Speaker's Reference, Descriptions and Information Structure*

Paul Dekker

ILLC/Department of Philosophy
Faculty of Humanities
University of Amsterdam

Abstract
The notion of information developed in systems of dynamic semantics is applied in an analysis of the referential interpretation of definite descriptions, and the specific interpretation of indefinite ones. A Russellian treatment of descriptions is upgraded with the dynamic semantic notion of a discourse referent, and this enables a combination of contextually given information with information which is properly semantic. The analysis is sharpened by the addition of a partition of utterances into a ground and a focus part. The two extensions suffice to account for the most important features of situations which involve the referential use of expressions in a both semantically and pragmatically satisfactory way. A by-product is a rudimentary analysis of negative existential statements involving names.

Introduction

In various recently employed systems of dynamic semantics a certain notion of information about objects has become fashionable. In this paper we want to show that this notion of information is very useful for the characterization of the referential interpretation of definite descriptions, and the specific interpretation of indefinite ones. With this, possibly trivial, observation, we hope to serve a more general goal. We hope to contribute to elucidating the interaction between the semantic and pragmatic components of an overall theory of interpretation.

We take a Russellian treatment of descriptions as our point of departure, and we furthermore assume an extension of it with:

1. some form of contextually restricted quantification
2. an interpretation of terms as 'discourse referents'
3. a division of propositions into a background and an assertion part

An extension along the first lines is obviously needed in order to get rid of overly strong uniqueness requirements in the interpretation of definites, and of

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overly weak readings of indefinites. An extension along the second and third lines forms the heart of this paper.

When utterances are made with definite or indefinite expressions, the context of these utterances may provide clues as to which individuals these expressions relate to. However, it has remained unclear in traditional systems of interpretation how this pragmatic type of information can be properly combined with the semantic content of the uttered sentences.

Tools developed in systems of dynamic semantics are very helpful in this respect. Dynamic semantic information states display precisely the kind of structure that enable a combination with this pragmatic type of information. Information states model information about 'discourse referents'—or 'subjects' as we call them here—which can be addressed and linked to specific entities in the real world.

If we furthermore consider the distinction between what people can be taken to say about individuals, and what descriptions they have used to refer to the individuals, a division of utterances into a (back-)ground and an assertion part seems to be pertinent, too. Interestingly, the dynamic semantic notion of information also enables the two components of structured propositions to combine in an appropriate way.

We proceed as follows. In the first two sections we give an explanation and some independent motivation for the dynamic semantic notion of information. In section 3 we review the main points of the discussion about (Russell's analysis of) definite descriptions, and in section 4 we show how the dynamic semantic notion of information can be used to account for the referential interpretation of definite descriptions and the specific interpretation of indefinite ones. Section 5 serves to sharpen the analysis by incorporating basic notions from the theory of information structure. We end the paper with a discussion of 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. These variables must be seen to label subjects which are addressed in a discourse. The kind of information dealt with in these systems conveys more than mere information about (the state of) the world. These systems of interpretation employ an upgraded notion of information, which is the key to the issues discussed in this paper.

1. I am quite generically referring to the well-known systems of discourse representation theory (*DRT*, Kamp 1984; Kamp and Reyle 1993), file change semantics (*FCS*, Heim 1983; Heim 1989), and dynamic predicate logic (*DPL*, Groenendijk and Stokhof 1991), and all those akin in spirit or by offspring.

A convenient way of looking at the sort of information at issue is that it is information dressed around 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, if we do not, naively, construe the relevant notions of 'talking about' and 'thinking about' as immediately relating us to the individuals out there in the world. Subjects can be understood to be the objects of linguistic and intentional acts.[2]

Subjects as they are presented to us in systems of dynamic semantics typically have three properties. Unlike ordinary individuals, which are total objects, they are *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. A second typical property of subjects is that they may depend on each other in an intrinsic way. The third characteristic property of subjects is that they are re-addressable. Many information states in systems of dynamic semantics have precisely the structure which enables reference to subjects, even though these are partial, or indefinite, objects.

Before we apply the notion of a subject to the analysis of descriptions, we first make it formally explicit. This can be done in a variety of ways, but for the purposes of this paper it is convenient to employ Heimian information structures.[3] Information about subjects then can modeled using sets of assignments of values to variables. These variable assignments assign individuals to sets of variables, and a possible world to a distinguished variable v. To fix our ideas, consider how such sets of variable assignments model the information about a number of subjects $x_1, \ldots, x_n$. Suppose that x_k has a property $\mathcal{P}$, and that a pair x_i, x_j stand in a relation $\mathcal{R}$ (for $1 \leq k, i, j \leq n$). This kind of information is modeled in terms of sets of assignments of values to $v, x_1, \ldots, x_n$, such that for each g in that set, $g(x_k) \in \mathcal{P}$ in $g(v)$, and $\langle g(x_i), g(x_j)\rangle \in \mathcal{R}$ in $g(v)$.

Information structures, which we call 'information aggregates' in the sequel, are defined relative to a non-empty set of possible worlds W, a non-empty domain D of *individuals*, and a set of *variables* V.[4] For a set of (indi-

2. Their, causal and intentional, relation with the real individuals around us will be addressed in the next section. A note on terminology is in order, since we will be dealing with objects from different realms, or, as we would prefer to put it, with objects conceived from different perspectives. We try to consistently use the terms 'individuals' and 'entities' for the objects out there in the real world, and for the residents of the basic domains of our model theory. The term 'subjects' is used for the epistemic representatives of individuals, and the term 'objects' for things of both orders. The last term 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 may be subjects from someone else's perspective or from the meta-theoretical perspective.

3. See (Heim 1983; Dekker 1996), for further motivation and study. Alternative formulations, which fit the purposes of this paper equally well, can be found in (Zeevat 1989; Vermeulen 1993; Groenendijk et al. 1995; Dekker 1999). All of these formulations are evidently inspired and motivated by (Kamp 1984; Heim 1989; Kamp 1990).

4. 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.

vidual) variables $X \subseteq V$, with $v \notin X$, the domain of possible assignments is $\{f \cup g \mid f \in W^{\{v\}}\ \&\ g \in D^X\}$, which we abbreviate as $D^{X_v}_W$. The notion of an information aggregate then can be defined as follows:

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

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

For $\sigma \in \Sigma^X$, we say that the domain $d(\sigma)$ of σ is X.[5] The set X can be conceived of as the set of names of the subjects of an aggregate. The reader may have notice that we often use 'x' itself to refer to the (possible) value(s) of x.

It may be clear that a subject x of an information aggregate σ can be a partial object, in that x can have different values in σ. Furthermore, these subjects are typically interdependent. Delineating the possible values of one may automatically involve restricting those of others. Finally, because the subjects of our information aggregates are hung onto variables, they can be addressed by simply 'calling' these variables.

In order to illustrate how information aggregates can be used in a system of interpretation, we sketch how two simple sentences are interpreted. (Consult the appendix for formal details.) We assume that all terms (definite and indefinite descriptions, proper names, pronouns and demonstratives) set up subjects, or refer back to them, and in order to indicate which subject they relate to, they are subscripted by variables. Thus, a sentence like (1) is, roughly, interpreted as information aggregate (2) (with $X = \{x, y\}$):

(1) A$_x$ man walks in the$_y$ park.

