Quantification and Contributing Objects to Thoughts*

Michael Glanzberg
University of California, Davis

In this paper, I shall explore a determiner in natural language which is ambivalent as to whether it should be classified as quantificational or object-denoting: the determiner *both*. *Both* in many ways appears to be a paradigmatic quantifier; and yet, I shall argue, it can be interpreted as having an individual—an object—as semantic value.

To show the significance of this, I shall discuss two ways of thinking about quantifiers. We often think about quantifiers via intuitions about kinds of thoughts. Certain terms are naturally used to express singular thoughts, and appear to do so by contributing objects to the thoughts expressed. Other terms are naturally used to express general thoughts, and appear to do so by contributing higher-order properties to the thoughts expressed. Viewed this way, the main condition on whether a term is a quantifier or not is whether its semantic value is an object or a higher-order property. At least, these provide necessary conditions. *Both* can be interpreted as contributing objects to thoughts, and in many cases appears to express genuine singular thoughts. Thinking about quantifiers this way, *both* can appear object-denoting and non-quantificational.

We also often think about quantifiers in terms of a range linguistic features, including semantic value, presupposition, scope, binding, syntactic distribution, and many others. Viewed this way, I shall argue, *both* can appear quantificational. In particular, it displays scope behavior that is one of the hallmarks of quantification. But, I shall show, it can do so even if given a semantics on which it denotes an object.

Thus, *both* appears quantificational by some linguistic standards, and yet appears object-denoting by standards based on intuitions about the kinds

*Thanks to Robert May and Adam Sennet for helpful discussions and comments.

of thoughts it expresses. It can appear this way, I shall argue, because the notion of quantification in natural language is in fact the intersection of a number of features, which do not always group together in the same ways, and do not always group together precisely in accord with our intuitions about expressing singular and general thoughts. *Both* has some important properties related to presupposition and to having objects as semantic values that allow it to contribute objects to thoughts. These are not present in some other canonical quantifiers. Yet *both* still has scope features that are present in other canonical quantifiers. Thus, *both* can be construed as contributing objects to thoughts, while at the same time displaying some important features of quantification.

The plan for this paper is as follows. In section I, I shall review some ideas about singular and general thoughts, and how they indicate a distinction between terms that denote objects and quantifier-terms. This suggests that a distinction between types of semantic values is basic to the notion of quantification in natural language, as I shall discuss in section II. The rest of the paper will be devoted to showing this is not so. Section III, the bulk of the paper, is an extended discussion of the term *both*. In that section, I shall argue that *both* can be assigned semantic values of *either* type discussed in section II. Finally, in section IV, I shall argue that *both* frequently contributes objects to singular thoughts, even though it displays other important linguistic properties of quantification. I shall conclude section IV by exploring how heterogeneous the linguistic features related to quantification can be, and how some, but not others, relate to our intuitions about contributing objects to thoughts.

I Expressing Singular Thoughts

Most of this paper will be devoted to the analysis of *both*. To set up the issues that will guide our investigation of this term, I shall start by clarifying the intuitive idea of contributing an object to a thought, and how it might indicate an important semantic property.

Some of our thoughts are genuinely about particular objects. If I focus on a clearly visible red apple and think that it is red, I appear to have a thought that is genuinely about that very object. On the other hand, I can think that whatever apple might be in my refrigerator is red. This latter thought is not about any object in particular, but about whatever may happen to answer to the description of being in my refrigerator. Even if the apple in my refrigerator happens to be the same one that I saw, the thoughts are different.

Thoughts of the first kind are usually called *singular* thoughts, while thoughts of the second kind are called *general* thoughts. 'Singular' might not be the best term, as such thoughts can be about more than one object. But, they are about specific objects. General thoughts are general in that they are about *whatever* objects may answer to some describing property.

I shall take the notions of singular and general thought to have their home in the philosophy of mind, where they have been much-discussed in recent years. (Discussion of singular thought often centers around such issues in the philosophy of mind as perception, for instance.) Even so, we are accustom to the idea that certain sorts of terms in language are used to express singular or general thoughts. Proper names, pronouns, and demonstratives typically express singular thoughts, while quantifier-expressions typically express general ones. If I say *John and Mary disagreed*, I express a singular thought about John and Mary, those specific people. If I say *whoever was in the room disagreed*, I express a general thought about whoever might have been in the room.

One reason for this seems to be that to express a singular thought, you need to pick out the object(s) it is about. We typically assume that names, pronouns, and demonstratives play the role of picking out objects, while quantifiers do not. Semantically, names, pronouns, and demonstratives are then analyzed as having as semantic values the objects they denote. Quantifier-expressions, on the other hand, are not understood as denoting objects, and have as semantic values something like higher-order properties. When you use a proper name, you *contribute* the object that is the semantic value of the name to the thought you express. When you use a quantifier, its semantic value is not an object, and you contribute no object to a thought.

There is more to this story, both from the mind side, and the language side. From the mind side, there are many questions about just what kinds of contents singular thought have. Neo-Russellian positions maintain that the contents of singular thoughts simply have objects as constituents. More Fregean views hold that the contents of singular thoughts might involve the right sorts of senses.[1] There are also important questions about just what

[1]Neo-Russellian views such as those of Kaplan (1989), Salmon (1986), and Soames (1987) typically draw inspiration from Russell (1903). This kind of view has been explored

kind of relation an agent needs to stand in to an object in order to have a singular thought. Perception is a key example, but the extent of singular thought is a debated issue.[2]

From the language side, the notion of contributing an object to a thought has not been fully described here. It is a natural hypothesis that a term must have an object as its semantic value to be able to contribute an object. This suggests itself as a necessary condition. Just what a sufficient condition might be depends on a number of other issues, including semantic issues of rigidity and what counts as contributing an object in intensional contexts, and meta-semantic issues like those of direct reference. Other issues include that of the *object-dependence* of singular thoughts, i.e. whether there could only be a singular thought with a given content if the object the thought is about exists, which relates closely to questions about reference failure and presupposition.[3]

Even with all these complications and questions, the apparent necessary condition remains important. It appears very plausible that to contribute an object to a thought semantically, a term must have an object as its semantic value. Hence, to semantically express a singular thought, a term must have an object as semantic value. Terms that do not have objects as semantic values do not express singular thoughts.[4]

---

in depth, with an eye towards contemporary issues in philosophy of language, by King (2007). Senses in the contents of singular thoughts are championed by Evans (1982) and McDowell (1982, 1984). Another option, proposed by Burge (1977), maintains that singular thought contents are relational, and contain something like indexicals whose values are provided by context.

[2]Again, the issue starts with Russell (1905), who proposed a relation of 'acquaintance' which has far-reaching epistemological consequences. A number of philosophers (e.g. Bach, 1994; Evans, 1982) have suggested that perception is one of many relations that suffice for singular thought.

[3]The object-dependence of singular thought is vigorously defended by Evans (1982) and McDowell (1982, 1984), and opposed by Bach (1994), Blackburn (1984), and implicitly Burge (1977). The literature on this issue is quite large; for further discussion and references, see Martin (2002).

[4]I shall not be concerned with the possibility of implicating different thoughts from the one semantically expressed by a sentence. That a speaker could express a general thought, but have in mind and convey a singular one, is familiar from work of Donnellan (1966) and Kripke (1977).

II Semantic Values and Quantifiers

Considerations from the philosophy of mind suggest the importance of the notion of picking out or denoting an object. Terms which do so can (semantically) contribute objects to singular thoughts. As we have already observed, this suggests an important distinction between kinds of semantic values. Certain expressions have objects as semantic values. These meet at least a necessary condition for contributing objects to singular thoughts. It is tempting to map this distinction back into semantic theory as a characterization of the notion of quantifier. Quantifier-expressions are those (of the right syntactic type) that do not have objects as semantic values, while denoting expressions have objects as semantic values. I shall challenge the adequacy of this characterization as this paper progresses, but it is a natural starting point, and will be a focal point of the discussion to follow. So, in this section, I shall lay out the notion of quantifier it indicates.

