

On Quantifier Domain Restriction

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Abstract: In this paper, we provide a comprehensive survey of the space of possible analyses of the phenomenon of quantifier domain restriction, together with a set of considerations which militate against all but our own proposal. Among the many accounts we consider and reject include the 'explicit' approach to quantifier domain restriction discussed, for example, by Stephen Neale, and the pragmatic approach to quantifier domain restriction proposed by Kent Bach. Our hope is that the exhaustive discussion of this special case of context-dependence will provide guidelines for how to decide, for an arbitrary case of context-dependent discourse, whether it should be treated syntactically, semantically, or pragmatically.

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1. Introduction

In interpreting the utterances of others, we cannot rely exclusively on the permanent features of the words used. For it is often the case that the very same words could be used in a different context to communicate something different. *The problem of context dependence* is the problem of explaining how context contributes to interpretation, that is, to the process of determining what a speaker meant by making a linguistic utterance on a certain occasion.

The topic of this paper is *the problem of quantifier domain restriction*, which is a special case of the problem of context dependence. What is the problem of quantifier domain restriction? Consider the sentence:

(1) Every bottle is empty.

Suppose someone utters (1) in a conversation. It is unlikely that what she intends to convey is that every bottle in the universe is empty; she most likely intends to convey that every one of a restricted class of bottles (say, the bottles in the room where she is, the bottles purchased recently, etc.) is empty. And if the context is right, she can succeed in communicating such a proposition. Permanent linguistic features of (1) – its phonological and morphological constituents, its syntactic structure, the meanings of the lexical items it contains – do not determine the proposition thereby communicated. They cannot do so, for these features are the same on every occasion when the sentence is used, but on most of those occasions the speaker would communicate a different proposition by the sentence. The problem of quantifier domain restriction is a special case of the problem of context dependence, because, to solve it, we need to explain how context, together with permanent linguistic features of quantified sentences, helps determine the proposition conveyed by an utterance of such a sentence, a proposition in which the domains of the quantifier expressions are suitably restricted.

There are many accounts of the phenomenon of quantifier domain restriction. We provide here a survey of the space of possible analyses, together with a set of considerations designed to select the best from amongst them. We hope that our exhaustive discussion of this special case of the problem of context-dependence may provide some guidelines for how to decide, for an

arbitrary case of context-dependent discourse, whether it should be treated syntactically, semantically, or pragmatically. We have no general theory here. Rather, we have a set of distinctions and arguments which we hope will prove useful in future research into context-dependent phenomena.

The first two sections are devoted to articulating some distinctions relevant to the problem of context-dependence generally. In the remainder of the paper, we use these distinctions to address the problem of quantifier domain restriction.

2. The Foundational and Descriptive Problems of Context-dependence

Nothing short of an extremely comprehensive theory of linguistic communication could provide a general solution to the problem of context dependence. To explain successfully how, together with linguistic rules, context determines what people mean by the utterances they make requires a great deal of information about the mind and about language that is currently unavailable. But perhaps we can separate the intractably hard questions from the more or less manageable ones in this area. This is what we will attempt in this section.

Consider a simple and uncontroversial case of context dependence, when a speaker pointing at one of the tires of his car utters the sentence:

(2) That is flat.

The most obvious way in which the interpretation of this utterance depends on the context is that in order to know what the speaker means, one has to know what is being demonstrated. It is uncontroversial that the full account of the context dependence of this utterance must include a specification of the truth-conditions of the utterance, and that this specification will, in turn, rely on a semantic clause like:

(2) An occurrence of 'that' in a context *c* refers to what is being demonstrated in *c*.

Context dependent expressions, such as pronouns and demonstratives, behave in natural languages somewhat like variables in the language of predicate calculus. Variables in predicate calculus occur either bound or free. In the semantics of first-order logic, the interpretation of a

bound variable is linked to the interpretation of a variable binding device; in standard first-order languages, a quantifier. Free variables do not receive an interpretation once and for all. Rather, their interpretation is relative to an ordered sequence of objects. In one standard treatment, variables receive indices; the variable marked with the index i , relative to a sequence, receives the i -th member of that sequence as value. In natural language, so-called 'bound' pronouns are like bound variables insofar as their interpretation is linked to the interpretation of another expression - an antecedent or a quantifier. Other pronouns - the 'unbound' ones - depend for their semantic value on the context in which they are used, and in this regard they are like the free variables of predicate calculus. Demonstratives and indexicals are parallel to unbound pronouns, and hence also to free variables.

Many theorists, impressed by the above analogy, have identified contexts with ordered sequences of objects, akin to the sequences in the semantics of first-order logic. Context dependent expressions then take contexts as arguments, and yield the corresponding member of the context as value. The linguistic meaning of a context dependent expression is represented, in such frameworks, as a function from contexts to values. This treatment of contexts has a distinguished recent history (cf. Montague (1974a), Kaplan (1989a), Lewis (1970)). However, there are other traditions, motivated for the most part by problems distinct from that of supplying the values of demonstrative and indexical expressions. For example, to treat phenomena such as presupposition, it is helpful to view contexts as sets of propositions (cf. Stalnaker (1973, 1974)). One might find the representation of contexts as sequences of objects misleading, because one thinks that the work done by such entities is in fact done by sets of propositions. One might also find the treatment of contexts as sequences of objects as objectionable on its own terms.¹

¹ According to Cresswell (1973, p. 111), identifying contexts with sequences of relevant objects is problematic, since it seems to require specifying in advance of interpretation a finite list of contextual coordinates which are relevant for the determination of content, and Cresswell suspects "...that there is no such list" (Ibid.). Cresswell himself defines a context of utterance as a certain kind of property of an utterance. Kamp (1981) objects to Cresswell's approach, on the

We will not enter these debates about the proper representation of conversational contexts. That is a subject worthy, at least, of its own paper. Rather, we will take the notion of conversational context for granted, and speak of expressions having values relative to contexts, or utterances communicating propositions relative to contexts, without giving a formal characterization of the notion (or notions) of context at issue.

There has been much debate in recent philosophy of language about whether one should consider the 'true' bearer of propositional content to be a sentence relative to a context, or rather a *utterance* of a sentence. For example, according to David Kaplan (1989a, pp. 522, 546), the former notion is required for model theoretic purposes. To evaluate an argument for validity, one needs to evaluate all of the premises and the conclusion with respect to the same context. But, Kaplan worries, on an approach that takes the true bearers of propositional content to be utterances, this sort of evaluation will be impossible, because distinct utterances occur in distinct contexts.²

This is also a debate we prefer to evade. For clarity's sake, however, we fix on one vocabulary. We will formulate our semantic rules in terms of expressions relative to contexts. Furthermore, we follow Kaplan in speaking of the bearers of content as *occurrences* of expressions, by which we mean pairings of expressions and contexts. So, an occurrence of an expression *e* is a pairing of *e* and a context *c*. However, our usage of this vocabulary does not mean we have a commitment to one position or another in the debate about whether the ultimate bearers of content are expressions relative to contexts, or uses of expressions.

Given this background, we can divide (3) into two claims:

grounds that there is no principled way to distinguish the properties of utterances that, according to Cresswell, are contexts, from those that are not.

² For more arguments in favor of an expression-based approach, see Kaplan (1989b, pp. 584-585), Braun (1996, p. 152)). Crimmins (1992, pp. 195-96), Israel and Perry (1996), and Garcia-Carpintero (1998) have advanced considerations in support of a use based approach.

(4) Relative to o , 'that' denotes o .

(5) o is what is demonstrated in context c

These two claims correspond to two aspects of the problem of context dependence of the interpretation of an utterance of (2). Someone who accepts (4) as part of her account of this context dependence accepts (i) that the relevant context dependence is linked to the occurrence of the pronoun 'that' within (2), and (ii) that the relevant context dependence is a matter of the semantic value of this pronoun. There is a sense in which these commitments jointly answer the question 'how does the interpretation of an utterance of (2) depend on the context?' In another sense, however, a solution to the problem of context dependence requires more. For, only given (4), we do not know *what it is in virtue of which* o is the semantic value of 'that' in c . (5) attempts to address this question. According to it, o is the semantic value of 'that' in c , because it is the object demonstrated in the context in which the utterance was made. Though (4) is no doubt far too simplistic, it addresses a question left unaddressed by (5).

Let us try to formulate in full generality the idea that led to the further analysis of (3). The *descriptive problem* of context dependence for an expression e relative to a context c is the problem of deriving the interpretation of e relative to c , given a prior characterization of what features of the context c have a bearing on the interpretation. (4) is a solution to the descriptive problem of context-dependence for the demonstrative expression 'that' relative to a context in which o is the value of that demonstrative expression. (4) is highly abstract, in the sense of not specifying what in the context makes it the case that the object mentioned in (4) is the denotation of the demonstrative in that context. The *foundational problem* of context dependence for an expression e relative to a context c is the problem of making these specifications. That is, the foundational problem of context dependence for an expression e relative to a context c is specifying what it is about the context in virtue of which certain entities (be they objects, properties, or propositions) play the role they do in the interpretation an occurrence of e .

Separating the descriptive from the foundational problem of context dependence by distinguishing between (4) and (5) is customary in discussions of demonstratives. Semanticists often think of the semantic value of a demonstrative as 'given' by the context and relegate

questions of what exactly it is in virtue of which it counts as the semantic value of that demonstrative in that context to a separate field of study.^{3,4} One can see this distinction as a specific instance of a general division within semantics between descriptive and foundational work. Descriptive semantics gives the semantics for a language by assigning semantic values to simple expressions relative to contexts and by specifying rules that determine the semantic values of more complex expressions in terms of their simpler constituents. It does not attempt to decide what in the practice of the language users explains why that semantics is the right one for their language. Foundational semantics fills the explanatory gap left by descriptive semantics.⁵

³ Cf. David Braun's fairly typical attitude in the following remark: 'I am imagining that in the formal semantics, the demonstratum of a context is simply given. But informally we can think of the demonstratum of a context as being determined, in some way that I won't go into here, by one or more factors of the following kind: the speaker's intentions, her overt and covert demonstrations, and the contextual cues that allow listeners to determine the referent.' (1994, p. 209). Reimer (1998, pp. 105-06) makes the same distinction with respect to quantifier expressions.

⁴ One can also make the distinction between descriptive and foundational problems of context dependence with respect to theories which take contexts to be sets of propositions. For example, there are different positions, among those who think of contexts in this way, about what determines the set of propositions which is the context. Some hold that the context is the set of propositions which the speaker supposes are shared (e.g. Stalnaker (1973, 1974)). Others hold that the context is determined by the commonly shared assumptions of all of the conversational participants. Still others have argued that propositions can make it into the context set without being entertained by any of the conversational participants (cf. Gauker (1998)).

⁵ Cf. Stalnaker (1997). See also Lewis's (1975) distinction between a theory of languages and a theory of language, and Kaplan's distinction between 'semantics' and 'metasemantics' (1989b, pp. 573ff.).

In general, discussions of descriptive and foundational problems should be clearly distinguished from one another. To use an example discussed at length in Stalnaker (1997), in the case of proper names, an example of a foundational semantic debate concerns the viability of the causal theory of names, according to which the denotation of a name is due to the existence of a causal relation of the appropriate sort between it and its bearer. However, the causal chains are no part of the descriptive semantics of names. The descriptive semantics of names only involve linking them up with their bearers. Causal chains are rather part of a foundational semantic account of why names have the descriptive semantical interpretation they do. An example of a descriptive semantical debate is whether names are rigid designators, or are rather short-hand for non-rigid definite descriptions. Only confusion results from running such distinct questions together.