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

Example (3) is associated with an aggregate like (4) (with $X = \{x, z, u, w\}$):

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

(4) $\{g \in D^{X_v}_W \mid g(x)$ *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 the aggregates (2) and (4) are themselves taken to represent the information content of the examples (1) and (3), they are not obtained by applying some 'update function' to a previously given state. Of course, the anaphoric subjects u and w in aggregate (4) must be 'resolved' in the context somehow. In the appendix we show how such a resolution can be accommodated in a static system of interpretation of the kind envisaged here.

Although our aggregates (2) and (4) are not the interpretations standardly associated with sentences like (1) and (3), the *type* of interpretation *is* standard. They are sets of variable assignments 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 find abstraction over the possible

5. We want to distinguish any two aggregates which contain information about different sets of variables, $\emptyset \in \Sigma^X$ and $\emptyset \in \Sigma^Y$ for any $X \neq Y$. We therefore stipulate, for any X, that there is one empty set $\emptyset^X \in \Sigma^X$ the domain $d(\emptyset^X)$ of which is X.

values of free variables (pronominal NPs), but also over that of 'bound' ones (definite and indefinite ascriptions alike). As a matter of fact, all noun phrases in (1) and (3) are interpreted as free variables in some sense.

This way of putting things deliberately complies with 'Lewis' philosophy' (Lewis 1975), according to which indefinites really behave like 'free' variables. The (pre-dynamic) motivation for this view stems from the analysis of examples like (5):

(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.' Notice, however, that, although adverbs of quantification may bind indefinites, they don't have any grip on really free variables. Consider example (6):

(6) Leslie is a real night-owl. When he has been in a foreign city for only a couple of days, he has usually tried out all local bars.

On no intuitive reading of this example the adverb 'usually' binds the pronoun 'he'. Clearly, indefinites, which can only be bound (semantically) by adverbial quantifiers or by a negation operator, are to be kept distinct from free variables such as pronouns (variables, traces), which are syntactically bound by natural language determiners, *wh*-elements, etc.

Without pushing the matter here, it should be clear that if we choose to treat indefinite noun phrases like free variables, we have to distinguish these from the ones associated with pronouns. In order to make such a distinction between a set of 'free' variables, and a set of really free variables, we can cash out the fairly standard assumption that we have an enumeration of our variables. We can set the odd and the even numbered ones apart, and split the set of variables V into a set of free variables $\{x_{2i+1} \in V \mid i \in \mathcal{N}\}$, and a set of 'free' (= binding) variables $\{x_{2i} \in V \mid i \in \mathcal{N}\}$.[6] The appendix provides more details.

2 Aboutness and Information Exchange

Information aggregates normally don't exist on their own. The information which agents have about subjects may derive from information other agents have about (corresponding) subjects, e.g., through games of linguistic information exchange. Moreover, of course, agents may have information about individuals which they are or have been acquainted with. Subjects, in other words, figure in a world wide web of meaningful relationships. Subjects from some aggregates can be seen to stem from those of others, and other subjects can be directly linked to individuals out there in the hard and fast world.

In this section we take a closer look at these kinds of relationships, and see how they motivate a general assumption that all subjects eventually ought to relate to very specific individuals in the world. The idea is that the subjects of

6. In (Montague 1974) such a distinction is made between two classes of variables (of type $\langle s, e\rangle$) for similar techno-philosophical reasons. Herman Hendriks aptly observed this, as well as the connection with the interpretation of anaphora (Hendriks 1993, Ch. 1, fn. 5 and fn. 20).

agents really do represent real individuals to them—their 'roots', or 'sources'—even though the agents may fail to know which these sources exactly are.[7]

Since an aggregate may use any set of variables to name its subjects, we can only sensibly compare the contents of two aggregates with respect to a function l linking up (the labels of) the subjects of one information aggregate with (those of) the subjects of the other. So, if we want to say when one aggregate $\sigma \in \Sigma^X$ supports (the information in) another aggregate $\tau \in \Sigma^Y$, we need a function linking the subjects of τ to those of σ. Let l be a function from the domain of τ to that of σ (i.e., $l \in X^Y$; recall that, for an aggregate σ, the domain $d(\sigma)$ of $\sigma \in \Sigma^X$ is X.) Then:

Definition 2 (Support) σ supports τ wrt l, $\sigma \sqsubseteq_l \tau$, iff $\forall g \in \sigma\ \exists h \in \tau$: $g \equiv_l h$ (with $g \equiv_l h$ iff $g(v) = h(v)$ and $\forall y \in d(\tau)$: $g(l(y)) = h(y)$)

An aggregate σ supports τ under l iff every possibility in σ corresponds to one in τ which is identical under the linking function l. If σ supports τ under l, then for all subjects $y_1, \ldots, y_j$ in τ there must be subjects $l(y_1), \ldots, l(y_j)$ in σ such that σ contains more information about $l(y_1), \ldots, l(y_j)$ then τ about $y_1, \ldots, y_j$. Thus, σ supports τ iff σ contains *at least as much* information about *at least as many* subjects as τ.

The notion of support 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, simply because they use different names (variables) for corresponding subjects.

We mentioned above that subjects are generally assumed to be rooted in real individuals. How can this be, if subjects have arisen from discourse and conversation? Of course, if the subjects of the agents who raised them were rooted in reality, then so may be the ones they raised in the aggregates of other agents. It appears that, for this reason, there is a general principle that agents should 'not make up subjects': agents should only raise subjects in discourse which are rooted in subjects of their own.

As a matter of fact, we here hit at a (first order) extension of Grice' maxim of quality, which has it that one should not say that for which one lacks adequate evidence. What evidence can be said to support an agent e's dressing a number of discourse subjects with certain attributes? We claim that a corresponding number of subjects in the aggregate σ_e of the dressman e, which are dressed with (at least) these attributes in σ_e, licenses what e says:

Definition 3 (Licensing) σ licenses ϕ under l iff $\sigma \sqsubseteq_l [\![\phi]\!]$

If σ_e licenses ϕ under l, then the roots of subjects raised by ϕ can be said to be

7. This has not always been the idea behind subjects or 'discourse referents'. They have been conceived of as partial objects per se, by me, for instance. They have also been considered to be mere remnants of the noun phrases which have introduced them (cf. Heim 1989; Groenendijk et al. 1995). The outlook upon subjects expressed in this paper has its roots in (Chastain 1975; Donnellan 1978; Evans 1982), and in a more dynamic setting in (Kadmon 1987; Kamp 1990). For further motivation see (van Rooy 1997; Zimmermann 1998; Dekker 1999).

the roots, if any, of the corresponding subjects of σ_e.

The requirement that an agent's utterances should be licensed by her information aggregate, helps to account for a number of puzzling facts about anaphoric cross-reference. We consider one example, others can be found in (Dekker 1999). Suppose that two men, Rod and Roger, visited A's office yesterday, and that both inquired after the secretary's office. Suppose, furthermore, that only Rod was smoking smelly pipe tobacco. Now 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 true or 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' (7+9). But it would not be true *of* the man which 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 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 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!