The semantic values we are concerned with here are those of determiner phrases (DPs). This is the *syntactic* category covering the wide range of full nominal expressions which can, for instance, serve as arguments of predicates. It is the syntactic category in natural language that plays the role of terms in logic. Many such expressions can be assigned objects as semantic values. Proper names, pronouns, and bare demonstratives are usually assigned such values. Though it is *much* more controversial, many theories assign definite descriptions and complex demonstratives objects as semantic values as well.

The customary terminology in semantic theory is to say these DPs have *individuals* as semantic values. Though it is not of much importance, I shall follow the customary terminology. (In many cases, the domain of individuals is allowed to be wider than what some metaphysical views might construe as genuine objects. In section III.3, we will consider plural individuals, for instance.) The *type* of individuals is labeled type e, and we say that DPs like proper names have semantic values of *type* e.[5]

Standard semantic theory tells us that many DPs cannot have semantic values of type e, including the DPs built from many quantifying determiners. Lists of just which determiners are quantifying vary, but they generally include such determiners as *every*, *most*, and sometimes *some*. Take, for instance, the DP *most students*. There is no individual who is 'most students',

[5]For an overview of the apparatus of types in semantic theory see, for instance, Heim & Kratzer (1998). The notation 'e' seems to be for 'entity'.

so no e-type value is available for this DP. Standard semantic theory instead assigns quantifying DPs something like second-order properties as semantic values. The semantic value $[\![\text{most students}]\!]^c$ of the DP *most students* it the second-order property that applies to first-order properties under which most students fall. In extensional terms, we model properties as sets of individuals, or in type-theoretic notation, elements of type $\langle e, t\rangle$. The semantic values of quantified DPs are then sets of sets, or in type-theoretic terms, of type $\langle\langle e, t\rangle, t\rangle$.[6] To ease notation, let us call the type of quantified DPs *type* Q.[7]

The occurrences of DPs we will be concerned with are either of type e or type Q.[8] DPs of type e are those which broadly pick out or denote objects. DPs of type Q do not, but instead contribute higher-order properties. The former thus meet our philosophy-of-mind-inspired necessary condition for expressing singular thoughts, while the latter meet our necessary condition for expressing general thoughts. It thus looks like having e-type versus Q-type semantic value is the fundamental semantic distinction tracking expression of singular or general thought. Insofar as intuitions about singular and general thought provide us with a criterion for what counts as a quantifier, it looks like having Q-type semantic value is a necessary condition for being a quantifier, while having e-type semantic value is a necessary condition for being a non-quantificational object-denoting term.[9]

As I said above, the goal of this paper is to argue against this identifica-

[6] The standard analysis encapsulates an idea due to Frege, and entered modern semantic theory via work of Barwise & Cooper (1981), Higginbotham & May (1981), Keenan & Stavi (1986), and Montague (1973).

[7] Here are some notational conventions I shall follow. Syntactic items are put in *italics*, and Greek letters serve as variables over them. I shall write $[\![\text{exp}]\!]^c$ for the semantic value of *exp* in context c.

[8] Some DPs can also occur in predicative positions. Many views argue that in such positions, DPs have values of a different type, appropriate for predicates (type $\langle e, t\rangle$). I shall ignore these occurrences in this discussion. A classic treatment may be found in Partee (1987). An extensive recent discussion is offered by Landman (2004).

[9] Many type-based semantic theories recognize that in some cases, DPs whose basic semantics is type e will have to be adjusted to higher types. For instance, coordination constructions are often taken to require this. Consider a standard example:

(i) John and most of the girls met for dinner.

Many theories require the value of *John* to be raised from e-type to Q-type to coordinate with the quantified DP *most of the girls* (cf. Partee, 1987; Partee & Rooth, 1983). Thus, claims about type are often put in terms of the basic type at which an expression is interpreted, allowing that the type may be shifted in some constructions.

tion. I shall present a determiner that shows many signs of being quantificational, but can have an e-type semantic value, and can intuitively express singular thoughts. Thus, I shall argue, our intuitive notion from philosophy of mind does not provide a theoretically apt way to capture the notion of quantifier in natural language.

Before presenting this case, let me mention a few issues I shall have to put aside. First, I shall work in an extensional setting, assigning individuals, sets, and sets of sets as semantic values. In the long run, an intensional treatment will be required, especially to capture interactions with intensional operators. Except for a few remarks in section III.4, I shall not discuss intensional contexts, and so I can safely work in an extensional framework.

There are issues of intensionality that are relevant to expressing singular and general thoughts which will be minimized by this apparatus. Questions about rigidity will often be suppressed. However, all the DPs I shall be concerned with here can be construed as rigid when they contribute objects to singular thoughts, as I shall discuss in section IV. Indeed, they are all complex terms, which can be explicitly rigidified if we so-require. More delicate is the issue of direct reference, and the corresponding issue in the philosophy of mind of the role of modes of presentation in singular thoughts. Because my main focus here is on the notion of quantification, I shall skirt this issue as well. I shall rely on cases where an object seems to be contributed to a thought, and where we can argue that the thought expressed is intuitively singular, without worrying about whether the DPs involved refer directly or some other way. (For this reason, I have tried to avoid the term 'reference' altogether, and have talked about having individuals as semantic values or denoting objects.) Finally, all the DPs I shall examine here are syntactically complex, and I shall not have space to explore the question of whether simplicity also plays a role in the expression of singular thought.[10]

[10]This issue is pressed by Neale (1993), and I think it raises a number of interesting questions. For the record, I believe that the kind of two-tiered approach I am taking here accounts for what is intuitively important about simplicity, without making it important to semantics. At the level of thought, there is something right about the idea that singular thoughts display their objects in a simple way, without articulated constituent structure. But at the level of linguistic theory, there is good reason to believe that DPs are always syntactically complex, and structurally simple nominal expressions cannot play the syntactic or semantic roles DPs play (cf. Stowell, 1991).

III *Both*

With this background in hand, we may turn to our main task: the analysis of DPs which appear like quantifiers, but can be interpreted at type e and can be understood as contributing objects to singular thoughts. I shall explore in detail one such example: the determiner *both*. In this section, I shall present a type e analysis of *both*. In section IV, I shall discuss how it can be understood as both like a quantifier and able to contribute objects to thoughts.

I shall focus on DPs like *both students*, which have the form $[_{\text{DP}}$ both $[_{\text{NP}}\ \alpha\ ]\ ]$. In this role, *both* has appeared to many to be a genuine quantifying determiner. But as we shall see, it also has decidedly e-type features.[11]

III.1 Initial Semantic Proposal

One of the main features of *both* is that it induces a kind of generalization. Consider:

(1) Both students read seven books.

This has a reading where for each of the two students, taken individually, that student read seven books. The books may differ for the two students. We thus have something like the force of universal generalization—quantificational if ever anything was. Sentence (1) also has an inverse scope reading, where a single set of seven books was read by each of the two students. This kind of scoping behavior is also typical of quantifiers. It is thus

[11]The distribution of *both* raises some difficulties I shall ignore here. It can appear in coordinate structures across categories, as in:

(i) The chicken is both cold and sour.

(See Schwarzschild (1996), from whom I take the example.) Also, *both* is among the *floating quantifiers* of English (along with *all* and *each*). As such, it appears in such constructions as:

(ii) a. Both the senators from New York have spoken.
b. The senators from New York have both spoken.

A common approach in current syntax is to analyze these in terms of movement, but it has also been proposed to analyze floated *both* in (iib) as a VP modifier (e.g. Dowty & Brodie, 1984). For an overview of these issues, see Bobaljik (2003).

no accident that lists of 'true quantifiers', even lists which are highly selective, tend to include *both*.[12]

Generalized quantifier theory naturally provides an account of this behavior, by assigning *both* α a Q-type semantic value. Barwise & Cooper (1981) offer the following definition.

