# Chapter 4. Compositional DRT with Generalized Quantification

## 1. Introduction

This chapter is the first one that adds to the previous literature in a more substantial way. Sections **2** and **3** are the central ones: they reformulate in type logic the DPL-style definitions of *unselective* and *selective* generalized quantification introduced in chapter **2**.

Section **4** then extends CDRT (introduced in the previous chapter) with these two notions of dynamic generalized quantification. The resulting system, which I will label CDRT+GQ, provides a *fully compositional* account of the proportion problem and of the weak / strong donkey ambiguity.

Section **5** introduces the analysis of the interaction between anaphora and generalized coordination in Muskens (1996): 176-182. I show that this analysis successfully generalizes to account for donkey sentences that contain a DP conjunction, e.g. *Every boy who has a dog and every girl who has a cat must feed it* (example (38) in Chierchia 1995: 77).

DP-conjunction donkey sentences of this kind are crucial for the argument that Chierchia (1995) develops in favor of an approach to natural language interpretation that builds (part of) the dynamics into the semantic value of natural language expressions and against approaches that build the dynamics of the interpretation into syntactic operations at the level of Logical Form (LF).

In a nutshell, the argument is that the same donkey pronoun is semantically bound by two distinct donkey indefinites, which can be naturally accounted for in a dynamic type-logical system with generalized conjunction (generalized to arbitrary types in the sense of Partee & Rooth 1983 among others). However, this kind of 'double binding' presents difficulties for approaches that require a particular syntactic configuration at the level of LF for the donkey pronouns to be semantically bound – because the same pronoun cannot enter two such distinct syntactic configurations.

Thus, by extension, such examples provide an argument for CDRT, which, just as DPL, aims to capture the dynamics of interpretation in terms of semantic values (i.e. meanings) and not syntactic representations.

The second reason for examining DP-conjunction donkey sentences is that this kind of examples will appear in the following chapter and they will help us distinguish between various (dynamic and static) accounts of the weak / strong donkey ambiguity.

Finally, section **6** shows that CDRT+GQ inherits the problems of DPL+GQ, i.e. it is not compositional enough. Just as in the case of DPL+GQ (see chapter **2**), the argument relies on mixed weak & strong donkey sentences, i.e. relative-clause donkey sentences with multiple indefinites in the restrictor of the donkey quantification that receive different readings.

In particular, I will show that determining which indefinite receives a weak reading and which one receives a strong reading cannot be compositionally implemented if we account for the weak / strong donkey ambiguity in terms of an ambiguity in the dynamic generalized determiner. This section paves the way for chapter **5**, which provides such a compositional account formulated in a version of CDRT with *plural* information states, i.e. info states which are modeled as *sets* of 'assignments' (type *st*) and not as single 'assignments' (type *s*).

The chapter ends with a summary of the main results (section **7**).

## 2. Translating Unselective Quantification into Dynamic Ty2

Consider again the definition of DPL-style unselective generalized quantification introduced in chapter **2**.

1. $\|\mathbf{det}(\phi, \psi)\| = \{<g, h>: g=h \text{ and } \mathbf{DET}((\phi)^g, \mathbf{Dom}(\|\psi\|))\}$,

   where **DET** is the corresponding static determiner

   and $(\phi)^g := \{h: \|\phi\|<g, h> = \mathrm{T}\}$

   and $\mathbf{Dom}(\|\phi\|) := \{g: \text{there is an } h \text{ s.t. } \|\phi\|<g, h> = \mathrm{T}\}$.

2. $\mathbf{det}_x(\phi, \psi) := \mathbf{det}([x]; \phi, \psi)$

Based on the definition schemes in (1) and (2), we were able to derive meanings for the natural language determiners *every* and *no* that were equivalent to the meanings assigned to them in DPL – as shown in (3) through (6) below.

3. $\|\mathbf{every}_x(\phi, \psi)\| = \{<g, h>: g{=}h \text{ and } \mathbf{EVERY}(([x]; \phi)^g, \mathbf{Dom}(\|\psi\|))\}$,

   i.e. $\|\mathbf{every}_x(\phi, \psi)\| = \{<g, h>: g{=}h \text{ and } ([x]; \phi)^g \subseteq \mathbf{Dom}(\|\psi\|)\}$

4. $\|\mathbf{no}_x(\phi, \psi)\| = \{<g, h>: g{=}h \text{ and } \mathbf{NO}(([x]; \phi)^g, \mathbf{Dom}(\|\psi\|))\}$,

   i.e. $\|\mathbf{no}_x(\phi, \psi)\| = \{<g, h>: g{=}h \text{ and } ([x]; \phi)^g \cap \mathbf{Dom}(\|\psi\|) = \emptyset\}$

5. $\forall x(\phi \rightarrow \psi) \Leftrightarrow \exists x(\phi) \rightarrow \psi \Leftrightarrow ([x]; \phi) \rightarrow \psi \Leftrightarrow \mathbf{every}_x(\phi, \psi)$

6. $\sim\exists x(\phi; \psi) \Leftrightarrow \forall x(\phi \rightarrow \sim\psi) \Leftrightarrow \sim([x]; \phi; \psi) \Leftrightarrow \mathbf{no}_x(\phi, \psi)$

It is straightforward to provide the corresponding definitions in Dynamic Ty2. Given that the above DPL formulas are tests, they will be translated as conditions, i.e. as terms of type *st*.

7. $\mathbf{det}(D, D') := \lambda i_s.\ \mathbf{DET}(Di, \mathbf{Dom}(D'))$,

   where **DET** is the corresponding static determiner

   and $Di = \{j_s: Dij\}$

   and $\mathbf{Dom}(D') := \{i_s: \exists j_s(Dij)\}$.

8. $\mathbf{det}_u(D, D') := \mathbf{det}([u]; D, D')$

Moreover, the meanings for *every* and *no* that we can derive based on the definition schemes in (7) and (8) above are equivalent to the CDRT meanings for *every* and *no* that we have provided in chapter **3**: the reader can easily check that the equalities in (11) and (12) below are true in Dynamic Ty2.

9. $\mathbf{every}_u(D, D') = \lambda i_s.\ \mathbf{EVERY}(([u]; D)i, \mathbf{Dom}(D'))$,

   i.e. $\mathbf{every}_u(D, D') = \lambda i_s.\ ([u]; D)i \subseteq \mathbf{Dom}(D')$.

10. $\mathbf{no}_u(D, D') = \lambda i_s.\ \mathbf{no}(([u]; D)i, \mathbf{Dom}(D'))$,

    i.e. $\mathbf{no}_u(D, D') = \lambda i_s.\ ([u]; D)i \cap \mathbf{Dom}(D') = \emptyset$.

11. $\forall u(D \rightarrow D') = \exists u(D) \rightarrow D' = ([u]; D) \rightarrow D' = \mathbf{every}_u(D, D')$

12. $\sim\exists u(D; D') = \forall u(D \rightarrow \sim D') = \sim([u]; D; D') = \mathbf{no}_u(D, D')$

## 2.1. Limitations of Unselectivity: Proportions

Just like its DPL counterpart, the CDRT definition of unselective generalized quantification in (7-8) above enables us to derive meanings for *most* and *few* that capture the anaphoric connections in donkey sentences based on them, but are unable to provide intuitively correct truth-conditions – they too have a proportion problem.

This is explicitly shown by the truth-conditions in (16) below, which are assigned to sentence (14) by the definition of unselective generalized quantification in (7-8). Note in particular that we end up quantifying over pairs of house-elves and witches; thus, the formula in (16) is true in the 'Dobby as Don Juan' scenario mentioned in chapter **2**, in contrast to the English sentence in (14), which is intuitively false.

13. $\mathbf{most}_u(D, D') = \lambda i_s.\ \mathbf{MOST}(([u]; D)i, \mathbf{Dom}(D'))$,

    i.e. $\mathbf{most}_u(D, D') = \lambda i_s.\ |([u]; D)i \cap \mathbf{Dom}(D')| > |([u]; D)i \backslash \mathbf{Dom}(D')|$ [1],

    i.e. $\mathbf{most}_u(D, D') = \lambda i_s.\ |([u]; D; [!D'])i| > |([u]; D; [\sim D'])i|$.

14. Most$^{u_1}$ house-elves who fall in love with a$^{u_2}$ witch buy her$_{u_2}$ an$^{u_3}$ alligator purse.

15. $[\mathbf{most}_{u_1}([u_2 \mid house\_elf\{u_1\}, witch\{u_2\}, fall\_in\_love\{u_1, u_2\}],$

    $[u_3 \mid alligator\_purse\{u_3\}, buy\{u_1, u_2, u_3\}])]$

16. $\lambda i_s.\ |([u_1, u_2 \mid h.elf\{u_1\}, witch\{u_2\}, f.i.l\{u_1, u_2\}];$

    $[!([u_3 \mid a.p\{u_3\}, buy\{u_1, u_2, u_3\}])])i| >$

    $|([u_1, u_2 \mid h.elf\{u_1\}, witch\{u_2\}, f.i.l\{u_1, u_2\}];$

    $[\sim([u_3 \mid a.p\{u_3\}, buy\{u_1, u_2, u_3\}])])i|$,

    i.e., by Axioms **3** and **4** ("Identity of 'assignments'" and "Enough 'assignments'"),

    $\lambda i_s.\ |\{<x_e, y_e>: h.elf(x) \wedge witch(y) \wedge f.i.l(x, y) \wedge \exists z_e(a.p(z) \wedge buy(x, y, z))\}| >$

    $|\{<x_e, y_e>: h.elf(x) \wedge witch(y) \wedge f.i.l(x, y) \wedge \neg\exists z_e(a.p(z) \wedge buy(x, y, z))\}|$

[1] '\' symbolizes set-theoretic difference.

