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Dynamic Quantification at a Distance

MARTIN HONCOOP

1 Introduction

1.1 Quantification at a Distance

In French, there are essentially two ways in which a *how many*-interrogative can be constructed. Either the entire *how many*-phrase is fronted to sentence-initial position, as illustrated in (1.1a), or just the *wh*-determiner, as exemplified in (1.1b). Following Obenauer (1984/85), we will refer to the first type of construction as 'full *wh*-extraction', and to the latter as 'Quantification At a Distance' (QAD).

1.1a	Combien de livres	est-ce que	Jean a	lus?	
	how many of books	*is-it that*	*Jean has*	*read*	
1.1b	Combien	est-ce que	Jean a	lu	de livres?
	how many	*is-it that*	*Jean has*	*read*	*of books*

As is well known, QAD is disrupted by certain intervening expressions, even though the same expressions do not interfere with full *wh*-extraction. The examples in (1.2) and (1.3) below are illustrative in this respect. In (1.2), we observe that negation cannot intervene between the *wh*-determiner and its remnant *de livres*.

1.2a	Combien de livres	est-ce que	Jean n'	a	pas	lus?	
	how many of books	*is-it-that*	*Jean neg*	*has*	*not*	*read*	
1.2b	*Combien	est-ce que	Jean n'	a	pas	lu	de livres?
	how many	*is-it that*	*Jean neg*	*has*	*not*	*read*	*of books*

Negative universals create opaque domains for QAD as well; cf. (1.3). We will henceforth refer to these intervention effects as ‘Weak Islands’ (WIs).

1.3a	Combien de livres	est-ce que	personne	n’	a	lus?	
	how many of books	*is-it that*	*no one*	*neg*	*has*	*read*	
1.3b	*Combien	est-ce que	personne	n’	a	lu	de livres?
	how many	*is-it that*	*no one*	*neg*	*has*	*read*	*of books*

1.2 The main claim

The most influential proposal to date to account for the WI sensitivity of QAD is de Swart’s (1992). Her analysis is grounded in a semantic locality principle that for our purposes can be stated as follows:

- **Scope Hypothesis**. An operator O_1 can only separate another operator O_2 from its restrictive clause if O_1 takes wide scope over O_2.

Consider again the ill-formed QAD structures in (1.2b) and (1.3b), where O_1 is *n’ … pas* and *personne* respectively, O_2 is the *wh*-determiner *combien* and its restrictive clause the remnant *de livres*. Both sentences are straightforwardly ruled out by the Scope Hypothesis, since neither negation nor a negative universal quantifier can take wide scope over a *wh*-phrase in general. In the discussion that follows, it is assumed that the empirical generalization embodied in de Swart’s Scope Hypothesis is essentially correct. My main objective in this paper is to show that this hypothesis is not an irreducible constraint stipulating how natural language quantification is to be expressed at the syntax-semantics interface. On the contrary, I will argue that its effects can be derived from certain basic principles of Dynamic Semantics (cf. Groenendijk & Stokhof 1989,1991; Dekker 1993; Chierchia 1995) that account for similar locality effects in the domain of discourse anaphora.[1]

1.3 Organization

This paper is organized as follows. In the next section, I will lay out some general assumptions in terms of which our account of the WI sensitivity of QAD will be couched. The assumption most specific to our analysis is the claim that the remnant of *combien*-extraction denotes a restricted existential quantifier. If so, the question arises how the remnant can restrict the range

[1] Cf. Honcoop (1998) for a more comprehensive dynamic approach to WIs in general, focusing on other types of split constructions, partial *wh*-movement and Negative Polarity licensing.

of the *wh*-determiner, as entailed by the Scope Hypothesis. This issue will be addressed in section 3. There, we will see that in Dynamic Semantics, even though it is assumed that indefinites uniformly denote restricted existential quantifiers, they can still be quantified over by means of an operation coined Existential Disclosure. Interestingly, this type-shifting mechanism only yields a semantically coherent reading in case the indefinite that needs to be disclosed is 'dynamically active', i.e. capable of anteceding discourse anaphora. It now follows that if QAD requires Existential Disclosure, *combien* cannot be extracted across a so-called 'inaccessible' domain for discourse anaphora. In section 4, I will show that in the light of this result, we can derive the effects of the Scope Hypothesis from those principles of Dynamic Semantics that account for inaccessibility. This paper will be concluded in section 5 with some discussion concerning comparable intervention effects with full extraction of *how many*-phrases.

