Structured Anaphora to Quantifier Domains

A Unified Account of Quantificational and Modal Subordination and Exceptional Wide Scope

Adrian Brasoveanu*

Stanford University

Abstract. The paper proposes a novel analysis of quantificational subordination, e.g. *Harvey courts a woman at every convention.* {*She is very pretty.* vs. *She always comes to the banquet with him.*} (Karttunen 1976), in particular of the fact that the indefinite in the initial sentence can have wide or narrow scope, but the first discourse as a whole allows only for the wide scope reading, while the second discourse allows for both readings. The cross-sentential interaction between scope and anaphora is captured in terms of structured anaphora to quantifier domains, formalized in a new dynamic system couched in classical type logic; given the underlying type logic, Montague-style compositionality at sub-clausal level follows automatically. Modal subordination (Roberts 1987) is analyzed in a parallel way, thereby capturing the parallels between the individual and modal domains argued for in Stone (1999). Several other phenomena are analyzed in terms of structured anaphora: exceptional wide scope, weak / strong donkey readings, anaphoric / uniqueness-implying definite descriptions and interactions between *same* / *different* and quantifier scope.

1 Introduction: Quantificational Subordination

The present paper proposes a novel account of the contrast between the interpretations of the discourses in (1) and (2) below based on Karttunen (1976) (the superscripts and subscripts indicate the antecedent-anaphor relations).

1. **a.** Harvey courts a^u woman at every convention. **b.** She$_u$ is very pretty.
2. **a.** Harvey courts a^u woman at every convention. **b.** She$_u$ always comes to the banquet with him. [**c.** The$_u$ woman is usually also very pretty.]

Sentence (1a/2a) by itself is ambiguous between two quantifier scopings: it "can mean that, at every convention, there is some woman that Harvey courts or that there is some woman that Harvey courts at every convention. [...] Harvey always courts the same [woman] [...] [or] it may be a different [woman] each time" (Karttunen 1976: 377). The contrast between the continuations in (1b) and (2b) is that the former allows only for the 'same woman' reading of sentence (1a/2a), while the latter is also compatible with the 'possibly different women' reading.

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Discourse (1) raises the following question: how can we capture the fact that a *singular anaphoric pronoun* in sentence (1b) can interact with and disambiguate *quantifier scopings*[1] in sentence (1a)? That number morphology on the pronoun she_u is crucial is shown by the discourse in (3) below, where the (preferred) relative scoping of *every convention* and a^u *woman* is the opposite of the one in discourse (1).

3. **a.** Harvey courts a^u woman at every convention. **b.** $They_u$ are very pretty.

Discourse (2) raises the following questions. First, why is it that adding an adverb of quantification, i.e. *always*/*usually*, makes both readings of sentence (2a) available? Moreover, on the newly available reading of sentence (2a), i.e. the *every convention*>>a^u *woman* scoping, how can we capture the intuition that the singular pronoun she_u and the adverb *always* in sentence (2b) elaborate on the quantificational dependency between conventions and women introduced in sentence (2a), i.e. how can we capture the intuition that we seem to have simultaneous anaphora to the two quantifier domains and to the quantificational dependency between them?

The phenomenon instantiated by discourses (1) and (2) is subsumed under the more general label of *quantificational subordination* (see Heim 1990: 139, (2)), which covers a variety of phenomena involving interactions between generalized quantifiers and morphologically singular cross-sentential anaphora.

The main goal of this paper is give an account of quantificational subordination couched within a new compositional dynamic system which straightforwardly generalizes to an account of modal subordination, thereby capturing the anaphoric and quantificational parallels between the individual and modal domains argued for in Stone (1999), Bittner (2001), Schlenker (2005), Frank (1996) and Geurts (1999) among others (building on Partee 1973, 1984). The very same system accounts for a variety of empirically unrelated phenomena: exceptional wide scope indefinites, weak vs. strong donkey readings, the (variable nature of the) uniqueness effects associated with singular anaphora, anaphoric vs. Russellian (i.e. non-anaphoric, uniqueness-implying) uses of definite descriptions and the interaction between the adjectives *same* and *different* and quantifier scope.

2 Plural Compositional DRT (PCDRT)

This section introduces the semantic framework in which the analysis of discourses (1) and (2) is couched. The main proposal is that (compositionally) assigning natural language expressions finer-grained semantic values (finer grained than the usual meanings assigned in static Montague semantics) enables us to capture the interaction between generalized quantifiers, singular pronouns and adverbs of quantification exhibited by the contrast between (1) and (2).

Accounting for *cross-sentential* phenomena in semantic terms (as opposed to purely / primarily pragmatic terms) requires some preliminary justification. First, the same kind of finer-grained semantic values (to be introduced presently) are independently motivated by intra-sentential phenomena (see the account of mixed weak & strong donkey sentences in Brasoveanu 2007a).

Second, the phenomenon instantiated by (1) and (2) is as much intra-sentential (hence part of the recursive definition of truth and satisfaction, i.e. a semantics matter) as it is cross-sentential: there are four separate components that come together to yield the contrast in interpretation between (1)

[1] To see that it is indeed quantifier scopings that are disambiguated, substitute *exactly* one^u *woman* for a^u *woman* in (1a); this yields two truth-conditionally independent scopings: (*i*) *exactly* one^u *woman*>>*every convention*, which is true in a situation in which Harvey courts more than one woman per convention, but there is exactly one (e.g. Faye Dunaway) that he never fails to court, and (*ii*) *every convention*>>*exactly* one^u *woman*.

and (2), namely (i) the generalized quantifier *every convention*, (ii) the indefinite a^u *woman*, (iii) the singular number morphology on the pronoun she_u and (iv) the adverb of quantification *always/usually*. To derive the intuitively correct interpretations for (1) and (2), we have to attend to both the cross-sentential connections a^u *woman–*she_u and *every convention–always/usually* and the intra-sentential interactions *every convention–*a^u *woman* and *always –*she_u.

I conclude that an account of the contrast between (1) and (2) that involves a revamping of semantic values has sufficient initial plausibility to make its pursuit worthwhile. To this end, I introduce a new dynamic system couched in classical (many-sorted) type logic which extends Compositional DRT (CDRT, Muskens 1996) in two ways: (i) with plural information states and (ii) with selective generalized quantification. The resulting system is dubbed Plural CDRT (PCDRT).

2.1 Plural Information States

The main technical innovation relative to CDRT is that, just as in Dynamic Plural Logic (van den Berg 1996), information states I, J etc. are modeled as *sets* of variable assignments i, j etc.; such *plural* info states can be represented as matrices with assignments (sequences) as rows, as shown below.

<table>
<tr><th>Info State I</th><th>...</th><th>u</th><th>u'</th><th>...</th></tr>
<tr><td>i_1</td><td>...</td><td>α_1 (i.e. ui_1)</td><td>β_1 (i.e. $u'i_1$)</td><td>...</td></tr>
<tr><td>i_2</td><td>...</td><td>α_2 (i.e. ui_2)</td><td>β_2 (i.e. $u'i_2$)</td><td>...</td></tr>
<tr><td>i_3</td><td>...</td><td>α_3 (i.e. ui_3)</td><td>β_3 (i.e. $u'i_3$)</td><td>...</td></tr>
<tr><td>...</td><td>...</td><td>...</td><td>...</td><td>...</td></tr>
<tr><td colspan="2">Quantifier domains (sets) are stored columnwise: $\{\alpha_1, \alpha_2, \alpha_3, \dots\}$, $\{\beta_1, \beta_2, \beta_3, \dots\}$</td><td colspan="3">Quantifier dependencies (relations) are stored rowwise: $\{(\alpha_1, \beta_1), (\alpha_2, \beta_2), (\alpha_3, \beta_3), \dots\}$</td></tr>
</table>

Plural info states enable us to encode discourse reference to both quantifier domains, i.e. *values*, and quantificational dependencies, i.e. *structure*. The values are the sets of objects that are stored in the columns of the matrix, e.g. a discourse referent (dref) u for individuals stores a set of individuals $\{\alpha_1, \alpha_2, \alpha_3, \dots\}$ relative to a plural info state given that u is assigned an individual by each assignment/row. The structure is encoded in the rows of the matrix: for each assignment/row in the info state, the individual assigned to a dref u by that assignment is structurally correlated with the individual assigned to some other dref u' by the same assignment.

2.2 Outline of the Account: Plural Info States and Structured Anaphora

Thus, plural info states enable us to pass information about both quantifier domains and quantificational dependencies across sentential / clausal boundaries, which is exactly what we need to account for the interpretation of discourses (1) and (2). More precisely, we need the following two ingredients.

First, we need a suitable meaning for generalized determiners that will store two things in the input plural info state: (i) the restrictor and nuclear scope sets of individuals that are introduced and related by the determiner; (ii) the quantificational dependencies between the individuals in the restrictor/nuclear scope set and any other quantifiers/indefinites in the restrictor/nuclear scope of the quantification, e.g. between *every convention* in (1a/2a) and the indefinite a^u *woman* in its nuclear scope. Given that plural info states store both sets of individuals and dependencies between them, both kinds of information are available for subsequent anaphoric retrieval; for example, *always* and she_u

in (2b) are simultaneously anaphoric to both the sets of conventions and women and the dependency between these sets introduced in (2a).

The second ingredient is a suitable meaning for singular number morphology on pronouns like she_u in (1b) and (2b) above. This meaning has to derive the observed interactions between (*i*) singular pronouns, (*ii*) quantifiers and indefinites in the previous discourse, e.g. *every convention* and a^u *woman* in (1a/2a), and (*iii*) quantifiers in the same sentence, e.g. the adverb *always* in (2b). In particular, I will take singular number morphology on she_u to require the set of u-individuals stored by the current plural info state to be a singleton. The set of u-individuals is introduced by the indefinite a^u *woman* and is available for anaphoric retrieval irrespective of whether the indefinite has wide or narrow scope in sentence (1a/2a). Thus, plural info states are yet again crucial for the analysis: they enable us to store and pass on structured sets of individuals, so that we can constrain their cardinality by subsequent, syntactically non-local anaphoric elements.

If the indefinite a^u *woman* has narrow scope relative to *every convention*, the singleton requirement contributed by she_u applies to the set of all women that are courted by Harvey at some convention or other. Requiring this set to be a singleton boils down to discarding all the plural info states that would satisfy the narrow-scope indefinite reading *every convention*>>a^u *woman*, but not the wide-scope reading a^u *woman*>>*every convention*. We therefore derive the intuition that, irrespective of which quantifier scoping we assume for sentence (1a), any plural info state that we obtain after a successful update with sentence (1b) is bound to satisfy the representation in which the indefinite a^u *woman* (or a quantifier like *exactly* one^u *woman*) takes wide scope.

In discourse (2), however, the adverb of quantification *always* in (2b), which is anaphoric to the nuclear scope set introduced by *every convention* in (2a), can take scope either below or above the singular pronoun she_u. If *always* takes scope below she_u, we obtain the same reading as in discourse (1). But if *always* takes scope above she_u, it 'breaks' the input plural info state, which stores all the conventions, into smaller sub-states, each storing a particular convention. Consequently, the singleton requirement contributed by she_u is enforced locally, relative to each of these sub-states, and not globally, relative to the whole input info state, and we end up requiring the courted woman to be unique *per convention* and not across the board.

The remainder of this section presents the basics of the compositional dynamic system, while Sect. 3 introduces the PCDRT meanings for selective generalized determiners, indefinites and singular/plural pronouns.

2.3 DRS's and Conditions in PCDRT

We work with a Dynamic Ty2 logic, i.e. with the Logic of Change in Muskens (1996) which reformulates dynamic semantics (Kamp 1981, Heim 1982) in Gallin's Ty2 (Gallin 1975). We have three basic types: type t (truth-values), type e (individuals; variables: x, x' etc.) and type s ('variable assignments'; variables: i, j etc.). A suitable set of axioms ensures that the entities of type s do behave as variable assignments[2].

A dref for individuals u is a function of type se from 'assignments' i_s to individuals x_e (the subscripts on terms indicate their type). Intuitively, the individual $u_{se}i_s$ is the individual that the 'assignment' i assigns to the dref u. Dynamic info states I, J etc. are plural: they are sets of 'variable assignments', i.e. terms of type st. An individual dref u stores a set of individuals with respect to a plural info state I, abbreviated as $uI \stackrel{\text{def}}{=} \{u_{se}i_s : i_s \in I_{st}\}$, i.e. uI is the image of the set of 'assignments' I under the function u.

[2] See Muskens (1996) for more details.

A sentence is interpreted as a Discourse Representation Structure (DRS), which is a relation of type $(st)((st)t)$ between an input state I_{st} and an output state J_{st}, as shown in (4) below. A DRS requires: (i) the input info state I to differ from the output state J at most with respect to the **new dref's** and (ii) all the **conditions** to be satisfied relative to the output state J. The definition of dref introduction (a.k.a. random assignment) is given in (5) below[3].

4. $[\textbf{new dref's} \,|\, \textbf{conditions}] \overset{\text{def}}{=} \lambda I_{st}.\lambda J_{st}.\ I[\textbf{new dref's}]J \wedge \textbf{conditions}J$
5. $[u] \overset{\text{def}}{=} \lambda I_{st}.\lambda J_{st}.\ \forall i_s \in I(\exists j_s \in J(i[u]j)) \wedge \forall j_s \in J(\exists i_s \in I(i[u]j))$

For example, the DRS $[u_1, u_2|woman\{u_1\}, convention\{u_2\}, courted\_at\{u_1, u_2\}]$ abbreviates the term $\lambda I_{st}.\lambda J_{st}.\ I[u_1, u_2]J \wedge woman\{u_1\}J \wedge convention\{u_2\}J \wedge courted\_at\{u_1, u_2\}J$. DRS's of the form $[\textbf{conditions}] \overset{\text{def}}{=} \lambda I_{st}.\lambda J_{st}.\ I = J \wedge \textbf{conditions}J$ are *tests*, e.g. $[woman\{u_1\}] \overset{\text{def}}{=} \lambda I_{st}.\lambda J_{st}.\ I = J \wedge woman\{u_1\}J$ tests that the input state I satisfies the condition $woman\{u_1\}$.

Conditions denote sets of info states, i.e. they are terms of type $(st)t$, and they are interpreted *distributively* relative to a plural info state, e.g. $courted\_at\{u_1, u_2\}$ is basically the term $\lambda I_{st}.\ I \neq \emptyset \wedge \forall i_s \in I(courted\_at(u_1 i, u_2 i))$, where $courted\_at$ is a static relation between individuals of type $e(et)$; see Subsect. 3.1 below for the general definition of atomic conditions.

2.4 Compositionality

Given the underlying type logic, compositionality at sub-clausal level follows automatically and standard techniques from Montague semantics (e.g. type shifting) become available. In more detail, the compositional aspect of interpretation in an extensional Fregean / Montagovian framework is largely determined by the types for the (extensions of the) 'saturated' expressions, i.e. names and sentences. Abbreviate them as **e** and **t**. An extensional static logic identifies **e** with e and **t** with t. The translation of the English noun ***woman*** is of type **et**, i.e. et: ***woman*** $\rightsquigarrow \lambda x_e.\ woman_{et}(x)$. The generalized determiner ***every*** is of type $(\mathbf{et})((\mathbf{et})\mathbf{t})$, i.e. $(et)((et)t)$: ***every*** $\rightsquigarrow \lambda S_{et}.\lambda S'_{et}.\ \forall x_e(S(x) \rightarrow S'(x))$.