The distinction between foundational and descriptive semantics can be generalized to all aspects of the interpretation process. So, one can bracket foundational questions like: What exactly makes it the case that in the interpretation of a sentence *S* relative to a context *c*, we have to choose the wide scope, rather than the narrow scope reading? Or, why is it that under certain circumstances the use of the phrase 'John's bike' indicates that the relation between John and the bike is that of spatial proximity? Solutions to descriptive problems of context-dependence should be thought of as ingredients in a descriptive theory; solutions to foundational problems belong to foundational accounts.

Most philosophical discussions of context involve foundational problems of context dependence. For example, debates about whether demonstrations or speaker intentions fix the reference of demonstrative expressions are instances of the foundational problem of context-dependence, as are debates about whether 'I' must refer to the person who utters it.⁶ Sperber and Wilson (1986) attempt to describe a general strategy exploited by language-users to discover which features of the context are relevant for the resolution of ambiguity and semantic

⁶ For the former, see for example Kaplan (1978, 1989b), McGinn (1981), Wettstein (1984), Reimer (1991, 1992), and Bach (1992). For the latter, see for example Smith (1989).

incompleteness, and so also involves the foundational problem of context-dependence.⁷ Gauker (1997) raises difficulties for possible solutions to the foundational problem of context-dependence for quantifier domain restriction. And so on.

The reason that philosophers have focussed their attention on foundational problems of context dependence is that they are sub-versions of the problem of linguistic intentionality, as are foundational semantic problems generally. Many philosophers who discuss foundational problems of context dependence seek to show that context-dependent constructions pose special problems for particular accounts of the problem of linguistic intentionality. For example, according to Griceans, the intentionality of language reduces to the intentionality of the mental. Philosophers have raised context-dependent constructions as counter-examples to this thesis.⁸ According to these philosophers, the solutions to some foundational problems of context-dependence involve non-mental facts, *contra* Gricean accounts of linguistic intentionality.

We will not engage in foundational debates about context dependence in this paper. Rather, our purpose is to resolve the often neglected descriptive problem of context-dependence for quantifier expressions. However, the fact that we are addressing a descriptive problem of context-dependence does not mean that we can completely neglect the corresponding foundational problem. Solving the descriptive and the foundational problems for a particular phenomenon of context dependence are interrelated, and so, even if one is primarily concerned

⁷ Indeed, Sperber and Wilson attempt to provide a very bold solution to the foundational problem of context dependence, since they argue that the same process underlies phenomena as distinct as the resolution of ambiguity and contextual supplementation of semantically incomplete information.

⁸ Usually, such philosophers argue their case using the examples of indexical and demonstrative reference, as in Wettstein (1984). However, Gauker attempts to formulate arguments for these conclusions with the examples of quantifier domain restriction (1997) and presupposition (1998).

about the descriptive problem, one should not devise a solution for it that would make any reasonable solution of the foundational problem impossible. In what follows, we will try to adhere to this general principle.

A full solution to a descriptive problem of context-dependence involves two steps. As we will argue in the next section, there are three basic roles context plays in interpretation: grammatical, semantic, and pragmatic. The first step in resolving a descriptive problem of context dependence for a class of expressions is establishing which of these roles context fundamentally plays in the interpretation of occurrences of expressions in that class. The second step involved in a full solution to a descriptive problem of context-dependence can only be undertaken once the first has been resolved. Once it has been decided whether context plays a grammatical, semantic, or pragmatic role in the interpretation of occurrences of these expressions, it must be decided how to integrate the relevant context-sensitivity into a grammatical, semantic, or pragmatic theory.

The first step in resolving the descriptive problem of context dependence for quantifier expressions requires deciding which role context plays in the provision of a restricted domain for a quantifier expression. We argue in Sections 4-6 that quantifier domain restriction is a matter of semantics. Thus, the second step involves deciding how to integrate the phenomenon into a semantic theory. This is the topic of our final section.

3. Three Roles of Context

In this section, we discuss three different ways in which interpretation depends upon features of context.⁹ Interpretation, as we use this word, is the process of determining the information

⁹ In making the distinctions which follow, we freely avail ourselves of some standard assumptions of linguistic theory. Here are two examples. First, we presuppose the viability of the standard picture of lexical and structural ambiguity, according to which ambiguous sentences correspond to distinct syntactic representations. This assumption is challenged in "underspecification" approaches, where, say, structural ambiguity is represented as a *semantic*

conveyed to an addressee by a speech act performed in a certain context. For the sake of simplicity, we will focus on the speech act of *assertion* and among assertions on what we will call *typical assertions*. In typical assertions (i) there is a single speaker and a single hearer, (ii) the speaker vocalizes a well-formed, meaningful sentence, and by doing so (iii) the speaker intends to convey a certain proposition. A typical assertion is successful just in case the hearer can identify the proposition the speaker intends to communicate. By focusing on typical assertions we do not wish to downplay the theoretical significance of other speech acts. Instead, along with most linguists and philosophers of language, we hedge our bet on the question whether a theory of the interpretation of all speech acts can best be formulated on the basis of a theory of the interpretation of typical assertions.

Consider a situation in which a speaker performs a typical assertion. Suppose that the hearer perceives the voice of the speaker with perfect clarity and that the hearer has an ideal grasp of the phonology, morphology, syntax and semantics of the language used by the speaker. There are, we believe, three distinctive ways in which in a situation like this communication may fail.

First of all, despite the clarity of the sound and despite his perfect linguistic knowledge the hearer may not have enough information to identify the sentence uttered. For example, suppose the speaker produces certain sounds, much like what you would produce if you read the sentence (6) aloud:

(6) John likes to go the bank.

There is a perfectly legitimate sense of ‘word’ in which the hearer could complain that he does not know what the last word of the utterance was, and consequently, does not know which sentence

phenomenon (e.g. Reyle (1993), and the essays in Van Deemter and Peters (1996)); it is also questioned in May (1985). A second example is our assumption in what follows that Verb Phrase ellipsis is a syntactic phenomenon, due to some sort of syntactic rule of reconstruction or copying, or PF deletion under a syntactic parallelism condition (Chomsky (1995, p. 125)). Most of the by now vast literature on ellipsis accords with this assumption. But the assumption certainly has had its detractors (e.g. Klein (1985), Dalrymple, Shieber, and Pereira (1991)).

the speaker used. Here is another example. Suppose the speaker produces a sequence of sounds much like you would reading (7) aloud:

(7) Visiting friends can be annoying.

There is a legitimate sense of 'grammatical structure' in which the hearer could say that he does not know which grammatical structure to ascribe to these sequence of sounds, and consequently, does not know which sentence was uttered.

In the first of these examples, the reason the hearer may fail to know what sentence was uttered is that the sound that is produced by the speaker's utterance of 'bank' is linked to what any lexicographer would recognize as distinct lexical items. One lexical item means financial institution, and the other means the edge of a river.¹⁰ In the second of these examples, the reason that the hearer may be ignorant of the sentence uttered is that the sound that is produced by an utterance of (7) can correspond to what any syntactician would recognize as two distinct analyses. One means that certain people - friends who come to visit - can be annoying, the other means that a certain activity - visiting one's friends - can be annoying.

To clarify matters, we need to distinguish between two senses of the words that refer to linguistic expressions (words, phrases, sentences, etc.) Let us call an expression in the sense of a sequence of sounds a *phonological expression*, and let us call an expression in the special sense we have been motivating a *grammatical expression*. A phonological expression contains certain sounds in a certain linear order, but what exactly the relevant segments of the sound sequence

¹⁰ It is common in lexicography to distinguish between two kinds of ambiguity: there are cases of polysemy, where the meanings associated with a single sequence of phonemes are related to one another, and cases of homonymy, where the meanings are independent. Polysemy is usually presented in dictionaries as subentries in a single entry; homonymy is presented as different entries. Etymology is a reliable, but by no means infallible guide in determining whether a certain sequence of phonemes is polysemous or homonymous. For example, there is an obvious etymological connection between the foot of a person and the foot of a mountain, but this is nevertheless arguably a case of homonymy.

correspond to in the lexicon and how exactly their linear order translates to a grammatical structure plays no role in individuating the phonological expression itself. A grammatical expression, on the other hand, is either a lexical item or is constructed from lexical items arranged within a determinate syntactic structure. The sequences of printed letters displayed as (6) and (7) in this paper each correspond to a single phonological sentence but more than one grammatical sentence.

Having distinguished between phonological and grammatical expressions, we need to say a word about quotation. A string of letters enclosed between quotation marks may ordinarily designate either a phonological or a grammatical expression. We may with equal right talk about *the* sentence ‘Visiting friends can be annoying’ and the sentences pronounced or spelled as ‘Visiting friends can be annoying’. To enhance clarity, in this paper we use underlining to refer to phonological expressions and quotation to refer to grammatical expressions. So, bank is a sequence of sounds and 'bank' does not exist. What does exist is 'bank₁' and 'bank₂', the former being a lexical item which means a financial institution and the latter another lexical item which means the edge of a river.¹¹ The use of other devices (such as indentation and numbering) will be left ambiguous.

In order to interpret typical assertions of others, we normally need to know what sentence they used, and know it in the stronger, grammatical sense of ‘sentence’. We will say that the phonological sentence produced by the speaker is *what is articulated* in the utterance, and that the grammatical sentence that in the context of the utterance is associated with the phonological sentence is *what is uttered* in the utterance. In cases like those discussed above, context has a characteristically *grammatical role* in determining what was uttered. Schematically:

what is articulated + context = what is uttered.¹²

¹¹ As will become evident below, our usage of quotation marks expresses Quinean quasi-quotation, rather than quotation proper.

¹² The intended interpretation of 'x + y = z' is that x and y jointly determine z. To say that

The second way in which context can play a role in the interpretation of typical assertions concerns the identification of the proposition that what is uttered expresses relative to the context of use. Consider a case when someone utters (8):

(8) I am a philosophy professor.

Arguably, the sentence articulated carries no lexical or structural ambiguity, and hence corresponds to a single sentence uttered. Nevertheless, different occurrences of this single grammatical sentence may express different propositions. What is said by (8) relative to a context in which the speaker is Bill Clinton is different from what is said by (8) relative to a context in which the speaker is Robert Stalnaker, since the latter occurrence expresses a truth, while the former expresses a falsehood.

We use the expression ‘what is said’ here in a somewhat arbitrary technical sense. It applies to propositions, entities which (like sentences) can be true or false and (unlike sentences) do not belong to any particular language.¹³ We do not want to commit ourselves here to anything more specific. In particular, we wish to remain neutral about the ontological status of propositions (are they *sui generis* or reducible to more fundamental entities?), about the structure of propositions (do they have constituents, and if they do how closely does their structure mirror the structure of sentences expressing them?) and about their role in the so-called propositional attitude ascriptions (are propositional attitudes two-place relations between a subject and a

what is articulated and context jointly determine what is uttered does not imply that in order to determine what was uttered one needs to know everything about the context. In fact, only a handful of contextual features are relevant. To determine exactly which ones is part of the foundational problem of context dependence.