2 Some preliminary assumptions

Firstly, we will assume that a unary *wh*-interrogative denotes the characteristic function of a set of objects. For example, we will represent the question expressed in (2.1a) as in (2.1b), keeping the semantics extensional throughout this paper for ease of exposition. It should be stressed though that this assumption is only motivated by the desire to keep matters as simple as possible. In what follows, nothing crucial hinges on this.

2.1a Which book did John read?
2.1b $\lambda x.$ **book**(x) ∨ **read**(x)(**john**)

Secondly, we will assume that *how many*-interrogatives denote functions from *cardinal* determiners to truth-values, where a binary determiner Q^2 will be called *cardinal* just in case $Q^2(A)(B)$ iff $Q^2(E)(A$ 1 $B)$ (E = the universe of discourse).[2] According to this definition then, (complex) numerals such as *three, exactly six*, *less than five*, etc. all denote cardinal determiners. We will thus represent the semantics of (2.2a) as in (2.2b), where Card is a property that holds of all and only the cardinal determiners.

[2] In fact, Keenan (1987) calls those determiners that satisfy this equivalence 'existential'. Our reason for calling these determiners cardinal resides in the fact that for virtually every existential determiner, we have that œA, B, A', B' f E: if $|A$ 1 $B| = |A'$ 1 $B'|$, then $D(A)(B)$ iff $D(A')(B')$ (Keenan's 1987 condition for cardinality). The only type of (two-place) existential determiner mentioned in Keenan 1996 that is not cardinal is *no ... but John*, which arguably does not count as a determiner in the syntactic sense.

2.2a	Combien	de livres	est-ce que	Jean	a	lus?
	how many	*of books*	*is-it that*	*Jean*	*has*	*read*

2.2b λQ^2 0 Card. Q^2(**book**)(λy. **has**(**read**(y))(**j**))

Fixing some terminology, suppose we define one-place determiners Q^1 as follows: $Q^1 =_{def} Q^2(E)$. It now follows that even though all determiners are syntactically two-place, it is immaterial for cardinal determiners whether we think of them as binary relations between properties or properties of properties.[3] Thus, given our definition of one-place determiners and the fact that (2.2b) is equivalent to λQ^2 0 Card. Q^2(**E**)(λy. **book**(y) ∨ **has**(**read**(y))(**j**)), it follows that (2.2b) is equivalent to (2.3).

2.3 λQ^1 0 Card. Q^1(λy. **book**(y) ∨ **has**(**read**(y))(**j**))

Thirdly, our analysis will be implemented in a type-logical categorial grammar essentially for reasons of perspicuity: it provides a smooth and instant fit between syntactic and semantic composition. To get a general sense of this framework, let us step through a derivation of (2.2a) with its semantics as indicated in (2.2b).[4] The first part of the derivation is given in (2.4a) below in 'natural deduction' form, where it is assumed along with Carpenter (1997) that *yes*/*no*-questions are of category S_y. Thinking of functional categories A/B or $B\backslash A$ (where the result category in written 'on top of' the slash) as conditional $A \rightarrow B$, then the /- and \-elimination rules simply correspond to Modus Ponens reasoning in propositional logic, effecting functional application in the semantics through the so-called Curry-Howard isomorphism. Similarly, the $\uparrow$-introduction rule, where $\uparrow$ is the extraction operator, can be seen to correspond to hypothetical reasoning, effecting λ-abstraction in the semantics. If on the basis of the hypothesized presence of a certain category A a string of words can be parsed into category B, then that string can be parsed into the 'conditional' category $B\uparrow A$, i.e. a B which misses an A. Furthermore, an expression e of category $B\Uparrow A$ behaves syntactically as a B and semantically as a free variable in its local

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[3] That is, cardinal determiners are sortally reducible in the sense of Keenan (1996). Cardinal determiners can therefore be taken to be of type ++e,t,,t, or ++e,t,,++e,t,,t,,. To preserve the functionality of the category-to-type assignment, this type-distinction would have to be coded somehow in the category of determiners.

