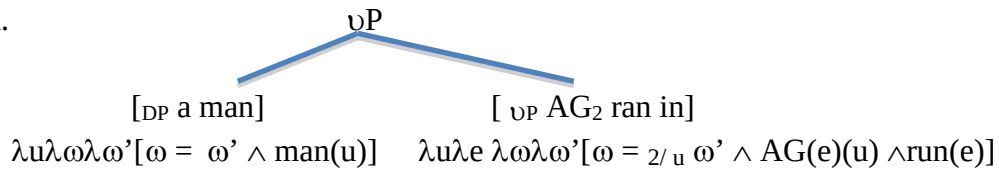
(ii) $\lambda \omega \lambda \omega' \exists s \exists v [\text{TH}(v_2)(s) \wedge v =_{1/s} \omega' \wedge \text{fast}(s)]$ incorrect

Use of function composition with pronouns guarantees that the outcome is the correct one.

The input assignment to (31) will have to be undefined on the 2nd, 4th, and 1st coordinates. The output assignment specifies these coordinates with the following values. The 2nd coordinate of the output is linked to John, who must be the agent of a running event anchored to the 4th coordinate. Furthermore the 1st coordinate in the output gets anchored to a state of John's being fast.

For indefinites there are options, more than we want or can consider here. I'll have to choose one and let the reader free to opt for any variant of it that may achieve similar effects. Indefinites are generally assumed to have a predicative variant (traditionally of type $\langle e, t \rangle$) and a Generalized Quantifier variant. The predicate level version of an indefinite can be used to saturate the argument of a verb through a local type adjustment (similar to DKP, mentioned above in connection with bare plurals):

(32) a.



b. If P is of type $\langle e, T \rangle$ and R of type $\langle e, \langle ev, T \rangle \rangle$,
 $R(P) = \lambda e \exists u [P(u) \wedge R(u)(e)]$

c. Application of (32b) to (32a):

$$\lambda u \lambda e \lambda \omega \lambda \omega' [\omega = 2/u \omega' \wedge AG(e)(u) \wedge run(e)] (\lambda u \lambda \omega \lambda \omega' [\omega = \omega' \wedge man(u)]) =$$

$$i. = \lambda e \exists u [\lambda \omega \lambda \omega' [\omega = \omega' \wedge man(u)] \wedge \lambda \omega \lambda \omega' [\omega = 2/u \omega' \wedge AG(e)(u) \wedge run(e)]]$$

$$ii. = \lambda e \lambda \omega \lambda \omega' \exists u [\omega = 2/u \omega' \wedge man(u) \wedge AG(e)(u) \wedge run(e)]$$

iii. After closure of the event argument:

$$\lambda \omega \lambda \omega' \exists e \exists u [\omega = 2/u \omega' \wedge man(u) \wedge AG(e)(u) \wedge run(e)]$$

$$d. TH_n(P) = \left\{ \begin{array}{l} \lambda \alpha \lambda e \exists u [\alpha(u) \wedge [TH(e)]_n(u) \wedge P(e)], \alpha \text{ is of type } \langle e, T \rangle \\ \lambda \alpha \lambda e [[TH(e)]_n(\alpha) \wedge P(e)], \alpha \text{ is of type } e \end{array} \right.$$

In (32a) a verb complex $[vP AG_2 ran in]$ (of type $\langle e, \langle ev, T \rangle \rangle$) combines with a dynamic predicate *a man* (of type $\langle e, T \rangle$). For simplicity, I am ignoring the DR associated with the running-in event itself. Furthermore, I am ignoring the Davidsonian argument for *a man* and I am assuming that *a man* does not come with a DR of its own. Both of these assumptions could be changed, but without much impact, for the verb complex has an active DR over its AG-argument, which will eventually be linked to some witness for the indefinite. The combination of the verb complex with the indefinite (which can be viewed as an extension of functional application) existentially quantifies over an instance of men and conjoins the result dynamically with the verb complex, returning a (modified) property of events. The extension of functional application to indefinites is sketched in two forms: (32b), a 'brute force' version, and a slightly less brute force version (32d),

where it is folded within the definition of TH-roles. The idea, on the latter version, is that TH-roles add an argument to a predicate of events and link it to an active DR. The argument can be an individual or another dynamic predicate, which gets witnessed in the process. Use of dynamic conjunction is not crucial in the example in (32), but it will be when the argument is an indefinite containing other active DRs, which will be passed onto the second conjunct and beyond (e.g.: *a man who owns a donkey* = $\lambda u \lambda \omega \lambda \omega' \exists v \exists s [\omega =_{2/v} \omega' \wedge \text{man}(u) \wedge \text{donkey}(v) \wedge \text{own}(s)(v)(u)]$). The result in (32.c.iii) shows how the CCP associated with *a man ran in* contains an active DR linked to some man, ready for pronominal pick in subsequent discourse, exactly as with *saw* with referential terms in example (30). This approach delivers only ‘narrow scope’ indefinites. Wide scope ones are to be obtained through the canonical scope assignment operation associated with the Generalized Quantifier version of indefinites and, in case of long distance indefinites, through (some version of) the choice functional strategy (Reinhart 1996, Winter 1997).¹⁵

Context change potentials, as we know, determine truth conditions. A sentence *S* with context change potential ϕ is true relative to an assignment *v* iff the result of applying ϕ to *v* to is non empty. More explicitly:

- (33) a. $\downarrow_v \phi = \exists \omega [\phi(v)(\omega)]$ (ϕ is true relative to *v*)
 b. $\downarrow_v \exists \text{ a man } AG_2 [\text{runs}]_4 \wedge He_2 \text{ is } [\text{fast}]_1$
 c. $\exists \omega \exists u \exists e \exists s [v = ((2/u) 4/e) 1/s) \omega \wedge \text{man}(u) \wedge AG(e)(u) \wedge \text{run}(e) \wedge TH(s)(u) \wedge \text{fast}(s)]$

For (31a) to be defined relative to *v*, the coordinates 2, 4, and 1 have to fall outside of *v*’s domain. Whenever defined, (33b) is true relative to *v* if we can find a man (to be assigned to the index 2) who is the agent of a running event (to be assigned to index 4), and that man is in a state of being fast (to be assigned to index 1). Clearly, if we are in a world where a man runs and is fast, we will be able to find an output assignment for any arbitrary *v* that doesn’t have 2,4, and 1 in its domain.

All we have done is adopt a version of dynamic semantics, summarized in the Appendix, which is a close variant to Heim’s (1982) file change semantics, Dekker’s (1996) or Muskens’ (1996) Compositional DRT. The only novelty of any substance put forth here is that DR introduction is done at the level of predicates, in reflection of the view that in an event semantics, theta roles/positions are a natural locus for such an operation. I have tried to make a case that this assumption has a certain amount of independent motivation. Whether I have managed to be convincing or not, the assumption that Th-roles/position introduce DRs is, I think, necessary to understand WCO.

4. The deduction of CO phenomena

The framework sketched in Section 3, as we just saw, allows us to formalize rather directly the informal proposal outlined in Section 2, and thus provides an account for the

¹⁵ Quantifier Raising does not introduce DRs (cf. Section 4.2, below). I believe that existential closure on choice functions does, as it is often associated with topic-hood. But a discussion of long distance indefinites is beyond the scope of this paper.

basic cases of WCO. In the present section, we will discuss some further consequences of our line of inquiry and some necessary extensions of it to quantified DPs and its interaction with indirect binding (i.e. E-type pronouns). We will conclude the section by observing how the present approach meets the desiderata for a theory of WCO identified in Section 1.