¹³ Some use the expression ‘what is said’ to refer not just to propositions, but also to non-propositional entities, such as proposition radicals (e.g. Bach (1994)), which must be augmented with extra constituents in order to be truth-evaluable. This usage must be sharply distinguished from our own.

proposition or are there other argument places as well?). The only significant commitment we accept at this point is that propositions expressed by a typical assertion are individuated at least as finely as the truth-conditions of the utterance. That is, if two typical assertions differ in their truth value potential, that is their truth-value in different possible situations, then they express different propositions.

In some semantic traditions, the first step in constructing a semantic theory for a language involves the provision of an algorithm that assigns propositions to sentences relative to contexts. In other semantic traditions, a semantic theory for a language involves giving a truth-definition for the language relative to contexts and perhaps also models. In the latter tradition, there might be no entity in the semantic theory that can be identified with a proposition. Which form a semantic theory ultimately should take is again a controversial question, which we do not wish to address in this paper. Our discussion throughout is neutral as between these two approaches.¹⁴

Since what is uttered can be the same in different contexts, even though what is said differs, the former by itself cannot determine what is said. Rather, what is said by an occurrence of a grammatical sentence is dependent both on the semantic features of what is uttered *and* features of the context. Therefore, context does not just play a role in grammatical interpretation. There is also what we might call the *semantic role* of context, which the role context plays in supplying additional values to what is said by an occurrence of a grammatical sentence, values that are not determined just from the linguistic meaning of the sentence uttered:

what is uttered + linguistic meaning + context = what is said

Note that, according to our usage of the word 'semantic', any contextual provision to what is said counts as semantic. In this sense, semantics, by definition, is about propositions. However, there are other uses of 'semantic', with which our use should not be confused. For example, according to a second, equally legitimate use of the word, semantics is the study of the denotations of expressions relative to contexts. An object or property only enters into semantic

¹⁴ In particular, those who are not kindly disposed to proposition talk, such as Davidsonians, may construe our talk of propositions in terms of truth-conditions.

interpretation by virtue of being either the semantic value of some expression relative to a context, part of the semantic value of some expression, or introduced via a rule of semantic composition. It is a substantial claim that these two uses of the term 'semantic' cover the same territory (cf. Travis (1997, p. 87)). It might very well turn out that assigning denotations to the constituents of sentences relative to contexts and combining them often does not yield full propositional content, as has been argued by advocates of 'the pragmatic view' (Travis, Ibid.). However, this debate is irrelevant to our paper. As we use the term 'semantic', it includes any contextual contribution to the proposition expressed by an occurrence of a grammatical sentence, whether traceable to a constituent in what is uttered or not.

The grammatical role of context and the semantical role of context do not exhaust the interpretive roles of context. For even where a determinate proposition has been fixed that was expressed by the occurrence of a sentence, it may not yet be clear what proposition the speaker meant. For instance, someone may ironically utter:

(9) Fred is a fine friend.

thereby communicating the proposition that Fred is a terrible friend. What this simple fact shows is simply that in the right context, words can convey something quite different from what they mean. Context plays what might be called a *pragmatic role*, in helping conversational participants move from what is said to what is communicated:

what is said + context = what is communicated.

Interpretation, in the broad sense in which we use this word, proceeds from the sentence articulated to the proposition communicated. Context plays a *grammatical role* in providing the proper lexical and syntactic analysis of the sentence articulated on a given occasion and thereby determining what was uttered. Context plays a *semantical role* in fixing what was said by that occurrence. Finally, context plays a *pragmatic role* in identifying the proposition communicated by the utterance. To solve the descriptive problem of context dependence for a particular expression, one needs to specify which of these three roles context fundamentally plays in the interpretation of that expression relative to a context. This may not be more than a first step in solving the descriptive problem, but it is a necessary step.

One need not assume psychological reality for the grammatical, semantic and pragmatic *phases* of interpretation. Interpretation may not be a linear progression from the sentence articulated through the sentence uttered and the proposition expressed to the proposition communicated. But there are two assumptions that are immensely plausible. First, that in normal instances of *successful* communication, the hearer who grasps the proposition communicated will also know what sentence was uttered and what proposition was expressed by that sentence on the given occasion. Second, that in normal instances of *unsuccessful* communication the hearer might know the sentence uttered without knowing the proposition expressed or the proposition communicated, or the hearer might know both the sentence uttered and the proposition expressed without knowing the proposition communicated. Cases when the hearer knows the proposition communicated without the proposition expressed or the proposition expressed without the sentence uttered are highly exceptional. The distinctions we drew in this section are based on nothing more than these two assumptions.¹⁵

4. The Problem of Quantifier Domain Restriction.

The first step in resolving the problem of quantifier domain restriction is deciding whether the role played by context is syntactic, semantic, or pragmatic. Once this crucial issue is resolved, we can then turn to the question of which particular syntactic, semantic, or pragmatic account is correct. To set up our discussion of these issues, it would help to focus in on a representative example.

Suppose Lisa went to the store to buy some bottles to give to Max, who wanted to fill

¹⁵ Many theorists would go further in their commitments. A fair number of successful natural language parsing programs are designed assuming that interpretation has a grammatical, semantic and pragmatic phase and that completely separate computational routines are responsible for these phases (cf. Hirst (1987)). Many psycholinguists are committed to there being separate modules of the brain responsible for the grammatical, semantic and pragmatic aspects of interpretation. The jury is still out whether such a modular approach is ultimately better than a non-modular one.

them with his home made beer. Max asks whether the bottles Lisa bought need to be emptied first. In response, Lisa utters (1):

(1) Every bottle is empty.

In this situation, we can plausibly assume that by uttering (1) Lisa conveyed to Max the proposition that every bottle of milk she just bought is empty. She succeeded to convey this by relying, in part, on the context of her utterance. The first question is whether the role context played in the interpretation of Lisa's utterance was grammatical, semantic or pragmatic.

One way to think about the problem is this. Had Lisa been more explicit, she could have conveyed the same proposition by uttering (10) instead:

(10) Every bottle I just bought is empty.

The difference between the grammatical, the semantic and the pragmatic solutions lies in the way they spell out the relationship between Lisa's actual utterance of (1) and her hypothetical utterance of (10). According to the grammatical approach, although the sentence articulated by Lisa is different from the sentence she would have articulated in the hypothetical case, there is no difference between what was and what would have been uttered; context supplies the additional material.¹⁶ According to the semantic approach, the sentences uttered are different, but they

¹⁶ One approach that does not meet this model, but in another sense might be thought of as a grammatical approach, is the *ambiguity* approach. According to this approach, the reason that (1) and (1') express the same proposition is that bottle is ambiguous. One of the lexical items corresponding to it is 'bottle₁' which is what we usually find as the first entry in any dictionary, and means what we would ordinarily expect. Normal dictionaries, however, omit the vast majority of other lexical items that correspond to the word bottle. One of the neglected lexical items is 'bottle₂₀₆₇' which in the context of Lisa's utterance means the same as the phrase 'bottle₁ of milk Lisa just bought'. When Lisa utters (1) in the situation described above, it is 'bottle₂₀₆₇' that features in the sentence she uttered. If, however, she had uttered (1'), 'bottle₁' would have been a constituent of the sentence she uttered. It is rather obvious why this approach has not much in its favor. We would have to assume that bottle corresponds to an infinite array of lexical items. If the

express the same proposition. Finally, according to the pragmatic approach, the sentences uttered as well as the propositions expressed in the actual and the hypothetical situations are different. Nevertheless, what (1) and (10) communicate on these occasions is exactly the same.

In the abstract, there is not much that could be used to choose among these alternatives. We must therefore consider the merits and faults of specific ways of implementing the grammatical, semantic and pragmatic approaches to quantifier domain restriction.

According to the grammatical approach to the problem of quantifier domain restriction, the way context operates to ensure that (1) and (10) express the same proposition in the envisaged scenario is by producing sentences whose context-independent features combine to express the same proposition. According to the most plausible version of this approach, context simply provides an unarticulated portion of the sentence uttered. We call such accounts *syntactic ellipsis approaches*.

(11) is a standard example of syntactic ellipsis:

(11) Sam plays chess on Sundays. Max does too.

For any utterance of (11), it is plausible to say that although the words plays chess on Sundays are missing from what is articulated, 'plays chess on Sundays' is nevertheless present in what is uttered. This claim can be supported by reflecting on what would be a *proper repetition* of this utterance. Suppose the addressee ask the question: 'Excuse me, I did not hear you properly. What does Max do?' There is a sense in which (12) and (13) are appropriate answers to this question, whereas (14) and (15) are not.

(12) He plays chess on Sundays.

(13) Max plays chess on Sundays.

(14) He plays chess on those days of the week which follow a Saturday.

meanings of these lexical items are unrelated, the lexicon is not learnable by a finite mind. If the meanings are related, it seems awkward to associate every one of them with a different lexical item. Approaches of this sort are generally implausible. In what follows, we only consider treatments which are not generally implausible.

(15) Max plays some games of chess on Sundays.

One could take the analogous line with regard to Lisa's articulation of (1). The words 'of milk we just bought' are covertly present in the grammatical sentence uttered by her. The covert expression cannot be heard by anyone who listens to Lisa's utterance; it is a syntactic constituent that has no phonological manifestation. We will call this *the syntactic ellipsis theory of domain restriction*.¹⁷

We now turn to semantic approaches. What semantic approaches to the problem of quantifier domain restriction have in common is the commitment that although Lisa uttered different sentences in the actual and hypothetical case, the two sentences express the very same proposition in their respective contexts. For example, consider the sentence:

(16) John is tall.

¹⁷ There are two versions of the syntactic ellipsis approach to quantifier domain restriction, which are usefully distinguished:

Syntactic Ellipsis Theory of domain restriction, Version 1

For any utterance of a phonological sentence S containing quantified expressions, the quantifier domain restrictions for the quantifier expressions in S are due to the presence, in the grammatical sentence uttered, of unarticulated natural language expressions whose interpretation is context-independent.

Syntactic Ellipsis Theory of domain restriction, Version 2

For any utterance of a phonological sentence S containing quantified expressions, the quantifier domain restrictions for the quantifier expressions in S are due to the presence, in the grammatical sentence uttered, of unarticulated natural language expressions.

According to the second, less restrictive version, unarticulated context-dependent natural language expressions may play a role in quantifier domain restriction. See the discussion of the "explicit approach" in Neale (1990, pp. 95 ff.) as well as the articles cited in footnote 49 of p. 115, for a discussion of these two versions of the syntactic ellipsis approach.

Without contextual background we only have a vague sense of what this sentence might say. In order to determine the proposition it expresses, we have to know what is the relevant comparison class with regard to which John is said to be tall. The very same sentence can express a truth if that class only includes John's colleagues and a falsehood if it also includes several professional basketball players. There is, however, no reason to think that some natural language expression denoting this comparison class is present in the grammatical sentence 'John is tall'. Rather, one can say that the relevant class is the value of a *contextual parameter*, and that an occurrence of (16) expresses a proposition relative to this value.

There are two sorts of ways to incorporate this general account of comparative adjectives into systematic theory. According to the first, what is uttered contains a variable that is assigned a comparison class by context. For example, (16) might be informally represented as:

(17) 'John is tall F' is true relative to a context *c* if and only if John is tall for a member of the value of *F* relative to *c*.

where context would assign a comparison class to the variable *F*. According to the second, reference to the comparison class only appears in the metalanguage (cf. Heim and Kratzer (1998, p. 71)):

(18) 'John is tall' is true relative to a context *c* if and only if John is tall for a member of the comparison class provided by *c*.