PCDRT assigns the following dynamic types to the 'meta-types' **e** and **t**: **t** abbreviates $(st)((st)t)$, i.e. a sentence is interpreted as a DRS, and **e** abbreviates se, i.e. a name is interpreted as a dref. The denotation of the noun ***woman*** is still of type **et**, as shown in (6) below. Moreover, the determiner ***every*** is still of type $(\mathbf{et})((\mathbf{et})\mathbf{t})$ – and its definition is provided in the next section.

6. ***woman*** $\rightsquigarrow \lambda v_{\mathbf{e}}.\ [woman_{et}\{v\}]$, i.e. ***woman*** $\rightsquigarrow \lambda v_{\mathbf{e}}.\lambda I_{st}.\lambda J_{st}.\ I = J \wedge woman_{et}\{v\}J$

3 Generalized Quantification in PCDRT

We turn now to the definition of selective generalized quantification in PCDRT. The definition has to satisfy four desiderata, the first three of which are about anaphoric connections that can be established *internally*, within the generalized quantification, i.e. between antecedents in the restrictor and anaphors in the nuclear scope, and the last of which is about anaphora that can be established *externally*, i.e. between antecedents introduced by/within the quantification and anaphors that are outside the quantification.

Let us begin with quantification-internal anaphora. First, we want our definition to be able to account for the fact that anaphoric connections between the restrictor and the nuclear scope of the

[3] See Brasoveanu (2007a) for its justification.

quantification can in fact be established, i.e. we want to account for donkey anaphora (*Every^u farmer who owns a$^{u'}$ donkey beats it$_{u'}$*).

Second, we want to account for such anaphoric connections while avoiding the proportion problem that *unselective* quantification (in the sense of Lewis (1975)) runs into. That is, we need generalized determiners to relate sets of individuals (i.e. sets of objects of type e) and not sets of 'assignments' (i.e. sets of objects of type s). The sentence *Most^u farmers who own a$^{u'}$ donkey beat it$_{u'}$* provides a typical instance of the proportion problem: intuitively, this sentence is false in a situation in which there are ten farmers, nine have a single donkey each and they do not beat it, while the tenth has twenty donkeys and he is busy beating them all. The unselective interpretation of the *most*-quantification, however, incorrectly predicts that the sentence is true in this situation because more than half of the $(farmer, donkey)$ pairs (twenty out of twenty-nine) are such that the farmer beats the donkey.

The third desideratum is that the definition of selective generalized quantification be compatible with both strong and weak donkey readings: we want to allow for the different interpretations associated with the donkey anaphora in (7) (from Heim 1990) and (8) (from Pelletier & Schubert 1989) below. Sentence (7) is interpreted as asserting that most slave-owners were such that, for *every* (strong reading) slave they owned, they also owned his offspring. Sentence (8) is interpreted as asserting that every dime-owner puts *some* (weak reading) dime of her/his in the meter. For more discussion of weak / strong donkey readings, see Sect. 5.1 below.

7. Most^u people that owned a$^{u'}$ slave also owned his$_{u'}$ offspring.
8. Every^u person who has a$^{u'}$ dime will put it$_{u'}$ in the meter.

The fourth desideratum is concerned with quantification-external anaphora – and this brings us back to discourses (1) and (2). These discourses indicate that we need to make the restrictor and nuclear scope sets of individuals related by generalized determiners available for subsequent anaphora – and we also need to make available for anaphoric take-up the quantificational dependencies between different quantifiers and/or indefinites. In particular, generalized quantification supports anaphora to two sets: (i) the maximal set of individuals satisfying the restrictor DRS, i.e. the *restrictor set*, and (ii) the maximal set of individuals satisfying the restrictor and nuclear scope DRS's, i.e. the *nuclear scope set*[4]. Note that the latter set is the nuclear scope that emerges as a consequence of the conservativity of natural language quantification – and, as van den Berg (1996) (among others) observes, we need to build conservativity into the definition of dynamic quantification to account for the fact that the nuclear scope DRS can contain anaphors dependent on antecedents in the restrictor DRS.

The discourse in (9) below exemplifies anaphora to nuclear scope sets: sentence (9b) is interpreted as asserting that the people that went to the beach are the students that left the party after 5 a.m. (which, in addition, formed a majority of the students at the party). The discourses in (10) and (11) exemplify anaphora to the restrictor sets contributed by the downward monotonic quantifiers *no^u student* and *very few^u people* respectively. Consider (10) first: any successful update with a *no^u* quantification ensures that the nuclear scope set is empty and anaphora to it is therefore infelicitous; the only possible anaphora in (10) is restrictor set anaphora. Restrictor set anaphora is the only possible one in (11) too, because nuclear scope anaphora yields a contradictory interpretation for (11b): most of the people with a rich uncle that inherit his fortune don't inherit his fortune.

9. **a.** Most^u students left the party after 5 a.m. **b.** They$_u$ went directly to the beach.

[4] Throughout the paper, I will ignore anaphora to complement sets, i.e. sets obtained by taking the complement of the nuclear scope relative to the restrictor, e.g. *Very few students were paying attention in class. They were hungover.*

10. **a.** No^u student left the party later than 10 p.m. **b.** They_u had classes early in the morning.
11. **a.** Very few^u people with a rich uncle inherit his fortune. **b.** Most of them_u don't.

Thus, a selective generalized determiner receives the translation in (12) below, which is in the spirit – but rather far from the letter – of van den Berg (1996)[5].

12. $\boldsymbol{det}^{u,u'\sqsubseteq u} \rightsquigarrow \lambda P_{\mathbf{et}}.\lambda P'_{\mathbf{et}}.\ \mathbf{max}^u({}_{\langle u\rangle}(P(u)));\ \mathbf{max}^{u'\sqsubseteq u}({}_{\langle u'\rangle}(P'(u')));\ [\mathbf{DET}\{u,u'\}]$
13. $D; D' \stackrel{\text{def}}{=} \lambda I_{st}.\lambda J_{st}.\ \exists H_{st}(DIH \wedge D'HJ)$, where D, D' are DRS's (type $\mathbf{t}$).

As expected, $\boldsymbol{det}^{u,u'\sqsubseteq u}$ relates a restrictor dynamic property $P_{\mathbf{et}}$ and a nuclear scope dynamic property $P'_{\mathbf{et}}$. When these dynamic properties are applied to individual dref's, i.e. $P(u)$ and $P'(u')$, we obtain a restrictor DRS $P(u)$ and a nuclear scope DRS $P'(u')$ of type $\mathbf{t}$. Moreover, a generalized determiner introduces two individual dref's: u stores the restrictor set and u' the nuclear scope set. These two dref's and the two dynamic properties P and P' are the basic building blocks of the three separate updates in (12).

The first update, namely $\mathbf{max}^u({}_{\langle u\rangle}(P(u)))$, ensures that the restrictor set u is the maximal set of individuals, i.e. $\mathbf{max}^u(\dots)$, such that, when we take each u-individual separately, i.e. ${}_{\langle u\rangle}(\dots)$, this individual satisfies the restrictor dynamic property, i.e. $P(u)$. The second update, namely $\mathbf{max}^{u'\sqsubseteq u}({}_{\langle u'\rangle}(P'(u')))$, ensures that the nuclear scope set u' is obtained in much the same way as the restrictor set u, except for the requirement that u' is the maximal structured subset of u, i.e. $\mathbf{max}^{u'\sqsubseteq u}(\dots)$. Finally, the third update, namely $[\mathbf{DET}\{u,u'\}]$, is a test: we test that the restrictor set u and the nuclear scope set u' stand in the relation denoted by the corresponding static determiner $\mathbf{DET}$. The three distinct updates in (12) are conjoined and, as (13) above shows, dynamic conjunction ";" is interpreted as relation composition. Note the difference between dynamic conjunction, which is an abbreviation, and the official, classical, static conjunction "$\wedge$".

To formally spell out the PCDRT meaning for generalized determiners in (12) above and the meanings for indefinites and pronouns, we need: (*i*) two operators over plural info states, namely a selective maximization operator $\mathbf{max}^u(\dots)$ and a selective distributivity operator ${}_{\langle u\rangle}(\dots)$ and (*ii*) a notion of structured inclusion $u' \sqsubseteq u$ that requires the subset to preserve the quantificational dependencies, i.e. the structure, associated with the individuals in the superset.

3.1 Structured Inclusion

Let us start with the notion of structured subset. Recall that plural info states store both values (in the columns of the matrix) and structure (in the rows of the matrix). Requiring one dref u_3 to simply be a value-subset of another dref u_1 relative to an info state I is defined as shown in (14) below; for example, the leftmost u_3 column in the table below satisfies the condition $u_3 \subseteq u_1$ because $u_3I = \{\alpha_1, \alpha_2, \alpha_3\} \subseteq u_1I = \{\alpha_1, \alpha_2, \alpha_3, \alpha_4\}$. Condition (14) requires only *value inclusion* and disregards structure completely. The correlation between the u_1-individuals and the u_2-individuals, i.e. the relation $\{(\alpha_1, \beta_1), (\alpha_2, \beta_2), (\alpha_3, \beta_3), (\alpha_4, \beta_4)\}$, is lost in going from the u_1-superset to the u_3-subset: as far as u_3 and u_2 are concerned, α_1 is still correlated with β_1, but it is now also correlated with β_3; moreover, α_2 is now correlated with β_4 (not β_2) and α_3 with β_2 (not β_3).

14. $u_3 \subseteq u_1 \stackrel{\text{def}}{=} \lambda I_{st}.\ u_3I \subseteq u_1I$
15. $u_3 \Subset u_1 \stackrel{\text{def}}{=} \lambda I_{st}.\ \forall i_s \in I(u_3i = u_1i \vee u_3i = \#)$

[5] Cf. van den Berg (1996: 149, definition (4.1)).

Info State I	u_1	u_2	u_3 $(u_3 \subseteq u_1, u_3 \notin u_1)$	u_3 $(u_3 \Subset u_1)$
i_1	α_1	β_1	α_1	α_1
i_2	α_2	β_2	α_3	α_2
i_3	α_3	β_3	α_1	#
i_4	α_4	β_4	α_2	α_4

If we use the notion of value-only subset in (14), we make incorrect empirical predictions. Consider, for example, the discourse in (16) below, where u_1 stores the set of conventions[6] and u_2 stores the set of corresponding women; furthermore, assume that *every*^{u_1} *convention* takes scope over *a*^{u_2} *woman* and that the correlation between u_1-conventions and courted u_2-women is the one represented in the table above. Intuitively, the adverb *usually* in (16b) is anaphoric to the set of conventions introduced in (16a) and (16b) is interpreted as asserting that, at most conventions, the woman courted by Harvey *at that convention* comes to the banquet with him. The leftmost dref u_3 in the table above does store most u_1-conventions (three out of four), but it does not preserve the correlation between u_1-conventions and u_2-women established in sentence (16a).

16. **a.** Harvey courts a^{u_2} woman at every^{u_1} convention.
    b. She$_{u_2}$ usually$^{u_3 \Subset u_1}$ comes to the banquet with him.
17. Most$^{u_1, u_3 \Subset u_1}$ farmers who own a^{u_2} donkey beat it$_{u_2}$.

We obtain similarly incorrect results for donkey sentences like the one in (17) above: the restrictor of the quantification introduces a dependency between all the donkey-owning u_1-farmers and the u_2-donkeys that they own; the nuclear scope set u_3 needs to contain most u_1-farmers, but in such a way that the correlated u_2-donkeys remain the same. That is, the nuclear scope set contains a *most*-subset of donkey-owning farmers that beat *their respective donkey(s)*. The notion of value-only inclusion in (14) is, yet again, inadequate.

Thus, to capture the intra- and cross-sentential interaction between anaphora and quantification, we need the notion of *structured inclusion* defined in (15) above, whereby we go from a superset to a subset by discarding rows in the matrix. We are therefore guaranteed that the subset will contain *only* the dependencies associated with the superset (but not necessarily *all* dependencies – see below). To implement this, I follow van den Berg (1996) and introduce a dummy/exception individual # that is used as a tag for the cells in the matrix that should be discarded in order to obtain a structured subset u_3 of a superset u_1 – as shown by the rightmost u_3 column in the table above.

Unlike van den Berg (1996), I do not take the introduction of the dummy individual # to require making the underlying logic partial, i.e. I will not take a lexical relation that has # as one of its arguments, e.g. *woman*(#) or *courted_at*(#, α_1), to be undefined. I will just require the dummy individual # to make any lexical relation false[7]. This allows us to keep the underlying type logic classical while making sure that we do not accidentally introduce # and inadvertently discard a cell when we evaluate another lexical relation later on. Thus, lexical relations (i.e. atomic conditions) are interpreted *distributively* relative to the non-dummy sub-state of the input plural info state I, as shown in (19) below.

18. $I_{u_1 \neq \#, \ldots, u_n \neq \#} \overset{\text{def}}{=} \{i_s \in I : u_1 i \neq \# \wedge \ldots \wedge u_n i \neq \#\}$

[6] In the case of a successful *every*-quantification, the restrictor and nuclear scope sets are identical with respect to both value and structure, so we can safely identify them.

[7] We ensure that any lexical relation R of arity n, i.e. of type $e^n t$, defined recursively as in Muskens (1996: 157-158): $e^0 t \overset{\text{def}}{=} t$ and $e^{m+1} t \overset{\text{def}}{=} e(e^m t)$, yields falsity whenever # is one of its arguments by letting $R \subseteq (D_e^{\mathfrak{M}} \setminus \{\#\})^n$.

19. $R\{u_1, \ldots, u_n\} \stackrel{\text{def}}{=} \lambda I_{st}.\ I_{u_1 \neq \#, \ldots, u_n \neq \#} \neq \emptyset \ \wedge\ \forall i_s \in I_{u_1 \neq \#, \ldots, u_n \neq \#}(R(u_1 i, \ldots, u_n i))$

The notion of structured inclusion $\Subset$ in (15) above ensures that the subset inherits *only* the superset structure – but we also need it to inherit *all* the superset structure, which we achieve by means of the second conjunct in definition (20) below. This conjunct is needed (among others) to account for the donkey sentence in (7) above, which is interpreted as talking about *every* slave owned by any given person, i.e. the nuclear scope set, which is a *most*-subset of the restrictor set, needs to inherit *all* the superset structure (each slave owner in the nuclear scope set needs to be associated with *every* slave that s/he owned).

20. $u' \sqsubseteq u \stackrel{\text{def}}{=} \lambda I_{st}.\ (u' \Subset u)I \ \wedge\ \forall i_s \in I(ui \in u'I_{u' \neq \#} \rightarrow ui = u'i)$

3.2 Maximization and Distributivity

We turn now to the maximization and distributivity operators $\mathbf{max}^u$ and $\mathbf{dist}_u$, which are defined in the spirit – but not the letter – of the corresponding operators in van den Berg (1996). Selective maximization and selective distributivity together enable us to dynamize λ-abstraction over both values (individuals, i.e. quantifier domains) and structure (quantificational dependencies); that is, $\mathbf{max}^u$ and $\mathbf{dist}_u$ enable us to extract and store the restrictor and nuclear scope structured sets needed to define dynamic generalized quantification.

Consider the definition of $\mathbf{max}^u$ in (21) below first: the first conjunct introduces u as a new dref, i.e. $[u]$, and makes sure that each individual in uJ satisfies D, i.e. we store *only* individuals that satisfy D. The second conjunct enforces the maximality requirement: any other set uK obtained by a similar procedure, i.e. any other set of individuals that satisfies D, is included in uJ – that is, uJ stores *all* individuals that satisfy D.