4.1. Binding into adjuncts

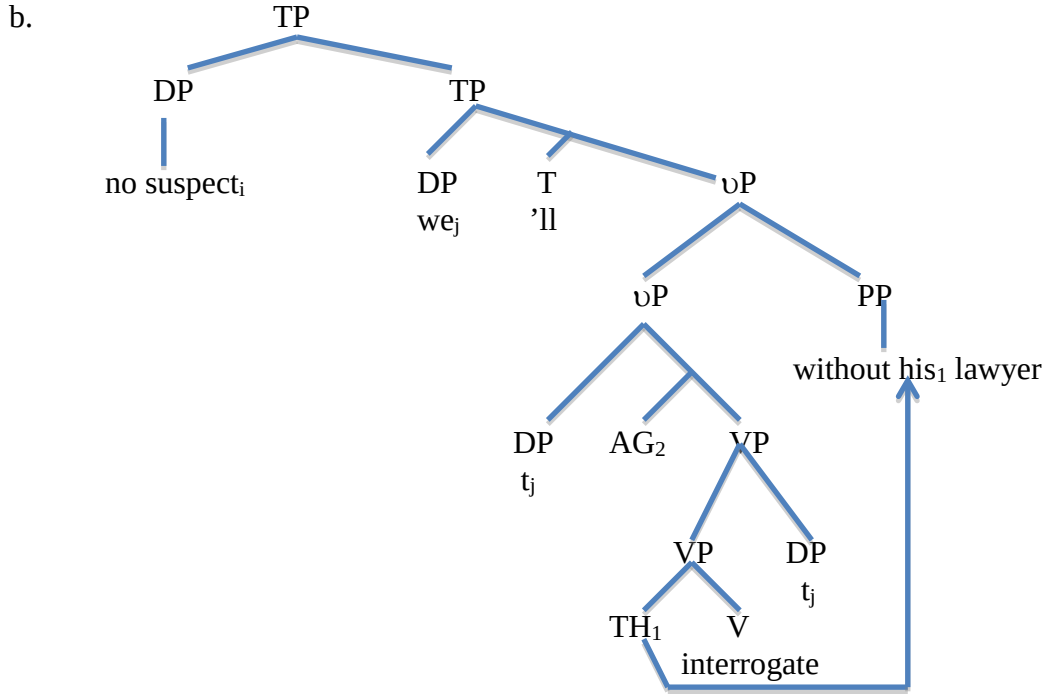
A signature property of DS is while conjunction is not commutative, it is associative, i.e., for any CCP ψ , ϕ , and γ , the following equivalence holds:

$$(34) \text{ i. } [\psi \wedge [\phi \wedge \gamma]] \quad \Leftrightarrow \quad \text{ii. } [[\psi \wedge \phi] \wedge \gamma]$$

This is a direct consequence of defining coordination as relation-composition, which is inherently associative. And this is also the key to understanding why objects can bind into structurally higher adjuncts. Typical adjuncts combine intersectively, i.e. via conjunction, with the main clause: the main clause introduces a set of events that gets narrowed down by subsequent layers of event modifiers. This is one of the historical insights of event-semantics: *John runs slowly* is analyzed as there is a running by John and it is slow.¹⁶ This entails that DRs in the main clause, wherever introduced, will always be accessible to pronouns contained in an (intersective) adjunct. In fact, formula (34ii) can be viewed as a schematic representation of an adjunction structure: ψ can be viewed as corresponding to the AG-position; ϕ to the TH one, and γ to the adjunct. Clearly, DRs introduced in the TH-position are accessible to pronouns contained in the adjunct. So while the present approach predicts that accessibility/binding is parallel to the C-command relation for arguments, we also obtain as a consequence that this parallelism breaks down in the case of adjuncts. The following is a concrete illustration.

¹⁶ The classical reference in this connection is Parsons (1990), who articulates with solid linguistic arguments Davidson's original insight.

(35) a. We'll interrogate no suspect without his lawyer



c. $\lambda\omega \lambda\omega'. \omega = \omega' \wedge \text{no suspect } (\lambda u \exists v \exists e[\omega = ((2/we) 1/u) v \wedge \text{AG}(e)(we) \wedge \text{TH}(e)(u) \wedge \text{interrogate}(e) \wedge \text{without } (1's \text{ lawyer})(e)])$

There is nothing non-standard about the structure in (35b). The PP event modifier is adjoined to vP (a position where it is not C-commanded by the object). The quantified object undergoes scope assignment (QR) and binds only its trace. Similarly, the external subject in Spec TP binds only its trace. DRs are introduced in correspondence of the AG- and TH-positions (and are linked to the corresponding arguments via functional application). In virtue of the conjunctive character of the vP-PP modification, the DR associated with the TH-position will be accessible to the pronoun embedded in the modifier.¹⁷ The CCP compositionally determined for the structure in (35b) is given in (35c). Like for all sentences involving non-indefinite quantifiers (see Section 4.2), this CCP is a ‘test’: it requires checking whether the input assignment satisfies certain

¹⁷ The actual syntax and semantics of the possessive DP in (35a) is more complex than what is given in the text, in line the Elbourne-style syntax we are adopting and the semantics we associate with it (cf (11) above). A more pedantic approximation to the structure of the DP *his lawyer* would be as follows:

- i. Syntax: [DP [DP ~~he~~ suspect -POSS lawyer]
- ii. Semantics: $\lambda\omega. \iota x [\text{lawyer}(x) \wedge \text{of } (\iota y [\text{suspect}(y) \wedge y = \omega_n])(x)]$
= ‘the lawyer of the suspect identical to n’

This combines with the rest of the DP via function composition with the preposition *without* yielding:

- iii. $\lambda e \lambda\omega \lambda\omega' [\omega = \omega' \wedge \text{without } (\iota x [\text{lawyer}(x) \wedge \text{of } (\iota y [\text{suspect}(y) \wedge y = \omega_n])(x))](e)]$
= the set of events that happen without the lawyer of the suspect identical to n.

conditions, and if so the input assignment is passed on.¹⁸ The relevant test in the present case consists of making sure that no suspect t (where t is to be linked to the 1st coordinate of some modification v of the input ω) must be such that we (to be linked to the 2nd coordinate of v) will interrogate t without the lawyer for whatever we find in the 1st coordinate of v (namely, the suspect t). We get the right truth conditions and the right anaphoric pattern without lifting a finger.

We also predict the contrast between (36a), which is parallel to the well formed (35a), and (36b), where the antecedent to the pronoun cannot be resolved sentence-internally:

- (36) a. John bought a car_i before seeing it_i
 b. *John bought it_i before seeing a car_i
 c. John AG₂ **TH₁ bought it_n** before $\exists u$ TH₄ seeing u

It is worth focusing on the part in boldface of the LF in (36c), repeated below as (37a). Suppose we try to resolve the anaphoric index on the pronoun to 1 as in (37b):

- (37) a. TH₁ bought it_n
 b. $\lambda u . \lambda \omega \lambda \omega' . [\omega = 1/u \ \omega' \wedge \text{TH}(e)(u)] (\omega_1)$
 $= \lambda \omega \lambda \omega' . [\omega' = \omega \cup \langle 1/ \omega_1 \rangle \wedge \text{TH}(e)(\omega_1)]$ UNDEFINED
 c. $\lambda u . \lambda \omega \lambda \omega' . [\omega = 1/u \ \omega' \wedge \text{TH}(e)(u)] (\omega_4)$
 $= \lambda \omega \lambda \omega' . [\omega' = \omega \cup \langle 1/ \omega_4 \rangle \wedge \text{TH}(e)(\omega_4)]$

The formula in (37b) winds then up having a contradictory presupposition. On the one hand, the input assignment ω must be defined over its 1st coordinate for the pronoun to be interpretable. On the other hand, ω must be undefined for its 1st coordinate, because of the novelty condition associated with DR-introduction by TH₁. Resolving n to 4, as in (37c), will create a similar problem. The input assignment to (37c) will have to be defined for its 4th coordinate. While this doesn't make (37c) contradictory per se, it is going to clash with requirement that the subsequent conjunct associated with TH₄ in (36c) (i.e. the theme of the modifier) requires the 4th coordinate of its input to be novel.¹⁹ So, there is no way to get the unwanted reading, a result obtained without any construction specific stipulation.