(2)

$$[\![\text{both } \alpha]\!]^c = \begin{cases} \{X : [\![\alpha]\!]^c \subseteq X\} & \text{if } |[\![\alpha]\!]^c| = 2 \\ \text{undefined} & \text{otherwise} \end{cases}$$

As usual in generalized quantifier theory, truth conditions are given by:

(3) [[both α] β] is true iff $[\![\beta]\!]^c \in [\![\text{both } \alpha]\!]^c$

(Definition (2) will be modified several times as we proceed, but provides a good starting point.)

Following our observation about (1), the first case of definition (2) gives *both* α the semantics of universal quantification. This definition also attributes to *both* another feature often associated with quantifiers. It makes *both* sensitive only to size, not to the identities of specific individuals. The truth conditions given in (3) are sensitive only to the size $|[\![\alpha]\!]^c \setminus [\![\beta]\!]^c|$. If we include the presupposition, we also need to take note of the size $|[\![\alpha]\!]^c|$. Thus, definition (2) gives *both* the property of *permutation-invariance*, in that any changes to the things falling under $[\![\alpha]\!]^c$ or $[\![\beta]\!]^c$ that do not change these sizes do not change the truth value of [[both α] β].[13] However, our analysis of the presuppositions of *both* in section III.2 will lead us to deny that *both* is permutation-invariant in anything but a highly attenuated sense.

III.2 Presuppositions

So far, we have noted ways in which *both* really looks like a quantifying determiner. But there is more to the story. Barwise and Cooper's definition also makes the value of *both* α undefined if $|[\![\alpha]\!]^c| \neq 2$. Thus, it makes this DP trigger a presupposition. The presupposition is a semantically triggered condition on the DP having a well-defined semantic value. This feature of the analysis appears to be correct. For instance, consider:

[12] One fairly extreme case is Landman (2004), whose list of quantifying determiners is down to *each*, *every*, *both*, and *most*.

[13] For discussion of these ideas, see van Benthem (1986).

(4) a. # Both presidents of the United States attended the summit.

b. # Both United States Congressmen attended the summit.

These are not simply false, but are infelicitous in most contexts.[14] Of course, infelicity is relative to context, and contextual restriction of the domain provided by α can sometimes affect felicity. If uttered in Rhode Island or Idaho in 2008, (4b) will be acceptable, as it will be understood as speaking about the two Congressmen from either of those states.

Thus, as far as it goes, Barwise and Cooper's analysis appears correct. But, I suggest, they have under-described the nature of the presuppositions involved. Consider:

(5) # Both teaching assistants worked long hours.

Even in a context where it could be worked out that the speaker has exactly two teaching assistants, this sentence is typically bad. It becomes good if we explicitly mention the relevant people in the discourse:

(6) I had only two teaching assistants last quarter: Alex and Hilary. Both teaching assistants worked long hours.

As it is often put, the presupposition of *both* shows an *anaphoric* quality. It requires the individuals that jointly satisfy the presupposition to have already been mentioned in the discourse, or at least, to be salient in the way that mention in discourse makes them. Further evidence of the anaphoric quality of the presupposition comes from the fact that making individuals salient in the right way to satisfy the presupposition also supports pronominal anaphora. We have:

(7) Alex and Hilary are my teaching assistants this quarter. Both teaching assistants are hard-working. They stay up quite late.

The occurrence of *both* is felicitous because the coordinated *Alex and Hilary* introduces the right collection of elements into the discourse. When it is felicitous, the collection is available as a target for the anaphoric *they* in the last sentence.[15]

[14] I follow the usual convention of marking infelicity in context by '#', and ungrammaticality by '*'.

[15] The idea that some presuppositions have an anaphoric character has been much discussed in the presupposition literature. It appears to go back to an unpublished paper of Kripke mentioned in Soames (1989), and is the main theme of van der Sandt (1992). See Beaver (2001) for further discussion.

This sort of presupposition is well-known for definites, notably from work of Heim (1982). We should not be surprised to see it arise here, as Barwise and Cooper's semantics makes *both* essentially the same as *the two*. In its strong form, an anaphoric presupposition requires an individual or collection to be made available by overt mention in prior discourse. As is also well-known, and as we have already seen from examples like (4b), other contextual factors can replace overt mention in some cases. It may be that the usual devices of presupposition accommodation can handle these cases (as Heim originally suggested), or perhaps a notion closer to the weak familiarity of Roberts (2003) is a more accurate standard for anaphoricity. For our purposes, we can leave the status of anaphoric only roughly described.[16]

One feature of this sort of anaphoric presupposition is that it can be satisfied by an indefinite in discourse, rather than by mention of specific individuals. We see:

(8) I have two teaching assistants this quarter. Both teaching assistants are hard-working.

In simple cases like this, an indefinite can make the appropriate set salient. Of course, we will need some apparatus for handling more complex cases, such as:

(9) If a professor has two teaching assistants, both teaching assistants are over-worked.

Any of the apparatus for handling anaphora on indefinite antecedents, be it existential closure and dynamic semantics (e.g. Heim, 1982; Kamp, 1984), variables over relations (e.g. Elbourne, 2005; Heim & Kratzer, 1998; Stanley, 2000), or some procedure to write additional restrictions into the NP complement (e.g. Heim, 1990; Neale, 1990), may be pressed into service for these cases.

The anaphoric presupposition of *both* plays the role of the existence presupposition for definite descriptions. At least on some views, definite descriptions also carry a uniqueness presupposition. For plural definite descriptions, this is usually understood as a maximality presupposition. *The students* picks out the maximal (salient) collection of students, and if there is none, its use is infelicitous.[17]

[16]For some discussion of how this kind of presupposition appears in non-dynamic frameworks, see Elbourne (2005).

[17]The equation of uniqueness and maximality is essentially due to Sharvey (1980). Challenges to uniqueness have been offered by Heim (1982), Ludlow & Segal (2004), and Szabó

In our case, the presupposition that $|[\![\alpha]\!]^c| = 2$ plays much the same role as a uniqueness presupposition (a 'two-ness' presupposition). It also engages maximality, as we would expect from the comparison with *the two*. The anaphoric (existence) presupposition requires there to be a salient collection A available in the discourse, which can be interpreted as the value of α. Hence, we expect $|A| = |[\![\alpha]\!]^c| = 2$. As with any uniqueness or maximality presupposition, this allows some appropriate contextual restriction on the value of α. For instance, the following is acceptable.

(10) Alex and Hilary are students in my seminar. Both students did well.

This remains acceptable, even when we note that on its natural interpretation, there are more than two students in the seminar. The antecedent makes $A = \{Alex, Hilary\}$ available, and by some mechanism we get $[\![\text{students}]\!]^c = A$. Roughly, we have $[\![\text{students}]\!]^c = [\![\text{students among Alex and Hilary}]\!]^c$. Some additional semantic mechanism is needed to work out exactly how *students* gets this restriction. Again, the techniques developed for definites mentioned above may be applied here, but I shall not develop a specific proposal.

There are some limitations on when such restrictions can be made. Compare (10) with:

(11) a. i. Pelosi and Boehner are members of Congress. Both members voted for the bill.
ii. # Pelosi and Boehner are members of Congress. Both members of Congress voted for the Bill.
b. i. Alex and Hilary are my teaching assistants this quarter and are taking my seminar. Both students are enthusiastic.
ii. # Alex and Hilary are my teaching assistants this quarter and are taking my seminar. Both students in my seminar are enthusiastic.

The (ii) cases in (11) are unacceptable, while the (i) cases are fine. The difference seems to be the NPs *members/students* versus *members of Congress/students in my seminar*. Evidently the PP blocks contextual restriction. It is tempting to say there is an argument in the DP which is set anaphorically to A in the (i) examples, but is set by the PP in the (ii)

(2000). Attempts to formulate accurate uniqueness conditions include Heim (1990), Kadmon (1990) and Roberts (2003), who also make the case that uniqueness is presupposed.

examples. However, absent a more substantial account of the restriction mechanism, a full explanation will have to wait.

