

Chapter 2

Background: E-type Interpretation

In this chapter I set out to present a detailed introduction into the basics of interpreting pronouns in context.

We focus on the formal alternatives that are available for the analysis of e-type pronouns in general. As we saw in the introduction there are basically two options: either we account for e-type pronouns by giving them a semantics of their own (e.g. by considering them as reconstructed descriptions) or we dismiss the distinction between e-type and non-e-type pronouns and account for e-type effects using a sophisticated semantics sensitive to the contexts e-type pronouns occur in. Traditionally, the former strategy is called an e-type strategy, while the latter approach is associated with dynamic semantics.

This thesis is not meant to contribute to the discussion about which of these approaches leads to better results. Rather, I try to present a sufficiently strong analysis of quantification and plurality which allows us to view plural pronominal anaphora as objects which take their antecedent from a context which is built up dynamically. Nevertheless, in order to get more grip on the subject, we will start by briefly considering some variants of e-type strategies in section (2.1). Then, in section (2.2), the basics of discourse representation theory and dynamic predicate logic are discussed extensively. This will provide many of the notions that are essential for an understanding of the rest of the thesis. Finally, in section (2.3), I focus on DRT's treatment of plurality.

E-type strategies have in common that they try to model the observation that e-type pronouns can be paraphrased by a definite description constructed from material in the antecedent sentence.¹ They differ in how such a reconstruction comes about, e.g. whether a pragmatic, semantic or syntactic operation is involved.² Cooper (1979) proposes a pragmatic strategy in which e-type pronouns are analysed as ‘the $R(x)$ ’, where the relation symbol R is resolved by pragmatics. Heim (1990) discusses alternative forms of pragmatic e-type strategies and points out some problems. One important defect is that pragmatic strategies ignore the role of a linguistic antecedent, witness the contrast between (2.1) and (2.2).

- For an e-type strategy to work, it seems that the reconstruction should be sensitive to the syntactic environment of the antecedent. Heim proposes such a syntactic account. The link between e-type pronouns and their antecedent is regulated by a single transformation rule (see Heim 1990, p. 170).

- The rule says that a sentence S occurring in some context containing some noun phrase indexed *i* enables a subsequent co-indexed pronoun to be interpreted using the syntactic material in S. The symbols 'X', 'Y' and 'Z' express the contextuality of this rule. The sentence 'S' and the e-type pronoun 'NP_{*i*}' are not required to stand in any particular syntactic relation, they appear in their own context. The newly formed 'augmented pronoun', i.e. '4+2', is interpreted as a definite description.³

³Interestingly, Irene Heim herself observes a problematic issue involving plurality (Heim 1990, p. 172–173). When e-type pronouns are accounted for by a syntactic reconstruction process, then plural pronouns as in (i) would be analysed as ‘the papers that *x* turned in’ instead of ‘the papers the students turned in.’

- (i) Every student turned in a paper. They were all identical. = Heim 1990 (ex. 79)

$$(2.4) \quad \llbracket \text{it } [\text{Det}_x \alpha] \beta \rrbracket^g = \text{the unique } d \text{ such that } \llbracket \alpha \rrbracket^{g[x/d]} = \llbracket \beta \rrbracket^{g[x/d]} = 1$$

Alternatively, Neale (1990) introduces a semantic rule to come to an interpretation of the e-type pronoun as a definite description:

“If x is a pronoun that is anaphoric on, but not c-commanded by ‘ $[Dx:Fx]$ ’ that occurs in an antecedent clause ‘ $[Dx:Fx](Gx)$ ’, then x is interpreted as the most “impoverished” definite description directly recoverable from the antecedent clause that denotes everything that is both F and G .” Neale 1990 (p. 182).

The uniqueness condition in (2.4) is also implicit in Neale’s rule and eventually leads to predictions which are too strong (just like Cooper’s pragmatically saturated definite descriptions would). For instance, in (2.5), we are forced to interpret ‘he’ as the unique man in Athens.

(2.5) If a man is in Athens, he is not in Rhodes.

Most of the modern work on e-type strategies is dedicated to resolving the uniqueness issue (see e.g. Lappin 1989; Kadmon 1990; Neale 1990; Chierchia 1992; van der Does 1993). I would like to leave the discussion at this point, however. The (interesting) finesses of modern e-type strategy proposals are beyond the scope of this thesis. What is important from our point of view is the idea that at least some pronouns are descriptive in nature. Interestingly, when adopting a strong version of the e-type strategy, one wherein *all* pronouns correspond to descriptions, the differences with dynamic semantics start to blur, since such a strong theory will have to explain how in every context the right descriptions are recoverable. The remaining difference seems to be only due to the fact that dynamic semantics naturally restricts itself to talk about predicate logic and variable binding. In van der Does 1993, however, a system is presented in which dynamic semantics and the e-type strategy seem to converge. Moreover, as I already suggested in the introduction and as we will see in more detail in the current chapter, the discourse representation theory of Kamp and Reyle 1993 also uses elements from the e-type strategy by modelling maximal discourse anaphora using a reconstruction process.

2.2 Dynamic semantics for singular anaphora

Since this thesis focuses on the tradition of *dynamic semantics*, I will discuss the formal and conceptual aspects of this approach extensively. What may be called ‘dynamic’ about dynamic semantics is that it involves a notion of interpretation which contributes some kind of *change*. In dynamic semantic theories, the meaning of an expression is said to be its ‘context-change potential.’ Apart from a notion of context change, dynamic

semantic theories have in common that pronouns are systematically analysed as ordinary bound variables. The distinction between ‘types’ of pronouns, such a e-type vs. bound, is a result of how these variables are evaluated. The notion of context standardly involves assignment functions and consequently different contexts result in different variable evaluations. Roughly, bound usages of pronouns are explained as variables which are evaluated with respect to iterated contexts; the iteration being instantiated by some operator (quantifier) in the scope of which the pronoun occurs. Referential usages of pronouns are variables evaluated in a context which provides a determined value for this variable. E-type pronouns are now to be explained as variable evaluations which, due to contextual circumstances, do not naturally fall under the previous two classes. The main point, however, is that from a dynamic semantic point of view, there is no useful distinction between *kinds* of pronouns, since all pronouns correspond to variables in context.

For instance, the case of inter-sentential anaphora in (2.6) is explained by considering the variable corresponding to *he* in a context which underdetermines the value for this variable.

(2.6) A man came in. He sighed.

The conditional in (2.7) is analysed as a universal quantifier over contexts satisfying the antecedent clause. (See Lewis 1975; Kratzer 1986.)

(2.7) If a farmer owns a donkey, he beats it.

(2.8) All cases in which x is a farmer, y a donkey owned by x , are cases in which x beats y .

The pronouns in the consequent clause can simply be analysed as bound variables, since they are evaluated in individual contexts in which x is a farmer owning donkey y .

Notice that this has immediate advantages over an e-type strategy. First, with respect to Heim’s argument that a linguistic antecedent is a necessary ingredient for pronominal reference, notice that a dynamic approach has a semantic explanation for this need. In Heim’s examples (2.1) and (2.2), repeated here as (2.9) and (2.11) respectively, the set of married men coincides with the set of men who have a wife, but the way these constituents change the context differs in an important way. In the paraphrase (2.12), there is no variable available for the pronoun ‘her’.