21. $\mathbf{max}^u(D) \stackrel{\text{def}}{=} \lambda I_{st}.\lambda J_{st}.\ ([u];D)IJ \wedge \forall K_{st}(([u];D)IK \rightarrow uK_{u \neq \#} \subseteq uJ_{u \neq \#})$
22. $\mathbf{max}^{u' \sqsubseteq u}(D) \stackrel{\text{def}}{=} \mathbf{max}^{u'}([u' \sqsubseteq u];D)$
23. $I_{u=x} \stackrel{\text{def}}{=} \{i_s \in I : ui = x\}$
24. $\mathbf{dist}_u(D) \stackrel{\text{def}}{=} \lambda I_{st}.\lambda J_{st}.\ uI = uJ \wedge \forall x_e \in uI(DI_{u=x}J_{u=x})$ [8]

Definition (24) states that updating an info state I with a DRS D *distributively* over a dref u means: (*i*) generating the u-partition of I, i.e. $\{I_{u=x} : x \in uI\}$, (*ii*) updating each cell $I_{u=x}$ in the partition with the DRS D and (*iii*) taking the union of the resulting output info states. The first conjunct in (24) is required to ensure that there is a bijection between the partition induced by the dref u over the input state I and the one induced over the output state J; without this requirement, we could introduce arbitrary new values for u in the output state J, i.e. arbitrary new partition cells[9]. The second conjunct is the one that actually defines the distributive update: the DRS D relates every partition cell in the input state I to the corresponding partition cell in the output state J.

[8] $\mathbf{dist}_{u_1,\ldots,u_n}(D) \stackrel{\text{def}}{=} \lambda I_{st}.\lambda J_{st}.\ \forall x_1 \ldots \forall x_n(I_{u_1=x_1,\ldots,u_n=x_n} \neq \emptyset \leftrightarrow J_{u_1=x_1,\ldots,u_n=x_n} \neq \emptyset) \wedge \forall x_1 \ldots \forall x_n(I_{u_1=x_1,\ldots,u_n=x_n} \neq \emptyset \rightarrow DI_{u_1=x_1,\ldots,u_n=x_n}J_{u_1=x_1,\ldots,u_n=x_n})$.

[9] Nouwen (2003): 87 was the first to observe that we need to add the first conjunct in (24) to the original definition of distributivity in (18), van den Berg (1996): 145.

3.3 Generalized Quantifiers and Indefinites

The PCDRT meanings for generalized determiners and weak/strong indefinites are provided in (28), (29) and (30) below[10].

25. $_u(D) \stackrel{\text{def}}{=} \lambda I_{st}.\lambda J_{st}.\ I_{u=\#} = J_{u=\#} \wedge I_{u\neq\#} \neq \emptyset \wedge \mathbf{dist}_u(D)I_{u\neq\#}J_{u\neq\#}$
26. $_{\langle u\rangle}(D) \stackrel{\text{def}}{=} \lambda I_{st}.\lambda J_{st}.\ I_{u=\#} = J_{u=\#} \wedge (I_{u\neq\#} = \emptyset \rightarrow I = J) \wedge (I_{u\neq\#} \neq \emptyset \rightarrow \mathbf{dist}_u(D)I_{u\neq\#}J_{u\neq\#})$
27. $\mathbf{DET}\{u, u'\} \stackrel{\text{def}}{=} \lambda I_{st}.\ \mathbf{DET}(uI_{u\neq\#}, u'I_{u'\neq\#})$, where $\mathbf{DET}$ is a static det.
28. $\mathit{det}^{\,u,u'\sqsubseteq u} \rightsquigarrow \lambda P_{\mathbf{et}}.\lambda P'_{\mathbf{et}}.\ \mathbf{max}^u(_{\langle u\rangle}(P(u)));\ \mathbf{max}^{u'\sqsubseteq u}(_{\langle u'\rangle}(P'(u')));\ [\mathbf{DET}\{u, u'\}]$
29. $\mathit{a}^{\,\mathbf{wk}:u} \rightsquigarrow \lambda P_{\mathbf{et}}.\lambda P'_{\mathbf{et}}.\ [u];\ _u(P(u);\ P'(u))$
30. $\mathit{a}^{\,\mathbf{str}:u} \rightsquigarrow \lambda P_{\mathbf{et}}.\lambda P'_{\mathbf{et}}.\ \mathbf{max}^u(_u(P(u);\ P'(u)))$

The **max**-based definition of generalized quantification correctly predicts that anaphora to restrictor / nuclear scope sets is always anaphora to *maximal* sets, i.e. E-type anaphora[11]. That is, the maximality of anaphora to quantifier sets is an automatic consequence of the fact that we independently need **max**-operators to formulate truth-conditionally correct dynamic meanings for quantifiers. This is one of the major results in van den Berg (1996), preserved in PCDRT.

The existential commitment associated with dref introduction is built into (*i*) the definition of lexical relations in (19) above (i.e. $I_{u_1\neq\#,\ldots,u_n\neq\#} \neq \emptyset$) and (*ii*) the definition of the operator $_u(\ldots)$ in (25) above (i.e. $I_{u\neq\#} \neq \emptyset$). We need these non-emptiness requirements because the pair $(\emptyset_{st}, \emptyset_{st})$ belongs, on the one hand, to the denotation of $[u]$ for any dref u (see (5) above) and, on the other hand, to the denotation of $\mathbf{dist}_u(D)$ for any dref u and DRS D (see (24) above).

There is, however, no existential commitment in the translation of $\mathit{det}^{\,u,u'\sqsubseteq u}$, which employs the distributivity operator $_{\langle u\rangle}(\ldots)$ defined in (26) above. The use of $_{\langle u\rangle}(\ldots)$ enables us to capture the meaning of both upward and downward monotonic quantifiers by means of the same definition. The problem posed by downward monotonic quantifiers is that their nuclear scope set can or has to be empty; e.g., after a successful update with $\mathit{no}^{\,u,u'\sqsubseteq u}$, the nuclear scope set u' is necessarily empty, i.e. the dref u' will always store only the dummy individual # relative to the output info state; this, in turn, entails that no lexical relation in the nuclear scope DRS that has u' as an argument can be satisfied. The second conjunct $I_{u\neq\#} = \emptyset \rightarrow I = J$ in (26) enables us to resolve the conflict between the emptiness requirement enforced by a *no*-quantification and the non-emptiness requirement enforced by lexical relations[12],[13].

[10] See Brasoveanu (2007a) for the justification of the account of weak / strong donkey ambiguities in terms of weak / strong indefinite articles and see Farkas (2002b) for a detailed investigation of various kinds of indefinites within a related dynamic framework.

[11] Recall the Evans examples *Few senators admire Kennedy and they are very junior* and *Harry bought some sheep. Bill vaccinated them* and (9), (10) and (11) above.

[12] Even if definition (28) allows for empty restrictor and nuclear scope sets, we can still capture the fact that subsequent anaphora to such empty sets is infelicitous (e.g. anaphora to the nuclear scope sets in (10) and (11) above) because pronominal meanings contribute non-emptiness requirements – see the conditions $\mathbf{unique}\{u\}$ and $u \neq \emptyset$ contributed by *she* and *they* in (33) and (34) below.

[13] The fact that the second conjunct in (26) requires the identity of the input and output states I and J correctly predicts that anaphora to both empty restrictor/nuclear scope sets and indefinites in restrictor/nuclear scope DRS's associated with such empty sets is infelicitous. For example, the nuclear scope DRS of a successful $\mathit{no}^{\,u,u'\sqsubseteq u}$-quantification, i.e. $\mathbf{max}^{u'\sqsubseteq u}(_{\langle u'\rangle}(P'(u')))$, will always be a test; hence, we correctly predict that anaphora to any indefinites in the nuclear scope of a *no*-quantification is infelicitous, e.g. *Harvey courts a*$^{u''}$ *woman at no*$^{u,u'\sqsubseteq u}$ *convention. #She*$_{u''}$ *is very pretty / #They*$_{u''}$ *are very pretty.*

3.4 Singular Number Morphology

Let us turn now to the last component needed for the account of discourses (1) and (2), namely the representation of singular pronouns. Their PCDRT translation, provided in (33) below, has the expected Montagovian form: it is the distributive type-lift of the dref u they are anaphoric to, with the addition of the condition $\mathbf{unique}\{u\}$. The condition is contributed by singular number morphology and requires uniqueness of the non-dummy value of the dref u relative to the current plural info state I. In contrast, plural pronouns do not require uniqueness, as shown in (34) below[14].

31. $\mathbf{unique}\{u\} \stackrel{\text{def}}{=} \lambda I_{st}.\ I_{u\neq\#} \neq \emptyset \wedge \forall i_s \in I_{u\neq\#} \forall i'_s \in I_{u\neq\#}(ui = ui')$
32. $u \neq \emptyset \stackrel{\text{def}}{=} \lambda I_{st}.\ I_{u\neq\#} \neq \emptyset$
33. $\mathit{she}_u \rightsquigarrow \lambda P_{\mathbf{et}}.\ [\mathbf{unique}\{u\}];\ P(u)$
34. $\mathit{they}_u \rightsquigarrow \lambda P_{\mathbf{et}}.\ [u \neq \emptyset];\ P(u)$
35. $\mathit{the}_{\mathbf{sg}:\mathrm{u}} \rightsquigarrow \lambda P_{\mathbf{et}}.\lambda P'_{\mathbf{et}}.\ [\mathbf{unique}\{u\}];\ P(u);\ P'(u)$
36. $\mathit{the}_{\mathbf{pl}:\mathrm{u}} \rightsquigarrow \lambda P_{\mathbf{et}}.\lambda P'_{\mathbf{et}}.\ [u \neq \emptyset];\ P(u);\ P'(u)$
37. $\mathit{the}^{\mathbf{sg}:\mathrm{u}} \rightsquigarrow \lambda P_{\mathbf{et}}.\lambda P'_{\mathbf{et}}.\ \mathbf{max}^u({}_u(P(u)));\ [\mathbf{unique}\{u\}];\ P'(u)$

The uniqueness enforced by the condition $\mathbf{unique}\{u\}$ is a rather weak requirement because it is relativized to the current plural info state. We can require uniqueness relative to the entire model (i.e. a stronger form of uniqueness) by combining the $\mathbf{max}^u$ operator and the $\mathbf{unique}\{u\}$ condition, as shown by the Russellian, non-anaphoric meaning for definite descriptions provided in (37) above, which requires existence and model-level uniqueness. This meaning is needed to interpret the DP *the banquet* in (2b) above. The alternative, anaphoric meanings for singular and plural definite articles (we need them to interpret the anaphoric DP *the woman* in (2c) above among others) are provided in (35) and (36) above; they exhibit the same kind of unique / non-unique contrast as the meanings for singular and plural pronouns[15].

The PCDRT translation for proper names and the definitions of dynamic negation and truth are provided in (38), (39) and (40) below. I take the default context of interpretation for all discourses, i.e. the default input info state relative to which a DRS is true/false, to be the singleton info state $\{i_\#\}$, where $i_\#$ is the 'assignment' that stores the dummy individual # relative to all individual dref's. Finally, the abbreviations in (41) and (42) below and the equalities in (43) and (44) enable us to simplify – and, therefore, enhance the readability of – some very common PCDRT representations.

[14] The translation for plural pronouns in 34 derives the intuitively correct, narrow-scope indefinite interpretation associated with discourse (3) above. However, if the plural pronoun is anaphoric to a non-atomic, group individual as in (i) below, the intuitively more salient interpretation is the wide-scope indefinite one – in contrast to example (ii) below, where both the wide and narrow scope readings are available (I am grateful to E. Swanson for this observation and examples (i) and (ii)).

(i) **a.** Harvey courts a pair of women at every convention. **b.** They are friends.
(ii) **a.** Harvey courts a pair of women at every convention. **b.** They are always friends.

We can account for this by distinguishing between discourse-level plurality (i.e. plural info states) and domain-level plurality (i.e. non-atomic individuals), as proposed in Brasoveanu (2007b), and optionally strengthening the translation of plural pronouns to include a **unique** condition, i.e. a discourse-level singularity condition, while being compatible with domain-level plurality (e.g. a pair of women); in contrast, singular prounouns require both discourse-level singularity and domain-level singularity / atomicity. See Brasoveanu (2007b) for more discussion and a version of PCDRT that countenances non-atomic individuals in addition to plural info states.

[15] Semantically distinguishing between singular and plural definite articles is supported by the fact that other languages, e.g. Romance, have overt number morphology on definite articles.

38. $\textit{Harvey}^u \leadsto \lambda P_{\mathbf{et}}.\ [u|u \Subset Harvey];\ P(u)$,
where $Harvey \overset{\text{def}}{=} \lambda i_s.\ harvey_e$ (i.e. $Harvey$ is a 'rigid' individual dref).
39. $\sim D \overset{\text{def}}{=} \lambda I_{st}.\ I \neq \emptyset \wedge \forall H_{st} \neq \emptyset(H \subseteq I \rightarrow \neg\exists K_{st}(DHK))$
40. A DRS D of type $\mathbf{t}$ is *true* with respect to an input info state I_{st} iff $\exists J_{st}(DIJ)$.
41. ${}_u(C) \overset{\text{def}}{=} \lambda I_{st}.\ I_{u\neq\#} \neq \emptyset \wedge \forall x_e \in uI_{u\neq\#}(CI_{u=x})$, where C is a condition (type $(st)t$).
42. ${}_u(u_1,\ \ldots\ , u_n) \overset{\text{def}}{=} \lambda I_{st}.\lambda J_{st}.\ I_{u=\#} = J_{u=\#} \wedge I_{u\neq\#}[u_1,\ \ldots\ , u_n]J_{u\neq\#}$,
where $u \notin \{u_1,\ \ldots\ , u_n\}$ and $[u_1,\ \ldots\ , u_n] \overset{\text{def}}{=} [u_1];\ \ldots\ ; [u_n]$.
43. ${}_u([C_1,\ \ldots\ , C_m]) = [{}_u(C_1),\ \ldots\ ,\ {}_u(C_m)]$
44. ${}_u([u_1,\ \ldots\ , u_n \,|\, C_1,\ \ldots\ , C_m]) = [{}_u(u_1,\ \ldots\ ,\ u_n) \,|\, {}_u(C_1),\ \ldots\ ,\ {}_u(C_m)]$

4 Quantificational Subordination as Structured Anaphora

This section presents the PCDRT analysis of discourses (1) and (2) and then shows that the very same system accounts for other kinds of phenomena: telescoping discourses, quantificational subordination without quantifiers scoping over the singular anaphors and donkey anaphora to quantifier domains[16]. We start with the two possible quantifier scopings for the discourse-initial sentence (1a/2a). For simplicity, I will assume that the two scopings are due to the two different lexical entries for the ditransitive verb ***court_at***, provided in (45) and (46) below[17]: $\textit{court\_at}^1$ assigns the indefinite ***a woman*** wide scope relative to ***every convention***, while $\textit{court\_at}^2$ assigns it narrow scope. I assume that the basic syntactic structure of the sentence is the one given in (47).