[4] For an excellent introduction into type-logical grammar from a semantic perspective, cf. Carpenter (1997). Cf. Morrill (1994) for the logical foundations and linguistic applications of type-logical grammar, and Moortgat (1997) for an overview of recent developments. In this paper, no attempt will be made to deconstruct the $\uparrow$- type constructor, as well as the $\Uparrow$- and !-type constructors to be discussed below, in a multi-modal setting.

context. At the point where an A is derived, the semantics of e is quantified in. The $\Uparrow$-type constructor is accordingly called the scope constructor. Finally, Lx refers to an application of a lexical insertion rule.

2.4a

$$
\dfrac{\dfrac{est\text{-}ce\ que}{\mathrm{S}_y/\mathrm{S}: \lambda p.\ p}\,\mathrm{Lx}
\quad
\dfrac{\dfrac{\dfrac{\dfrac{Jean}{\mathrm{NP}: \mathbf{j}}\,\mathrm{Lx}
\quad
\dfrac{\dfrac{a}{(\mathrm{NP}\backslash\mathrm{S})/(\mathrm{NP}\backslash\mathrm{S}): \mathbf{has}}\,\mathrm{Lx}
\quad
\dfrac{\dfrac{lu}{(\mathrm{NP}\backslash\mathrm{S})/\mathrm{NP}: \mathbf{read}}\,\mathrm{Lx}
\quad
\dfrac{[\mathrm{NP}\Uparrow\mathrm{S}: T]^0}{\mathrm{NP}: y}\,{\Uparrow}\mathrm{E}^1}{\mathrm{NP}\backslash\mathrm{S}: \mathbf{read}(y)}\,/\mathrm{E}}{\mathrm{NP}\backslash\mathrm{S}: \mathbf{has}(\mathbf{read}(y))}\,/\mathrm{E}}{\mathrm{S}: \mathbf{has}(\mathbf{read}(y))(\mathbf{j})}\,\backslash\mathrm{E}}{\mathrm{S}: T(\lambda y.\ \mathbf{has}(\mathbf{read}(y))(\mathbf{j}))}\,1}{\dfrac{\mathrm{S}_y: T(\lambda y.\ \mathbf{has}(\mathbf{read}(y))(\mathbf{j}))}{\mathrm{S}_y{\uparrow}\mathrm{NP}{\Uparrow}\mathrm{S}: \lambda T.\ T(\lambda y.\ \mathbf{has}(\mathbf{read}(y))(\mathbf{j}))}\,{\uparrow}\mathrm{I}^0}\,/\mathrm{E}
$$

As for the internal composition of *combien de livres*, let us again follow Carpenter (1997) in assuming that *wh*-questions are of category $\mathrm{S}_{wh.}$. Then the *wh*-determiner *combien* can be analyzed as a function from (prepositionally marked) common nouns to functions, which map an S_y in which a generalized quantifier $\mathrm{NP}\Uparrow\mathrm{S}$ is missing to an S_{wh}. The semantics can then simply follow suit, as indicated in (2.4b) where D indicates that *de livres* $|$ N_{de}: **book** is a derivable sequent in our grammar.

2.4b

$$
\dfrac{\dfrac{combien}{(\mathrm{S}_{wh}/\mathrm{S}_y{\uparrow}\mathrm{NP}{\Uparrow}\mathrm{S})/\mathrm{N}_{de}: \lambda P \lambda F \lambda Q^2\ 0\ \mathrm{Card.}\ F(Q^2(P))}\,\mathrm{Lx}
\quad
\dfrac{de\ livres}{\mathrm{N}_{de}: \mathbf{book}}\,\mathrm{D}}{\mathrm{S}_{wh}/\mathrm{S}_y{\uparrow}\mathrm{NP}{\Uparrow}\mathrm{S}: \lambda F \lambda Q^2\ 0\ \mathrm{Card.}\ F(Q^2(\mathbf{book}))}\,/\mathrm{E}
$$

It is easy to see that the result category in (2.4b) will then combine with the result category in (2.4a) to produce an S_{wh} with the semantics represented in (2.2b) above, as desired.

Finally, we will assume that the remnant of *combien*-extraction denotes a restricted existential quantifier which takes narrowest scope. This assumption receives some support from observations such as (2.5a), which

Obenauer (1984/85) analyzed as involving QAD licensed by negation.[5] The only interpretation (2.5a) can receive is the one represented in (2.5b), where **some**(**book**) scopes under **not**.