(2.9) Every man who has a wife sits next to her.

(2.10) All cases in which x is a man such that there exists a y being x ’s wife is such that x sits next to y .

(2.11) *Every married men sits next to her.

- (2.12) All cases in which x is a man such that x is married are such that x sits next to -?-.

Second, issues of uniqueness do not play a role in dynamic semantics. The example in (2.5) is repeated here with a dynamic paraphrase. Notice that whatever value is chosen for ‘a man’ will be the value for ‘he’, but that nothing is said about how many such values exist.

- (2.13) If a man is in Athens, he is not in Rhodes.
All cases in which x is a man and x is in Athens, are cases in which x is not in Rhodes.

In the introduction to dynamic approaches to meaning below, I focus on two frameworks: Kamp (1981)’s discourse representation theory and Groenendijk and Stokhof (1991)’s dynamic predicate logic. This creates an oversimplified image of dynamic semantics. In what follows, many contributions and discussions are not discussed, such as, for instance, the seminal papers Heim 1982, Rooth 1987, Barwise 1987, Chierchia 1992 and Groenendijk and Stokhof 1990.

2.2.1 Discourse Representation Theory

Although of paramount importance to the emergence of dynamic semantics, discourse representation theory (henceforth, DRT) should not really be seen as a part of that tradition. DRT fits in the Geachian tradition of viewing pronouns as variables, but ‘meaning’ in DRT certainly does not correspond to context-change potential. As we will see, some elements of dynamics do exist, though.

The key feature of the discourse representation theory presented in Kamp 1981 is that all ‘types’ of pronouns, as well as indefinite NPs, can be accounted for by translating them as predicated plain variables. The specific effects responsible for the seemingly different types of pronouns are caused by interactions with operators introduced by other syntactic material. Likewise, the quantificational force of an indefinite is established by the context it appears in. The difference between an indefinite and a pronoun is due to nothing more than the fact that the former corresponds to a ‘new’ variable, while the latter corresponds to an ‘old’ one.

In DRT, given a syntactic form, the representation of the meaning of that form is generated by applying construction rules. For instance, the rule for pronouns says that a variable should be selected and used for predication (conform the rest of the sentence). By recursively applying such rules, sentences result in discourse representation structures or DRSs, which “can be regarded as the mental representations which speakers form in response to the verbal inputs they receive” (Kamp 1981, p. 282). Subsequent syntactic forms are incorporated in the existing representation and transformed in meaning representations by again applying construction

rules. This shows an element of dynamics: syntactic forms are interpreted inside representations formed by previously processed material and they also set the stage for forms that follow.

DRSs are formal objects containing a set of variables or ‘(discourse) referents’⁴ called the *universe* and a set of conditions. These structures can be interpreted. Again, this notion of interpretation is not dynamic.⁵ Consider a model $M = \langle D_e, I \rangle$ and a set of referent symbols VAR. A DRS is a pair $\langle V, C \rangle$, where $V \subseteq \text{VAR}$ and C is a set of conditions. Another way of looking at these structures is by viewing them as a list of conditions paired with (some of) the free variables that occur in them. In this light, a DRS like the one in (2.14) is nothing more than the predicate logical formulae $P(x)$. Its interpretation (in (2.15)), however, tells us that it is *true* as soon as we find a value for x which satisfies P in the model.

$$(2.14) \quad \begin{array}{|c|} \hline x \\ \hline P(x) \\ \hline \end{array}$$

$$(2.15) \quad \exists f : \{x\} \rightarrow D_e \text{ such that } f(x) \in I(P)$$

A DRS is true in DRT if and only if there exists a function assigning values to the free variables such that the conditions are satisfied in the model. As a result, free variables are standardly existentially quantified. Indefinite NPs, thus, need not be translated as existentially quantified expressions, but simply as variables. This allows them to adopt the quantificational force of whatever context they appear in. For instance, conditionals introduce embedded DRSs with a more complex interpretation.

$$(2.16) \quad \begin{array}{|c|c|} \hline \begin{array}{|c|} \hline \Upsilon \\ \hline \Gamma \end{array} & \Rightarrow & \begin{array}{|c|} \hline \Upsilon' \\ \hline \Gamma' \end{array} \\ \hline \end{array}$$

$$(2.17) \quad \text{All functions } f \text{ that verify } \langle \Upsilon, \Gamma \rangle \text{ in } M \text{ can be extended to a function which verifies } \langle \Upsilon', \Gamma' \rangle \text{ in } M.$$

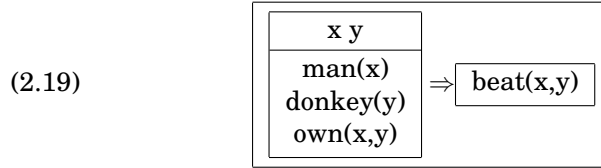
A function g extends another function f if the domain of g includes that of f and with respect to this joint domain, they agree on the values they provide. This is the source of many effects involving pronouns and indefinites. The embedded boxes introduced by a conditional are interpreted in a *local*

⁴In this introduction, we do not distinguish the notion of variable from the notion of discourse referent as this is not relevant for the purpose of introducing DRT. However, the reader should keep in mind that discourse referents are linguistically motivated objects, while variables can play many roles in natural language semantics, including some for purely derivational purposes. Groenendijk and Stokhof (1990), page 3, for example, point out that in the lambda abstract $\lambda x.\text{farmer}(x) \wedge \exists y(\text{donkey}(y) \wedge \text{own}(x, y))$, y , but not x can be considered a discourse referent (i.e. with the properties they have in DRT).

⁵The interpretation of conditionals (see below), however, *is* dynamic, since the consequent clause is interpreted with respect to an assignment function changed by the antecedent clause.

context. The consequent clause is iteratively interpreted with respect to whatever the function f is changed into by the antecedent clause. Consider for instance the DRS in (2.19) which represents the classic donkey example and its interpretation in (2.20).

(2.18) If a man owns a donkey, he beats it.

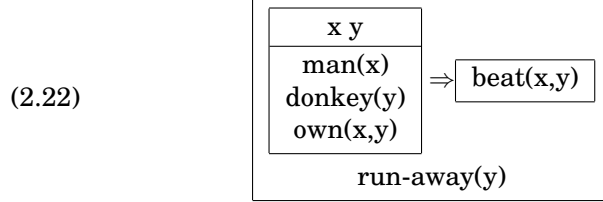


(2.20) All functions $f : \{x,y\} \rightarrow D_e$ such that $f(x)$ is a man and $f(y)$ is a donkey owned by $f(x)$ in model M extend to a function $f' : \{x,y\} \rightarrow D_e$ such that $f'(x)$ beats $f'(y)$.

(2.21) All functions $f : \{x,y\} \rightarrow D_e$ such that $f(x)$ is a man and $f(y)$ is a donkey owned by $f(x)$ in model M are such that $f(x)$ beats $f(y)$.

