ANAPHORA AND OPERATORS

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The combination of a variety of operators, anaphoric pronouns and definite descriptions, and their quantifier antecedents produces an array of data that can be bewildering to the semanticist:

(1) Suzi believes that a man1 is following her. It is possible that he1 is from the I.R.S. Ann doubts that he1 is a spy. Suzi hopes that he1 is a private detective who has been hired to find her in order to present her with a large inheritance. It is unlikely that he1 is an assassin.

(2) It ought to be the case that every employee of Knight Industries1 receives a gift2. It is permissible that the employee1 return the gift2 for a cash refund3. It is unclear whether it is permissible for the employee1 to keep the refund3. However, it is permissible that the employee1 donate the refund3 to charity.

(3) Suzi ought to apologize to most of Ann's dinner guests1. It is certain that she insulted them1. But it is unclear whether they1 noticed. They1 brought many gifts2 to dinner. Suzi made a point of belittling the gifts2. It is unfortunate that they1 had to listen to Suzi's remarks about the gifts2. Fortunately several guests3 had to attend a concert4 and left before the gifts2 were opened. It is certain that they3 had more fun at the concert4 than they3 would have had they3 stayed.

(4) It is possible that most cars1 come equipped with a driver's side air bag2. It is unlikely that the air bag2 isn't reflected in what the car1 costs. In fact, Michael believes that the air bag2 is just a marketing scam3 to sell the car1. David doubts that the scam3 works. But he believes it3 is clever. Paul believes that many consumers4 fall for the scam3. He doubts that they4 ever see it3 as a scam.

In particular, it is unclear what semantic account ought to be given of the
subscripted anaphoric expressions in such examples. It is clear that in general these expressions cannot be treated as bound variables. Both (1) and (4), for example, have readings on which all quantifiers in the first sentences take narrow scope relative to the operators there. The scopes of those operators seem confined to the first sentences. So the scopes of the quantifiers are unable to extend far enough to bind the alleged variables in later sentences. And in any case, contemporary syntactic theory has produced a characterization of scope for natural language quantifiers which explains a wide variety of phenomena and according to which the scope of a natural language quantifier cannot extend beyond the sentence in which it occurs.3

In previous work I have defended a view of expressions anaphoric on quantifiers in other sentences according to which they are context dependent quantifiers (cdq's).4 By this I mean that the anaphoric expressions themselves express quantifications and that which quantifications they express (among other things) is partly a function of the linguistic environments in which they are embedded. The present work is an attempt to extend that theory to enable it to handle cases, such as (1)-(4) above, in which such anaphoric expressions, singular and plural, combine with various operators. I begin by reviewing the theory that anaphoric pronouns and definite descriptions whose quantifier antecedents occur in different sentences than those in which they occur are cdq's.5

I shall assume a generalized quantifier account of natural language quantification of the sort proposed by Barwise and Cooper [1981]. On such a view quantifier phrases are noun phrases formed from determiners (‘every’, ‘some’, ‘most’, ‘fewer than two’, etc.) combining with nouns (actually N-bar constituents: ‘man’, ‘men’, ‘fat men’, ‘fat man who knows John’, etc.). The resulting quantified noun phrases combine with (e.g.) transitive or intransitive verb phrases to form sentences. Semantically, N-bar constituents and intransitive verb phrases (either intransitive verbs or transitive verbs with NP objects) denote sets of individuals. We shall therefore sometimes refer to such expressions as set terms. Determiners denote functions from sets of individuals to sets of sets of individuals. Thus quantified noun phrases denote sets of sets of individuals: the result of applying the function its determiner denotes to the denotation of its N-bar constituent. The idea, then, is that determiners combine with set terms (N-bar constituents) to form quantifiers; and quantifiers combine with set terms (intransitive verb phrases) to form sentences. A sentence consisting of a quantifier combined with a set term (intransitive verb phrase) is true iff the denotation of the set term belongs to the denotation of the quantifier.

We can illustrate these ideas by means of a simple example. The denotation of ‘sneezes’ is the set of individuals who sneeze (henceforth the denotation of an expression ‘X’ will be represented as |X|). \( \text{lman} = \text{the set of men. levery} = f \) such that if A is a set of individuals \( f(A) = \{B : B \text{ is a set of individuals and } A \text{ is a subset of } B \} \). Thus every man \( \text{levery}(\text{lman}) = \{B : B \text{ is a set of individuals and } \text{lman is a subset of } B \} \). Finally, ‘every man sneezes’ is true iff \( \text{lsneezes} \in \text{levery} \)
manl (i.e. iff the set of men is a subset of the set of individuals who sneeze).

Within a framework of this sort, the claim that anaphoric expressions such as those underlined in (1)-(4) above express quantifications amounts to the claim that they denote sets of sets of individuals just as ordinary quantifiers do. However the fact that they are context dependent quantifiers suggests that which set of sets of individuals they denote (i.e. which quantification they express) will vary with (linguistic) context. Consider, for example, the following simple data:

(5) At most four professors stood in the hallway. They looked upset about something.
(6) Some students stood in the hallway. They looked upset about something. They talked quietly among themselves.

In (5), the second sentence intuitively asserts that all professors who stood in the hallway looked upset about something. Hence in that linguistic context ‘They’ expresses the quantification which could be expressed without exploiting linguistic context by the phrase ‘all professors who stood in the hallway’. In the second sentence of (6) ‘They’ clearly expresses a different quantification in virtue of being embedded in a different linguistic context. That is, the second sentence of (6) does not make an assertion about all professors who stood in the hallway. We shall capture this by assigning ‘They’ different denotations in (5) and (6).

Many would claim that ‘They’ in the second sentence of (6) nonetheless does express a universal quantification, as it did in (5). The difference between the two occurrences of ‘They’ would concern merely which universal quantification gets expressed. By contrast I claim, but do not argue here, that it rather expresses an existential quantification, so that the second sentence of (6) asserts that some students who stood in the hallway looked upset about something. Indeed, I hold that whether a cdq has the force of a universal quantifier or some other quantifier depends on its quantifier antecedent. Cdq’s whose quantifier antecedents are what Barwise and Cooper [1981] call symmetric monotone increasing express quantifiers whose force is like that of their antecedents, whereas cdq’s anaphoric on quantifiers not possessing this property express universal quantifications.

Thus we will need two clauses in our definition for cdq denotation (in a context): one for cdq’s with symmetric monotone increasing antecedents and one for the others.

Thus far we have discussed the force (universal or otherwise) of the quantification expressed by a given cdq. However, we must be more explicit about exactly what quantification a given cdq expresses. Our discussion will be facilitated by the introduction of some terminology. Quantifier phrases are syntactically complex, the result of combining a determiner (e.g., ‘some’) with an N-bar constituent (‘man who is tall’). From a semantic standpoint, quantifiers are complex too: their denotations are the result of applying the function denoted by their determiners to the sets denoted by the N-bar constituents. Let us call the set that a determiner’s denotation maps to a quantifier denotation the bound of
the quantifier. The bound of an ordinary quantifier is the denotation of its N-bar constituent.

Cdq's, since they are quantifiers, have bounds as well. Their bounds, of course, are determined by linguistic context. The bound of a cdq whose antecedent isn't symmetric monotone increasing and is formed with a universal determiner is the denotation of the antecedent's N-bar constituent. Combined with what was said above about the force of the quantification expressed by a cdq, this means, for example, that in a discourse like 'All professors who came to the party had fun. They didn't leave until two o'clock in the morning,' the cdq in the second sentence has the same denotation as the quantifier phrase 'all professors who came to the party'. The bound of a cdq whose antecedent isn't symmetric monotone increasing and isn't formed from a universal determiner is the intersection of the denotation of the antecedent's N-bar constituent and the denotation of the set term the antecedent attaches to. Thus 'They' in the second sentence of (5) has the same denotation as the quantifier phrase 'all professors who stood in the hallway'. For cdq's whose antecedents are symmetric monotone increasing, the situation is more complex. This can be illustrated by considering (6). I have already said that in the second sentence 'They' expresses an existential quantification such that the sentence asserts that some students who stood in the hallway looked upset about something. If 'They' in the third sentence expressed the same quantification, then the third sentence would assert that some students who stood in the hallway talked quietly among themselves. This, in turn, would entail that all the sentences of (6) would be true if e.g. some students who stood in the hallway looked upset about something and some students who stood in the hallway talked quietly among themselves but no students who stood in the hallway both looked upset about something and talked quietly among themselves. And obviously that is not correct. In effect, we shall end up saying that 'They' expresses different quantifications in the second and third sentences as a result of the fact that predicative material in the second sentence plays some role in determining the bound on the cdq in the third sentence. Hence the third sentence of (6) asserts that some students who stood in the hallway and looked upset about something talked quietly among themselves. In general, the bound for a cdq occurring in a sentence S with a symmetric monotone increasing antecedent is the intersection of the denotation of its antecedent's N-bar constituent, the denotation of the set term the antecedent attaches to, and the denotation of any predicative material occurring in a sentence intervening between S and the antecedent which contains a cdq with the same antecedent. The reader will desire, rightly, some explanation as to why the bounds of cdq's vary depending on the type of quantifier antecedent they have. Unfortunately, however, the explanation is not a simple one and would involve addressing a number of issues that would take us too far afield.

It is not merely the denotation of a context dependent quantifier which is affected by linguistic context. Intuitively, we could know the denotations of two
cdq's, but not know what a sentence containing them asserts because we don't know in which order the cdq's ought to be semantically treated. That is, cdq's have relative scopes or required orders of semantic treatment just as do ordinary quantifiers. However, in the case of cdq's, these are determined by linguistic context. To illustrate, consider the following:

(7) At most four golfers\textsubscript{1} bogeyed several holes\textsubscript{2}. They\textsubscript{1} played the holes\textsubscript{2} conservatively.
(8) Several holes\textsubscript{2} were bogeyed by at most four golfers\textsubscript{1}. They\textsubscript{1} played the holes\textsubscript{2} conservatively.