2.5a	Max n'	a	pas vendu	de livres
	Max neg	*has*	*not sold*	*of books*
2.5b	**not**(**some**(**book**)(λy. **has**(**sold**(y))(**m**)))			

We could derive the obligatory narrowest scope reading of the remnant by stipulating that a verb can only combine with a prepositionally marked noun phrase after the syntactic and semantic type of the relevant argument position has been raised. In the case at hand, our grammar should derive *vendu* | (NP\S)/NP⇑S: $\lambda T \lambda x.\ T(\lambda y.$ **sold**$(y)(x))$ from *vendu* | (NP\S)/NP: **sold**, which it does through a combination of hypothetical reasoning and ⇑-elimination (cf. Carpenter 1997). But this obviously raises the question why a verb should not be able to directly combine with the remnant through ⇑E and Modus Ponens in a manner similar to what we saw in (2.4a), thus allowing the remnant to scope out. It seems natural to relate the fact that subextraction of *combien* bleeds scoping out the remnant to another well-known fact: overt displacement of the remnant blocks QAD, as in (2.6).

2.6a	Combien	est-ce qu'	il est	arrivé	de livres?
	how many	*is-it that*	*it is*	*arrived*	*of books*
2.6b	*Combien	est-ce que	de livres	sont	arrivés?
	how many	*is-it that*	*of books*	*are*	*arrived*

I suspect that the suggested analogy between the obligatory narrowest scope reading of the remnant in (2.5) and the contrast in (2.6) can be fruitfully probed in a multi-modal setting. Here, both extraction and quantifier scope can be analyzed in terms of similar, more primitive modes of composition, that can be controlled by various modal operators (cf. Morrill 1994, Moortgat 1997). A detailed exploration of these issues must be left for another occasion, however.

We conclude this section by noting an apparent conflict between our claim that the remnant of *combien*-extraction denotes a restricted existential quantifier, and our analysis in (2.4b) where the same type of expression is

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[5] Note that *Max a vendu de livres* is ungrammatical in French. It seems hard to analyze cases such as (2.5a) as involving actual movement, as *ne de livres* or *pas de livres* is ill-formed. I must leave it to future research whether the analysis of QAD developed below can be extended to these constructions as well.

taken to be a common noun, restricting the range of *combien*. This conflict will be resolved in the next section.

3 Dynamic quantification at a distance

Since our analysis of QAD will draw on some elementary principles of Dynamic Semantics, a compositional variant of Discourse Representation Theory (cf. Groenendijk & Stokhof 1989, 1991; Dekker 1993; Chierchia 1995), let us first briefly discuss these, only in so far as they bear on what is to follow. For our purposes, it suffices to look at Dynamic Semantics as a higher-order logic which includes the constant $\mathbf{some}^d$, subsequently referred to as 'dynamic existential quantifier'. It shares its semantics with two-place **some**, sending two properties to True just in case they have a non-empty intersection, but differs from it in its logical syntax in that it validates the so-called 'donkey equivalence' in (3.1).[6] Simply put, $\mathbf{some}^d$ is like **some** except that it can extend its semantic scope indefinitely to the right, regardless of whether the so-called 'discourse marker' *d* occurs free in Φ.

3.1 $\mathbf{some}^d(P)(Q) \vee \Phi \Leftrightarrow \mathbf{some}^d(P)(\lambda d.\ Q(d) \vee \Phi)$

Suppose that an indefinite such as *a*^{d} *man* translates into the restricted dynamic existential quantifier $\mathbf{some}^d(\mathbf{man})$. Suppose furthermore that a sequence of sentences S_1. S_2. … S_n amounts to Boolean conjunction $\Phi_1 \vee \Phi_2 \vee \ldots \vee \Phi_n$. Then (3.1) immediately suggests a compositional account of simple cases of discourse anaphora, such as the one illustrated in (3.2a).