## 2.2. Limitations of Unselectivity: Weak / Strong Ambiguities

Moreover, the meaning of *every*, repeated in (17) below, is able to derive only the strong reading of donkey sentences, just like its DPL equivalent. To see this, consider again the example in (18) below (from Pelletier & Schubert 1989): this sentence is assigned intuitively *incorrect* truth-conditions because the formula in (20) below is true iff the dime-owners put *all* their dimes in the meter.

17. $\mathbf{every}_u(D, D') = \lambda i_s.\ \mathbf{EVERY}(([u];\ D)i, \mathbf{Dom}(D'))$,

    i.e. $\mathbf{every}_u(D, D') = \lambda i_s.\ ([u];\ D)i \subseteq \mathbf{Dom}(D')$,

    i.e. $\mathbf{every}_u(D, D') = \lambda i_s.\ ([u];\ D)i \subseteq ([u];\ D)i \cap \mathbf{Dom}(D')$,

    i.e. $\mathbf{every}_u(D, D') = \lambda i_s.\ ([u];\ D)i \subseteq ([u];\ D;\ !D')i$,

18. Every$^{u_1}$ person who has a$^{u_2}$ dime will put it$_{u_2}$ in the meter.

19. $[\mathbf{every}_{u_1}([u_2 \mid person\{u_1\}, dime\{u_2\}, have\{u_1, u_2\}], [put\_in\_meter\{u_1, u_2\}])]$

20. $\lambda i_s.\ ([u_1, u_2 \mid person\{u_1\}, dime\{u_2\}, have\{u_1, u_2\}])i \subseteq$

    $([u_1, u_2 \mid person\{u_1\}, dime\{u_2\}, have\{u_1, u_2\}];\ [!([put\_in\_meter\{u_1, u_2\}])])i$,

    i.e., by Axioms **3** and **4** ("Identity of 'assignments'" and "Enough 'assignments'"),

    $\lambda i_s.\ \{<x_e, y_e>: person(x) \wedge dime(y) \wedge have(x, y)\} \subseteq$

    $\{<x_e, y_e>: person(x) \wedge dime(y) \wedge have(x, y) \wedge put\_in\_meter(x, y)\}$, i.e.

    $\lambda i_s.\ \forall x_e \forall y_e(person(x) \wedge dime(y) \wedge have(x, y) \rightarrow put\_in\_meter(x, y))$

## 2.3. Conservativity and Unselective Quantification

Finally, the observation we have made about DPL-style *conservative* unselective quantification extends to its CDRT translation [2]: assuming that the static determiner **DET** is conservative, we have that $\mathbf{DET}((D)i, \mathbf{Dom}(D'))$ holds iff $\mathbf{DET}((D)i, (D)i \cap \mathbf{Dom}(D'))$ holds. Moreover, the latter formula is equivalent to $\mathbf{DET}((D)i, (D;\ !D')i)$, which perspicuously encodes the intuition that a dynamic generalized determiner relates two sets of info states, the first of which is the set of output states compatible with the

[2] The observation was in fact used in deriving the final form of the *every* definition in (17) above.

restrictor, i.e. $(D)i$, while the second one is the set of output states compatible with the restrictor that, in addition, *can* be further updated by the nuclear scope, i.e. $(D; !D')i$.

The conservative definitions of unselective generalized quantification based on the non-conservative ones in (7) and (8) above are provided in (21) and (22) below.

21. **Built-in 'unselective' dynamic conservativity:**

$$\mathbf{det}(D, D') := \lambda i_s.\ \mathbf{DET}(Di, (D; [!D'])i)$$

22. **Unselective generalized quantification with built-in dynamic conservativity:**

$$\mathbf{det}_u(D, D') := \lambda i_s.\ \mathbf{DET}(([u]; D)i, ([u]; D; [!D'])i)$$

Given that the definition of conservative unselective quantification in (22) provides access to the dref $u$ in both the restrictor and the nuclear scope of the quantification, this definition provides the basic format for the CDRT definition of selective generalized quantification, to which we now turn.

## 3. Translating Selective Quantification into Dynamic Ty2

The syntax for selective generalized quantification is the same as the one used in the previous section, i.e. I will continue to use abbreviations of the form $\mathbf{det}_u(D, D')$, where $u$ is the 'bound' dref [3], $D$ is the restrictor and $D'$ is the nuclear scope of the quantification.

The *selective* determiner $\mathbf{det}_u$ relates two sets of individuals (type $e$) and not two sets of 'assignments' (type $s$), as the unselective determiner **det** defined in the previous section does. The fact that $\mathbf{det}_u$ relates sets of individuals will solve the proportion problem. As far as the weak / strong donkey ambiguity is concerned, I will analyze it just as in chapter **2**, i.e. as an ambiguity in the generalized determiner, which can have a *weak* basic meaning $\mathbf{det}^{wk}{}_u(D, D')$ or a *strong* one $\mathbf{det}^{str}{}_u(D, D')$. Both basic meanings are defined in terms of the static determiner **DET** and both of them are conditions, i.e. terms of type $st$, as shown in (23) below.

[3] Recall that $u$ is a *constant* of type $\mathbf{e} := se$, so it cannot possibly be bound in the official type logical language (which is Dynamic Ty2) – hence the scare quotes on 'bound'.

23. $\mathbf{det}^{wk}{}_u(D, D') := \lambda i_s.\ \mathbf{DET}(u[Di],\ u[(D; D')i])$

$\mathbf{det}^{str}{}_u(D, D') := \lambda i_s.\ \mathbf{DET}(u[Di],\ u[([D \rightarrow D'])i])$,

where $Di := \{j_s: Dij\}$

and $u[Di] := \{u_{se}j_s: ([u]; D)ij\}$,

i.e. $u[Di]$ is the image of the set of 'assignments' $([u]; D)i$ under the function $u_{se}$.

As already indicated, the generalized quantification defined in (23) is selective because the static determiner **DET** relates sets of *individuals*, e.g. $u[Di] := \{x_e: \exists j_s(([u]; D)ij \wedge x{=}uj)\}$, and not sets of info states (as it does in the unselective definitions in (21) and (22) above).

The difference between the *weak* and the *strong* lexical entry for the selective generalized determiners is localized in the nuclear scope of the quantification:

- the weak, 'existential' reading is obtained by simply sequencing (i.e. conjoining) the restrictor DRS $D$ and the nuclear scope DRS $D'$;
- the strong, 'universal' reading is obtained by means of the universal quantification built into the definition of dynamic implication that relates the restrictor DRS $D$ and the nuclear scope DRS $D'$.

Given Axiom **3** ("Identity of 'assignments'") and Axiom **4** ("Enough 'assignments'"), the weak and strong selective determiners in (23) above can be alternatively defined in terms of generalized quantification over info states – we just need to make judicious use of the anaphoric closure operator '!', as shown in (24) below [4].

24. $\mathbf{det}^{wk}{}_u(D, D') := \lambda i_s.\ \mathbf{DET}(([u \mid !D])i,\ ([u \mid !(D; D')])i)$

$\mathbf{det}^{str}{}_u(D, D') := \lambda i_s.\ \mathbf{DET}(([u \mid !D])i,\ ([u \mid !([D \rightarrow D'])])i)$ [5],

where $Di := \{j_s: Dij\}$.

---

[4] Note the formal similarities between the type-logical definition schemes in (24) and their DPL-style counterparts introduced in chapter **2**.

[5] Given that $!([D \rightarrow D']) = D \rightarrow D'$, the strong determiner can be more simply defined as $\mathbf{det}^{str}{}_u(D, D') := \lambda i_s.\ \mathbf{DET}(([u \mid !D])i,\ ([u \mid D \rightarrow D'])i)$.

## 3.1. Accounting for Weak / Strong Ambiguities

It is obvious that the predictions made by the definition schemes in (23) and (24) above are identical to their DPL-style counterparts, so I will only briefly go through several examples. Consider the usual donkey example in (25) below.

25. Every$^{u_1}$ farmer who owns a$^{u_2}$ donkey beats it$_{u_2}$.

The weak and strong meanings for the English determiner *every* are provided in (26) below and simplified in (27).