(I intend these discourses to be read with subject position quantifiers taking widest scope.) The second sentences of these discourses, in spite of being identical and containing cdq's with identical antecedents, make different assertions. The second sentence of (7) asserts that all golfers who bogeyed several holes (possibly different holes for different golfers) played several holes they bogeyed conservatively; whereas in (8) the same sentence asserts that several holes were such that each golfer who bogeyed them played them conservatively. So in effect, the cdq's in the second sentences of (7) and (8) have different relative scopes or required orders of semantic treatment in the two cases. In (7), 'They' (golfers bogeying several holes) gets evaluated first and hence has "wide scope"; and in (8) 'the holes' has wide scope. It should be clear that it is the fact that the relative scopes of the quantifier antecedents are reversed in the two cases which produces the difference in the relative scopes of the anaphoric expressions themselves. Of course if these anaphoric expressions are quantifiers as I am claiming they are, we would expect them to be capable of such variety in their scope relations. In addition to assigning cdq's denotations which vary with linguistic context, we need somehow to capture the way in which their relative scopes or required orders of semantic treatment vary with linguistic context. In King [1992b] both of these tasks were accomplished by defining the denotation and argument of a cdq in a context.

Now that it is clear what is meant by the claim that expressions anaphoric on quantifiers in other sentences are context dependent quantifiers, we need to turn our attention to the various operators which combine with such anaphoric expressions to produce data such as (1)-(4) above. These operators include deontic operators ('It is permissible that'), epistemic operators ('It is possible that'), "attitudinal" operators ('Ann doubts that') and others that are more difficult to classify ('It is unfortunate that'). The most common semantic accounts of these operators have borrowed the possible worlds framework familiar from the treatment of athletic modalities. The worlds are interpreted differently (e.g. "ought" worlds, "belief" worlds, etc.) and accessibility relations are modified to capture the behavior of the favored operator. Nonetheless the accounts share the feature that where $O$ is an operator and $\Theta$ a sentence, $O(\Theta)$ is true (at a world) iff $\Theta$ is true at some, all, etc. worlds accessible from the given world. Operators are...
construed as expressing quantifications over the relevant worlds.

Recently, however, many philosophers have rebelled against such a treatment of "attitudinal" operators. They have sought to replace the possible worlds account of propositions as sets of worlds with an account of propositions as highly structured entities; and to replace the view of "attitudinal" operators as expressing quantifications over "attitude" worlds with the view that attitudinal verbs express relations between individuals and these structured entities. It is beyond the scope of the present work to compare or evaluate various semantic treatments of the operators discussed herein. Still, some view must be adopted in order to provide a treatment of our target data involving anaphoric expressions and various operators. Because I am sympathetic to "structured proposition" accounts of attitude ascriptions, I adopt such an account here without argument. Indeed, I pursue the much more radical course of supposing that all the operators discussed in the present work can be understood as expressing properties of propositions or relations between propositions and other things. This will allow a more uniform and hence simpler semantic account. In addition, there is much to be said for this view and it may just be right! As far as I can see, however, nothing I do depends on accepting this: one should be able to rework everything within a "worlds" framework.

Further, my primary concern here is with the semantics of the anaphoric expressions which combine with various operators to produce data such as (1)-(4) above. I am not interested here in idiosyncratic semantic properties of individual operators. As a result, I want to abstract from the specific semantic properties of individual operators as much as is practicable in an attempt to focus on the semantic features of the anaphoric expressions under study which manifest themselves in the presence of various operators. This will have the unfortunate side effect of making the resulting view appear subject to counterexamples which would not pose any real difficulties for the view when combined with a serious treatment of the operators considered. For the particular semantic (and pragmatic!) features of particular operators no doubt affect the possibility and interpretation of anaphora. The present account ought to be viewed as a basic theory of how the anaphoric expressions under study interact semantically with operators. It will certainly need to be combined with a thorough semantic account of the operators considered to have any real claim to adequacy. Still, as I hope to show, even in its present form, the theory does have significant explanatory power.

Similar considerations necessitate leaving open important questions about propositions. To the extent that part of the philosophical work to be done by propositions is to assist in the production of a semantics for various operators, questions such as how "fine-grained" propositions need to be will require careful study of individual operators. Questions such as this will have to wait.

The simple theory of cdq's sketched to this point must be supplemented to handle the interaction of cdq's and operators. In particular, we need to add to the
theory a principle specifying how cdq scope relative to operators is determined or constrained by linguistic context. We have seen in (7) and (8) above that linguistic context affects the relative scopes of cdq's with respect to each other. As it turns out, linguistic context also constrains the possible scope relations between cdq’s and operators. Thus we need to discuss which features of their linguistic contexts constrain their scope relations with operators and how the scope relations are constrained. In order to address these questions, we must begin by discussing some features of natural language determiners and quantifiers.

Some determiners $\delta$ have the property that when they combine with a set term $\Sigma$ to form a quantifier $\delta(\Sigma)$ and the quantifier combines with another set term $\wedge$ to form a sentence $\delta(\Sigma)\wedge$, the truth of the sentence requires that the intersection of the denotations of $\Sigma$ and $\wedge$ is non-empty. The determiner 'some' is a paradigmatic example. The truth of 'Some student is happy' requires the intersection of the denotations of 'student' and 'is happy' to be non-empty, (i.e. it requires there to be a happy student). To capture this idea, we shall say that the denotation $f$ of a determiner (i.e. a function from sets to sets of sets) is existence entailing iff for any set $A$, every member $B$ of $f(A)$ is such that the intersection of $A$ and $B$ is non-empty. So the denotations of the determiners 'several', 'at least two', and 'many', for example, are existence entailing. On the other hand, we shall say that the denotation $f$ of a determiner is non-existence entailing iff for any set $A$, every member $B$ of $f(A)$ is such that the intersection of $A$ and $B$ is empty. The denotation of 'no' is non-existence entailing. Finally, we shall say that the denotation of a determiner is existence indeterminate iff it is neither existence nor non-existence entailing. The denotation of 'At most two' is existence indeterminate. In some cases, there may be a question as to whether a determiner’s denotation is existence entailing, existence indeterminate or non-existence entailing. For example does the truth of 'Every student who received an “A” is happy' require that there be happy students who received “A”'s? If so, the denotation of 'every' is existence entailing; if not, it is presumably existence indeterminate. (Similar questions arise for the denotations of 'most', 'few' and other determiners.) I here adopt the cautious course of considering the denotations of determiners existence indeterminate when in doubt. It will do no harm to speak of determiners themselves as existence entailing, etc. when their denotations have this property. Similarly, we shall sometimes say that a quantifier is existence entailing etc. when it is formed from an existence entailing determiner.

For the purposes of the following definition, let us say that an operator $\Xi$ is transparent iff $\Xi[S]$ entails $S$. The operators 'Jody knows that', 'It is certain that', 'It is unfortunate that' etc. are transparent, whereas 'It is possible that', 'Mandy believes that' and so on are not. Let $S$ be a sentence containing $n$ quantifiers $\Omega_1,...,\Omega_n$. The quantifier $\Omega_i (1 \leq i \leq n)$ is existentially positive in $S$ iff $\Omega_i$ is either existence entailing or existence indeterminate; and in $S$, $\Omega_i$ does not
take narrow scope relative to a quantifier which is non-existence entailing nor to a non-transparent operator. So in a sentence such as 'No man caught a trout.' (wide scope for 'No man'), neither 'No man', nor 'a trout' is existentially positive. And in 'Jody knows that a man is outside' (narrow scope for 'a man') 'a man' is existentially positive; whereas in 'Mandy believes a man is outside' (again narrow scope for 'a man') it isn't.

Before returning to the question of how linguistic context constrains the scopes of cdq's relative to operators, let me briefly mention what I take to be a more general application of the notion of being existentially positive. I believe that this notion provides the key for understanding when a quantifier will support (simple) anaphora in another sentence. In particular, I claim that an occurrence of a quantifier in a sentence must be existentially positive to support subsequent anaphora in another sentence. This explains why one cannot get discourse anaphora on quantifiers formed using the determiner 'no', as well as the following contrast:

\[(9a)\] Every professor has a computer. It is used for research and administrative work.

\[*(9b)\] No professor has a computer. It is used for research and administrative work.

In the first example, but not the second, 'a computer' is existentially positive.

It shall prove useful to be able to apply our notion of an occurrence of a quantifier in a sentence being existentially positive to occurrences of cdq's. Recall that our definitions of existence entailing, non-existence entailing and existence indeterminate applied in the first instance to determiner denotations: viz. functions from sets to sets of sets. Cdq's, like other quantifiers, have their denotations determined by applying such functions to sets (which in the case of cdq's are contextually determined). So, we can apply our definitions of existence entailing, etc. to the functions used to determine the denotations of cdq's, and so apply these terms to the cdq's themselves, just as was done for "ordinary" quantifiers. It turns out that this done, all cdq's are either existence entailing or existence indeterminate. This in turn means that a cdq is existentially positive iff it doesn't take narrow scope relative to a non-transparent operator.

Returning at last to our question concerning relative scopes of cdq's and operators, the primary constraint that linguistic context puts on the scopes of cdq's relative to operators can be summed up as follows:

**SCOPE CONSTRAINT (SC):** If a cdq is existentially positive, its antecedent must be.

The best way to make clear what SC means is by considering a variety of examples.

First, consider the following examples:
(10) Mary believes that some student flunked the exam. He is sitting right there.

(11) It ought to be the case that some friend of Ann’s apologize to Suzi. He is an accountant.

(12) John believes that at most four teams have won two NBA championships. They are teams with rich histories.