Like we said above, subjects do not arise only in discourse (by gossip, for instance), they also show up by walking into your room, so to speak. Through the channels of perception, representatives of real individuals may show up in the aggregates of the perceiving agents, and in such cases of direct acquaintance we deem it an objective fact that the raised (and often identified) subjects represent the perceived real individual. These factual aboutness relations, can be modeled on a par with *DRT*'s anchoring functions. An anchoring function a simply is a (partial) function from the subjects of an agent e's aggregate σ_e to individuals in e's world. The idea is that a determines which of e's subjects actually represent, or relate to, which individuals.

With reference to such anchoring functions we can study the information which agents have about real individuals. An anchoring relation can be used to characterize the information (Quine 1956)'s Ralph has concerning an individual, known to him (i) as a suspectly 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 subject Ralph believes to be a spy, the second one, which is constructed from hear-say and watch-television, Ralph believes not to be a 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.

Let us conclude this section by summing up what we have established so far. In the preceding section we have presented a notion of information 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, by relating it to the world in which the agents live, and where they extract and exchange information about individuals in their surroundings. What we call the 'subjects of information aggregates' can be conceived of as the holes through which information about real individual is transmitted in the game of information exchange.

Of course, what we have provided in this section may strike one as quite marginal if one's aim is an overall and empirically as well as philosophically sound theory of aboutness.[8] However, such has not been our aim here. Although we do believe that a theory of the kind mentioned should at least accommodate some of the concepts and distinctions which we have sketched here, our aim has been no more than to present and motivate some fundamental tools which have been developed in systems of dynamic semantics, and which we want to apply in the next sections.

3 On Denoting Descriptions

We now turn to the issue of descriptions. The analysis of definite descriptions which we take as our point of departure in this paper is that of Russell. Russell's analysis (originally from Russell 1905) 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 rephrased as:

(12) $(\iota x\phi x)(\psi x) = \exists x(\forall y(\phi y \leftrightarrow y = x) \wedge \psi x)$

In more colloquial terms, a sentence *The F is G* on Russell's analysis can be said to assert three things: that there is at most one F, that there is at least one F, and that that F is G. Upon this 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*, but it also asserts the existence of such an individual.

Russell's analysis is applied to a couple of epistemological and analytical puzzles 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. We quickly review some results.

The most famous application probably involves the king of France:

8. See, among many others, the work of Boër and Lycan, 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.

(13) The present king of France is bald.

If France is not a monarchy when example (13) is evaluated, the sentence is false upon Russell's analysis instead of just deviant, as it would be in, e.g., Frege's theory.[9] A more interesting example is the following. If A and B do not differ, one can very well say "The difference between A and B does not exist," without thereby predicating non-existence of some presupposed difference between A and B (as, e.g., Meinong would have had it).

Russell's analysis also applies to two epistemological issues. Firstly, if George IV wished to know whether Scott was the author of *Waverley*, and if in fact Scott *was* the author of *Waverley*, does this mean George IV wished to know whether Scott was Scott? Obviously not, and Russell's analysis of *the author of Waverley* as a non-referring expression may explain why. Secondly, Russell's analysis may explain how we can make statements and form beliefs about 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 third millenium*.

Of course, Russell's analysis of definite descriptions hasn't gone unchallenged. Two major antitheses have been formulated over the years (by Peter Strawson and Keith Donnellan) both of which seemed to suffer from such an excessive amount of common sense, that proponents as well as antagonists felt safe in assuming that these attacks were completely / not at all successful.[10]

Russell's theory has been challenged on two scores: that his analysis of definite descriptions invokes overly strong uniqueness requirements, and that it fails to account for the referential use of definite descriptions. In reply to the first type of objection (Russell 1957) points to the (deemed old) observation that definite descriptions have a context-dependent interpretation. As is argued recently in (Neale 1993), this type of context-dependence does not at all seem to be specific to definite descriptions. Any one of the following examples can be understood to quantify over a restricted domain of individuals, for instance the individuals in (one part of) a certain room:

(14) { The / Every } table is covered with books.
{ Most / No } tables are covered with books.

For this reason we will henceforth, silently, assume some pragmatic mechanism which serves to restrict natural language quantifiers to appropriate domains of quantification.[11]

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9. In (Frege 1892) definite descriptions are conceived of as compound proper names, the use of which *presupposes* reference. The possibility that such a presupposition is not fulfilled, is called an "Unvolkommenheit der Sprache."

10. Cf., e.g., Russell's (belated) reaction to the first attack by Strawson: "The main purpose of the article [Strawson 1950, 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)

11. Simply observing that the explicit restrictions on quantifying noun phrases should be understood to be contextually restricted themselves, is not the same as offering an analysis of course, and we do not offer one here. Let us suffice with pointing out that such mechanisms can be of various kinds. They may consist of contextually restricted quantification (Westerståhl 1984), possibly related to the dynamics of interpretation (Groenendijk et al. 1995); it

The second objection to Russell's theory hasn't lost much of its force, however. In the aforementioned paper, Strawson appeals to the intuition that definite descriptions are used to refer, and it is not immediately clear how one can account for that intuition upon a Russellian analysis.[12] This referential use of definite descriptions also plays a key role in a couple of papers by Keith Donnellan, the first one of which is (Donnellan 1966).

Donnellan argues that a definite description does not only have an attributive (Russellian) reading but also a referential one. Under a referential interpretation, the speaker "uses the description to enable his audience to pick out whom or what he is talking about and he states something about that person or thing." (p. 285) Such a referential use of a definite description can be illustrated by means of the following example from (Geach 1962):[13]

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

Example (15) can be used to make a claim about a particular person—that he has just been made full professor—which is identified by means of the definite description "the fat old humbug we saw yesterday."

Donnellan's analysis significantly differs from Russell's when it comes to referentially used misdescriptions. Thus, even if a person who utters (15) and her addressee didn't meet a fat old humbug the day before the utterance was made, the addressee 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. For this reason the addressee might reply in the way suggested by (Donnellan 1978, p. 54):

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

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 (15) can be used to get an addressee accept a proposition about a person who, maybe, is not a fat old humbug after all.

Donnellan's views, and related insights, have been criticized 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)

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may employ suppletion of 'elided' (syntactic) material (Ludlow and Neale 1991; Neale 1993), bridging (van Deemter 1992; Geurts 1995) or other 'primary' pragmatic processes (Recanati 1996).

12. The much less widely known (Strawson 1964) presents a much more sophisticated view of the matter; we will return to that paper in due course.

13. Geach himself qualifies the kind of 'reference' at issue as "of negligible importance for logic." He mentions it "only to get it out of the way" (Geach 1962, 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 (15) 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 (15) is used to say something about an individual who is not a fat old humbug, there still is something very wrong with the sentence.

In the second place, as for instance Kripke has argued, even if one can utter (15) 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, pragmatic analyses of Donnellan's observations have been proposed. The idea behind these 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, that of linguistic meaning. Donnellan's observations, on the other hand, should be accounted for in 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.

