On Denoting Descriptions

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Introduction

In this paper we want to show that the notions of information that have become fashionable in various recently employed systems of dynamic semantics, are very useful for the characterization of the referential interpretation of definite descriptions, and the specific interpretation of indefinite ones. With this more or less trivial observation, we hope to serve a more general goal. To our opinion, current linguistic theorizing fails a clear and generally accepted picture concerning the delineation of the semantic and pragmatic components of a comprising theory of interpretation. In addition, we think, we nowadays fail a convincing conception of the interaction of these two components of the whole theory, even where we were to have consensus about their delineation in certain areas of work. With the work reported in this paper we want to bring back the issue of the semantics – pragmatics interface back on the agenda again.

Employing tools from dynamic semantics, viz., its notions of information, we present a separate, but combined, semantic – pragmatic treatment of definite and indefinite noun phrases. Basically, we adopt a Russellian treatment of these descriptions on the semantic side, thereby (i) assuming some form of context dependent quantification and (ii) adopting a dynamic-style constructive reading of the (implicit) existential quantifiers. A modification of Russells theory along the first lines is obviously needed in order to get rid of too strong uniqueness requirements in the case of definites (and of too *weak* readings of indefinites). The modification along the second lines is key to this paper.

Precisely the use of dynamic semantic 'discourse referents'—or 'subjects' as we call them here—provides us with a hook to attach the pragmatics of these noun phrases to. Contextual (that is: non-semantic) information may provide clues as to which individuals the speaker has or had in mind when uttering certain noun phrases, and these may justify one to link or anchor the discourse referents to entities in the real world. Thus, pragmatically available information combines with the semantics of these phrases to yield a referential or specific reading.

* This paper was written partly in Amsterdam, partly during my visit of the IMS in Stuttgart. I would like to thank Maria Aloni, Tim Fernando, Jelle Gerbrandy, Hans Kamp, Peter Krause, Robert van Rooy and Ede Zimmermann for helpful suggestions and comments. Of course, all errors are mine. The research for this work is supported by a fellowship from the Royal Netherlands Academy of Arts and Sciences (KNAW), which is hereby gratefully acknowledged.

Although the kinds of information states which figure in this paper are taken from systems of dynamic semantics, our treatment of referentiality and specificity is cast in a static semantic framework. Thus, we hope to show more specifically that it is mainly the richess of dynamic semantic information states, and not the dynamic meaning assignment all by itself, which allows us to deal with these relations between terms in sentences and elements in the outside world.

We proceed as follows. In the first section we will explain and motivate (a particular version of) the dynamic semantic notion of information. In section 2 we will show how this notion of information can be used to model two notions of aboutness, an epistemic and an ontological one. In section 3 we discuss the main properties of Russell's analysis of definite descriptions, and in section 4 we use our notion of information to account for referential readings of definite descriptions, and specific readings of indefinites. Section 5 resumes the results.

1 Subjects in discourse

Systems of dynamic semantics[1] accommodate a notion of information which characterizes a certain subject matter. For instance, the discourse representation structures of *DRT* code information concerning the properties of subjects, referred to by 'discourse markers', which have been introduced in a discourse, and which can be taken up later and delineated further. For a similar purpose *FCS* trades information about the possible values of variables, where these variables must be seen to label the subjects mentioned or addressed in discourses. (The same may be said to hold for e.g., *DPL*, and Zeevat's compositional *DRT*.) For a third example, my (Dekker 1994) employs structures containing the sequences of individuals which a discourse may be talking about, given what is said about the subjects addressed in the discourse.

The kind of information dealt with in the mentioned systems conveys more than mere information about the (state of the) world. These systems of dynamics semantics therefore not only differ from more traditional, truth-conditional, semantic systems in that they are *dynamic*, in addition they employ an upgraded notion of information, which is seen to be relevant in (discourse) interpretation. A convenient way of looking upon the sort of information at issue is that it is information carried by subjects. But what are subjects? Roughly, and inconclusively, subjects are things people talk about, think about, and care about. This is a rather rough and inconclusive characterization, but it suffices for the moment, as long as one refrains from construing the notions of 'talking' and 'thinking about' as immediately relating us to the objects out there in the world.[2] For the moment subjects can be understood as objects of linguistic and

1. Here I am very generally referring to the well-known systems of discourse representation theory (*DRT*, Kamp 1981; Kamp and Reyle 1993), file change semantics (*FCS*, Heim 1982), and dynamic predicate logic (*DPL*, Groenendijk and Stokhof 1991), and all those akin in spirit or by offspring.

2. For one thing, people *can* be quite mistaken or badly informed about the existence and identity of the things they think and talk about, so generally equating subjects with individuals simply will not do.

intentional acts. Their, causal and intentional, relation with the real individuals around us will be addressed in the next section.

The subjects as they are presented to us in systems of dynamic semantics generally have three typical properties. Unlike ordinary individuals, which are *total* objects, they are typically *partial* objects. Indefinite descriptions may be used to talk about individuals the identity of which must remain—what's in a name?—indefinite to the interpreter. But also definite descriptions may succeed in giving us information about partial objects only. For instance, their descriptive information may be uniquely identifying, given that we know to a sufficient degree what the world is like, but we may simple fail this knowledge about the world, and, hence, fail to nail the individual involved.[3]

A second typical property of subjects is that they may depend on each other in a non-trivial way. Like total objects, partial objects may be related to each other, but unlike total objects this relation may be part of their constitution, so to speak. Learning more about one partial object may involve learning more about an other.[4]

The third characteristic property of subjects—given their partial nature a most important one—is that subjects are re-addressable. Aggregates of information, or 'information states' in systems of dynamic semantics, have precisely this structure so as to allow or enable reference to subjects, even though the subjects are partial, or indefinite, entities.[5] The interesting question—why such things should be addressed or readdressed at all?—is left for the next section.

Before we carry on, it is expedient first to make the notion of a subject formally explicit. This can be done in a variety of ways. For the purposes of this paper the differences between these various ways are quite immaterial, but for reasons of notation and exposition it turns out to be handy to employ Heimian information structures here.[6]

Information about subjects can be modeled using sets of assignments of individuals to variables. In order to obtain uniform notation we have chosen to code information about the world also in terms of the possible values of a

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3. So, you may be quite confidently that it is dangerous to touch the cable over there which carries a voltage of 20.000, as you have been told, but it doesn't help you very much if you have to cut "the other cable, which is safe", and if you just see two cables lying there, apart from being distinct, indistinguishable.

4. Following up on the previous footnote: if somebody tells you which is the cable under high voltage, then you have learned—you hope—which one you can safely cut.

5. A note on terminology may be in order here, now we are constantly dealing with entities from different realms, or, as we would prefer to put it, with entities conceived from different perspectives. We try to consistently use the term 'individuals' for the entities out there in the world, and for the residents of the basic domains when we turn to the model theory. The term 'subjects' is used for the epistemic representatives of individuals, and the term 'entities' for things of both orders. The term 'object' is meant to play a communicating part. If subjects, which are partial objects, have grown into total objects, they correspond to real individuals. Notice that what are individuals from one's own epistemic perspective, are subjects from another one's perspective, and from the meta-theoretical perspective.

6. See (Heim 1983; Dekker 1996b), for further motivation and study. Alternative formulations, which equally fit the purposes of this paper, can be found in (Zeevat 1989; Vermeulen 1993; Dekker 1994; Groenendijk et al. 1996; Dekker 1996a). All of these formulations are evidently inspired, and motivated, by (Kamp 1981; Heim 1982; Kamp 1990).

distinguished variable x_0, also referred to with 'v'. Thus, the information about subjects $x_1, \ldots, x_n$ that x_k (for $1 \leq k \leq n$) has a property $\mathcal{P}_k$, and that (for $1 \leq i, j \leq n$) a pair x_i, x_j stand in a relation $\mathcal{R}_{i,j}$, etc., is captured by means of sets assignments of individuals to $v, x_1, \ldots, x_n$, such that for each g in that set, $g(x_k) \in \mathcal{P}_k$ in $g(v)$, and $\langle g(x_i), g(x_j) \rangle \in \mathcal{R}_{i,j}$ in $g(v)$, etc.