Because of the two possibilities for relative scope between the quantifier and operator in the first sentences of these discourses, these sentences are ambiguous in isolation. However, in (10)-(12) the sentences are not ambiguous: the first sentences require a wide scope reading for the quantifier.\textsuperscript{18} SC makes precisely this prediction. For if the quantifiers take narrow scope relative to the operators in the first sentences, they aren’t existentially positive. Hence the cdq’s anaphoric on these quantifiers must not be. That means they must take narrow scope relative to a non-transparent operator. But there is no non-transparent operator for them to take narrow scope relative to. So the only way to satisfy SC is for the quantifier antecedents to take wide scope over the operators in the first sentences. By contrast, consider:

(13) Mary knows that some student flunked the exam. He is sitting over there.

(14) John knows that at most four teams have won two NBA championships. They are teams with rich histories.

(13) and (14) differ from (10) and (12) syntactically only in that ‘knows’ has been substituted for ‘believes’. Yet there is a significant semantic difference. The first sentence of (13) as it occurs in (13), unlike the first sentence of (10), can be read as asserting either that some student is such that Mary knows that he flunked the exam or that Mary knows that some student or other flunked the exam (that is, the quantifier can be read as taking wide or narrow scope relative to the operator). Similar remarks apply to (14). So unlike (10)-(12), the anaphoric continuations in (13) and (14) do not force a wide scope reading of the first sentence quantifier. Again, this is predicted by SC. Of course the wide scope reading of the quantifier is allowed by SC. In this case the quantifier is existentially positive and the continuation is allowed. On the other hand, if the quantifier takes narrow scope relative to the operator, it still is existentially positive in virtue of the operator being transparent. The continuation is, therefore, still allowed. Hence SC can be satisfied on either reading of the relative scopes of the quantifier antecedent and operator, and so both readings are available.

Similar things happen when we consider examples which are more complex than (10)-(14) in having an operator in the second sentence as well:

(15) Lytie believes that John bought a computer. Ann hopes that it is an IBM.
(16) It is possible that some students flunked the exam. It is permissible that they retake it.

As before, we are interested in the readings of the first sentences here on which the quantifier takes narrow scope relative to the operator, (so that Lytie’s belief isn’t directed at a particular computer and it is possible that some students or other flunked). On these readings of the first sentences, I claim, the cdq’s in the second sentences must be read as taking narrow scope relative to the operators, so that the only readings available for them can be represented as follows:

(15a) Ann hopes that [John bought a computer which is an IBM.]
(16a) It is permissible that [some students who flunked the exam retake it]

This, of course, is precisely what SC predicts. For the quantifiers in the first sentences of (15) and (16) on the readings we are considering, in virtue of having narrow scope relative to the operators in those sentences, are not existentially positive. Hence SC requires that the cdq’s be read as taking narrow scope relative to the operators in the second sentences. However, consider the following example:

(17) It is certain that some professor will resign. Sue believes that he was involved in a dispute over a tenure decision.

Let us once again read the first sentence so that the quantifier takes narrow scope relative to the operator. On this reading the sentence asserts that it is certain that some professor or other will resign (as opposed to asserting that, concerning some professor, it is certain that he will resign). Given this reading of the first sentence of (17), the second sentence allows either of two readings which can be represented as follows:

(17a) [some professor who will resign:x] Sue believes that [x was involved in a dispute over a tenure decision]

(17b) Sue believes that [some professor who will resign was involved in a dispute over a tenure decision]

That is to say, the cdq in the second sentence can be read as taking wide or narrow scope relative to the belief operator in that sentence. On the wide scope reading for the cdq, represented by (17a), the second sentence asserts that Sue has a belief about a particular professor. On the narrow scope reading for the cdq represented by (17b), the sentence asserts that Sue has the general belief that some professor who will resign was involved in a dispute over a tenure decision. As in the previous cases, SC correctly predicts the availability of these readings.

Further predictions made by SC can be illustrated by considering the following examples:
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(18) Chris bought a horse. He ought to give it to charity.

(19) At most four students received “A’s” in Math 411. Laura believes they are smart.

In these examples the quantifier antecedent in the first sentence is existentially positive. Hence SC allows the cdq in the second sentence to take wide or narrow scope with respect to the operator there. For on the narrow scope reading the cdq is not existentially positive; and though it is on the wide scope reading this is allowed in virtue of its antecedent being existentially positive. Looking at (19), let us convince ourselves that the second sentence in fact possesses the readings SC predicts. To this end let us imagine different scenarios which make each of these readings salient. First suppose that Laura took Math 411 and it was very difficult for her. Exactly three students received “A’s” in the class, but Laura hears only that more than one student received an “A”. Not knowing of any particular student who received an “A”, Laura believes that all students who received “A’s” are smart in virtue of how difficult the class was. In such a situation, we would judge both sentences of (19) to be true. Yet there are no particular students who Laura believes to be smart. Hence we seem to take the second sentence of (19) to be equivalent to:

(19a) Laura believes [all students who received “A’s” in Math 411 are smart].

Thus we read the cdq as taking narrow scope relative to the belief operator in the second sentence. Imagine now that Brad, Glenn and Anna are the only students to receive “A’s” in Math 411. Laura, a professor in the math department, doesn't know anything about this class and so has no general view about students who did well in this class. Based on interactions in other contexts with Brad, Glenn and Anna, however, Laura believes each of them to be smart. The professor of Math 411 is concerned about the grading of the course; in particular he is concerned about the number of students who received “A’s” in the course and whether they are good students. Addressing this concern to his teaching assistant, the assistant replies with (19). Again, I claim, we judge the sentences of (19) to be true. Here, however, the second sentence of (19) cannot have the reading given by (19a). For that reading is false in our circumstance (recall that Laura knows nothing about Math 411)! In this situation, it would seem that we take the second sentence to assert:

(19b) (all students who received “A’s” in Math 411: x) Laura believes [x is smart]

That is, we seem to read the cdq as taking wide scope over the operator. Similar considerations suggest that the same thing occurs in (18). Again, SC’s predictions seem on target.

When we consider cases similar to (18) and (19) except that the first
sentences themselves contain operators, SC’s predictions again seem bourne out:

(20) Suzi ought to apologize to a friend of Ann’s. It is certain that he lives in Newport Beach.

Consider the reading of the first sentence of (20) on which the quantifier takes wide scope over the operator, so that the first sentence asserts that some friend of Ann’s is such that Suzi ought to apologize to him. Since on this reading the quantifier antecedent is existentially positive, SC allows both wide and narrow scope readings relative to the operator in the second sentence for the cdq. This means that given the wide scope reading of the quantifier in the first sentence, the second sentence is ambiguous and can be read as equivalent to either of the following:

(20a) (some friend of Ann’s to whom Suzi ought to apologize:x)(it is certain that[x lives in Newport Beach])
(20b) It is certain that((some friend of Ann’s to whom Suzi ought to apologize:x)(x lives in Newport Beach])

Again, let us imagine scenarios which make these readings more salient. Suppose that Ann’s friend Jim invited Suzi to a dinner party which Suzi attended. Suzi insulted a number of guests causing Jim considerable embarrassment. Suppose that everyone in Suzi’s and Ann’s circle of friends knows that Jim lives in Newport Beach. Harry, Suzi and Ann’s friend, utters (20). In such a case we take the sentences of (20) to be true and, I claim, take the second sentence to assert that some friend of Ann’s is such that Suzi should apologize to him and it is certain that he lives in Newport. That is, we take the second sentence to commit Harry to the claim that it is certain that this very man lives in Newport.

By contrast, imagine that a group of Suzi’s friends know that as a result of Suzi’s actions, some friend of Ann’s lost his job. It is agreed that he is owed an apology from Suzi. Suppose however, that no one knows who this person is (including Suzi). However, they know that he worked in Newport Beach and that he lived in the town in which he worked. In such a situation it seems that both sentences of (20) are true (recall that we are reading the first sentence with the quantifier taking widest scope). However, there is no friend of Ann’s such that it is certain that he lives in Newport. Hence we seem to be reading the second sentence of (20) as (20b).20

To be sure, there are examples which seem at odds with the predictions made by SC. To take a simple example, consider:

(21) Glenn believes that an architect in his firm will resign. Glenn believes that she is being pressured into resignation.

If the first sentence of (21) is read with the quantifier taking widest scope (so that
it asserts that some architect in Glenn’s firm is such that Glenn believes of her that she will resign), the quantifier is existentially positive. So SC allows a wide or narrow scope reading for the cdq relative to the operator in the second sentence. However, given the widest scope reading for the quantifier in the first sentence, it does not seem that the second sentence has a reading on which the cdq takes narrow scope relative to the belief operator. That is, we seem forced to read the second sentence as ascribing a belief about a particular person to Glenn. Exceptions of this sort seem to occur in cases in which the sentences containing the quantifier antecedent and the cdq contain the same operator (as in (21)) or when the operator in the sentence containing the quantifier and the operator in the sentence containing the cdq are logically related. There are at least two ways such exceptions could be accommodated within the present theory. SC could be modified so as to predict the exceptions; or we could retain SC and hold that pragmatic considerations filter out the readings which are allowed by SC but unavailable in examples such as (21). Since we hope that SC itself has a pragmatic explanation, there does not seem to be much to choose between these alternatives. It amounts to choosing between the claim that a principle whose operation is a result of pragmatic factors can be overridden by additional pragmatic factors and the claim that a more complex set of pragmatic factors result in the operation of a more complex principle. I shall not pursue this matter further here.

Let us take up a final prediction made by SC. Consider the following example:

   (22) It is (epistemically) possible that some man is following me. Suzi knows he is the mayor of Chicago.