4 Reference and Specificity

Neale (e.g., Neale 1993, p. 89) has presented an analysis by means of 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. This analysis invokes a Gricean style of reasoning involving the contemplation of the various reasons and intentions which a speaker may have inspired to utter precisely what she uttered. As it is stated, however, the reasoning explicitly refers to the specific expressions which a speaker has used, and, thus, it can be conceived of as a re-analysis or re-valuation of the uttered sentence, not just of its meaning.

In this section (and the following one) we propose an alternative way of reconciling a Russellian analysis of the meaning of definite descriptions with a referential understanding of them. Key to our analysis is the use of information aggregates as the meanings of sentences, and a pragmatic partition of the meanings of sentences in what we call a background- and an assertion-part.

As the reader may remember from the first two sections of this paper, our we take definite (and indefinite) expressions to show up as subjects in the information aggregates associated with the sentences in which the expressions occur. These expressions are labeled by variables in these information aggregates and are fully re-addressable, or accessible. In this setting, one can obtain a referential interpretation of a definite description by specifying a value for the corresponding subject.

In order to be more specific, let us consider a slightly modified example adopted from Donnellan. Two agents, who are partaking in some social event, are both gazing at a group of small-talkers. 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. Our protagonist says:

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

Neglecting the ways in which the domain of quantification can be restricted, the contents of the utterance are given by the following information aggregate:

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

('*MWM*' is short for 'man with a martini', and '*SWS*' for 'sells wooden shoes'.)

Assuming that the utterance of (17) is licensed by the speaker's information aggregate, the speaker must have somebody in mind—a subject of her information aggregate—whom she refers to with the definite description. Moreover, in the described situation it is most likely that the speaker has this man with the long-drink glass in mind, which we know as Mr. Carotti. Partly on the basis of this information, we may conclude that the information aggregate (18) associated with (17) relates to this man.

This kind of contextual information, that the value of x is c, Mr. Carotti, is easily integrated with the information in the aggregate associated with (17):

(19) $\{g \in D_W^{\{x\}_v} \mid g(x) = c\} \cap (18) \;=$
$\{g \in D_W^{\{x\}_v} \mid g(x) = c \;\&\; g(x) \text{ is the } MWM \text{ in } g(v) \;\&\; g(x)\ SWS \text{ in } g(v)\}$

This, then, is the referential interpretation of example (17).

Two things may have to be observed about the sketched analysis. Firstly aggregate (19) is obtained from the meaning (18) of example (17) by a purely semantic operation, not by a re-analysis of the utterance. Secondly, the additional information, that Mr. Carotti is the referent, really is contextual information, not semantic information. Saying that the utterance of (17) actually is about Mr. Carotti is justified, if the speaker, in uttering (17), had the subject in mind which presents Mr. Carotti to her. It can hardly be a matter of the meaning of sentence (17) that somebody who utters it is not thinking of a person different from Mr. Carotti.

We have seen how someone who utters example (17) 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. Thus, the utterance may be making false claims about him. It may very well be that Mr. Carotti does not sell wooden shoes in the actual world, but that he earns a living by importing Limburger cheese instead, or, contrary to what the speaker has been thinking, he may be sipping from a long-drink, not a martini. Clearly, this comes out fine on our analysis, since, in such cases, the actual world will not be a possible value of the variable v in aggregate (19).

However, our analysis so far fails to account for one important thing which Donnellan's seems to give a natural account of. For suppose that Mr. Carotti is, indeed, trading wooden shoes, but also that, contrary to what the speaker thinks, he is having a long-drink, and not a martini. On both Donnellan's analysis and ours, an utterance can still be construed as being about Mr. Carotti. However, on Donnellan's analysis the speaker can be seen to have said something true of Mr. Carotti, viz., that he sells wooden shoes. Our analysis, as it stands, only allows us to say that he has uttered a false proposition: that he is a man with a martini who sells wooden shoes. We will come back to this issue in the next section. We first take a look at the specific use of indefinite descriptions.

In addition to referential interpretations of definite descriptions, so-called 'specific' interpretations of indefinite descriptions have been identified, and these can be analyzed in a parallel fashion.[14] The following example is a slightly adapted version of one due to (Kasher and Gabbay 1976):

(20) A painting is missing from the museum.

This sentence can be uttered by someone who just discovered that, for instance, *Who's afraid of Red, Yellow and Blue II* (painted by Daniel Goldreyer) has been taken away from the museum. The speaker may utter (20) with reference to (his subject presenting) this painting, and in that case one can—but need not!—construe the utterance as being about the mentioned painting.

The contents of (20) are given by an aggregate like (21) ('P' and 'MFM, abbreviate 'picture' and 'is missing from the museum,' respectively):

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

This aggregate can be related to *Who's afraid of Red, Yellow and Blue II*, or $w2$, for short, by adding that that's the value of z. This gives us the specific interpretation of example (20):

(22) $\{g \in D_W^{\{z\}_v} \mid g(z) = w2\} \cap (21) \ =$
$\{g \in D_W^{\{z\}_v} \mid g(z) = w2 \text{ and } g(z) \text{ is a } P \text{ in } g(v) \text{ and } g(z)\ MFM \text{ in } g(z)\}$

Notice that the specific interpretation of an indefinite description, like the referential interpretation of a definite one above, is obtained, not by a syntactic or semantic reconstruction of the indefinite, but by the mere addition of contextually available information.[15]

It may not have escaped the reader that agents may use indefinites in non-specific ways, when they can be said not to know which objects are at issue. For instance, suppose a guard in the control room of the museum sees an alarm blinking, and suppose that the alarm signals that some painting has been removed. Clearly the guard may use (20) in her report to the police, without being able to indicate *which* picture actually is missing. Doesn't this contradict our licensing principle, which requires our agents to know what they are talking about?

As a matter of fact it does not, because the guard does refer to a definite object. She is referring to the painting the supposed removal of which has caused

14. We will not go into the (non-)scopal properties of specific indefinites in this paper.
15. Thus, our analysis goes against, e.g., (Donnellan 1978; Kasher and Gabbay 1976; Partee 1972; Fodor and Sag 1982), and is in line with, e.g., (Kripke 1979; Klein 1979; Groenendijk and Stokhof 1980; Ludlow and Neale 1991) .

the alarm to go off. If, in fact, the removal of one painting caused the alarm to go off, all speculation between her and the police about 'the missing painting' is appropriately construed as being about that painting.[16] The fact that the guard, at the same time, can be said not to know which picture is missing, apparently relates to the different perspectives which she may have on the paintings. Although the guard may know the title and (normal) location of each individual painting, including the title and (normal) location of the missing one, she does not know the name of the missing one, in the sense that she doesn't know that *that* one is missing.[17]

The specific use of indefinites gives rises to Donnellan-style situations, too. Consider the following dialogue between two boys sitting on a park bench:

(23) *Nic*: A man is trying to push that oak down!
(24) *Leo*: It is a woman, but she is indeed trying to push that oak out of her way!