3.2a John bought a^d book. It$_d$ was expensive.
3.2b John bought a^d book that was expensive

On the intended co-reference reading, its truth-conditions are identical to those of (3.2b). Given the above assumptions, it is a routine exercise to show that (3.2a) can be compositionally translated into $\mathbf{some}^d(\mathbf{book})(\lambda x.\ \mathbf{bought}(x)(\mathbf{j})) \vee \mathbf{expensive}(d)$. Thanks to (3.1), we know that this is logically equivalent with $\mathbf{some}^d(\mathbf{book})(\lambda d.\ \mathbf{bought}(d)(\mathbf{j}) \vee \mathbf{expensive}(d))$, which captures the truth-conditions of (3.2b).

6 For the sake of simplicity, we will assume here that the cardinal determiner $\mathbf{some}^d$ can simultaneously act as a one- and two-place determiner. A suitable version of the donkey-equivalence in (3.1) will then carry over to one-place $\mathbf{some}^d$; i.e. $\mathbf{some}^d(P) \vee \Phi \Leftrightarrow \mathbf{some}^d(\lambda d.\ P(d) \vee \Phi)$.

In Dynamic Semantics, it is assumed that the semantics of indefinites such as *a man* is uniformly represented in terms of dynamic existential quantification. But what about such cases as (3.3a), which have been argued by many to have a reading that can be represented as in (3.3b)? Apparently, indefinites must be allowed at times to act as restricted variables as well.

3.3a Usually, if John buys a book, he reads it
3.3b **most**(λ*x*. **book**(*x*) ∨ **buys**(*x*)(**j**))(λ*x*. **reads**(*x*)(**j**))

Dekker (1993) has shown that even while granting the point that indefinites can be 'unselectively' bound by other operators in the sense of Lewis (1975), we need not succumb to the conclusion that indefinites are ambiguous between quantificational and bound-variable readings. He observes that the open-ended nature of dynamic existential quantification, made explicit in (3.1) above, can be exploited to type-shift a proposition into a property-denoting expression. Dekker appropriately coined this type-shifting operation 'Existential Disclosure' (ED). For the case at hand, its mechanics can be illustrated as follows. ED conjoins *John buys* a^d *book* with the identity-statement it_d *is identical to x*, where the variable *x* is bound by a λ that takes scope over the entire expression. The result of this process is given in (3.4a). Since a^d *book* can antecede discourse anaphora, it follows that (3.4a) is equivalent to (3.4b). Finally, some elementary reasoning reveals that the set of objects characterized in (3.4b) is identical to the set of objects characterized in (3.4c). Note that (3.4c) paraphrases the first argument of **most** in (3.3b).[7]

3.4a λ*x*. John buys a^d book. It_d is identical to *x*
3.4b λ*x*. John buys a^d book that is identical to *x*
3.4c λ*x*. *x* is a book and John buys *x*

ED seems well suited for solving the problem mentioned at the end of the previous section. We can now treat the remnant of *combien*-extraction as a restricted dynamic existential quantifier, while at the same time ensuring it can properly restrict the range of the *wh*-determiner. All we need to do

[7] Dekker's ED bears some resemblance to Partee's (1987) BE, where BE = λ*T*λ*x*. *T*(λ*y*. *x* = *y*). For example, BE(**some**(**book**)) ≡ λ*x*. **some**(**book**)(λ*y*. *x* = *y*) ≡ **book**. However, BE cannot replace ED in our account of (3.3), unless we are prepared to stipulate some hefty additional combinatorics which would enable us to compose **buys** (type +e,+e,t,,) with **book** (type +e,t,) into λ*y*λ*x*. **book**(*y*) ∨ **buys**(*y*)(*x*). The latter could then be function composed with λ*P*. *P*(**j**) to produce the desired λ*y*. **book**(*y*) ∨ **buys**(*y*)(**j**). Thanks to Anna Szabolcsi for discussion of this point.

is type-lift Dekker's original formulation of ED as in (3.5), where x does not occur free in Φ. We will henceforth refer to the operation defined in (3.5) as Lifted ED, or LED for short.

3.5 $\Lambda d.\ \Phi =_{def} \lambda T.\ T(\lambda x.\ \Phi \vee d = x)$

We will now show how we can derive the proper semantics for (3.6a), as represented in (3.6b), in terms of LED in a way that is consistent with the assumptions laid out in section 2.