The simplification in (2.21) of (2.20) is due to the fact that, if two functions have the same domain, one of them can only extend the other if they are, in fact, the same function. The pronouns as well as the indefinites in (2.18) are simply represented as variables. The e-type effect is explained by the semantics of the conditional rather than by a reconstruction procedure.

A final important basic ingredient of DRT is its notion of accessibility. As stated above, the only difference between a pronoun and an indefinite is that the latter corresponds to a fresh variable while the former corresponds to a referent which has already been introduced. The construction rule for pronouns thus states that a pronoun should be replaced by an *accessible* variable. The notion of accessibility is not stipulated, but is semantically based: it follows from the truth-conditions for a DRS and is therefore very similar to the syntactic requirements of variable binding in predicate logic. For instance, from the interpretation in (2.17), it follows that referents introduced in the antecedent DRS of a conditional are accessible in the consequent DRS. This is so because the functions used to test verification of the right DRS are functions verifying the left DRS and, therefore, these functions will have as their domain the universe of the left DRS. In contrast, the referents in a conditional are *not* accessible from outside the two embedded DRSs. That is, the referent 'y' in the predication 'run-away(y)' in (2.22) is *free*. It cannot originate from a pronoun, since the referent 'y' introduced in the embedded DRS is inaccessible from within the main DRS. This is supported by the infelicity of (2.23).



(2.23) If a man owns a donkey, he beats it. ??It runs away.

As I mentioned above in the introduction chapter, DRT was one of the causes of the rise of a programme of dynamic semantics in which interpretation is context-change potential. The specific representational architecture of DRT, however, begged the question whether a more direct expression of this potential was not possible.

2.2.2 Dynamic predicate logic

In Groenendijk and Stokhof 1991, a dynamic predicate logic is presented which fulfilled the goal of creating “a compositional, non-representational theory of discourse semantics.” The dynamics of this system follows directly from the fact that predicate logical formulae are not interpreted in terms of truth-conditions, but in terms of how they change the context, or, to be precise, how they change assignment functions. Every formula denotes a set of pairs of assignment functions, i.e., it denotes a relation between assignments. Conceptually, these pairs should be seen as the inputs and corresponding outputs of the predicate logical ‘instructions.’ For instance, $\langle f, g \rangle$ is in the interpretation of Γ if g is a possible output for interpreting Γ with respect to f .

Crucial is the interpretation of conjunction as relation composition. That is, in interpreting a formula $p \wedge q$ the output of interpreting p is used as an input for the interpretation of q . Let $\llbracket \cdot \rrbracket$ map formulae to relations between assignment functions. We write $f \llbracket \varphi \rrbracket g$ to express that $\langle f, g \rangle$ is one of the pairs of assignment functions in the dynamic interpretation of φ .

$$(2.24) \quad f \llbracket p \wedge q \rrbracket g :\Leftrightarrow \exists h : f \llbracket p \rrbracket h \ \& \ h \llbracket q \rrbracket g$$

Dynamic conjunction is thus *internally* dynamic: the change brought about by p is passed on to the interpretation of q . Moreover, it is *externally* dynamic: the change brought about by processing p and subsequently q can be recovered from the output assignment. The prime source of such ‘changes’ is the dynamic existential quantifier. It uses the notion of *random assignment*.

$$(2.25) \quad f \llbracket \exists x(\varphi) \rrbracket g :\Leftrightarrow \exists h : f \text{ and } h \text{ differ at most in the value they assign to } x \text{ and } h \llbracket \varphi \rrbracket g$$

The existential quantifier replaces whatever value the input assignment assigns to x with some value that satisfies its scope φ . Combining the

definition of the existential quantifier with relation composition as the interpretation for conjunction, we are able to derive the so-called donkey equivalence in (2.26), which says that existentially introduced values have unlimited scope to the right.

$$(2.26) \quad f \llbracket \exists x(\varphi) \wedge \psi \rrbracket g \Leftrightarrow f \llbracket \exists x(\varphi \wedge \psi) \rrbracket g$$

In fact, this points out that it is unnecessary to define the existential quantifier with a scopal formula. We could alternatively define just the bare quantifier:

$$(2.27) \quad f \llbracket \exists' x \rrbracket g :\Leftrightarrow f \text{ and } g \text{ differ at most in the value they assign to } x$$

Existential quantification changes the context in an important way. Other atomic formulae have no such influence on the context and simply test whether the context is to their satisfaction. Such expressions are accordingly called *tests*. A predication $P(x)$, for instance, returns an incoming assignment whenever this assigns a value to x which is in the extension of P .

$$(2.28) \quad f \llbracket P(x_1, \dots, x_n) \rrbracket g :\Leftrightarrow f = g \ \& \ \langle f(x_1), \dots, f(x_n) \rangle \in I(P)$$

Dynamic implication is also a test, although a much more complex one. Similar to DRT, conditionals are analysed as introducing universal quantification over contexts. In DPL's terms, this means that given an input assignment f , we first interpret the antecedent clause and for each output assignment this interpretation returns, we check whether we can use that as an input for interpreting the consequent clause successfully (i.e., returning some output assignment function). If this test succeeds, we return the input assignment again.

$$(2.29) \quad f \llbracket p \Rightarrow q \rrbracket g :\Leftrightarrow f = g \ \& \ \forall h : f \llbracket p \rrbracket h \rightarrow \exists k : h \llbracket q \rrbracket k$$

All this gives us the tools to analyse a number of ordinarily problematic pronouns as simple (bound) variables. For instance, the semantics of intersentential anaphora in (2.30), represented in (2.31), follows directly from the donkey equivalence in (2.26). The classic donkey conditional in (2.32) can be analysed parallel to the proposal in DRT, except that the indefinite results in an existential quantification as opposed to a predication over a free variable. The effect from (2.33) is the same.

(2.30) A man came in. He sighed.

$$(2.31) \quad \begin{aligned} \llbracket \exists x(\text{MAN}(x) \wedge \text{CAME_IN}(x)) \wedge \text{SIGH}(x) \rrbracket &= \\ \llbracket \exists x(\text{MAN}(x) \wedge \text{CAME_IN}(x) \wedge \text{SIGH}(x)) \rrbracket &= \\ \llbracket \exists' x \wedge \text{MAN}(x) \wedge \text{CAME_IN}(x) \wedge \text{SIGH}(x) \rrbracket & \end{aligned}$$

(2.32) If a man owns a donkey, he beats it.

$$(2.33) \quad \llbracket (\exists' x \wedge \text{MAN}(x) \wedge \exists' y \wedge \text{DONKEY}(y) \wedge \text{OWN}(x, y)) \Rightarrow (\text{BEAT}(x, y)) \rrbracket$$

The *accessibility* of antecedents follows from the semantics. Consider for instance (2.33). In (2.23), we saw that a conditional like (2.32) does not allow subsequent anaphoric reference to indefinites introduced in one of its clauses. The formula in (2.33) is interpreted as a test. Given an assignment function f , it returns f if and only if all possible output functions for the left-hand side of the dynamic implicator ' \Rightarrow ' yield an output when used as an input function for the interpretation of the right-hand side of the implicator. But when these conditions are met the input assignment (f) is returned and consequently all random assignments considered during the test are lost.