Although Leo here does not agree with the proposition which Nic uttered, he feels justified, apparently, in understanding it as a proposition about an individual in their visual field. This is a true Donnellan situation since, it seems, the speaker manages to refer to a person by means of an indefinite description which does not really apply to that person.

As a matter of fact, an interlocutor may object to both the verbal predicate(s) and the descriptions which a speaker uses. Consider the following alternative reply by Leo:

(23) *Nic*: A man is trying to push that oak down!
(24′) *Leo*: It is a woman, and she is a jogger, stretching her hamstrings. Besides, it is a birch.

As long as Leo can be taken to talk about the same individual Nic started about, there doesn't seem to be anything wrong with such a reply.

5 Descriptions, Focus, and Ground

As we have seen in the preceding section, with a domain of information aggregates as the domain of sentence meanings, it is pretty straightforward to construe referential readings of definite descriptions and specific readings of indefinite ones. By linking subjects of propositions to individuals in the outside world, the propositions can be construed as being about these individuals. Information aggregates display just the kind of structure that enable us to do precisely this.

However, we have also seen that there is one thing we could not account for without further ado. We can account for the cases in which an agent utters a true proposition about a certain individual, we can account for those in which she utters a false proposition about that individual, but, so far, we cannot

16. If it turns out that none are missing, or more than one, clearly, the guard and the police will have to adjust their assumptions concerning this subject.
17. For recent approaches to the issue of 'knowing-who' within the context of a dynamic or epistemic semantics, cf., e.g., (Aloni 1997; Gerbrandy 1997).

account for the cases in which she can be said to have uttered a true proposition about an individual and to have misdescribed him, all of this in one go.

We do not, however, think that this is a defect of our analysis of definite descriptions. Precisely the same observations can be made about indefinite descriptions and proper names, as Kripke acutely observed. It seems that no analysis of a particular category of expressions, be it a semantic or a pragmatic analysis, will put us on the right track. Instead, we would like to take the observation at face value that the problematic utterances convey both something which is right and something which is wrong. We take this to suggest that the proposition which is expressed is (or can be or should be) construed as being composed of two or more component parts.

This tentative observation can be fleshed out by drawing from theories of information structure, and accommodating a distinction between presupposition (or background, or implicature, ...) on the one hand and assertion (or focus, or extension, etc.) on the other.[18] In this section we opt for a division of propositions into what we call a 'background' and an 'assertion'.[19] We here assume a Karttunen and Peters-style analysis of the compositional derivation of such background-assertion structures.

Syntactic and prosodic clues, in conjunction with contextual and subjective factors, guide (or constrain) the interlocutors in constructing background-assertion structures as the (structured) denotations of sentences and utterances. Formally, these structures are represented as constructs of the form (B/A), where both B and A are formulas. Semantically, they are associated with pairs of information aggregates $\langle [\![B]\!], [\![A]\!] \rangle$. Such a construct (B/A) must be understood as follows. The background B must be 'appropriately connected' with the context for a statement to be felicitous. If it is, the statement is true if A is true, the statement is false otherwise.[20]

Now consider the following examples, with associated analyses:[21]

(25) The king of FRANCE visited the exhibition yesterday.
$(\exists x VTEx / KOFx)$

(26) The king of France visited the EXHIBITION yesterday.
$(\exists x KOFx / VTEx)$

Upon an analysis along the lines sketched, example (25) presupposes that the exhibition was visited by someone (in a sense to be made precise elsewhere), and

18. Original and motivating ideas behind such a distinction can be found in (Jackendoff 1972, Ch. 6, linguistic), (Stalnaker 1974; Stalnaker 1978, philosophical), (Karttunen and Peters 1979, Montagovian), (Rooth 1985; Rooth 1992, focus), and (Vallduví 1992, discourse). It can be said to be anticipated by the early and underestimated (Strawson 1964). Strawson seems to have been the first to observe that a term presupposes reference (only) if the term is 'topical'.

19. We realize that more intricate divisions and classifications are needed, and have been made, and that the interaction between assertion and background and between background and context is much more involved than we can account for in the present context.

20. What it means for a background to be 'appropriately connected' with the context can be spelled out in a variety ways: truth, definiteness, familiarity, binding or resolution, ... We will not commit ourselves to any specific implementation of the notion in this paper.

21. In both examples the free variable x in the assertion must be matched with the existentially quantified variable in the background; a more sophisticated way of resolving free variables can be found in the appendix.

example (26) presupposes that there is a (definite, familiar, ...) king of France. Assuming that France does not have a king, and assuming that somebody did visit the exhibition yesterday, an utterance of (26) turns out to be infelicitous, and an utterance of (25) false (upon the indicated interpretations).[22]

This seems to be an appropriate place to elucidate our choice for a Karttunen and Peters-style approach to information structure, or, rather, to explain why we didn't eschew this approach. Karttunen and Peters analysis of presupposition (or of 'implicature' as they themselves called it) faced a problem which has been deemed 'killing'. Consider Karttunen and Peters' own example (27):

(27) Somebody managed to succeed George V on the throne of England.

According to Karttunen and Peters' theory, this sentence presupposes that someone had a hard time trying to succeed George V, and it asserts that someone did succeed George V. Thus, they fail to account for the intuition that the one who is said to have succeeded George V is the same person as the one who is somehow presupposed to have had a hard time doing that.[23] We hold that this so-called 'binding problem' should not be seen as a real problem nowadays.

Example (27) can be seen to presuppose that someone had a hard time succeeding George V, and to assert that *(s)he* did succeed George V.[24] Phrased thus, an example like (27) only requires an account of anaphoric binding between presupposition and assertion, not an alternative theory of presupposition, or a modification of it. Since we have accounts of anaphoric binding at our disposal nowadays (both dynamic and static ones, cf., e.g., the appendix), example (27) is fully harmless now.

Let us now return to the cases of Donnellan which troubled us. Consider once more example (17), under the assumption that the definite description "the man with a martini" relates to Mr. Carotti who, as a matter of fact, is *not* drinking a martini:

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

With the tools now available the utterance can be analyzed as:

(28) $(\exists! x MWMx / SWSx)$

and, thus, it is associated with the following pair $\langle [\![B]\!], [\![A]\!] \rangle$ of aggregates:

(29) $[\![B]\!] = \{g \in D_W^{\{x\}_v} \mid g(x) \text{ is the } MWM \text{ in } g(v)\}$
$[\![A]\!] = \{g \in D_W^{\{x\}_v} \mid g(x)\ SWS \text{ in } g(v)\}$

In the circumstances sketched, $[\![B]\!]$ is an ordinary information aggregate, which may cover the actual world, although it will not include an assignment with the

22. Similarly, in reply to the question "Who visited the exhibition yesterday?" the answer "The king of France did." is false, intuitively speaking, while a statement like "As for the king of France, he visited the exhibition yesterday." is pointless, intuitively speaking.

23. For many, it seems, this problem has meant the death warrant for a Karttunen and Peters-style theory of presupposition, and all kinds of dynamic or discourse representational alternatives have been developed afterwards, some of which relate back to earlier work by Karttunen.