26. $\mathbf{every}^{wk}{}_{u}(D, D') := \lambda i_s.\ \mathbf{EVERY}(u[Di],\ u[(D; D')i])$

$\mathbf{every}^{str}{}_{u}(D, D') := \lambda i_s.\ \mathbf{EVERY}(u[Di],\ u[([D \rightarrow D'])i])$

27. $\mathbf{every}^{wk}{}_{u}(D, D') := \lambda i_s.\ u[Di] \subseteq u[(D; D')i]$

$\mathbf{every}^{str}{}_{u}(D, D') := \lambda i_s.\ u[Di] \subseteq u[([D \rightarrow D'])i]$

The weak reading of sentence (25) is represented in Dynamic Ty2 as shown in (28) below. The formula in (29) in the scope of the vacuous λ-abstraction over 'assignments' shows that the Dynamic Ty2 representation derives the intuitively correct *weak* truth-conditions.

28. $[\mathbf{every}^{wk}{}_{u_1}([u_2 \mid farmer\{u_1\}, donkey\{u_2\}, own\{u_1, u_2\}],\ [beat\{u_1, u_2\}])]$

29. $\lambda i_s.\ u_1[([u_2 \mid farmer\{u_1\}, donkey\{u_2\}, own\{u_1, u_2\}])i] \subseteq$

$u_1[([u_2 \mid farmer\{u_1\}, donkey\{u_2\}, own\{u_1, u_2\}, beat\{u_1, u_2\}])i]$, i.e.

$\lambda i_s.\ \{x_e\text{: } farmer(x) \wedge \exists y_e(donkey(y) \wedge own(x, y))\} \subseteq$

$\{x_e\text{: } farmer(x) \wedge \exists z_e(donkey(z) \wedge own(x, z) \wedge beat(x, z))\}$, i.e.

$\lambda i_s.\forall x_e(farmer(x) \wedge \exists y_e(donkey(y) \wedge own(x, y))$

$\rightarrow \exists z_e(donkey(z) \wedge own(x, z) \wedge beat(x, z)))$

The strong reading of sentence (25) is represented in Dynamic Ty2 as shown in (30) below. The formula in (31) in the scope of the vacuous λ-abstraction over 'assignments' shows that the representation derives the intuitively correct *strong* truth-conditions.

30. $[\mathbf{every}^{str}{}_{u_1}([u_2 \mid farmer\{u_1\}, donkey\{u_2\}, own\{u_1, u_2\}],\ [beat\{u_1, u_2\}])]$

31. $\lambda i_s.\ u_1[([u_2 \mid farmer\{u_1\}, donkey\{u_2\}, own\{u_1, u_2\}])i] \subseteq$

$u_1[([[u_2 \mid farmer\{u_1\}, donkey\{u_2\}, own\{u_1, u_2\} \rightarrow [beat\{u_1, u_2\}]]])i]$, i.e.

$\lambda i_s.\ \{x_e: farmer(x) \wedge \exists y_e(donkey(y) \wedge own(x, y))\} \subseteq$

$\{x_e: \forall z_e(farmer(x) \wedge donkey(z) \wedge own(x, z) \rightarrow beat(x, z))\}$, i.e.

$\lambda i_s.\forall x_e(farmer(x) \wedge \exists y_e(donkey(y) \wedge own(x, y))$

$\rightarrow \forall z_e(farmer(x) \wedge donkey(z) \wedge own(x, z) \rightarrow beat(x, z)))$, i.e.

$\lambda i_s.\forall x_e \forall z_e(farmer(x) \wedge donkey(z) \wedge own(x, z) \rightarrow beat(x, z))$

## 3.2. Solving Proportions

The fact that the proportion problem is solved is shown by the intuitively correct truth-conditions in (35) and (38) below, which are assigned to the sentences in (33) and (36) respectively.

32. $\mathbf{most}^{wk}{}_u(D, D') := \lambda i_s.\ \mathbf{MOST}(u[Di],\ u[(D; D')i])$,

i.e. $\mathbf{most}^{wk}{}_u(D, D') := \lambda i_s.\ |u[Di] \cap u[(D; D')i]| > |u[Di] \backslash u[(D; D')i]|$

$\mathbf{most}^{str}{}_u(D, D') := \lambda i_s.\ \mathbf{MOST}(u[Di],\ u[([D \rightarrow D'])i])$,

i.e. $\mathbf{most}^{str}{}_u(D, D') := \lambda i_s.\ |u[Di] \cap u[([D \rightarrow D'])i]| > |u[Di] \backslash u[([D \rightarrow D'])i]|$

33. Most$^{u_1}$ house-elves who fall in love with a$^{u_2}$ witch buy her$_{u_2}$ an$^{u_3}$ alligator purse.

34. $[\mathbf{most}^{str}{}_{u_1}([u_2 \mid house\_elf\{u_1\}, witch\{u_2\}, fall\_in\_love\{u_1, u_2\}],$

$[u_3 \mid alligator\_purse\{u_3\}, buy\{u_1, u_2, u_3\}])]$

35. $\lambda i_s.\ |\{x_e: h.elf(x) \wedge \exists y_e(witch(y) \wedge f.i.l(x, y)) \wedge$

$\forall y'_e(witch(y') \wedge f.i.l(x, y') \rightarrow \exists z_e(a.p(z) \wedge buy(x, y', z)))\}| >$

$|\{x_e: h.elf(x) \wedge \exists y'_e(witch(y') \wedge f.i.l(x, y') \wedge \neg\exists z_e(a.p(z) \wedge buy(x, y', z)))\}|$

36. Most$^{u_1}$ drivers who have a$^{u_2}$ dime will put it$_{u_2}$ in the meter.

37. $[\mathbf{most}^{wk}{}_{u_1}([u_2 \mid driver\{u_1\}, dime\{u_2\}, have\{u_1, u_2\}],\ [put\_in\_meter\{u_1, u_2\}])]$

38. $\lambda i_s.\ |\{x_e: driver(x) \wedge \exists y_e(dime(y) \wedge have(x, y) \wedge put\_in\_meter(x, y))\}| >$

$|\{x_e: driver(x) \wedge \exists y_e(dime(y) \wedge have(x, y)) \wedge$

$\forall y'_e(dime(y') \wedge have(x, y') \rightarrow \neg put\_in\_meter(x, y'))\}|$

Everything is now in place to introduce CDRT+GQ, i.e. the extension of CDRT with the notions of unselective and selective dynamic generalized quantification we have just defined in Dynamic Ty2.

## 4. Extending CDRT with Generalized Quantification (CDRT+GQ)

The syntax of the English fragment is the same as the one defined for CDRT in the previous chapter. As far as the semantics CDRT+GQ is concerned, we only need:

- to replace the CDRT meanings for generalized determiners with the newly defined selective generalized determiners;
- to replace the CDRT meaning for dynamic implication (i.e. for bare conditional structures) with the newly defined unselective generalized determiners; thus, CDRT+GQ will introduce a generalized definition of dynamic implication that also subsumes adverbs of quantification [6].

The CDRT+GQ meanings have the same types as the corresponding CDRT meanings, i.e. (**et**)((**et**)**t**) for determiners and **t**(**tt**) for dynamic implication+adverbs of quantification.

As expected, the meaning of the indefinite determiner *a* remains the same as in CDRT: redefining it in terms of selective generalized quantification would make it a *test*, which is empirically inadequate given that singular indefinites support cross-sentential anaphora, e.g. *A$^u$ house-elf left the Three Broomsticks. He$_u$ was drunk.*

---

[6] Of course, assigning an *unselective* meaning to conditionals fails to account for the fact that they also exhibit weak / strong donkey ambiguities; see section **6** below for more discussion.

