University of Massachusetts Occasional Papers in Linguistics

Volume 15 *Papers on Quantification* Article 10

1989

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0. Introduction

That I am sitting on this chair is a very transitory property of mine. That I have brown hair is not. The first property is a stage-level property in the terminology of Carlson (1977). The second property is an individual level property. Stage-level properties are expressed by stage-level predicates . And individual-level properties correspond to individual-level predicates. A number of grammatical phenomena have been shown to be sensitive to the distinction between stage-level and individual-level predicates. "There"-insertion sentences (Milsark 1974), bare plurals (Carlson 1977), and absolute constructions (Stump 1985) are relevant examples. Here are some illustrations.

"There"-insertion

1(a) There are firemen available
(b) *There are firemen altruistic

Bare Plurals

2(a) Firemen are available
(b) Firemen are altruistic

Absolute Constructions (Stump 1985, p. 41-43)

3(a) Standing on a chair, John can touch the ceiling
(b) Having unusually long arms, John can touch the ceiling

"Altruistic" and "having unusually long arms" are typical individual-level predicates. "Available" and "standing on a chair" are typical stage-level predicates. The contrast between 1(a) and (b) is a contrast in grammaticality. The contrasts between 2(a) and (b) and between 3(a) and (b) are contrasts in interpretation. 2(a) can mean that there are available firemen, but 2(b) cannot mean that there are altruistic ones. 3(a) can mean 'If John stands on a chair, he can touch the ceiling', but 3(b) cannot mean 'If John has unusually long arms, he

can touch the ceiling'.

If a distinction between stage-level and individual-level predicates is operative in natural language, it cannot be a distinction that is made in the lexicon of a language once and for all. If I dyed my hair every other day, my property of having brown hair would be stage-level. Usually we think of having brown hair as an individual-level property, though, since we don't think of persons dying their hair capriciously. Hence we classify predicates like "having brown hair" as individual-level predicates. We now know that there may be some problems with such classifications. This being said, we will make use of the convenient classifications just the same. As long as we are careful, no harm is likely to result from this simplification.

In this paper, I am going to argue that stage-level predicates and individual-level predicates differ in argument structure. That is, the argument structure of "having brown hair" changes when you start using it as a stage-level predicate. I will propose that stage-level predicates are 'Davidsonian' in that they have an extra argument position for events or spatiotemporal location. Individual-level predicates lack this position.

This view is different from the proposal defended in Carlson 1977 and subsequent work. Carlson assumes that stage-level properties and individual-level properties are properties of different types of entities. Stage-level properties are properties of stages, and individual-level properties are properties of individuals. An individual can be a kind like the kind of pots or the kind of pans, but it can also be an object like this pot or that pan. A stage is a spatiotemporal part of an individual: this pot here and now, or that pan there and then.

The view advanced here also differs from some neo-Davidsonian approaches that have it that <u>all</u> kinds of predicates have an eventuality argument in the sense of Bach (1981). Predicates may then differ as to the kind of eventuality involved. We may have events, processes or states, for example. (This approach is taken in Higginbotham 1985, among others).

The proposal that stage-level predicates are Davidsonian will not come as a surprise at a time when Davidsonian approaches to the

semantics of verbs are becoming ever more popular (see in particular Parsons 1980, 1985, Higginbotham 1985, 1988). What I want to show here is that this proposal has a number of truly unexpected consequences. We will see that it will shed light on phenomena as diverse as extraction facts in German and the proportion problem for donkey sentences.

1. Locatives as evidence for an extra argument position

This section presents a first set of data supporting a Davidsonian treatment of the distinction between stage-level and individual-level predicates. The following sentences illustrate some uses of spatial and temporal expressions in German.

Stage-level predicates

(4) weil fast alle Flüchtlinge in dieser Stadt umgekommen
since almost all refugees in this city perished
sind
are

(a) Since almost all of the refugees in this city perished
(b) Since almost all the refugees perished in this city

(5) weil ihn fast alle Flöhe in diesem Bett gebissen haben
since him almost all fleas in this bed bitten have

(a) since almost all of the fleas in this bed bit him
(b) since almost all the fleas bit him in this bed

(6) weil fast alle Antragsteller in diesem Wartesaal
since almost all petitioners in this waiting room
sassen
sat

(a) since almost all of the petitioners in this waiting room were sitting
(b) since almost all the petitioners were sitting in this waiting room

(7) weil uns heute fast alle Kandidaten beeindruckt haben
since us today almost all candidates impressed have
(a) since almost all of today's candidates impressed us
(b) since almost all the candidates impressed us today