Information aggregates are defined relative to a non-empty set of possible worlds W[7], a non-empty domain D of *individuals*[8], and a set of *variables* V[9]. For a set of (individual) variables X, the domain of possible assignments is $W^{\{v\}} \times D^X$, which we abbreviate as $D_W^{X_v}$. The notion of an information aggregate now can be made more precise in the following way:

Definition 1 (Information Aggregates) For finite $X \subseteq V$:

- $\Sigma^X = \mathcal{P}(D_W^{X_v})$ is the set of *information aggregates* about X

An aggregate of information about X is a set of assignments of values to the elements of $\{v\} \cup X$. According to the present definition, subjects can be conceived of as being *named* by the variables. A variable x figures as a location to store information about its possible value(s). It can also be seen that one subject may have different names in an aggregate σ: if $\forall g \in \sigma$: $g(x) = g(y)$, then x and y name the same subject.[10] As may be clear from our practice sofar, we often use 'x' to refer to the (possible) value(s) of x when, we think, this doesn't raise confusion.[11]

It may be clear that a subject x of an information aggregate σ can be a partial object, in that x can have different possible values in σ: if there are assignments g, h in σ with $g(x) \neq h(x)$, then the value of x is not fully determined. Furthermore, these subjects are typically interdependent. If $\sigma = \{g, h\}$, and $g(x)$ is Dagmar, $g(y)$ Benjamin, $h(x)$ Odile, and $h(y)$ Marianne, then σ contains the information that if x is Dagmar then y is a male, and if x is Odile, then y is female. Concerning the so-called readdressability of subjects we can be short. Because the subjects of our information aggregates are hung onto variables, we can address them by simply using these variables. For instance, we might increase the information in the last-mentioned information aggregate σ, by adding the information that x is Dagmar. Doing so, we would automatically add the information that y is Benjamin, as one can easily verify.

Information aggregates can be put to use in a system of discourse interpretation roughly along the following lines. Definite and indefinite descriptions, proper names, pronouns and demonstratives can all be taken to set up, or refer

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7. Or 'possible ways the world might be'.
8. It may be more intuitive not to assume that this domain is the same in all possible worlds, but this issue is not relevant to our present concerns. See (Dekker 1996a) for a system not built upon this single domain assumption.
9. It is a useful simplification to think of these variables as the variables of a language which is to be interpreted. However, as we will see in the next section, it does not at all matter *what* is used as a set of variables here. See (Vermeulen 1996) for relevant discussion.
10. See (Dekker 1996b) for more discussion.
11. It will be clear that we want to distinguish any two aggregates which contain information about different sets of variables. In fact this requires us to make it explicit that $\emptyset \in \Sigma^X$ and $\emptyset \in \Sigma^Y$ are distinct if $X \neq Y$, and that we can say that the domain of $D(\emptyset)$ of the first is X.

back to, subjects. Thus, the information coming along with a sentence like (1):

(1) A_x man walks in the$_y$ park.

is contained in an information aggregate like (2) (with $X = \{x, y\}$):

(2) $\{g \in D_W^{X_v} \mid g(x)$ *is a man in* $g(v)$ & $g(y)$ *is a park in* $g(v)$ & $g(x)$ *walks in* $g(y)$ *in* $g(v)\}$

Similarly, example (3) can be associated with a aggregate like (4) (with $X = \{x, z, u, w\}$):

(3) An actress$_x$ gave it$_u$ to him$_w$ on a$_z$ rainy Sunday.

(4) $\{g \in D_W^{X_v} \mid g(x)$ *is an actress in* $g(v)$ & $g(z)$ *is a rainy Sunday in* $g(v)$ & $g(x)$ *gave* $g(u)$ *to* $g(w)$ *on* $g(z)$ *in* $g(v)\}$

Notice that, in the present paper, we do not take the aggregates (2) and (4) to be the result of applying a dynamic update function to some preliminary context; here (2) and (4) themselves constitute the interpretation independently associated with the examples (1) and (3). Clearly, in this static approach to meaning which we adopt for the time being, the subjects v and w in aggregate (4) are in need of somehow being 'resolved' in the context. In the appendix we will show how the dynamics of interpretation at issue can be modeled in a suitable way by a proper extension of this framework.[12]

Although our aggregates (2) and (4) are not the interpretations standardly associated with sentences like (1) and (3), the *type* of interpretation by itself is standard. They are sets of variable assignments, as we have seen, and sets of variable assignments are the kinds of things which exhaust the meanings of predicate logical formulas in a Tarski-style framework. (Cf. Janssen 1983, p. 30*ff*, for discussion.) The only 'remarkable' thing here is that we do not only find abstraction over the possible values of free variables (pronominal NPs), but also over that of bound ones (definite and indefinite ascriptions alike). The noun phrases in (2) and (4) are all associated with a variable, and they are all interpreted in a sense as *free* variables.

This way of putting things is, deliberately, in line with 'Lewis' philosophy' (Lewis 1975), according to which indefinites really are (phrases containing) 'free' variables . The (pre-dynamic) motivation for this view comes from examples like the following:

(5) A quadratic equation never has more than two solutions.

Lewis suggests that the adverbial 'never' in example (5) effectively quantifies over quadratic equations, more precisely, over possible values of the free variable x satisfying 'x is a quadratic equation'. It is fair to say that this doctrine of indefinites as free variables has inspired many people working in the *DRT* and the dynamic tradition. At the same time it may be clear that, nevertheless, indefinites and ordinary free variables, or pronouns, are not one and the same thing, for adverbs of quantification do not bind really free variables. Consider an example like:

(6) Leslie is an enterprising guy. When he is in an foreign city, and if he goes out to buy a pack of cigarettes in the night, he usually tries out all local

12. For a similar mapping between sentences and information aggregates, see (Zeevat 1989).

bars.

It doesn't make any sense to suppose that the adverb 'usually' in example (6) binds the pronoun 'he'. Clearly, 'free' variables such as indefinites are to be kept distinct from free variables such as pronouns, or such as the variables which are eventually bound by natural language determiners, *wh*-elements, etc.

Without pushing the matter here, it will be clear that if we choose to treat indefinite (and definite) noun phrases as (phrases containing) free variables, we have to distinguish these from the ones associated with pronouns. To this end, we employ the fairly standard assumption that we have an enumeration of the variables of our formal language. Thus we can distinguish the odd and the even numbered ones. In a sense this splits our set of variables in two disjoint sets: the set of free variables $\{x_{2i+1} \in V \mid i \in \mathcal{N}\}$, and the set of 'free' (= bound) variables $\{x_{2i} \in V \mid i \in \mathcal{N}\}$.[13] See the appendix for more details.

2 Aboutness and Information Exchange

Information aggregates serve to model the information we have gathered about certain subjects, those presenting individuals we are or have been acquainted with, or those which are described by names and definite and indefinite descriptions in a discourse. The last can be conceived of as descriptive 'traps' of the individuals which the speaker (or other source) had in mind when producing the discourse. The last ones, typically, are of a partial nature. A discourse may only disclose a small number of properties of the subjects it talks about, and an agent who *buys* the story is typically left in the dark about the true identity of these subjects. Yet, in the kinds of (informative) discourse we are here thinking of, we still claim there is a general assumption that there always is *some* answer to the question who or what is being talked about.

It is precisely this idea that constitutes the motivation for subjects. Although they are generally partial objects, we however assume that they present real individuals, which may be called their *sources* (in an abstract sense). The source of a subject of an agent a can be a real individual which a himself is acquainted with, or—and by recursion—it can be the (presumed) source of the subject which a speaker had in mind when describing it as a subject to a. We take it that the assumption that subjects have definite sources, makes it into a sensible thing to inquire after them, and aspire to acquire more information about them. If our partial objects were not assumed to be related to real individuals in the end, then there could in principle be no measure to judge whether it is true or false that they have some property $\mathcal{P}$.[14]

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13. In (Montague 1974) the same distinction is made between two classes of variables (of type $\langle s, e\rangle$) for similar techno-philosophical reasons. This has been noted by Herman Hendriks who aptly observed the connection with the interpretation of anaphora (Hendriks 1993, Ch. 1, fn. 5 and fn. 20).

14. This has not always been the idea behind subjects or 'discourse referents'; for instance, they have been looked at as partial individuals pur sang, not in the least by the present author; alternatively, they have been considered to be no more than remnants of the noun phrases which introduced them. Heim (Heim 1982), for instance, identifies them with the indices on these noun phrases in LF; and in (Groenendijk et al. 1996) they are also identified with

In order to do justice to this role of subjects, we will now introduce some more notions related to the 'linking' of subjects of (different) aggregates, and the 'anchoring' of subjects to individuals in the outside world.