24. Given our analysis of the use of indefinite expressions, the example can just as well be seen to assert that someone succeeded George V, and to presuppose that *(s)he* had a hard time doing so.

actual world as a value of v and Mr. Carotti as a value of x.[25] Nevertheless, the context still may provide good reasons for construing an utterance of (17) as being about Mr. Carotti.

The background $[\![B]\!]$ can be understood to be about Mr. Carotti by linking its subject x to this man. It is easily seen that this yields a factually false proposition. Understood thus, the example is infelicitous, because the background cannot connect up with the context in an appropriate way. However, the subject x in the assertion will be linked to the very same man, and in that case the assertion $[\![A]\!]$ is also understood to be about Mr. Carotti. In the given circumstances, this yields a true proposition about Mr. Carotti.

We see that, on the present analysis, an utterance of example (17) can be seen to be about a contextually determined individual c, and it can be seen to express both something true of c—viz., that he sells wooden shoes—as well as something false—viz., that he is having a martini. All that we need to account for this situation is (i) the notion of an information aggregate, which enables us to readdress the subjects of propositions, and (ii) some bi-partition of propositions into a focal and a ground part.

The examples involving indefinite descriptions, (23–24) and (23–24′), can be analyzed in a similar fashion.

(23) *Nic*: A man is trying to push that oak down!
(24) *Leo*: It is a woman, but she is indeed trying to push that oak out of her way!
(24′) *Leo*: It is a woman, and she is a jogger, stretching her hamstrings. Besides, the tree is a birch.

The utterances (24) and (24′) indicate that Leo renders Nic's utterance as something like the schematic structure (30):

(30) $(\exists x \exists y(Mx \wedge Oy)/TPxy)$

As appears from (24), Leo relates the pair of aggregates (30) to two objects, a person and a tree, and takes Nic to assert that the first is trying to push the second down. He agrees with the assertion, although he objects against the characterization of the person as a man. Also in the case of (24′), Leo relates (30) to a person and a tree, but this time he objects to everything which Nic says of the two: that the person is a man, that the tree is an oak, and that the first is trying to push the second down.[26]

25. The utterance can be understood to be about the man, whoever he is, who is the one and only man in the domain of quantification who has a martini, and to be saying of that man that he sells wooden shoes. This type of reference (Kripke 1979) calls 'semantic reference'.
26. In both cases we have construed the background as involving two objects, about which the mentioned predications are asserted. Alternatively, it seems reasonable to construe the utterance as being about a (perceived) situation. However, upon such an analysis it is not at all clear how to analyze the pronouns in Leo's replies. As Friederike Moltmann has observed, an E-type analysis certainly wouldn't do the job, since it would render Leo's reply two-way contradictory:

(31) A man who is a woman, is stretching his strings against an oak which is a birch.

Discussion

in this paper we have proposed an analysis of referential readings of definite and indefinite descriptions, basically employing a notion of information which is taken from systems of dynamic semantics. That notion of information, which is used to model both the content of sentences as well as that of the epistemic states of linguistic agents, displays precisely the type of structure relevant for the construal of referential interpretations in a non-ad hoc way.

The analysis has next been extended with a Karttunen and Peters-style approach to backgrounds and assertions. Such a bi-partition has enabled a complete account of the observations made by Donnellan and others about situations in which specific individuals are characterized both wrongly and rightly by one and the same proposition. Propositions can be seen to involve true assertions about individuals also when these individuals are not identified appropriately. Here, too, the dynamic semantic notion of information plays a key role.

The gist of our analysis can be reduced to two points. First, when somebody says that the so-and-so is bla-bla-bla, somebody else may have good reasons to conclude that *he*, the so-and-so, is Mr. such-and-such. Dynamic semantic information aggregates can be used to explain what the anaphor *he* amounts to, semantically, and, thus, explain what the referential reading of the utterance boils down to.

Secondly, a Russellian analysis of 'the so-and-so is bla-bla-bla' can be deconstructed, in an, equivalent, Karttunen and Peters-style construct:

(32) There is *one* so-and-so and *(s)he* is bla-bla-bla.

Again, the dynamic semantic notion of information can be called upon to establish the (co-)referential connection between the two conjuncts. Notice that these two conjuncts correspond to the two components of the assertion which Donnellan might have liked to associate with an utterance of the sentence. Thus, Russell's analysis is reconciled with Donnellan's observations.

By now we have a relatively satisfactory analysis of the cases discussed by Donnellan, and a couple more, and the question that arises is which analysis is to be preferred. As the reader may have guessed, we tend to side with Kripke and Grice, and to opt for *not* positing an ambiguity between referential and attributive uses of definite (and indefinite) descriptions. The cases discussed by Donnellan can be accounted for by means of general interpretative principles, which, besides genuinely semantic rules, include mechanisms governing resolution (speaker's reference), and principles controlling the management of information structure (grounding and assertion). Of course, such theoretical considerations hardly ever tend to be decisive, but we think there is also an empirical pay-off.

In the first place, our proposal seems to be more flexible than Donnellan's. According to Donnellan, the content of a simple sentence is divided up in (non-asserted) material expressed by a referentially used definite description, and asserted material in the remainder. Now consider Geach's example (15) with Donnellan's reply (16):

(15) *Peter*: The fat old humbug we saw yesterday has just been made full professor!
(16) *Keith*: I don't think he's fat; he's just large boned. And as for his being a humbug, he seemed quite genuine and aboveboard.

An utterance of (16) can be seen to object to two attributions example (15) makes to the new professor under discussion: 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.[27] However, notice that this distinction between what is denied and what is left unobjected, cuts right through Donnellan's distinction between what is and what is not asserted. Of course, Peter may have wanted only to assert that the man, which he referred to as "the fat old humbug we saw yesterday," has been made full professor, but Keith is free not to construe Peter's utterance that way, and not to bother about who has and who has not been made full professor. Keith is concerned with the denigrating descriptions Peter used to refer to the new professor.

In the second place, our analysis is much more general. It automatically generalizes to the specific uses of indefinite descriptions and referential uses of proper names as well. (Actually, this point has first been made in Kripke 1979.) These other terms, too, license Donnellan-style situations. The sequence (23–24) may bear witness of that in relation to indefinite descriptions, and a case which involves proper names can be situated at the social event where we first met Mr. Carotti.

Suppose one of the acquaintances of our interlocutors has joined the group of Mr. Carotti, and is overacting in an embarrassing way. Suppose one of our friends opens with (33), and that he is immediately corrected by the other:

(33) *One*: Pete is behaving outrageously tonight.
(34) *The Other*: It's Karl, by the way, but he is indeed shameful.

The situation is entirely similar to the one in which a definite description was used, and it can be handled by the same principles we invoked for the previous cases. As Kripke had already pointed out, if an analysis along Donnellan's lines were to cover cases like this, too, then it would have to posit yet another ambiguity, for proper names this time.

In the third and last place, our analysis also seems to give us a handle on the notoriously problematic negative existential statements (cf., e.g., Stalnaker 1978, for some discussion). Russell's analysis may have accounted for negative existentials involving definite descriptions, but, so far, it has remained unclear what to do with negative existentials involving names, like (35):

(35) Pegasus does not exist.