Individual-level predicates

(8) weil fast alle Schwäne in Australien schwarz sind
since almost all swans in Australia black are
(a) since almost all swans in Australia are black

(9) weil fast alle Lebewesen auf diesem Planet von
since almost all living beings on this planet from
der Amöbe abstammen.
the amoeba descend
(a) since almost all living beings on this planet descend from the amoeba

(10) weil fast alle Schüler in dieser Schule Französisch
since almost all students in this school French
können
know
(a) since almost all of the students in this school know French

(11) weil heute fast alle Kandidaten "Hans" hiessen
since today almost all candidates "Hans" were named
(a) since almost all of today's candidates were named "Hans"

In the above examples, all the sentences with stage-level predicates have two readings (sometimes corresponding to a difference in intonation), while the sentences with individual-level predicates have only one. The readings differ as to the role played by spatial and temporal expressions like "in this city" or "today". In the (a) readings, the spatial or temporal expression modifies the restricting predicate of the quantifier "fast alle". In the (b) readings, the spatial or temporal expression modifies the main predicate of the sentence. On

a Davidsonian account, temporal and spatial expressions accompanying verbs relate to the verb they modify via the Davidsonian argument. If stage-level predicates do, but individual-level predicates don't have such an extra argument , we can explain why temporal and spatial expressions can modify stage-level predicates, but not individual-level predicates. Here are are some examples illustrating how spatial and temporal expressions can modify verbs on a Davidsonian approach.

(12) Manon is dancing on the lawn
[dancing (Manon, l) & on the lawn (l)]

(13) Manon is dancing this morning
[dancing (Manon, l) & this morning (l)]

(14) Manon is a dancer
dancer (Manon)

"Is dancing" is a stage-level predicate. Consequently, it has a Davidsonian argument that appears in the form of a variable . The locatives "on the lawn" and "this morning" relate to the verb "is dancing" by taking another occurrence of the same variable as their argument. "Is a dancer" is a fairly typical individual-level predicate. It normally lacks a Davidsonian argument, hence cannot be modified by locatives . If it can, it has turned into a stage-level predicate. At this point, I don't want to commit myself to a particular view with respect to the precise nature of the Davidsonian argument. It may not be an event argument. It may simply be an argument for spatiotemporal location. This is the minimal assumption necessary to explain the data presented above. It is also the minimal assumption needed for the data to be discussed in the remainder of this paper. In what follows, then, I will try out the minimal assumption, being curious about how far it can be carried. The proposal to consider the Davidsonian argument as an argument for spatiotemporal location was first made by E.J. Lemmon in his comments on Davidson's paper "The Logical Form of Action Sentences" (Lemmon 1967). Lemmon meant to

identify events with their spatiotemporal locations, though, a view I don't want to embrace here.
Let us assume, then, that in the logical representations given above "l" is a variable ranging over spatiotemporal locations. A spatiotemporal location is a space-time chunk like the space occupied by this room today . The logical representations for (12) and (13) contain free occurrences of "l" . These free occurrences of "l" may become bound by quantifiers when the sentences appear as parts of more complex constructions. Or else they may be supplied with a value by the context of use. (12) says that Manon is dancing at l, and the spatial extension of l consists of the surface of the lawn. The context of use may now specify the temporal extension of l. (13) says that Manon is dancing at l, and the temporal extension of l is this morning. This time, the context of use may specify the spatial extension of l. (14) simply says that Manon is a dancer.
Having looked at some aspects of the technical implementation of a Davidsonian treatment of the stage-level/ individual-level distinction, let us now turn to another argument in favor of our position.

2. <u>"When"-clauses: a second argument for the extra argument position</u>
This section will present a second argument for the presence of an extra argument position in stage-level predicates. This time, the argument has to do with variable binding, and it makes use of certain features of "Discourse Representation Theory" (Kamp 1981, Heim 1982). Consider the following sentences.

15(a) * When Mary knows French, she knows it well
(b) When a Moroccan knows French, she knows it well
(c) When Mary knows a foreign language, she knows it well
(d) When Mary speaks French, she speaks it well
(e) * When Mary speaks French, she knows it well
(f) * When Mary knows French, she speaks it well

Following Kratzer (1978, 1986), I am assuming that, quite generally, the antecedents of conditionals have no other function apart from restricting the domain of some operator. This extends Lewis' treatment of "if"-clauses in connection with adverbs of quantification to all types of conditionals (Lewis 1975). For an "if"-clause, the operator to be restricted can be a determiner quantifier, an adverb of quantification, or any kind of modal operator. "When"-clauses are more selective in that they don't seem to be able to restrict epistemic modals. Hence the following contrast.