Since two aggregates need not employ the same variables to name their subjects, we can only sensibly compare the contents of two aggregates with respect to a relation r linking up the subjects of one information aggregate with the other. So, let, for an aggregate $\sigma \in \Sigma^X$, the domain $D(\sigma)$ of σ be X. Then:

Definition 2 (Support) σ supports τ wrt r, $\sigma \trianglelefteq_r \tau$, iff $r \subseteq D(\sigma) \times D(\tau)$ and $\forall g \in \sigma\ \exists h \in \tau$: $g \equiv_r h$ (with $g \equiv_r h$ iff $g(v) = h(v)$ and $\forall \langle x, y\rangle \in r$: $g(x) = h(y)$)

An aggregate σ supports τ under r iff r is a relation between the domain of σ and that of τ and to every possibility in σ corresponds one in τ which is identical under the linking relation r. The support relation is a relatively flexible one, because the relation r is allowed to vary freely.

A specific instantiation of the supports relation is one called 'substantiation'. Let $R(r)$ be the range $\{y \mid \exists x$: $\langle x, y\rangle \in r\}$ of r, then:

Definition 3 (Substantiation) σ substantiates τ (wrt l), $\sigma \mathrel{|\!\!<}_{(l)} \tau$, iff $\exists r$: $\sigma \trianglelefteq_r \tau$ with $R(r) = D(\tau)$ (and $r = l$)

(Sometimes we need the subscripted l to refer to the specific linking relation(s) under which one information aggregate substantiates another.) It is relatively easily seen that if σ substantiates τ, then for all subjects $y_1, \ldots, y_j$ in τ there are subjects $x_{i_1}, \ldots, x_{i_j}$ in σ such that σ contains more information about $x_{i_1}, \ldots, x_{i_j}$ then τ about $y_1, \ldots, y_j$. An appropriate way of formulating this is as follows: σ substantiates τ iff σ contains *at least as much* information about *at least as many* subjects as τ. The notion of substantiation is reflexive and transitive, but it is not antisymmetric. This is precisely as we want it to be. Two aggregates can be substantially equivalent without being identical, because they use different names (variables) for corresponding subjects.[15]

As indicated above, we think that the role or function of subjects is not exhausted by their figuring as hooks information aggregates hang information on. We think epistemic agents in general act under the supposition that, eventually, these subjects relate to real and specific individuals in the real world. A particular case in point may be one in which an agent is or was directly acquainted with one of more individuals in this real world. Although we do not want to

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representational or discursive aspects of information exchange. The outlook upon subjects expressed in this paper has its roots in the work of Chastain and Evans, and in a more dynamic setting in (Kadmon 1987; Kamp 1990). For further motivation see (Zimmermann 1996; Zimmermann 1997; Dekker 1996a; van Rooy 1996; van Rooy 1997).

15. A specific form of substantiation is obtained by requiring not only that the range $R(l)$ of the linking relation r equals the domain $D(\tau)$ of τ, but even that r itself is the identity-relation $\{\langle y, y\rangle \mid y \in D(\tau)\}$ on that domain. Under this requirement σ substantiates τ iff σ contains at least as much information as τ about at least as many subjects as τ *under the same names*. We just note here that this is precisely the notion of *information update* which is employed in systems of dynamic semantics. This notion *does* establish a partial order, it even constitutes a lattice, cf. (Dekker 1993) for relevant discussion.

equate the subjects presenting these individuals to the agent with these individuals themselves, we do want to speak of a very hard and factual 'aboutness' relation which in such a situation holds between the presenting subjects and the presented individuals.[16]

Factual aboutness relations which hold between subjects of information aggregates and individuals, we think of as *DRT*'s anchoring functions. In a given world, such an anchoring function a is a function from information aggregates to partial functions from the subjects of these information aggregates to individuals. The idea is that for each epistemic agent e there is an information aggregate σ_e, and that a determines which of e's subjects are about which individuals.

With reference to this anchoring relation, we can now make claims about the information which agents have about real individuals. It can be used to characterize the information Quine's protagonist Ralph has concerning an individual, known to him (i) as a suspect behaving man in a brown hat observed on the beach, and (ii) as a prototypical pillar of the community named 'Bernard J. Ortcutt'. The first one Ralph believes to be a spy, the second one, which is constructed from hear-say, and watch-television, Ralph believes not to be spy. Ralph can be said to hold two conflicting bits of information true of Ortcutt without this rendering his beliefs inconsistent. He simply fails to see that the two bits apply to the same individual, that his two subjects have one and the same source.

The anchoring of subjects is only one of the ways in which subjects can be seen to present real individuals. Subjects may also arise from reasoning, but then, we think, they must be associated with uniquely identifying properties. In that case, we would say, a subject stands in for the unique individual in the actual world which has that property. (If, that is, there really is such an individual. Of course one may be mistaken in believing that there is one, just as one may be mistaken in believing that one is perceiving something.) That leaves us with the subjects which arise and which are transmitted in discourse.

The assumption that subjects in general are rooted in reality, also if they arise from discourse and conversation, can be justified if we furthermore assume that speakers generally 'don't make up' subjects: speakers should only present subjects in discourse which are rooted in subjects of their own. Thus, if H's subjects derive from a conversation he had with S, and if the subjects raised in the conversation derive from subjects of S, then the roots of H's subjects can be said to be those, if any, of S's subjects. As a matter of fact, we think we here hit at a (first order) extension of Grice' maxim of quality. Besides requiring that one should not claim propositions for which one lacks adequate evidence, we want to rule that one should not raise subjects which are no proper subject.

This requirement can be made more precise. The aggregate of an epistemic agent e should substantiate the things e says, in case of which we will say that ϕ is licensed:

16. About the various properties of such situations a lot must be added, and has been added, but not in this paper.

Definition 4 (Licensing) σ licenses ϕ under l iff $\sigma \mid\!<_l [\![\phi]\!]$

Thus, the subjects raised by e's uttering ϕ should be grounded in subjects in e's own information aggregate σ_e. Notice that licensing involves substantiation under a specific linking relation l. For each utterance there should be one such relation, which uniquely characterizes which subjects raised by ϕ are related to which subjects of σ_e. If σ_e licenses ϕ under l, then the roots of subjects raised by ϕ can be said to be the roots, if any, of the corresponding subjects of σ_e.[17]

The requirement that speaker's utterances must be licensed by the information they have may help to account for a number of puzzling facts about anaphoric cross-reference. We consider one example, others can be found in (Dekker 1997). Suppose two men, Rod and Roger, visited A's office yesterday, who both inquired after the secretary's office. Suppose, furthermore, that only Rod was smoking smelly pipe tobacco. Then consider the following dialogue:

(7) (A:) Yesterday a man came into my office who asked where he could find the secretary.
(8) (B:) Was he smoking this smelly pipe tobacco?
(9) (A:) He was indeed smoking this smelly pipe tobacco.

We think A here gives a perfectly acceptable answer, which can be judged to be both true and false. If A's first utterance in (7) is licensed under a link to (his subject for) Rod, then we may say the reply in (9) is true, if it is linked to (his subject for) Roger, we may say it is false. Notice that, in the last case, the conjunction of A's two utterances (7 and 9) may count as true, but not licensed. It would be true because there actually was a man satisfying the whole 'story', but it would not be true *of* the man A had in mind.

Notice, moreover, that it would have been pretty odd for A to reply:

(10) (A:) I don't know.

if he realized that Rod was and Roger was not smoking this smelly pipe tobacco. We would say this is odd because A ought to know whom he was talking about in (7), so he ought to know whether that person was smoking this smelly pipe tobacco or not. It would be quite surprising indeed if A were to defend himself stating that at the moment of uttering (10) he didn't yet know who he was talking about, as if he had not yet made up his mind which story to tell!

Let us conclude this section by summing up what we have established sofar. In the preceding section we have given a formal definition of information aggregates of the kind used in systems of dynamic semantics. In this section we have tried to motivate this notion of information by accommodating it to the needs of epistemic agents. We have viewed it from a broader perspective, where it is seen to relate to the world in which the agents live, and where they extract and exchange information about their surroundings. More in particular, we have characterized two aboutness relations. The first one specifies which subjects of an information aggregate actually (causally, perceptually) derive from which source, or individual. The second one specifies which subjects from one

17. Observe that if a subject v in ϕ is linked to two subjects x and z in σ_e, then, by the definition of $\mid\!<_l$, σ_e must contain the information that x and z are identical.

aggregate derive from which subjects other aggregates by conversational and intentional principles.

Of course, what we have provided in this section is quite marginal indeed if one's aim is an overall and empirically as well as philosophically sound theory of aboutness.[18] However, such has not been our aim here. What we wanted to show in this section is that some of the fundamental distinctions and concepts required in such a theory can already be found in the apparatus of systems of dynamic interpretation. As we have seen, a proper assessment of these is already a subject of its own.