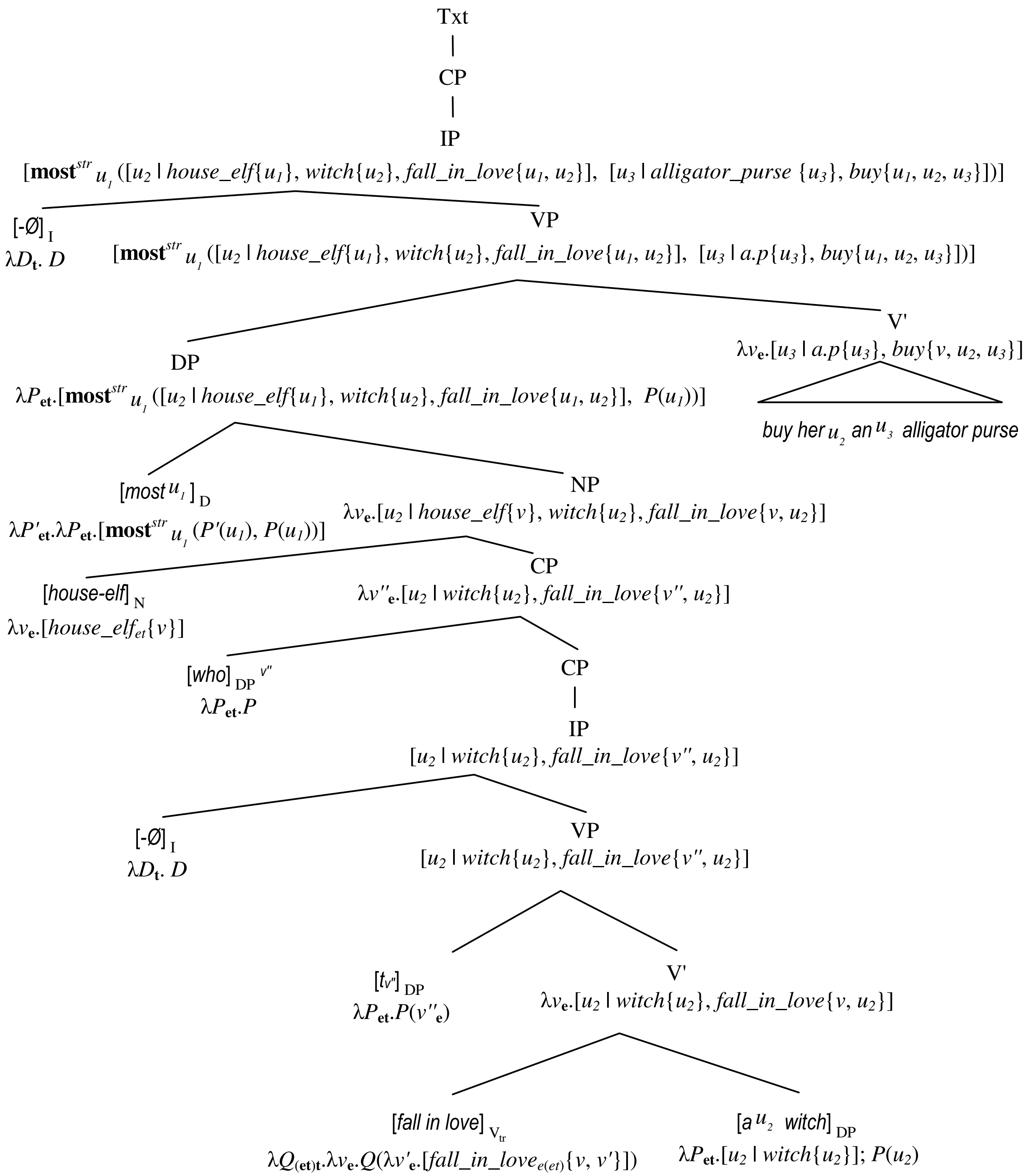
39. **TR 0 (only the revised entries are listed): Basic Meanings (TN).**

| Lexical Item | Translation | Type<br>$\mathbf{e} := se$<br>$\mathbf{t} := s(st)$ |
|---|---|---|
| $[\mathit{det}^{\mathbf{wk},u}]_D$ / $[\mathit{det}^{\mathbf{str},u}]_D$<br>e.g. *every*$^{\mathbf{str},u}$, *no*$^{\mathbf{wk},u}$, *most*$^{\mathbf{str},u}$…<br>(but not $a^u$) | $\leadsto \lambda P'_{\mathbf{et}}.\ \lambda P_{\mathbf{et}}.\ [\mathbf{det}^{wk/str}_u(P'(u), P(u))]$, where:<br>$\mathbf{det}^{wk}_u(P'(u), P(u)) := \lambda i_s.\ \mathbf{DET}(u[P'(u)i],\ u[(P'(u); P(u))i])$<br>$\mathbf{det}^{str}_u(P'(u), P(u)) := \lambda i_s.\ \mathbf{DET}(u[P'(u)i],\ u[([P'(u) \rightarrow P(u)])i])$,<br>where $P(u)i := \{j_s: P(u)ij\}$ and $u[P(u)i] := \{uj: ([u]; P(u))ij\}$ and **DET** is the corresponding static determiner. | $(\mathbf{et})((\mathbf{et})\mathbf{t})$ |
| $[\mathit{if}\ (+\mathit{adv. of quant.})]_C$ | $\leadsto \lambda D'_{\mathbf{t}}.\ \lambda D_{\mathbf{t}}.\ [\mathbf{det}(D', D)]$, where:<br>$\mathbf{det}(D, D') := \lambda i_s.\ \mathbf{DET}(Di, (D; [!D'])i)$,<br>where $Di := \{j_s: Dij\}$ and **DET** is the corresponding static determiner. | $\mathbf{t}(\mathbf{tt})$ |
| $[\mathit{if}\,]_C$ (i.e. bare *if*) | $\leadsto \lambda D'_{\mathbf{t}}.\ \lambda D_{\mathbf{t}}.\ [\mathbf{every}(D', D)]$ | $\mathbf{t}(\mathbf{tt})$ |

## 4.1. Proportions and Weak / Strong Ambiguities in CDRT+GQ

It is easily seen that, based on these lexical entries, we can compositionally derive the correct interpretation for the proportion examples and for the examples ambiguous between a weak and a strong reading. I will therefore treat only one example in detail – the reader will have no difficulties constructing and translating the LF's for the others.

40. Most$^{\mathbf{str},u_1}$ house-elves who fall in love with a$^{u_2}$ witch buy her$_{u_2}$ an$^{u_3}$ alligator purse.



# *5. Anaphora and Generalized Coordination in CDRT+GQ*

This section prepares the ground for the analysis of all the conjunction-based donkey sentences in the chapters to come. Most of the material is based on Muskens (1996): 176 et seqq and Partee & Rooth (1983). There are two main novelties:

- I provide direct dynamic counterparts of the definitions of conjoinable types and generalized conjunction and disjunction in Partee & Rooth (1983);
- I show that CDRT (and its extension CDRT+GQ) can account for the DP-conjunction donkey example in (41) below, from Chierchia (1995): 77, (38).

41. Every$^{u_1}$ boy who has a$^{u_2}$ dog and every$^{u_3}$ girl who has a$^{u_2}$ cat must feed it$_{u_2}$.

This is one of the central examples used in Chierchia (1995) to argue for an approach to natural language that builds (part of) the dynamics into the semantic value of natural language expressions as opposed to syntactic operations on the LF of sentences/discourses. Therefore, *mutatis mutandis*, his argument that discourse dynamics should be captured semantically and not syntactically also supports the architecture of CDRT+GQ.

## 5.1. Generalized Dynamic Conjunction and Disjunction

First, we need to define in Dynamic Ty2 a notion of generalized dynamic conjunction and disjunction. Following Partee & Rooth (1983), I define the set of dynamically conjoinable types as shown in (42) below.

42. **Dynamically Conjoinable Types (DCTyp).**

The set of dynamically conjoinable types **DCTyp** is the smallest subset of **Typ** s.t. $\mathbf{t}\in$**DCTyp** (where $\mathbf{t}$ := $s(st)$) and, if $\tau\in$**DCTyp**, then $(\sigma\tau)\in$**DCTyp** for any $\sigma\in$**Typ**.

We can now define generalized (pointwise) dynamic conjunction and disjunction as shown in (43) below.

43. **Generalized Pointwise Dynamic Conjunction $\sqcap$ and Disjunction $\sqcup$.**

For any two terms $\alpha$ and $\beta$ of type $\tau$, for any $\tau \in \mathbf{DCTyp}$:

$$\alpha \sqcap \beta := (\alpha; \beta) \text{ if } \tau = \mathbf{t} \quad \text{and} \quad \alpha \sqcap \beta := \lambda v_\sigma.\ \alpha(v) \sqcap \beta(v) \text{ if } \tau = (\sigma\rho);$$

$$\alpha \sqcup \beta := [\alpha \vee \beta] \text{ if } \tau = \mathbf{t} \quad \text{and} \quad \alpha \sqcup \beta := \lambda v_\sigma.\ \alpha(v) \sqcup \beta(v) \text{ if } \tau = (\sigma\rho).$$

**Abbreviation.** $\alpha_1 \sqcap \alpha_2 \sqcap \ldots \sqcap \alpha_n := (\ldots(\alpha_1 \sqcap \alpha_2) \sqcap \ldots \sqcap \alpha_n)$;

$$\alpha_1 \sqcup \alpha_2 \sqcup \ldots \sqcup \alpha_n := (\ldots(\alpha_1 \sqcup \alpha_2) \sqcup \ldots \sqcup \alpha_n).$$

Note that the translation rule GSeq (Generalized Sequencing) we have introduced in chapter **3** above is simply a restricted form of generalized dynamic conjunction $\sqcap$.

We can now define the basic meanings for *and* and *or* by means of the schemata in Table (44) below.

44. **TR 0 (only the revised entries are listed): Basic Meanings (TN).**

| Lexical Item | Translation | Type<br>$\mathbf{e} := se$ $\mathbf{t} := s(st)$ |
|---|---|---|
| $[\mathit{and}]_{\text{Conj}}$ | $\rightsquigarrow \lambda v_1. \ldots \lambda v_n.\ v_1 \sqcap \ldots \sqcap v_n$ | $\tau(\ldots(\tau\tau)\ldots)$ |
| $[\mathit{or}]_{\text{Conj}}$ | $\rightsquigarrow \lambda v_1. \ldots \lambda v_n.\ v_1 \sqcup \ldots \sqcup v_n$ | $\tau(\ldots(\tau\tau)\ldots)$ |

## 5.2. Revising the Coordination Rule: Generalized Coordination

We generalize our translation rule for coordinated constructions as shown in (45) below, i.e. the translation of a coordinated construction is obtained by applying the translation of the coordinating element to the translations of the coordinated expressions.