So far, we have replaced uniqueness with the cardinality presupposition $|A| = |[\![\alpha]\!]^c| = 2$. But maximality is also significant in limiting how the restricted value of α can be set. A must be the maximal salient set which can satisfy $[\![\alpha]\!]^c$. Observe:

(12) # Alex and Hilary are students in my class and so is Bill. Both students are enthusiastic.

This is unacceptable, even though the first clause introduces $\{Alex, Hilary\}$ as a salient set. It is not the maximal set of students, and so, it is not acceptable as the restricted value of *students*. Thus, we wind up interpreting α as restricted to a maximal contextually salient collection of individuals falling under it, and the restricted value (= the maximal set) must be of size 2. This still conforms to the *the two* analysis. *The*$_{Pl}$ α has an anaphoric presupposition, requiring a salient maximal set satisfying α, and *two* adds that the set must be of cardinality 2.

I have left a number of details unexplored, but we now have enough information about the presuppositions of *both* to refine our Barwise-and-Cooper-inspired semantics.

(13) $[\![\text{both } \alpha]\!]^c$ (Q-type, revised).

a. Anaphoric presupposition: Salient set in the discourse A. α is interpreted as contextually restricted to A.
b. Maximality presupposition: A is the maximal contextually salient set of satisfiers of $[\![\alpha]\!]^c$.
c. Cardinality Presupposition: $|A| = |[\![\alpha]\!]^c| = 2$.
d. $[\![\text{both } \alpha]\!]^c = \{X : A \subseteq X\}$

We thus see the semantics of both as breaking down into two components. First, a set A is presupposed, with appropriate restrictions of maximality and cardinality. Then, we have the semantics of universal quantification over A.

III.3 Plurals and Partitives

The semantics of *both* we have developed so far follows Barwise and Cooper in making *both* effectively *the two*. My main departure from their analysis has been to add more details about presupposition.

Barwise and Cooper themselves, and subsequently Ladusaw (1982), observed that the equation of *both* to *the two* is problematic. They do not have the same distribution in partitive DPs:

(14) a. one of the two men
b. * one of both men

Something more is needed for our analysis.

The first steps towards a refined analysis were taken by Ladusaw (1982). To present Ladusaw's observation, we must introduce an important feature of the semantics given in (13). When $[\![\text{both } \alpha]\!]^c$ is defined, the semantics of (13) gives it the value $\{X \colon A \subseteq X\}$. This is a familiar construction from logic, known as the *principal filter* generated by A. Principal filter interpretations are available for a number of terms we think of as *definite*, including *the* α and *that* α. Indeed, Barwise and Cooper proposed having a principal filter semantic value as an analysis of definiteness.[18]

Determiners that are allowed in the partitive are at least close cousins of definites (as observed by Jackendoff, 1977):

(15) a. one of the men
b. one of those men

These have principal filter interpretations. So, one constraint on the partitive, suggested by Barwise and Cooper and Ladusaw, is that the DP in the partitive phrase must have a principal filter semantic value. As we have already observed, however, this does not explain the unacceptability of *both* in the partitive. Hence, Ladusaw (1982) proposes in addition that the generator of the filter needs to be a single individual, not a collection of individuals.[19] *Both* α does not have this property. Its presuppositions require its generator to be a collection of two individuals, not a single individual. Thus, it is not acceptable in the partitive according to Ladusaw's partitive constraint.

The partitive constraint points to the way in which *both* can be interpreted as of type e. It does so by focusing on the plural status of *both*. The constraint requires the semantics of *both* to be genuinely plural. But it is stronger than

[18] A little more specifically, they propose being a non-trivial proper principal filter in every model where the value is defined as an analysis of definiteness. For a related proposal, see Heim (1991).

[19] This is what is known as the *partitive constraint*, following terminology of Jackendoff (1977). An essentially equivalent proposal is developed by Hoeksema (1984).

that. It encodes the idea that *both* α is a plural that has only *distributive* readings. For instance, compare:

(16) a. Both men lifted the piano.

b. The two men lifted the piano.

The second sentence (16b) has two readings: a collective reading where the two men lifted the piano together, while neither one of them alone lifted it; and a distributive reading, where they each lifted the piano alone. In contrast, (16a) only has the distributive reading.[20]

This observation supports Ladusaw's constraint. Collective readings may be construed as predicating something of a single plural element, conceived as a group. In the collective reading of (16b), the group of two men is what lifts the piano. *Both* cannot be construed this way, and so, cannot be taken to be about a single plural element. When we treat its semantic value as a principal filter, it likewise cannot have a single plural individual generator. Rather, the generator for $[\![\text{both } \alpha]\!]^c$ must be a collection of two distinct individual elements.

When a predicate is applied collectively, it acts like it predicates of a single plural object. When it is applied distributively, it applies individually to each element of the plurality. Distributive predication thus has the force of universal quantification. If we think of the subject in (16b) as picking out a plural individual, then the sentence is true iff $[\![\text{the two men}]\!]^c \in [\![\text{lifted the piano}]\!]^c$. If the predicate is read collectively, it is natural to interpret this as simply predicating, of the group, that it (they) did the carrying. But if the predicate is read distributively, it is natural to interpret it as $\forall y \in [\![\text{the two men}]\!]^c . y \in [\![\text{lifted the piano}]\!]^c$. Insofar as we can think of the subject in (16b) as simply contributing a plural object in both readings, the force of universal quantification in the distributive reading is to be found in the predicate, not in the semantics of the subject DP. We can have universal quantification with distributivity, without writing it into the semantics of the DP.

The quantificational effect of *both* is the effect of distributivity. We have already seen that the anaphoric presupposition of *both* introduces a salient set A, and the cardinality and maximality requirements ensure $|A| = 2$. (The partitive constraint reminds us that because of this, *both* cannot appear in

[20] The claim that *both* is necessarily distributive has been challenged by Brisson (1998) and Schwarzschild (1996). As Brisson notes, some of her data has been challenged by Ladusaw, and my own judgments tend to follow his.

the partitive.) The semantics in (13) then interprets *both* α as universal quantification over A, via the generalized quantifier value $\{X\colon A \subseteq X\}$. But we can get the same effect without generalized quantifiers, with a few modifications. We may analyze *both* as contributing a distributivity operator. If we do, we may treat the presupposed set A as a plural individual, and treat it as the subject of predication itself. As *both* requires the predicate to apply distributively, we get the effect of universal quantification over A, just as the generalized quantifier semantics provides.

I shall make the apparatus of plural individuals a little more precise in a moment. But we are now in a position to describe the truth conditions of simple sentences like *Both students are smart* without generalized quantifiers. We can do so with the help of a D-operator, which applies to predicate values to interpret them distributively. Using it, we have the following.

(17) [[both α] β]] is true iff

a. Anaphoric presupposition: Salient set in the discourse A. α is interpreted as contextually restricted to A.

b. Maximality presupposition: A is the maximal contextually salient set of satisfiers of $[\![\alpha]\!]^c$.

c. Cardinality Presupposition: $|A| = |[\![\alpha]\!]^c| = 2$.

d. $A \in {}^D[\![\beta]\!]^c$

The anaphoric presupposition provides a set A of the right kind, and the predicate is simply predicated distributively over A. Universal quantification comes from the D-operator.

If this is right, the role of the NP α is purely presuppositional. It places requirements on A, but then, semantically, we simply predicate of A. The *non-presuppositional* component of the semantics of *both* α then looks something like $[\![\text{both } \alpha]\!]^c = \lambda P.{}^D P(A)$. There remain a number of delicate issues of syntax which affect the right compositional analysis of *both* along these lines. We will see a slightly different, and I think simpler, way of capturing it in a moment. But the truth conditions given in (17) appear correct, and show how the subject of predication can be construed as the presupposed generator for the generalized quantifier defined in (13).[21]

[21]The syntactic complications mentioned in footnote 11, relating to the floating behavior of *both*, make the compositional analysis of *both* α delicate. The analysis I have just sketched is very close to the proposal of Roberts (1987). She argues that floated *each* is a distributivity operator, and presumably, *both* is simply *each* plus presuppositions.