On both of these accounts, an occurrence of (16) and an occurrence of:

(19) John is tall for a basketball player.

may say the same thing, despite being distinct grammatical sentences. The role of context is not to provide expressions, but rather to provide semantic values.

One can follow a similar line in the case of quantifier domain restriction. There are no covert natural language expressions which contexts adds to what is articulated by Lisa's utterance of (1), but there are covert semantic values which play their role in determining the proposition expressed. The semantic value of the sentence is a proposition that quantifies over the relevant bottles. This is due to the fact that the value of a contextual parameter somehow contributes to the semantic value of the whole sentence. We call any such approach a *semantic parameter*

approach to the problem of quantifier domain restriction.

There are several ways to implement a semantic parameter approach, depending on where the contextual parameter is incorporated into the theory. As in the case of comparative adjectives, the main question is again whether the parameter is present in what is articulated, as in (20), or shows up only in the metalanguage, as in (21):

(20) 'Every bottle F is empty' is true relative to *c* if and only if every bottle in the domain *c* provides as the value of F is empty.

(21) 'Every bottle is empty' is true relative to *c* if and only if every bottle in the domain provided by *c* is empty.

Again, in both cases, the role of context is not to supplement a phonological sentence with covert material to yield a distinct grammatical sentence. Context rather supplies semantic values.

One might feel that the approach in (20) is better called 'grammatical', since the quantifier domain is represented in the grammatical sentence itself. But this is not how we have chosen our terminology. According to grammatical approaches to the problem of quantifier domain restriction, Lisa's actual utterance of (1) and her hypothetical utterance of (10) correspond to the very same grammatical sentence. This is clearly not the case according to a theory that avails itself of a clause like (20). In such a theory, the grammatical sentence actually uttered by Lisa does not contain the lexical items 'I', 'just', and 'bought', but the grammatical sentence uttered by her in the hypothetical utterance does.¹⁸

Finally, there are ways to treat quantifier domain restriction pragmatically. According to a pragmatic theory of quantifier domain restriction, the actual occurrence of (1) and the hypothetical occurrence of (10) express different propositions. However, they *communicate* the same proposition. Here is an example of a case in which a pragmatic approach is plausible (cf.

¹⁸ A proposal according to which the ellided material contains *just* a covert indexical expression might be considered to be intermediate between a syntactic ellipsis and a purely semantic approach. However, we classify this proposal as a syntactic ellipsis proposal, and include discussion of it in our section discussing the syntactic ellipsis approach.

Bach (1994, p. 134)). Imagine a child who is crying because of a minor cut. Her mother attempts to calm her by uttering:

(22) You are not going to die.

Intuitively, the proposition communicated in this case is something like that expressed by an occurrence of 'You are not going to die from that cut'. It is, however, possible that this is not what is expressed by (22) in this context. Perhaps what was said was that the child will not die *tout court*, which is quite certainly false.

There are ways to treat quantifier domain restriction in a similar fashion. For example, one may say that what is said by (1) in the envisaged context is the obviously false proposition that every bottle in the universe is empty. Realizing that the proposition is obviously false, her audience looks for a contextual elimination of the pragmatic anomaly. The reasoning to be followed here can be thought of as broadly Gricean. Upon realizing that the proposition expressed violates the maxim of quality, the interpreter looks for some other proposition that the speaker may reasonably be taken to have meant.¹⁹ We call any such approach, a *pragmatic approach* to quantifier domain restriction.

As in the case of the expression 'semantic', our vocabulary here, too, could lead to misunderstanding. An approach does not count as pragmatic just because broadly Gricean mechanisms may be used to select a particular domain of quantification. For example, one could hold that broadly Gricean mechanisms are used to determine *what is said* by an occurrence of a quantified sentence. Such an approach counts as semantic, in our terms, not pragmatic. Rather, an approach is pragmatic just in case the quantifier domain restriction determined by contextual features does not affect what is said, but rather only what is communicated.

In the next two sections, we assess the merits of the different approaches to the problem

¹⁹ However, the reasoning differs from standard cases of conversational implicature, since the proposition implicated in such cases will have to be semantically similar to the proposition expressed, whereas no such requirement exists in normal cases of implicature.

of quantifier domain restriction. We argue first that the syntactic ellipsis approach is incorrect.²⁰ Next, we argue that all versions of the pragmatic specification approach are incorrect. It then follows that the role played by context in the providing of a contextually restricted domain to quantifier expressions is semantic.

5. Against the Syntactic Ellipsis Approach

According to the syntactic ellipsis theory, when someone is articulating a sentence like:

(1) Every bottle is empty.

what is said contains an expression which does not correspond to any segment of what was articulated. This unpronounced expression is a one-place predicate and its function is to restrict the domain of the quantifier 'every' in (1).²¹ So, the sentence uttered is 'Every bottle which is F is empty', where F abbreviates the unpronounced predicate. The domain of quantification is simply the intersection of the set of all bottles and the set of all things that are F . What expression F is depends on the context in which (1) is uttered.

What makes the syntactic ellipsis theory initially plausible is the idea that normal linguistic communication essentially relies on uses of linguistic expressions. Suppose a speaker utters the sentence 'Snow is white' and thereby successfully conveys the proposition to a hearer that snow is white. The hearer came to know what the speaker meant because the hearer knows which words were used by the speaker, knows how one can properly use those words, and knows that the speaker used his words properly. In particular, the hearer came to know that the proposition the

²⁰ Others who have criticized the syntactic ellipsis approach to quantifier domain restriction include Bach (pp. 130 ff. of his (1994)) and Recanati (1996, pp. 448ff.).

²¹ This assumption is natural, but it is not indispensable. One could argue, for example, that the unarticulated expression is a relative clause, an adjectival phrase, or a prepositional phrase. None of these decisions make a difference to our discussion in this section.

speaker meant is about snow because the speaker used the word 'snow', because the hearer knows what 'snow' means, and because the hearer knows that the speaker meant just what the word means. So, it seems that a feature of the proposition conveyed (namely, that it is about snow) can be linked to certain features of the speaker's use of a certain expression (namely, 'snow').

Analogously, one might suggest that since an utterance of (1) can convey in the course of normal linguistic communication a proposition that is about a restricted class of bottles, there must be an expression in the sentence uttered that is appropriately linked to that class. According to the proposal we are concerned here, that expression would be 'bottle which is F ' for some contextually specified value of the schematic letter F and the appropriate linkage is that this predicate is true of all and only the elements of the class that the proposition conveyed is about.²²

The main problem the syntactic ellipsis theory faces is that of *underdetermination*.²³ There

²² According to the 'modified traditional account' of Blackburn (1988), an utterance of (1) expresses the set of propositions expressible by sentences which result from (1) by expanding the quantifier phrase 'every bottle' into an expression that the speaker 'would be prepared to fall back on' (Blackburn (1988, p. 271)). We are not sure what is meant by this latter phrase. Be that as it may, Blackburn's account is not a version of a syntactic ellipsis approach. In cases of syntactic ellipsis, there is a unique phrase recoverable from the context.

²³ A contemporary paper in which an underdetermination problem is raised is in Wettstein (1981), in which it is used to argue that definite descriptions cannot be treated along Russellian lines. We object to this usage of the problem of underdetermination on two grounds. First, it presupposes that the only strategy available to the Russellian to address the problem of quantifier domain restriction is the syntactic ellipsis approach. Secondly, the problems with the syntactic ellipsis approach are not unique to the definite description, but occur with all quantificational expressions. Schiffer (e.g. (1992, pp. 512-518), (1995)) has emphasized that underdetermination worries are relevant where ever "hidden indexicality" is at issue. His term for the problem of underdetermination is "the meaning-intention problem". We have learned much from Schiffer's discussions. However, his vocabulary presupposes the Gricean thesis that the intentions of

are very few cases where there is a single plausible candidate for the role of the domain restricting predicate. Consider again the situation described in the previous section where (1) is uttered by Lisa. We assumed that the proposition conveyed by Lisa's utterance was that the same she could have conveyed by uttering the sentence:

(10) Every bottle I just bought is empty.

It seems natural then to assume that F is simply the predicate 'was just bought by me'. However, one might wonder whether this choice is somewhat arbitrary. Why could F not be the predicate 'was recently purchased by me', or 'is one of those things that I bought at the store'? We need not even restrict ourselves to synonyms or near synonyms. It seems that in the context of Lisa's utterance F could equally be something like 'is one of those things you are looking for'. Since the sole function of F in communicating is to restrict the domain of the quantifier, it is hard to see how to select among predicates that apply to the same bottles.

We can articulate the problem of underdetermination using the distinction between the descriptive and the foundational problems of context dependence. The concern is that the syntactic ellipsis approach to quantifier domain restriction provides a solution to the descriptive problem by placing intolerable burdens on any possible solution to the foundational problem. If context has to provide a specific predicate whose extension will contribute to the determination of the domain, a solution to the foundational problem involves specifying the relevant features of the context which select the predicate F among other candidates. And it is exceedingly hard to see what feature of the context could do that.

There is only one plausible principle that could tell us which predicate to choose in interpreting utterances of quantified sentences. The principle is that one should choose a purely

conversational participants are all that is relevant to resolving the context-dependence. Since we wish to remain neutral on issues concerning the foundational problem of context-dependence, we have replaced his vocabulary by our own.

demonstrative predicate, for there is a clear sense in which that is the simplest of all the acceptable contenders. So, the sentence uttered by Lisa would have to be 'every bottle which is one of those is empty'. The demonstrative pronoun 'those' will denote, relative to the context of Lisa's utterance, the set of things that comprise the domain of quantification. This is the *pure indexical* version of the syntactic ellipsis theory.

The first thing to say about this proposal is that while it is syntactic in letter, it is semantic in spirit. Although there is a grammatical expression to be identified on contextual grounds, the expression is almost completely void of context-independent meaning. What ultimately settles the domain of the quantifier is the semantic mechanism that assigns the appropriate value to this expression. However, a defender of the pure indexical version of the syntactic ellipsis theory may concede that the proposal is very close to a semantic theory but insist that it is superior to those because it links the domain of the quantifier to a particular expression within the sentence.

But there is still an argument to be given against the pure indexical approach. Suppose that Max is not a fully competent speaker of English. In fact, he started to learn the language only a few weeks ago. As it happens, the first lessons in his language book focus on prepositions and the use of 'every' and 'some' as well as a few basic nouns like 'bottle'. The use of demonstrative pronouns is not discussed until unit 7 and Max is not there yet. We believe that under these circumstances Max could grasp the proposition meant by Lisa *in the normal way*. This, of course, is in conflict with the pure indexical version of the syntactic ellipsis theory. Since Max does not know the word 'those', he cannot identify the sentence uttered by Lisa which contains that word as an unarticulated constituent. Consequently, he cannot in the normal way know what was expressed by Lisa's utterance, and *a fortiori* he cannot in the normal way know what she meant.

This concludes our arguments against the syntactic ellipsis theories of quantifier domain restriction. The basic trouble with these theories can be summarized as follows. Either there is a way to specify which is the unarticulated constituent of the sentence uttered or there is not. If there is not, the hearer cannot know what sentence was uttered and consequently cannot know in

the normal way what proposition was meant. That is, when a quantified sentence is used whose domain is not articulated, the hearer can never know in the normal way what is conveyed, which is absurd. If there is a way to specify the unarticulated constituent, then it is conceivable that the hearer does not know this expression but knows all the articulated constituents of the sentence uttered. In such a case the syntactic ellipsis theory entails that the hearer cannot know in the normal way the proposition conveyed, which is very implausible.