¹⁸ The input assignment must be not defined for the 2nd and the 1st coordinate because on the novelty condition on DR introduction. Since this assignment is then passed on if the test is successful, such coordinates, correctly, will NOT be available for subsequent pronominal pick up.

¹⁹ Of course, the DRs introduced by AG₂, or, say, TH₄ will be accessible to pronouns in subsequent discourse. The following sentence, structurally isomorphic in the relevant parts to (36b), illustrates:

(a) Mary left her home before meeting a friend she was supposed to meet. He would have advised her against leaving

Notice also that absolutely nothing would change if we were to move long distance the indefinite *a car* in (36) to the front of the main clause, for that would simply bring about a basic crossover violation and it would be ruled out in exactly the same way.

The above results are only derivable if the right adjunct is intersective and combines with the main clause via conjunction. If this condition is not met, the possibility for anaphora will depend on the nature of the main connective associated with the modifier. Contrast, in particular, (36b), repeated below as (38a) with the right adjoined if-clauses (38b-c):

- (38) a. *John bought it before seeing a car.
 b. John never endeavors to read it, if a book is too long.
 c. John always buys it on the spur of the moment, if he falls in love with a painting.

The contrast is robust and systematic: Sentences like (38b-c) are considerably better than sentences like (38a). This is to be expected on the basis of the fact that the antecedent of an if-clause is accessible to material in the consequent regardless of how if-clauses are linearly realized.²⁰

We observed in the introduction that one of the hardest things to understand about WCO is the asymmetry in binding from the object position into the subject position vs. into a right adjunct. This asymmetry is explained in a remarkably simple way in terms of accessibility, and the semantics of adjunction. I know of no other approach that has a comparably principled account to these phenomena.

4.2. Quantifiers

Generalized quantifiers (GQs) are usually analyzed as relations between sets/predicate extensions. The standard move in a dynamic setting is to lift such a relation so that the outcome is a test. Assuming that dynamic predicates are of type $\langle e, T \rangle$, the arguably simplest way of achieving this goal is along the following lines:

- (39) a. i. $\text{donkey}_{\langle e, T \rangle} = \lambda u \lambda \omega \lambda \omega'. \omega = \omega' \wedge \text{donkey}_{\langle e, t \rangle}(u)$
 ii. $\text{smokes}_{\langle e, T \rangle} = \lambda u \lambda \omega \lambda \omega'. \omega = \omega' \wedge \text{smokes}_{\langle e, t \rangle}(u)$ ²¹
 b. $\text{no}(\text{donkey}_{\langle e, T \rangle})(\text{smokes}_{\langle e, T \rangle})$
 $= \lambda \omega \lambda \omega'. [\omega = \omega' \wedge \{u: \downarrow_{\omega} \text{donkey}_{\langle e, T \rangle}(u)\} \cap \{u: \downarrow_{\omega} \text{smoke}_{\langle e, T \rangle}(u)\} = \emptyset]$
 $= \lambda \omega \lambda \omega'. [\omega = \omega' \wedge \{u: \text{donkey}_{\langle e, t \rangle}(u)\} \cap \{u: \text{smoke}_{\langle e, t \rangle}(u)\} = \emptyset]$
 i. $\text{no}_{\langle \langle e, T \rangle, \langle \langle e, T \rangle, T \rangle \rangle}(P)(Q) = \lambda \omega \lambda \omega'. \omega = \omega' \wedge \text{no}_{\langle \langle e, t \rangle, \langle \langle e, t \rangle, t \rangle \rangle}(\lambda u. \downarrow_{\omega \omega} P(u))(\lambda u. \downarrow_{\omega \omega} Q(u))$
 ii. For any $D_{\langle \langle e, t \rangle, \langle \langle e, t \rangle, t \rangle \rangle}$,
 $D_{\langle \langle e, T \rangle, \langle \langle e, T \rangle, T \rangle \rangle}(P)(Q) = \lambda \omega \lambda \omega'. \omega = \omega' \wedge D_{\langle \langle e, t \rangle, \langle \langle e, t \rangle, t \rangle \rangle}(\lambda u. \downarrow_{\omega \omega} P(u))(\lambda u. \downarrow_{\omega \omega} Q(u))$

²⁰ It should be noted that the sentences in (38a-b) are generic, which is surely relevant. But there are also cases of backward dependencies involving also epistemic ‘one-time’ conditionals:

(a) John surely killed it, if he found a mosquito.

For discussion of more complex patterns of backwards and forward analysis and their interaction with genericity, cf., e.g., Chierchia (1995).

²¹ I am ignoring for simplicity the Davidsonian arguments of *donkey* and *smokes*. Also, I omit type subscripts whenever the context makes it clear what type is meant.

The idea is to extend the theory of GQs to a dynamic setting by extracting from dynamic predicates their extensions, and then check whether the relevant relation between sets holds in the world/model. If the relation between extensions does hold, the test is passed and one goes on with the input assignment. Otherwise, we get error (i.e., the empty set relative to that input assignment). A consequence of this take is that there is no dynamic transfer of active DRs from the restriction onto the scope of a GQ: antecedents active in the restriction are not accessible to pronouns embedded in the scope. This in turn means that donkey pronouns in the scope of a quantifier (the infamous *it* in *every man who has a donkey beats it*) will have to be analyzed as a (non trivial) E-type pronoun (= the donkey or donkeys he owns).

As discussed in the literature (e.g. Chierchia 1995, among many others), there are recipes to define dynamic GQs that allow dynamic transfers of antecedents from the restriction to the scope in several arguably reasonable ways. However, if that was the correct way to go, one would expect sentences like (40a), interpreted as in (40b), to be as good as canonical donkey sentences like (40c):²²

- (40) a. Its mother kicks every farmer who beats a donkey.
 b. [every farmer who beats a donkey]_i [its_j mother kicks t_i]
 c. [every farmer who owns a donkey]_i beats it_j

But anaphoric possibilities like (40a-b), i.e. ‘donkey-crossover’, are systematically impossible. This only makes sense if GQs are *not* really dynamic: the dynamics stops at the level of propositional connectives. This is a welcome possibility on conceptual grounds, as it makes for a simpler dynamic theory.

One may wonder why the E-type strategy works for canonical donkey sentences like (40c), but not for cases that involve scoping such as (40a). The answer, in a nutshell, is the following. In canonical cases, the pronoun (*it* in (40c)) has an accessible antecedent namely the subject (i.e. the farmer); hence a suitable indirect relation (*the donkey or donkeys he (the farmer) owns*) can readily be built. But in cases like (40a) the pronoun *its* does not have any accessible sentence internal antecedent, because scoping operations do not introduce one. Hence the anaphoric link cannot be resolved sentence internally. There is independent evidence that TH-positions activate DRs and this provides some motivation *not* to introduce DR at scope positions, for they are already active at the ‘first merge’ site. One might still argue that the distinction between positions that introduce DRs and positions that don’t is ‘descriptive.’ I am happy to concede that this may be so. But I think the distinction between DR-introducing vs non DR-introducing positions constitutes a better description than ‘existential terms introduce DRs,’ which is what we had before. It has a broader empirical coverage (e.g. with respect to the anaphoric properties of definites) and it enables us to derive a rather complex pattern of cross-over phenomena.