If we can interpret *both* α as having a plural individual value, we can essentially understand it as a type e DP, in spite of its universal (i.e. distributive) force. To flesh out this view, I shall say a little more about plural individuals. This will also offer an alternative way of understanding the role of the distributivity operator. The leading idea is that some plural DPs pick out individuals, but individuals that are plural in nature. This is perhaps most intuitive for the collective reading of a plural definite, where it seems to be a plural group that is picked out. According to this idea, we should expand the domain of type e to include pluralities.

For purposes of presentation, I shall introduce an extended type e of plural individuals along the lines suggested by Landman (1989), building on ideas of Link (e.g. Link, 1998). I do so advisedly, as the ontology of plurals, and its role in semantics, remains a disputed issue.[22]

Advisedly or not, we will now suppose that our type e of individuals contains plural individuals. For convenience, we can model this as follows. Start with a domain I of genuine singular individuals, or set-theoretic urelements. We can then form $\wp^+(I)$, the set of non-empty subsets of I. This is a 'complete atomic join semi-lattice', i.e. it is closed under a sum operation provided by union, it has a 'parthood' relation provided by subset, and the singletons of urelements are atoms. It thus has the structure Link and Landman highlight for domains of plural entities. We think of the non-plural individuals as the singletons of urelements, and the non-singletons as the genuinely plural individuals. (I shall cavalierly and without notice identify urelements with their singletons.) To capture the collective readings of plurals, Link and Landman argue that we need additional plural entities: *groups*. These function like atoms, and so in our simple model should be singletons. For our purposes, it is enough to add the singletons of members of $\wp^+(I)$. So, let $I^+ = \wp^+(I) \cup \{\{x\}\colon x \in \wp^+(I)\}$. This domain gives us genuinely non-plural individuals as singletons of urelements, plural individuals as non-singletons, and group individuals (plurals thought of as single entities) as singletons of non-urelements. (Having identified urelements and their singletons, we can

(Related apparatus can be found in Kamp & Reyle (1993).) I am arguing that once we take the presuppositions of *both* α into account, it can be analyzed essentially the same way. I am not sure Roberts would agree, as she insists on a difference between determiner *both*, which she classifies as quantificational, and (plural) individual-denoting determiners.

[22]There are a number of alternatives in the large literature on plurals. I hasten to note the neo-Davidsonian approach of Schein (1996), which avoids the commitment to plural objects I shall casually make use of here.

also identify $\{\{u\}\}$ with u for urelements u. Under this identification, we can suppose I^+ contains urelements, non-singleton sets of urelements, and singletons of non-singleton sets of urelements.) From now on, we will suppose that type e is the type of I^+, and so has plural as well as singular individuals.

As highlighted by Landman (1989), this apparatus allows us to reduce distributivity to plural predication *simpliciter*. Following Landman, suppose that predicates start out life as basically singular, applying only to singletons in I^+. For appropriate predicate phrases β, $[\![\beta]\!]^c \subseteq AT \subseteq I^+$ where AT is the set of singletons in I^+. Some such predicates apply only to non-plural individuals (singleton urelements), like *boy*. Some apply only to groups (singleton non-urelements), like *meet*. Some apply to both, like *carry the piano*. Pluralization is the result of an operator $\star$ that closes a set under unions (i.e. sums). Thus, $[\![\text{boys}_{Pl}]\!]^c = {}^\star[\![\text{boy}]\!]^c = \{i \in I^+ \colon \exists X \subseteq [\![\text{boy}]\!]^c \wedge i = \cup X\}$. The result is that $[\![\text{boys}]\!]^c = {}^\star[\![\text{boy}]\!]^c$ is the set of sums of things that are boys.

One of the main points of Landman (1989) is that if we treat pluralization this way, distributivity reduces to plural predication. The D-operator is defined by ${}^D[\![\beta]\!]^c = \{i \in I^+ \colon \forall y((y \in AT \wedge y \subseteq i) \to y \in [\![\beta]\!]^c)\}$. As Landman stresses, given a singular predicate value $[\![\beta_{Sing}]\!]^c$ is a set of atoms (singletons), ${}^\star[\![\beta]\!]^c = {}^D[\![\beta]\!]^c$. On this approach, distributive predication is just plural predication, when it encounters non-singleton pluralities.

Getting back to our main theme, we can make use of the expanded I^+ to re-state the semantics of *both* as type e. The domain I^+ of type e now contains plural individuals of two sorts: groups are singletons of non-urelements, while other pluralities are non-singletons. Collective predication is predication of groups. With this apparatus, the partitive constraint, which told us that *both* is essentially distributive, becomes the restriction that it cannot contribute groups. In terms of generalized quantifier theory, Ladusaw put this that it must have a generator set of cardinality 2. But now, we can put it that it must have a non-singleton (plural, non-group) value. In contrast, determiners that are acceptable in partitives must have singleton generators. Thus, we can have *one of the two*, interpreting *the two* as generated by a group (a singleton of the form $\{\{a, b\}\}$).[23]

Once we see that *both* α is presupposed to have a particular kind of plural e-type generator, we can dispense with the Q-type value altogether, much as

[23]We will have to modify our measures of cardinality accordingly, but that poses no fundamental problem.

we did in (17). Instead, *both* α may be interpreted as its generator: a non-singleton set, but still of type e. We can modify our semantics accordingly.

(18) $[\![\text{both } \alpha]\!]^c$ (plural e-type).

a. Anaphoric presupposition: Salient *non-singleton set* in the discourse A. α is interpreted as contextually restricted to A.
b. Maximality presupposition: A is the maximal contextually salient set of satisfiers of $[\![\alpha]\!]^c$.
c. Cardinality Presupposition: $|A| = |[\![\alpha]\!]^c| = 2$.
d. $[\![\text{both } \alpha]\!]^c = A$

A is a plural individual of type e. This gets the truth conditions right for such constructions as *Both senators from California are Democrats.* We can compute: $[\![\text{both senators from California}]\!]^c = \{f, b\}$. As we have $f \in [\![\text{democrat}]\!]^c$ and $b \in [\![\text{democrat}]\!]^c$, $\{f, b\} \in {}^\star[\![\text{democrat}]\!]^c$.[24]

It is worth noting that the anaphoric presupposition of *both* in (18) is in a certain way tolerant as to how it is satisfied. In particular, it does not require that A be introduced as a non-singleton. At least, arguments of essentially collective predicates can satisfy the anaphoric requirement.

(19) John and Sally met last year. Both say it was in September.

Presumably *John and Sally* first introduces a group, which can be converted into a non-singleton plurality (perhaps by something like Landman's $\downarrow$-operator, which does the job of converting groups to non-singletons).

III.4 Scope

Issues about scope and plurality are involved and complicated, and I shall not really be able to explore them here. But, I do think it is important to pause long enough to see that interpreting a purported quantifier like *both* via the e-type semantics of (18) does not preclude a treatment of its scoping behavior.

[24]In this rather truncated discussion of plurals, I have not explored what to say about the anomaly of *both* with essentially collective predicates, such as *Both Senators met.* Obviously, a great deal of weight is being put on the analysis of plural predication, and the role of distributivity in it. Alternative views, putting the locus of distributivity in the DP rather than the VP, include Scha (1981).

Distributive quantifiers, including *both*, have fairly free scope interaction with other quantifiers (construing the class of quantifiers widely, including indefinites and numerals). Consider:

(20) a. Both students read two books.
 b. Both students like most of the cafes.

These are both ambiguous between surface and inverse scope readings.[25]

The e-type semantics in fact can handle these readings. For any of them to be felicitous, there needs to be a contextually salient set $A = \{a, b\}$ of two students. We see that (20a) can be interpreted as having a reading two books and b reading two different books (*both* wide scope), or two books being such that both a and b read them (*both* narrow scope). Similarly for (20b).