We think we can come to (some) grips with such statements if we proceed along the following lines.

Firstly, of course, we have to extend our (formal) language with proper names (individual constants). Secondly, we assume that these names may fail to have a denotation in some worlds, so the interpretation of names is a partial

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

function. Thirdly, however, the interpretation of (atomic) formulas remains *total*.[28] Finally, and as we had already assumed above, infelicity only shows up when the interlocutors (fail to) connect up backgrounds with the context in an appropriate way.

Example (35) can now be read in two ways. It can be read as an all focus sentence, thus giving rise to a structure like (36), or Pegasus may be assumed to figure in the background (as a topic), thus yielding a structure like (37):

(36) $(\top / \neg\exists x(pegasus = x))$
(37) $(\exists x(pegasus = x) / \neg\exists y(x = y))$

The first (36) is always felicitous, and it is true in worlds where 'pegasus' has a denotation, false in all the others. The second is felicitous only in worlds where 'pegasus' has a denotation (or contexts where it is known to have one), and it asserts of that denotation that it does not exist—which is absurd, of course.

The upshot of this discussion is in line with the ideas from (Strawson 1964). Names may fail to have a denotation, but that does not by itself induce infelicity, or undefinedness. However, an improper use of backgrounds does, and a certain way of making backgrounds improper is to use non-referring names topically.

To conclude this section, and this paper, we would like to point out that the following situation also completely complies with the main ideas and observations proposed here. Suppose that one of our agents utters (35) with, of course, an intended interpretation as given by (36) (because the other one is absurd). Then, if one of his interlocutors doesn't agree, she may construe the utterance as in (37). This construal licenses her to continue with a pronoun, and utter, for instance, (38):

(35) Pegasus does not exist. (36 $\top / \neg\exists x(pegasus = x)$)
(38) (37 $\exists x(pegasus = x) / \neg\exists y(x = y)$) Oh yes, he does. He is flying over the pampas of Patagonia these days.

In order to make sense of both propositions, we may have to acknowledge that the two interlocutors fully sensibly construe one and the same utterance of (35) in two different ways.

Appendix

In this appendix we want to back up some claims underlying the main ideas of this paper. First we will show how the sentences of a formal first order language can be interpreted in terms of information aggregates using a *static* system of interpretation. After that we will show how singular anaphora can be dealt with, by adding a *resolver* to this little system. Such a resolver determines which of the free variables of one aggregate are bound by which 'free' (= binding) variables of the other, when the two are combined in a conjunction.

28. So we say that an atomic formula $Rt_1 \dots t_n$ is satisfied relative to a model M and an assignment g if and only if the interpretation $[t_i]_{M,g(v),g}$ of any term t_i is defined and $[t_1]_{M,g(v),g}, \dots, [t_n]_{M,g(v),g}$ stand in the relation R in $g(v)$ in M. Thus, a sentence 'Pegasus walks.' is deemed false, and its negation 'It is not true that Pegasus walks.' is deemed true.

The assumption that such a resolver can be taken for granted is adopted in virtually all theories of dynamic semantics; the fact that the resolver constitutes a separate module of the system of interpretation itself, 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' behavior of indefinite noun phrases in natural language. These phrases are seen to behave like 'free' variables, but they should not be treated on a par with really free variables.[29] In a formal setting this requires us to make a distinction between free and 'free' (= existentially quantified, or 'binding') variables. Following Montague (as observed by Hendriks) we formally distinguish the set of really free variables $F = \{x_{2i+1} \in V \mid i \in \mathcal{N}\}$ from the set of 'free' (= binding) variables $B = \{x_{2i} \in V \mid i \in \mathcal{N}\}$.

The language of our toy formal system PL^i is like that of ordinary predicate logic PL^0 except for the fact that this explicit distinction between free and binding variables is hard-wired into the syntax. Characteristic clauses are:

(39) 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 binding variable, and y is a free variable, then $\exists x_y \psi$ is a formula

The variables of an atomic formula are literally *free* variables. In a quantified formula $\exists x_y \phi$ the quantifier $\exists$ comes with a binding variable x, which binds all occurrences of a free variable y in the formula ϕ in the scope of the quantifier.

Aggregates and Domains PL^i formulas are interpreted as information aggregates. For the purposes of this appendix we may skip all distinctions which can be made between different possible worlds, and, for the sake of simplicity, keep to standard extensional first order models. Thus, for any set of variables X:

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

For an aggregate $s \in S^X$, we will use $d(s)$ to refer to the domain X of s. We furthermore assume that the aggregates associated with formulas range over all free variables in F. Thus, the domain $d(\phi)$ of (the aggregate associated with) a formula ϕ can be defined such that: $d(Ry_1 \ldots y_n) = d(\neg\phi) = F$, $d(\exists x_y \phi) = \{x\} \cup d(\phi)$, and $d(\phi \wedge \psi) = d(\phi) \cup d(\psi)$. The set $b(\phi)$ of binding variables of ϕ is the set $d(\phi) \cap B$ of binding variables in the domain of ϕ.

Static Interpretation Before we turn to the definition of PL^i-interpretation, let us first fix some notation. For any relation (or function) r we use $d(r)$ for the domain $\{x \mid \exists y\colon \langle x, y\rangle \in r\}$ of r, and $r(r)$ for its range $\{y \mid \exists x\colon \langle x, y\rangle \in r\}$. For two assignments g and h, and for a set of variables X, we use $g[X]h$ to indicate that g and h differ at most in their valuation of the variables in X, that is, $\forall x \in V$: if $x \notin X$ then $g(x) = h(x)$ (or both are undefined). Furthermore, we say that r is a

29. Unlike truly free variables, they can be bound by adverbs of quantification or by a negation operator.

binding relation, if it is a relation $r \subseteq B \times F$ between bound and free variables. Each element $\langle x, y\rangle \in r$ of a binding relation r is also indicated as x_y. Finally we say that g binds h under a binding relation r, $g[r]h$, iff $d(g) = d(r) \cup d(h)$, $g[d(r) \cup r(r)]h$, and $\forall x_y \in r$: $g(x) = h(y)$.

Now we can turn to the definition of PL^i-interpretation. All references to a model are suppressed, so the (extensional) interpretation of any predicate R will be assumed to be (exhaustively specified as) $[R]$. We also suppress reference to the domains from which the information aggregates draw their assignments, so it is left implicit that for all assignments $g \in [\![\phi]\!]$: $d(g) = d(\phi)$. The definition runs as follows:

(41) $[\![Ry_1 \ldots y_n]\!] = \{g \mid \langle g(y_1), \ldots, g(y_n)\rangle \in [R]\}$
$[\![\neg\phi]\!] = \{g \mid \neg\exists h \in [\![\phi]\!]\text{: } h \supseteq g\}$
$[\![\exists x_y \psi]\!] = \{g \mid \exists h \in [\![\psi]\!]\text{: } g[\{x_y\}]h\}$
$[\![\phi \wedge \psi]\!] = \{g \mid \exists f \in [\![\phi]\!]\text{: } g \supseteq f \ \&\ \exists h \in [\![\psi]\!]\ \exists h'[b(\phi)]h\text{: } g \supseteq h'\}$

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

Comments The above definition is pretty straightforward, except, possibly, for the last two clauses. Atomic formulas are interpreted in the usual way. The negation $\neg\phi$ of a formula ϕ involves unselective binding of all the binding variables in ϕ. Thus, the interpretation of $\neg\phi$ consists of all those assignments to the free variables which have no extension in the interpretation of ϕ. In the clause dealing with an existentially quantified formula $\exists x_y \phi$ we see that the information which has ϕ about the value of the free variable y is effectively transmitted to the binding variable x.