In particular, consider the reading of the first sentence resulting from giving the quantifier narrow scope relative to the operator. On this reading, the sentence asserts that for all we know some man or other is following me. Given this reading of the first sentence, the continuation comprised by the second sentence is infelicitous. And SC predicts that this continuation is unacceptable. For the quantifier is not existentially positive in the first sentence. However, the cdq in the second sentence will be existentially positive whether it is read with wide or narrow scope. So, given a narrow scope reading for the quantifier antecedent in the first sentence, there is no way to assign scope to the cdq in the second sentence and satisfy SC. Similar remarks apply to examples such as:

   (23) Suzi hopes some man asks her to dance. Ann is unaware that he is an accountant.
   (24) Michelle believes that Harry saw several movies last night. It is interesting that they won Academy Awards.

As before, there appear to be examples which cast doubt on SC’s prediction here:
Paul believes that Suzi met a man last night. It is certain that he is a loser.

This discourse seems to be acceptable even when the quantifier antecedent in the first sentence is given narrow scope relative to the operator there. Interestingly, however, when the quantifier antecedent is given narrow scope, the second sentence makes a "universal" assertion lacking existential commitment: the second sentence of (25) seems to assert that any man Suzi met last night is a loser, without committing its utterer to the claim that Suzi did meet any man. I take this reading to be a reading induced by charity. The hearer notes that the quantifier in the first sentence is not existentially positive and thus that the utterer hasn't committed herself to the existence of a man (such that Paul believes Suzi met him). The hearer also sees that both wide and narrow scope readings for the cdq in the second sentence are existentially positive and would entail the existence of a man Suzi met. Hence these are ruled out (by SC). So what could the utterer of (25) intend? Since, as we have seen, the speaker hasn't committed herself to the existence of a man Suzi met, we want to avoid interpreting the second sentence in such a way that it results in such a commitment. The most reasonable thing to do is to interpret the sentence as expressing the claim that the speaker has knowledge which entails that any man Suzi may have met is bound to be a loser.

In claiming that this interpretation of the second sentence of (25) is induced by charity, I am claiming that it is not a literal meaning of the sentence (i.e. that our semantics should not assign the sentence such a meaning). One piece of evidence for this latter claim is that the second sentences of discourses like (25) often show no tendency to allow this reading. Neither (23) nor (24) allows such a reading, nor does the following:

John believes that a computer is in his office. It is unfortunate that it is an IBM.

If such readings were literal meanings of the second sentences of such discourses, one would expect them always to be available unless strongly suppressed by pragmatic factors. But this does not seem to be the case.

Having fully stated our theory of cdq's, there is a point that needs emphasizing. For the purposes of illustrating the theory and making SC clear, we have considered quite simple discourses. They have generally contained only two sentences, one quantifier (often an existential quantifier), one anaphoric expression and at most two operators. This may have misled the reader into thinking that our theory is primarily intended to handle such relatively simple data; and that successfully handling such data is the primary argument in favor of the theory. However, this is far from the case. I take the primary argument in favor of the theory to be its promise to handle quite complicated extended discourses containing a wide variety of quantifiers, anaphoric expressions and
operators. I began the paper by exhibiting some data of this sort, and I remind the reader that the strength of the present theory is its success with these complex cases. Though we have not worked through an example of this sort, following the formal semantics presented at the end of the paper such an example is treated.

Finally, we turn to difficulties with our theory. The account we have given of how the bounds of cdq's with symmetric monotone increasing antecedents are determined appears to lead to trouble in certain instances. I shall sketch three kinds of cases in which our theory appears to make incorrect predictions. Other sorts of problematic cases could be constructed, however my response to the following three will yield the tools for addressing other problematic cases. In each, the quantifier antecedent of the cdq is a singular existential quantifier, though analogous examples could be constructed using other symmetric monotone increasing quantifiers.

1. Walter Edelberg [1986] asks us to consider the following situation:

*Monday:* Smith (the mayor) and Jones (the commissioner) have been shot, at opposite ends of Chicago. Detectives A and B are investigating both cases, but neither knows that Smith is the mayor or that Jones is the commissioner. Smith and Jones, though hospitalized, are (and are known by both detectives to be) alive. A and B have discussed the two cases at length, and though they think someone shot Smith and that someone shot Jones, both believe the two cases are entirely unconnected. At this time neither has anyone in mind as a suspect.

*Tuesday:* Both Smith and Jones have died of their gunshot wounds. Detective A knows Smith died, and thus now believes that the person who shot Smith murdered him, but doesn't know that Jones is dead. Likewise, B knows Jones died, and thus now believes that the person who shot Jones murdered him, but doesn't know that Smith is dead. Detective A knows that Smith was the mayor, but not that Jones was the commissioner. Similarly, B now knows that Jones was the commissioner, but not that Smith was the mayor. After reflecting on certain similarities between the two cases, Detective B infers that the man who shot Smith is the same person as the man who shot Jones. He communicates this to A saying "the man who shot Smith is the man who shot Jones." A disagrees, but B persists in his opinion.

Edelberg claims that in these circumstances, the following sentence is true

(27) Detective A thinks someone murdered the mayor and Detective B thinks he murdered the commissioner.

when (as we would say) 'someone' takes narrow scope relative to the belief operator in the first conjunct. And indeed, we do seem inclined to judge the sentence true on this reading in these circumstances. However, on the theory I have been sketching (27) should be false in such circumstances on the reading in question. For our theory predicts that the second conjunct asserts that B thinks [someone who murdered the mayor murdered the commissioner]; B, however doesn't believe that someone murdered the mayor, but merely that someone shot Smith.
2. David Kaplan (in the discussion of a paper presented at UCR) imagines a situation in which Jim received one hundred percent on the exam, but Wendy doesn't believe that he did (perhaps not knowing Jim); but Wendy does falsely believe that Harry received one hundred percent on the exam and cheated in so doing. In such a situation our theory predicts that both sentences of

(28) Someone scored one hundred percent on the exam. Wendy believes he cheated.

should be true on the reading of the second sentence (which SC allows) on which the cdq takes narrow scope relative to the belief operator. For on that reading, the second sentence is equivalent to: Wendy believes[someone who scored one hundred percent on the exam cheated]. And this is true in the situation (in virtue of Wendy's belief about Harry), as is the first sentence (in virtue of Jim's performance on the exam). However, it seems as though the second sentence has no true reading in this situation.

3. Walter Edelberg [1991] considers the following argument:

(29) I ought to give you a four legged horse
It is permissible that I give you a three legged horse

I ought to give you a horse and it is permissible that it be three legged when all quantifiers take narrow scope relative to the operators in the sentences containing them. Intuitively the argument is invalid on these readings of the sentences. However, on my view the second conjunct of the conclusion should be equivalent to: it is permissible that [some horse I give you be three-legged]. But then the conclusion is entailed by the premises and the argument ought to be valid.

In all three cases, it seems as though the difficulty is traceable to our account of how the bounds of cdq's are fixed. In 2, for example, it is the claim that the bound for the cdq is people who received one hundred percent on the exam which results in the cdq expressing the quantifier someone who received one hundred percent on the exam and thus the sentence containing the cdq asserting that Wendy believes that [someone who received one hundred percent on the exam cheated]. It appears, then, that there is something wrong with our account of how the bounds of cdq's are determined. At the same time, there are phenomena which appear to support our account of bound determination. First, if one were to hear someone utter the following discourse

(30) It is possible that a man is following Ann. Melanie thinks he is a policeman.

(assume that it is somehow clear that 'a man' takes narrow scope relative to the operator in the first sentence) in the absence of any background information, one would take the second sentence to assert that Melanie believes that a policeman
is following Ann. Of course this is precisely what our theory, including our account of cdq bound determination, predicts that the second sentence asserts. So here our theory correctly predicts how we would naturally interpret the second sentence of (30). Second, our theory correctly predicts that in the following discourse, when the first sentence is read with the quantifier taking narrow scope relative to the operator, the second sentence will be anomalous:

(31) It is possible that a man is following Ann. Melanie believes that he is a policeman but that he isn't following Ann.

For our theory predicts that the second sentence is equivalent to 'Melanie believes that [a man is following Ann and is a policeman and isn't following Ann]'. Hence the sentence attributes an explicitly inconsistent belief to Melanie, resulting in anomaly. Clearly our account of bound determination plays a crucial role in this prediction. Finally our account explains why the first and second sentences of the following discourse:

(32) It is possible that a man is following Ann. Melanie believes he wants to date Ann.

are not equivalent to the second and first sentences, respectively, of the following discourse:

(33) Melanie believes a man wants to date Ann. It is possible that he is following Ann.

when the quantifiers in the first sentences of both discourses take narrow scope relative to the operators.\(^{30}\) For our account predicts that the second sentence of (32) is equivalent to 'Melanie believes a man who is following Ann wants to date Ann.', and hence is not equivalent to the first sentence of (32). Similar remarks apply to the second sentence of (33). Again here, our account of cdq range determination plays a significant role.

So on the one hand, a variety of considerations seem to support our account of cdq bound determination; and yet the three problematic cases outlined above appear to show that the account cannot be right. Again let me stress that the problem cases arise only in connection with cdq's whose antecedents are symmetric monotone increasing.

We can begin to solve this puzzle by reflecting on the differences between cases, such as (30), where our account of bound determination makes correct predictions and cases, such as (27), where it doesn't. The important difference for our purposes is that as a result of having access to the background information provided about Detectives A and B, we bring to the interpretation of (27) the presupposition that the sentence 'Detectives A and B believe that someone shot Smith' is true, (and perhaps other presuppositions as well). Now consider the relation between the presupposed sentence and the first conjunct of (27), which contains the antecedent of the cdq in the second conjunct. The first conjunct is an
elaboration of the presupposed sentence in the sense that if we take the predicative material constituting the scope of the quantifier antecedent in the presupposed sentence \((x \text{ shot Smith})\) and add it to the predicative material constituting the scope of the quantifier antecedent in the first conjunct of (27), the first conjunct remains true and, intuitively, is “about” the same topic. When a presupposed sentence bears this sort of relation to a sentence containing the quantifier antecedent of a cdq, let us say it is an \textit{antecedent presupposition}. I claim that the reason we judge (27) to be true in the described situation is that we treat the quantifier in the antecedent presupposition as the cdq’s antecedent rather than the quantifier in the first conjunct. This results in using the predicative material constituting the scope of the quantifier in the antecedent presupposition to determine the bound of the second conjunct cdq. Thus we interpret the second sentence as asserting that Detective B thinks that someone shot Smith and murdered the commissioner, which is true in the situation described.