As has often been noted, distributivity is one of the key factors that goes into scope, and in this case, it is sufficient to generate these scope ambiguities.[26] For both scope readings of (20a) and (20b), the force of *both* remains universal quantification over A, which is captured by *distributivity*, either in its guise as D or as $\star$. In either form, we have a distributive-forming operator which is itself able to take scope. The different scope readings we need are simply the effect of this operator taking different scopes.

As we are thinking of distributivity as a property of predicates, scope is realized in terms of how the plural formation operator $\star$ and the scope of the embedded DP interact. (The same goes if we prefer a D-based system.) For instance, we might represent the two readings of (20a) by something like:

(21) a. ${}^{\star}[\lambda x.[\mathit{two\ books}]_y \mathit{Read}(x, y)](A)$
 b. $[\mathit{two\ books}]_y[{}^{\star}[\lambda x.\mathit{Read}(x, y)](A)]$

I am playing fast and loose with logical form here (and abusing use and mention), but this should make clear how scoping the distributivity operator $\star$ accounts for the scope behavior of *both*, even when *both* is given an e-type value. In this sort of case, the semantics of generalized quantifiers and of scope come apart. Scope-wise, *both* behaves like a distributive universal quantifier (like *each*), pulling its presuppositions along for the ride. But, the

[25]In fact, distributive quantifiers are far more free in their scope potentials than some others. This is one of the main topics of Beghelli & Stowell (1997) and Szabolcsi (1997). Part of their account involves interpreting distributive quantifiers as set variables, in a dynamic framework. Though the frameworks differ, I believe that their proposal and the semantics of (18) come to much the same thing.

[26]Again, this is a theme of Beghelli *et al.* (1997) and Beghelli & Stowell (1997).

combination of presupposition and distributivity allow us to interpret *both* α as type e and still capture this scope behavior.

When it comes to quantifier scope behavior, the presuppositions of *both* do not seem to have a great effect. For instance, being interpreted as a salient set A established anaphorically does not allow *both* to take exceptional scope. In particular, it does not show the exceptional scope behavior the indefinite *a* does. In this respect, it continues to behave scope-wise like *each*. Compare:

(22) a. If each partner of mine had died in the fire, I would have inherited a fortune.
b. If both partners of mine had died in the fire, I would have inherited a fortune.
c. If a partner of mine had died in the fire, I would have inherited a fortune.

As Fodor & Sag (1982) observed, in (22c) *a* seems able to take wide scope across the whole sentence (though whether this is really a scope phenomenon has been extensively debated ever since). Regardless, we do not see this kind of reading for *each* in (22a) or *both* in (22b). Generally, *both* and *each* seem to be restricted by the same sorts of locality conditions as most other quantifiers are. This suggests that the distributivity operator is so-restricted. This restriction on the distributivity operator restricts the scope potential of *both*, regardless of the fact that the presuppositions of *both* identify A extra-clausally.

In contrast, interactions between *both* and modals do seem to be affected by presupposition. Consider:

(23) Alex and Hilary are my two teaching assistants this quarter. Both teaching assistants could have been easy graders.

It is very hard—I think impossible—to read this as saying that whoever wound up being my teaching assistants this quarter, they could have been easy graders. The only available reading is the one where Alex and Hilary are described as possibly being easy graders. Only the de re reading, and not the de dicto reading, is available here.

In contrast, if we can accept *each* without the initial set-up, the de dicto reading becomes easy to get:

(24) Each student in my class could be from California.

This shows the usual de re/de dicto ambiguity not found in (23). *Each* does not carry an anaphoric presupposition, which seems to be the crucial difference.

Not only the presence of the presupposition, but how it is satisfied, affects readings under modals. For instance, we can generate readings where the presupposition is itself satisfied under a modal, such as:

(25) I should find two new papers to teach this quarter. Both papers might help liven-up my seminar.

(Roberts (1987) names this *modal subordination*.) Example (25) is naturally read as having the anaphoric presupposition satisfied under the scope of the modal in the first sentence, which makes it effectively de dicto.

The one case I know of where we can get scope-like de re/de dicto ambiguity for *both* is with *role predicates*: predicates for which we have standing presuppositions that there is a role which *can* be filled by different individuals.

(26) Both senators from New Jersey might be liberals.

This is ambiguous between two readings. Presumably, the standing role presuppositions that go with *senators from New Jersey* are modalized, and they allow us to understand the presuppositions of *both* as either being satisfied under or outside the scope of the modality.[27]

I have not put the issue of modality in terms of whether the quantifier takes narrow scope with respect to a modal operator. The contrast between (23) and (24) suggests that this is not the relevant factor for *both*, and it is well-known that the phenomenon in (25) cannot be handled in terms of the scope of clause-bound operators. Instead, as I have noted, the important factor for the behavior of *both* in these kinds of cases seems to be how its anaphoric presupposition is satisfied. When the presupposition is satisfied outside the scope of a modal, we get only de re readings, as in (23); when it is satisfied under the scope of a modal, we get de dicto readings. Indeed, the e-type analysis of (18) does not allow a treatment of these cases in terms of scope. Even in cases where we are able to suitably scope the (clause-bound) distributivity operator, it is the treatment of A that determines whether we get de re or de dicto readings. That is independent of the scope of the

[27] Here I follow Rothschild (2007).

distributivity operator $\star$. A fuller account of this is yet again something else I shall have to defer to another occasion.[28]

IV Quantification and Objects

This completes my exploration of the semantics of *both*. We have seen that this determiner carries substantial presuppositions, and we have seen two different semantics for it, one of Q-type and one of e-type. (Perhaps, if you count the D and $\star$ analyses as different, I have presented three semantics.) In this final section, I shall return to the idea about quantifiers introduced in sections I and II, and apply them to *both*.

In section I, we looked at the notion of a quantifier through the lens of philosophy of mind. From this perspective, the important condition appeared to be whether a term contributes objects to singular thoughts. We proposed the necessary condition for doing so that a term must have an object as semantic value. Does *both* α meet this condition? And moreover, is *both* able to express singular thoughts?

Clearly, according to the e-type semantics, *both* meets the necessary condition (though not according to the Q-type semantics). It also seems to me that in many of its occurrences, *both* contributes (plural) objects to genuinely singular thoughts (or if we like, contributes each of the objects in its plurality to them). Consider a case like (7), where I utter *Both teaching assistants are hard-working* after explicitly mentioning Alex and Hilary. In this context, it seems intuitive that we express a genuine singular thought about Alex and Hilary—those very people.

It is not easy to argue for this claim, beyond the brute appeal to intuitions of what we are talking about. But three points support it. First, the facts about interactions with modals we reviewed in section III.4 make it plausible. The obligatory nature of the de re reading for (23) applies equally to embeddings of (7) under modal operators. This shows that *both teaching assistants* behaves rigidly in (7). Rigidity is weaker than genuinely contributing an object to a singular thought, but it is one of the main diagnostics for doing so.

[28]A related proposal about de re/de dicto and presupposition is made by Rothschild (2007). Another approach to interactions with modals for e-type terms is to rely on world variables. This is discussed by Elbourne (2005) and Heim (1991).

A second, related point is that we can use these facts about rigidity to echo (or parrot) an argument offered in favor of direct reference by Kaplan (1989). In Kaplan-style, call the thought expressed by (7) *Pat*. Suppose in some other circumstance, I would have had two slackers as teaching assistants who do not work hard. Now, following Kaplan, we note that the proposition I would have expressed in that context using the sentence would be false, but our intuitions seems to be pretty firmly that *Pat* remains true. Our intuitions about truth or falsehood of the proposition *Pat* go with the presupposed set of individuals, not with any descriptive content that was used to determine the set. This sort of argument supports the intuition that the object—the set of Alex and Hilary—is contributed to the thought expressed.