6. Against Pragmatic Approaches

According to pragmatic approaches to quantifier domain restriction

(1) Every bottle is empty.

expresses, in every context, the false proposition that every bottle in the universe is empty. The audience then uses general pragmatic principles to infer from information available in the context that the speaker intended to communicate a proposition concerning a more restricted domain of quantification. Thus, occurrences of (1) always express false propositions, but they communicate true ones.

This characterization of the pragmatic approach may be somewhat narrow on two grounds. First, one might propose a pragmatic solution to the descriptive problem of quantifier domain restriction without claiming that utterances of sentences containing quantifiers are usually false. There might be some other peculiarity about them that would explain why the proposition expressed by these utterances differs from the proposition they convey. This sort of solution may be plausible for other instances of the problem of context-dependence. It is, however, in the particular case of quantifier domain restriction, unclear to us what this alternative peculiarity could be.

Secondly, one might suggest that the pragmatic rules that help one to derive the proposition conveyed are not general principles of conversation. Domain restriction may well be something like conventional, rather than conversational, implicature. Note, however, that standard

examples of conventional implicature (e.g. the implicature that when two clauses are conjoined with 'but' there must be some contextually salient contrast between their contents) tend to add extra information to the proposition expressed, rather than override what is said. This would not be the case for a parallel account of quantifier domain restriction. So, the defender of such a conventional implicature approach has to provide an explanation for the distinction. Be that as it may, the assumption that a pragmatic approach would use general principles of conversation in deriving the proposition conveyed for utterances containing quantifiers is not an assumption that is essential to our arguments in this section.

Pragmatic approaches have an obvious advantage and an obvious disadvantage. The obvious advantage is that one can propose a syntax and semantics for sentences containing quantifiers that is extremely simple and does not involve covert expressions or covert semantic values. In this regard they follow the advice of radical pragmatics: try to keep your syntax and semantics as simple as possible. The obvious disadvantage is that one has to abandon ordinary intuitions concerning the truth or falsity of most sentences containing quantifiers. This is worrisome because accounting for our ordinary judgments about the truth-conditions of various sentences is the central aim of semantics. Since these judgments are the data of semantic theorizing, we should be careful with proposals that suggest a radical revision of these judgments. How to weigh the obvious advantage and the obvious disadvantage is not entirely clear. So, we will focus on arguments for and against pragmatic approaches that are independent of these considerations.²⁴

Kent Bach is the philosopher most associated with pragmatic approaches to quantifier domain restriction. But it should be noted that Bach, especially in his most recent work, is not a straightforward proponent of pragmatic approaches as we have defined them. For Bach's

²⁴ Thus, our argument against pragmatic approaches will differ substantially from that given by Recanati, in his (1993). Recanati's critique of pragmatic approaches focuses on essentially this consequence of them (cf. his discussion of the "Availability Principle", on pp. 248ff.).

distinction between semantics and pragmatics differs sharply from our own (cf. Bach (1999)). Bach uses the term 'semantic' in the second sense discussed in Section 3. Because of his belief that the effects of context on the truth-conditions of utterances usually outstrip denotation assignment and composition, Bach believes that the output of semantic interpretation is often a non-propositional entity. In addition to its standard Gricean role, for Bach, pragmatics involves turning these non-propositional entities into propositions. However, pragmatic approaches to quantifier domain restriction, in our sense, are ones that account for quantifier domain restriction in terms of Gricean-like inferences from the proposition expressed to the proposition communicated. It follows from this difference that Bach has resources at his disposal that a proponent of pragmatic approaches, in our sense, does not.

Bach is nevertheless an appropriate target for our arguments. First, in the special case of quantifier domain restriction, he in fact holds that semantics does deliver a proposition, that is, a truth-evaluable entity, and pragmatics yields a different one. Secondly, our positive argument against pragmatic approaches in our sense ultimately shows that quantifier domain restriction is due to denotation assignment to a quantifier domain variable in the actual syntactic structure of quantified sentences, and so is semantic in Bach's sense.

Here is an argument, due to Bach (1994, 138-9), against the view that one should incorporate quantifier domain restriction into the syntax or the semantics of quantification. The first premise is what Bach calls 'syntactic parallelism'. According to it, syntactically parallel sentences should receive parallel semantic treatment. Bach's second premise is that there is no reason to accept that the proposition expressed by utterances of (23) quantifies over a restricted domain:

(23) A book is on the table.²⁵

Bach's third premise is that (23) is syntactically parallel to any sentence which results from replacing 'a book' by any other quantifier expression. Bach's conclusion is then that there is no

²⁵ We ignore, in what follows, the context dependency associated with the quantifier expression 'the table'.

reason to believe that the proposition expressed by a use of (1) quantifies over a restricted domain.

The first problem with this argument is that syntactic parallelism cuts both ways. Bach's opponent believes that utterances of (1) are best interpreted as quantifying over a restricted domain. So, if the opponent accepts Bach's first and third premises she can justifiably say that the second premise cannot be true. There *is* a reason for thinking that utterances of (23) expresses a proposition that quantifies over a restricted domain, namely, that utterances of (1) do and that the sentences (1) and (23) are syntactically parallel.

The second problem with Bach's argument involves its second premise. What Bach needs to show is that there are reasons to believe this premise that could be persuasive to someone who does not already believe the conclusion. What could such a reason be? We suspect it is based on the observation that whenever an existentially quantified sentence is true when interpreted as governed by a domain, it is also true when interpreted as governed by a broader domain. Hence, it is true when interpreted as governed by a domain that encompasses absolutely everything.²⁶ This is a feature of existential quantification that is not shared by universal quantification: if a universally quantified sentence is true when interpreted as governed by a domain, it may nevertheless be false when interpreted as governed by a broader domain. So, it may seem to follow that assuming a more restricted domain for the proposition expressed serves no theoretical purpose.

But this line of reasoning is incorrect. It is clear that as long as we are convinced that an occurrence of (23) expresses a truth, we might as well interpret it as quantifying over absolutely everything. But what if, intuitively, an occurrence of (23) expresses something false? If (23)

²⁶ This feature is usually called 'upward monotonicity'. A unary quantifier Q is upward monotone (or monotone increasing) iff for all sentences S whose main connective is Q and for all domains D if S is true with regard to D and $D \subseteq D'$ then S is true with regard to D' .

expresses a falsehood when interpreted as quantifying over D, it may still express a truth when interpreted as quantifying over a superset of D (that is, the existential quantifier is not downward monotone). So, domain restriction is truth-conditionally relevant for existentially quantified sentences.

Consider the following example. John and Bill are printing copies of *Naming and Necessity* in their printing shop. There are thousands of copies of this book lying around. Lunch break is approaching and John complains to Bill that he wants to read a book, since he needs to get his mind off of *Naming and Necessity*. Bill believes that there are several detective novels lying on the table beyond him, and, on this basis, utters (23). If, however, all there are on the table behind Bill are more stacks of *Naming and Necessity*, then this occurrence of (23) seems false. Intuitively, that is because (23), relative to this context quantifies over (copies of) books other than *Naming and Necessity*. Extending the domain in such a way that it would include copies of *Naming and Necessity* would result in a different interpretation for (23) and under this interpretation it would express a truth.

Now, Bach can (and would) deny that (23) expresses a falsehood in the context of John's utterance. But notice that the burden of proof is on him. In order for his argument to work, it must be the case that, intuitively, there are no truth-conditionally relevant effects of domain restriction on (23). He must believe that this alleged contrast between (1) and (23) can be appreciated independently of accepting the conclusion of Bach's argument, namely, that quantifier domain restriction is pragmatic. But this is not true. There is no reason for Bach's opponent to accept the second premise of his argument. Therefore, Bach's argument is powerless against its intended audience.

It is one thing to undermine an argument in favor of pragmatic approaches; it is another to provide an argument against them. We now turn to the latter task.²⁷ What we claim is that the phenomenon of *quantified contexts* poses an insurmountable difficulty for pragmatic approaches.

²⁷ The arguments to follow are developed in greater detail in Stanley (forthcoming).

Quantified contexts are cases involving sentences containing multiple quantified expressions whose intuitive readings are only possible to capture by assuming that an index representing the quantifier domain of the second quantifier expression is bound by the first quantifier expression. Since the pragmatic approach does not postulate syntactically represented, or semantically reflected quantifier domains, it cannot capture these readings.

Consider the following sentences (cf. von Stechow (1994), Cooper (1993)):

(24) In most of John's classes, he fails exactly three Frenchmen.

(25) In every room in John's house, every bottle is in the corner.

(26) Whatever John does, most of the class falls asleep.

In each of these examples, the domain of the second quantifier expression varies with the values of the first quantifier expression. For example, the proposition intuitively expressed by an utterance of (24) is the proposition that, for most x such that x is a class of John's, John failed three frenchmen in x . Thus, the domain of the quantifier expression 'three frenchmen' varies with the value of the variable introduced by the quantifier 'most'. Thus, the quantifier domain variable associated with 'three frenchmen' is *bound* by the preceding quantifier expression. Similarly, the proposition intuitively expressed by an utterance of (25) is the proposition that in every room x in John's house, every bottle in x is in the corner. Therefore, the quantifier domain variable associated with 'every bottle' is bound by the preceding quantifier expression. Finally, the proposition intuitively expressed by an utterance of (26) is the proposition that whatever action x John undertakes, most of the class in the situation in which x occurs falls asleep. Therefore, the quantifier domain variable associated with 'most of the class' varies with the value of the variable introduced by the quantifier expression 'whatever John does'. Thus, the quantifier domain variable associated with 'most of the class' is *bound* by the preceding quantifier 'whatever'.

However, the pragmatic approach does not posit any quantifier domain variable associated with the quantifier 'three Frenchmen'. According to the pragmatic approach, the only reading of (24) is one according to the second part of the sentence is completely unrelated to the first part of the sentence. Indeed, it is not clear, on a pragmatic approach, that sentences such as (24-26)

express coherent propositions at all.²⁸

Since it is not clear that (24-26) even express coherent propositions on the pragmatic approach, one standard defense of the pragmatic approach fails. According to this defense, occurrences of (1) *really* express a proposition about every bottle in the universe, since it is always possible to respond to an utterance of (1) by saying 'Strictly speaking, that is not true, since there are some bottles in the universe that are not on the table'. According to the defender of the pragmatic view, what this shows is that, strictly speaking, occurrences of (1) expresses the proposition that every bottle in the universe is on the table.

This defense is unpersuasive even for examples such as (1). For the defender of grammatical or semantic approaches to quantifier domain restriction may simply maintain that, in so responding to an utterance of (1), one thereby shifts the context.²⁹ Be that as it may, even

²⁸ In the face of this difficulty, a defender of the pragmatic approach may argue that although 'he fails exactly three frenchmen' does not contain any syntactically represented quantifier domain, this is not a problem since the full structure of (24) is akin to that of 'For most x such that x is a class of John, he fails three frenchmen in x'. There are two responses. The first is that it is unclear how this approach would treat examples such as (26), since it is completely unclear what the unarticulated constituent would be. Secondly, this sort of move is blatantly inconsistent with the spirit of the pragmatic approach. It is in part because the proponent of the pragmatic approach believes that it is absolutely illegitimate to postulate structure on semantic grounds that she is able to make the case for a pragmatic approach (cf. Bach (1994b), pp. 130ff.).