Negation is a test as well. It blocks access from outside its scope to variables introduced within its scope. The negation operation checks whether there exists an assignment function which can serve as a proper output for its scope given some input assignment. If so, the test fails. If not, the input assignment is returned.

$$(2.34) \quad f \llbracket \neg(\varphi) \rrbracket g :\Leftrightarrow f = g \ \& \ \neg \exists h : f \llbracket \varphi \rrbracket h$$

Changes brought about to f by φ can thus never surface outside the scope of the negation. Therefore, a variable x occurring after $\neg(\exists x)$ can never access the value assigned to x inside the negation. This explains why negated indefinites are not proper antecedents.⁶

Something similar occurs with universal quantification.

$$(2.35) \quad f \llbracket \forall x(\varphi) \rrbracket g :\Leftrightarrow f = g \ \& \ \forall k : f \llbracket \exists' x \rrbracket k \Rightarrow \exists j : k \llbracket \varphi \rrbracket j$$

This says that any extension of f assigning some value to x can successfully interpret φ . The output assignments j of these successful interpretations, however, are not passed on.

This way, the semantics of DPL mirrors the anaphora facts of natural language. While existential quantification is externally dynamic, universal quantification is externally static. Like the semantics of negation, the semantics of universal quantification does not pass on any values introduced in its scope. Both conjunction and predication are also externally dynamic, the latter trivially so.

2.2.3 Information increase

The relations expressed by DPL formulae carry information about the content of the formulae. For instance, the set of assignments g paired with some assignment f according to such a relation, inform us about the possible values for the variables. They inform us about which values are still

⁶It has often been pointed out that a definition as in (2.34) constrains the accessibility of negated antecedents too strongly. See, e.g. Krahmer and Muskens 1995 and van Rooy 1997 for discussion.

open to discussion. Accordingly, the predicate logical expressions in DPL can be seen as *actions* on information states. Predication, being a test, has the capability of reducing the number of possible values for variables. For instance, after introducing ‘a man’ in the discourse using the action ‘ $\exists x(\text{MAN}(x))$ ’, the possible values we wish to entertain for ‘ x ’ are all the objects satisfying the property of being a man. If, somewhere further on in the discourse, an utterance instantiates the action ‘ $\text{OLD}(x)$ ’, the possible values for ‘ x ’ are reduced to objects which are old men. This way, predication reduces the number of options that are open and thus increases the information stored in context.

Given a set of assignment functions F and a dynamic predicate logical expression φ , we are able to express the update potential of this expression. That is, given a set of possible value assignments that is consistent with the foregoing discourse, we are able to express how a form like φ influences this set.

Definition 2.1 Update potential

$$F[\varphi] := \lambda g. \exists f \in F : f \llbracket \varphi \rrbracket g$$

□

Ideally, only three possibilities are open for formulae of a dynamic formalism: (i) φ accepts the possibilities in F , i.e. $F[\varphi] = F$, (ii) φ adds information, i.e. $F[\varphi] \subset F$ or (iii) φ is inconsistent with respect to F , i.e. $F[\varphi] = \emptyset$. In such a formalism, no action can cause a loss of information: for any formula φ it holds that $\forall F : F[\varphi] \subseteq F$. For DPL, however, this does not hold.⁷ For example, say that some set of assignments F contains only functions assigning some entity d to x . Clearly, however, $F[\exists'x] \not\subseteq F$, for the existential quantifier *resets* the variable x .

Intuitively, this is related to the fact that apart from reduction of the set of possible assignment functions, there seems to be a second form of information increase associated with quite a different notion of information. During the processing of a discourse, not only do we constantly reduce the number of options open as a value for some variable, we moreover keep track of which variables are under discussion. By introducing new topics we expand the information we have about the discourse.

In DRT, this type of information is represented by the universe of a DRS. Each NP that is encountered introduces a fresh referent in the universe. As the discourse unfolds, more and more referents will be introduced, increasing the potential for anaphoric reference. The contexts of

⁷This is in contrast to the update semantics presented in Veltman 1991, which does have this property. See Vermeulen 1994 (also 1993) for an elaborate discussion of this so-called eliminativity property and an elegant variation on DPL's variable management which guarantees eliminativity. Other proposals can be found in Fernando 1992; Dekker 1993; Dekker 1994 and van Eijck 2001.

DPL, however, are assignment functions that assign values to all the variables in their domain and as such do not have a way of discerning between *active* and *inactive* variables. Moreover, the notion of context of DPL is not able to represent something like *an initial state* wherein an item has yet to be introduced in the discourse.⁸

An intuitively attractive way of enriching DPL with information concerning the introduced discourse topic is by using partial (instead of total) assignment functions. This way, the active domain of a function expresses which variables are under discussion, just like the universe of a DRS supplies the domain of the verifying assignment function in DRT. The initial state, in such a set-up, will be the function that is undefined for every variable.

As we will see below, particularly in chapters 4 and 5, we will need to model both kinds of information discussed here. There, we return to the issue of defining DPL with partial functions.

2.3 DRT and plural e-type pronouns

The fourth chapter of Kamp and Reyle 1993 is doubtlessly the first analysis of anaphoric aspects of plurality which is detailed enough to make serious empirical claims about virtually all of the numerous phenomena involving plural reference. Although the framework is DRT, the analysis of plural e-type pronouns presented in this work very much resembles an *e-type* strategy.

Kamp and Reyle distinguish between two types of NPs, namely quantificational NPs and non-quantificational NPs. The latter group is treated like ordinary indefinites. That is, they introduce a (possibly plural) referent in the local universe which is accessible in the local DRS as well as in embedded DRSs. For instance, (2.36) is represented as (2.37).

(2.36) Two students wrote an article.

(2.37)	X y
	$ X =2$ student*(X) article(y) wrote(X,y)

Uppercase letters are used for referents which correspond to plural indi-

⁸This is not entirely true. For DPL one could take as an initial state the set of all possible assignment functions. In such a state, each variable is associated with every possible value in the domain of entities. The state, therefore, represents a tabula rasa, since all options are still open. However, this is at the cost of representing all non-introduced topics as topics about which nothing is known.

viduals, lower case letters have an atomicity required implicit in them⁹. The conditions in the DRS say that the referent 'X' should refer to a plurality containing two atoms which occurs in the plural closure of the set of students. Furthermore, 'y' corresponds to an article written by these students. Subsequent plural pronouns are able to pick up these two referents.

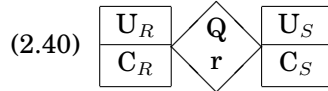
(2.38) Two students wrote an article. They sent it to L&P.

(2.39)	X y
	X =2
	student*(X)
	article(y)
	wrote(X,y)
	senttoL&P(X,y)

There is no maximality involved in the case of anaphora in (2.38). There might have been other students writing a paper, but they need not have sent a paper to L&P to verify (2.38). This is indeed allowed by the DRS in (2.39), since *any* function f assigning a set of two students to X that wrote some article $f(y)$ and sent it to L&P verifies this DRS.