Kaplan never claimed this sort of argument is definitive, and neither do I, but it should support the brute appeal to intuitions of aboutness. Finally, a third supporting point comes from more theory-internal considerations. On the e-type analysis, the semantic value of *both* α is simply A. Thus, the DP is able to carry out the function we intuitively think of as contributing an object to a singular thought, by contributing its value. The rest of the semantics of *both* α is a collection of presuppositions which (among things) provide A. The descriptive material in the NP complement α is involved only in the presuppositions, and then plays no further semantic role. I suggest that our intuitions about expressing singular thoughts go with these presuppositions, and how they are satisfied. When the anaphoric presupposition is satisfied by providing A directly, we have an 'object of thought', which is simply contributed to the thought expressed via the semantics of *both*. In this case, *both* α works much like a complex demonstrative, in that it relies on complex presuppositions to determine an object, but then simply contributes that object to thought.[29] In other cases, we get different results. When the presuppositions are satisfied under the scope of a modal, as we considered in section III.4, we intuitively do not have singular thoughts expressed. When the presuppositions are satisfied by an indefinite antecedent, or when we have quantification into the NP α, we get what to my intuitions are somewhat mixed results.

Thus, we may conclude that at least some occurrences of *both* contribute objects to singular thoughts. By the lights of section I, these function as object-denoting expressions, and not as quantifiers. But perhaps more im-

[29] At least, it works like a complex demonstrative under the analysis of their presuppositions offered in Glanzberg & Siegel (2006).

portant is the observation that whether they do depends on how the presuppositions of *both* are satisfied. Issues of expressing singular thought go with the presuppositions.

In section II, we introduced the idea that semantic type might provide necessary conditions for being a quantifier. There we considered the conditions that having type Q is necessary for being a quantifier, and having type e is necessary for being a denoting expression. We are now in a position to show this is incorrect. We have seen two semantic analyses for *both* α, one of type Q and one of type e. I have not tried to offer reasons to choose one over the other. As far as the considerations we have examined here go, they seem to me to be essentially variants of one-another. They both capture the presuppositional aspects of *both*, and its distributive-universal quantificational force. We can account for the scoping behavior of *both* with either analysis. The type difference between A and $\{X : A \subseteq X\}$ itself is trivial, as each can be recovered from the other by simple operations. Insofar as *both* can have either type, it either automatically falsifies the necessary conditions based on type, or renders them vacuous. Either way, we see that analyzing the notion of quantification in terms of semantic type is unhelpful in this case.

The type-based conditions of section II were introduced as a reflection in semantic theory of the ideas about expressing thoughts we discussed in section I. One moral of our exploration of *both* is that it is not well-described by this approach. We have see that many occurrences of *both* can contribute objects to singular thoughts, and the type e analysis helps us to understand how it can do so. But all the same, *both* retains some important features of quantification. In particular, we have seen that it has universal quantificational force, and enters into scope relations with quantifiers. It can do so while at the same time contributing an object to a thought. It can look like a denoting expression by lights of contributing objects, but like a quantifier by other lights.

The semantic analyses we have developed, in either type, help to explain how this can be. There are two main components to the semantics of *both*: anaphoric presupposition, and distributivity. The two analyses agree on this, and simply gloss it at different types. We have already seen that intuitions about contributing objects to singular thoughts go with the anaphoric presupposition. Likewise, the universal force and scoping properties of *both* are determined by distributivity. But presupposition and distributivity are *independent* features of *both*. Thus, it can look quantifier-like when it comes to distributivity, and denoting-expression-like when it comes to presupposition.

We thus see one way in which the notion of quantification in natural language turns out to be the intersection of a number of different properties. It includes features of the independent properties of distributivity and presupposition.[30] These are but two of the many properties that go into quantification. Other important ones relate to binding, and to syntactic scope properties. Some of these features, like presupposition, relate closely to the notion of contributing an object to thought; while others, like distributivity, do not. These features do not always come together in ways that are captured by our ideas from philosophy of mind or by classification by type.

Finally, to close, let me mention two avenues for further investigation. First, I have focused on the properties of distributivity and presupposition here, but I have also noted that they are two of many important properties of quantification. When we look at other properties, we again find that *both* in some ways appears like other canonical quantifiers, but in some ways does not. For instance, it shows mixed results in some common diagnostics relating to syntactic aspects of scope and binding. In antecedent-contained deletion environments (cf. May, 1985), *both* patterns with *every* and not with proper names.

(27) a. Dulles suspects everyone who Angleton did.
b. * Dulles suspects Philby who Angleton did.
c. Dulles suspects both spies who Angleton did.

Yet, in weak crossover environments (cf. Chomsky, 1976; Lasnik & Stowell, 1991), *both* appears to pattern differently than either.

(28) a. His$_i$ mother loves John$_i$.
b. * His$_i$ mother loves [every boy]$_i$.
c. ? Their$_i$ mother loves [both boys]$_i$.

The judgments on (28c) is disputed in the literature, but it is more marginal than those for (28a) and (28b). (Actually, to my ear, (28c) can sound fine if given the right intonation.) More study of what underlies these facts, and how syntactic properties combine with those of presupposition and distributivity, will help articulate the view of quantification as a complex collection of properties.

[30] Indeed, distributivity and its attendant scope properties are sometimes offered as among the key necessary properties of 'true quantifiers' (cf. Partee, 1995).

Second, the kind of semantics for *both* developed here can be applied, with some important variations, to a number of other determiners whose status as quantificational or object-denoting has been disputed; including complex demonstratives (e.g. King, 2001 versus Kaplan, 1989) and definite descriptions (e.g. Neale, 1990 versus Elbourne, 2005). I believe the sort of semantic analysis I have offered here, along with the picture of quantification I have suggested, can help shed light on these debates as well.

References

Bach, K. (1994). *Thought and Reference.* Oxford: Oxford University Press, paperback edn.

Barwise, J. & Cooper, R. (1981). Generalized quantifiers and natural language. *Linguistics and Philosophy*, *4*, 159–219.

Beaver, D. I. (2001). *Presupposition and Assertion in Dynamic Semantics.* Stanford: CSLI Publications.

Beghelli, F., Ben-Shalom, D., & Szabolcsi, A. (1997). Variation, distributivity, and the illusion of branching. In A. Szabolcsi (Ed.), *Ways of Scope Taking*, pp. 29–69. Dordrecht: Kluwer.

Beghelli, F. & Stowell, T. (1997). Distributivity and negation: The syntax of *Each* and *Every*. In A. Szabolcsi (Ed.), *Ways of Scope Taking*, pp. 71–107. Dordrecht: Kluwer.

van Benthem, J. (1986). *Essays in Logical Semantics.* Dordrecht: Reidel.

Blackburn, S. (1984). *Spreading the Word.* Oxford: Oxford University Press.

Bobaljik, J. D. (2003). Floating quantifiers: Handle with care. In L. Cheng & R. Sybesma (Eds.), *The Second Glot International State-of-the-Article Book*, pp. 107–148. Berlin: de Gruyter.

Brisson, C. M. (1998). *Distributivity, Maximality, and Floating Quantifiers.* Ph.D. dissertation, Rutgers University.

Burge, T. (1977). Belief *De Re*. *Journal of Philosophy*, *74*, 338–362.

Chomsky, N. (1976). Conditions on rules of grammar. *Linguistic Analysis*, *2*, 303–351. Reprinted in Chomsky (1977).

——— (1977). *Essays on Form and Interpretation*. Amsterdam: North-Holland.

Donnellan, K. S. (1966). Reference and definite descriptions. *Philosophical Review*, *77*, 281–304.

Dowty, D. R. & Brodie, B. (1984). The semantics of "floated" quantifiers in a transformationless grammar. *Proceedings of the West Coast Conference on Formal Linguistics*, *3*, 75–90.

Elbourne, P. D. (2005). *Situations and Individuals*. Cambridge: MIT Press.