²⁹ Indeed, the smoothest account of operators such as 'strictly speaking' suggests that they are context-shifting *operators*. David Kaplan has, however, argued that there are no operators which shift contexts (Kaplan (1989a, pp. 510ff.); see also, for discussion of Kaplan's thesis, Israel and Perry (1996)). We do not know what to think of Kaplan's restriction on such operators. However, if, as it appears to be, it is motivated by the assumption that sentence-operators operate on propositions, then it is unconvincing. For example, tense-operators are sentence operators, but they do not operate on propositions (cf. Salmon (1986, pp. 37ff.)).

assuming that this line of defense is plausible for examples like (1), it is simply unavailable for examples of quantified contexts. For it is not coherent to respond to an utterance of (24) by saying, 'strictly speaking, that is not true, since John has failed many more than three Frenchmen'.

Here is a possible response to our argument for the existence of quantifier domain variables. One might respond by conceding that in sentences such as (24-26) there is a quantifier domain variable that is bound by the initial quantifier, but deny that in an 'unembedded' sentence such as:

(27) John failed exactly three students.

there is a quantifier domain variable present. According to this response, a variable is associated with quantifier expressions only in the special case of bound readings such as (24)-(26).

However, consideration of facts from ellipsis serves to dispose of this response. Consider the discourse:

(28) John failed exactly three Frenchmen. In fact, in most classes John has taught, he has. The natural reading of the second sentence in (28) is that in most classes x such that John has taught x , he has failed exactly three frenchmen in x . However, if there is no quantifier domain variable present in the initial sentence in (28), then there is no way of deriving the natural reading of the second sentence.

The second sentence of (28) is a standard case of syntactic ellipsis (verb phrase ellipsis). According to standard theories of such ellipsis, the predicate 'failed exactly three Frenchmen' in the first sentence is copied or reconstructed in the final syntactic structure of the second sentence.³⁰ If there is no quantifier domain variable available for binding in the predicate 'failed exactly three Frenchmen' in the first sentence of (28), then the result of copying or reconstructing it in the logical form of the second sentence will also not contain a bindable variable, in which case there will be no way to derive its natural reading (cf. Stanley, (forthcoming, Section III)).

³⁰ The argument to follow does not depend upon a copy theory of ellipsis; it would work equally well under the minimalist assumption that ellipsis amounts to PF deletion under a parallelism requirement.

Therefore, on the assumption that standard theories of syntactic ellipsis are correct, there is a bindable variable for quantifier domains present even in sentences such as (27).³¹

We have therefore demonstrated the existence of quantifier domain variables, or at least some process that semantically mimics syntactic binding.³² In the face of these considerations, arguing that quantifier restriction must be treated pragmatically is akin to arguing that the reading in which 'his' is bound in:

(29) Every boy loves his mother.

should also be captured pragmatically. Examples such as (24-26) also pose an even greater difficulty for the task of developing a pragmatic approach to the problem of quantifier domain restriction. For it is even more difficult to see how to derive the intended meaning from the absurd proposition predicted to be expressed on such an approach.

We have argued that both the syntactic ellipsis approach and the pragmatic approach to quantifier domain restriction are incorrect. Thus, quantifier domain restriction must be, in our terminology, a semantic process. In the next section, we turn to the different candidate semantic

³¹ Kent Bach has suggested to us another line of response, one which has some initial promise for examples such as (24) and (25), but is unavailable for examples such as (26).

According to this suggestion, (24) is transformationally derived from:

(24') He fails exactly three students in most of John's classes.

However, (24) is not transformationally derived from (24'). (24') does not permit co-indexing between 'he' and 'John'; the theoretical explanation of this fact in syntax is that such co-indexing would violate Condition C of the Binding Theory. If the prepositional phrase 'in most of John's classes' were to move in the way suggested, then one should not expect a reading of (24) in which 'John' and 'he' are co-indexed, because that would result in a strong crossover violation. Since (24) has a very natural reading in which 'John' and 'he' are co-indexed, (24) is not transformationally derived from (24').

³² For the details of the latter sort of process, see Max Cresswell's treatment of examples such as (25) on pp. 81-87 of his (1996).

processes that could underlie the phenomenon of quantifier domain restriction.

7. Semantic Approaches

In this section, we discuss ways to represent quantifier domain restriction semantically. Our desire throughout is to keep our presentation both as informal and as theory neutral as possible. But we will of course need some rudimentary semantic tools. The phenomenon of quantifier domain restriction has received interesting treatment in several different theoretical frameworks.³³ However, to meet our goals of maximum accessibility and theoretical neutrality, we will use only some elementary resources of model theory. Where possible, we provide explanations of the basic tools we use.

We also need, at the outset, to introduce some very rudimentary syntax. The first reason is that, to differentiate between proposals, we will need to talk about the structure of the sentences that are being interpreted by the semantics. But we also believe, and assume in this discussion, that semantic interpretation is run off of the output of a syntactic mechanism, whose nature it is the purpose of syntactic theory to uncover.

We realize that some semanticists and philosophers use their semantic theories to interpret structures that differ greatly from the syntactic structures produced by plausible syntactic theories for natural language. There are essentially two different theoretical motivations for doing this: one that is popular among philosophers doing semantics and another that is popular among linguists

³³ For example, Robin Cooper (1993) treats quantifier domain restriction in the 'Extended Kamp Notation' of Barwise and Cooper (1993). Max Cresswell treats quantifier domain restriction in a 'propositional language', which mirrors variable binding with the use of sentence operators (cf. Part II of his (1996)).

doing semantics. The philosophical motivation is the felt need for regimented discourse. As far as pure syntactic evidence is concerned, it is hard to see what difference there would be between sentences like '2 is an even number' and 'Joe is a skillful painter'. But then if semantic interpretation uses this shared syntactic structure as its input, it is hard to see how to avoid the conclusion that just as the truth of the second sentence commits us to the existence of Joe, the truth of the first sentence commits us to the existence of 2. And for many philosophers, this seems unacceptable.

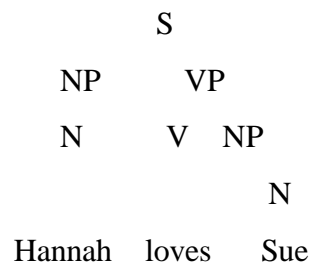
In general, it is hard for philosophers to part from the idea that one can freely construct alternative semantic structures for various natural language sentences without being constrained by empirical evidence from linguistics. Such a view, however, is tantamount to the endorsement of the hypothesis that syntax is a superficial feature of language, detached from the way we understand the utterances of others. We find this hypothesis implausible in the extreme.

The linguistic motivation for being cavalier about syntax is the belief that semantic interpretation should take cross-sentential phenomena into account, and hence cannot run off the output of a syntactic mechanism that consists of isolated sentential structures. Instead, a proper semantic theory should proceed in two steps: first, articulating a mechanism that builds unified semantic representations out of syntactic structures associated with each of the sentences within a longer discourse, and second, assigning semantic interpretations to these structures.³⁴ Now, one can of course provide unified syntactic representations for sequences of sentences by providing the standard syntactic representation for each sentence, and grouping together sequences of such representations under a text or discourse node (cf. Heim (1982)). Why not take these as the inputs of the assignment of semantic values? The reason might be that these syntactic representations are not interpretable compositionally, or that the resulting interpretation is too complicated, or perhaps that it lacks the psychological reality the unified semantic representations have.

³⁴ This is essentially the program of Discourse Representation Theory (cf. Kamp (1981), Kamp and Reyle (1983)).

Whether any of these claims is in fact true is an open empirical question.³⁵ However, the default assumption should certainly be that they are false. A system in which the outputs of the standard syntactic process are directly assigned semantic interpretations is significantly less complex than one which includes, in addition, a translation of these outputs into intermediate semantic representations, which are then interpreted by the semantics. Unless this additional complexity is justified by strong empirical arguments, good methodology should lead us to reject it.³⁶ That is our justification for our assumption that what is semantically interpreted are the outputs of a syntactic mechanism, whose nature it is the purpose of syntactic theory to describe.

We will call the output of the syntactic process that is visible to semantic interpretation a *logical form*. A logical form is a lexically and structurally disambiguated ordered sequence of word types, where word types are individuated both by semantic and syntactic properties. Logical Forms are phrase-markers. An example of such a phrase marker, for the sentence 'Hannah loves Sue' is as follows:



The nodes in this diagram are the points labeled either with syntactic categories or lexical items.

³⁵ The first of these claims was, in fact, the contention of Kamp (1981). In the ensuing years, a number of authors have elaborated frameworks within which the phenomena which motivated the development of DRT receive compositional treatments (e.g. King (1987), Groenendijk and Stokhof (1991), Neale (1990)).

³⁶ We do not wish to be taken as denying the importance of approaches such as DRT. Being more flexible than conventional theories, they can approach phenomena which are as yet unapproachable by other means. That is, they articulate theoretical challenges for what might turn out to be more methodologically sound syntactic and semantic theorizing.

So, 'Hannah' labels a node, as does 'N', 'VP', and 'V' (we shall also talk of labels of nodes as *occupying* these nodes). The nodes are connected by branches, which are the lines in the diagram. We say that a node *X dominates* another node *Y* in a phrase marker if there is a path of branches leading downward in the tree from *X* to *Y*. We say that a node *X* immediately dominates another node *Y* in a phrase marker just in case *X* dominates *Y*, and there is no node *Z* between *X* and *Y*. Nodes that dominate other nodes are called *nonterminal nodes*. Nodes that dominate no other nodes are *terminal nodes*. The nodes labeled with lexical items such as 'Hannah' or 'loves' are always terminal nodes. These are the objects that we assume are interpreted by semantic theories.

The main division between semantic parameter approaches lies in whether the contextual parameter is provided as the value of a variable in the logical form of a sentence relative to a context, or whether it is provided in the metalanguage. Approaches of the latter sort may be called metalinguistic semantic parameter approaches. We begin by presenting and rejecting the two conceivable metalinguistic parameter approaches to quantifier domain restriction.³⁷ We then turn to different versions of the first sort of semantic parameter approach, and select amongst them.

Perhaps the most natural way of representing domain restriction semantically is in fact a metalinguistic semantic parameter approach. It is as follows. In a model-theoretic semantics, the truth of sentences is considered relative to a model. Each model has a domain of individuals, and an assignment of subsets of the domain to predicates. This suggests the following elegant treatment of quantifier domain restriction. Since the truth of a sentence is considered with respect to a model, and the model already has a domain of individuals, perhaps one could treat the domain of individuals in the model as the quantifier domain restriction supplied by context. We call this approach, the *model theoretic* approach.

³⁷ One might think that the variable-free approach so clearly presented in Cresswell (1996) is a metalinguistic approach. Not so. On this approach, quantifier domain restriction is treated via the provision to Logical Forms of a series of covert, object-language *operators*.

The model theoretic approach works very well for sentences which contain only one quantified expression, such as:

(30) Everyone smokes.

According to the model theoretic approach, the (informal) truth-clause for (30) is:

(31) 'Everyone smokes' is true relative to a model M iff everyone in the domain of M smokes in M.

Suppose that the domain of quantification for a particular utterance of (30) is the students in Mr. Desiato's third-grade class. We incorporate this fact into the semantic theory, according to the Model Theoretic approach, by considering the truth of (30) relative to models in which the domain is the set of students in Mr. Desiato's third-grade class. The sentence is true in such models just in case every member of the domain smokes, and false otherwise.