3.6a	Combien	est-ce que	Jean a	lu	de livres
	how many	*is-it that*	*Jean has*	*read*	*of books*

3.6b $\lambda Q^1\ 0\ \text{Card}.\ Q^1(\lambda x.\ \mathbf{book}(x) \vee \mathbf{has}(\mathbf{read}(x))(\mathbf{j}))$

Let us first define a new type constructor !, which we will call 'dynamic extraction constructor': if A and B are categories, then $A!B$ is a category. Its semantic type is the expected one; i.e. Type($A!B$) = +Type(B), Type(A), (but cf. footnote 3). We will furthermore assume the following introduction rule for !, which is syntactically identical in all relevant respects to the introduction rule for the extraction constructor $\uparrow$, though semantically diverges from the latter in non-trivial respects.[8]

3.7 DYNAMIC EXTRACTION INTRODUCTION

$$\dfrac{\dfrac{\begin{matrix} ! & [B: \mathbf{some}^d]^n & ! \\ ! & ! & ! \end{matrix}}{A: \alpha}}{A!B: \Lambda d.\ \alpha}\ !\mathrm{I}^n$$

Turning now to (3.6), observe first that we can derive the sequent in (3.8a) in a way similar to (2.4a) by hypothesizing an $(\mathrm{NP}\Uparrow\mathrm{S})/\mathrm{N}_{de}$ e with semantics $\mathbf{some}^d$ to the immediate left of *de livres*, bearing in mind our discussion surrounding (2.5). Then, by discharging this hypothesis through !I, we obtain the sequent in (3.8b). Its λ-term can be simplified as follows: $\Lambda d.\ \mathbf{some}^d(\mathbf{book})(\lambda y.\ \mathbf{has}(\mathbf{read}(y))(\mathbf{j})) \equiv$ (def. 3.5) $\lambda T.\ T(\lambda x.\ \mathbf{some}^d(\mathbf{book})(\lambda y.\ \mathbf{has}(\mathbf{read}(y))(\mathbf{j})) \vee x = d) \equiv$ (cf. 3.1) $\lambda T.\ T(\lambda x.\ \mathbf{some}^d(\mathbf{book})(\lambda d.\ \mathbf{has}(\mathbf{read}$

[8] Pending a more serious analysis, (3.7) should for now be taken with some grain of salt; cf. footnote 4. It has only been included here for the sake of being explicit.

$(d))(\mathbf{j}) \vee x = d)) \equiv$ (elementary logic) $\lambda T.\ T(\lambda x.\ \mathbf{book}(x) \vee \mathbf{has}(\mathbf{read}(x))(\mathbf{j}))$.

3.8a *est-ce que Jean a lu e de livres* |
$\quad S_y$: $\mathbf{some}^d(\mathbf{book})(\lambda y.\ \mathbf{has}(\mathbf{read}(y))(\mathbf{j}))$
3.8b *est-ce que Jean a lu de livres* |
$\quad S_y!(NP{\Uparrow}S)/N_{de}$: $\Lambda d.\ \mathbf{some}^d(\mathbf{book})(\lambda y.\ \mathbf{has}(\mathbf{read}(y))(\mathbf{j}))$
3.8c *combien est-ce que Jean a lu de livres* |
$\quad S_{wh}$: $\lambda Q^1\ 0\ \text{Card}.\ Q^1(\lambda x.\ \mathbf{book}(x) \vee \mathbf{has}(\mathbf{read}(x))(\mathbf{j}))$

Finally, suppose subextracted *combien* has the following lexical entry: *combien* | $S_{wh}/(S_y!(NP{\Uparrow}S)/N_{de})$: $\lambda F \lambda Q^1\ 0\ \text{Card}.\ F(Q^1)$. The sequent in (3.8c) can then simply be derived through /E. Note that $\lambda F \lambda Q^1\ 0\ \text{Card}.\ F(Q^1)(\lambda T.\ T(\lambda x.\ \mathbf{book}(x) \vee \mathbf{has}(\mathbf{read}(x))(\mathbf{j}))) \equiv \lambda Q^1\ 0\ \text{Card}.\ Q^1(\lambda x.\ \mathbf{book}(x) \vee \mathbf{has}(\mathbf{read}(x))(\mathbf{j}))$ (= 3.6b) through two applications of λ-conversion.