45. $\textit{court\_at}^1 \leadsto \lambda Q'_{(\mathbf{et})\mathbf{t}}.\lambda Q''_{(\mathbf{et})\mathbf{t}}.\lambda v_{\mathbf{e}}.\ Q'(\lambda v'_{\mathbf{e}}.\ Q''(\lambda v''_{\mathbf{e}}.\ [court\_at\{v, v', v''\}]))$
46. $\textit{court\_at}^2 \leadsto \lambda Q'_{(\mathbf{et})\mathbf{t}}.\lambda Q''_{(\mathbf{et})\mathbf{t}}.\lambda v_{\mathbf{e}}.\ Q''(\lambda v''_{\mathbf{e}}.\ Q'(\lambda v'_{\mathbf{e}}.\ [court\_at\{v, v', v''\}]))$
47. ***Harvey [[court_at***$^{1/2}$ ***[a woman]] [every convention]]***

Turning to the meaning of the quantifier ***every convention***, note that we can safely identify the restrictor and nuclear scope dref's u and u' of any $\textit{every}^{u,u'\sqsubseteq u}$-quantification: the definition in (28) above entails that, if J is an arbitrary output state of a successful $\textit{every}^{u,u'\sqsubseteq u}$-quantification, u and u' have to be identical with respect to both value and structure, i.e. $\forall j_s \in J(uj = u'j)$. We can therefore assume that ***every*** contributes only one dref, as shown in (48) below. I will also assume that the restrictor set of the $\textit{every}^{u_1}$-quantification is non-empty, so we can safely replace the operator ${}_{\langle u_1\rangle}(\ldots)$ with the operator ${}_{u_1}(\ldots)$.

48. $\textit{every}^{u_1} \leadsto \lambda P_{\mathbf{et}}.\lambda P'_{\mathbf{et}}.\ \mathbf{max}^{u_1}({}_{u_1}(P(u_1)));\ {}_{u_1}(P'(u_1))$
49. $\textit{every}^{u_1}\ \textit{convention} \leadsto \lambda P_{\mathbf{et}}.\ \mathbf{max}^{u_1}([convention\{u_1\}]);\ {}_{u_1}(P(u_1))$
50. $\textit{a}^{\mathbf{wk}:u_2}\ \textit{woman} \leadsto \lambda P_{\mathbf{et}}.\ [u_2 \,|\, woman\{u_2\}];\ {}_{u_2}(P(u_2))$
51. $\textit{a}^{\mathbf{wk}:u_2}\ \textit{woman}{>>}\textit{every}^{u_1}\ \textit{convention} \leadsto [u_2 \,|\, woman\{u_2\}];$
${}_{u_2}(\mathbf{max}^{u_1}([convention\{u_1\}]));\ [{}_{u_2}(court\_at\{Harvey, u_2, u_1\})]$
52. $\textit{every}^{u_1}\ \textit{convention}{>>}\textit{a}^{\mathbf{wk}:u_2}\ \textit{woman} \leadsto \mathbf{max}^{u_1}([convention\{u_1\}]);$
$[{}_{u_1}(u_2) \,|\, {}_{u_1}(woman\{u_2\}),\ {}_{u_1}(court\_at\{Harvey, u_2, u_1\})]$

The PCDRT representations of the two quantifier scopings for sentence (1a/2a) are provided in (51) and (52) above (some of the redundant distributivity operators are omitted). For simplicity, I

[16] For a detailed account of donkey anaphora in PCDRT, see Brasoveanu (2007a).
[17] But it should be clear that PCDRT is compatible with any of the quantifier scoping mechanisms proposed in the literature; for a version of PCDRT that incorporates Quantifying-In / Quantifier Raising, see Brasoveanu (2007a).

take the translation of the proper name ***Harvey*** to be $\lambda P_{\mathbf{et}}.\ P(Harvey)$ instead of the more complex one in (38) above; the reader can check that this simplification does not affect the truth-conditions assigned to the discourses under consideration.

The representation in (51) updates the default input info state $\{i_{\#}\}$ as follows. First, we introduce some non-empty (i.e. non-dummy) set of individuals relative to the dref u_2. Then, we test that each u_2-individual is a woman. Then, relative to each u_2-individual, we introduce the set of all conventions and store it in the dref u_1. Finally, we test that, for each u_2-woman and for each of the corresponding u_1-conventions (i.e., in this case: for every convention), Harvey courted her at the convention. The output info state obtained after updating with (51) contains a non-empty set of u_2-women that where courted by Harvey at every convention and, relative to each u_2-woman, u_1 stores the set of all conventions.

The representation in (52) updates the default input info state $\{i_{\#}\}$ as follows. First, we introduce the set of all conventions relative to the dref u_1. Then, for each u_1-convention, we introduce a u_2-set of individuals. Finally we test that, for each u_1-convention, each of the corresponding u_2-individuals are women and are such that Harvey courted them at the convention under consideration. The output info state obtained after updating with (52) stores the set of all conventions under the dref u_1 and, relative to each u_1-convention, the dref u_2 stores a non-empty set of women (possibly different from convention to convention) that Harvey courted at that particular convention.

We can now see how sentence (1b) – in particular, the singular number morphology on the pronoun $\textit{she}_{u_2}$ – forces the 'wide-scope indefinite' reading: the condition $\mathbf{unique}\{u_2\}$ (see (53) and (54) below) effectively conflates the two scopings by requiring the set of u_2-women obtained after updating with (51) or (52) to be a singleton. This requirement leaves the truth-conditions derived on the basis of (51) untouched, but makes the truth-conditions associated with (52) strictly stronger.

53. $\textit{she}_{u_2} \rightsquigarrow \lambda P_{\mathbf{et}}.\ [\mathbf{unique}\{u_2\}];\ P(u_2)$
54. $[\mathbf{unique}\{u_2\}, very\_pretty\{u_2\}]$

In contrast, sentence (2b) contains the adverb of quantification $\textit{always}_{u_1}$, which can take scope above or below the singular pronoun $\textit{she}_{u_2}$. In the former case, the u_2-uniqueness requirement is weakened (i.e., in a sense, neutralized) by being relativized to u_1-conventions. As shown in (55) below, I take the meaning of $\textit{always}_{u_1}$ to be a universal quantification over an anaphorically retrieved restrictor, i.e. over the nuclear scope set introduced by the quantifier $\textit{every}^{u_1}$ ***convention*** in the preceding sentence. Since ***always*** is basically interpreted as ***every*** (modulo the anaphorically retrieved restrictor), its translation is parallel to the translation for ***every*** in (48) above. The general format for the interpretation of quantifiers that anaphorically retrieve their restrictor set is provided in (56).

55. $\textit{always}_{u_1} \rightsquigarrow \lambda P_{\mathbf{et}}.\ {}_{u_1}(P(u_1))$
56. $\textit{det}_{u}^{u' \sqsubseteq u} \rightsquigarrow \lambda P_{\mathbf{et}}.\ \mathbf{max}^{u' \sqsubseteq u}({}_{\langle u' \rangle}(P(u')));\ [\mathbf{DET}\{u, u'\}]$

The definite description ***the banquet*** in (2b) is intuitively a Russellian definite description (see (37) above), which contributes existence and uniqueness (relativized to conventions – we are talking about a unique banquet per convention[18]). For simplicity, however, I will assume that sentence (2b) contributes a transitive predication of the form ***come_with_Harvey_to_banquet_of*** relating women

[18] The existence and uniqueness are contributed by the Russellian definite article, translated as: $\textit{the}^{u_3} \rightsquigarrow \lambda P_{\mathbf{et}}.\lambda P'_{\mathbf{et}}.\ \mathbf{max}^{u_3}({}_{u_3}(P(u_3)));\ [\mathbf{unique}\{u_3\}];\ P'(u_3)$. The relational noun ***banquet*** is anaphoric to u_1-conventions and is translated as: $\textit{banquet}_{u_1} \rightsquigarrow \lambda v_{\mathbf{e}}.\ [banquet\{v, u_1\}]$ – intuitively, the set of banquets organized at convention u_1. The two translations yield the following PCDRT representation for our Russellian definite description:
$\textit{the}^{u_3}\ \textit{banquet}_{u_1} \rightsquigarrow \lambda P_{\mathbf{et}}.\ \mathbf{max}^{u_3}([banquet\{u_3, u_1\}]);\ [\mathbf{unique}\{u_3\}];\ P(u_3)$.

and conventions which, as shown in (57) and (58) below, can be translated in two different ways corresponding to the two possible relative scopes of $\mathtt{she}_{u_2}$ and $\mathtt{always}_{u_1}$ (that is, the scoping technique is the same as in (45) and (46) above). The translation in (57) gives the pronoun $\mathtt{she}_{u_2}$ wide scope over the adverb $\mathtt{always}_{u_1}$, while the translation in (58) gives the pronoun narrow scope relative to the adverb. The corresponding PCDRT representations, obtained on the basis of the syntactic structure in (59), are provided in (60) and (61) below.

57. $\mathtt{come\_to\_banquet\_of}^1 \leadsto \lambda Q_{\mathbf{(et)t}}.\lambda Q'_{\mathbf{(et)t}}.\ Q'(\lambda v'_{\mathbf{e}}.\ Q(\lambda v_{\mathbf{e}}.\ [c.t.b.of\{v', v\}]))$
58. $\mathtt{come\_to\_banquet\_of}^2 \leadsto \lambda Q_{\mathbf{(et)t}}.\lambda Q'_{\mathbf{(et)t}}.\ Q(\lambda v_{\mathbf{e}}.\ Q'(\lambda v'_{\mathbf{e}}.\ [c.t.b.of\{v', v\}]))$
59. $\mathtt{she\ [[always]\ come\_to\_banquet\_of}^{1/2}\mathtt{]}$
60. $\mathtt{she}_{u_2} >> \mathtt{always}_{u_1} \leadsto [\mathbf{unique}\{u_2\},\ c.t.b.of\{u_2, u_1\}]$
61. $\mathtt{always}_{u_1} >> \mathtt{she}_{u_2} \leadsto [_{u_1}(\mathbf{unique}\{u_2\}),\ c.t.b.of\{u_2, u_1\}]$

Thus, there are two possible PCDRT representations for sentence (2a) and two possible representations for sentence (2b). Out of the four combinations, three end up requiring the indefinite $\mathtt{a}^{\mathbf{wk}:u_2}$ $\mathtt{woman}$ to have wide scope relative to $\mathtt{every}^{u_1}$ $\mathtt{convention}$. The fourth combination (52+61), provided in (62) below, encodes the 'narrow-scope indefinite' reading that is intuitively available for discourse (2), but not for (1). The PCDRT representation in (62) updates the default input info state $\{i_\#\}$ as follows: first, we introduce the set of all conventions relative to the dref u_1, followed by the introduction of a non-empty set of u_2-individuals relative to each u_1-convention; the remainder of the representation tests that, for each u_1-convention, the corresponding u_2-set is a singleton set whose sole member is a woman that is courted by Harvey at the u_1-convention under consideration and that comes with him to the banquet of that convention.

62. $\mathbf{max}^{u_1}([convention\{u_1\}]); [_{u_1}(u_2)\,|\,woman\{u_2\},\ court\_at\{Harvey, u_2, u_1\},$
$_{u_1}(\mathbf{unique}\{u_2\}),\ c.t.b.of\{u_2, u_1\}]$

Summarizing, PCDRT enables us to formulate a compositional dynamic account of the intra- and cross-sentential interaction between generalized quantifiers, anaphora and number morphology exhibited by the quantificational subordination discourses in (1) and (2) above. The main proposal is that plural info states together with a suitable dynamic reformulation of the independently motivated denotations for generalized determiners and number morphology in static Montague semantics enable us to account for quantificational subordination in terms of structured anaphora to quantifier domains.

4.1 Telescoping and Quantificational Subordination without Quantifiers

The quantificational subordination discourse in (2) above contains an overt adverb of quantification that licenses the narrow-scope indefinite reading. There are, however, cases in which such a reading is licensed without any overt quantificational element scoping over the singular pronoun, as shown by (63) (from Sells 1985) and (64) (see Roberts 1996: 216, (1′)) below.

63. **a.** Every^u chess set comes with a$^{u'}$ spare pawn.
b. It$_{u'}$ is taped to the top of the box.

The relativized uniqueness effect, i.e. the intuition that the banquet is unique per u_1-convention, is due to the fact that the definite description is in the scope of the adverb $\mathtt{always}_{u_1}$ and, therefore, in the scope of the distributivity operator $_{u_1}(\dots)$ contributed by the adverb. For a way to unify anaphoric and Russellian definite descriptions and assign a single meaning to the definite article, see Sect. 5.2 below.

64. **a.** Every^{u} frog that saw an$^{u'}$ insect ate it$_{u'}$. **b.** It$_{u'}$ disappeared forever.
65. **a.** Every^{u} frog that saw an$^{u'}$ insect ate it$_{u'}$. **b.** #It$_{u'}$ was a fly.

The felicitous examples in (63) and (64) contrast with the infelicitous example in (65) (see Roberts 1996: 216, (1)) above. This contrast suggests that the availability of quantificational subordination without an overt quantificational element is more constrained than ordinary quantificational subordination, as suggested in Karttunen (1976), Gawron (1996), Roberts (1996), Wang et al. (2006) among others. The PCDRT account is well equipped to capture this generalization – as things stand, we predict that quantificational subordination without an overt quantificational element should always be infelicitous. This is a consequence of the conflict between the **unique** condition contributed by singular pronouns and the **non-unique** condition (i.e. the non-singleton requirement) associated with the restrictor set of a generalized determiner, argued for in Green (1989), Neale (1990), Chierchia (1995) among others – and which can be formalized as shown in (66) and (67) below[19],[20].

66. $\mathbf{non\text{-}unique}\{u\} \stackrel{\text{def}}{=} \lambda I_{st}.\ I_{u\neq\#} \neq \emptyset \wedge \exists i_s \in I_{u\neq\#} \exists i'_s \in I_{u\neq\#}(ui \neq ui')$
67. $\textit{\textbf{det}}^{\,u,u'\sqsubseteq u} \rightsquigarrow \lambda P_{\mathbf{et}}.\lambda P'_{\mathbf{et}}.\ \mathbf{max}^{u}({}_{u}(P(u)));\ [\mathbf{non\text{-}unique}\{u\}];\ \mathbf{max}^{u'\sqsubseteq u}({}_{\langle u'\rangle}(P'(u')));\ [\mathbf{DET}\{u,u'\}]$

Thus, PCDRT captures the observation in van den Berg (1996) (see also Wang et al. 2006) that quantificational subordination without overt quantifiers (or telescoping – see the discussion below) is problematic only when the anaphor is singular. If the anaphor is plural, structured anaphora to quantifier domains is acceptable, as shown by (68) (see van den Berg 1996: 168, (16)) and (69) below. This is a consequence of the fact that only singular anaphors contribute a **unique** condition that contradicts the **non-unique** condition contributed by generalized determiners, while plural anaphora to quantifier domains is by default felicitous because no such conflict arises.

68. **a.** Every^{u} man loves a$^{u'}$ woman. **b.** They$_{u}$ bring them$_{u'}$ flowers to prove this.
69. **a.** Every^{u} frog that saw an$^{u'}$ insect ate it$_{u'}$. **b.** They$_{u'}$ were all flies.

In PCDRT, we can capture the fact that quantificationally subordinated singular anaphors that occur by themselves (i.e. without other quantificational elements in the same sentence) are felicitous only in restricted contexts by proposing that covert distributivity operators ${}_{u}(\ldots)$ with scope over the singular anaphors are licensed only in particular kinds of contexts. Such distributivity operators resolve the conflict between the **unique** and **non-unique** conditions (contributed by singular pronouns and generalized determiners respectively) because they basically neutralize the **unique** condition, much like the adverb *always* neutralizes this condition in discourse (2) above. This is schematically shown in (70) below.