Unfortunately, the model theoretic approach fails for sentences containing more than one quantified expression. Consider, for example:

(32) Every sailor waved to every sailor.

This sentence can express the proposition that every sailor on the ship waved to every sailor on the shore (cf. Stanley and Williamson (1995)). The moral of such examples is, as Scott Soames (1986, p. 357) has written, '...that contextual supplementation works at the level of constituents of sentences or utterances, rather than the level of the sentences or utterances themselves.' (cf. also Westerståhl (1985) and Recanati (1996)). The model theoretic approach, in contrast, associates whole sentences with domains of quantification. This is simply not fine-grained enough to capture the phenomenon of quantifier domain restriction.³⁸

³⁸ This is not to say that the model theoretic approach is of no use in addressing problems of context dependence. One way to use models to reflect the effects of context is in dealing with the sort of examples raised in Reimer (1998). According to Reimer, there are cases in which context forces us to ignore certain *facts*. In Reimer's cases, to capture the intuitive truth of certain utterances, one has to ignore the fact that the individuals under consideration have certain properties. One can account for these examples by treating the effect of context as restricting the

However, the model theoretic approach is not the only metalinguistic semantic parameter approach. One can associate domains with quantifier expressions metalinguistically, in such a way as to incorporate Soames's moral. To do so, one must provide some way for the context to shift within a clause.³⁹ Given that context can shift within a clause, one can treat examples such as (32) by providing the following sort of meaning rule for lexical items such as 'sailor':

(33) The denotation of 'sailor' in *c* is the set of sailors in the domain provided by *c*.

If context can shift within a clause, then different sets can be provided as domains for the two occurrences of 'every sailor' in (32). The set provided by the context relative to which the first occurrence is evaluated can be the set of things on the ship, and the set provided by the context relative to which the second occurrence is evaluated can be the set of things on the shore.

Though this version evades some of the difficulties facing the model-theoretic approach, it too is ultimately unsatisfactory. Furthermore, it is unsatisfactory for reasons that apply to any version of a metalinguistic approach. In the last section, we discussed the phenomenon of quantified contexts, in which a domain of a quantified expression varies with the values

evaluation of the utterances under consideration to models in which the individuals in question lack those properties, in effect treating the models as possible situations in which some actual facts do not obtain.

However, Reimer's examples are still problematic for some standard approaches. For example, Davidsonian approaches operate with a non-relativized notion of truth, that is, a definition of truth that is not relative to a model. On a Davidsonian approach, it would therefore appear as if one would have to deny the semantic significance of the intuitions at issue in the examples. However, it is unclear that this poses a problem for Davidsonian approaches. Appeal to an absolute notion of truth might provide just the sort of principled basis for rejecting the significance of the intuitions that Reimer claims is difficult or impossible to produce (cf. *Ibid.*, pp. 100-103).

³⁹ For a treatment of demonstratives and indexicals along these lines, see the appendix to Braun (1996).

introduced by a higher operator. This phenomenon is amenable to treatment in an approach in which logical forms contain variables that are assigned quantifier domains, for on such approaches, the quantifier domain variable is then bound by the higher operator. However, the phenomenon of quantified contexts is not amenable to treatment in a metalinguistic approach to quantifier domain restriction, since there is no variable to be bound.

Simplifying dramatically for the purposes of exposition (including omitting reference to 'exactly'), we can consider the syntax of (24) to be as in:

(34) [_S [_{PP} [_P In] [_{NP_i} [_{DET} most] [_{N'} [_{PP} [_P of] [_{NP} John's classes]]]]]] [_S [_{NP_i} he] [_{VP} [_V fails] [_{NP} [_{DET} three] [_{N'} [_N Frenchmen]]]]]]]

The natural interpretation of (34) is that, where *x* is a class of John's, John fails three frenchmen in *x*. To capture this reading, we need to postulate a variable bound by 'most of John's classes' which is in some way associated with the quantifier phrase 'three Frenchmen'. The different values of these variables correspond to the different quantifier domains for the phrase 'three Frenchmen'. So, the phenomenon of quantified contexts shows that quantifier expressions contain variables which can be bound, and whose purpose is to supply the domains for quantifier expressions.

However, it is not completely straightforward how, in examples such as (24)-(26), quantifier domains vary as a function of the values introduced by the preceding quantifiers. Consider example (24). Here, the quantifier domain for 'three Frenchmen' varies as a function of the values introduced by 'most of John's classes'. But the values introduced by this latter quantifier expression are classes (in the educational sense), which are not appropriate entities to be quantifier domains. If quantifier domains are sets, then the context must provide a function from classes (in the educational sense) to sets. This function will map a class onto the set of students in that class. Similarly, to treat example (26), context must provide a function from events to sets. A successful analysis of these constructions must incorporate such a function (cf. von Stechow (1994, Section 2.2.2) and Cresswell (1966, pp. 81-87)).

What the phenomenon of quantified contexts shows is that, assuming standard treatments of binding, quantifier domain restriction must be treated with the use of variables. But we have to

be somewhat subtle about the use of variables here. We cannot simply replace the noun 'bottle' in (1) with a variable in logical form, since common nouns are obviously not pure demonstrative or indexical expressions. We must rather associate variables with some part of quantifier expressions, such as 'every bottle'. Distinct non-metalinguistic treatments of the problem of quantifier domain restriction correspond to different ways of associating variables with quantifier expressions.

However, we first need to say more about what it is to *associate* a variable with an expression. In our terminology, a variable is associated with a syntactic element, either a syntactic category or a lexical item, just in case it *co-habits* a node with it. We represent the cohabitation relation as an ordered pair of an expression and a variable. The details of this treatment will emerge in our discussion of the different accounts of quantifier domain restriction.

We first present our favored way to use contextual variables to treat the problem of quantifier domain restriction. Suppose each common noun (e.g. 'bottle' and 'cat') co-habits a node with a contextual variable.⁴⁰ Then, a sentence such as:

(35) Every man runs.

would receive the representation:

(36)	S	
	NP	VP
	Det	N V
	Every	<man, f(i)> runs

The value of 'i' is an object provided by the context, and the value of 'f' is a function provided by the context that maps objects onto quantifier domains. The restriction on the quantified expression 'every man' in (35), relative to a context, would then be provided by the result of

⁴⁰ The use of contextual variables as parasitic on other syntactic elements is an idea we have adopted from Westerståhl's classic (1985). Westerståhl's approach, however, differs in important respects from ours. According to him, contextual variables co-habit nodes with the categorial label, "Det". This analysis is a mixture of the second and third alternatives to our approach, discussed below, and inherits the problems of both.

applying the function that context supplies to ‘f’ to the object that context supplies to ‘i’.

By representing quantifier domain variables as co-habiting nodes with common nouns, we do not mean to deny to them syntactic reality. If binding is ultimately a syntactic relationship between a binder and a variable, then our arguments in the previous section demonstrate that they do indeed exist in the syntax (cf. Stanley (forthcoming, Section III)). Indeed, in what follows, we use the assumption that quantifier domain variables are syntactically real in some of our arguments against alternative accounts.

Before we give an explicit semantics, we note a simplifying assumption. In what follows, we treat quantifier domains as *sets*. However, the domains contexts provide for quantifiers are better treated as intensional entities such as *properties*, represented as functions from worlds and times to sets. Here is why. If quantifier domain restriction is a semantic process of a variable being assigned a value by the context, then, following standard semantic procedure, these values will be assigned before the sentence is evaluated with respect to other possible worlds or times. It follows that, relative to a context, contextual variables *rigidly designate* their values. However, relative to other worlds and times, the set corresponding to the quantifier domain may vary.

Suppose that John has a strange habit of buying exactly seventy bottles every time he goes to a supermarket. Suppose that John visits a supermarket that has exactly seventy bottles on the shelf, and purchases every bottle. Someone could then truly utter the sentence:

(37) If there were a few more bottles on the shelf, John would not have purchased every bottle.

However, if we assign to the contextual variable associated with 'every bottle' the set of bottles in the supermarket in the context of utterance of John's sentence, given the standard semantics for counterfactuals, (37) could not be truly uttered. To capture the reading of (37) on which it is true, one must treat the entity assigned to the contextual variable as a function from worlds and times to, say, the sets of bottles in the relevant supermarket at those worlds and times.

However, treating quantifier domains as properties only would complicate the discussion. All of the points we make in this section remain valid even when the extra complexities attached to the addition of intensional operators are factored in.

Let us now turn to the semantics. We adopt the by now standard generalized quantifier treatment of quantifiers such as 'every', whereby they express relations between sets (cf. Barwise and Cooper (1981), Westerståhl (1989)). On this account, the semantic clauses for quantifiers such as 'every' and 'some' are as in (38):

(38) (a) Every A B iff $A \subseteq B$.

(b) Some A B iff $A \cap B \neq \emptyset$.

On this account, the first argument of a quantified expression is determined by the head noun, and the second argument is determined by the verb phrase. For example, in the case of a sentence such as (35), the first argument would then be the set of men, and the second argument would be the set of runners.

No adjustment is required to extend the standard generalized quantifier treatment to interpret structures such as (36). But we do need to say something about the interpretation of expressions such as '<man, f(i)>'. Since we are taking quantifier domains to be sets, relative to a context, what results from applying the value of 'f' to the value of 'i' is a set. Relative to a context, 'f' is assigned a function from objects to sets. Relative to a context, 'i' is assigned an object. The denotation of '<man, f(i)>' relative to a context c is then the result of intersecting the set of men with the set that results from applying the value given to 'f' by the context c to the value given to 'i' by c . That is (suppressing reference to a model to simplify exposition), where $[\alpha]_c$ denotes the denotation of α with respect to the context c , and ' $c(\alpha)$ ' denotes what the context c assigns to the expression α :

(39) $[\langle \text{man}, f(i) \rangle]_c = [\text{man}] \cap \{x: x \in c(f)(c(i))\}$

In the case of (36), the resulting set is then the first argument of the generalized quantifier 'every'.⁴¹

⁴¹ One might think that one has to relativize both arguments of the quantifier to a domain. Not so. It is generally accepted that all true quantifiers found in natural language have the following two properties. First, they are *conservative*; that is, where Q is a binary natural language quantifier, $QAB \leftrightarrow QA(A \cap B)$. Secondly, they satisfy the *extension principle*; that is,

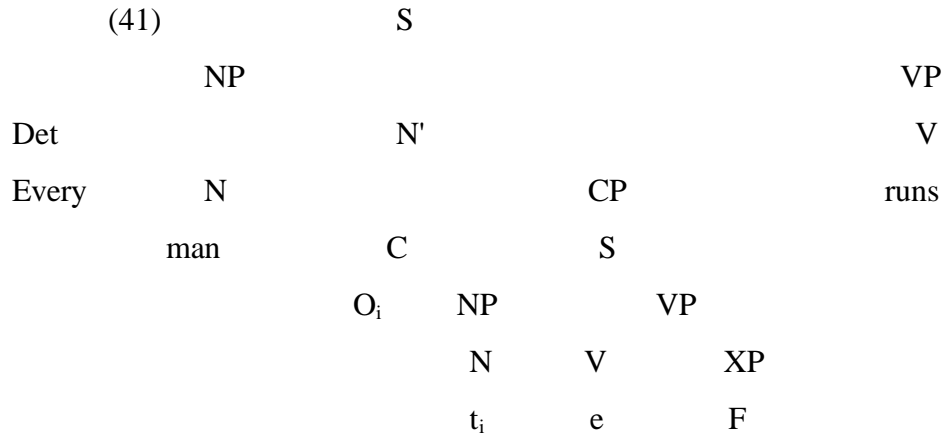
It is important, in understanding our analysis, to remember that what co-habits a node with common nouns are variables of the form ‘f(x)’, where ‘f’ is a variable that is assigned a function from objects to sets by contexts, and ‘x’ is a variable that is assigned objects relative to contexts. However, to simplify exposition in what follows, we will represent quantifier domain variables more simply as just single variables.