²² In Chierchia (1995), GQs are treated dynamically and allow transfer of antecedents that allow for both $\forall$ - and $\exists$ -readings. Then a stipulation blocks the dynamic transfer at scope position to handle crossover cases like (40). I think the line of inquiry explored in this paper is more principled.

4.3. Which E-type approach?

So far we have analyzed pronouns as in (41a-b), following, basically, Elbourne.

- (41) a. i. $[_{DP} \text{it } \text{NP}]$ ii. $[_{DP} \text{it } \text{donkey}]$ Syntax
 b. i. $\iota y [NP(y) \wedge R(\omega_n)(y)]$ ²³ Semantics
 ii. $\iota y [NP(y) \wedge \omega_n = y]$ Default interpretation
 iii. $\iota y [NP(y) \wedge \text{own}(\omega_n)(y)]$ Non trivial E-type interpretation
 c. A donkey walked in. It seemed hungry.

A pronoun contains a relation R to an element that must be accessible (ω_n). The default resolution of R as in (41b.ii) (which is analogous to how traces are interpreted according to, e.g., Fox's 'trace convention') is only possible when the antecedent x_i is directly accessible (as in, e.g. (41c) – see example (30) in Section 3). Non-trivial resolutions of R , such as (41b.iii), become necessary when the intended antecedent (i.e. the NP that triggers the elision) is not directly accessible to the anaphoric index. If we are correct, relative clause donkey sentences, in a funny turn of things, are one such case.

Now, our semantics in (41), as extensively discussed in the literature, yields excessively strong uniqueness presuppositions for donkey pronouns. There are many cases in which donkey sentences are exempt from uniqueness and yield both universal ($\forall$) and existential ($\exists$) readings, depending on the context. The semantics in (41) needs to be emended. Which kind of E-type approach should one adopt, in order to get the right interpretation in the various cases that have been collected over the years? ²⁴

- | (42) <i>Donkey dependency</i> | Preferred Interpretation |
|---|--------------------------|
| a. Every man that has a donkey beats it | $\forall$ |
| b. Every man who had a dime put it in the meter | $\exists$ |
| c. No one with a teen age son lends him the car on weekdays | $\exists$ |
| d. No one who has an umbrella leaves it home on a rainy day | $\forall$ |
| e. A friend who had a car lent it to me | $\exists$ |

I do not think that it matters much which theory of donkey pronouns one adopts. All we really need/want is a theory that distinguishes between the well-formed examples in (42) and the ill formed ones on (43):

²³ Strictly speaking, pronouns are of type $\langle \omega, e \rangle$, i.e.:

(a) $\lambda \omega. \iota y [NP(y) \wedge R(\omega_n)(y)]$

However, for simplicity, in the context of the present discussion, I will omit the initial abstraction. Nothing hinges on this.

²⁴ Cf. Kanazawa (1994), Chierchia (1995), Guerts (2002), Champollion et. al (2018), among many others.

- (43) a. Its mother kicks every man who beats a donkey.
 b. Its engine fails no owner of a snow blower.
 c. Its engine caught fire on a man who had an airplane.

The dynamic theory explored in the present work combined with the approach to pronouns summarized in (41) has the right architecture, in the sense that it approximates what we need: it correctly rules in sentences like (42) (modulo the excessively strong uniqueness presupposition) and it does rule out sentences like (43), on the arguably principled idea that QR does not introduce DRs. It is worth emphasizing in this connection that a situation theoretic approach does not seem capable of accomplishing similar results in an equally simple way. The reason for this is the following. In sentences like those in (42) the way to regulate anaphora in situation theory is by making accessible the relevant situation for subsequent pronominal pick up. For example, a sentence like, say, (42a) has to be analyzed along the following lines (cf. Heim 1990, Buring 2004):

- (44) every minimal situation s that contains a man and a donkey he owns is part of a situation s' in which the man in s beats the donkey in s .

If shaving off the relevant situations in (42) is systematically built into the compositional semantics of quantifiers, it will also be available under scoping in examples like those in (43). The only hope to capture the asymmetry between ‘standard’ cases of anaphora (i.e. (42)) and crossover situations (i.e. (43)) is by making the relevant minimal situations inaccessible under scope assignment (i.e. QR). It is unclear how to technically achieve this goal within situation theory. On the present approach, DRs are activated by existential operators associated with specific positions. We have seen that there is independent evidence that thematic positions must activate DRs and it is an arguably natural consequence of this that scoping normally would *not* introduce DRs, as they are already present at thematic positions.

Accordingly, I believe that the present approach shows promise regardless of the specifics of the E-type approach one favors. However, an existence proof for an empirically adequate theory of donkey pronouns might be in order. Let me briefly sketch one that might be on the right track, inspired by Champollion et al. (2018). The proposal comes in two steps. The first is a modification of the semantics pronouns in terms of choice functions. In particular, replace (41), repeated here as (45a-b), with (45c):

- | | | |
|---|---|--------------------|
| (45) a. $[_{DP} \text{ it } \mathbf{NP}]$ | ii. $[_{DP} \text{ it } \text{donkey}]$ | Syntax (unchanged) |
| b. $\iota y [NP(y) \wedge R(\omega_n)(y)]$ | | Old semantics |
| c. $f(\lambda y [NP(y) \wedge R(\omega_n)(y)])$ ²⁵ | | New semantics |
- where f is a variable over choice functions.

²⁵ The remark in Footnote 23 applies here as well. The proper semantics for pronouns should be:

(a) $\lambda \omega. f(\lambda y [NP(y) \wedge R(\omega_n)(y)])$

Under this view, a relative clause donkey sentence (like (42a)) will be interpreted as follows:

- (46) a. Every man that has a donkey beats it
 b. every man that has a donkey beats $f(\lambda y [\text{donkey}(y) \wedge \text{own}(\omega_n)(y)])$
 where ω_n is anaphorically linked to the subject *every man*.
 c. $[\text{every man that has a donkey}]_i [\ t_i \text{ AG}_1 \text{ beats } f(\lambda y [\text{donkey}(y) \wedge \text{own}(\omega_1)(x)])]$

Our ‘official’ LF is as in (46c). An equivalent rendering, without dynamics, as it is unessential in this case, is as in (46b). (The dynamics *is*, of course, essential in general for a host of other cases: discourse sequencing, i.e. (41c), binding into adjuncts from the object position, conditionals, etc.). Now, looking at (46b), if there are men who own more than one donkey, there will be more than one choice function over donkeys around. So when will a sentence like (46), which contains a free variable over choice functions, be true? It is natural to resort in such cases to a supervaluationist move. If people beat all the donkeys they own, then no matter which f we pick, the sentence will come out true. If there is a man around who beats none of the donkey he owns, then the sentence will definitely be false (for regardless of which f we pick, it will fail to find a donkey beaten by the non violent man in question). This supervaluationist approach yields something equivalent to the universal reading of donkey sentences in the case at hand. If, on the other hand, all the men beat some though not all of the donkeys they own, we may well be undecided, as to whether the sentence is true or not. Context, in the form of ‘Questions under Discussion’, presuppositions, world knowledge, etc. may well affect our intuitions in systematic ways. For example, if the question under discussion is whether a park meter can be paid, then an existential or a universal construal become equivalent (i.e. putting in the meter all or just some of one’s dimes equally allows one to pay our dues) and hence one can go for an existential construal (say, by selecting a subdomain of choice functions).²⁶

Truth conditions along these lines, duly spelled out and married with an appropriate pragmatics may account for the pattern of intuitions laid out in (42). The one case where

²⁶ In so far as I can see, we get the same predictions as those of Champollion et al. (Their version of dynamic semantics yields the wrong results for crossover cases, viz. (43), a phenomenon that their approach was not intended to cover). A way to see the similarity between the two approaches is by noticing that an alternative way to obtain the results in the text is via a homogeneity presupposition along the following lines:

- (a) whenever f occurs free in ϕ , ϕ is defined in w iff $\exists f[\phi] \leftrightarrow \forall f[\phi]$ holds in w . Whenever defined, ϕ is true in w iff it is true relative to some assignment.