In general, I claim that when an antecedent presupposition is present, we often, indeed perhaps always, treat the (relevant) quantifier in it as the antecedent of the subsequent cdq, and so use the predicative material in the scope of the quantifier to determine the bound of the cdq. Before arguing for this claim, let me address an objection. It might be objected that this claim has the implication that the sentence which contains the “real” antecedent of the anaphoric expression (in the case at hand, the first conjunct of (27)) is not relevant to the anaphoric expression and that this flies in the face of the fact that it \textit{is} the (at least grammatical) antecedent of the expression. But of course we don’t deny that the sentence containing the “real” antecedent is relevant to the anaphoric expression and its interpretation. It is just relevant in an indirect way. It is only because the sentence containing the “real” antecedent constitutes an elaboration of the antecedent presupposition (in the sense described above) and the anaphoric expression is grammatically linked to the sentence that contains the “real” antecedent, that the anaphoric expression gets linked to the antecedent presupposition. So the sentence containing the “real” antecedent is highly relevant to the anaphoric expression and its interpretation. It is just that its predicative material is not used in interpreting the anaphoric expression.

Our claim that antecedent presuppositions function as indicated can be supported by considering (23) above. It was pointed out that when the quantifier in the first sentence is read with narrow scope relative to ‘Suzi hopes’, the second sentence is infelicitous. This infelicity, predicted by (SC), was claimed to result from that fact that the cdq is existentially positive whereas its antecedent isn’t. But now consider the following story. Suzi has been receiving flowers and notes from a secret admirer. On the basis of this and perhaps other evidence, Suzi and Ann know that some man who works where Suzi and Ann do likes Suzi, but they don’t know who he may be. Another employee, Laura, has somehow determined that the admirer is an accountant, but hasn’t told Suzi or Ann. Suzi’s
employers throw a party which Suzi and Ann attend. Suzi moves to the edge of
the dance floor in the hope that “her admirer” will see her and ask her to dance.
Observing Suzi, Laura says to a friend

(23) Suzi hopes some man asks her to dance. Ann is unaware that he is
an accountant.

Against the background of our story, the reading of (23) resulting from giving
the quantifier antecedent narrow scope is now judged to be both felicitous and
true! The reason, I claim, is that our story creates the antecedent presupposition
‘Suzi and Ann know that some man who works where Suzi and Ann do likes
Suzi’. As before, the quantifier in this latter sentence functions as the antecedent
of the pronoun. But since this quantifier (unlike that in the first sentence of (23))
is existentially positive, (SC) allows the continuation containing the anaphoric
expression. Hence it is felicitous.32

Note too that if this is the correct explanation of why we judge (27) to be
true in the situation described above, we can also explain why our original
account of bound determination is correct in cases like (30) above. For in
interpreting (30), no background information was supplied and hence there were
no antecedent presuppositions. Thus we have no choice but to use the predicative
material in the scope of the quantifier antecedent to determine the bound on the
cdq. So our theory correctly predicts how we interpret the anaphoric expression
in the absence of antecedent presuppositions.

Turning now to (29), I believe that the same type of explanation underlies
our intuition that the argument is not valid. However, this time the antecedent
presupposition comes not from a background story, but is given in the first
premise of the argument. Note that the first conjunct of the conclusion is an
elaboration of the first premise in the sense outlined above.

In discussing the way in which the interpretation of cdq’s with symmetric
monotone increasing antecedents may be affected by predicative material drawn
from antecedent presuppositions, I have skirted the question of whether the
resulting interpretations represent literal readings of the cdq’s. That is, one could
hold either that such interpretations do represent literal readings of the cdq’s or
one could hold that the literal reading of such cdq’s are always given by using
only material in the scope of the “real” quantifier antecedent for bound
determination.33 On the latter view, “readings” resulting from using other
material for bound determination are a pragmatic phenomenon, akin to the
singular propositions which, many claim, are sometimes conveyed though not
literally expressed by utterances of existentially quantified sentences.34 Because
of the difficulty of this question, raising as it does the question of how/where to
draw the line between pragmatics and semantics, I leave it here as an open
question.35 What is clear, at any rate, is that such use of material drawn from
antecedent presuppositions in bound determination is a common feature of the
interpretation of cdq’s with symmetric monotone increasing antecedents.
Finally, let us consider (28) in the situation described. Here I believe somewhat different mechanisms are at work from those in the previous two cases. However, as in the previous two cases, information conveyed by the “story” we are told plays a role in our intuitions about truth and falsity. First, as a result of the background information we are given, we cannot help feeling that Jim is being “talked about” in the first sentence of (28). In effect, we associate the singular proposition that Jim received one hundred percent on the exam with the general proposition that someone received one hundred percent, which is literally expressed by the first sentence of (28). As generally occurs in such cases, we have some tendency to read the subsequent anaphoric expression as referring to the “objectual constituent” of the singular proposition (i.e. Jim). Of course read in this way the second sentence of (28) is false, since Wendy doesn’t believe Jim scored one hundred percent. In addition, it is part of the background story that Wendy has a de re belief (i.e. she believes that Harry cheated on the exam). This inclines us to read the cdq in the second sentence as taking wide scope over the belief operator, so that the second sentence attributes a de re belief to Wendy. On this reading, the sentence asserts that someone who received one hundred percent on the exam is such that Wendy believes that he cheated. But again this is false, since Wendy only believes that Harry cheated and Harry did not receive one hundred percent. Thus features of the story incline us to read the discourse in the two ways described above, both of which are false. The two readings are complementary, in that one results in attributing to Wendy the belief that Jim cheated and the other asserts that someone who received one hundred is such that Wendy believes that he cheated, where Jim is the only person who we are told scored one hundred. So both readings result in our ascribing to Wendy the belief that Jim cheated. I claim that the story we are told, by inclining us toward the two complementary readings just described, very strongly suppresses the reading on which the second sentence asserts that Wendy believes that someone (or other) who scored one hundred percent on the exam cheated. Thus we get no true reading of the second sentence.

Formal semantics

(I) SYNTAX

For each $n \geq 1$ we have the $n$-ary relation symbols $A,C,...,N,A_1,...$. Our variables are $w,x,y,z,w_1,x_1,y_1,z_1,...$ and our determiners are ‘every’, ‘an’, ‘some2’ (plural), and ‘all’. We have the individual constants $a,b,c,...,v,a_1,b_1,c_1,...$. Finally, we have the operators $O,O_1,O_2,...$; and we have the attribudal verbs $B,B_1,B_2,...$. We shall call $O_1,O_3,...$ transparent operators and the other operators are non-transparent. The verbs $B_1,B_3,...$ are used to form transparent operators; the other verbs form non-transparent operators.

1. If $\Theta$ is a formula and $\alpha$ is a variable, then $^\wedge \alpha[\Theta]$ is a set term.
2. If $\delta$ is a determiner and $\Sigma$ is a set term, then $\delta(\Sigma)$ is a quantifier.
3. If $\Pi$ is an $n$-ary relation symbol and $\alpha_1, \alpha_2, ..., \alpha_n$ are $n$ variables, then $\Pi\alpha_1, ..., \alpha_n$ is a formula.
4. If $\Omega$ is a quantifier and $\Sigma$ is a set term, then $\Omega\Sigma$ is a formula.
5. If $X$ is an attitudinal verb, $\beta$ is an individual constant, and $\Theta$ is a formula, then $X[\Phi,\Theta]$ is a formula.
6. If $\Xi$ is an operator and $\Theta$ is a formula, then $\Xi[\Theta]$ is a formula.
7. If $\Psi$ and $\Phi$ are formulas, so are $\neg \Phi$ and $(\Phi \& \Psi)$.

(II) PROPOSITIONS EXPRESSED BY FORMULAS

We shall assign semantic contents to various expressions of our language. Let $f$ be a function from variables to individuals. Then the semantic content of a variable $\alpha$ relative to $f$ is $f(\alpha)$. The semantic content of an individual constant $\beta$ relative to $f$ is the individual $\beta$ names. The semantic content of an $n$-ary relation symbol is the relation it expresses. The semantic content of an attitudinal verb is the two place relation it expresses. The semantic content of an operator is the property it expresses. In what follows, let $\Pi$ be an $n$-ary relation symbol; $\alpha_i$ be a variable; $\delta$ be a determiner; $\Sigma, \land$ be set terms; $\Xi$ be an operator; $X$ be an attitudinal verb; $\beta$ be an individual constant; $\Phi, \Psi$ be formulas. The semantic content of a sentence, a proposition, is determined by the semantic contents of its part as follows:

1. The proposition expressed by: $\Pi\alpha_1, ..., \alpha_n$ relative to $f$ is $<<\alpha_1, ..., \alpha_n>,\Pi*>>$ where $\alpha_i$ is the semantic content of $\alpha_i$ relative to $f$ and $\Pi*$ is the semantic content of $\Pi$.
2. The proposition expressed by: every($^\langle\Phi\rangle\bigwedge^\langle\Psi\rangle$) relative to $f$ is $<<\text{EVERY},g>,h>>$ where $\text{EVERY}$ is the function from a set of individuals $A$ to the set of sets of individuals $B$ such that $A$ is a subset of $B$, $g$ is the function from an individual $o'$ to the proposition expressed by $\Phi$ relative to $f'$ where $f'$ differs from $f$ at most in that $f'(\alpha_1)\neq o'$; and $h$ is the function from an individual $o''$ to the proposition expressed by $\Psi$ relative to $f''$ where $f''$ differs from $f$ at most in that $f''(\alpha_2)\neq o''$,
(similarly the same formula prefixed instead by the determiners 'all', 'a(n)' and 'some' expresses relative to $f$ the propositions $<<\text{ALL},g>,h>>$, $<<\text{AN},g>,h>>$ and $<<\text{SOME}_2,g>,h>>$, with $g,h$ as above; where $\text{ALL}$ is the function from a set of individuals $A$ containing at least two members to the set of sets of individuals $B$ such that $A$ is a subset of $B$, and $\text{ALL}$ maps sets with fewer than two members to the empty set; and where $\text{AN}$ is the function from a set of individuals $A$ to the set of sets of individuals $B$ such that $A$'s intersection with $B$ is non-empty; and where $\text{SOME}_2$ is the function from a set of individuals $A$ to the set of sets of individuals $B$ such that $A$ and $B$ share at least two members).
3. The proposition expressed by $X[\Phi]$ relative to $f$ is $<<\text{Prop} \Phi>,X*>>$.
where \( X^* \) is the relation expressed by \( X \), \( o' \) is the semantic content of \( \beta \) relative to \( f \) and \( \text{Prop}_\Phi \) is the proposition expressed by \( \Phi \) relative to \( f \).