3 Russell on Denoting

The analysis of definite (and indefinite) descriptions which we take as our point of departure in this paper is that of Russell. Russell's by now famous analysis has originally been proposed in (Russell 1905), and was stated in (Whitehead and Russell 1910) in the following most concise way (definition $*14 \cdot 01$):

(11) $[(\iota x)(\phi x)].\psi(\iota x)(\phi x).=:(\exists b):\phi x.\equiv_x.x = b:\psi b$

By employing more up to date notation (including more familiar devices to indicate 'scope'), this definition can be turned into the following:

(12) $(\iota x \phi x)(\psi x) = \exists x(\forall y(\phi y \leftrightarrow y = x) \wedge \psi x)$ (or, equivalently:)
(13) $(\iota x \phi x)(\psi x) = \exists x(\forall y(\phi y \rightarrow y = x) \wedge \phi x \wedge \psi x)$

(We will adopt the last one of these here.) On Russell's analysis the content of a sentence *The F is G* thus can be seen to state three things: that there is at most one F, that there is at least one F, and that he is G.

Upon Russell's analysis, a sentence *The F is G* does not simply say that G is a property of the individual which is referred to by the phrase *the F*, the sentence itself is taken to assert that there exists such an individual, and, moreover, that it has the property G. Russell uses this analysis deal with sentences like the following:

(14) The present king of France is bald.
(15) The difference between A and B does not subsist.

If France is not a monarchy at the time of evaluating example (14), the sentence is simply false upon Russell's analysis, in stead of deviant in one or other way, as it would be in, e.g., Frege's theory.[19] Likewise, if A and B do not differ, then the difference between A and B simply does not exist, or 'subsist'. So, upon Russell's analysis, example (15) does not presuppose the existence of something, viz., the difference between A and B, in order to assign it the predicate of 'non-subsistence', as, e.g., Meinong would have had it.

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18. See, among many others, the work of Chastain, Donnellan, Evans, Kaplan, Kripke to get an idea of the wealth of facts and conceptual problems which a full theory in the end should cover.
19. In (Frege 1892) definite descriptions are conceived of as compound proper names, and Frege observes that when a proper name is used, it is presupposed that it has a referent. The possibility that such presuppositions are not fulfilled, Frege calls an "Unvolkommenheit der Sprache."

Russell also applies his analysis in a diagnosis of the following line of reasoning, in the author's words (Russell 1905, p. 485):

(16) (...) George IV wished to know whether Scott was the author of *Waverley*; and in fact Scott *was* the author of *Waverley*. Hence we may substitute *Scott* for *the author of 'Waverley'*, and thereby prove that Scott wished to know whether Scott was Scott. Yet an interest in the law of identity can hardly be attributed to the first gentleman of Europe.

This would not occur if we had adopted Russell's analysis of definite descriptions, upon which the phrase *the author of* Waverley fails to be a referring term.

Finally, Russell's analysis accounts for the fact that we can make statements about, and have knowledge of, things that are not known to us by acquaintance, but by description, such as *the centre of mass of the solar system at the first instant of the twentieth century*. Believing—or indeed even knowing—that such a point exists, we can formulate propositions about it, and believe—or know—them, without this requiring any existing individual to have ever been confronted with this center in the first place.

Russell's analysis thus deals with a couple of epistemological and analytical puzzles which can be formulated using definite descriptions, and it seems fair to say that, despite several of its apparent problems and limitations, no alternative analysis of definite descriptions as referential noun phrases has ever reached these same results by equally simple means.

Of course, Russell's analysis of definite descriptions hasn't gone unchallenged. Two major antitheses have been formulated over the years which both seemed to suffer from such an amount of common sense, that proponents as well as antagonists felt safe to assume that these attacks completely / not at all reached their respective purposes.[20]

The first major challenge of Russell's theory came from Peter Strawson, who insists that, firstly, it is not sentences which are true or false, but the assertions which sentences can be used to make, and, secondly, that the function of definite descriptions in making assertions consists in determining a specific individual with further help of the context of use. Thus, "[t]o use the sentence ['The table is covered with books', PD] is not to assert, but it is (in the special sense discussed) to imply, that there is only one thing which is *both* of the kind specified (*i.e.* a table) *and is being referred to* by the speaker." (Strawson 1950, p. 178)

In (Russell 1957), Russell replies that Strawson doesn't really add anything of substance to his concerns, except for the (deemed old) observation that definite descriptions have a context-dependent interpretation. But context-dependence and the interpretation of descriptions constitute two different problems. As is also argued more extensively in (Neale 1993), the relevant type of

20. Cf., e.g., Russell's (belated) reaction against the first attack by Strawson: "The main purpose of the article [Strawson's "On Referring", PD] is to refute my theory of descriptions. As I find that some philosophers whom I respect consider that it has achieved its purpose successfully, I have come to the conclusion that a polemical reply is called for." (Russell 1957, p. 385)

context-dependence does not at all seem to be specific to definite descriptions. Any one of the following examples can be understood as quantifying over a very restricted domain of individuals, for instance the individuals in (one part of) a certain room:

(17) The table is covered with books.
(18) Most tables were covered with books.
(19) Every table was covered with books.

Of course, simply observing that the common nouns or relative clauses restricting quantifying noun phrases should be understood to be contextually restricted themselves, is not the same as offering an analysis of the phenomena at issue, and we will not try to do so here either. In the remainder we will simply assume some pragmatic mechanism which serves to restrict natural language quantification to the appropriate domains of quantification.[21]

Notice that, despite Russell's claims to the contrary, Strawson's critique of Russell's theory involves more than the mere context dependence of descriptive phrases. Strawson also appeals to the intuition that definite descriptions can be used to refer, and it is not (immediately) clear how to account for that intuition, if one should account for it at all, that is. Now it is especially this referential use of definite description which plays a prominent role in a couple of papers by Keith Donnellan (the first one of which is (Donnellan 1966)).

Donnellan's points can be illustrated by means of the following example from Geach:

(20) The fat old humbug we saw yesterday has just been made full professor!

Although Russell's analysis appropriately renders the meaning of the definite description "the fat old humbug" on what Donnellan calls its 'attributive' reading, the analysis falls short in not accounting for its 'referential' interpretation. Under a referential interpretation, Donnellan argues, example (20) can be used to make a claim *about* a particular person, viz., the claim that *that person* has just been made full professor. If a speaker thus uses such a definite description in a referential way, "he uses the description to enable his audience to pick out whom or what he is talking about and states something about that person or thing." (p. 285) [22]

An instrumental understanding of definite descriptions becomes really interesting when a definite description does not actually fit the person or thing which it is meant to describe or which it is used to refer to. Thus, even if the person who utters (20) and his audience didn't meet a fat old humbug the day before the utterance was made, the audience may in certain cases be able to figure out *whom* the speaker is referring to, and understand that the speaker asserts of *that* person that he has been made full professor. Suppose someone

21. We only note that such a mechanism can be of various kinds. It may consist of contextually restricted quantification (Westerståhl 1984), possibly related to the dynamics of interpretation (Groenendijk et al. 1995); it may employ suppletion of 'elided' (syntactic) material (Ludlow and Neale 1991; Neale 1993), bridging (van Deemter 1992; Geurts 1995; Hendriks 1996) or other 'primary' pragmatic processes (Recanati 1996).
22. We have to add that Geach himself qualifies the kind of 'reference' involved here as "of negligible importance for logic", and that he mentions it "only to get it out of the way" (p. 8).

replies to an utterance of example (20) in the way suggested by (Donnellan 1978, p. 54):

(21) I don't think he's fat; he's just large boned. And as for his being a humbug, he seemed quite genuine and above board.

Such a reply may, apparently, serve to express one's disagreement with the description of the individual who is the referent of 'the fat old humbug' as a fat old humbug. But this only makes sense if such an individual has been identified. Moreover, it seems that this reply leaves the proposition that this person is made full professor unobjected. That is to say, example (20) can be used to get addressee accept a proposition about a person who, maybe, is not a fat old humbug after all.[23]

Donnellan's views, and related insights, have been critized by, in particular, Kripke, Grice, and Neale. These criticisms do not so much question the validity of Donnellan's observations, they are mainly directed at Donnellan's analysis of the referential interpretation of definites as a *semantic* phenomenon. As (Neale 1993) puts it: "No one, I take it, contests the phenomenon of referential usage. But there is considerable disagreement as to the *significance* of this phenomenon when it comes to the construction of a semantical theory." (p. 8)

We will not want to review the whole discussion here, but we will confine ourselves to the main points. In the first place it is observed that although someone may use example (20) to say something true about some individual who is not in fact a fat old humbug, that fact does not suffice to make the sentence true. If example (20) is used to say something about an individual who is not a fat old humbug, there still is something very wrong with the sentence. If the speaker in fact didn't meet a fat old humbug the day before, we can, in line with Russell's analysis, understand the defect to be that the sentence is strictly speaking false.