70. **a.** Every^{u} **non-unique**$\{u\}$ frog that saw an$^{u'}$ insect ate it.
b. ✓${}_{u}($ It$_{u'}$ **unique**$\{u'\}$ disappeared forever $)$. vs.
c. # It$_{u'}$ **unique**$\{u'\}$ was a fly.

[19] Green (1989) and Chierchia (1995) among others argue that this non-singleton requirement has presuppositional status. In contrast, Neale (1990) suggests that it is in fact an implicature. I find the arguments in Green (1989) more persuasive, but I leave a more careful investigation of this issue for future research. For simplicity, I will take the **non-unique** condition contributed by generalized determiners to be part of the assertion.

[20] The **non-unique**$\{u\}$ condition enables us to use the simpler distributivity operator ${}_{u}(\ldots)$ instead of ${}_{\langle u\rangle}(\ldots)$ when we translate the restrictors of generalized determiners – as shown in (67) above.

The continuation in (70c) is infelicitous because the **unique**$\{u'\}$ condition is interpreted relative to the entire plural info state, requiring the set of all insects under consideration to be a singleton. But, since the same insect cannot be typically eaten by two or more frogs, it follows that, if there is only one u'-insect, there can be only one u-frog, which contradicts the **non-unique**$\{u\}$ condition contributed by the determiner $every^u$. In contrast, the continuation in (70b) is felicitous because the **unique**$\{u'\}$ condition is in the scope of the distributivity operator $_u(\dots)$, which requires u'-insects to be unique *relative to* each u-frog.

Various factors determine when a covert distributivity operator can be licensed, ranging from world knowledge, e.g. knowledge of scripts, as proposed in Poesio & Zucchi (1992), to the rhetorical structure of discourse, e.g. Wang et al. (2006) propose that discourses like (70b) are felicitous because the two discourse segments containing the antecedent and the anaphor are linked by a particular discourse relation. The task of identifying the relevant generalizations and investigating them goes beyond the contributions that PCDRT, as a semantic theory, can make. The goal of this section is only to show that the very same ingredients that are required to analyze 'ordinary' cases of quantificational subordination like (2) above can also: (*i*) capture the fact that, in general, the distribution of singular cross-sentential anaphora is more restricted than the distribution of plural anaphora and (*ii*) provide the kind of semantic representations (in particular, discourse-level distributivity operators) that can be straightforwadly interfaced with more general pragmatic reasoning involving world knowledge and rhetorical relations.

The restricted licensing of covert distributivity operators also enables us to capture the restricted distribution and the intuitively correct interpretation of telescoping discourses like the ones in (71) (see Roberts 1987: 36, (38)) and (72) (see Roberts 1987: 36, (34), attributed to B. Partee) below, where a singular pronoun is cross-sententially anaphoric to a quantifier domain. The term "telescoping" is due to Roberts (1987, 1989) and is meant to convey the intuition that, in such discourses, "from a discussion of the general case, we zoom in to examine a particular instance" (Roberts 1987: 36).

71. **a.** Each^u candidate for the space mission meets all our requirements.
    b. He$_u$ has a PhD in Astrophysics and extensive prior flight experience.
72. **a.** Each^u degree candidate walked to the stage.
    b. He$_u$ took his$_u$ diploma from the Dean and returned to his$_u$ seat.
73. **a.** Each^u **non-unique**$\{u\}$ candidate for the space mission ...
    b. $_u$(He$_u$ **unique**$\{u\}$ has a PhD in Astrophysics ...).

The distributivity operators $_u(\dots)$ that PCDRT employs to account for such discourses – as shown schematically in (73) above – formally capture the telescoping / zooming-in intuition in a rather direct way: discourse-level distributivity 'breaks' a plural info state into sub-states that each store a particular individual, i.e. the updates in the scope of a distributivity operator are evaluated one individual / one case at a time. Therefore, the **unique**$\{u\}$ condition contributed by a singular anaphor is effectively cancelled in the scope of a distributivity operator $_u(\dots)$ because it is vacuously satisfied. Thus, the PCDRT account of telescoping is, in a nutshell: a singular pronoun anaphoric to a quantifier domain contributes a **unique** condition that requires zooming-in / telescoping, i.e. the covert insertion of a distributivity operator, to be successfully interpreted.

As already mentioned, the possibility of licensing such covert distributivity operators that 'rescue' singular anaphors is dependent on various factors, including the rhetorical structure of the discourse under consideration – in fact, one of the main observations about telescoping, which can be traced back to Fodor & Sag (1982) and Evans (1980), is that "the possibility of anaphoric relations in such [...]

cases depends in part on the plausibility of some sort of narrative continuity between the utterances in the discourse" (Roberts 1987: 36). Without a covert distributivity operator $_{u}(\dots)$, the two conditions **non-unique**$\{u\}$ and **unique**$\{u\}$ contradict each other and the update fails. This is how PCDRT accounts for the fact that the discourses in (74) (Evans 1980: 220, (21)[21]), (75) (Poesio & Zucchi 1992: 347, (1)) and (76) (Poesio & Zucchi 1992: 360, (39c)) below are infelicitous.

74. #Every^{u} congressman came to the party and he$_{u}$ had a marvelous time.
75. #Every^{u} dog came in. It$_{u}$ lay down under the table.
76. #Each^{u} dog came in. It$_{u}$ lay down under the table.

Summarizing. the challenge posed by telescoping and quantificational subordination discourses in which there are no quantifiers scoping over the singular anaphors is that we need our semantic theory to be able to account for both felicitous discourses like (63), (64), (68), (69), (71) and (72) above and infelicitous discourses like (65), (74), (75) and (76).

DRT/FCS/DPL-based approaches (Kamp 1981, Heim 1982, Groenendijk & Stokhof 1991, Kamp & Reyle 1993) fail because they can account only for the infelicitous discourses, but not for the felicitous ones – this is a direct consequence of the fact that generalized quantifiers are externally static in this kind of systems. In contrast, Dynamic Montague Grammar (DMG, Groenendijk & Stokhof 1990) and related systems, e.g. Chierchia (1995), take generalized quantifers to be externally dynamic and fail in the opposite way: they can account for the felicitous discourses, but not for the infelicitous ones; moreover, DMG does not derive the correct truth-conditions for all the felicitous telescoping and quantificational subordination discourses (see the discussion in Poesio & Zucchi 1992: 357-359).

The accounts in Poesio & Zucchi (1992), Roberts (1995, 1996) and Wang et al. (2006) (discourse structure based)among others are more flexible and can account for both classes of discourses. These accounts differ with respect to their main strategy of analysis: Poesio & Zucchi (1992) and Roberts (1995, 1996) take the infelicitous examples to be the basic ones and then devise special accommodation-based mechanisms to account for the felicitous examples, i.e. to make available and pass on the relevant discourse information. In contrast, Wang et al. (2006) take the felicitous examples as basic, assume that the relevant discourse information is always available, but that it has to accessed in a particular way, crucially regulated by rhetorical relations between discourse segments.

The PCDRT account falls in the same category as Wang et al. (2006): plural info states ensure that the relevant anaphoric information is always available, but the singular number morphology on the anaphoric pronoun constrains the way in which it can be accessed. This enables us to avoid the rather poorly understood and unconstrained mechanism of DRS accommodation invoked by Poesio & Zucchi (1992) and Roberts (1995, 1996) (see also Roberts 1987, 1989). The main difference between Wang et al. (2006) and the PCDRT account is that the latter builds on a significantly simpler semantics (in particular with respect to the requisite notion of plural info state and the operators manipulating plural info states). Moreover, the semantics / pragmatics interface is more streamlined in PCDRT, the crucial point of contact being the pragmatic licensing of covert distributivity operators.

Finally, the PCDRT account takes the semantic contribution made by number morphology seriously – unlike van den Berg (1996) among others – and, in this sense, it is a development of a suggestion made in Evans (1980: 220) with respect to example (74) above: Evans proposes that the infelicity of this example is a consequence of a clash in semantic number between the antecedent and the anaphor (note that there is no clash in morphological number). This clash is cashed out in PCDRT as the

[21] Page references to Evans (1985).

conflict between the fact that the quantificational antecedent contributes a non-singleton condition on its restrictor set, while the singular pronoun anaphoric to the restrictor set requires it to be a singleton.

Paying attention to the semantic contribution of number morphology has additional benefits: it enables us to derive the fact that felicitous quantificational subordination discourses exhibit relativized uniqueness effects. For example, in discourse (2), the courted woman is unique per convention and, in discourse (63), the spare pawn is unique per chess set. Importantly, discourse (63) contrasts with the non-subordination discourse in (77) below (also from Sells 1985), which does not exhibit relativized uniqueness effects – and this contrast is captured in PCDRT[22],[23].

77. Every chess set comes with a spare pawn that is taped to the top of the box.

4.2 Donkey Anaphora to Quantifier Domains

The same PCDRT meanings for generalized determiners and singular / plural anaphors enable us to account for the three-way contrast between the discourses in (78), (79) and (80) below, i.e. for the fact that donkey anaphora to quantifier domains has to be plural.

78. Every^{u} boy who read a$^{u'}$ *Harry Potter* book recommended it$_{u'}$ to his$_{u}$ friends.
79. #Every^{u} boy who read every$^{u'}$ *Harry Potter* book recommended it$_{u'}$ to his$_{u}$ friends.
80. Every^{u} boy who read every$^{u'}$ *Harry Potter* book recommended them$_{u'}$ to his$_{u}$ friends.

DRT/FCS/DPL-based accounts can capture only the contrast between examples (78) and (79) because they take generalized quantification to be externally static, but they cannot capture the fact that *plural* donkey anaphora to quantifier domains of the kind instantiated in (80) is felicitous. PCDRT captures the three-way contrast between (78), (79) and (80) in the same way in which it captures the contrast between singular and plural anaphora in quantificational subordination and telescoping discourses: the infelicity of singular anaphora is a consequence of the clash between the 'non-singleton restrictor set' requirement contributed by the generalized determiner (i.e. the **non-unique** condition) and the 'singleton set' requirement contributed by the singular anaphor (i.e. the **unique** condition).

Finally, infelicitous donkey sentences like (81) below, in which the indefinite is singular and the pronoun is plural, can be ruled out if we take them to instantiate a clash in morphological / syntactic number. That is, following once again in the footsteps of Evans (1980), we assume a distinction between morphological / syntactic number and semantic number: telescoping discourses like (74) above and singular donkey anaphora to quantifiers like the one in (79) above are infelicitous because they involve a clash in semantic number (but not in morphological / syntactic number), while donkey sentences like (81) below are infelicitous because they involve a mismatch in morphological / syntactic number (but no clash in semantic number since plural pronouns are compatible with semantic singularity[24]).

[22] See Brasoveanu (2007a) for a detailed discussion of the (variable nature of the) uniqueness effects exhibited by various anaphoric structures, including donkey anaphora and quantificational subordination structures, and their PCDRT account.

[23] The meanings for singular and plural pronouns in (33) and (34) above also account for the fact that the most salient interpretation of the discourse in (*i*) below (Wang et al. 2006: 7, (20)) is that all men love the same woman, i.e. the wide-scope indefinite reading, in contrast to the discourse in (68) above, where the most salient reading is the narrow-scope indefinite one.

(*i*) Every^{u} man loves a$^{u'}$ woman. They$_{u}$ bring her$_{u'}$ flowers to prove this.

We can obtain the narrow-scope indefinite reading for discourse (*i*) – to the extent this reading is available – if we take plural pronouns to be optionally interpreted as distributive, i.e. $\textbf{\textit{they}}_{u} \rightsquigarrow \lambda P_{\mathbf{et}}.\ [u \neq \emptyset];\ _{u}(P(u))$.

[24] Much like in the static semantics for number morphology in Sauerland (2003).

81. #Every boy^{u} who read a$^{u'}$ *Harry Potter* book recommended them$_{u'}$ to his$_{u}$ friends.

5 Exceptional Wide Scope as Quantificational Subordination

This section outlines a novel solution to the problem of exceptional scope (ES) of (in)definites, first noticed in Farkas (1981) and Fodor & Sag (1982) – a problem that is still open despite the many insightful attempts in the literature to solve it. The novel account brings further empirical support for the way in which PCDRT captures anaphora to quantificational dependencies (i.e. structured anaphora) in natural language.

The ES cases we will focus on are the widest and intermediate scope readings of (82), the first order translations of which are provided in (85) and (84) below respectively. Note that the narrowest scope reading is truth-conditionally the strongest reading – unlike the usual *Every student read a paper* kind of examples, in which the narrowest scope reading is the weakest.

82. Every$^{u \sqsubseteq r}$ student of mine read every$^{u'}$ poem that a$^{u'' \sqsubseteq r''}$ famous Romanian poet wrote before World War II.
83. Narrowest scope (NS) indefinite:
$\forall x(stud(x) \rightarrow \forall y(poem(y) \wedge \exists z(poet(z) \wedge write(z, y)) \rightarrow read(x, y)))$
84. **a.** Intermediate scope (IS) indefinite:
$\forall x(stud(x) \rightarrow \exists z(poet(z) \wedge \forall y(poem(y) \wedge write(z, y) \rightarrow read(x, y))))$
b. Context for the IS reading: (At the beginning of the year:) Every^{r} student chose a$^{r''}$ (different) poet. (By the end of the year:) (82)
85. **a.** Widest scope (WS) indefinite:
$\exists z(poet(z) \wedge \forall x(stud(x) \rightarrow \forall y(poem(y) \wedge write(z, y) \rightarrow read(x, y))))$
b. Context for the WS reading: (At the beginning of the year:) Every^{r} student chose a$^{r''}$ poet – the$_{r''}$ same poet. (By the end of the year:) (82)

The crucial observation is that the availability of the ES readings is dependent on the discourse context relative to which sentence (82) is interpreted. In particular, the IS reading is available when (82) is interpreted in the context provided by (84b), which in fact forces an IS interpretation. Similarly, the WS reading is the only available one in the context provided by (85b). Thus, I follow Farkas (1997: 184) in taking scope to be essentially discoursal: the syntax/semantics interface underdetermines scopal relations – it only specifies "when an expression *may* be in the scope of another, but not when it *must* be in its scope".[25]

The proposal is that ES readings are available when sentence (82) is interpreted as an instance of quantificational subordination, i.e. as anaphoric to quantifier domains and quantificational dependencies introduced in the previous discourse, i.e. when the two *every* determiners and the indefinite article in (82) further elaborate on the sets of individuals and the correlations between them introduced in (84b) and (85b). I take the indefinite article to receive a weak reading only for simplicity; the analysis also goes through if the indefinite has a strong reading.

[25] That is, quantificational subordination in the more general sense of structured anaphora to quantifier domains is a very common phenomenon – it is, for example, the source of the joke in (*i*) below, where the domain of the quantifier *very few people* ought to be restricted by the generic quantification in the previous sentence.

(*i*) If you live to be one hundred, you've got it made. Very few people die past that age. (George Burns)

The IS interpretation arises because of the presence in the input discourse context of a function pairing u-students and u''-Romanian poets that rules out the possibility of co-variation between u''-poets and u'-poems. The WS reading arises because the value of the discourse referent (dref) r'', i.e. the value of the domain restrictor for the indefinite, is constant, thereby ruling out any possibility of co-variation. Finally, the NS reading arises by default, when there are no special contextual restrictions on the indefinite article and the *every* determiners.

Unlike the tradition inaugurated in Fodor & Sag (1982) and varied upon in Reinhart (1997) and Kratzer (1998), (in)definites are not ambiguous between their ordinary existential meanings and choice-function based meanings. Moreover, there is no need to posit covert syntactic movement violating island constraints, special storage mechanisms (as in Abusch 1994) or special choice-functional variables (as in Winter 1997). The proposal builds on the insight in Schwarzschild (2002) concerning the crucial role of contextual restrictions in the genesis of ES readings without, however, relying on his singleton quantifier domain restriction.