45. **TR 5 (revised) – Generalized Coordination (GCo).**

If $A_1 \rightsquigarrow \alpha_1, \ldots, A_n \rightsquigarrow \alpha_n$, Conj $\rightsquigarrow \beta$, $A_{n+1} \rightsquigarrow \alpha_{n+1}$ and $A_1, \ldots, A_n$, Conj and $A_{n+1}$ are the only daughters of A in that order
(i.e. $A \rightarrow A_1 \ldots A_n$ Conj $A_{n+1}$),

then $A \rightsquigarrow \beta(\alpha_1)\ldots(\alpha_n)(\alpha_{n+1})$,

provided this a well-formed term and has the same type as $\alpha_1, \ldots, \alpha_n, \alpha_{n+1}$.

## 5.3. Catching and Eating a Fish in CDRT+GQ

We can now go through some examples. First, consider the sentences in (46) and (47) below, from Partee & Rooth (1983): 338, (12) and (13)[7].

46. John caught and ate a$^{u_1}$ fish.

47. John hugged and kissed three$^{u_1}$ women.

As Partee & Rooth (1983): 338 observe, under the most salient reading of sentence (46), John catches and eats the same fish; similarly for (47), John hugs and kisses the same three women. Unfortunately, we can obtain this reading in CDRT+GQ (or CDRT) only by quantifying-in the direct object indefinite *a*$^{u_1}$ *fish* – that is, CDRT+GQ predicts that the default reading (the one without quantifying-in) should be one in which the fish that John catches and the fish that John eats are possibly different.

This is a consequence of the fact that, following Montague (1974), transitive verbs are interpreted as taking a GQ as direct object (a term of type (**et**)**t**) and not an individual dref (a term of type **e**). However, this is not an empirically unmotivated feature of the system: it correctly predicts that the preferred relative scope of the subject and direct object is the one in which the subject scopes over the object [8].

In sum, given our current setup, there is no analysis that would make the correct predictions both with respect to the preferred quantifier scoping of transitive verbs and with respect to the preferred reading of transitive verb conjunctions. I will therefore leave the system as it is and leave this matter for future research[9].

---

[7] Page references are to Partee & Portner (2002).

[8] Moreover, this kind of representation receives independent empirical support from the interpretation of singular number morphology on donkey indefinites and pronouns as semantic distributivity – but this topic falls beyond the scope of the current investigation.

[9] As far as I can see, we can provide a novel solution to this problem if we leave the lexical entries for transitive verbs as they are now (i.e. as in Montague 1974) and employ cataphora (see e.g. Chierchia 1995: Chapter 3 for a discussion of what cataphora is) to obtain the desired reading for the transitive verb conjunction examples; structured cataphora (where 'structured' is to be understood in the sense of chapter **5** below) could also be used as the mechanism in terms of which reverse quantifier scope and Bach-Peters sentences are analyzed – but the exploration of these suggestions must be left for another occasion.

The two possible LF's of sentence (46) are schematically represented in (48) and (51) below, together with their respective translations.

48. John$^{u_2}$ [$_{\mathrm{Vtr}}$ caught and ate] a$^{u_1}$ fish.

49. $[u_2 \mid u_2{=}John]$; $[u_1 \mid fish\{u_1\}, catch\{u_2, u_1\}]$; $[u_1 \mid fish\{u_1\}, eat\{u_2, u_1\}]$

50. $\lambda i_s.\ \exists x_e(fish(x) \wedge catch(john, x)) \wedge \exists y_e(fish(y) \wedge eat(john, y))$

51. [a$^{u_1}$ fish]$^{v''}$ [ John$^{u_2}$ [$_{\mathrm{Vtr}}$ caught and ate] $t_{v''}$ ].

52. $[u_1 \mid fish\{u_1\}]$; $[u_2 \mid u_2{=}John]$; $[catch\{u_2, u_1\}, eat\{u_2, u_1\}]$,

i.e. $[u_1, u_2 \mid fish\{u_1\}, u_2{=}John, catch\{u_2, u_1\}, eat\{u_2, u_1\}]$

53. $\lambda i_s.\ \exists x_e(fish(x) \wedge catch(john, x) \wedge eat(john, x))$

As already indicated, the LF in (48) with the direct object *in situ* yields the 'possibly distinct fish' interpretation, while the LF in (51) with the QR-ed direct object yields the 'same fish' interpretation.

## 5.4. Coordination and Discourse Referent Reassignment

The 'possibly distinct fish' representation in (49) above and its interpretation are unlike anything in classical DRT / FCS, where reintroducing a dref, e.g. dref $u_1$ in (49), is either banned or, if it is allowed, it is *not* interpreted as *reassigning* a value to that dref – the output info state assigns the same value to the dref as the input info state. In contrast, CDRT+GQ allows dref reintroduction and interprets it as reassignment of value to the dref.

Thus, it would seem that the classical DRT / FCS design choice is empirically better than the CDRT+GQ one: the representation in (49) yields the 'same fish' interpretation in a DRT / FCS-like system. However, in such a system, we cannot easily obtain a representation of the 'distinct fish' interpretation, which *is* an intuitively available reading of sentence (46) (although dispreferred)[10]: we would have to postulate a mechanism whereby the indefinite object *a fish* occurs twice in the LF of sentence (46) and

---

[10] Moreover, as Partee & Rooth (1983): 338 observe, the 'distinct fish' representation is the preferred one for conjunctions of intensional transitive verbs, e.g. *John needed and bought a new coat*.

contributes distinct dref's – i.e. we would have to syntactically simulate the semantic Montagovian analysis in (49) above[11].

Moreover, the necessary syntactic operations on LF's become increasingly stipulative as soon as we turn to more complex examples like the coordination donkey sentence in (41) above (from Chierchia 1995), which, as we will presently see, receives a straightforward reassignment-based analysis in CDRT+GQ.

I conclude that the reassignment-based architecture of CDRT+GQ is a desirable one and, in some form or other, it is a necessary component of any account of the interaction between anaphora and generalized coordination (exhibited by sentence (41) above, for example).

That being said, we have to admit that the particular implementation of dref reassignment in CDRT+GQ is not the empirically optimal one: reassignment in CDRT+GQ (just as in DPL) is destructive – the previous value of the dref is completely lost and cannot be later accessed in discourse.

And destructive reassignment has unwelcome empirical consequences. Consider for example the DP conjunction *Mary and Helen* in discourse (54-55) below.

54. Mary$^{u_1}$ and Helen$^{u_2}$ (each) bought an$^{u_3}$ alligator purse.

55. They$_{u_3}$ were (both) bright red.

56. $[u_1, u_3 \mid u_1{=}Mary, alligator\_purse\{u_3\}, buy\{u_1, u_3\}]$;
$[u_2, u_3 \mid u_2{=}Helen\ , alligator\_purse\{u_3\}, buy\{u_2, u_3\}]$;
$[bright\_red\{u_3\}]$

As indicated by the parenthesized floating quantifier, the most salient reading of sentence (54) is the one in which Mary and Helen buy a purse each. However, if we analyze this sentence as shown in (56) above, we will be able to retrieve in sentence (55)

[11] I leave for future research the dynamic reformulation of the analysis of intensional verbs in Zimmermann (1993) and its comparison with the Montagovian counterpart.

only the purse mentioned last, i.e. Helen's purse: the destructive CDRT+GQ reassignment renders Mary's purse inaccessible for subsequent anaphora.

Thus, irrespective of how we decide to analyze the plural anaphor *they* in (55), we need to somehow preserve the values that are currently overwritten by dref reintroduction.

Summarizing, we face the following problem. On the one hand, we need to provide an account of the interaction between anaphora and generalized coordination exhibited by sentence (41) and, for that, we need to allow for dref reintroduction – or, more exactly, *index* reusability – so that both donkey indefinites $a^{u_2}$ *dog* and $a^{u_2}$ *cat* can be anaphorically associated with the donkey pronoun $it_{u_2}$. On the other hand, the only way to capture index reusability in CDRT+GQ is as dref reintroduction, i.e. as destructive random (re)assignment.

However, index reusability does not have to be interpreted as destructive reassignment: we could in principle associate a new value with a previously used index while, at the same time, saving the old value for later retrieval by associating it with another index. This idea can be implemented in various ways, e.g. by taking information states to be *referent systems* (see e.g. Vermeulen 1993 and Groenendijk, Stokhof & Veltman 1996) or *stacks* (see e.g. Dekker 1994, van Eijck 2001, Nouwen 2003 or Bittner 2006) – and not DPL-style, total 'variable assignments'.

Such information states, however, are formally more complex than our current ones and their empirical superiority and intuitive appeal are largely orthogonal to the matters with which the present dissertation is concerned – so I will continue to employ total 'variable assignments' and the current notion of (destructive) random assignment for the remainder of this work. Extending CDRT+GQ and the novel dynamic system of chapters **5**, **6** and **7** below with referent systems or stacks is left for future research.

## 5.5. Anaphora across VP- and DP-Conjunctions

Let us turn now to sentences involving both anaphora and generalized conjunction, as it is this kind of examples that really bring out the benefits of having a dynamic type-logical system. Consider sentences (57), (60) and (63) below (from Muskens 1996: 177-180, (52), (54) and (58)).