In the case of a conjunction a choice had to be made. We could have chosen to take those assignments to the variables in the domain of ϕ and ψ which extend assignments in the interpretation of both ϕ and ψ. This would have had the effect that the values of a binding variable which figures in the domains of both ϕ and ψ get identified. We don't want this to happen, and therefore we had to decide which occurrence of the variable—if indeed any one of them—would have to contribute to the whole conjunction. According to the above definition the first 'declaration' of x wins: we don't use extensions g of h in $[\![\psi]\!]$ itself, but extensions of those assignments h' which can be obtained from h after quantifying away binding variables in ψ which are also in the domain of ϕ. Clearly, other options are available.

PL^i *and First Order Predicate Logic* The presently sketched system of PL^i does quite the right things for the purposes of the present paper. The system generates the kind of information aggregates needed for a treatment of reference and specificity along the lines sketched in section 4. Besides, it is still intimately related to ordinary first order predicate logic (PL^0). Consider a language of predicate logic built up using the relational constants from PL^i and its set F of free variables. We define the following translation $()^\flat$ from PL^i into PL^0:

(43) $(Ry_1 \ldots y_n)^\flat = Ry_1 \ldots y_n$ $\quad (\exists x_y \psi)^\flat = \exists y(\psi)^\flat$
$(\neg\phi)^\flat = \neg(\phi)^\flat$ $\quad (\phi \wedge \psi)^\flat = (\phi)^\flat \wedge (\psi)^\flat$

By induction on the construction of ϕ it can be seen that:

(44) $[\![\phi^\flat]\!]_{PL^0} = \{f \in D^F \mid \exists g \supseteq f\colon g \in [\![\phi]\!]_{PL^i}\}$

Obviously, we can as well define a translation $()^\sharp$ from PL^0 into PL^i, in which the only non-trivial clause has it that $(\exists y\phi)^\sharp = \exists x_y(\phi)^\sharp$, for an arbitrary variable $x \in B$ not used in $(\phi)^\sharp$. Then it is easily established that:

(45) $[\![\phi]\!]_{PL^0} = \{f \in D^F \mid \exists g \supseteq f\colon g \in [\![\phi^\sharp]\!]_{PL^i}\}$

Dynamic Interpretation Since the formulas of PL^i 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 (binding) variables of another. To this end we use resolvers r which we called 'binding relations' above. We assume that resolution takes place when two aggregates merge,[30] and we therefore hang the resolver as an index on the conjunction sign which initiates the resolution. So, conjunctions will now be of the form $\phi \wedge_r \psi$, where r is a resolver. The system of interpretation which uses this notion of conjunction is referred to as PL^a. Before we define the interpretation of the resolving connective, we first settle the domain of the new type of formula $\phi \wedge_r \psi$: $d(\phi \wedge_r \psi) = d(\phi) \cup d(r) \cup d(\psi)$. The interpretation is specified as follows:

(46) $[\![\phi \wedge_r \psi]\!] = \{g \mid \exists f \in [\![\phi]\!]\colon g \supseteq f \;\&\; \exists h \in [\![\psi]\!]\; \exists h'[b(\phi)]h\colon g[r]h'\}$

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, 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 is in r and y does not occur free in ψ) as well as vacuous resolution (e.g., when x_y is 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.

Finally, notice that if r is the empty relation, then $\wedge_r$ equals the interpretation associated with $\wedge$ in PL^a. This means that we are still dealing with a proper extension of ordinary predicate logic. The reader may verify for herself that, nevertheless, this extension analysis enables an account of intersentential anaphoric relationships. Consider the following conjunction:

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

The second conjunct Bce here contains two free variables, which the resolver $r = \{x_c, z_e\}$ binds to the binding variables x and z, respectively. The conjunction thus turns out to be equivalent with the following existentially closed formula:

(48) $\exists x_u(Fu \wedge \exists z_w(Dw \wedge (Ouw \wedge Buw)))$

30. Apparently, this is not the only sensible option to be considered. Many (dynamic) theories of interpretation build on the assumption that resolution takes place before that; Bart Geurts (pc) has argued that it has to take place *afterwards*.

PL^a *and Dynamic Predicate Logic* The system of PL^a enables a static treatment of intersentential anaphoric relationships, and, therefore, it is also related to dynamic predicate logic (DPL), this in a fairly straightforward way. In order to simplify the comparison, we build on three assumptions. In the first place we assume our resolvers r to correspond to partial functions from their range to their domains. This is to say that there are no pairs x_y and z_y in r such that $x \neq z$.[31] In the second place we assume that resolvers only bind free variables to binding variables which have already been declared. That is to say that for any conjunction $\phi \wedge_r \psi$, the domain $d(r)$ of the resolver r is a subset of that of ϕ.[32] In the third place we assume that binding variables are used at most once as a binder. This assumption enables us to avoid certain technical complications which are completely artificial when we look at things from the point of view of a natural language semanticist.[33] Now consider the following translation $()^\dagger$ from PL^a into DPL:

(49) $(Ry_1 \dots y_n)^\dagger = Ry_1 \dots y_n \qquad (\exists x_y \psi)^\dagger = \exists x([x/y]\psi)^\dagger$
$(\neg\phi)^\dagger \qquad = \neg(\phi)^\dagger \qquad (\phi \wedge_r \psi)^\dagger = (\phi)^\dagger \wedge ([r]\psi)^\dagger$
where $[x/y]\psi$ is ordinary substitution of x for y in ψ, and $[r]\psi$ involves the simultaneous substitution in ϕ of all x for y such that $x_y \in r$

Using $f =_X g$ to indicate that f and g agree on the valuation of all the variables in X, it can now be seen that:

(50) $[\![\phi^\dagger]\!]_{DPL} = \{\langle f, h\rangle \in (D^V)^2 \mid \exists g \in [\![\phi]\!]_{PL^a}\colon f =_F g =_{b(\phi)} h \ \&\ f[b(\phi)]h\}$

This equation may serve to show that dynamic semantic results can be obtained by a mere extension of classical predicate logic, an extension with aggregates and a resolver, that is.

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31. This is a harmless assumption, really, because any resolver which is not functional in this sense, can be replaced, in a meaning-preserving way, by one which is, simply by adding a couple of equations.

32. This, too, is a harmless assumption, because resolvers which do bind to undeclared variables can be replaced, in a meaning preserving way, by ones which don't, by adding existentially quantified formulas.

33. The interested reader is referred to (Dekker 1996; Dekker 1999) for more discussion.

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