In the second place, as for instance Kripke has argued, even if one can utter (20) to say of someone who is not a fat old humbug that he has been made full professor, this does not at all need to lead to a conflict with Russell's analysis. For the grounds for characterizing the utterance as an utterance *about* such a person need not at all depend on a referential, non-Russellian, meaning of the definite description. On the contrary, it seems, for similar referential effects have also been observed with other noun phrases, proper names, indefinites or even "all sorts of quantifiers" (Neale 1993, p. 88). As an alternative, then, pragmatic analyses of Donnellan's observations have been proposed, according to which the 'referential' types of reading can be seen to emerge from the interaction of several pragmatic factors with the semantic information conveyed by the sentence upon its Russellian analysis.

The idea guiding such approaches is this. On the one hand, Russell's analysis of definite descriptions can be maintained, and is indeed all we need, as long as we stay in the semantic realm, in the realm of linguistic meaning. Donnellan's

23. For the sake of completeness we have to add that, according to Donnellan, a referential use or interpretation of definites is not restricted to the domain of indicative sentence utterances, but that it also occurs in questions and, notably, imperatives. However, these other kinds of sentence or utterance types are beyond the scope of the present paper.

observations, on the other hand, can be assigned to the pragmatic realm, the realm of utterance meaning. The nice thing about this division of labour is that it keeps the semantic component of a theory of interpretation 'clean', by not unnecessarily positing semantic ambiguities. Of course, this division of labour also invokes the task of actually presenting a pragmatic account of Donnellan's observations, so this is what we now turn to in the last section of this paper.

4 Reference and Specificity

In this paper we favor an analysis of descriptions according to which a referential interpretation of definite descriptions is obtained by combining the semantic information of a sentence with pragmatic information about the context in which the sentence is uttered. Neale (e.g., Neale 1993, p. 89) presents such an account, using a Gricean style of reasoning, which involves contemplating the various reasons and intentions and the evidence which a speaker may have inspired to utter the sentence she has actually uttered. As it is stated, however, this method of determining the referential interpretation explicitly refers to the specific expressions which the speaker used, and, thus, it can be conceived of as a re-analysis or re-valuation of the uttered sentence, not just of its meaning.

The nice thing about interpreting sentences using information aggregates is that these aggregates have precisely the kind of structure which allows us to assign a *referential* interpretation to the subjects presented by indefinite and definite descriptions, without this requiring us to step back to the syntactic level.

Consider the following example, adopted from Donnellan but slightly modified. Think of it as uttered at some social event. Speaker and hearer are both gazing at a group of small-talkers, and they are, or seem to be, aware of that. One man in the group is holding a glass, a long-drink glass, which contains a fluid. We will call him 'Mr. Carotti', or 'c' for short.

(22) The man with a martini sells wooden shoes.

Neglecting the ways in which the domain of quantification can be restricted, and assuming that the property MWM of being a man with a martini is sufficiently specific, the example is roughly interpreted as the following information aggregate:

(23) $\{g \in D_W^{\{x\}_v} \mid g(x) \text{ is the } MWM \text{ in } g(v) \text{ and } g(x)\ SWS \text{ in } g(v)\}$

with 'SWS' short for 'sells wooden shoes'.

We may assume that aggregate (22) is substantiated by the speaker's information aggregate, that is to say, if the speaker is not deluded, and if she is sincerely partaking in the linguistic game of information exchange. In that case the speaker must have had somebody in mind—a subject of her information aggregate—whom she referred to with her utterance of (22). Moreover, given the described situation, it seems no more than natural to assume that the speaker is having this man with the long-drink glass in mind, which we know as Mr. Carotti. On the basis of this information, we may therefore conclude that example (22), or the information aggregate (23), is actually about this man. So, combining the information expressed by (22), with this contextual

information that the value of x is c, we may gain the following information from the utterance of (22) in the context as it is described:

(24) $\{g \in D_W^{\{x\}_v} \mid g(x) = c\} \cap$ (23)
$\{g \in D_W^{\{x\}_v} \mid g(x) = c$ & $g(x)$ is the MWM in $g(v)$ & $g(x)$ SWS in $g(v)\}$

A couple of things may have to be said about an interpretation of example (22) along the lines sketched.

First, and foremost, aggregate (24) can be obtained from the meaning (23) of example (22) by adding the information that the value of x equals c (that is, the information that Mr. Carotti is the referent). The extended interpretation procedure, thus, is properly semantic. Second, the additional information, that Mr. Carotti is the referent, really is contextual information, not semantic information. We are only justified in saying that the utterance of (22) actually is about Mr. Carotti, if the speaker has a certain subject in mind when uttering (22) (licensing) which presents Mr. Carotti for her (anchoring). It can hardly be a matter of the *meaning* of the *sentence* (22) that somebody who utters (22) is sincere, not deluded, and not by coincidence thinking of a person completely different from Mr. Carotti. So when we say that the utterance of example (22) is about Mr. Carotti we can be terribly wrong, but that, then, does not mean that we didn't assign the sentence the right meaning.

Notice, finally, that we have specified a referential interpretation of example (22) from some 'objective' point of view. We have assumed that the utterance of the sentence had a clear meaning, and that it concerned a definite individual. We would like to point out that, eventually, we want to model the subjective point of view, viz., the interpretation that epistemic agents actually assign to utterances in the context they find themselves in. In order for this to be feasible, we would have to bring in, among others, partial information about what has actually been said, about whom what has been said is about, and about the identity of these aboutees. We leave that for another occasion.

Sofar, we have been concerned with relating (the interpretation of) sentences with definite descriptions to the individuals which they are assumed to be providing information about. Thus, we saw how someone who utters example (22) can be taken to have said a couple of things about Mr. Carotti, e.g., that he is having a martini, and that he sells wooden shoes. Now, if we assume that we correctly interpret the utterance as one about Mr. Carotti, the utterance may still be making false claims about him. For one thing, it may well be that, in the actual world, Mr. Carotti does not sell wooden shoes, and that he earns a living by importing Limburger cheese instead. For another, contrary to what the speaker has been thinking, he may have just a long drink in his hands, not a glass of martini. Clearly, this comes out fine upon our analysis, since in such a case we will not find the actual world among the possible values of the variable v according to aggregate (24).

At this point, however, our analysis fails to account for one thing which Donnellan's does account for. Consider again example (20), in a situation in which it is used to say something of a person, dr Emerotti, who cannot appropriately be described as a fat old humbug. Upon Donnellan's analysis the referentially read definite description then still may succeed in identifying dr

Emerotti as the referent of the assertion, and the remainder of the sentence can be construed as expressing the (true) proposition that dr Emerotti has been made full professor. By contrast, our analysis only allows us to say in that case that something false has been said of dr Emerotti, viz., that he is a fat old humbug who has been made full professor. Sofar, it does not provide us with non-ad hoc means to single out, from the associated aggregate, the proposition that dr Emerotti has been made full professor. So, sofar, we fail to account for the intuition that in the sketched case the speaker has said something true of dr Emerotti by uttering (20).

We do not think, however, that in particular this fact should be accounted for by an analysis of *definite descriptions*, be it a semantic, or a pragmatic one. An alternative account of facts like these might start of from the observation that speech participants in general do not assign equal weight to everything a speaker says.[24] So, for instance, the information expressed by the verb phrases of the examples (20) and (22) can be taken to be more 'interesting', 'relevant', 'to the point', than the information provided by the descriptions involved.[25] For this reason, if someone is retrieving information from these utterances, he may focus on the bits of information which are judged more important, and eventually *skip* the information provided by the descriptions. (That is, of course, if the context has already enabled him to figure out whom the utterance is about.) In this way such a 'sophisticated' interpreter may take from example (22) the information that *he*, viz., Mr. Carotti, sells wooden shoes, and skip the rest. If Mr. Carotti actually sells wooden shoes, this constitutes truthful information, completely independent from the question whether Mr. Carotti at present is holding a glass with martini or not. In this sense, clearly, the interpreter has learned something true from the speaker, and this part of the story fits in neatly with our account.