16(a) *When the library has this book, it must be on the second floor

(b) If the library has this book, it must be on the second floor

If "if"-clauses and "when"-clauses are both devices for restricting the domain of operators, we have to stipulate non-overt operators whenever a conditional sentence introduced by "if" or "when" lacks an overt one. An adverb of quantification like "always" or an epistemic necessity operator seem to be the available options (Kratzer 1986). If "when"-clauses cannot restrict epistemic modals, the non-overt operator in the sentences 15(a) to (f) must be "always". Following Lewis (1975) and some further developments in Kamp (1981) and Heim (1982), the analysis of 15(a) to (f) will now be as follows.

15'(a) *Always [knows (Mary, French)]
[knows well (Mary, French)]

(b) Always_x [Moroccan(x) & knows (x, French)]
[knows well (x, French)]

(c) Always_x [foreign language(x) & knows (Mary,x)]
[knows well (Mary, x)]

(d) Always$_1$ [speaks (Mary, French,1)]
[speaks well (Mary, French, 1)]
(e) *Always$_1$ [speaks (Mary, French, 1)]
[knows well (Mary, French)]
(f) * Always [knows (Mary, French)]
$\exists_1$ [speak well (Mary, French, 1)]

15'(a) to (f) are all tripartite quantifier structures consisting of the quantifier "always", a restrictive clause and a "nuclear scope" (Heim 1982). The adverb of quantification is indexed with all those variables that occur free in its restrictive clause. As a consequence, it binds all free occurrences of these variables in its entire scope. The nuclear scope of a tripartite quantifier construction is closed by an existential operator binding all occurrences of variables in its scope which are not bound otherwise. Indefinite noun phrases like "a Moroccan" or "a foreign language" are not analyzed as existential quantifiers. They are treated as predicates introducing a variable into the logical representation. This variable may then be bound by the quantifier "always". For details of this analysis , see Lewis 1975 and Heim 1982. See also Kamp 1981 for an analogous approach. Note, however, that contrary to assumptions in Discourse Representation Theory, we didn't let proper names and referential pronouns introduce variables into our logical representations. Alternatively, we might assume that proper names and referential pronouns do introduce variables, but these variables are 'anchored' to the context of use, hence not available for binding. In what follows, we will not be able to do justice to directly referential expressions. Since they are not our main concern here, we will occasionally be satisfied with ad hoc solutions.

We are now in the position to explain why sentences 15(a), (e), and (f) are ungrammatical. Assuming that stage-level predicates do, but individual-level predicates don't introduce a variable that can be bound by "always", we predict that 15(a), (e), and (f) should be

excluded, given the following natural prohibition against vacuous quantification (see Chomsky 1982 for a similar proposal).

Prohibition against vacuous quantification
For every quantifier Q, there must be a variable x such that Q binds an occurrence of x in both its restrictive clause and its nuclear scope.

In 15(a), the main predicate in the antecedent and in the consequent is individual-level. Hence there is no Davidsonian argument introducing a variable . No other expression in 15(a) introduces variables. The sentence, then, is excluded by the prohibition against vacuous quantification. Similar considerations apply to 15(e) and 15(f) that lack a bindable variable in the consequent and in the antecedent respectively. 15(b) and (c) are good since variables are introduced by indefinites in the antecedent and reappear again in the consequent. The interesting case is 15(d). 15(d) is exactly like 15(a), except that it contains the stage-level predicate "speak" where 15(a) contains the individual-level predicate "know". If stage-level predicates introduce a free variable, but individual-level predicates don't, 15(a) will , but 15(d) will not violate the prohibition against vacuous quantification. Assuming that the prohibition against vacuous quantification is well-motivated and that there is ample support for a Lewis-Kamp-Heim analysis of sentences like 15(a) to (f), we now have another argument in favor of the view that stage-level predicates are Davidsonian, but individual-level predicates are not.
There is one loose end that we should attend to before closing this section. Why is 16(b) good? Or why is it that 15(a), (e), and (f) all become grammatical as soon as we replace "when" by "if"? Recall that "if"-clauses differ from "when"-clauses in being able to restrict epistemic modals. In fact, 15(a), (e), and (f) all turn into epistemic conditionals after the replacement. 17(a), (b) and (c) correspond to 15(a), (e), and (f) respectively.