Evans, G. (1982). *The Varieties of Reference*. Oxford: Oxford University Press. Edited by John McDowell.

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

Glanzberg, M. & Siegel, S. (2006). Presupposition and policing in complex demonstratives. *Nous*, *40*, 1–42.

Heim, I. (1982). *The Semantics of Definite and Indefinite Noun Phrases*. Ph.D. dissertation, University of Massachusetts at Amherst. Published by Garland, New York, 1989.

——— (1990). E-type pronouns and donkey anaphora. *Linguistics and Philosophy*, *13*, 137–177.

——— (1991). Artikel und Definitheit. In A. von Stechow & D. Wunderlich (Eds.), *Semantics: An International Handbook of Contemporary Research*, pp. 487–535. Berlin: de Gruyter.

Heim, I. & Kratzer, A. (1998). *Semantics in Generative Grammar*. Oxford: Blackwell.

Higginbotham, J. & May, R. (1981). Questions, quantifiers and crossing. *Linguistics Review*, *1*, 41–79.

Hoeksema, J. (1984). Partitives. Unpublished manuscript, University of Groningen.

Jackendoff, R. (1977). *$\bar{X}$ Syntax*. Cambridge: MIT Press.

Kadmon, N. (1990). Uniqueness. *Linguistics and Philosophy*, *13*, 273–324.

Kamp, H. (1984). A theory of truth and semantic representation. In J. Groenendijk, T. Janssen, & M. Stokhof (Eds.), *Truth, Interpretation, and Information*, pp. 1–41. Dordrecht: Foris.

Kamp, H. & Reyle, U. (1993). *From Discourse to Logic*. Dordrecht: Kluwer.

Kaplan, D. (1989). Demonstratives. In J. Almog, J. Perry, & H. Wettstein (Eds.), *Themes From Kaplan*, pp. 481–563. Oxford: Oxford University Press. First publication of a widely circulated manuscript dated 1977.

Keenan, E. L. & Stavi, J. (1986). A semantic characterization of natural language determiners. *Linguistics and Philosophy*, *9*, 253–326. Versions of this paper were circulated in the early 1980s.

King, J. C. (2001). *Complex Demonstratives*. Cambridge: MIT Press.

——— (2007). *The Nature and Structure of Content*. Oxford: Oxford University Press.

Kripke, S. (1977). Speaker's reference and semantic reference. In P. A. French, T. E. Uehling, & H. K. Wettstein (Eds.), *Contemporary Perspectives in the Philosophy of Language*, vol. II of *Midwest Studies in Philosophy*, pp. 6–27. Minneapolis: University of Minnesota Press.

Ladusaw, W. A. (1982). Semantic constraints on the English partitive construction. *Proceedings of the West Coast Conference on Formal Linguistics*, *1*, 231–242.

Landman, F. (1989). Groups, I. *Linguistics and Philosophy*, *12*, 569–605.

——— (2004). *Indefinites and the Type of Sets*. Oxford: Blackwell.

Lasnik, H. & Stowell, T. (1991). Weakest crossover. *Linguistic Inquiry*, *22*, 687–720.

Link, G. (1998). *Algebraic Semantics in Language and Philosophy*. Stanford: CSLI Publications.

Ludlow, P. & Segal, G. (2004). On a unitary semantical analysis for definite and indefinite descriptions. In M. Reimer & A. Bezuidenhout (Eds.), *Descriptions and Beyond*, pp. 420–436. Oxford: Oxford University Press.

Marsh, R. C. (Ed.) (1956). *Logic and Knowledge*. London: George Allen and Unwin.

Martin, M. F. G. (2002). Particular thoughts and singular thoughts. In A. O'Hear (Ed.), *Logic, Thought and Language*, pp. 173–214. Cambridge: Cambridge University Press.

May, R. (1985). *Logical Form: Its Structure and Derivation*. Cambridge: MIT Press.

McDowell, J. (1982). Truth-value gaps. In L. J. Cohen, J. Łós, H. Pfeiffer, & K. P. Podewski (Eds.), *Logic, Methodology, and Philosophy of Science VI*, pp. 299–313. Amsterdam: North-Holland.

——— (1984). *De Re* senses. *Philosophical Quarterly*, *34*, 283–294.

Montague, R. (1973). The proper treatment of quantification in ordinary English. In J. Hintikka, J. Moravcsik, & P. Suppes (Eds.), *Approaches to Natural Language*, pp. 221–242. Dordrecht: Reidel. Reprinted in Montague (1974).

——— (1974). *Formal Philosophy*. New Haven: Yale University Press. Edited by R. Thomason.

Neale, S. (1990). *Descriptions*. Cambridge: MIT Press.

——— (1993). Term limits. In J. E. Tomberlin (Ed.), *Logic and Language*, vol. 7 of *Philosophical Perspectives*, pp. 89–123. Atascadero: Ridgeview.

Partee, B. H. (1987). Noun phrase interpretation and type-shifting principles. In J. Groenendijk, D. de Jongh, & M. Stokhof (Eds.), *Studies in Discourse Representation Theory and the Theory of Generalized Quantifiers*, pp. 115–143. Dordrecht: Foris.

——— (1995). Quantificational structures and compositionality. In E. Bach, E. Jelinek, A. Kratzer, & B. H. Partee (Eds.), *Quantification in Natural Languages*, pp. 541–601. Dordrecht: Kluwer.

Partee, B. H. & Rooth, M. (1983). Generalized conjunction and type ambiguity. In R. Bäuerle, C. Schwarze, & A. von Stechow (Eds.), *Meaning, Use and the Interpretation of Language*, pp. 361–393. Berlin: de Gruyter.

Roberts, C. (1987). *Modal Subordination, Anaphora, and Distributivity.* Ph.D. dissertation, University of Massachusetts at Amherst. Published in revised form by Garland, New York, 1990.

——— (2003). Uniqueness in definite noun phrases. *Linguistics and Philosophy*, *26*, 287–350.

Rothschild, D. (2007). Presuppositions and scope. *Journal of Philosophy*, *104*, 71–106.

Russell, B. (1903). *Principles of Mathematics.* Cambridge: Cambridge University Press, 1st edn.

——— (1905). On denoting. *Mind*, *14*, 479–493. Reprinted in Marsh (1956).

Salmon, N. (1986). *Frege's Puzzle.* Cambridge: MIT Press.

van der Sandt, R. A. (1992). Presupposition projection as anaphora resolution. *Journal of Semantics*, *9*, 333–377.

Scha, R. J. H. (1981). Distributive, collective and cumulative quantification. In J. A. G. Groenendijk, T. M. V. Janssen, & M. B. J. Stokhof (Eds.), *Formal Methods in the Study of Language*, vol. 2, pp. 483–512. Amsterdam: Mathematish Centrum.

Schein, B. (1996). *Plurals and Events.* Cambridge: MIT Press.

Schwarzschild, R. (1996). *Pluralities.* Dordrecht: Kluwer.

Sharvey, R. (1980). A more general theory of definite descriptions. *Philosophical Review*, *89*, 607–624.

Soames, S. (1987). Direct reference, propositional attitudes, and semantic content. *Philosophical Topics*, *15*, 47–87.

——— (1989). Presupposition. In D. Gabbay & F. Guenthner (Eds.), *Handbook of Philosophical Logic*, vol. IV, pp. 553–616. Dordrecht: Kluwer.

Stanley, J. (2000). Context and logical form. *Linguistics and Philosophy*, *23*, 391–434.

Stowell, T. (1991). Determiners in NP and DP. In K. Leffel & D. Bouchard (Eds.), *Views on Phrase Structure*, pp. 37–56. Dordrecht: Kluwer.

Szabó, Z. G. (2000). Descriptions and uniqueness. *Philosophical Studies*, *101*, 29–58.

Szabolcsi, A. (1997). Strategies for scope taking. In A. Szabolcsi (Ed.), *Ways of Scope Taking*, pp. 109–154. Dordrecht: Kluwer.