As shown below, the V'-conjunction example in (57) and the DP-conjunction examples in (60) and (63) are compositionally interpreted in CDRT+GQ and they are assigned the intuitively correct truth-conditions.

57. A$^{u_1}$ cat [$_{V'}$[$_{V'}$caught a$^{u_2}$ fish] and [$_{V'}$ate it$_{u_2}$]].

58. $[u_1, u_2 \mid cat\{u_1\}, fish\{u_2\}, catch\{u_1, u_2\}, eat\{u_1, u_2\}]$

59. $\lambda i_s.\ \exists x_e \exists y_e (cat(x) \wedge fish(y) \wedge catch(x, y) \wedge eat(x, y))$

60. John$^{u_4}$ has [$_{DP}$[$_{DP}$a$^{u_1}$ cat which caught a$^{u_2}$ fish] and [$_{DP}$a$^{u_3}$ cat which ate it$_{u_2}$]].

61. $[u_4 \mid u_4{=}John]$; $[u_1, u_2 \mid cat\{u_1\}, have\{u_4, u_1\}, fish\{u_2\}, catch\{u_1, u_2\}]$;
$[u_3 \mid cat\{u_3\}, have\{u_4, u_3\}\ eat\{u_3, u_2\}]$

62. $\lambda i_s.\ \exists x_e \exists y_e \exists z_e (cat(x) \wedge have(john, x) \wedge fish(y) \wedge catch(x, y) \wedge$
$cat(z) \wedge have(john, z) \wedge eat(z, y))$

63. John$^{u_3}$ admires [$_{DP}$[$_{DP}$a$^{u_1}$ girl] and [$_{DP}$a$^{u_2}$ boy who loves her$_{u_1}$]].

64. $[u_3 \mid u_3{=}John]$; $[u_1 \mid girl\{u_1\}, admire\{u_3, u_1\}]$;
$[u_2 \mid boy\{u_2\}, admire\{u_3, u_2\}, love\{u_2, u_1\}]$

65. $\lambda i_s.\ \exists x_e \exists y_e (girl(x) \wedge admire(john, x) \wedge boy(y) \wedge admire(john, y) \wedge \ \ love(y, x))$

Moreover, given that CDRT+GQ interprets all generalized quantifiers as conditions / tests, the anaphoric connections in the structurally identical examples in (66), (67) and (68) below are correctly predicted to be infelicitous.

66. #A$^{u_1}$ cat [$_{V'}$[$_{V'}$caught no$^{u_2}$ fish] and [$_{V'}$ate it$_{u_2}$]].

67. #John$^{u_4}$ has [$_{DP}$[$_{DP}$a$^{u_1}$ cat which caught no$^{u_2}$ fish] and [$_{DP}$a$^{u_3}$ cat which ate it$_{u_2}$]].

68. #John$^{u_3}$ admires [$_{DP}$[$_{DP}$no$^{u_1}$ girl] and [$_{DP}$a$^{u_2}$ boy who loves her$_{u_1}$]].

## 5.6. DP-Conjunction Donkey Sentences

Finally, the donkey sentence with DP-conjunction from Chierchia (1995) is compositionally interpreted as shown in (70) below; the truth-conditions – provided in

(71) – that are derived on the basis of the translation assign strong readings to the donkey indefinites, which is intuitively correct[12].

69. [[Every$^{\mathbf{str}, u_1}$ boy who has a$^{u_2}$ dog] and [every$^{\mathbf{str}, u_3}$ girl who has a$^{u_2}$ cat]] must feed it$_{u_2}$.

70. *every*$^{\mathbf{str}, u_1}$ *boy who has a*$^{u_2}$ *dog* ⇝

$$\lambda P_{\mathbf{et}}.\ [\mathbf{every}^{str}{}_{u_1}([u_2 \mid boy\{u_1\}, dog\{u_2\}, have\{u_1, u_2\}],\ P(u_1))]$$

*every*$^{\mathbf{str}, u_3}$ *girl who has a*$^{u_2}$ *cat* ⇝

$$\lambda P_{\mathbf{et}}.\ [\mathbf{every}^{str}{}_{u_3}([u_2 \mid girl\{u_3\}, cat\{u_2\}, have\{u_3, u_2\}],\ P(u_3))]$$

*every*$^{\mathbf{str}, u_1}$ *boy who has a*$^{u_2}$ *dog and every*$^{\mathbf{str}, u_3}$ *girl who has a*$^{u_2}$ *cat* ⇝

$$\lambda P_{\mathbf{et}}.\ [\mathbf{every}^{str}{}_{u_1}([u_2 \mid boy\{u_1\}, dog\{u_2\}, have\{u_1, u_2\}],\ P(u_1)),$$
$$\mathbf{every}^{str}{}_{u_3}([u_2 \mid girl\{u_3\}, cat\{u_2\}, have\{u_3, u_2\}],\ P(u_3))]$$

*must feed it*$_{u_2}$ ⇝ $\lambda v_{\mathbf{e}}.\ [must\_feed\{v, u_2\}]$

*every*$^{\mathbf{str}, u_1}$ *boy who has a*$^{u_2}$ *dog and every*$^{\mathbf{str}, u_3}$ *girl who has a*$^{u_2}$ *cat must feed it*$_{u_2}$

$$\rightsquigarrow [\mathbf{every}^{str}{}_{u_1}([u_2 \mid boy\{u_1\}, dog\{u_2\}, have\{u_1, u_2\}],\ [must\_feed\{u_1, u_2\}]),$$
$$\mathbf{every}^{str}{}_{u_3}([u_2 \mid girl\{u_3\}, cat\{u_2\}, have\{u_3, u_2\}],\ [must\_feed\{u_3, u_2\}])]$$

71. $\lambda i_s.\ \forall x_e \forall y_e(boy(x) \wedge dog(y) \wedge have(x, y) \rightarrow must\_feed(x, y)) \wedge$
$\forall x'_e \forall y'_e(girl(x') \wedge cat(y') \wedge have(x', y') \rightarrow must\_feed(x', y'))$

As Chierchia (1995): 96 observes, structurally similar sentences like (72) below are infelicitous.

72. ??[[Every$^{\mathbf{str}, u_1}$ boy who has a$^{u_2}$ dog] and [a$^{u_3}$ girl]] must feed it$_{u_2}$.

---

[12] In contrast, the corresponding translation in Chierchia (1995): 96, (76b) delivers the *weak* truth-conditions (i.e. the donkey indefinites are assigned the weak readings), which are arguably incorrect for the most salient reading of this type of example.

In all fairness, it should be noted that Chierchia (1995): 96 aims to interpret the slightly different example: *Every boy that has a dog and every girl that has a cat will beat it* (see Chierchia (1995): 96, (76a)). Therefore, his implicit claim might be that this particular example is preferably interpreted by accommodating an 'anger management' kind of scenario wherein the children are advised to beat their pets rather than each other – which would favor the weak reading of the sentence.

73. $[\mathbf{every}^{str}{}_{u_1}([u_2 \mid boy\{u_1\}, dog\{u_2\}, have\{u_1, u_2\}],\ [must\_feed\{u_1, u_2\}])];$

$[u_3 \mid girl\{u_3\}, must\_feed\{u_3, u_2\}]$

I suggest (following Chierchia 1995: 96) that their infelicity should be explained just as the infelicity of examples (66), (67) and (68) above: given that CDRT+GQ interprets generalized quantifiers as conditions / tests, the anaphoric connection between the pronoun $it_{u_2}$ and the indefinite $a^{u_2}$ *dog* cannot be successfully established in the second conjunct of the translation in (73) above. That is, the occurrence of the dref $u_2$ in the second condition $must\_feed\{u_3, u_2\}$ is 'unbound', i.e. deictically used, despite the fact that the pronoun $it_{u_2}$ is co-indexed with a preceding indefinite, which is meant to encode that all occurences of the dref $u_2$ should be 'bound' (anaphorically used).

Alternatively, the infelicity of sentences like (72) above can be attributed to the fact that they fail to establish a discourse-level parallelism between the two DP-conjuncts relative to the anaphor in the VP. Besides accounting for the infelicity of (72), this hypothesis also provides an explanation for the particular indexing exhibited by the felicitous example in (69) above: the indefinites $a^{u_2}$ *dog* and $a^{u_2}$ *cat* receive the same index as a consequence of the fact that the two DP-conjuncts (or the two DRS's we obtain by combining the DP semantic values with the semantic value of the VP) are related by a *Parallel* discourse relation[13],[14].

This completes our analysis of the interaction between anaphora and generalized conjunction in CDRT+GQ – and, at the same time, the exposition of the basic framework for the present investigation.

---

[13] For theories of parallelism in discourse, see Hobbs (1990) and Kehler (1995, 2002) among others. For similar observations with respect to disjunctive structures, see Stone (1992).