The analysis relies on two independently motivated assumptions: (*i*) the discourse context stores not only (sets of) individuals that are mentioned in discourse, but also dependencies between them (already needed for quantificational subordination, telescoping and donkey anaphora), and (*ii*) quantifier domains are always contextually restricted. The compositionally obtained update contributed by (82) is provided in (89) below (simplified in various ways, e.g. redundant distributivity operators are omitted).

86. ***det***$^{u \sqsubseteq r, u' \sqsubseteq u} \rightsquigarrow$
$\lambda P_{\mathbf{et}}.\lambda P'_{\mathbf{et}}.\ \mathbf{max}^{u \sqsubseteq r}(_{\langle u \rangle}(P(u)));\ \mathbf{max}^{u' \sqsubseteq u}(_{\langle u' \rangle}(P'(u')));\ [\mathbf{DET}\{u, u'\}]$
87. ***every***$^{u \sqsubseteq r} \rightsquigarrow \lambda P_{\mathbf{et}}.\lambda P'_{\mathbf{et}}.\ \mathbf{max}^{u \sqsubseteq r}(_{u}(P(u)));\ _{u}(P'(u))$
88. ***a***$^{u'' \sqsubseteq r''} \rightsquigarrow \lambda P_{\mathbf{et}}.\lambda P'_{\mathbf{et}}.\ \mathbf{max}^{u'' \sqsubseteq r''}(_{u''}(P(u'');\ P'(u''))),$
which, if there is no anaphora to the dref u'' introduced by the indefinite, can be substituted *salva veritate* with the non-max translation: ***a***$^{u'' \sqsubseteq r''} \rightsquigarrow \lambda P_{\mathbf{et}}.\lambda P'_{\mathbf{et}}.\ [u'' \mid u'' \sqsubseteq r''];\ _{u''}(P(u'');\ P'(u''))$[26]
89. ***every***$^{u \sqsubseteq r}$ ***student of mine read every***$^{u'}$ ***poem that a***$^{u'' \sqsubseteq r''}$ ***Romanian poet wrote*** $\rightsquigarrow$
$\mathbf{max}^{u \sqsubseteq r}([stud\{u\}]);\ _{u}(\mathbf{max}^{u'}([poem\{u'\}];\ _{u'}([u'' \mid u'' \sqsubseteq r'', poet\{u''\}, write\{u'', u'\}])));\ [read\{u, u'\}]$

The update in (89) can be paraphrased as follows: first, we introduce the dref u and store in it all the speaker's students among the previously introduced r-individuals (as required by $\mathbf{max}^{u \sqsubseteq r}$). Then, relative to each u-student (as required by the distributivity operator $_{u}(\dots)$), we introduce the set of all poems written by a Romanian poet and store these poems in dref u', while storing the corresponding poets in dref u''. Finally, we test that each u-student read each of the corresponding u'-poems. The output info state obtained after updating with (89) stores the set of all r-students in dref u, the corresponding r''-Romanian poets in u'' and the set of all poems written by a u''-poet in u'.

The update in (89) yields the NS indefinite reading if there are no special constraints on the restrictor dref's r and r''. If the discourse context places particular constraints on these dref's, as the sentences in (84b) and (85b) above do, the update in (89) yields different truth-conditions, namely the truth-conditions associated with the IS and WS readings.

Consider the update contributed by sentence (84b) first, provided in (90) below (simplified in various ways): the output info state obtained after we process 90) stores a dependency associating

[26] See Sect. (5.1) below for mode discussion of the meaning assigned to indefinite articles.

each r-student with the r''-poet that s/he chose. Consequently, the update in (89) above will retrieve this dependency and further elaborate on it, thereby yielding the IS reading.

90. The context for the IS reading:
    every^r student chose a$^{r''}$ poet $\rightsquigarrow$ $\mathbf{max}^r([stud\{r\}]);\ _r([r''\,|\,poet\{r''\}, choose\{r, r''\}])$

Similarly, the update contributed by sentence (85b) – provided in (91) below – ensures that the output info state stores the same r''-poet relative to every r-student. This is required by the update-final $\mathbf{unique}\{r''\}$ condition contributed by the parenthetical ***the$_{r''}$ same poet***[27]; crucially, the condition is outside the scope of the distributivity operator $_r(\dots)$ introduced by ***every^r***. When the update in (89) anaphorically retrieves and elaborates on this *contextually* singleton indefinite (i.e. singleton in the plural info state, but not necessarily relative to the entire model – as Schwarzschild (2002) would have it), we obtain the WS reading.

91. The context for the WS reading:
    every^r student chose a$^{r''}$ poet – the$_{r''}$ same poet $\rightsquigarrow$
    $\mathbf{max}^r([stud\{r\}]);\ _r([r''\,|\,poet\{r''\}, choose\{r, r''\}]);\ [\mathbf{unique}\{r''\}]$

Summarizing, the readings of sentence (82) differ with respect to whether the indefinite co-varies with another DP or not, and if it does, which of the two *every*-DPs it co-varies with. Traditionally, this sort of (in)dependence was the result of the structural relation between the existential quantifier contributed by the indefinite and the two universal quantifiers contributed by the two *every*-DPs. Previous *in situ* analyses, including Schwarzschild (2002), employ implicit arguments present in the interpretation of the indefinite (as arguments of a choice function or as implicit arguments in the restrictor) that could be left free (WS reading) or that could be bound by the first universal (IS reading) or the second (NS reading). In contrast, the present account dispenses with bound implicit arguments in favor of independently needed contextually introduced and stored dependencies.

Finally, the PCDRT account of exceptional wide scope as structured anaphora to quantifier domains generalizes to exceptional wide scope in downward entailing contexts – that is, unlike some choice- / Skolem-function based approaches, we can solve the problem posed by exceptional scope readings in downward entailing contexts (noticed in Chierchia 2001). To see what the puzzle is, consider sentence (92) below; its most salient reading, provided in (93), has the indefinite *some*$^{u''\sqsubseteq r''}$ taking ES scope intermediately between the two universal quantifiers.

92. Every$^{u\sqsubseteq r}$ linguist that studied every$^{u'}$ solution that some$^{u''\sqsubseteq r''}$ problem might have has become famous.
93. The most salient reading of (92): $\forall x(linguist(x) \wedge \exists z(problem(z) \wedge \forall y(solution(y) \wedge might\_have(z,y) \rightarrow study(x,y))) \rightarrow famous(x))$
94. $\forall x(linguist(x) \wedge \forall y(solution(y) \wedge might\_have(\mathbf{f}(problem), y) \rightarrow study(x,y))) \rightarrow famous(x))$
95. $\forall x(linguist(x) \wedge \exists \mathbf{f}(\forall y(solution(y) \wedge might\_have(\mathbf{f}(problem), y)) \rightarrow study(x,y))) \rightarrow famous(x))$

As Chierchia (2001) observes, 'free choice-function variable' approaches (Kratzer 1998, Matthewson 1999) represent sentence (92) as shown in (94) above, while 'intermediate existential closure' approaches (Reinhart 1997, Winter 1997) represent it as shown in (95). The former kind of approaches derive truth conditions that are too weak: "formula [(94)] will be verified by any problem whatsoever for which some linguist didn't consider every solution (for that makes the antecedent false, and

[27] See Sect. 5.3 below for more discussion of the meaning of *same*

hence the whole formula true)" (Chierchia 2001). The latter kind of approaches derive the correct truth conditions, but allowing for non-local, intermediate-level existential closure of choice-function variables nullifies much of the initial motivation for choice functions, namely that they enables us to give the indefinite exceptional scope (semantically), while syntactically leaving it *in situ*. If we need to existentially bind choice function variables in the way shown in (95) above, we could very well allow for a similar existential closure procedure over individual-level variables – and this will account for pretty much the same range of cases without any recourse to choice functions.

In contrast, the PCDRT account proceeds as before: in a context like (96) below, which provides a suitable dependency between the restrictor dref's r and r'', the representation of sentence (92), given in (97), derives the intuitively correct truth-conditions.

96. Context for the most salient reading of (92):
Every scientist^{r} has a$^{r''}$ favorite problem that she$_{r}$ studied systematically. (And being systematic is enough to bring one fame in linguistics:) (92)
97. $(context: \mathbf{max}^{r}([scientist\{r\}]);\ _{r}([r''\,|\,problem\{r''\}, study\{r, r''\}]))$
$\mathbf{max}^{u \sqsubseteq r}([linguist\{u\}];\ _{u}(\mathbf{max}^{u'}([solution\{u'\}];\ [u''\,|\,u'' \sqsubseteq r'', problem\{u''\}];$
$[might\_have\{u'', u'\}]));\ [study\{u, u'\}]);\ [famous\{u\}]$

The PCDRT analysis of the ES example in (92) does not face the same problems as choice-/Skolem-function analyses because the quantifier ***every*** is not analyzed in terms of material implication. The PCDRT analysis also generalizes to other kinds of downward entailing contexts besides the restrictor of ***every*** – consider, for example, the wide-scope negation sentence in (98) below, also from Chierchia (2001). We can derive the correct truth-conditions for this sentence, provided in (99) below, if we represent it as shown in (100). The crucial point is the introduction / accommodation of the dref r'' that provides the domain restrictor for the indefinite ***some***$^{u'' \sqsubseteq r''}$ ***problem*** intermediately between the two universal quantifiers ***every***^{u} ***linguist*** and ***every***$^{u'}$ ***linguist***.

98. Not every^{u} linguist studied every$^{u'}$ solution that some$^{u'' \sqsubseteq r''}$ problem might have.
99. The most salient reading of (98): $\exists x(linguist(x) \wedge$
$\forall z(problem(z) \rightarrow \exists y(solution(y) \wedge might\_have(z, y) \wedge \neg study(x, y))))$
100. $\sim (\mathbf{max}^{u}([linguist\{u\}]);\ _{u}([r''];\ \mathbf{max}^{u'}([solution\{u'\}];$
$[u''\,|\,u'' \sqsubseteq r'', problem\{u''\}, might\_have\{u'', u'\}]));\ [study\{u, u'\}])$

The above account of ES under negation in terms of a suitable restrictor dref accommodation is just an extreme case of the proposed account of ES as structured anaphora to quantifier domains – and it generalizes to upward entailing contexts instantiated by the first example we considered (see (82) above) or the example in (101) below, identical to (98) above except for the absence of negation.

101. Every^{u} linguist studied every$^{u'}$ solution that some$^{u'' \sqsubseteq r''}$ problem might have.
$\mathbf{max}^{u}([linguist\{u\}]);\ _{u}([r''];\ \mathbf{max}^{u'}([solution\{u'\}];$
$[u''\,|\,u'' \sqsubseteq r'', problem\{u''\}, might\_have\{u'', u'\}]));\ [study\{u, u'\}]$

Accommodating the restrictor dref for the indefinite between the two universal quantifiers is reminiscent of the 'intermediate existential closure of choice-function variables' in Reinhart (1997) and Winter (1997) (to the extent that any new dref is implicitly a Skolem function in any dynamic system based on plural info states) and of the (ultimately) movement-based accounts in Farkas (1997) and Geurts (2007). However, the PCDRT account does not need choice-function variables or the postulation of a special evaluation order or a special presupposition associated with ES indefinites: the accommodation procedure for domain restrictors is independently needed to capture the behavior of presupposition projection and accommodation in general (for a recent discussion, see Beaver & Zeevat 2007).

5.1 Weak and Strong Donkey Readings

The availability of domain-restricting dref's r, r' etc. enables us to provide a non-ambiguity analysis of weak / strong donkey readings that improves on the proposal in (29) and (30) above. The PCDRT translation for indefinite articles is provided in (102) below: an indefinite introduces the maximal set of individuals u among a contextually provided set of individuals r that satisfy both the restrictor and the nuclear scope property.

102. $\mathfrak{a}^{u\sqsubseteq r} \rightsquigarrow \lambda P_{\mathbf{et}}.\lambda P'_{\mathbf{et}}.\ \mathbf{max}^{u\sqsubseteq r}({}_{u}(P(u);\ P'(u)))$

As the reader can check, if there is no anaphora to the dref u introduced by the indefinite, the **max**-based meaning can be substituted *salva veritate* with the non-**max** meaning $\mathfrak{a}^{u\sqsubseteq r} \rightsquigarrow \lambda P_{\mathbf{et}}.\lambda P'_{\mathbf{et}}.\ [u\,|\,u \sqsubseteq r];\ {}_{u}(P(u);\ P'(u))$.

If there is no salient restrictor dref r that can be anaphorically retrieved, we accommodate it, as shown in (103) below. The accommodation procedure has two extreme cases, which are by default available because they do not require any contextually salient, non-trivial condition / property to constrain the restrictor dref r: (*i*) we just introduce a new dref r whose value is left completely unconstrained (except for the trivially satisfied non-emptiness condition $r \neq \emptyset$[28]), which results in the weak reading for the indefinite – as shown in (104) below; (*ii*) we introduce a new dref r that stores all the individuals, which results in the strong reading for the indefinite – as shown in (105) below.

103. accommodating the domain restrictor of an indefinite:
 $\mathfrak{a}^{u\sqsubseteq r,\mathbf{conditions}:r} \rightsquigarrow \lambda P_{\mathbf{et}}.\lambda P'_{\mathbf{et}}.\ [r\,|\,\mathbf{conditions}\{r\}];\ \mathbf{max}^{u\sqsubseteq r}({}_{u}(P(u);\ P'(u)))$
104. weak donkey readings (accommodating an arbitrary restrictor):
 $\mathfrak{a}^{u\sqsubseteq r,r} \rightsquigarrow \lambda P_{\mathbf{et}}.\lambda P'_{\mathbf{et}}.\ [r\,|\,r \neq \emptyset];\ \mathbf{max}^{u\sqsubseteq r}({}_{u}(P(u);\ P'(u)))$,
 basically: $\mathfrak{a}^{u}$ (or: $\mathfrak{a}^{\mathbf{wk}:u}$) $\rightsquigarrow \lambda P_{\mathbf{et}}.\lambda P'_{\mathbf{et}}.\ [u];\ {}_{u}(P(u);\ P'(u))$
105. strong donkey readings (accommodating the set of all individuals):
 $\mathfrak{a}^{u\sqsubseteq r,\mathbf{max}:r} \rightsquigarrow \lambda P_{\mathbf{et}}.\lambda P'_{\mathbf{et}}.\ \mathbf{max}^{r}([r \neq \emptyset]);\ \mathbf{max}^{u\sqsubseteq r}({}_{u}(P(u);\ P'(u)))$,
 basically: $\mathfrak{a}^{\mathbf{max}:u}$ (or: $\mathfrak{a}^{\mathbf{str}:u}$) $\rightsquigarrow \lambda P_{\mathbf{et}}.\lambda P'_{\mathbf{et}}.\ \mathbf{max}^{u}({}_{u}(P(u);\ P'(u)))$

In general, maximal accommodation, i.e. the second of the two default options, seems to be preferred. Perhaps the most suggestive kind of evidence for this preference is provided by discourses involving singular cross-sentential anaphora like (1) and (2) above (recall also the Evans example *There is a doctor in London and he is Welsh*), where the (relativized) uniqueness effects are a consequence of the maximality of the indefinite article in conjunction with the **unique** condition contributed by the singular anaphor.