There is not much to disagree with in the claim that our favored semantic treatment is *one* possible way to accommodate a domain variable into the logical form of a sentence like (35). But why choose this semantic theory over others? In what follows, we will try to justify our preference. To do so, we will discuss three alternatives to our proposal. According to the first, domain variables co-habit *non-terminal nodes* with other syntactic elements. For example, the domain variable in the logical form for (35) co-habits a non-terminal node, namely the one labeled with *NP* dominating both the terminal node labeled with *every* and the terminal node labeled with *man*:

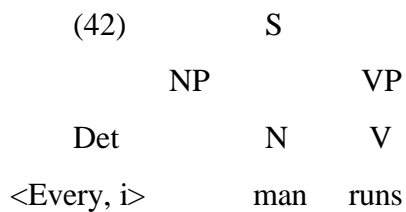
(40)	S		
	NP _i	VP	
	Det	N	V
	Every	man	runs

According to the second, the quantifier domain variable occupies its own terminal node in the logical forms of sentences containing quantifier expressions. For example, the logical form of (35), on this approach, would be:

where $A, B \subseteq D \subseteq D'$, then, where Q is a binary quantifier, QAB is true relative to the domain of quantification D if and only if QAB is true relative to the domain of quantification D' . This entails that the result of relativizing the first argument of a natural language quantifier to a domain of quantification D is equivalent to the result of relativizing both arguments to D (for the proof, see Westerståhl (1985, pp. 54-55); for discussion see Keenan and Westerståhl (1997, pp. 852ff.)).



Finally, according to the third approach, the domain variable co-habits a terminal node with the quantifier 'every', rather one with the noun 'man'. On this account, the logical form of (33) would be as in (42):



According to the first alternative, contextual variables occur in non-terminal nodes. To interpret the resulting structures, such as (40), one needs the following sorts of composition rules (we give these composition rules in basic Montague Grammar). Let ' $[\alpha]_{M,c}$ ' denote the denotation of α with respect to the model M and context c . As is standard, verb phrase denotations and noun denotations are functions from objects to truth-values, noun-phrase denotations are functions from such functions to truth-values, and determiner denotations are functions from functions from objects to truth-values to noun-phrase denotations.

$$(43) \text{ (a) } [{}_S \text{ NP}_i \text{ VP}]_{M,c} = t \text{ iff } [{}_{NP_i}]_{M,c} ([{}_{VP}]_{M,c}) = t.$$

$$\text{(b) } [{}_{NP_i} \text{ Det N}]_{M,c} = [{}_{\text{Det}}]_{M,c} ([{}_{N}]_{M,c} \cap c(i)).$$

It is the composition rule (43b) which we find objectionable. What it does is apply the

function denoted by the determiner to the result of intersecting the denotation of the noun with the value of the contextual variable. Our worry with composition rules of this sort is that they violate *compositionality*. Compositionality can be stated as follows: Suppose α is a non-terminal node immediately dominating $\beta_1 \dots \beta_n$. Then there is a function f such that $[\alpha] = f([\beta_1], \dots, [\beta_n])$.⁴²

According to (43b), the denotation of a noun phrase consisting of a determiner and a noun is determined by more than just applying the function expressed by the determiner to the denotation of the noun. Rather, in different contexts, the denotation of the noun phrase is a different function of the denotation of the determiner and the denotation of the head noun. Therefore, (43b) violates compositionality. One sometimes hears the view, voiced by philosophers of a pessimistic persuasion, that context-dependence poses a serious worry for the project of giving a systematic natural language semantics. This view is sometimes expressed by the thesis that context-dependence threatens the possibility of a compositional semantics. If composition rules of the kind in (43b) were required to accommodate the influence of context on semantic interpretation, then, on the assumption that compositionality is required for systematic semantics, there would be reason to adopt this pessimistic viewpoint.

We are not ourselves completely convinced that systematic semantics requires the truth of compositionality. For example, several semanticists have argued that full-blown compositionality should be rejected, though the sorts of potential failures they discuss would not undermine the systematicity of semantics. However, the sort of failures contemplated by these authors involve the alleged dependence of semantic value on *linguistic* context.⁴³ The sort of failure of

⁴² For expository purposes, we suppress reference to a model and a context. It is worth mentioning that this version of compositionality is rather lax, since it allows different syntactic configurations to involve different modes of semantic composition. According to some versions of compositionality (e.g. Lewis (1970), Heim and Kratzer (1998)), compositionality is the stronger requirement that there is only one mode of semantic composition.

⁴³ One example of this line of thought is found in discussions of game-theoretical semantics, which is not compositional (e.g. Jaako Hintikka and Gabriel Sandu (1997, pp. 370ff.)).

compositionality involved in rules of the kind in (43b) is significantly more drastic than this. Rules such as (43b) allow the composition rules associated with a single linguistic structure to vary freely as a function of *extra-linguistic* context. An indefinite number of composition rules that vary not just according to linguistic context, but also according to extra-linguistic context, seems in tension with learnability considerations. If contextual variables were allowed to occur in non-terminal nodes, then the semantic theories required to interpret the resulting structures would violate compositionality in this quite drastic manner. Therefore, the distribution of contextual variables should be restricted to terminal nodes. Our favored treatment of quantifier domain restriction accords with this restriction on the distribution of contextual variables, whereas the postulation of structures such as (40) does not.

But what about the second and third alternatives to our favored approach? These do not drastically violate compositionality, so we need other arguments to show that they are theoretically inferior to our proposal. Consider the second proposal, according to which contextual variables occupy their own terminal nodes. We do not have a decisive objection against this account. But it does seem to us to be methodologically troublesome in the following respect. According to it, quantifier domain variables occupy their own terminal nodes. This involves the postulation of an entire unarticulated relative clause. Such a postulation ultimately requires syntactic justification.

Our worry is not that such a syntactic justification is impossible to provide. It is rather that, without compelling reasons, one should not place such a burden on syntactic theory. We do think that occasionally semanticists have such reasons. But we do not see that this is so in the case of this approach to quantifier domain restriction. For there is a perfectly legitimate theoretical alternative which does not postulate extra syntactic complexity, namely the one we advocate. It is therefore to be preferred over one that does.

Another author who rejects compositionality for reasons involving the dependence of semantic value on linguistic context is James Higginbotham (cf. his discussion of the "Indifference Principle" (1986, p. 33ff.)).

Our concern with the third alternative arises from a consideration of facts involving cross-sentential anaphora. Consider the sentence:

(44) Most people regularly scream. They are crazy.

Suppose the domain is the set of things in a certain village. There are two anaphoric readings of the pronoun in the second sentence in (44). On the first reading, it refers to all of the people in the village. On the second reading, it refers to those people in the village who regularly scream. The third alternative has difficulties explaining both of these readings.

Consider the first reading, that everyone in the village is crazy. Ideally, one would wish to say that cross-sentential anaphora of this sort requires antecedents that are constituents (nodes) of a preceding logical form. However, if the domain variable co-habits a terminal node with 'most', there is no single node in the logical form of the first sentence of (44) whose associated semantic value is the set of people in the village. In our favored approach, however, there is such a node: the one labeled with '<people, i>'. So, our favored approach provides a far more natural account of the first reading of the second sentence of (44).

Our favored approach also does a much better job with the second reading of the second sentence of (44). One theory in the literature which elegantly captures this reading is presented by Stephen Neale. He treats 'they' as a proxy for a certain description reconstructable from the logical form of the first sentence. The reconstruction is guided by the following principle:

If x is a pronoun that is anaphoric on, but not c-commanded by a non-maximal quantifier '[Dx:Fx]' that occurs in an antecedent clause '[Dx:Fx](Gx)', then x is interpreted as '[the x : Fx&Gx]'.⁴⁴

But note what happens if we apply this rule to (44), on the assumption that the domain variable cohabits the node of the quantifier 'most'. In constructing the definite description which gives the interpretation of the pronoun in the second sentence, we drop the quantifier and loose the domain variable with it. 'They' is then interpreted as [the x : person (x) & regularly-scream(x)], which

⁴⁴ Neale (1990, p. 266, rule (P5b)). A quantifier '[Dx:Fx]' is non-maximal iff there is some G for which '[Dx:Fx](Gx)' is true but '[every x : Fx] (Gx)' is false. So, 'most' is non-maximal.

results in an unrestricted reading of the second sentence, according to which everyone in the universe who regularly screams is crazy. By contrast, if, as on our favored approach, the variable co-habits a node with 'person', 'they' is interpreted as [the x : \langle person, i \rangle (x) & regularly-scream(x)], we obtain the desired reading of the second sentence, according to which it expresses the proposition that every person in the village who regularly screams is crazy.^{45, 46}

In previous sections, we located the source of the solution to the descriptive problem of context dependence for quantifier expressions in the semantics. In this section, we have advanced and defended a particular semantic approach. We thereby take ourselves to have provided a

⁴⁵ There are three main alternatives to Neale's account (which is a development of that of Evans (1977)). First, there are DRT-type theories (for a DRT treatment of plural cross-sentential anaphora, see Kamp and Reyle (1993): 345-56). Secondly, there is the "context-dependent quantifier" approach of Jeffrey King (1987, 1994)). The point we will be making carries over to these two frameworks with some modifications. For example, on King's theory, expressions that are anaphoric on non-symmetric quantifiers like 'most' do not inherit the quantificational force of their antecedent. So, it is difficult to see how to transfer to the interpretation of the anaphoric expression domain variables that would occur on such quantifiers. Finally, there are pragmatic style solutions. These resemble Neale's account except that they do not attempt the reconstruction of the antecedent clause from the LFs of the previous sentences. Such an account is advocated in Cooper (1979), Heim, (1990), and Chierchia (1995). However, even such approaches should grant that the default interpretation of such pronouns is the semantic value of the expression given by a reconstruction algorithm of the sort found in Neale. The assumption that an algorithm like Neale's provides a default semantic value is strong enough for our purposes.

⁴⁶ Our approach also gives a much more satisfactory account of facts related to what one might call N-bar ellipsis. Consider the sentence "Sue paid for most bottles. Bill paid for most as well". There is no context in which this sentence has a true reading. But if the domain variable were on the determiner, then one should expect a true reading, since the domains for the two quantifier expressions should then be able to vary. Thanks to Jeff King for discussion here.

satisfactory solution to the descriptive problem of context dependence for quantifier expressions. A sentence such as (1) can *communicate* a proposition concerning a restricted domain of bottles, because, relative to certain contexts, it *expresses* such a proposition. It expresses such a proposition relative to certain contexts because common nouns such as 'bottle' always occur with a domain index. It follows that, in the logical form of quantified sentences, there are variables whose values, relative to a context, are (often restricted) quantifier domains.

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