The other class of NPs, quantificational NPs, does not introduce referents. They introduce a type of representation called *duplex conditions*. These representations follow the common wisdom that (quantificational) determiners create a tripartite structure. Duplex conditions take care of the truth-conditions of the structures following the techniques of generalised quantifier theory (Barwise and Cooper 1981). At the same time, they account for possible anaphoric links between the arguments of the determiner. Let us briefly consider how this is done.

Ignoring some details, duplex conditions consist of two DRSs, one corresponding to the restrictor argument of the determiner and the other to the nuclear scope. These boxes are connected by a symbol expressing the quantificational relation corresponding to the determiner as well as the referent(s) quantified over.



The referents introduced by the restrictor ($[U_R|C_R]$) are accessible in the scope ($[U_S|C_S]$). The interpretation is not straightforward. I will ignore several important issues here and aim at communicating the general intuition behind the interpretation.¹⁰ Say that Q corresponds to some relation

⁹Actually, the system of plural and singular referents presented in Kamp and Reyle 1993 is much more refined, but we will ignore these subtle (though important) details.

¹⁰See especially subsection 4.3.2.1 of Kamp and Reyle 1993 for discussion of some details.

between sets $I(Q)$, then a model and an embedding function f verify (2.40) if the following sets A and B are in the $I(Q)$ relation:¹¹

(2.41) A : The set of individuals d , such that there is an extension g of $f \cup \{\langle r, d \rangle\}$ which verifies C_R .

(2.42) B : The set of individuals d , such that there is an extension g of $f \cup \{\langle r, d \rangle\}$ which verifies C_R , for which in turn there exists an extension h which verifies C_S .

The accessibility facts follow from the interpretation. Referents in the scope are interpreted relative to an extension of an embedding function which verifies the restrictor. Referents in the restrictor are thus accessible to the scope. Outside the duplex conditions no referents introduced in it are accessible. This way, DRT needs to use an independent procedure to account for non-bound pronouns with quantified antecedents.

2.3.1 Abstraction

In DRT, the so-called abstraction procedure makes it possible to reconstruct a description using representation material of the antecedent. Plural e-type pronouns can be analysed as variables equated with such a description. This is made possible by a summation operator ‘ Σ ’, which creates the plural individual maximally satisfying the description. For instance, the abstraction in (2.43) corresponds to the maximal plurality of farmers owning a donkey.

(2.43) $\Sigma x.$

x y
farmer(x)
donkey(y)
own(x, y)

The operator can be used to abstract information from a duplex condition. That is, following a duplex condition as in (2.44), we want the individual in (2.43) to be a potential antecedent for subsequent (e-type) plural anaphors. It stands for the farmers that own a donkey.

(2.44)

x
farmer(x)

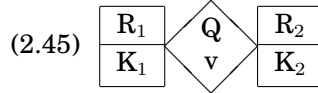
Most
x

y
donkey(y)
own(x, y)

A construction rule regulated when abstraction can be applied. It is a special kind of construction rule since the “application conditions relate to the DR-theoretical structure of the DRS, not to the syntactic form of particular reducible DRS-conditions” (Kamp and Reyle 1993, p. 344). That is, the

¹¹To be slightly more precise, the following conditions hold for such duplex conditions: $r \in U_R$ and $\text{DOM}(f) \cap (U_R \cup U_S) = \emptyset$.

occurrence of a duplex condition in a DRS is enough to trigger application of the procedure. In fact, Kamp and Reyle suggest that Abstraction could be seen as a kind of “inference principle on DRSs” (Kamp and Reyle 1993, p. 344). According to the construction rule, given a duplex condition as in (2.45), we may perform the operations specified in (2.46).



- (2.46) Form the union $K_0 = K_1 \cup K_2$ of the two component DRSs of this condition. Choose a discourse referent \mathbf{w} from $R_1 \cup R_2$. Introduce into the universe of the DRS in which the duplex condition occurs a new discourse referent \mathbf{Y} and add to its set of conditions:

$$\mathbf{Y} = \Sigma \mathbf{w}. K_0$$

According to this rule, we can extend any DRS containing a duplex condition to one containing an abstraction over the restrictor and scope of the quantification that introduced the duplex condition.

Notice that abstraction makes use of the representational nature of DRT. It is triggered not by a linguistic quantificational structure, but rather by the semantic representation of such a structure. This is necessary since the abstraction procedure comes on top of the ordinary interpretation of quantification, which needs to represent the constituents of the structure piece by piece. Only after the whole quantification is represented can the formation of antecedents start. The duplex condition specifies exactly which referents can be abstracted over, namely those in $R_1 \cup R_2$ with respect to $K_1 \cup K_2$.

The representational nature of abstraction becomes especially clear if we try to incorporate abstraction in DPL. Of course, it is perfectly possible to find a way in which a formula ‘ $X = \Sigma x. \varphi$ ’ is meaningful in an extended version of DPL. It would have to express the identity relation $\langle f, f \rangle$ if and only if $f(X)$ equals the set of d 's such that if we interpret φ with respect to $f \cup \{ \langle x, d \rangle \}$ we successfully find some output function.

The question, however, is where φ comes from. The conditions it contains will, of course, not be retrievable from the input function. They will have to be copies of conditions which occurred in a formula representing an antecedent quantificational structure. For instance the example in (2.47) could be successfully modelled in our neo-DPL as (2.48), but this would be completely counter to the compositional ideology of DPL, since the anaphoric reference Y is retrieved not by context change, but through a copy instruction on formulae.¹²

¹²Moreover, the fact that the abstraction procedure is in essence a *copy* instruction illustrates once more the strong resemblance with the e-type strategy tradition.

(2.47) Every student wrote a paper. They worked very hard.

(2.48) $\forall x[[\text{STUDENT}(x)] \Rightarrow [\exists y[\text{PAPER}(y) \wedge \text{WROTE}(x, y)]]] \wedge$
 $\exists X[X = \Sigma x. [\text{STUDENT}(x) \wedge \exists y[\text{PAPER}(y) \wedge \text{WROTE}(x, y)]]] \wedge$
 $\text{WORKED_VERY_HARD}(X)$

For now, it suffices to conclude that there is an interesting tension between the dynamic semantic ideal and DRT's treatment of maximal plural anaphora.

2.3.2 Domain information

Turning now to more complex kinds of anaphora that involve pluralities, namely dependent interpretations of pronouns, it becomes clear that the abstraction procedure is not enough. Consider (2.49).

(2.49) Three students wrote an article.
 They sent it to L&P.