This way to go is, I think, also equivalent to the one in the text (and closer even in form to Champollion et al.)

Yet another way to go is to say that a sentence with a free E-type donkey pronoun is true iff it is true for every relevant interpretation of f (as on the approach in the text), and false otherwise (differently from what is done in the text). Then one can simply use domain selection to regulate which set of choice functions is relevant, and thereby obtaining weaker readings on pragmatic grounds. These two approaches are alike with respect to truth conditions, but differ on falsehood conditions in ways that would take us too far afield to sort out. As argued in the main text, the differences among these takes do not affect the architecture of the present proposal on crossover.

intuitions diverge from the predictions of the approach just sketched is in connection with indefinites (42e), where preference for $\forall$ -readings is expected by the account we just sketched. However, recall that indefinites have the option of being directly merged in Th-position, with a conjunctive semantics. When this happens, active DRs stay active and can be subsequently picked up by pronouns:

- (47) a. [[a friend who TH₃ had a car] AG₄ lend it₃ to me]]
 b. $\lambda\omega \lambda\omega'. \exists u \exists v [\omega = ((3/u)4/v) \omega' \wedge \text{friend}(v) \wedge \text{car}(u) \wedge \text{has}(u)(v) \wedge \text{lent}(\text{me})(u)(v)]$

The DR associated with *a car* in (47a), namely TH₃, is active and can be picked up by the pronoun *it*₃, yielding an existential construal. This is likely to be the source of the main reading of sentences like (42e).

The present proposal extends to the other cases of non C-command binding mentioned in Section 1, like inverse linking and possessor binding. As the two cases are parallel, we illustrate how the present theory works for inverse linking.

- (48) a. i. The mayor of no city₁ despises it₁/its₁ population.
 ii. no city_i [[the mayor of t_i] AG₂ despises f(λy .population(y) $\wedge$ R(ω_2)(y))]
 where R(ω_2)(y) = y is in the city of which ω_2 is mayor
 b. i. * Its mayor despise the population of no city.
 ii. no city_i [t_z.mayor(z) of(ω_2)(z) AG₂ despises t_i's population]

I am assuming here that the quantifier *no city* can be scoped out of the DP that hosts it. As usual, however, it can bind only its own trace. At the same time, the AG argument introduces a DR, linked by construction to the mayor. The agent DR is accessible to the pronoun embedded in the Theme-argument in (48a), pronoun that can be interpreted as ‘the population of the city of the (relevant) mayor.’ So the mayor varies in function of the city, and the population varies in function of the mayor. This is not so in (48b). In (48b), the pronoun embedded in the subject position does not have a clause internal accessible antecedent: AG₂ is not accessible to it, plus it requires the index 2 to be novel (while the pronouns requires it to be old), as discussed in connection with examples (36)-(37) above.

In conclusion, while the approach to E-type pronouns discussed in the present section surely needs to be fleshed out more fully, the sketch we have given should be enough to confirm the predictive nature of the general proposal we are exploring. The point is that even if a different take on E-type pronouns ultimately emerges, it is not going to affect our argumentation, to the extent that the result will involve a functional dependency of some sort on a pronominal element: the present theory predicts that in typical crossover configurations a functional pronoun won't have a clause internal accessible antecedent.

4.4. Interim summary

In the present section, we have first seen how binding into right adjuncts from the object position is correctly predicted: Objects are expected to bind into adjuncts without C-command, whenever adjuncts are intersective/conjunctive. We have then argued that

while the interpretation of propositional connectives is dynamic, GQs are not. This entails that antecedents embedded in the restriction of a GQ are not accessible to pronouns embedded in its scope and this explains why ‘donkey crossover’ situations do not arise. We have then discussed how and where ‘indirect binding’ through functional (non trivial E-type) pronouns comes about. The approach to WCO that emerges is fairly articulated and does lack construction specific provisions. When pronoun binding follows C-command and when it does not is determined by accessibility, i.e., ultimately, the dynamics of basic propositional operators, which also provides, if you like, a functional grounding for crossover phenomena.²⁷ None of the issues that beset traditional accounts (like binding into adjuncts, or possessor binding cases, etc.) affects the present proposal. The desiderata set out at the outset appear to have been met.

5. Further issues

WCO has many spin offs, too numerous to be considered within a single paper. In the present section we address two of them, particularly relevant to the present proposal. The first concerns the interaction between WCO and A-movement. The second, a case of topicalization in Italian, namely Clitic Left Dislocation (CLLD). The latter will allow us to take a quick look at resumption and, indirectly, at so called ‘weakest crossover’ phenomena (Lasnik and Stowell 1991).

5.1. The subject position²⁸

The nature of the subject position raises an interesting issue from our perspective. So far we have argued that DR-introduction is associated with theta-roles or theta-positions. But this hypothesis is too narrow. The range of positions capable of activating DRs, i.e. endowed with strong anaphoric properties must be broader. In the present subsection we argue that the so called ‘external’ subject position, also known as the Extended Projection Principle (EPP) -subject position, while being non thematic, (i) activates DRs and (ii) has a cluster of properties characterizable in terms of a notion of ‘aboutness.’ This correlation is likely not to be accidental, which leads one to expect that when similar a clustering occur, DRs should also be introduced, a hypothesis we will investigate in Section 5.2.

It is a familiar result that the EPP- subject position is not necessarily thematic. The existence of expletives and raising verbs is one of the traditional pieces of evidence in favor of this view:

²⁷ I am assuming that the Binding Theory (along the traditional lines of Chomsky 1981) is in place. The indices that matter for BT purposes are those associated with A-positions. A pronoun is (syntactically) bound iff it is coindexed with a C-commanding accessible antecedent. Reflexive pronouns must be locally bound (Principle A), and non-reflexive pronouns must be locally free (Principle B), as in the following example:

(a) i. John EX₂ hates himself₂
 ii. * John EX₂ hates him₂

Principle C requires more discussion. See Section 5.2 below.

²⁸ The present section summarizes a line of argumentation developed more extensively in Chierchia (2017).

- (49) a. It rains.
 b. It seems to John that every athlete is ready to compete.
 c. Every athlete_i seems to his coach [_i to be ready to compete]

Verbs like *rain* or *seem* does not assign an ‘external’ theta-role. *Seem* assigns an ‘experiencer’-theta role (realized as an oblique argument marked by the preposition *to*) and a propositional one (realized in (49b) as a *that*-clause and in (49c) as an infinitival one). The absence of an external theta role for *seem* is confirmed by the possibility of raising the embedded subject as in (49c). The subject *every athlete* in (49c) receives its theta role from the embedded predicate *ready to compete*, and it is then promoted to subject of the matrix clause.

What is the issue? Raised, non-thematic subjects clearly can antecede pronouns, as (49c) illustrates. This entails that the EPP-subject position, when filled by a non expletive, must activate a DR, which can be picked up by subsequent pronouns. This fact seems to correlate with another, as discussed by, e.g. Rizzi (2005), Rizzi and Shlonsky (2007), among others, namely that EPP-subjects, while non-thematic, have clearly identifiable semantic properties. For example, question (50a) forms a congruent Question-Answer pair with (50b) but less so with (50c):

- (50) a. What happened to John’s truck?
 b. John’s truck hit a car
 c. *? A car hit John’s truck

Sentence (50c), pronounced with ‘Nuclear Stress’ intonation (i.e. with focus on the whole VP, without focusing more narrowly any constituent in particular) is substandard in answer to (50a). Using, e.g. Rooth’s (1992) approach, the set of focal alternatives to (50b) can be represented as in (51b), while, while the set of focal alternatives to (50c) would be of the form (51c). According to Rooth’s theory of congruence for question-answer pairs, only (50b) is congruent with (i.e. a subset of the denotation of) the question in (50a), whose meaning, in schematic form, is represented in (51a).