17(a) If Mary knows French, she knows it well
(b) If Mary speaks French, she knows it well
(c) If Mary knows French, she speaks it well

If 17(a) to (c) are epistemic conditionals, the "if"-clause restricts an epistemic modal. While some modals can act as quantifiers and bind variables as argued in Heim (1982), it seems that epistemic modals cannot. Consider the following example:

(18) A car must be in the garage

When "must" is interpreted deontically, the indefinite noun phrase in (18) can have an existential or a universal (generic) interpretation. On Heim's account, the universal reading of "a car" is due to the modal "must" that can function as a universal quantifier just like "always". On this reading, (18) would be represented as follows.

(18') $\mathbf{Must}_{x,l}$ [car(x) & be (x,l)] [in the garage (l)]

(18') means (roughly) that whenever there is a car in an accessible world w, then its location is within the garage in w. If "a car" is understood existentially, the logical representation would be (18'').

(18'') $\mathbf{Must}\ \exists_{x,l}$ [car(x) & be(x,l) & in the garage (l)]

(18'') means that in all accessible worlds there is a car in the garage. (18'') is only well-formed if the modal "must" is not necessarily a quantifier. Otherwise, it would be ruled out by the prohibition against vacuous quantification. We have to conclude, then, that deontic modals are only optionally quantificational. When "must" is interpreted epistemically, "a car" in (18) can only be interpreted existentially. This suggests that epistemic modals are never quantifiers and can therefore never bind variables. But if epistemic modals are not quantifiers, 17(a) to (c) don't violate the prohibition

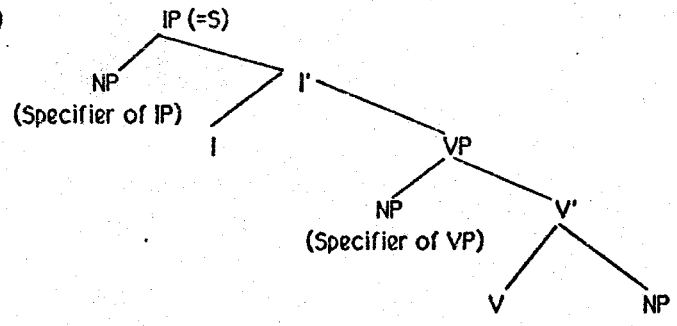
modals are not quantifiers, 17(a) to (c) don't violate the prohibition against vacuous quantification.

3. A syntactic argument for the extra argument position in stage-level predicates

(a) Extraction facts from German

Recent work by a variety of scholars suggests that configurational sentence structures with VPs seem to be plausible for many languages including Japanese (Saito 1985), German (Webelhuth 1985 and dissertation in progress), Breton, Niuean, Chamorro, Jacaltec, Papago, and Warlpiri (Woolford 1988). Most of this work also converges on the conclusion that VPs may contain deep-structure subjects even if their heads are not unaccusative verbs (Koopman & Sportiche 1985, Kuroda to appear, Kitagawa 1986, Tateishi 1988, Diesing forthcoming). These subjects are claimed to appear in the specifier position of VP. They may stay there in surface-structure provided that they can get case in this position. The specifier position of VP is the highest position within the VP. It is distinct from the customary object position, which is the position adjacent to V. Neglecting any variation concerning the position of heads, the structure of simple sentences is usually assumed to be as shown in (19).

(19)



In a recent paper (Diesing 1988), Molly Diesing argues that certain extraction facts from German (Kratzer, lecture notes spring 1988) can be explained if we assume that at the relevant level of representation, subjects of stage-level predicates are within VP, while subjects of individual-level predicates are in the specifier of IP position. While Diesing is very careful in not making unwarranted claims as to the level of representation involved, I will adopt the common assumption that the level for generalizations about the realization of arguments is deep-structure (rather than logical form, for example). The exploration of alternatives might be worthwhile, but will be left for another occasion. Here are two examples illustrating the kind of facts relevant for what we might call "Diesing's conjecture".

20(a) weil uns viele Lehrer geholfen haben.
since us many teachers helped have
since many teachers helped us.

(b) Lehrer haben uns viele geholfen.
teachers have us many helped
As for teachers, many of them helped us.

21(a) weil das viele Lehrer wissen.
since this many teachers know
since many teachers know this.

(b) *Lehrer wissen das viele.
teachers know this many
As for teachers, many of them know this.

The above examples illustrate the so-called "quantifier split" construction in German. The (a) -sentences give examples of

subordinate clauses with unsplit quantifier phrases. In the corresponding (b) -sentences, verb second has taken place and the quantifier phrase is split. (20) involves a stage-level predicate, (21) has an individual-level predicate. Quantifier split is possible with subjects of stage-level predicates, but impossible with subjects of individual-level predicates.