Krifka 1996a (ex. 1)

The first sentence of this example can have a distributive reading, wherein three students each wrote a (different) article. Given that reading, the second sentence is to be interpreted as meaning that the students each sent *their own article* to Linguistics and Philosophy. The puzzle this example presents is how the singular pronoun accesses the individual papers when the only procedure for antecedent formation involves the summation of values for the referents in the first sentence. That is, given the representation of the first sentence in (2.49) in figure 2.1a, the second sentence will result in a quantification over the abstracted referent 'X' (the students that wrote an article),¹³ as in figure 2.1b. However, the pronoun 'it' can only access the abstracted referent 'Y' (the papers written by the three students) which leads to the undesirable interpretation that the students did not only send their own article but also those written by the other two students. Kamp and Reyle conclude from a similar example that "[w]hen a set is introduced via Abstraction over some duplex condition δ , then the information contained in the constituent DRSs of δ is available as information concerning the members of that set. This means that when we distribute over such a set, the DRS occurring on the right-hand side of the Abstraction equation may be "copied" into the left-hand DRS of the duplex condition which the distribution introduces" (Kamp and Reyle 1993, p. 379).

In order to derive the intended interpretation of (2.49), we have to execute the "copy" instruction proposed by Kamp and Reyle. Next to the DRS in (2.1b), which we can discard as an interpretation for (2.49) due to the mismatch between the plurality of the group of papers ('Y') and the singular number feature of 'it', we come to a second DRS, one in which the

¹³Or, alternatively, it can access the referent 'X', which, in this case, describes the same group of students.

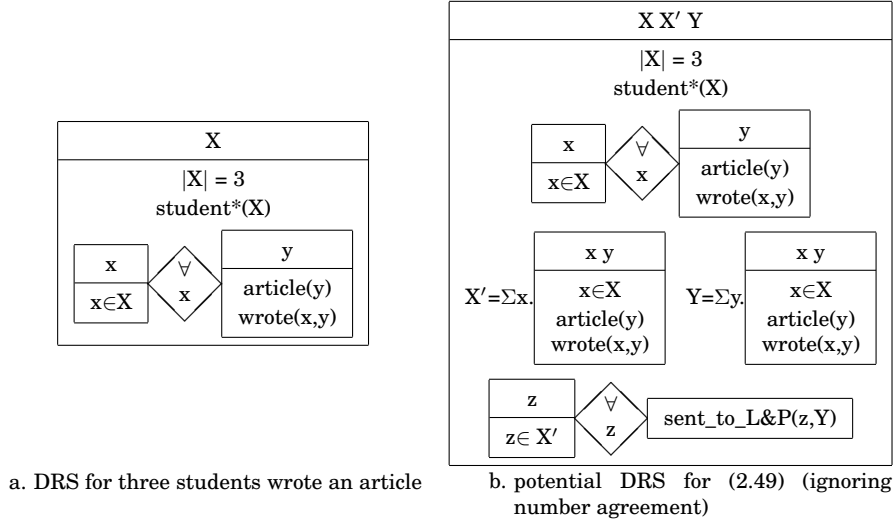


Figure 2.1: Abstraction applied to example (2.49)

individual papers are accessible. This DRS is given in figure 2.2. Quantifying over 'X' allowed the copying of the descriptive material (i.e. the set of conditions) that was abstracted from the 'antecedent' duplex condition.

Krifka criticises this last move as being unmotivated: "[T]he anaphoric phenomenon of box copying is treated in a quite different and strikingly informal way. This stands in sharp contrast to the narrowly defined and well-motivated constraints for the accessibility of discourse entities that represent standard anaphora" Krifka 1996a (p. 561).

I agree with Krifka's criticism and wish to add that DRT's treatment of dependent pronouns is completely dependent on the use of representations. The copy-instruction under discussion here accesses individuals depending on the members of some group antecedent by accessing the representation responsible for describing the group. From our point of view, we prefer to have these individuals accessible in the form of semantic objects (as in the range of assignment functions). As we saw above with our attempt to integrate an abstraction procedure in a dynamic predicate logic, an extension of a semantic analysis using DPL with a treatment of dependent pronouns in the style of Kamp and Reyle would not comply with DPL's compositional roots. The accessibility of individuals that are (indirectly) involved in group formation when quantifying over such a group would not be due to context change potential, but due to a copy-procedure on formulae.

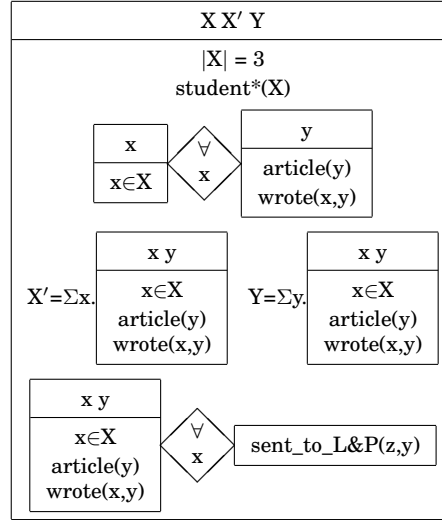


Figure 2.2: Quantification over an inferred domain

2.4 Discussion

The abstraction procedure makes it clear that after processing a quantificational sentence, not only a duplex condition taking care of the internal dynamics as well as of the truth-conditions of the quantification is inserted in the DRSs, but also an abstraction over the material in the conditions of the duplex condition. Under normal circumstances (i.e. when the quantificational structure is not embedded in a negative context), this means that the maximal individual satisfying restrictor and scope is accessible in the subsequent discourse. One might wonder, however, why this individual is introduced in such an indirect way. It is difficult to decide whether the strategy employed by DRT is an e-type strategy or whether it belongs to the more dynamic tradition. It is dynamic in the sense that plural e-type pronouns are still simple variables (equated with an abstracted individual). However, the anaphoric effect these cases of anaphora display are not due to the linguistic context they appear in, but rather due to a stipulated inference principle on a specific representational form. Nevertheless, it is hard to criticise the abstraction procedures on these grounds. The predictions it makes seem to be correct. We could possibly only accuse Kamp and Reyle of a lack of elegance. Still, there are some cases which show weaknesses in the abstraction procedure.

In this section, I discuss the merits of DRT, as well as some questions about the nature of its anaphoric mechanisms.

2.4.1 Merits of DRT's analysis

The empirical coverage of the abstraction procedure (and the other inference principle of box-copying) goes beyond merely accounting for Evans' remarks on e-type pronouns and maximality. First of all, quantificational noun phrases are *distributive*, in contrast to non-quantificational noun phrases.¹⁴

(2.50) Exactly four students wrote a paper. dist/*coll

(2.51) Four students wrote a paper. dist/coll

This is predicted by duplex conditions, which counts the possible *atomic* extensions to an embedding function. In other words, only assignment functions that are extended with an assignment to an atomic individual are considered. The same goes for the abstraction procedure. In ' $\exists x.K$ ', no groups that possibly satisfy K are considered, due to the atomicity restriction implicit in the small letter ' x '.

A second success of the DRT treatment of quantificational noun phrases is the maximality of the abstraction procedure. By simply collecting the successful values, what is recovered is not just any set of values which would have verified the duplex condition, but a maximalised one. The distinction above between distributive quantificational noun phrases and the potentially collective referential ones is relevant with respect to maximality as well. Indefinites and bare numerals, which do not introduce duplex conditions and therefore do not depend on the abstraction procedure for the introduction of antecedents, license non-maximal discourse anaphora. We can assure ourself of this fact by applying a test taken from Szabolcsi 1997.