4. The proposition expressed by \( \Xi[\Phi] \) relative to \( f \) is \( \langle \text{Prop}_\Phi, \Xi^* \rangle \) where \( \text{Prop}_\Phi \) is the proposition expressed by \( \Phi \) relative to \( f \) and \( \Xi^* \) is the property expressed by \( \Xi \).

5. The propositions expressed by \( \neg \Phi, (\Phi \& \Psi) \) relative to \( f \) are
\( \langle \neg \text{Prop}_\Phi \rangle \) and \( \langle \text{CONJ}, \langle \text{Prop}_\Phi, \text{Prop}_\Psi \rangle \rangle \) where NEG and CONJ are the appropriate functions from truth values/pairs of truth values to truth values, and \( \text{Prop}_\Phi, \text{Prop}_\Psi \) are the propositions expressed by \( \Phi,\Psi \) relative to \( f \).

(III) TRUTH OF PROPOSITIONS IN CIRCUMSTANCES

The intension of an \( n \)-place relation is a function from a circumstance \( c \) to a set of \( n \)-tuples of individuals in \( c \). The intension of a function \( g \) from individuals to propositions is a function from a circumstance \( c \) to the set of individuals \( o' \) in \( c \) such that \( g(o') \) is true in \( c \). The intension of the semantic content of an operator is a function from a circumstance \( c \) to a set of propositions. The intension of the semantic content of a verb of propositional attitude is a function from a circumstance \( c \) to a set of pairs of individuals and propositions. The extension of a semantic content in a circumstance \( c \) is the value of its intension when applied to \( c \). We use \( \text{ext}_c(\varepsilon) \) for the extension of the semantic content \( \varepsilon \) in \( c \).

1. A proposition of the form \( \langle o_1,...,o_n,\Pi^* \rangle \) is true in \( c \) iff \( \langle o_1,...,o_n \rangle \) belongs to \( \text{ext}_c(\Pi^*) \).
2. A proposition of the form \( \langle \text{EVERY},g,h \rangle \) is true in \( c \) iff \( \text{ext}_c(h) \) belongs to \( \text{EVERY}(\text{ext}_c(g)) \), (similarly for propositions of the form \( \langle \text{AN},g,h \rangle, \langle \text{SOME}2,g,h \rangle \) and \( \langle \text{ALL},g,h \rangle \)).
3. A proposition of the form \( \langle o',\text{Prop}_\Phi,X^* \rangle \) is true in \( c \) iff \( \langle o',\text{Prop}_\Phi \rangle \) belongs to \( \text{ext}_c(X^*) \).38
4. A proposition of the form \( \langle \text{Prop}_\Phi,\Xi^* \rangle \) is true in \( c \) iff \( \text{Prop}_\Phi \) belongs to \( \text{ext}_c(\Xi^*) \).
5. A proposition of the form \( \langle \text{NEG},\text{Prop}_\Phi \rangle,\langle \text{CONJ},\langle \text{Prop}_\Phi,\text{Prop}_\Psi \rangle \rangle \) is true in \( c \) iff \( \text{NEG/CONJ} \) when applied to the truth values of \( \text{Prop}_\Phi/\text{Prop}_\Phi,\text{Prop}_\Psi \) in \( c=T \).

(IV) RULES OF DISCOURSE FORMATION

1. A formula without free variables may be entered at any point in a discourse \( D \).
2. The variables of each quantifier in \( D \) are unique.39
3. An operator or verb of propositional attitude subscripted by an individual constant may have no more than one occurrence in any formula in \( D \).

Free variables will play the role of cdq's in our formal discourses. A free variable
will be understood as anaphoric on the quantifier which has it as its primary variable, (rule 2 guarantees that the antecedent will be unique). Thus free variables will be interpreted in the light of features of the discourse in which they occur. This task shall be made easier by representing features of a discourse relevant to the interpretation of a variable by an \textit{announcement} for the variable. These announcements, then, encode information about the interpretation of "cdq’s". A flag for a variable $\alpha$ is an expression of the form $<\delta:\alpha>$ or $<\delta\delta:\alpha>$ where $\delta$ is a determiner and $\delta$ is an attitudinal verb subscripted with an individual constant or an operator. An announcement for $\alpha$ is a scope line whose flag is a flag for $\alpha$. So any of the following could be an announcement for the variable $x$:

$$
<\text{every}:x> \quad <\text{O,every}:x> \quad <B\alpha,\text{an}:x>
$$

Intuitively, the presence of an operator or subscripted attitudinal verb in a variable’s announcement indicates that the variable/cdq takes narrow scope relative to that operator in subsequent sentences. Since announcements tell us how to interpret free variables/cdq’s, we need to make sure that they properly represent information about the discourse relevant to the interpretation of the cdq. The following rule insures this:

4. If a quantifier whose primary variable is $\alpha$ occurs in a formula at a prior point in D, $\alpha$ may be announced as follows: (i) $\alpha$’s announcement must be subordinate to the announcements of any variables which are primary variables of quantifiers which take wide scope over $\alpha$’s antecedent and to the announcements of any variables which occur free in the sentence containing $\alpha$’s antecedent; and subordinate to any other announcements; (ii) $\delta$ in $\alpha$’s flag is the determiner of its antecedent; (iii) if $\alpha$’s antecedent occurs in the scope of a non-transparent operator, $\alpha$’s flag must be of the form $<\delta,\delta:\alpha>$ where $\delta$ is a non-transparent operator.

Note that nothing rules out a variable being introduced more than once. Indeed, this must happen when e.g. two sentences contain the same free variable and distinct operators which the variable is to be interpreted as taking narrow scope relative to; in such a case, the variable needs two different announcements (one containing each operator); 4(i) rules out either announcement being subordinate to the other. See the example at the end of the formulation of the semantics. Finally, we have the rule for entering cdq-containing formulas:

5. A formula $\Phi$ containing free variables may be entered in D as follows: (i) $\Phi$ is subordinate to an announcement for each free variable in $\Phi$; (ii) each free variable in $\Phi$ only occurs in $\Phi$ in the scope of any operator or attitudinal verb in its announcement; (iii) any operator or attitudinal verb $\delta$ occurring in an announcement of a free variable $\alpha$ in $\Phi$ occurs in $\Phi$ within the scope of any operator in an announcement superordinate to
(V) PROPOSITIONS EXPRESSED BY FORMULAS IN CONTEXTS

The context of a formula \( \Phi \) occurring at line \( i \) in discourse \( D \) is \( \langle v_1, \ldots, v_p \rangle \), where the \( v_j \)'s are the announcements to which \( \Phi \) is subordinate at \( i \) in \( D \) in their order of subordination in \( D \).

For a formula \( \Phi \) occurring at line \( i \) in \( D \) with context \( \langle v_1, \ldots, v_p \rangle \), we define the \( \theta^{th} \) through \( \eta^{th} \) propositions expressed by \( \Phi \) at \( i \) in \( D \) relative to \( f \).

The \( \theta^{th} \) proposition expressed by \( \Phi \) at \( i \) in \( D \) relative to \( f \) is the proposition expressed by \( \Phi \) relative to \( f \).

The \( \eta^{th} \) \((0 < m \leq n)\) proposition expressed by \( \Phi \) at \( i \) in \( D \) relative to \( f \), \( \text{Prop}(\Phi, \theta_{m,D,f}^1) = \)

\[\text{case i: } \forall_{(n+1)-m} = \langle \text{an: } \alpha \rangle : \alpha \text{'s antecedent and the set term it attaches to is of the form: } \forall \langle \alpha_1(\Theta) \rangle \forall \langle \Omega \rangle \]

\( \text{Prop}(\Phi, m_{i,D,f}^1, \langle \text{AN, } g \rangle, h) \) where \( g \) is the function from individuals \( \alpha \) to propositions expressed by the formula \( \Theta \) relative to \( f \), where \( f \) differs from \( f \) at most in assigning \( \alpha \) to \( \alpha_1 \) and \( h \) is the function from individuals \( \alpha \) to \( \text{Prop}(\Phi, m_{-1,D,f}^1, f'') \) where \( f'' \) differs from \( f \) at most in assigning \( \alpha \) to \( \alpha_1 \) and \( \alpha_2 \).

\[\text{case ii: } \forall_{(n+1)-m} = \langle \text{every: } \alpha \rangle : \alpha \text{'s antecedent is of the form: } \exists \langle \alpha_1(\Theta) \rangle \forall \langle \Omega \rangle \]