Not only do we think that along these lines we may come up with a promising analysis of locutions of the form "with uttering S, speaker e has said ϕ of d", we also think that Donnellan's analysis does not offer an alternative which is general enough. Assume that the content of sentences can be divided up in (non-asserted) material expressed by definite descriptions, and asserted material in the remainder. Then we might say, with Donnellan, that the first may or may not involve a misdescription of the intended referent(s), and that the second may or may not express a true proposition about the intended referent(s). But this does not seem to be detailed enough to describe what is going on in a dialogue consisting of Geach' example (20), and the reply (21) which Donnellan himself came up with:

(20) The fat old humbug we saw yesterday just been made full professor!
(21) I don't think he's fat; he's just large boned. And as for his being a humbug,

24. Although, to our opinion, meanings should be rigidly assigned to analyzed sentences, the actual interpretation of them can be quite a flexible thing indeed. What people actually do with the things other people utter—reject them, accept them, ignore them, misconstrue them—that is not something which we think belongs to the scope of a theory of interpretation.
25. One can insert one's favourite theory of focus and background here. What form such a theory may take is immaterial for our present concerns. What counts is that not all information provided in a discourse generally counts as of equal weight.

he seemed quite genuine and above board.

An utterance of (21) in this context can be understood as an objection to two attributions to dr Emerotti made by means of example (20): that he is fat, and that he is a humbug. That he is old, and that he has been made full professor is left unobjected.[26] But if a response to an utterance of (20) thus consists in denying that dr Emerotti is fat and large boned, and in agreeing that he is old and has been made full professor, then, we think, example (20) can be—or has been—interpreted as saying that dr Emerotti is fat and large boned and as saying that he is old and has been made full professor. But notice that this distinction between what is denied and what is left unobjected cuts through the suggested distinction between what is and what is not asserted with example (20). Our conclusion is that what we may say a speaker can assert by uttering example (20) is a much more open class of propositions than the set simply consisting of Donnellan's attributive and his referential interpretation of example (20).

We now turn to the contextual interpretation of indefinite descriptions. Parallel to the referential interpretation of definite descriptions, we find a so-called 'specific' interpretation of indefinite descriptions, which can be analyzed in a similar way.[27] Consider the following slightly adapted version of an example from (Kasher and Gabbay 1976):

(25) A painting is missing from the museum.

This sentence can be uttered by someone who just discovered that a very specific painting, for instance *Who's afraid of Red, Yellow and Blue II*, painted by Daniel Goldreyer, has been taken away from the museum. Most probably, then, the speaker utters (25) with (his subject presenting) this painting in mind, and the sentence then is appropriately construed as being about the mentioned painting.

Let (26) be the information aggregate associated with example (25):

(26) $\{g \in D_W^{\{z\}_v} \mid g(z) \text{ is a } P \text{ in } g(v) \text{ and } g(z) \text{ is } MFM \text{ in } g(z)\}$

This aggregate can be related to *Who's afraid of Red, Yellow and Blue II*, or $w2$, for short, to give us the contextual or specific interpretation of example (25) as in (27):

(27) $\{g \in D_W^{\{z\}_v} \mid g(z) = w2\} \cap (26)$
$\{g \in D_W^{\{z\}_v} \mid g(z) = w2 \text{ and } g(z) \text{ is a } P \text{ in } g(v) \text{ and } g(z) \text{ is } MFM \text{ in } g(z)\}$

Notice that, as against, e.g., (Donnellan 1978; Kasher and Gabbay 1976; Partee 1972; Fodor and Sag 1982), but in line with, e.g., (Kripke 1979; Klein 1979; Groenendijk and Stokhof 1980; Ludlow and Neale 1991), we account for the specific interpretation of indefinites not on the semantic, but on the pragmatic level, which seems appropriate.

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26. One might even add, explicitly, "(...) but I agree, he is old and he has been made full professor".

27. We will not go into the (non-)scopal properties of specific indefinites in this paper. We only focus on establishing the connection between specifically interpreted indefinites and (individuals in) the real world.

We see that a specific interpretation of indefinites is motivated when utterances are licensed, and when the relevant subjects are properly anchored to real individuals. Needless to say, that in case an indefinite description is used, it may be unclear what specific subject (if any!) the speaker has in mind when uttering the indefinite. A speaker may use an indefinite precisely because the identity of the involved subject is not relevant to the purposes of the discourse at hand, or because the recipient is not even aware of the existence of the subject.

The fact remains that a speaker can use an indefinite in a non-specific way, in the sense that she may be taken not to know what the identity of the mentioned subject is. For instance, example (25) may be uttered by a guard in the control room of the museum, because she sees an alarm blinking, where the alarm indicates that some painting has been removed. In such a case we think, however, there is still a sense in which the guard refers to a definite subject, viz., the painting the supposed removal of which has caused the alarm to go off. If, in fact, the removal of one painting caused the alarm to go off, all speculation about 'the missing painting' to our opinion can be construed as being about this painting.

What remains, then, is an explanation of the fact that the guard can be said not to know which picture is missing. Apparently we have to refer, here, to the domain of individual paintings with which the guard can be thought to be more directly acquainted, viz., all the individual paintings in the gallery. Although it is supposed that exactly one picture is actually missing, and although the guard is himself acquainted with that picture, as he is with all the pictures in the gallery, he simply doesn't know which one of all the pictures is the missing one is. So, in relation to a more familiar domain of individuals—or subjects—the indefinite 'a painting' in an example like (25) can be said to count as non-specific.

5 Conclusion

Although subjects have been seen to spring to life in discourse (or, rather, in *theories of* discourse interpretation), it will be clear that we do not think that their role or function is restricted to the process of discourse interpretation only. In this paper, we have made a case for using them for for other, transtextual, purposes. For precisely this reason we have chosen to call these things "subjects", in stead of "discourse referents", a name by which they are more widely known.

We have shown in what sense aggregates of information can be said to be (causally / perceptually) 'linked' or 'anchored' to real individuals, and in what sense subjects can be said to be (intentionally or conversationally) related to other subjects. With reference to these kinds of links, specific utterances can be seen to be about specific individuals, and in the kinds of information aggregates employed in systems of dynamic semantics, this separate kind of (contextual) information can be matched with the semantic information expressed. Thus, referential readings of definites and specific readings of indefinites can be neatly modeled.

All along we have been assuming that sentences are associated with a content of their own, not with dynamic update functions. According to the picture suggested in this paper, the dynamics of interpretation resides at the level where context dependent linguistic constructs get in construction with the constructs which make up the context. And as is shown more specifically in the appendix, standard types of sentence denotations can even be used to model the 'dynamics' of anaphoric binding. We do not, however, think that a single moral can be drawn from this.

It will be clear from the appendix that the dynamic treatment of pronouns is much more tractable and transparent than the static one presented there, which is committed to such an involved notion of conjunction. Apparently, a lot of descriptive efficiency and perspicuity is gained by taking the resolution of pronouns for granted and by side-stepping the evaluation of meanings in the pragmatic-semantic description of linguistic updates. Nevertheless, we also think the paper shows the use of 'deconstructing' dynamic update functions into a meaning component and a pragmatic component dealing with resolution and acceptance. Such a deconstruction not only may serve to give a further motivation for a dynamic semantics, for instance, by showing that it still comprises traditional semantic notions like that of truth and satisfaction. It also may serve to extend its scope with more pragmatic phenomena.

Bibliography

Dekker, P.: 1993, *Transsentential Meditations. Ups and Downs in Dynamic Semantics*, Ph.D. thesis, ILLC/Department of Philosophy, University of Amsterdam, Amsterdam

Dekker, P.: 1994, Predicate logic with anaphora (seven inch version), in L. Santelmann and M. Harvey (eds.), *Proceedings of SALT IV*, pp 79–95, DMLL Publications, Cornell University

Dekker, P.: 1996a, Reference and representation, in K. von Heusinger und Urs Egli (ed.), *Proceedings of the Konstanz Workshop "Reference and Anaphorical Relations"*, Fachgruppe Sprachwissenschaft, Universität Konstanz, Konstanz, Arbeitspapier Nr. 79

Dekker, P.: 1996b, The values of variables in dynamic semantics, *Linguistics and Philosophy* 19(3), 211–257

Dekker, P.: 1997, On first order information exchange, in A. Benz and G. Jäger (eds.), *Proceedings of Mundial'97. Munich Workshop on the Formal Semantics and Pragmatics of Dialogue*, Centrum für Informations- und Sprachverarbeitung, München, in preparation

Donnellan, K.: 1966, Reference and definite descriptions, *Philosophical Review* 75, 281–304

Donnellan, K.: 1978, Speaker reference, descriptions and anaphora, in P. Cole (ed.), *Syntax and Semantics, Vol 9. Pragmatics*, pp 47–68, Academic Press, New York

Fodor, J. and Sag, I.: 1982, Referential and quantificational indefinites, *Linguistics and Philosophy* 5(3), 355–398

Frege, G.: 1892, Über Sinn und Bedeutung, *Zeitschrift für Philosophie und philosophische Kritik* NF 100, 25–50

Geurts, B.: 1995, *Presupposing*, Ph.D. thesis, Universität Osnabrück, Osnabrück

Groenendijk, J. and Stokhof, M.: 1980, A pragmatic analysis of specificity, in F. Heny (ed.), *Ambiguities in Intensional Contexts*, Reidel, Dordrecht

Groenendijk, J. and Stokhof, M.: 1991, Dynamic predicate logic, *Linguistics and Philosophy* 14(1), 39–100

Groenendijk, J., Stokhof, M., and Veltman, F.: 1995, Coreference and contextually restricted quantification, in *Proceedings of SALT V*, DMLL Publications

Groenendijk, J., Stokhof, M., and Veltman, F.: 1996, Coreference and modality, in S. Lappin (ed.), *The Handbook of Contemporary Semantic Theory*, pp 179–213, Blackwell, Oxford

Heim, I.: 1982, *The Semantics of Definite and Indefinite Noun Phrases*, Ph.D. thesis, University of Massachusetts, Amherst, Published in 1989 by Garland, New York.