(2.52) A few students wrote a paper.
 Perhaps there were other students who did the same.

(2.53) Two students wrote a paper.
 Perhaps there were other students who did the same.

¹⁴Although the intuitions for examples as (2.50) are clear, it remains a simplification to call quantificational noun phrases *distributive*. For instance, both (i) and (ii) below, can clearly be said to be collective.

- (i) Exactly four students wrote this paper.
- (ii) Exactly forty students gathered in the square yesterday.

There are many complicating subtleties. For instance, (iii) shows that not all quantificational noun phrases behave in the same way. (That is, the example cannot mean that a group of students collaborated in writing the paper and that this group forms a majority.)

(iii) ??Most students wrote this paper.

Since –apart from the complications involving collective predication– the group of quantificational noun phrases behaves the same in many respects, I will ignore this problem and assume that QNPs are, in essence at least, distributive.

- (2.54) More than two students wrote a paper.
 # Perhaps there were other students who did the same.
- (2.55) Most students wrote a paper.
 # Perhaps there were other students who did the same.

Whenever anaphora is maximal, there is nothing ‘others’ can refer to. Thus, (2.53) shows that anaphoric relations with ‘two students’ involve two students no matter whether there were actually more than two students that wrote a paper. With quantificational determiners, like ‘more than two’ and ‘most’, pronouns will have to pick up the abstracted referent, which is exhaustive.

A third success of DRT’s treatment of quantification has to do with accessibility. Since the abstraction procedure can only be applied once its trigger, a duplex condition, is formed, it is predicted that the type of maximal anaphora for which the abstraction forms an antecedent will always occur after the quantificational structure is completed. That is, quantificational noun phrases do not display referential effects within the sentence level. This is supported by the data in (2.56) and (2.57).

- (2.56) Two lawyers (each) hired a secretary they interviewed.
- (2.57) Most lawyers hired a secretary they interviewed.

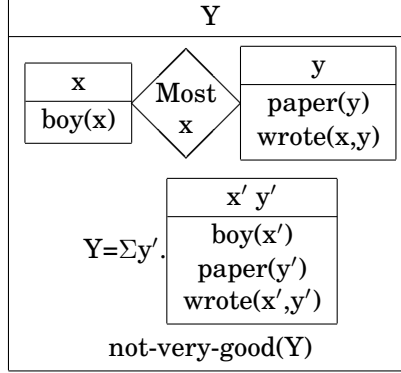
The example in (2.56) is ambiguous between a reading in which each of the two lawyers hired a secretary he or she interviewed and one in which they each hired a secretary that was interviewed by them both. The ambiguity involves the possibility of the plural pronoun ‘they’ to be construed as a collective subject for ‘interview’. In other words, in the first reading, the secretary is interviewed by the lawyer that hired him and in the second, he is interviewed by the two lawyers. In contrast, (2.57) lacks this latter reading, since no plural antecedent has been introduced yet by the subject. For instance, (2.57) cannot mean that a majority of lawyers each hired a (different) secretary they collectively interviewed.¹⁵

A fourth virtue of DRT is the fact that abstraction is free to abstract over any referent in the universe of either sub-DRS of the duplex condition. This way, indefinite noun phrases introduced somewhere in the quantificational structure trigger exhaustive reference in discourse. For instance, in (2.58) a plural pronoun accesses the set of papers written by the students. The DRT account is in (2.59).

- (2.58) Most students wrote a paper. They weren’t very good.

¹⁵Note that, strikingly, the paraphrase given here *does* have this reading, since I replaced the QNP ‘most lawyers’ with ‘a majority of lawyers.’

(2.59)



In sum, we have discussed four successes of the duplex condition and abstraction approach to plural e-type pronouns. We now turn to two of the less clearly advantageous sides of the proposal.

2.4.2 Some questions

2.4.2.1 Entailment, negativity and emptiness

Let us turn to a particular aspect of entailment patterns between examples with downward-entailing quantifiers. These quantifiers license anaphora just like upward-entailing quantifiers do, even though they do not assure us of the existence of anything satisfying both restrictor and scope.

(2.60) Few students went to the party.

≠

Some student went to the party.

With the abstraction procedure, DRT seems to acknowledge that the possibility for anaphora is not influenced by the choice of the determiner. However, by automatically constructing the antecedent as soon as a duplex condition is inserted in a DRS, it is in danger of ignoring the lack of entailment in (2.60). The reason is that a condition ' $X = \Sigma x.K$ ' is interpreted as the condition that there should exist a function which assigns to X a value all the atoms satisfy the condition K . Following downward entailing quantifiers, this could be the empty set. The functions we are considering should therefore include functions assigning the empty set to a referent for if we were to exclude such sets, we would not do justice to (2.60).

What are the effects of allowing empty sets as values for referents?¹⁶ Allowing for the empty set is not straightforwardly harmless. For instance,

¹⁶Actually, DRT does not talk about sets at all, but about the elements of a free complete atomic upper semilattice with a zero element. Here, we confuse the elements in such structures with sets, which does not have any serious consequences for our purposes given the isomorphism between the structures used by DRT and the set of subsets of the domain of atomic entities together with the subset relation.

a DRS like the one in (2.61) becomes a tautology, since we may assume the empty set not to have any lexical property P .

(2.61)

X
¬ P(X)

Nevertheless, it is questionable whether this causes problems for the interpretation of natural language expressions. In general, it seems to me that the restriction of a quantification will already exclude the empty set as a value. That is, there is no natural language paraphrase for (2.61), since there is nothing in the DRS that can play the role of a restrictor. For instance, ‘something does not have property P ’ or ‘nothing has property P ’ both quantify over ‘things’ and since the empty set is not a thing it does not verify these sentences. Moreover, quantifier domains are contextually restricted and we may assume these restrictions to exclude empty sets.

There might be more danger in an example like: ‘Only women do not like Kylie’, which would be analysed as ‘for all x such that x does not like Kylie, it holds that x is a woman’ and thus seems to be immediately falsified by the empty set since it neither likes Kylie, nor is a woman. But here, too, there is a restriction, namely the set of alternatives (e.g. men, women, martians) brought about by focus on ‘women’, which again excludes the empty set. The empty set, then, seems to be an element in the ontology which never surfaces in linguistic meanings.