- (51) a. {P(John’s truck): happened to (P, John’s truck)}
 b. {P(John’s truck): P is relevant}
 c. { $\exists x$ car(x) $\wedge$ P(x): P is relevant}

The contrast in (50) constitutes evidence that the subject position is associated with some kind of ‘aboutness’ property (in Rizzi’s terminology), reflected in the focal structure of the sentence. One can make a case, in other words, that the EPP-subject position triggers as a presupposition that that the common ground include a Question under Discussion of the form in (51a), which in turn will have consequences for the focal structure of the clause. These highly informal considerations are just a way of pointing out that while moving an argument to an EPP position does not affect the thematic structure of a clause, it may well be not void of semantic consequences. We conjecture that activating a DR is part of the semantic import of the EPP-subject position. In what follows, I will spell out

this conjecture. The goal is not so much to arrive at an ultimate theory of clause structure, but rather to show that the proposal just made is both internally coherent and compatible with the prevailing assumptions about the interfaces.

In current theories, the clausal spine looks roughly as follows:

(52) [John_i T [t_i ASP $\exists$ [t_i υ_n runs]]]

The thematic structure of the V is projected within the υ P layer. After the arguments of the verb have been merged into the structure and event modification, if any, has taken place, the event argument is existentially closed ($\exists$ in (52) indicates the scope of event closure). The outer functional heads introduce aspectual and temporal information, in ways that I won't spell out, as they are orthogonal to our present concerns. The outermost argument of the V is merged in spec of little υ , where it gets its theta role and is associated with a DR (n in (52)); the subject subsequently raises through the Specs of the various intervening functional heads, to land eventually in the Spec of the outermost functional layer, say T, driven by an EPP-feature associated with it. With verbs like *rain* or *seem* that do not have an external theta-role, an expletive *it* is merged into the Spec of little υ position, and then raised upwards to satisfy the EPP feature of T:

(53) a. [it_i T [t_i ASP $\exists$ [t_i υ rains]]]

b. [~~it~~_i T [~~t~~_i ASP $\exists$ [~~t~~_i υ rains]]]

There are various ways of dealing with expletives from an interpretive point of view. On one approach, which we will follow here, they simply have no meaning and must be elided for the structure in which they occur to be interpreted (as indicated in (53b)). It is natural to assume that when no external theta-role is assigned, no DR is introduced, and in such case, little υ carries no anaphoric index, for otherwise the derivation would crash. On the present implementation, one might want to say that indices on theta-assigning heads may be inserted freely and, when inserted, create predicates of type $\langle e, \langle ev, T \rangle \rangle$; if however, there the set of eventualities is not defined for the relevant th-relation (as the set of raining events is not), insertion of an index/activation of a theta role will be undefined:

(54) a. [υ_n rains] = $\lambda\alpha\lambda e$ [[TH(e)]_n(α) $\wedge$ rain(e)] UNDEFINED
(raining events have no theme or agent).

b. [υ rains] = λe [rain(e)]

Un-indexed little υ is semantically vacuous, as indicated in (54b). (Conversely, if one leaves little υ un-indexed in say (52), it will be impossible to semantically combine the V with its argument, and we would get, yet again something uninterpretable). Raising structures work in exactly the same way, with an extra twist. Let us consider unraised structures first:

- (55) a. It seems to us that every athlete is in good shape
 b. $[\text{t}_i \text{ T } \exists [\text{t}_i \text{v seems to us that every athlete is in good shape }]]^{29}$
 c. $\lambda\omega\lambda\omega'. \exists s [\omega = ((1/us) \text{ 2/prop}) \text{ 3/s } \omega' \wedge \text{EX}(s)(us) \wedge \text{TH}(s)(\lambda w. \text{ every athlete is in good shape in } w) \wedge \text{seem}(s)$
 “There is a state s which is a seem-state with experiencer we/us and (propositional) theme the proposition that every athlete is in good shape”

Sentence (55a) has the structure in (55b) and is interpreted as something like (55c), per the interpretive procedure just outlined. Such a sentence has three active DRs: one corresponding to the EX-argument of *seem*, one corresponding to the propositional theme (abbreviated as *prop*) and one corresponding to the seem-state. Nothing surprising here. Truth-conditions are as in (55c).

The extra twist occurs when raising takes place: in such a case, the EPP-head can (or must) introduce a DR:³⁰

- (56) a. Every athlete seems to his coach to be in good shape.
 b. every athlete_i $[\text{TP } \text{t}_i \text{ T}_{4/i} \exists [\text{t}_i \text{v seems to } \omega_4 \text{'s coach } [\text{t}_i \text{ to be in good shape }]]]$

The EPP-head (T, in our implementation) activates a DR (as indicated by the subscript on T in (56b)) without also adding a theta-role. The DR activated by the T-head provides an antecedent to subsequent pronouns thanks to the dynamics. I am assuming that when a DP is internally merged (i.e. moved) to the Spec of an indexed head H_n , the index of the moved DP is passed onto the head H_n (say, via Spec-Head agreement) creating the configuration $[\text{DP}_i \text{ H}_{n/i}]$; if H_n introduces a DR, as T does, the index i in $H_{n/i}$ is semantically meaningful, as in (57) below; otherwise (i.e. if H does not introduce a DR) i on H is meaningless and gets erased. Here is a sample derivation.

- (57) a. $[\text{T}_{4/i} \exists [\text{vP } \text{t}_i \text{v seems to } \omega_4 \text{'s coach } [\text{t}_i \text{ to be in good shape }]]] =$
 $\lambda x_i [\lambda\omega\lambda\omega'. \omega = (4/i) \omega' \wedge \text{vP}]$ Type: $\langle e, T \rangle$
 where:
 i. $\text{vP} = \lambda\omega\lambda\omega'. \exists s [\omega = (3/s) \omega' \wedge \text{EX}(s)(\omega_4 \text{'s coach}) \wedge \text{TH}(s)(\text{prop}) \wedge \text{seem}(s)]]$
 ii. $\text{prop} = \lambda w. \text{t}_i \text{ is in good shape in } w$
 (a) is applied to t_i (cf. (56b)) and the result is:
 b. $\lambda\omega\lambda\omega' \exists v \exists s. \omega = (4/t_i) v \wedge v = (3/s) \omega' \wedge \text{EX}(s)(v_4 \text{'s coach})$
 $\wedge \text{TH}(s)(\lambda w. \text{t}_i \text{ is in good shape in } w) \wedge \text{seem}(s)]]$ Type: T
 c. $[\text{T}_{n/i} \text{vP}] = \lambda x_i \lambda\omega\lambda\omega'. \omega = (n/i) \omega' \wedge \text{vP}$

The computation in (57a-b) is straightforward, if tedious. Notice that t_i (the trace of the raised subject) is linked to a (novel) DR in (57b), which supplies the antecedent for the

²⁹ Here and henceforth I omit the ASP-head as it plays no role in our argument.

³⁰ I see no difference as to whether the EPP head introduces a DR optionally or obligatorily.

pronoun embedded in the experiencer argument. The general semantics of an indexed EPP-heads is as simple as (57).³¹ Notice, furthermore, that the identity between the trace in Spec T and the trace in Spec of the embedded clause is guaranteed by the syntax of raising. Traces are interpreted in the familiar way (as Tarskian variables) and get bound in the familiar way by the GQ *every athlete*.