\( \text{Prop}(\Phi, m_{i,D,f}^1, \langle \text{EVERY, } g \rangle, h) \) where \( g \) is the function from individuals \( \alpha \) to propositions expressed by the formula \( \Theta \) relative to \( f \), where \( f \) differs from \( f \) at most in assigning \( \alpha \) to \( \alpha_1 \) and \( h \) is the function from individuals \( \alpha \) to \( \text{Prop}(\Phi, m_{-1,D,f}^1, f'') \) where \( f'' \) differs from \( f \) at most in assigning \( \alpha \) to \( \alpha_1 \).

\[\text{case iii: } \forall_{(n+1)-m} = \langle \exists, \text{an: } \alpha \rangle : \exists \text{'s antecedent and the set term it attaches to is of the form: } \forall \langle \alpha_1(\Theta) \rangle \forall \langle \Omega \rangle \text{ and } \text{Prop}(\Phi, m_{-1,D,f}^1, f'') \text{ is or has a constituent of the form: } \langle \text{Prop C, } \exists^* \rangle \text{ (where Prop C is some proposition and } \exists^* \text{ is the semantic content of } \exists \rangle \]

\( \text{Prop}(\Phi, m_{i,D,f}^1) \) is the result of substituting \( \langle \text{AN, } g \rangle, h \) for \( \text{Prop C in Prop}(\Phi, m_{-1,D,f}^1) \) where \( g \) is the function from individuals \( \alpha \) to the proposition expressed by \( \Theta \) relative to \( f \) where \( f \) differs from \( f \) at most in assigning \( \alpha \) to \( \alpha_1 \), and \( h \) is the function from individuals \( \alpha \) to \( \text{Prop C} \) where \( \text{Prop C} \) is the constituent of \( \text{Prop}(\Phi, m_{-1,D,f}^1) \) corresponding to the constituent \( \text{Prop C} \) of \( \text{Prop}(\Phi, m_{-1,D,f}^1) \) and \( f'' \) differs from \( f \) at most in assigning \( \alpha \) to \( \alpha_1 \).

\[\text{case iv: } \forall_{(n+1)-m} = \langle \exists, \text{every: } \alpha \rangle : \exists \text{'s antecedent is of the form: } \]
every(\^{\alpha_1[\Theta]}) and Prop\Phi,m_{1,D,f} is or has a constituent of the form 
<Prop C, \Xi^*> (Prop C, \Xi^* as above)

Prop\Phi,m_{1,D,f} is the result of substituting <<EVERY,g>,h> for Prop C in 
Prop\Phi,m_{1,D,f} where g is the function from individuals o' to the proposition 
expressed by \Theta relative to f' where f' differs from f at most in assigning o' to a_i 
and h is the function from individuals o' to Prop C' with Prop C' as above. 
(similar clause for <<\Xi, all:\alpha>>)

case v: v_{(n+1)}=-<X_B, an:\alpha> for some verb of propositional attitude X 
and some individual constant \beta: \alpha's antecedent and the set term it 
attaches to is of the form: an(\^{\alpha_1[\Theta]})\alpha[\Omega] and Prop\Phi,m_{1,D,f} is or has 
a constituent of the form <<\alpha, Prop C>, X^*>> (where Prop C is some 
proposition and X* is the semantic content of X, and \alpha is the semantic 
content of \beta relative to f)

Prop\Phi,m_{1,D,f} is the result of substituting <<AN,g>,h> for Prop C in Prop 
\Phi,m_{1,D,f} where g is the function from individuals o' to the proposition 
expressed by (\Theta&\Omega) relative to f' where f' differs from f at most in assigning o' 
to \alpha_1 and \alpha and h is the function from individuals o' to Prop C' with Prop C' 
as above. (similar clause for <<X_B, some_{2:}\alpha>>; and similar clauses for 
<<X_B, every:\alpha>>, <<X_B, all:\alpha>> with differences similar to those between clauses iii 
and iv above)

(VI) AN EXAMPLE

Jennifer believes that every professor at the University is assigned a 
teaching assistant. It is possible that the teaching assistant works harder 
than the professor. Suzi believes that the teaching assistant earns much 
less than the professor.

When the quantifiers in the first sentence take narrow scope relative to the belief 
operator, the following is a "formal analogue" of this discourse:

1. Bj[every(\^{\w Fw}[Fw])x[an(\^{\z Gz})y[Axy]])]
   <O, every:x> | <O, an:y> | O[Hx]

2. <B_k, every:x> | <B_k, an:y> | B_k[Ey]

Note that the variables x and y need to be announced twice as a result of the fact 
that they appear in the scope of distinct operators in 2 and 3. Further, discourse
formation rule 4 requires announcements for \( y \) to be subordinate to those for \( x \) (and no others); and it requires the announcements of \( x \) and \( y \) to contain non-transparent operators since their antecedents occur in the scope of a non-transparent operator in 1. The context of the formula at line 2 is \( \langle O,every:x \rangle \), \( \langle O,\forall:y \rangle \); and that of the formula at line 3 is \( \langle B_2, every:x \rangle \), \( \langle B_2, \forall:y \rangle \). The 0th proposition expressed by the formula at line 2 relative to \( f \) is: \( \langle \langle f(y), f(x) \rangle, H^*, O^* \rangle \). The 1st proposition is: \( \langle \langle AN, g \rangle, h, O^* \rangle \), where \( g \) is the function from individuals \( o' \) to propositions expressed by \( (Gz & Axy) \) relative to \( f' \) where \( f' \) differs from \( f \) at most in that \( f'(z) \neq f(y) = o' \); and \( h \) is the function from individuals \( o'' \) to \( \langle o', f(x) \rangle, H^* \). Finally, the 2nd proposition expressed by line 2 relative to \( f \) is: \( \langle \langle Every, g_1 \rangle, h_1, O^* \rangle \), where \( g_1 \) is the function from individuals \( o''' \) to \( \langle o', f(x) \rangle, H^* \), where \( g' \) is the function from individuals \( o'' \) to \( \langle AN, g \rangle, h \rangle \), where \( g' \) is the function from \( f'' \) differs from \( f \) at most in that \( f''(x) = o' \) and \( f''(x) = o'' \); and \( h' \) is the function from \( o''' \) to \( \langle o', h \rangle, H^* \). This proposition is what the formula at line 2 intuitively asserts, which is the claim that it is possible that every professor at the University is assigned a teaching assistant who works harder than he/she does.

Notes

1. This paper has benefitted from discussions of related papers delivered at the University of Illinois, Chicago; the University of Wisconsin, Milwaukee; the University of California, Davis; Princeton University; and the University of California, Riverside. Remarks made by Charles Chastain, Michael Jubien, Michael Liston, and David Kaplan proved especially useful. I wish to thank Scott Soames, David Copp, Paul Teller, Howard Wettstein, George Wilson, and Mark Wilson for helpful discussions or suggestions.

2. Numerical subscripts indicate intended anaphoric relations and will be suppressed when the intended relations are obvious. The initiated will notice a similarity between the data in (1)-(4) and Geach's "statements of intentional identity" (e.g. 'Hob believes a witch blighted Bob's mare and Nob wonders whether she killed Cob's sow.' ) (1)-(4) are more complex than Geach's examples in several respects (attitudinal operators are combined with other sorts of operators; various quantifiers serve as antecedents of pronouns; anaphoric expressions in the scope of distinct types of operators share the same antecedent; quantifiers which have relative scopes with respect to each other both serve as antecedents of anaphoric expressions; etc.). As a result, (1)-(4) pose problems over and above those posed by Geach's examples.

3. See May [1985].

4. In King [1987] such a view was outlined for singular pronouns and descriptions with singular quantifier antecedents, based on ideas presented in Wilson [1984]. In King [1993a] and [1992b] this account is extended to handle cases involving belief operators (including Geach's 'intentional identity statements' and more) and plurals, respectively.

5. What immediately follows is a sketch of the semantics given in King [1992b].

6. This is argued in some detail in King [1992b].
7. Where \( \delta \) is a determiner and \( \Sigma, \Xi, \) and \( X \) are set terms, the quantifier \( \delta(\Sigma) \) is monotone increasing iff \( \Xi \subseteq \delta(\Sigma) \) and \( \Xi \subseteq \delta(\Xi) \). \( \delta \) is symmetric iff \( \Xi \subseteq \delta(\Sigma) \) iff \( \Sigma \subseteq \delta(\Xi) \). A quantifier is symmetric iff it is formed from a symmetric determiner.

8. A determiner \( \delta \) is universal iff \( \delta(\Sigma) \Delta \) entails every \( (\Sigma) \Delta \) for any set terms \( \Sigma, \Delta \). Due to limitations of space I have not motivated the difference in treatment between cdq's with non-symmetric antecedents formed from universal determiners and cdq’s with other non-symmetric antecedents.

9. See, for example, Soames [1987]. I intend this description to include views according to which attitude ascriptions assert three (or more) place relations between individuals, structured propositions and something like "sentential meanings", "guises" or whatever.

10. There is some sloppiness in this remark. The idea is that expressions such as 'possibly' which attach to sentences to form complex sentences express properties of propositions and that expressions like 'believes' which require completion by both a sentence and a noun phrase express relations between propositions and other things. The way I have been using the term 'operator', 'Suzi believes' but not 'believes' would be an operator, ('believes' would be an operator-forming device). But then all operators would express properties of propositions, (whereas operator forming devices express relations between propositions and other things).

11. As it stands, this definition contains semantic and syntactic elements. I would prefer a wholly semantic characterization of the notion, but I haven't found a way to do this which doesn't significantly obscure the import of the definition.

12. The qualification indicated by 'simple' here is that the sentence containing the anaphoric expression contain no operators, modal verbs, or devices to that effect. For as we shall see, in some cases in which simple anaphora is prohibited one can get anaphora if the sentence containing the anaphoric expression contains such devices. In the context of the discussion of the present point, I shall suppress this qualification, taking it to be understood.