The revised account of weak / strong donkey readings in terms of domain restrictions on the indefinite builds on the insight and (informal) suggestions in Barker (1996: 254-258) (see also the discussion in Schein 2003: 342-345) and can be taken to accomplish the task – left there for future research – of formalizing the proposal and developing it into a more complete account of weak / strong

[28] Equivalently, we can use the identity condition $r = r$. Identity is defined as expected, i.e.: $u = u' \stackrel{\text{def}}{=} \lambda I_{st}.\ I_{u\neq\#} \neq \emptyset \wedge \forall i_s \in I(ui = u'i)$.

alternations[29]. As (104) and (105) above show, the revised account is formally reducible to the old one[30]; theoretically, however, the revised account superior: the variation in meaning is now attributed to different ways of resolving the independently needed domain restrictor anaphora and we do not need to postulate that the indefinite article is lexically ambiguous between two very closely related meanings.

5.2 Anaphoric and Uniqueness-Implying Definite Descriptions

The availability of domain-restricting dref's also enables us to account for both anaphoric and unique uses of definite descriptions with only one meaning. The two uses are exemplified by discourse (2) above: the definite DP ***the banquet*** in (2b) is not anaphoric to a previously mentioned banquet and it implies uniqueness (the banquet is unique per convention), while the definite DP ***the woman*** in (2c) is anaphoric – its antecedent is the indefinite ***a woman*** in (2a). Similarly, the discourse in (106) below (see Roberts 2003: 290, (3)) exemplifies both uses of definite descriptions.

106. (Teacher, giving directions:) On the next page, you will find a puzzle. Find the clown (unique, non-anaphoric) in the puzzle (anaphoric).

The meanings for ***the***$_{\mathbf{sg:u}}$ and ***the***$_{\mathbf{sg:u}}$ provided in (35) and (37) above captured the two uses of definite articles – but this analysis of the definite article is not entirely satisfactory because it postulates a lexical ambiguity between two meanings that, intuitively, are rather closely related and because it predicts that Russellian, non-anaphoric definites are freely available, while, in fact, their distribution is fairly restricted (basically, they occur only in bridging-like cases and in inherently unique descriptions like superlatives etc.). I will therefore follow the proposal in Farkas (2002a) (see, in particular, her notion of determined reference) and assign a single meaning to definite articles, which incorporates features from both the anaphoric (Heimian) and the uniqueness-based (Russellian) analysis of definite descriptions, i.e. that requires them to be unique in context, as shown in (107) below[31].

107. $\textit{the}^{\mathbf{sg}:u\sqsubseteq r} \leadsto \lambda P_{\mathbf{et}}.\lambda P'_{\mathbf{et}}.\ \underline{{}_r(P(r))};\ \mathbf{max}^{u\sqsubseteq r}({}_u(P(u)));\ [\mathbf{unique}\{u\}];\ P'(u),$
   basically: $\textit{the}_{\mathbf{sg:r}} \leadsto \lambda P_{\mathbf{et}}.\lambda P'_{\mathbf{et}}.\ P(r);\ [\mathbf{unique}\{r\}];\ P'(r)$

In contrast to indefinites, the restrictor dref r of a definite cannot be accommodated (except in the special cases discussed below) and has to be anaphorically resolved. Moreover, the restrictor property of the definite article has to be satisfied by the anaphorically retrieved restrictor – underlining in (107) indicates the presuppositional status of the DRS $\underline{{}_r(P(r))}$[32]. These two features of the meaning for

[29] For a detailed comparison with alternative approaches to weak / strong donkey alternations (e.g., the one in Kanazawa 1994), see Brasoveanu (2007a).

[30] Hence, the revised proposal preserves all the results of the previous one, including a compositional account of mixed weak & strong donkey sentences like *Every*^{u} *person who buys a*$^{str:u'}$ *book on amazon.com and has a*$^{wk:u''}$ *credit card, uses it*$_{u''}$ *to pay for it*$_{u'}$.; see Brasoveanu (2007a) for more discussion of this kind of donkey sentences.

[31] For a different way of thinking about the contextually-relativized uniqueness of definite descriptions, see Roberts (2003) and Kamp (2007).

[32] Generalized determiners that anaphorically retrieve their restrictor dref r can also be taken to presuppose that r satisfies their restrictor property, as shown in (*i*) below. This hypothesis, together with the generally accepted assumption that presuppositions triggered in the nuclear scope of a quantification have to be satisfied relative to the restrictor of that quantification, enables us to derive the observation in Beaver & Zeevat (2007) (and references therein) that the presupposition triggered by the possessive *his*$_u$ *king* in discourse (*ii*) below (from Beaver & Zeevat 2007) has to be satisfied relative to the dref r restricting the quantifier *every*$^{u\sqsubseteq r}$ *man*, thereby yielding the

definite articles (resistance to accommodation and presupposing the restrictor) are the PCDRT reformulation of the anaphoric analysis of definites in Heim (1982); the $\mathbf{max}^u$ & $\mathbf{unique}\{u\}$ combination in (107) is just the PCDRT reformulation of the Russellian analysis.

Definites whose restrictor property is (based on) an anaphoric relational noun, e.g. $\textit{banquet}_{u'} \rightsquigarrow \lambda v_{\mathbf{e}}.\ [banquet\{v,u'\}]$ in discourse (2) above is anaphoric to u'-conventions, allow for the accommodation of the restrictor dref r because the anaphoricity of the definite article is vicariously satisfied by the anaphoricity of the relational noun. The translation of such bridging definites – before the restrictor dref r is accommodated – is provided in (108) below.

108. $\textit{the}^{\mathbf{sg}:\mathrm{u}\sqsubseteq\mathrm{r}}\ \textit{banquet}_{u'} \rightsquigarrow \lambda P_{\mathbf{et}}.\ \underline{[banquet\{r,u'\}]};\ \mathbf{max}^{u\sqsubseteq r}([banquet\{u,u'\}]);\ [\mathbf{unique}\{u\}];\ P(u)$

Just as in the case of indefinites (see the previous section), the accommodation of the restrictor dref r can by default proceed in two ways. One option is to just introduce the dref r and make sure it satisfies the presupposition of the definite, i.e. its restrictor property, as shown in (110) below. This gives us the basic analysis of weak definites in Rawlins (2006) (see also Barker 1991, 2005, Poesio 1994).

Weak definites, like *the cube* in discourse (109) below (based on Rawlins 2006: 341, (13)), are neither unique nor anaphoric: a cube has multiple sides and no particular side is mentioned in the discourse that precedes the weak definite. Hence, neither of the two most prominent analyses of definite descriptions (the uniqueness-based, Russellian one and the anaphoric, Heimian one) can account for them. In PCDRT, however, their analysis follows from two independently motivated components: the meaning for definite articles in (107) above and the accommodation procedure in (104) above, needed to account for weak donkey readings.

109. **a.** In the center of the room is a$^{u'}$ stone cube.
b. Engraved on the$^{u\sqsubseteq r}$ side$_{u'}$ is some lettering.
110. weak definites – existence & non-uniqueness (accommodating an arbitrary restrictor):
$\textit{the}^{\mathbf{sg}:\mathrm{u}\sqsubseteq\mathrm{r},\mathrm{r}}\ \textit{side}_{u'} \rightsquigarrow \lambda P_{\mathbf{et}}.\ [r \,|\, side\{r,u'\}];\ \mathbf{max}^{u\sqsubseteq r}([side\{u,u'\}]);\ [\mathbf{unique}\{u\}];\ P'(u),$
basically: $\textit{the}^{\mathbf{sg}:\mathrm{u}}\ \textit{side}_{u'} \rightsquigarrow \lambda P_{\mathbf{et}}.\ [u \,|\, side\{u,u'\}];\ [\mathbf{unique}\{u\}];\ P(u)$

The other option for the accommodation of the restrictor dref – parallel to the one in (105) above, which delivers strong donkey readings – is to store in r the maximal set of individuals that satisfies the presupposition of the definite, as shown in (111) below. This gives us genuine maximality, which, together with the **unique** condition contributed by singular number morphology, gives us the Russellian meaning for definite articles. Just as in the case of indefinites, there is a general preference for maximal accommodation, which yields the uniqueness implications commonly associated with definite descriptions.

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interpretation: every one of the seventeen men has a king and they all love their respective king.

(i) $\textit{det}^{u\sqsubseteq r, u'\sqsubseteq u} \rightsquigarrow$
$\lambda P_{\mathbf{et}}.\lambda P'_{\mathbf{et}}.\ \underline{r(P(r))};\ \mathbf{max}^{u\sqsubseteq r}({}_{\langle u\rangle}(P(u)));\ \mathbf{max}^{u'\sqsubseteq u}({}_{\langle u'\rangle}(P'(u')));\ [\mathbf{DET}\{u,u'\}]$
(ii) **a.** There are seventeen^r men in the room. **b.** Every man$^{u\sqsubseteq r}$ loves his$_u$ king.

However, just like indefinites (and unlike definites), generalized determiners always have the option of accommodating their restrictor dref r and, by the same token, all the presuppositions that r has to satisfy. This is how we derive the fact that an out of the blue utterance of sentence (iib) can be interpreted as: every man who has a king loves him.

111. Russellian definites – existence & uniqueness (accommodating the set of all individuals):
$\textit{the}^{\mathbf{sg}:u\sqsubseteq r, \mathbf{max}:r}\ \textit{banquet}_{u'} \rightsquigarrow$
$\lambda P_{\mathbf{et}}.\ \mathbf{max}^{r}([banquet\{r, u'\}]);\ \mathbf{max}^{u\sqsubseteq r}([banquet\{u, u'\}]);\ [\mathbf{unique}\{u\}];\ P(u),$
basically: $\textit{the}^{\mathbf{sg},\mathbf{max}:u}\ \textit{bqt}_{u'} \rightsquigarrow \lambda P_{\mathbf{et}}.\ \mathbf{max}^{u}([bqt\{u, u'\}]);\ [\mathbf{unique}\{u\}];\ P(u)$

5.3 *Same*, *Different* and Quantifier Scope

The fact that, in PCDRT, we can represent structured quantifier domains, retrieve them anaphorically, place constraints on them in a syntactically non-local manner and relate various quantifier domains to one another enables us to analyze adjectival items like *same* and *different* and their interactions with quantifier scope in a way that captures the intuition (going back at least to Dowty (1985); see also Beck (2000)) that *same* and *different* are pronoun-like items and their semantic behavior is a consequence of their pronominal nature.

Consider the sentences in (112) and (113) below – intuitively, they have two readings (as observed in Carlson (1987); see also Alrenga (2007) and Barker (2007) for recent discussions): (*i*) a deictic reading, according to which every student chose a poet that is the same as / different from a contextually salient poet (e.g. the poet that the teacher chose), and (*ii*) an internal one, according to which every student chose a poet and, for any two students, the poets they chose are the same individual / two distinct individuals.

112. Every^{u} student chose $\text{the}^{\mathbf{sg}:u'\sqsubseteq r'}$ $\text{same}_{r'\div u}$ poet.
113. Every^{u} student chose $\text{a}^{u'\sqsubseteq r'}$ $\text{different}_{r'\div u}$ poet.

I will confine myself to analyzing the internal reading of sentences (112) and (113), leaving the generalization of this basic account for another occasion[33]. The proposal is that *same* and *different* contribute presuppositional constraints on the domain restrictor of their definite / indefinite DP – and these constraints are anaphoric to the dref previously introduced by a suitable (distributive) quantifier.

For example, in (112) and (113) above, the adjectives *same* and *different* require the dref r' restricting their respective DP's to be related in a particular way to the quantifier domain u introduced by *every*: $\underline{\mathbf{same}_{r'\div u}}$ requires r' to store the same individual relative to all u-individuals, while $\underline{\mathbf{diff}_{r'\div u}}$ requires r' to store different individuals relative to different u-individuals – as shown in (114) and (115) below[34].

The PCDRT representations for sentences (112) and (113) obtained after presupposition resolution[35] are provided in (116) and (117) below. In both cases, the presuppositional conditions introduced by the adjectives *same* and *different* are interpreted as 'high' as possible, i.e. as soon as the dref u is introduced; the restrictor dref r' is introduced at that same site, in parallel to the way restrictor dref's are introduced / accommodated for weak indefinites and bridging weak definites (see (104) and (110) above). The resulting representation for the quantifier *every student* is reminiscent of the 'discontinuous quantification' approach in Stump (1982) and Keenan (1992) – without actually postulating the existence of discontinuous quantifiers.

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[33] The full account will have to capture not only deictic readings, but also the interactions between *same* / *different* and distributive / collective predications (see Carlson 1987), their NP-internal uses (see Barker 2007), their interaction with generalized conjunction / disjunction etc.
[34] Note the similarity between the definition of the **same** condition and the definition of the **unique** condition in (31) above.
[35] I assume a presupposition resolution procedure of the kind proposed in van der Sandt (1992).

114. $\underline{\mathbf{same}_{r' \div u}} \overset{\text{def}}{=}$
$\lambda I_{st}.\ I_{u=\#} \subseteq I_{r'=\#} \wedge \forall x_e \in uI_{u\neq\#}(I_{u=x,r'\neq\#} \neq \emptyset) \wedge \forall i_s \in I_{r'\neq\#} \forall i'_s \in I_{r'\neq\#}(r'i = r'i')$

115. $\underline{\mathbf{diff}_{r' \div u}} \overset{\text{def}}{=}$
$\lambda I_{st}.\ I_{u=\#} \subseteq I_{r'=\#} \wedge \forall x_e \in uI_{u\neq\#}(I_{u=x,r'\neq\#} \neq \emptyset) \wedge \forall i_s \in I_{r'\neq\#} \forall i'_s \in I_{r'\neq\#}(ui \neq ui' \rightarrow r'i \neq r'i')$

116. $\mathbf{max}^u([r' \,|\, \mathbf{same}_{r' \div u}];\ _u([stud\{u\}]));\ _u(\mathbf{max}^{u' \sqsubseteq r'}([poet\{u'\}];\ [\mathbf{unique}\{u'\}];\ [choose\{u, u'\}])$

117. $\mathbf{max}^u([r' \,|\, \mathbf{diff}_{r' \div u}];\ _u([stud\{u\}]));\ _u(\mathbf{max}^{u' \sqsubseteq r'}([poet\{u'\}];\ [choose\{u, u'\}]))$

The analysis outlined here enables us to give an explanation for two facts observed in Barker (2007: Sect. 5.7): (*i*) we have to use the definite article with ***same*** – the indefinite DP ***a same poet*** is not acceptable; (*ii*) definite descriptions involving ***same*** do not trigger existence presuppositions, unlike typical definite descriptions like ***the Romanian poet*** – compare, for example, (118) and (119) below.

118. Did every student choose the same poet?
119. Did every student choose the Romanian poet?

The anaphoric PCDRT analysis captures both generalizations. We use the definite article because the presupposition contributed by ***same*** guarantees uniqueness (or determined reference, to use the terminology in Farkas (2002a)) and, *ceteris paribus*, we will use the strongest possible article (note that, in a generalized sense of entailment, the definite article entails / is stronger than the indefinite one). This kind of explanation is available to both non-anaphoric approaches like the one in Barker (2007) and anaphoric approaches like the PCDRT one.