The upshot of this discussion, beyond details of execution, is the following. We have argued that theta-roles/positions introduce DRs that act as pivot for anaphora. This idea is correct but needs to be expanded. There must be other positions besides theta-positions that are also endowed with DR-introduction powers. In particular, we have considered here the EPP-subject position, where DR introduction correlates with aboutness. It is reasonable to expect this situation not to be circumscribed to EPP-subjects, for other positions (e.g. topic positions) clearly have properties of aboutness very similar to those of EPP-subjects.

The present discussion has followed in a way the debate one finds in the literature about A-positions. Originally, A-positions were defined as those at which theta-roles are assigned, but this characterization had to be rapidly expanded so as to include the external-subject positions (very much like what did here), and arguments have been made to expand it even further (cf. the debate on scrambling: e.g., Baylin (2001) and references therein). While the exact definition of A-position may remain somewhat vague, the present theory offers a way of sharpening it through the following criterion:

(58) *The A-criterion*:³²

The Spec position of a head H is ‘argumental’ iff the semantics of H activates a novel Discourse Referent.

The positions endowed with DR activation powers should, furthermore, have similar semantic properties, including, e.g., ‘aboutness’. The spectrum of semantic properties of A-positions is to be determined more fully by further empirical investigation. The main consequence of this proposal is that movement into a position characterized by the A-criterion will obviate WCO effects, exactly like raising or passive do, and for the same reasons: the DR introduced by the head H that attracts the dislocated constituent will be able to antecede pronouns intervening between H and the trace of the dislocated constituent. In the next section, we will see how this extends to other types of dislocations.

5.2. Topics

Lasnik and Stowell (1991) show that English Topicalization (ET) is a construction in which WCO effects are obviated:

(59) This book_i [I would expect its_i author to disavow t_i] but that book_j [I wouldn’t ___]

³¹ To this one should add whatever presupposition characterizes aboutness (say, e.g., that there be salient QUD about u as part of the common ground). I am not attempting to formalize this here.

³² The A-criterion might be useful in providing a semantic basis for the line of inquiry on the A/A’ contrast developed in Safir (2018). But pursuing this within the limits of the present paper would take us too far afield.

ET is restricted to referential expressions and therefore the dependency in (59) could in principle just be a case of pronoun-antecedent coreference. However, Lasnik and Stowell observe that ET licenses sloppy readings in VP ellipsis constructions, as shown in (59), which suggests that the pronoun-antecedent relation in (59) cannot be just a matter of coreference. This state of affairs is in a way expected in light of the considerations in Section 5.1 Topic-positions share many of the properties of prototypical subjects, to the point that it is sometimes hard to distinguish the two (as has been noted for, e.g., subjects in Mandarin). It is therefore natural to adopt an analysis whereby a topicalized element is attracted to a Top-head in the left periphery (null in English, but overt in many languages), which is endowed with a DR-introducing semantics, exactly like the EPP-subject head.³³

While ET obviates WCO, Principle C effects are never obviated:

(60) * That man_i TOP_{2/i} [he₂ would expect me to disavow t_i]³⁴

We assume that the BT and, in particular, Principle C are operative. In the present set up, Principle C takes on the following form:

- (61) a. A trace cannot be co-bound with a C-commanding pronoun.
 b. A trace is co-bound with a pronoun in the following configuration:
 [...H_{n/i} ...pro_n...t_i...] , where H_{n/i} C-commands pro_n and the latter C-commands t_i

As all BT-principles, Principle C is a syntactic constraint with semantic consequences, i.e. blocking semantic co-variance of a trace with a C-commanding pronoun. This is perhaps the occasion to point out that on the present approach, ‘canonical’ Principle C violations, such as those in (62), are not ruled out in terms of Principle C, but just along side with WCO violations:

- (62) a. He_i criticizes every new author_i’s book.
 b. i. [Whose_i book]_j does he_i criticize t_j?
 ii. who_i does he_i believe that Mary will meet t_i?

³³ Lasnik and Stowell examine other cases of WCO obviation, involving tough-movement and parasitic gaps, such as the following:

(a) Which employee did you talk to ___ before his boss had a chance to brief ___

A parasitic gap construction such as (a) is generally taken to involve an (abstraction) operator and a form of co-predication of the adjunct with the object of *talk to* as schematically indicated in the following Logical Form:

(b) Which employee_i [did you talk to t_i O_jⁱ [before his boss had a chance to brief t_j]]

In our framework this obviation effect would follow from the fact that the object of *talk to* introduces a DR accessible to the pronoun *his* embedded in the adjunct clause.

³⁴ Recall that, as motivated in connection with (56), that the index on that man is uninterpretable.

QR and *wh*-movement are pure scope marking operations and their landing sites are not linked to a head that can act as pivot for anaphora. Hence, what happens in cases like (62) is that the pronoun fails to have a clause internal accessible antecedent. So, in so far as I can see, (61) is the only ‘residue’ of Principle C, if the present perspective is on the right track.

This line on topicalization appears to be confirmed by Clitic Left Dislocation (CLLD) in Italian,³⁵ a construction that shares key properties with ET. Syntactically, CLLD involves dislocation of a constituent to the left periphery, with a resumptive clitic pronoun (obligatory for arguments – cf. (63a-b)) in the base position, subject to island effects (cf. (63c)):

- (63) a. Francesco, io lo amo __molto
 Francesco, I him love a lot
 b. * Francesco, io __ amo__ molto
 c. * Francesco, Maria è uscita prima di incontrarlo
 Francesco, Maria went out before meeting him
 d. i. [DP Francesco [DP lo]] ‘Big DP’
 ii. Francesco_i [I [~~Francesco~~ him_i] love [~~Francesco~~ him_i]]

On an influential analysis (cf. Cecchetto 2002, which builds on Torrego 1994), CLLD is viewed as extraction out of a Clitic Doubling configuration. First, a DP is merged in a Spec-Head structure with the clitic double forming a ‘Big DP’, as in (63.d.i). This complex is moved as a whole to whatever Spec position usually hosts clitics; then the smaller DP is subextracted and moved to a TOP head in the left periphery. A highly schematic derivation, using English as metalanguage, is provided in (63d.ii).

As for the inventory of items that can be CLL-dislocated, Italian is more liberal than English. Besides definites, indefinites are acceptable on generic or ‘specific indefinite’ readings (while strong quantifiers are deviant):

- (64) a. Un bravo studente, lo si deve aiutare sempre
 A good student, him one must help always
 b. *? Ogni bravo studente lo si deve aiutare.
 Every good student, him one must help

Like with ET, in CLLD, WCO-effects are obviated and Principle C effects are not:

- (65) a. Uno studente così_j TOP_{3/j} [mi aspetterei che il suo_j advisor lo₃ sosterrrebbe __ ad
 oltranza]
 ‘A student like that [I would expect that his advisor him would support__
 strongly]’
 b. * Un bravo studente_j anche lui_j crede che Gianni lo_j aiuterebbe
 A good student also he believes that Gianni him would help

³⁵ See, e.g. Cinque (1977), Cecchetto and Chierchia (1999), Cecchetto (2002) and references therein.

- c. [A good student]_j **TOP**_{3/j} also **he**₃ believes that Gianni [_{tj} **him**₃] would help

This is not the place to provide a detailed compositional semantics for CLLD, as that would involve getting into generics, among other things (the sentence in (65a) is generic, as is the embedded clause in (65b)). Various options are possible (see, e.g. Cecchetto and Chierchia 1999 for discussion). In broad strokes, however, the DR introduced at the TOP position is accessible to pronouns in the main clause (including the resumptive one, which can be treated as a ‘real’ pronoun). Sentence (65a) is well formed, and WCO is obviated as for ET; sentence (6b), on the other hand, runs afoul of Principle C, as the Logical Form in (65c) illustrates, with the relevant elements in boldface.