4 Inaccessibility and the Scope Hypothesis

Our account of QAD in terms of dynamic extraction makes one important prediction. Take a look again at (3.4). For LED to produce a semantically coherent reading on which the remnant restricts the range of *combien*, it is essential that the restricted dynamic existential quantifier corresponding to the remnant is still 'dynamically active'. That is, it must be able to bind the pronoun it^d in the identity statement it^d *is identical to x* introduced by LED. However, it is well known there are a number of environments that impair the ability of indefinites to antecede discourse anaphora. This phenomenon is referred to as 'inaccessibility', and is illustrated in (4.1). The judgments concern readings on which the indefinite takes narrowest scope.

4.1a *John didn't buy a^d book on algebra. It_d was difficult.
4.1b *Nobody bought a^d book on algebra. It_d was difficult.
4.1c *Everybody bought a^d book on algebra. It_d was difficult.
4.1d *John often bought a^d book on algebra. It_d was difficult.

Recall that we had already established in section 2 that the remnant of QAD takes narrowest scope. We therefore predict that *combien* cannot be dynamically extracted across an inaccessible domain for discourse anaphora on pains of semantic incoherence, provided the operator *O* that creates the inaccessible domain does not take scope over the *wh*-determiner. As for the latter provision, note that if *O* does take scope over *combien*, both the 'indefinite' remnant as well as it^d in the identity statement it^d *is identical to x* reside in *O*'s scope. No problem is expected to arise in such a situation, as for example *Nobody said that John bought a*^{d} *book on algebra and that it*$_{d}$ *was difficult* is entirely acceptable.

Thus, in the light of (4.1a-b), we immediately explain the WI effects on QAD induced by negation and negative universals, as observed in (1.2) and (1.3). Furthermore, (4.1c-d) lead us to expect that universals and Q-adverbs of the *often*-type block QAD as well just in case they scope below *combien*. If any one of these two types of expressions can scope above this *wh*-determiner, thus giving rise to the so-called 'pair-list reading, QAD is expected to be fine only on that reading. These predictions are indeed borne out, as shown in (4.2) and (4.3). The observation in (4.2) has been taken over from de Swart (1992), and the one in (4.3) from Obenauer (1984/85). As for (4.3), de Swart had already observed that *beaucoup* cannot induce pair-list readings.

4.2	Combien	ont-ils	tous	lu	de livres?
	how many	*have-they*	*all*	*read*	*of books*
a	WH ,, SU:	*What is the number *n* such that they all read *n*-many books?			
b	SU ,, WH:	For every one of them, what is the number *n* such that he/she read *n*-many books?			

4.3	*Combien	as-tu	beaucoup	lu	de livres?
	how many	*have-you*	*often*	*read*	*of books*

In general, even though space precludes me from showing this on a case by case basis, all WI effects attending QAD that de Swart accounts for in terms of her Scope Hypothesis fall out rather naturally from our dynamic approach as well.[9] This is not accidental. The Scope Hypothesis directly inspires the intuition behind the present account that QAD's sensitivity to intervention effects evidences a violation of some notion of semantic locality. In fact, our dynamic account should be viewed as an attempt to derive de Swart's Scope Hypothesis from independently motivated principles of Dynamic Semantics, viz. those that account for inaccessibility. Unfortunately, due to reasons of space, we cannot discuss these principles in any detail here. The point of this paper is just to show that such a reduction is possible. The interested reader is referred to Chierchia (1995) for an accessible and in-depth discussion of the basic principles of Dynamic Semantics.

[9] Cf. Honcoop (1998) for a much more detailed empirical discussion in the context of the *wat voor*-split construction in Dutch, which is addressed in de Swart (1992) as well.

5 Concluding remarks

De Swart (1992) also inspired Szabolcsi & Zwarts's (1993; henceforth: Sz&Z) algebraic semantic approach to WIs in general. Not surprisingly then, Sz&Z too discuss QAD. Their position on *combien*-extraction and its sensitivity to WIs can be summarized as follows. Firstly, they argue that *how many*-phrases in general are ambiguous between a so-called 'individual' and an 'amount' reading. The two readings are most easily discerned in intensional contexts:

5.1	How many books should John read?	
a	INDIVIDUAL:	For what number *n*, there are *n*-many books that John should read?
b	AMOUNT:	For what number *n*/amount, John should read *n*-many/that amount of books?