But only anaphoric approaches can account for the fact that no existence presuppositions are associated with internal readings of ***same*** – in contrast to deictic readings, where definites are in fact associated with existence presuppositions. The lack of existence presuppositions is due to the restrictor dref r' being introduced / accommodated at the quantification-internal site where the presupposition contributed by ***same*** is resolved: the correlation between the non-projection of the existence presupposition and the internal resolution of the **same** presupposition follows from the fact that both of them target the same dref r' and the internal reading of ***same*** 'anchors' the domain restrictor r' to the dref u introduced by the quantifier ***every***. In the case of a deictic reading, the **same** presupposition targets a previously introduced, contextually salient dref – hence, the restrictor dref r' and its associated existence presupposition will also project out of the sentence.

6 A Parallel Account of Modal Subordination

In this section, I will briefly indicate how PCDRT can be extended to give a compositional account of modal subordination discourse like the one in (120) below (based on examples in Roberts 1987, 1989).

120. **a.** A^u wolf might come in. **b.** It$_u$ would attack Harvey first.

Under its most salient interpretation, (120) asserts that, for all the speaker knows, it is possible that a wolf comes in. Moreover, in *any* such epistemic possibility, the wolf attacks Harvey first. Discourse (120) is parallel to discourse (2) above: the interaction between the indefinite ***a^u wolf*** and the modal ***might*** on the one hand and the singular pronoun ***it$_u$*** and the modal ***would*** on the other hand is parallel to the interaction between ***a^u woman-every convention*** and ***she$_u$-always***.

The addition of another basic type **w** for possible worlds together with dref's p, p' etc. of type $s\mathbf{w}$ is almost everything that is needed to account for discourse (120). In the resulting Intensional PCDRT

(IP-CDRT) system, the dref's p, p' etc. store sets of possible worlds, i.e. *propositions*, relative to a plural info state, e.g. $pI \stackrel{\text{def}}{=} \{p_{s\mathbf{w}}i_s : i_s \in I_{st}\}$, i.e. pI is the image of the set of 'assignments' I under the function p. The basic IP-CDRT system is very much parallel to the PCDRT system introduced in the previous sections, so I provide only some of the relevant definitions. In particular, the definition of structured inclusion for sets of worlds in (123) below employs a dummy/exception world $\#_{\mathbf{w}}$[36] which makes every lexical relation false just as the dummy/exception individual $\#_e$ does.

121. $R_p\{u_1, \ldots, u_n\} \stackrel{\text{def}}{=} \lambda I_{st}.\ I_{p\neq\#, u_1\neq\#, \ldots, u_n\neq\#} \neq \emptyset \wedge \forall i_s \in I_{p\neq\#, u_1\neq\#, \ldots, u_n\neq\#}(R_{pi}(u_1 i, \ldots, u_n i))$[37]
122. $[p] \stackrel{\text{def}}{=} \lambda I_{st}.\lambda J_{st}.\ \forall i_s \in I(\exists j_s \in J(i[p]j)) \wedge \forall j_s \in J(\exists i_s \in I(i[p]j))$
123. $p' \sqsubseteq p \stackrel{\text{def}}{=} \lambda I_{st}.\ (p' \Subset p)I \ \wedge\ \forall i_s \in I(pi \in p'I_{p'\neq\#} \rightarrow pi = p'i)$,
where $p' \Subset p \stackrel{\text{def}}{=} \lambda I_{st}.\ \forall i_s \in I(p'i = pi \vee p'i = \#)$.

In an intensional Fregean/Montagovian framework, the compositional aspect of interpretation is largely determined by the types for the extensions of the 'saturated' expressions, i.e. names and sentences, plus the type that enables us to build intensions out of these extensions. Let us abbreviate them as **e**, **t** and **s** respectively. We preserve the dynamic types that PCDRT assigns to the 'meta-types' **e** and **t**, i.e. $\mathbf{t} \stackrel{\text{def}}{=} (st)((st)t)$ and $\mathbf{e} \stackrel{\text{def}}{=} se$; predictably, IP-CDRT uses possible-word dref's to build intensions, i.e. $\mathbf{s} \stackrel{\text{def}}{=} s\mathbf{w}$. Just as generalized determiners in PCDRT relate dynamic properties P, P' etc. of type **et** (see (28) above), modal verbs relate dynamic propositions $\mathbb{p}$, $\mathbb{p}'$ etc. of type **st**, as shown in (124) below. Moreover, just as a pronoun anaphorically retrieves an individual dref and makes sure that a dynamic property holds of that dref (see the meaning for ***she*** in (33) above), the indicative verbal mood anaphorically retrieves p^*, which is the designated dref for the actual world, and makes sure that a dynamic proposition holds of p^*, as shown in (125) below.

Finally, just as the quantifier ***always*** in (2b) is anaphoric to the nuclear scope set introduced by ***every convention*** in (2a), the modal quantifier ***would*** in (120b) is anaphoric to the nuclear scope set introduced by ***might*** in (120a). The general format for the translation of anaphoric modal quantifiers is provided in (126) below (cf. the translation of anaphoric determiners in (56) above); μ and ω are dref's for a modal base and an ordering source respectively, with contextually-suplied values (see Brasoveanu (2007a) for more details).

124. $\textit{if}^{p} + \textit{modal}_{\mu,\omega}^{p'\sqsubseteq p} \rightsquigarrow$
$\lambda\mathbb{p}_{\mathbf{st}}.\lambda\mathbb{p}'_{\mathbf{st}}.\lambda q_{\mathbf{s}}.\ \mathbf{max}^{p}(_{\langle p\rangle}(\mathbb{p}(p)));\ \mathbf{max}^{p'\sqsubseteq p}(_{\langle p'\rangle}(\mathbb{p}'(p')));\ [\mathbf{MODAL}_{q,\mu,\omega}\{p, p'\}]$
125. $\textit{indicative}_{p^*} \rightsquigarrow \lambda\mathbb{p}_{\mathbf{st}}.\ [\mathbf{unique}\{p^*\}];\ \mathbb{p}(p^*)$
126. $\textit{modal}_{\mu,\omega}^{p'\sqsubseteq p} \rightsquigarrow \lambda\mathbb{p}_{\mathbf{st}}.\lambda q_{\mathbf{s}}.\ \mathbf{max}^{p'\sqsubseteq p}(_{\langle p'\rangle}(\mathbb{p}(p')));\ [\mathbf{MODAL}_{q,\mu,\omega}\{p, p'\}]$

The IP-CDRT account successfully generalizes to more complex interactions between modal and invidual-level anaphora exhibited by naturally occurring discourses like (127) below (Thomas Aquinas, attributed).

127. **a.** [A] man cannot live without joy. **b.** Therefore, when he is deprived of true spiritual joys, it is necessary that he become addicted to carnal pleasures.

[36] We can take the dummy world $\#_{\mathbf{w}}$ to be the world where no individual whatsoever exists, hence all the lexical relations are false because a relation between certain individuals obtains at a particular world w only if those individuals exist in w.

[37] The definition of atomic conditions in (121) assumes static lexical relations $R_w(x_1, \ldots, x_n)$ of the expected intensional type $e^n(\mathbf{w}t)$, where $e^n\tau$ (for any type τ) is defined as: $e^0\tau \stackrel{\text{def}}{=} \tau$ and $e^{m+1}\tau \stackrel{\text{def}}{=} e(e^m\tau)$.

In particular, we are interested in the entailment relation established by therefore between the modal premise in (127a) and the modal conclusion in (127b) - and, to capture this, we need to account for several interrelated phenomena. First, we want to capture the meaning of the entailment particle *therefore*, which relates the content of the premise (127a) and the content of the conclusion (127b) and requires the latter to be entailed by the former. I take the content of a sentence to be truth-conditional in nature, i.e. the set of possible worlds in which the sentence is true, and entailment to be content inclusion, i.e. (127a) entails (127b) iff for any world w, if (127a) is true in w, so is (127b)). Second, we want to capture the meanings of (127a) and (127b), i.e. their context-change potentials, which encode both content (truth-conditions) and anaphoric potential.

Thus, on the one hand, we are interested in the contents of (127a) and (127b). They are both modal quantifications: (127a) involves a circumstantial modal base (to use the terminology in Kratzer 1981) and asserts that, in view of the circumstances, i.e. given that God created man in a particular way, as long as a man is alive, he must find some thing or other pleasurable; (127b) involves the same modal base and elaborates on the preceding modal quantification: in view of the circumstances, if a man is alive and has no spiritual pleasure, he must have a carnal pleasure. Note that we need to make the contents of (127a) and (127b) accessible in discourse so that the entailment particle therefore can relate them. On the other hand, we are interested in the anaphoric potential of (127a) and (127b), i.e. in the anaphoric connections between them. These connections are explicitly represented in discourse (128) below, which is intuitively equivalent to (127) albeit more awkwardly phrased.

128. **a.** (content q:) If^{p} a^{u_1} man is alive, he$_{u_1}$ must$_{p}$ find something pleasurable / he$_{u_1}$ must have a pleasure. **b.** Therefore$_{q,q'}$ (content q':) if$_{p}^{p'}$ he$_{u_1}$ doesn't have any spiritual pleasure, he$_{u_1}$ must$_{p'}$ have a carnal pleasure.

Discourse (127/128) is analyzed as a network of structured anaphoric connections and the meaning (and validity) of the Aquinas argument emerges as a consequence of the intertwined individual-level and modal anaphora. In particular, note that the conditional in (128b) is modally subordinated to the antecedent of the conditional in (128a), i.e. (128b) is interpreted as: if *a man is alive and* he doesn't have any spiritual pleasure, he must have a carnal pleasure. That is, we have an instance of multiply embedded modal subordination, since the two modalized conditionals are embedded under the modal quantification contributed by *therefore*.

Unlike most other approaches to modal subordination, IP-CDRT does not need any additional stipulations to allow anaphoric information to be non-locally available across multiple levels of quantificational embedding and to extracting and cross-sententially relate propositional contents for modal quantifications.

IP-CDRT also enable us to capture modal subordination across attitude reports, exemplified in (129) below (from Heim (1990); see van Rooy (1998) for an analysis of this phenomenon in a dynamic system that also builds on van den Berg (1996)) – and modal subordination across *de se* attitude reports[38], where we need to pass information about centered worlds across sentential boundaries, as in (130) below.

129. John thinks^{p} that he will$_{p}$ catch a^{u} fish and he hopes$_{p}^{p'}$ I will$_{p'}$ grill it$_{u}$ tonight.

130. John believes$^{p,u^{self}}$ that his$_{u^{self}}$ pants are$_{p}$ on fire and he hopes$_{p,u^{self}}^{p',u^{self\prime}}$ that he$_{u^{self\prime}}$ will$_{p'}$ find a fire extinguisher some time soon.

[38] For more discussion of *de se* reports, see Lewis (1979), Creswell & von Stechow (1982), Kaplan (1989), Chierchia (1989), Abusch (1997), Schlenker (1999) and Anand (2006) among others. For a comparison of dynamic and structured-proposition approaches, see Moltmann (2006) and Cumming (2007).

The centered worlds needed for *de se* reports are pairs / dependencies of the form (w, x^{self}), where w is an attitude internal world (a belief world, a hope world etc.) and x^{self}, the center of world w, is the individual that the attitude holder takes herself to be in w. Centered worlds are represented by means of a modal dref p and an individual dref u^{self} and the rows in a plural info state store the dependencies between worlds and their centers (note that we allow the same world to be associated with multiple centers, as argued for in Lewis (1979) – see, for example, his two-god scenario); see Cumming (2007) for an account of attitude reports and their interactions with anaphoric phenomena in a related dynamic framework.

Finally, given that IP-CDRT integrates in a rather even-handed way Montagovian and plural dynamic semantics, it is rather straightforward to incorporate the static analysis of questions in Groenendijk & Stokhof (1984) and provide an account of modal subordination in questions – a phenomenon first observed in van Rooy (1998) and analyzed there in a closely related dynamic system. The discourses below exemplifying this phenomenon are (based on examples) from van Rooy (1998). I leave a more detailed investigation of the interaction between structured anaphora, quantifier domain restrictions and information packaging (e.g. the phenomena investigated in von Fintel 1994, Lahiri 2002) for future research.

131. Who^{u} went to the party and what did they$_{u}$ bring as a present?
132. **Q:** Who^{u} went to the party? **A:** I don't know, but John wasn't one of them$_{u}$.
133. Which^{u} guest brought which$^{u'}$ present and where did they$_{u}$ buy them$_{u'}$?

This concludes our brief survey of IP-CDRT. It is hopefully clear that IP-CDRT enables us to provide an analysis of the modal subordination that is systematically parallel to the analysis of the quantificational subordination; for more detailed investigation of the anaphoric and quantificational parallels between the individual and modal domains, see Brasoveanu (2007a).

7 Comparison with Previous Approaches

PCDRT differs from most previous dynamic approaches in at least three respects. The first difference is conceptual: PCDRT captures the idea that reference to structure is as important as reference to value and that the two should be treated in parallel. This is primarily encoded in the definition of new dref introduction in (5) above, which differs from the corresponding definitions in van den Berg (1996), Krifka (1996), van Rooy (1998) and Nouwen (2003) (among others) with respect to the treatment of discourse reference to structure.

Capturing reference to structure as discourse reference to structure, i.e. by means of plural information states rather than by means of choice and / or Skolem functions (or dref's for such functions), is preferable because the arity of such functions and which particular functions are needed is determined by the discourse context and should, therefore, be encoded in the database that stores discourse information, i.e. the information state, and not in the representation of a lexical item (be it the anaphor and / or its antecedent).

Consider for example the discourse in (134) below; to capture the fact that sentence (134b) elaborates on the dependency between three sets of individuals (boys, gifts and girls) introduced in sentence (134a), Skolem function based approaches would need functions of a greater arity than the ones needed to account for discourse (2), for example, and the functions themselves would just repeatedly encode – in the meaning of certain lexical items – the dependency incrementally constructed in discourse. This being said, various assumptions and proposals are shared by PCDRT and the Skolem-function based approach in Steedman (2007), which deserves a more detailed discussion than what is possible here.

134. (The Christmas party organized by my son's school was kind of funny:)

a. Every^{u} boy bought a$^{u'}$ red pencil for every$^{u''}$ girl in his$_{u}$ class.

b. Invariably, the$_{u''}$ girl politely thanked the$_{u}$ boy for the$_{u'}$ gift and gave it$_{u'}$ back to him$_{u}$.

The second difference is empirical: the motivation for plural information states is provided by several distinct kinds of phenomena, including singular intra- and cross-sentential individual-level anaphora and modal anaphora and subordination, in contrast to the previous literature (e.g. van den Berg (1996), Krifka (1996) and Nouwen (2003)), which relies mostly on plural individual-level anaphora. Consequently, the empirical coverage of (Intensional) PCDRT is correspondingly broader and the dynamic import of various items, e.g. number morphology, is systematically investigated and compositionally encoded.

Finally, from a formal point of view, PCDRT accomplishes two non-trivial goals for the first time. On the one hand, it is not obvious how to recast van den Berg's Dynamic Plural Logic in classical type logic, given that the former logic is partial and conflates discourse-level plurality (i.e. the use of plural information states) and domain-level plurality (i.e. non-atomic individuals)[39].

On the other hand, Intensional PCDRT – which builds on and unifies Lewis (1973)/Kratzer (1981), Muskens (1996), van den Berg (1996) and Stone (1999) – is, to my knowledge, the first dynamic framework that systematically and explicitly captures the anaphoric and quantificational parallels between the individual and modal domains while, at the same time, keeping the underlying logic classical and preserving the Montagovian approach to compositionality – but see van Rooy (1998), Stone (1999) and Bittner (2001) for three dynamic systems closely related to Intensional PCDRT and designed with same general goals in mind.

[39] See Brasoveanu (2007b) for more discussion of discourse-level vs. domain-level plurality.

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