There is another assumption which is necessary and relevant to empty sets. Downward entailing quantifiers are to be represented by duplex conditions and not simply by the introduction (and existential closure) of a referent. This is because if we were to represent them as ordinary existential constructions, the predication involved would exclude the empty set as a possible value for the referent involved, thus strengthening the truth-conditions. Here is an example. Say we represent ‘Less than three players are holding a card’ as the following DRS:

(2.62)

X
player*(X) X < 3 card(y) hold(X,y)

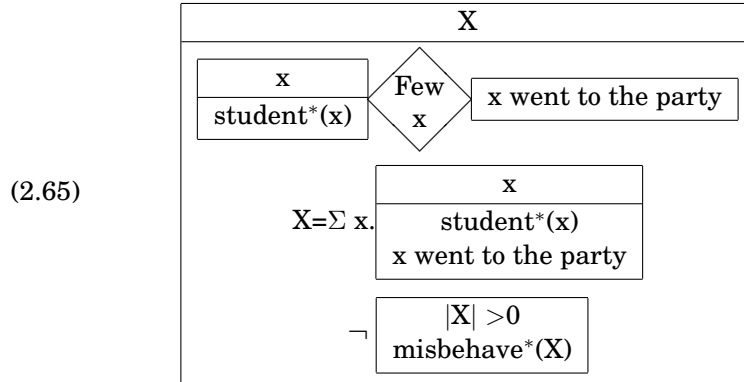
Since the empty set is not a player, this DRS is only verified by two players or a single player holding a card. The DRS is falsified by a situation in which no players is holding a card. As we will see in chapter 6, the semantics I propose makes an assumption similar to the one described here: downward entailing NP are to be interpreted as quantificational structures, not as predication structures over some introduced (potentially empty) group of individual.

Let us focus some more on the burden of the pronoun. The pattern in (2.63) suggests that with pronominal reference there comes some non-emptiness condition on its referent. What the contrast between (2.60) and (2.63) shows is that this condition is due to the pronoun rather than due to the duplex condition or the subsequent abstractions. Pronouns, then, trigger an extra condition on abstracted referents, namely that they are non-empty.

- (2.63) Few students went to the party. They had a good time.
 \Rightarrow Some students went to the party.

Thus, in order to do justice to both (2.63) and (2.60), two assumptions have to be made. The first assumption is that abstraction is able to abstract the empty set, that is, that empty sets are allowed in the range of assignment functions. Second, it is necessary to have the pronoun trigger a non-emptiness condition on its reference. Against this latter assumption, however, a more philosophical complication comes to mind. The non-emptiness condition is semantic in nature, that is, it can only be a predication over a referent. This means that there is no distinction between a false predication over an abstracted referent and an empty referent picked up by a pronoun. From the point of view of accounting for (2.63), this is a good thing, since what we see there is obviously a *semantic* fact. However, (2.64) and its supposed representation (2.65) show that the condition triggered by a pronoun is not a simple predication condition.

- (2.64) Few students went to the party. And it is not the case that they misbehaved.



The representation in (2.65) is wrongly verified if no students went to the party. Clearly, the condition that comes with a pronoun is presuppositional. This is confirmed by an example like (2.66), where the condition seems to bind into the antecedent clause, causing the paraphrase in (2.67).

- (2.66) If less than ten students pass the test, the teacher will take them out for dinner.

- (2.67) If less than ten but more than one student passes the test, the teacher will take them out for dinner.

Similar issues play a role if we consider another alternative understanding of DRT's abstraction procedure, namely one where it is seen as a run-of-the-mill e-type strategy by making the pronoun the crucial factor in the triggering configuration, instead of the quantificational sentence. This means that a plural pronoun introduces a variable equated with a description formed from material from an antecedent duplex condition. This description is taken to correspond to a non-empty set (i.e. the empty set is not allowed in the range of assignment functions). Here, it is the site of insertion of the abstraction equation which becomes crucial. Like the non-emptiness condition in (2.65), the abstraction equation should end up in a higher DRS.

It is clear that with respect to downward entailing quantification, many more details concerning the application of the abstraction procedure have to be clarified.

2.4.2.2 Accessibility of other sets

As we saw above, given a quantificational sentence $Dx(A)(B)$, the abstraction procedure correctly predicts that the reference set, $(\lambda x.A) \cap (\lambda x.B)$, is not the only set that is accessible after processing a quantificational sentence. Sets depending on the reference set, such as $(\lambda y.A) \cap (\lambda y.B)$, are also accessible using abstraction. DRT also makes the strong prediction that the reference set is the *only* set related to the ranging variable (here, x) of the antecedent quantifier that is accessible. That is, Kamp and Reyle predict the unavailability of the maximal set, $\lambda x.A$, and the complement set, $(\lambda x.A) - (\lambda x.B)$. Recall from chapter one, however, that cases of pronominal reference to the maximal set and to the complement set are both reported.

There does exist a procedure in DRT which comes close to an analysis of maxset reference, namely *kind introduction*. Kamp and Reyle's motivation for this procedure is closely related to the phenomenon of maximal set reference. Consider the following example (Kamp and Reyle 1993, p. 391):

- (2.68) Few women from this village came to the feminist rally.
No wonder.
They don't like political rallies very much.

The plural pronoun here does not refer to the few women from the village that came to the feminist rally. Instead, it seems to generalise over *all* women from the village (or maybe even over all women in the world). Kamp and Reyle choose to treat this phenomenon as a general option for the plural pronominal reference and introduce the procedure of *kind introduction*, which given some "noun establishes a discourse referent for the genus within the universe of the main DRS" Kamp and Reyle 1993 (p.392).

Kamp and Reyle correctly remark that a genus is not simply a set. Rather than a case of reference to the maximal set, they would argue that the anaphoric phenomenon in (2.68) is independent of reference to the maximal set. However, most examples do not involve generic reference at all. Consider, (2.69).

- (2.69) Most marbles in this bag are red. But exactly three of them are black.

The preferred interpretation for the second sentence of (2.69) is that three of the marbles in the bag are black. The genus ‘marbles in the bag,’ whatever this may mean, does not seem to be involved. Should the treatment of genera in DRT be worked out in more detail, however, so that it allows for examples like (2.69), the question becomes how kind introduction is to be restricted. As we will see in more detail in chapter 3, the maximal set is *not* generally accessible in the case of weak quantifier. Since kind introduction is a general principle working on representations, there does not seem to be a way of restricting it to not operate on structures that are due to those kind of noun phrases.

Turning now to reference to the complement set, Kamp and Reyle explicitly mention that such type of pronominal reference is predicted *not* to exist. They explicitly argue that set-subtraction is not an operation that could be involved in antecedent formation. Again, however, we have seen that cases of pronominal reference to the complement set seem to exist. If Kamp and Reyle are right about the set-subtraction not being one of the tools involved in anaphora, then we should at least be able to explain the existence of such cases (away). In the next chapter, we will turn to an evaluation of the kinds of anaphora Kamp and Reyle do not consider.

2.4.3 Conclusion

Abstraction can account for many of the facts. Yet, as the case of downward entailing quantifiers and reference to sets like the maximal set and the complement set show, a several details of what exactly the relation between pronominal reference and abstraction is remain unclear. Moreover, as Krifka (1996a)’s criticism shows, the procedures that control abstraction are in many ways unmotivated. The operation is ad hoc, since it does not treat plural e-type anaphora as a phenomenon which is derivable from accessibility facts in a straightforward way. This in contrast to singular e-type anaphora. In general, since accessibility is not a purely semantic notion, but dependent on representations, it follows that DRT’s analysis of plurality is not compatible with a non-representational compositional enterprise in a straightforward way.

Criticism of the abstraction procedure, however, will always have to deal with the massive empirical coverage of chapter 4 of Kamp and Reyle

1993. DRT's success, however, is only due to the fact that the overgenerating tool of set-abstraction can only be operated by a small set of independently motivated rules.