[14] Yet another way of thinking about examples like (69), suggested to me by Matthew Stone (p.c.), is to take the pronoun *it* in the VP to refer to the union of the referents contributed by the donkey indefinites in the two DP-conjuncts (see Stone 1992 for disjunction-based examples that seem to require this kind of analysis). This interpretation of the doubly-anteceded pronoun in the VP might emerge as a consequence of the parallelism between the two DP-conjuncts. Just like the parallelism-based explanation suggested in the main text, this hypothesis would also explain why the two indefinites receive the same index: co-indexation would be a necessary prerequisite for the union operation. The infelicity of examples like (72) above would presumably be explained just as suggested in the main text, i.e. as a failure to infer a discourse relation of parallelism – or any other discourse relation that would establish the (local) coherence of the discourse.

## 6. Limitations of CDRT+GQ: Mixed Weak & Strong Donkey Sentences

This section shows that CDRT+GQ, just as DPL+GQ, cannot give a compositional account of mixed weak & strong donkey sentences, i.e. relative-clause donkey sentences with multiple indefinites in the restrictor of the donkey quantification that receive different readings. In particular, we will see that determining which indefinite receives a weak reading and which one receives a strong reading cannot be compositionally implemented if we account for the weak / strong donkey ambiguity in terms of an ambiguity in the dynamic generalized determiner.

Consider again the examples with two donkey indefinites in (74) and (75) below.

74. Every$^{u_1}$ person who buys a$^{u_2}$ book on amazon.com and has a$^{u_3}$ credit card uses it$_{u_3}$ to pay for it$_{u_2}$.
75. Every$^{u_1}$ man who wants to impress a$^{u_2}$ woman and who has an$^{u_3}$ Arabian horse teaches her$_{u_2}$ how to ride it$_{u_3}$.

The most salient reading of (74) is one that is *strong* with respect to a$^{u_2}$ book and *weak* with respect to a$^{u_3}$ credit card, i.e. every person uses *some* credit card or other to pay for *any* book bought on amazon.com. Similarly, in (75) every man teaches *any* woman he wants to impress to ride *some* Arabian horse of his.

The problem with the weak and strong CDRT+GQ meanings for determiners is that they do not distinguish between the indefinites in the restrictor: all of them receive either a weak or a strong reading. The obvious fix is to make generalized determiners even more ambiguous, i.e. to redefine them as determiners binding a sequence of dref's and specifying for each dref that is different from the 'primary' one, i.e. the one that encodes the selective generalized quantification, whether it receives a weak or a strong reading.

For example, a determiner of the form $\mathbf{det}_u^{\mathbf{wk}:u',\mathbf{str}:u''}(D, D')$ quantifies over three drefs $u$, $u'$ and $u''$; the 'primary' dref is $u$ and the dref's $u'$ and $u''$ are introduced by donkey indefinites in the restrictor of the quantification and receive a weak and a strong reading respectively.

Such determiners could be defined by combining the weak and strong determiner meanings that we have introduced in CDRT+GQ; the definition would have the form shown in (76) below, where the DRS's $D_3$ and $D_4$ are subparts of DRS $D_1$. More precisely, $D_3$ is the subpart of $D_1$ relevant for the interpretation of dref $u'$ associated with a strong donkey reading, while $D_4$ is the subpart of $D_1$ relevant for the interpretation of $u''$, which is associated with a weak donkey reading.

76. $\mathbf{det}_u^{\mathbf{str:}u',\mathbf{wk:}u''}(D_1, D_2) := \lambda i_s.\ \mathbf{DET}(u[D_1 i],\ u[([D_3 \rightarrow (D_4; D_2)])i])$

Sentence (74) above, for example, would be represented in CDRT+GQ as shown in (77) below.

77. $\mathbf{every}_{u_1}^{\mathbf{str:}\,u_2,\mathbf{wk:}\,u_3}([u_2, u_3|\ pers\{u_1\}, bk\{u_2\}, buy\{u_1, u_2\}, c.card\{u_3\}, hv\{u_1, u_3\}],$

$[use\_to\_pay\{u_1, u_3, u_2\}]) :=$

$\lambda i_s.\ u_1[([u_2, u_3|\ person\{u_1\}, book\{u_2\}, buy\{u_1, u_2\}, c.card\{u_3\}, have\{u_1, u_3\}])i] \subseteq$

$u_1[([[u_2\ |\ person\{u_1\}, book\{u_2\}, buy\{u_1, u_2\}] \rightarrow$

$[u_3|\ c.card\{u_3\}, have\{u_1, u_3\}, use\_to\_pay\{u_1, u_3, u_2\}]])i])$

There is another possible lexical entry for the determiner in (76) above, namely the entry where the two indefinites stand in the other possible relative scope, as shown in (78) below.

78. $\mathbf{det}_u^{\mathbf{str:}u',\mathbf{wk:}u''}(D_1, D_2) := \lambda i_s.\ \mathbf{DET}(u[D_1 i],\ u[(D_4; [D_3 \rightarrow D_2])i])$

For example, this meaning assigns sentence (74) a reading in which each person uses the same credit card to pay for all the books s/he buys, as shown in (79) below.

79. $\mathbf{every}_{u_1}^{\mathbf{str:}\,u_2,\mathbf{wk:}\,u_3}([u_2, u_3|\ pers\{u_1\}, bk\{u_2\}, buy\{u_1, u_2\}, c.card\{u_3\}, hv\{u_1, u_3\}],$

$[use\_to\_pay\{u_1, u_3, u_2\}])$, i.e.

$\lambda i_s.\ u_1[([u_2, u_3|\ person\{u_1\}, book\{u_2\}, buy\{u_1, u_2\}, c.card\{u_3\}, have\{u_1, u_3\}])i] \subseteq$

$u_1[([u_3|\ person\{u_1\}, c.card\{u_3\}, have\{u_1, u_3\}];$

$[[u_2\ |\ book\{u_2\}, buy\{u_1, u_2\}] \rightarrow [use\_to\_pay\{u_1, u_3, u_2\}]])i])$

It is not clear that this kind of pseudo wide-scope reading for the weak indefinite is a *separate reading* for sentence (74) as opposed to merely being a special case of the (more general and weaker) reading in which the credit card can vary from book to book [15].

For concreteness, imagine that there are two kinds of Amazon credit cards, one for the Christmas shopping period and one for the Easter shopping period and whenever a person uses the appropriate Amazon credit card at the appropriate time to buy a book on amazon.com, the person gets a discount. In this context, the sentence in (80) below is intuitively interpreted as assigning pseudo wide-scope to the weak indefinite (i.e. pseudo wide-scope relative to the strong indefinite).

80. Last Christmas, every$^{u_1}$ person who bought a$^{u_2}$ book on amazon.com and had an$^{u_3}$ Amazon credit card used it$_{u_3}$ to pay for it$_{u_2}$ and got a discount.

However, the fact that the credit card does not vary from book to book in the most salient reading of sentence (80) cannot be taken as an argument for a distinct, pseudo wide-scope reading for this sentence: the lack of co-variation is a direct consequence of the way we have set up the context relative to which sentence (80) is interpreted – and, in the given situation, the indefinite *an*$^{u_3}$ *Amazon credit card* is contextually restricted in such a way that it is a *singleton* indefinite[16].

Thus, it seems that the English sentence in (74) does not have two distinct readings. But as far as CDRT+GQ is concerned, we *can* in fact assign a distinct, pseudo wide-scope representation to sentence (74) (given the superscripted index notation that we have just introduced to capture the intuitively available reading of sentence) and we *should* distinguish this representation encoding an intuitively unavailable reading from the other, pseudo narrow-scope representation (see (77) above), which encodes the intuitively correct interpretation of sentence (74).

---

[15] I call such readings *pseudo* wide-scope or *pseudo* narrow-scope because, as we have already noticed in chapter **2**, the donkey indefinites in sentences (74) and (75) are trapped in their respective VP-/CP-conjuncts and cannot take (syntactic) scope one relative to the other.

[16] See Schwarzschild (2002) for more discussion of singleton indefinites.

Therefore, besides having to specify which indefinite receives which reading (weak or strong), the CDRT+GQ lexical entry for a generalized determiner has to further specify the relative scope of the donkey indefinites. Thus, if we abbreviate that α has scope over β as α>>β, the lexical entries in (76) and (78) above are in fact the ones in (81) below.

81. $\mathbf{det}_u^{\mathbf{str}:u'>>\mathbf{wk}:u''}(D_1, D_2) := \lambda i_s.\ \mathbf{DET}(u[D_1 i],\ u[([D_3 \rightarrow (D_4; D_2)])i])$

$\mathbf{det}_u^{\mathbf{str}:u'<<\mathbf{wk}:u''}(D_1, D_2) := \lambda i_s.\ \mathbf{DET}(u[D_1 i],\ u[(D_4; [D_3 \rightarrow D_2])i])$,

where $D_3$ is the subpart of $D_1$ constraining dref $u'$

and $D_4$ is the subpart of $D_1$ constraining dref $u''$.