Heim, I.: 1983, File change semantics and the familiarity theory of definiteness, in R. Bäuerle, C. Schwarze, and A. von Stechow (eds.), *Meaning, Use, and Interpretation of Language*, de Gruyter, Berlin

Hendriks, H.: 1993, *Studied Flexibility*, Ph.D. thesis, University of Amsterdam

Hendriks, H.: 1996, Information packaging: From cards to boxes, in T. Galloway and J. Spence (eds.), *Proceedings of Semantics And Linguistic Theory VI*, pp 75–92, CLC Publications, Ithaca, New York

Janssen, T. M.: 1983, *Foundations and Application of Montague Grammar*, Ph.D. thesis, University of Amsterdam, Amsterdam

Kadmon, N.: 1987, *On Unique and Non-unique Reference and Asymmetric Quantification*, Ph.D. thesis, University of Massachusetts, Amherst

Kamp, H.: 1981, A theory of truth and semantic representation, in J. Groenendijk, T. Janssen, and M. Stokhof (eds.), *Formal Methods in the Study of Language*, Mathematical Centre, Amsterdam, Reprinted in J. Groenendijk, T. Janssen, and M. Stokhof (eds.), *Truth, Interpretation and Information*. Foris, Dordrecht, 1984

Kamp, H.: 1990, Prolegomena to a structural theory of belief and other attitudes, in C. A. Anderson and J. Owens (eds.), *Propositional Attitudes*, pp 27–90, CSLI, Stanford

Kamp, H. and Reyle, U.: 1993, *From Discourse to Logic*, Kluwer, Dordrecht

Kasher, A. and Gabbay, D. M.: 1976, On the semantics and pragmatics of specific and non-specific indefinite expressions, *Theoretical Linguistics* 3, 145–190

Klein, E.: 1979, *On Sentences which Report Beliefs, Desires and Other Attitudes*, Ph.D. thesis, University of Cambridge, Cambridge

Kripke, S.: 1979, Speaker's reference and semantic reference, in P. A. French, T. E. Uehling, and H. K. Wettstein (eds.), *Contemporary Perspectives in the Philosophy of Language*, Chapt. 6–27, University of Minnesota Press, Minneapolis, originally published in P. E. French, T. E. Uehling and H.K. Wettstein (eds.), 1977, *Studies in the Philosophy of Language*, Midwest

Studies in Philosophy II, University of Minnesota, Morris, pp 255-276.
Lewis, D.: 1975, Adverbs of quantification, in E. L. Keenan (ed.), *Formal Semantics*, Cambridge University Press, Cambridge, U.K.
Ludlow, P. and Neale, S.: 1991, Indefinite descriptions, *Linguistics and Philosophy* 14(2), 171–202
Montague, R.: 1974, The proper treatment of quantification in ordinary English, in R. Thomason (ed.), *Formal Philosophy. Selected papers of Richard Montague*, pp 247–270, Yale University Press, New Haven
Neale, S.: 1993, *Descriptions*, MIT Press, Cambridge, MA
Partee, B. H.: 1972, Opacity, coreference, and pronouns, in D. Davidson and G. Harman (eds.), *Semantics for Natural Language*, pp 415–441, D. Reidel, Dordrecht, Holland
Recanati, F.: 1996, Domains of discourse, *Linguistics and Philosophy* 19, 445–475
Russell, B.: 1905, On denoting, *Mind* XIV, 479–493
Russell, B.: 1957, Mr. Strawson on referring, *Mind* 66, 385–389
Strawson, P. F.: 1950, On referring, *Mind* 59, 320–344
van Deemter, K.: 1992, Towards a generalization of anaphora, *Journal of Semantics* 9, 27–51
van Rooy, R.: 1996, Anaphoric relations across belief contexts, in U. Egli and K. von Heusinger (eds.), *Proceedings of the Konstanz Workshop on Reference and Anaphorical Relations*, FSW, Universität Konstanz, Konstanz
van Rooy, R.: 1997, *Attitudes, and Changing Contexts*, Ph.D. thesis, IMS, Stuttgart
Vermeulen, C. F.: 1993, Sequence semantics for dynamic predicate logic, *Journal of Logic, Language and Information* 2, 217–54
Vermeulen, C. F.: 1996, Merging without mystery or: Variables in dynamic semantics, *Journal of Philosophical Logic* 24(4), 405–450
Westerståhl, D.: 1984, Determiners and context sets, in J. van Benthem and A. ter Meulen (eds.), *Generalized Quantifiers in Natural Language*, pp 45–71, Foris, Dordrecht
Whitehead, A. N. and Russell, B.: 1910, *Principia Mathematica*, Vol. I, Cambridge University Press, Cambridge
Zeevat, H.: 1989, A compositional approach to discourse representation theory, *Linguistics and Philosophy* 12, 95–131
Zimmermann, E.: 1996, Subjects in perspective. Comments on Paul Dekker's 'On context and identity', in H. Kamp and B. Partee (eds.), *Proceedings of the Workshop on Context Dependence*, IMS, Stuttgart and UFAL, Prague
Zimmermann, E.: 1997, Remarks on the epistemic rôle of discourse referents, in L. Moss (ed.), *Proceedings of ITALLC 96*

Appendix

With this appendix we want to back up a couple of claims made in this paper. First we will show how sentences of a formal language can be interpreted in terms of information aggregates using a *static* system of interpretation, similar

to that of (Zeevat 1989). After that we will show how singular anaphora can be dealt with, by adding a *resolver* to this little system. The idea is that, in order to account for singular anaphoric dependencies between two information aggregates, one only needs a resolver which determines which of the free variables of one aggregate are 'bound' by which 'free' (= bound) variables of the other, when the two aggregates are combined. The assumption that such a resolver can be taken for granted is adopted from virtually *all* theories of dynamic semantics; the particular fact that the resolver constitutes a separable module of the system, we have only seen in *DRT* before, and in the work of Kees Vermeulen, which constituted a major source of inspiration for the system presented here.

Language

In the first section of this paper we have drawn two conclusions from the discussion in the literature on the 'dynamic' behaviour of indefinite noun phrases in natural language. First, these phrases are seen to behave like 'free' variables, but, second, they should not be treated as really free variables. In a formal setting this requires us to make a distinction between the free and the 'free' (= existentially quantified) variables of a formula, and in order to make sense of this we propose to follow Montague (as observed by Hendriks) and formally distinguish the set of free variables $F = \{x_{2i+1} \in V \mid i \in \mathcal{N}\}$ from the set of 'free' (= bound) variables $B = \{x_{2i} \in V \mid i \in \mathcal{N}\}$.

The language of our toy formal system PL^s is like that of ordinary predicate logic PL but for the fact that this explicit distinction between free and bound variables is hard-wired into the syntax. Characteristic clauses therefore are:

(28) If $y_1, \ldots y_n$ are *free* variables, and R is an n-ary predicate, then $Ry_1 \ldots y_n$ is an atomic formula; If ψ is a formula, x is a bound variable, and y is a free variable, then $\exists x_y \psi$ is a formula.

One can see that the variables of an atomic formula are *literally* free variables. Quantified formulas are more involved. A quantifier of course involves a 'bound' variable, x in the sample clause above. But, of course, it also has to bind a free variable in the formula to which it attaches, so that is why a second (*free*) variable y is associated with the quantifier. A quantifier $\exists x_y$ binds the free occurrences of a free variable y in ϕ to the bound variable x in $\exists x_y \phi$. As in ordinary usage, this means that the free variable y in ϕ is bound in $\exists x_y \phi$.