5.2 Combien de circles as-tu dessiné? (*INDIVIDUAL, AMOUNT)
how many of circles have-you drawn

Secondly, Sz&Z claim that on its amount construal, a *how many*-phrase cannot scope over an expression which creates a WI (cf. 5.3-5.4), since the algebraic structure into which amounts are assembled is not closed under one of the Boolean operations with which the harmful intervener is associated. Note that the contrast between (5.2) and (5.4) was already observed by Sz&Z.

5.3	How many books should no student read?	
a	INDIVIDUAL:	For what number *n*, there are *n*-many books that no student should read?
b	AMOUNT:	*For what number *n*/amount, no student should read *n*-many/that amount of books?

5.4	*Combien de circles	as-tu	beaucoup	dessiné?
	how many circles	*have-you*	*a lot*	*drawn*

Finally, Sz&Z assume that *combien*-extraction unambiguously invokes the amount reading. In the light of the two preceding claims, it then follows that QAD is impossible across WIs.

To my mind, it cannot be a coincidence that amount readings are most easily elucidated in modal/intensional contexts. Let us then follow Cresti (1995), and explore the consequences of the assumption that Sz&Z's distinction between individual and amount readings just amounts to a distinction between wide and narrow scope readings respectively of the *n-many N* part of a *how many*-phrase *vis à vis* some intensional or modal operator.[10] Thus, we propose to represent the 'amount reading' in (5.1b) as in (5.5), keeping our semantics fully extensional for ease of exposition. Consistent with this proposal, we could then argue that (5.2) does not admit of a reading where Q^2(**circle**) scopes above **drawn** on account of the fact that **circle** denotes the empty set in worlds other than those created by the act of drawing.

5.5 λQ^2 0 Card. **should**(Q^2(**book**)(λx. **read**(x)(**j**))) (cf. 5.1b)

It is tempting to extend our dynamic extraction approach to QAD to *how many*-interrogatives in general so as to account for the effects noted in (5.1-5.4) as well. Let us see what this entails for the contrast noted between (5.1) and (5.3) above. By hypothesizing an NP⇑S with semantics **some**^{d} right adjacent to *read*, we can derive the sequent in (5.6a) the last step of which involves discharging the hypothesis through !I. The mechanics involved is essentially identical to what we saw in (2.4a), except that ↑I has been replaced by !I. Suppose furthermore that *how many* is a complex *wh*-determiner with the lexical entry *how many* | (S_{wh}/S_y!NP⇑S)/N: $\lambda P \lambda F \lambda Q^2$ 0 Card. $F(Q^2(P))$; a similar entry will replace our earlier analysis of *combien* (cf. 2.4b) in order to account for (5.2) and (5.4). Then (5.6b) is obtained through two applications of /E and a number of λ-conversion steps. Note that the semantics represented in (5.6b) accords with our scopal reassessment of the 'individual reading' paraphrased in (5.3a).

5.6a *should no student read* |
S_y!NP⇑S: $\lambda T.\ T(\lambda y.$ **no**(**student**)(λx. **should**(**read**(y)(x))))

5.6b *how many books should no student read* |
λQ^2 0 Card. Q^2(**book**)(λy. **no** (**student**)(λx. **should**(**read**(y)(x))))

This analysis immediately predicts why the 'amount reading', on which *n many N* takes narrow scope with respect to the modal auxiliary *should*, is missing in (5.3) but present in (5.1).[11] If the hypothetical **some**^{d} remains

[10] Even though we will not follow Cresti (1995) in her account of the WI effects attending *how many*-interrogatives. For relevant discussion of her proposals, cf. Honcoop (1998).

[11] The reader might wonder how the narrow scope reading of *n many N* in (5.1) and (5.2) can be obtained on our approach, as it is well-known that intensional operators create inaccessible domains for discourse anaphora. Cf. Honcoop (1997,1998) for an intensional version of ED which does permit dynamic extraction out of a modal/intensional domain. This could then be type-lifted to an intensional version of LED so as to eliminate the aforementioned problem.

inside the scope of **no**(**student**), LED will be prevented from producing a semantically coherent reading, as *no student* induces an inaccessible domain for discourse anaphora. The same analysis carries over to account for the contrast between (5.2) and (5.4) as well.

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