13. Indeed, I believe that the idea of a quantifier being existentially positive is central to understanding when a quantifier can support (simple) anaphora outside of its scope generally, even in cases such as 'No executive who owns a computer uses it.' However, this issue must be addressed elsewhere.

14. It can seem as though one can get discourse anaphora on a quantifier taking narrow scope relative to a quantifier formed using the determiner 'no'. E.g. 'No student correctly answered most questions. They were too difficult.' However, in such cases I claim the expression is anaphoric not on the quantifier 'most questions', but on the N-bar constituent 'questions'.

15. This is because the functions used to determine cdq denotations are those denoted by 'all' or by a determiner used to form symmetric monotone increasing quantifiers.

16. We get this result when we apply our original definition of being existentially positive to cdq's, and add that cdq's are existence entailing or indeterminate and can't take narrow scope relative to any "ordinary" quantifier (i.e. only another cdq).

17. This is formulated differently from and not equivalent to what I called the scope principle in King [1993a]. The reason for the latter is that in King [1993a] I had not yet considered the range of data considered in this paper, confining myself to examples containing belief operators. The principle adopted there, though fine for that data, failed to handle the wider range addressed herein. As for the differences in formulation (the notion of being existentially positive played no roll in the older formulation), by invoking the notion of being existentially positive here, I mean to suggest that it is possible that Gricean reasons be given as to why the principle governs cdq scope relative to operators. I hope to address this issue elsewhere.

18. It may seem possible to read e.g. (10) with the quantifier taking narrow scope.
But in so doing one is forced to suppose that the speaker him/herself endorses the embedded sentence (as though implicitly asserting that some student did flunk the exam). It is this that makes the continuation allowable in such a case.

19. In the following I am assuming that 'It is certain that P' asserts something like that P follows from some body of knowledge, where the body of knowledge in question is usually clear from the context. Generally, when one asserts that it is certain that P, one claims that P follows from things he/she knows or things known by those present or some such thing. Serious semantic treatments of the operator therefore would probably want to represent it as indexed to a specific body of knowledge. Recall that the specific semantic properties of operators are beyond the scope of the present work.

20. SC makes an interesting prediction in the case of data even more complex than that which we are considering. Consider the following: 'Someone broke into Sue's apartment. He ought to be punished. It is certain that he got in through the window.' Since the quantifier is existentially positive in the first sentence, SC allows wide and narrow scope readings for the cdq's relative to the operators in the subsequent sentences. Further SC says nothing that would prevent (e.g.) the cdq in the second sentence from taking widest scope while the cdq in the third sentence takes narrow scope relative to the operator there. It seems to me that the discourse as a whole has a reading corresponding to this. However, one must be careful with examples of this degree of complexity, because a variety of pragmatic factors play a role in determining which readings are possible.

21. I have in mind here operator pairs such as 'It is certain that' and 'It is (epistemically) possible that'. These are logically related in so far as 'It is certain that P' entails 'It is not the case that it is possible that not P'. When some such implications obtain between operators, they are logically related. If we decided to allow that every operator is logically related to itself, since for any operator O, O[P] entails O[P], then we could say that the exceptions to SC concern only logically related operators.

22. The idea would be that the use of logically related operators induces the supposition that whatever status the quantifier antecedent has with regard to being existentially positive is shared by subsequent cdq's.

23. Of course (22)-(24) all have perfectly acceptable uses in which the quantifier antecedent in the first sentence takes wide scope over the operator, and SC doesn't deny this. Hence it is important in checking SC's predictions here to keep the narrow scope reading of the quantifier antecedent before one's mind.

24. Actually, I have found that many native speakers don't find the discourse acceptable under the reading described. Saarinen [1978] discusses examples which are similar to these; however in his examples it isn't clear that the operators in the second sentences are transparent.

25. There is a second way in which the second sentence might have an acceptable reading. Imagine that (25) was uttered in a context in which it is known (or presupposed) that Suzi met a man, Joe, last night. Suppose further that the first sentence is read with the quantifier taking narrow scope relative to the belief operator (the utterer attributing to Paul the belief that Suzi met some man or other, knowing that Paul has no belief about a particular man that Suzi met). Finally, suppose that we are certain that Joe is a loser. It seems that in such a context we can read the second sentence of (24) as equivalent to:

\[(24a) \text{ (some man Suzi met last night: x) it is certain that [x is a loser].}\]

and hence read the cdq in that sentence as taking wide scope over the operator 'It is certain that'. Thus the cdq is existentially positive here. So the cdq is existentially positive but its antecedent is not, and SC is violated. However, it is easily seen why such a violation would be allowed. For in this context the truth of the sentence containing the quantifier antecedent which is embedded in the belief operator in the first sentence is presupposed. Hence the truth of the sentence containing the quantifier antecedent in which it is existentially
positive is presupposed. This is sufficient to license the wide scope reading of
cdq. The case discussed in note 18 is similar.
26. By 'discourses like (25)' I mean discourses whose first sentences have an
existential quantifier taking narrow scope relative to a non-transparent operator
and whose second sentences contain an expression anaphoric on the quantifier
and a transparent operator.
27. There is an apparent problem with our account of the bounds for cdq's with
symmetric monotone increasing antecedents which isn't addressed in the
following remarks. We have said that the bounds for cdq's with symmetric
monotone increasing antecedents are partly determined by predicative material in
intervening sentences containing occurrences of cdq's with the same antecedent.
This means that in an example like
Laura believes a man is following her. Jennifer believes he is from the IRS.
Mary believes he means Laura no harm.
(where the quantifier in the first sentence takes narrow scope relative to the belief
operator), the third sentence attributes to Mary the belief that some man from the
IRS who is following Laura means her no harm. However, it seems as though we
might hold the third sentence to be true even if it is not part of Mary's belief that
someone from the IRS is following Laura. Hence it may seem as though the
predicative material in the second sentence does not play a role in determining
the bound on the cdq in the third sentence as claimed. The same thing occurs in
simple cases not involving operators. Consider 'A man is following Laura. He is
from the IRS. He means her no harm.' We may be inclined to judge the third
sentence of such a discourse to be true even if no man from the IRS is following Laura.
I tend to think that this phenomenon is pragmatic so that e.g. the
"reading" of the third sentence in the last example which is true even if no man
from the IRS is following Laura is not a literal reading of the sentence at all.
However when examples involving other operators are considered, the situation
becomes quite complex. I hope to discuss this phenomenon more fully
elsewhere.
28. Edelberg [1986], pps. 17-18. This example is discussed in King [1993a].
29. It is important to note that cases of this sort can arise when the existential
quantifier antecedent of the cdq is in the scope of another quantifier, (this is true
of the two problematic cases discussed below as well). Suppose, for example,
that at Knight Industries it is obligatory to give each employee a Christmas gift.
It is permissible and not obligatory that the gift be inexpensive (under twenty
dollars), but it is obligatory that the gift cost over ten dollars. In such a
situation, 'It is permissible that Knight Industries gives each employee an
inexpensive gift but it ought to be the case that it costs over ten dollars.' seems
true. However, our theory predicts that the second conjunct here is equivalent to
'It ought to be the case that Knight Industries gives each employee an
inexpensive gift which costs over ten dollars', which is false in the situation,
(because it is not obligatory that each employee be given an inexpensive gift).
The fact that such cases can arise casts doubt on Edelberg's own account of (27),
since it doesn't seem as though that account will generalize to handle these more
complex cases. Similar remarks apply to Edelberg's account of (29) below.
30. Edelberg [1986] discusses similar cases.
31. I believe that sometimes we use the conjunction of the predicative material in the
scope of the (relevant) quantifier in the antecedent presupposition and the
predicative material in the scope of the quantifier which is the antecedent of the
cdq to determine the bound of the cdq. But discussing such cases would take us too
far afield.
32. Though considerations of space prevent me from pursuing the issue, I think it
can be shown that antecedent presuppositions are operative in the way suggested
in simple cases involving no operators as well. Showing this would strengthen
our case and rebut the charge that their invocation is an ad hoc way of dealing
with certain complex cases.

33. Plus material contained in sentences which have occurrences of a cdq anaphoric on the same quantifier and which intervene between the given sentence and the quantifier antecedent.

34. I have in mind a case in which I utter (e.g.) 'Someone didn't do his homework' and manage to convey the claim that Joe didn't do his homework.

35. For ease of formulation, the formal semantics sketched below does not assign readings to sentences containing cdq's which result from having cdq bounds determined by material drawn from antecedent presuppositions.

36. Note that this can be true even if the speaker doesn't know who scored one hundred percent on the exam. For example, if a speaker who doesn't know who broke in to the school is addressing an audience of people who know (or believe) that it was Brad, when the speaker says 'Someone broke in to the school. He stole a computer,' the audience will have the feeling that Brad is being talked about and that his properties determine whether the sentences are true or false. We might call this phenomenon hearers reference.

37. The formal semantics given here makes use of an account of propositions and ascriptions of propositional attitudes given in Soames [1987]. For the most part I have ignored distinguishing use and mention to reduce clutter.

38. We really should distinguish between attitudinal verbs which form transparent operators and others here by requiring that for a verb X which forms transparent operators, if \( \langle \alpha', \text{Prop}\Phi \rangle \) belongs to \( \text{ext}_t(X^*) \), \( \text{Prop}\Phi \) is true in c. Similar remarks apply to transparent operators.

39. The variables of a quantifier are the variable of the set term which combines with a determiner to form the quantifier and the variable of the set term the quantifier attaches to in forming a formula. E.g. in \( \text{every}(\forall x[Fx]) \forall y[Dy] \), \( x \) and \( y \) are the variables of the quantifier \( \text{every}(\forall x[Fx]) \) and we shall call \( y \) the primary variable.

40. This clause actually would need to be slightly more complicated in order to handle multi-sentence discourses in which the bound of a cdq is partly determined by material contained in prior sentences containing cdq's anaphoric on the same quantifier. Similar remarks apply to clauses iii and v below.

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