Static Semantics

PL^s formulas are interpreted as information aggregates. In this appendix we skip all distinctions which can be made between several possible worlds, and just keep to standard extensional first order models, for the sake of simplicity. If F is the set of free variables, then we can single out the relevant sets of information aggregates in the following way. For any set of bound variables X

(29) $S^X = \mathcal{P}(D^X)$ is the set of PL^s *information aggregates* about X.

For any aggregate $s \in S^X$, we will use $D(s)$ for X, $B(s)$ for $D(s) \cap B$, and $F(s)$ for $D(s) \cap F$. For any formula ϕ, we define $D(\phi)$ (and, consequently,

$F(\phi) = D(\phi) \cap F$ and $B(\phi) = D(\phi) \cap B$) such that $D(Ry_1 \ldots y_n) = \{y_1, \ldots, y_n\}$; $D(y_i = y_j) = \{y_i, y_j\}$; $D(\neg\phi) = F(\phi)$; $D(\exists x_y \phi) = (D(\phi) \cup \{x\}) \setminus \{y\}$; and $D(\phi \wedge \psi) = D(\phi) \cup D(\psi)$.

Now we can present the definition of PL^s-interpretation. We use the notation $\alpha \doteq \beta$ to indicate the requirement that α and β are the same if defined at all. In the definition below $g[X/Y]h$ means that $D(g) = (D(h) \cup X) \setminus Y$, and $\forall \nu \in D(g)$: if $\nu \notin X$ then $g(\nu) = h(\nu)$. All references to a model are suppressed, so the (extensional) interpretation of any predicate R will be assumed to be (exhaustively specified as) $[R]$. The definition runs as follows:

(30)
$$\begin{array}{lll}
[\![Ry_1 \ldots y_n]\!] & = \{g \in D^{\{y_1,\ldots,y_n\}} & \mid \langle g(y_1), \ldots, g(y_n)\rangle \in [R]\} \\
[\![y_i = y_j]\!] & = \{g \in D^{\{y_i,y_j\}} & \mid g(y_i) = g(y_j)\} \\
[\![\neg\phi]\!] & = \{g \in D^{D(\neg\phi)} & \mid \neg\exists h\colon g \subseteq h \;\&\; h \in [\![\phi]\!]\} \\
[\![\exists x_y \psi]\!] & = \{g \in D^{D(\exists x_y \psi)} & \mid \exists h\colon g[\{x\}/\{y\}]h \;\&\; h \in [\![\psi]\!] \;\&\; g(x) \doteq h(y)\} \\
[\![\phi \wedge \psi]\!] & = \{g \in D^{D(\phi\wedge\psi)} & \mid \exists f \in [\![\phi]\!]\colon f \subseteq g \;\& \\
 & & \quad \exists h \in [\![\psi]\!]\; \exists h'[\emptyset/B(\phi)]h\colon h' \subseteq g\}
\end{array}$$

$[(\phi \rightarrow \psi) = \neg(\phi \wedge \neg\psi);\ (\phi \vee \psi) = (\neg\phi \rightarrow \psi);\ \forall x_y \phi = \neg\exists x_y \neg\phi]$

The above definition is pretty straightforward, except for the clause dealing with conjunction. In the case of a conjunction a choice had to be made. For instance, if two conjuncts both introduce the 'free' (= bound) variable x, we have to decide which one—if indeed any one of them—will introduce the variable to the whole conjunction. According to the above definition the first 'declaration' of x wins.

The presently sketched system of PL^s does quite the right things for the purposes of the present paper. The system generates the kind of information aggregates we can expect from a first order language. But surely we want to see the formal relation with ordinary first order languages, which is fairly simple. Define the following translation $()^\dagger$ from PL^s to PL:

(31)
$$\begin{array}{llll}
(Ry_1 \ldots y_n)^\dagger & = Ry_1 \ldots y_n & (\exists x_y \phi)^\dagger & = \exists y (\phi)^\dagger \\
(\neg\phi)^\dagger & = \neg(\phi)^\dagger & (\phi \wedge \psi)^\dagger & = (\phi)^\dagger \wedge (\psi)^\dagger
\end{array}$$

By induction on the construction of ϕ it can be seen that $\forall g \in D^{F(\phi)}$:

(32) $\exists h\colon g \subseteq h \;\&\; h \in [\![\phi]\!]$ in PL^s iff $\exists h\colon g \subseteq h \;\&\; h \in [\![\phi^\dagger]\!]$ in PL

Dynamic Semantics

Since the formulas of PL^s are interpreted as information aggregates, their interpretation already displays sufficient structure to enable an account of intersentential anaphora. In order to work this out we need a device telling us which free variables in one aggregate are bound by which (bound) variables of another. We call such a device a resolver, and we spell out the resolution which such a resolver offers as a finite relation $r \subseteq B \times F$ between bound and free variables. In order to emphasize the intended binding effect of having a pair $\langle x, y\rangle$ in such a relation r we will generally indicate it as x_y. We use $D(r)$ for the domain $\{x \in B \mid \exists y \in F\colon x_y \in r\}$ of r, and $R(r)$ for the range $\{y \in F \mid \exists x \in B\colon x_y \in r\}$ of r.

We assume that resolution takes place when two aggregates merge.[28] For

28. Apparently, this is not the only sensible option to be considered. Many (dynamic) theories

this reason, it is appropriate to write a resolver on the conjunction sign which initiates the merge to be resolved. So, from now on we will come across formulas of the form $\phi \wedge_r \psi$, where r is a resolver. The system of interpretation with this notion of conjunction is referred to as PL^{us}. Before we define the interpretation of our new subscripted connective, we need to settle the domain of the formulas $\phi \wedge_r \psi$ formed: $D(\phi \wedge_r \psi) = D(\phi) \cup D(r) \cup (D(\psi) \setminus R(r))$. (So we find that $F(\phi \wedge_r \psi) = F(\phi) \cup (F(\psi) \setminus R(r))$, and $B(\phi \wedge_r \psi) = B(\phi) \cup D(r) \cup B(\psi)$.) The interpretation is specified as follows:

(33) $[\![\phi \wedge_r \psi]\!] = \{g \in D^{D(\phi \wedge_r \psi)} \mid \exists f \in [\![\phi]\!]\colon f \subseteq g \;\&$
$\exists h \in [\![\psi]\!]\colon \forall x_y \in r\colon g(x) \doteq h(y) \;\&$
$\exists h'[\emptyset / B(\phi) \cup D(r) \cup R(r)]h\colon h' \subseteq g\}$

This definition may need some comments. Firstly, notice that we have interpreted our resolver as indicating which bound variables in the left conjunct bind which free variables in the right one. Of course, there are various alternative ways to go about here (which are just as easily spelled out), but we have chosen to just stick to the practice of allowing left-to-right binding only, which is relatively standard in systems of dynamic semantics.

Notice, secondly, that we have imposed no restrictions on our relation r. For this reason we may find both vacuous binding (e.g., when some $x_y \in r$ and y does not occur free in ψ) as well as vacuous resolution (e.g., when $x_y \in r$ and x does not occur in a binding position in ϕ). Neither possibility presents any problems, but it may have to be pointed out that vacuous resolution amounts to in situ (existential) quantification. Notice that, for this reason, we may just as well do away with existential quantification, because it has become *definable*[29]:

(34) $\exists x_y \psi = (\top \wedge_{\{x_y\}} \psi)$

where $\top$ is a trivially true formula, for instance, $(p \vee \neg p)$, for p a 0-place predicate of PL^{us}.

Finally, notice that if r is the empty relation, then $\wedge_r$ equals the interpretation associated with $\wedge$ in PL^{us}. This means that we are still dealing with a proper extension of ordinary predicate logic.

What a specific resolution brings about can be seen from the following equivalence:

(35) $(\exists x_u(Fu \wedge \exists z_w(Dw \wedge Ouw)) \wedge_{\{x_c, z_e\}} Bce) \Leftrightarrow$
$\exists x_u(Fu \wedge \exists z_w(Dw \wedge (Ouw \wedge Buw)))$

Resolutions, thus, can be analyzed away, in order to produce equivalent formulas in normal binding form, that is, PL^s-formulas.

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build on the assumption that resolution takes place before that; Bart Geurts (pc) argues that it has to take place *afterwards*.

29. This result should not come as too big a surprise, now we have learned that indefinites (read: 'existentially quantified' phrases) are 'free' variables.