To summarize, the CDRT+GQ strategy of analyzing mixed weak & strong 'indefinites' by locating the weak / strong ambiguity at the level of generalized determiners is undesirable for at least three reasons:

- first, it greatly increases the number of lexical entries for each determiner: we do not only have to specify for each indefinite in the restrictor of the determiner whether it receives a strong or a weak reading, but we also need to specify their relative scope;
- second, the interpretation procedure is not compositional – and this happens precisely because we pack in the lexical entry of the determiner many features that should in fact be encoded in the LF of its restrictor, i.e. what indefinites it contains, what reading they receive and what their relative scope is;
- third, the large number of lexical entries leads to (rampant) over-generation; for example, we have noticed that sentence (74) intuitively has a single reading[17], while CDRT+GQ assigns it several other readings that are intuitively unavailable.

Thus, if we want to give a precise definition of the CDRT+GQ interpretation procedure for sentence (74) for example, we have to either reject the Montagovian notion of compositionality or define fairly wild syntactic operations at the LF level, e.g.

[17] This is not to say that other readings, e.g. a '**strong**:$u_2$, **strong**:$u_3$' reading, are not available for other examples.

identifying the substrees in the restrictor that correspond to the indefinites, duplicating them in the nuclear scope, moving them around to obtain various relative scopes, relating the subtrees via dynamic implication or dynamic conjunction depending on whether they have a strong or a weak reading etc. And, even if this daunting task were accomplished in a relatively plausible way, we would still face the ensuing over-generation problem.

I take the above reasoning to establish that CDRT+GQ (and similar systems) cannot account for mixed weak & strong donkey sentences containing VP- or CP-conjunctions like the ones in (74) and (75) above. It is the goal of the following chapter (chapter **5**) to offer a compositional account of the mixed weak & strong donkey sentences.

In particular, I will show that modifying CDRT+GQ so that information states are modeled as *sets* of 'assignments' (type *st*) and not as single 'assignments' (type *s*)[18], together with the hypothesis that any indefinite is ambiguous[19] between a weak and a strong reading, enables us to assign a unique meaning to each generalized determiner and to provide a *fully compositional* and intuitively correct interpretation for a wide range of donkey sentences, including the mixed weak & strong examples in (74) and (75) above.

CDRT+GQ faces the same basic kind of problems with respect to conditionals that exhibit asymmetric readings, i.e. weak / strong ambiguities. Recall Kadmon's generalization: a multi-case conditional with two indefinites in the antecedent generally allows for three interpretations, one where the QAdverb (which is a covert *always* or *usually* in the case of bare conditionals) quantifies over pairs, one where it quantifies over instances of the first indefinite and one where it quantifies over instances of the second. For example, consider sentences (82), (83) and (84) below.

82. If a$^{u}$ village is inhabited by a$^{u'}$ painter, it$_{u}$ is usually pretty.
    (Kadmon 1987)

---

[18] The idea of extending DPL by using sets of variable assignments for info states is due to van den Berg (1994, 1996a), which proposes this to account for a different kind of phenomena, namely discourses involving *plural cross-sentential* anaphora of the form *Every$^{u}$ man saw a$^{u'}$ woman. They$_{u}$ greeted them$_{u'}$*.

[19] Or, to put in (possibly) more appealing terms: each indefinite is *underspecified* with respect to its 'strength' (it can be either weak or strong) and its 'strength' needs to be specified in each particular donkey sentence; for a discussion of the various factors that influence this 'strength' specification, see chapter **5**.

83. If a$^{u}$ drummer lives in an$^{u'}$ apartment complex, it$_{u'}$ is usually half empty.
    (Bäuerle & Egli 1985, apud Heim 1990: 151, (29))
84. If a$^{u}$ woman owns a$^{u'}$ cat, she$_{u}$ usually talks to it$_{u'}$.
    (Heim 1990: 175, (91))

The most salient reading of (82) is an asymmetric one in which we quantify over villages *u* inhabited by a painter; thus, that conditional is translated in CDRT+GQ by means of the selective determiner $\mathbf{most}^{wk}{}_{u}$ or $\mathbf{most}^{str}{}_{u}$.

The most salient reading of (83) is an asymmetric one in which we quantify over apartment complexes *u'* inhabited by a drummer; hence, the conditional is translated in CDRT+GQ by means of the selective determiner $\mathbf{most}^{wk}{}_{u'}$ or $\mathbf{most}^{str}{}_{u'}$.

Finally, the most salient reading of (84) is one where we quantify over woman-cat pairs; therefore, the conditional is translated in CDRT+GQ by means of the unselective determiner **most**.

Various factors influence what is the most salient reading of a donkey conditional: Bäuerle & Egli (1985) notice that it depends on which indefinites from the antecedent are anaphorically picked up in the consequent. Rooth (1985) and Kadmon (1987) (see also Heim 1990 and Chierchia 1995 among others) observe that the focus-background structure of the sentence also determines which indefinites receive which reading, the generalization being that the non-focused indefinite in the antecedent is the one that is bound by the *if*+QAdverb quantification. As Heim (1990): 152 observes, the sentence in (85) below receives precisely the most salient interpretation of (83) above, i.e. an 'apartment complex' asymmetric reading, while sentence (86), with a different focus-background, receives a 'drummer' asymmetric reading.

85. Do you think there are vacancies in this apartment complex? – Well, I heard that Fulano lives there, and if a DRUMMER lives in an apartment complex, it is usually half empty.
86. Drummers mostly live in crowded dormitories. But if a drummer lives in an APARTMENT COMPLEX, it is usually half empty.

Accounting for how these factors determine what reading is the most salient, i.e. which one of the determiners $\mathbf{most}^{wk/str}{}_{u}$, $\mathbf{most}^{wk/str}{}_{u'}$ and **most** should be selected in the translation, is clearly beyond the scope of CDRT+GQ. What I want to point out is simply that the translation of a conditional by means of a selective determiner like $\mathbf{most}^{wk/str}{}_{u}$ or $\mathbf{most}^{wk/str}{}_{u'}$ exhibits the same kind of non-compositionality as the translation of relative-clause donkey sentences with mixed readings: one of the indefinites in the antecedent of the conditional is somehow supposed to 'fuse' with the QAdverb and be interpreted as a selective generalized determiner.

There are even more complex examples with three indefinites – like the one in (87) below. Its most salient reading seems to be one in which we quantify over most woman-man pairs that have some son or other (i.e. the indefinite $a^{u'}$ *son* receives a weak reading).

87. If $a^{u}$ woman has $a^{u'}$ son with $a^{u''}$ man, $she_{u}$ usually keeps in touch with $him_{u''}$.
(I. Heim, apud Chierchia 1995: 67, (14b))

Because of their different, multi-sentential syntactic structure and because of their somewhat different behavior with respect to the weak / strong donkey ambiguity, I will generally avoid conditional structures (with or without QAdverbs) and use mainly mixed weak & strong *relative-clause* donkey sentences to motivate the novel dynamic system I will introduce in chapter **5** and the analysis of the weak / strong ambiguity I will propose there.

Let's turn now to another welcome consequence of the fact that CDRT (and its extension CDRT+GQ) unifies Montague semantics and dynamic semantics, namely the account of the interaction between donkey anaphora and generalized conjunction (generalized to arbitrary types in the sense of Partee & Rooth 1983 among others).

## *7. Summary*

The overarching goal of this chapter and of the previous two was to incrementally describe a compositional dynamic system formulated in many-sorted type logic with selective dynamic generalized quantification and generalized conjunction, which I have labeled CDRT+GQ. Three phenomena provide the primary motivation for CDRT+GQ:

- the proportion problem;
- the weak / strong donkey ambiguity;
- the interaction between donkey anaphora, dynamic quantification and generalized dynamic conjunction.

Besides providing a streamlined notation integrating various DRT, DPL and CDRT notational conventions, CDRT+GQ contributes several new notions and analyses:

- it shows how to define in Dynamic Ty2 the DPL-style conservative definition of unselective dynamic generalized quantification in chapter **2**;
- it integrates CDRT (Muskens 1996) and the DPL-style notion of selective generalized quantification (Bäuerle & Egli 1985, Root 1986, Rooth 1987, van Eijck & de Vries 1992, Chierchia 1992, 1995);
- it provides the dynamic counterparts of the definitions of conjoinable types and generalized conjunction and disjunction in Partee & Rooth (1983)**;**
- it accounts for the DP-conjunction donkey example *Every*$^{u_1}$ *boy who has a*$^{u_2}$ *dog and every*$^{u_3}$ *girl who has a*$^{u_2}$ *cat must feed it*$_{u_2}$ from Chierchia (1995).

Finally, section **6** showed that CDRT+GQ has the same problems as DPL+GQ when confronted with relative-clause donkey sentences with mixed weak & strong readings, e.g. *Every person who buys a book on amazon.com and has a credit card uses it / the card to pay for it*. Such examples are difficult to analyze in CDRT+GQ and, if they can be analyzed at all, the account is stipulative, non-compositional and over-generates fairly wildly.

The last three chapters in general and the introduction of CDRT+GQ in particular pave the way for chapter **5**, which shows that a minimal modification of CDRT+GQ, i.e. the introduction of *plural* info states (type *st*) as opposed to 'singular' ones (type *s*), enables us to give a compositional analysis of a wide range of singular donkey sentences, including mixed weak & strong relative-clause donkey sentences.