I believe that the present approach also naturally extends to cases scrambling that obviate WCO, much discussed in the literature, and can be viewed as way of making semantic sense of the idea that such cases are an instance of A-movement. The following example, from Baylin (2001), illustrates:

- (66) a. ?? ee₁ sobaka nnavitsja kazhdoj devochke₁
 NOM-her dog appeals DAT-every girl
 ‘Her dog appeals to every girl.’
 b. kazhdoj devochke₁ nnavitsja ee₁ sobaka
 DAT-every girl appeals NOM-her dog
 ‘Her dog appeals to every girl.’

Sentence (66a) reflects the unscrambled structure, which displays WCO. In (66b) the dative argument is fronted and WCO is ameliorated. We would analyze this along lines parallel to ET and CLLD, as a movement to a position at which a DR is introduced.

5.3. Interim summary

In the present section we have made a case that DR-introduction is not limited to Theta-positions/heads, but it extends to non base positions loosely characterized by an ‘aboutness’ property. These include the EPP-subjects, various topic positions, and the landing site of certain kinds of scrambling. The basic intuition here is that there are two types of movements, relevant to the object of our inquiry. One type, exemplified by Quantifier Raising and wh-movement (of the English variety), is essentially just a scope marking device. As such, it is not associated with semantic properties other than scope marking itself, and it doesn’t target landing sites associated with strong anaphoric properties (i.e. heads that introduce DRs). This type of movement will display WCO effects. The second kind of movement, exemplified by the constructions discussed in this section, is not just a scope marking phenomenon (though it may also have scope fixing as a by product) and targets heads that carry an aboutness presupposition (not fully formalized here). Such heads act as pivot for anaphora in the sense of introducing DRs that get semantically linked to the dislocated constituent, and typically lead to bleed WCO effects.

Along the way, we have discussed some consequences of the present approach for the Binding Theory, and illustrated one way in which the present approach to Crossover phenomena may extend to some cases of resumption. The suggestion, for CLLD, is that

the resumptive clitics should be treated semantically as ordinary pronouns. But the phenomenology of resumption, like that of topic-hood, is much broader and very diverse. For example, Demirdache and Percus (2011) argue that resumption in Jordanian Arabic involves movement of the resumptive pronominal element, and obviously this would require a different semantics for such elements (vis-à-vis non resumptive pronouns), regardless of whether the present take is on the right track or not.

6. Conclusions

In so far as I can see, the main ‘axioms’ of the present proposal, implementation aside, are the following four:

- (67) a. The structure of clauses, for arguments and intersective modifiers, is to be decomposed into a set of structurally determined conjunctive statements about events.
- b. i. Propositional connectives are dynamic.
ii. Quantification is not dynamic.
- c. i. Pronouns are quasi-indexical elements, i.e. pointers to accessible antecedents.
ii. Traces are ordinary Tarskian variables (a corollary of (65b.ii)).
- d. Thematic heads and heads endowed with an aboutness presupposition introduce Discourse Referents.

Some of these principles have a sizeable amount of independent justification, and have been motivated in ways that are totally independent of WCO phenomena. This is so, for example, for (67a), which is central to the architecture of event semantics. Similarly for (67d): while couched here in a dynamic semantics terminology, the idea that certain argumental positions are semantically linked to existential quantifiers that sustain anaphora seems to be required by phenomena as diverse as the anaphoric properties of definites and the behavior of bare plurals (as is independently motivated the idea that certain derived positions have argument-like properties). The other assumptions in (67) are more internal to dynamic semantics, and rely on the appeal of the corresponding *Weltanschauung*. This is so, obviously, for (67b) and (67c).

In a way, the most surprising aspect of these axioms is the claim that quantification is not dynamic. What does this mean? Basically, that Generalized Quantifiers remain relations between sets, adjusted for types. This move has the appeal of simplicity: it constitutes the simplest possible way of overlying quantification on top of the basic dynamics of propositional connectives. Its main consequence is that scope marking movement, whether it is semantically motivated adjunction (like Quantifier Raising) or movement to a designated wh-head, is not expected to introduce Discourse Referents (and, of course, traces are not expected to be quasi-indexicals like pronouns). Notice, furthermore, that Principles (c) and (d) can be viewed as a way of providing a semantic basis to Büring’s idea that pronoun binding and scope assignment are ‘separate circuits’ (i.e., in his terms, they are involve separate indices and operators). I have tried to make a case that a highly complex range of crossover phenomena are derivable from the axioms in (65), in ways that overcome many of the empirical difficulties that current proposals

face. To be sure, many issues remain open. For example, the proper way of dealing with E-type phenomena needs further investigation, as does resumption, among other things. And we have said nothing about the behavior of long-distance indefinites, and its connection to topic-hood.

Be that as it may, WCO has been around for many years. The possibility of deconstructing it into a number of more basic, fairly principled axioms such as those in (65) gives us hope and grounds to move the discussion forward.

Appendix: Summary of the formal theory

(1) Types

a. Basic: $e, t, \mathbf{n}$; where: $D_e = U$ (domain of individuals, including events), $D_t = \{0,1\}$,
 $D_n = \mathbb{N}$ (the set of positive integers)

b. $D_{\langle a,b \rangle} = [D_a \Rightarrow D_b]$ (the set of all total or partial functions from D_a into D_b)

The set of meaningful expressions, models, etc. for a formal language with these types are defined as for TY2 (Gallin xx).

c. Abbreviations:

i. $\omega = \langle \mathbf{n}, e \rangle$

ii. $T = \langle \omega, \langle \omega, t \rangle \rangle$.

(2) DR-introduction

$[P_{\langle e,t \rangle}]_n = \lambda u [\lambda \omega \lambda \omega'. \omega =_{n/u} \omega' \wedge P(u)]$

where $\omega =_{n/u} \omega'$ is an abbreviation of $\omega' = \omega \cup \langle n, u \rangle$, defined only if the input assignment is *undefined* for the n th-coordinate.

(3) Pronouns

Pronouns are of type $\langle \omega, e \rangle$. E.g.:

a. $he_n = \lambda \omega. \omega_n$

Pronouns combine with dynamic predicates (of type $\langle e, T \rangle$) via function composition:

b. If β is of type $\langle e, T \rangle$, α is of type $\langle \omega, e \rangle$, and n is of type $\mathbf{n}$, then

$\beta(\alpha_n) = \lambda \omega \lambda \omega'. \beta(\alpha(\omega)(n))(\omega)(\omega')$

(4) The logic

For any ψ, ϕ of T , any variable ω, ω' of type ω and any variable α_a of type a :

a. $\downarrow_\omega \phi = \exists \omega' [\phi(\omega)(\omega')]$ ' ϕ is true relative to ω ;' $\downarrow$ is of type $\langle \omega, \langle T, t \rangle \rangle$

b. $\neg \phi = \lambda \omega \lambda \omega'. \neg \downarrow_\omega \phi \wedge \omega = \omega'$

c. $(\phi \wedge \psi) = \lambda \omega \lambda \omega'. \exists \omega'' [\phi(\omega)(\omega'') \wedge \psi(\omega'')(\omega')]$

d. $\phi \rightarrow \forall \psi = \neg (\phi \wedge \neg \psi)$

e. $\phi \vee \psi = \neg (\neg \phi \wedge \neg \psi)$

f. $\exists \alpha_a \phi = \lambda \omega \lambda \omega'. \exists \alpha_a [\phi(\omega)(\omega')]$

g. $\forall \alpha_a \phi = \neg \exists \alpha_a \neg \phi$

This logic encodes the standard characterization of accessibility (cf., e.g., Groenendijk and Stokhof 1991).

Acknowledgments

To be written.

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