Diesing proposes an ECP explanation for those facts, and we will follow her in this respect. Let us assume that the quantifier split construction is the result of moving a common noun phrase out of its NP as argued by van Riemsdijk (1987). Suppose now that subjects of individual-level predicates are base-generated in the specifier of IP position. They will then have several options at surface-structure. They may stay in their original position, or else may scramble, that is, adjoin to IP. In either case, they are ungoverned . Hence movement from subjects of individual-level predicates will always lead to an ECP violation. (Subjects of individual-level predicates can also appear in the specifier of CP position. We may assume that they may optionally be base-generated there.) As for subjects of stage-level predicates, suppose that they are base-generated within VP. They, too, will then have several options at surface-structure. They may stay in their original position. In this case, they are in a governed position and movement from such subjects will not lead to an ECP violation. If they move on to the specifier of IP position or scramble, they will occupy an ungoverned position. Movement from such subjects, then, will again violate the ECP. Little is known about the factors that make a subject move in German. At this point, all we can say is that assuming that subjects of stage-level predicates are base-generated within VP and that they can stay there at surface-structure, we expect to find cases where movement from those subjects is possible. 20(b) is such a case. We also expect that, sometimes, movement from subjects of stage-level predicates might not be possible. This expectation is borne out as illustrated by the following pair of sentences.

22(a) weil viele liebe Nachbarn einem alten Ehepaar halfen
since many dear neighbors an old couple helped
since many dear neighbors helped an old couple

(b) *Liebe Nachbarn halfen viele einem alten Ehepaar
dear neighbors helped many an old couple
As for dear neighbors, many of them helped an old couple

A similar explanation might be given for the following data illustrating extraction possibilities for relative clauses. (23) involves a stage-level predicate, (24) an individual-level predicate. Subjects of stage-level predicates permit the extraposition of a relative clause, but subjects of individual-level predicates don't.

(23) weil zwei Kinder hier waren, mit denen niemand
since two children here were, with whom nobody
spielen wollte
play wanted
since two children were here with whom nobody wanted to play

(24) * weil zwei Bücher teuer waren, die niemand lesen wollte
since two books expensive were that nobody read wanted
since two books were expensive that nobody wanted to read

In the following section, I am going to show that our assumptions concerning the argument structure of the two types of predicates plus some plausible additional premises will allow us to derive a result that is almost Diesing's conjecture (as modified above). In particular, we will be able to derive that subjects of stage-level predicates are always base-generated within the maximal projection

of their predicates. And that subjects of individual-level predicates are base-generated outside of the maximal projection of their predicates, unless the predicates are unaccusatives (in the sense of Perlmutter1978). We will also see that this slight deviation from Diesing's original proposal has the right consequences.

(b) Deriving (almost) Diesing's conjecture

The reasoning in this section will closely follow the structure of an argument given in Williams (1981). Williams argues that in nominalizations like "Caesar's destruction of the city", the agent argument "Caesar" may be realized within the maximal projection of "destruction", since nominalizations like "destruction" have an event argument. Consequently, the event argument, and not the agent argument is the external argument here.

Following Williams, let us assume that the argument structure of lexical items consists of a list of thematic role labels like "agent", "experiencer", "theme", "goal". Let us assume furthermore that we also have a Davidsonian thematic role, in our case a role for spatiotemporal location . At most one of the thematic role labels of a predicate may be underlined. The underlined label corresponds to the external argument of the predicate. All other arguments are internal. There may be some generalizations as to which argument of a lexical item will wind up as its external argument. Here are some candidates: If a predicate has a Davidsonian argument, it will always be its external argument. If a predicate has no Davidsonian argument, but an agent argument, the agent argument will be its external argument. The arguments of a predicate are linked to their syntactic positions in deep-structure according to the following principle.

Argument linking (Williams)

In deep-structure, all arguments except the external argument are realized within the maximal projection of their predicate.

There may be further principles guiding the realization of internal

arguments. Maybe internal agent arguments have to occupy the specifier position, while internal theme arguments have to occupy the object position, for example. This may lead to a more hierarchical view of argument structure as proposed in Grimshaw (1987), among others. There will also be principles regulating case assignment and agreement. All of these issues are addressed in the literature mentioned above, so we will not go into details here. Let us now look at some examples illustrating possible argument structures for different types of predicates.

(25) Stage-level predicates that are not unaccusatives

hit	<location, agent, theme>
dance	<location, agent>

(26) Stage-level predicates that are unaccusatives

die	<location, theme>
fall	<location, theme>

(27) Individual-level predicates that are not unaccusatives

know	<experiencer, theme>
altruistic	<theme>

(28) Individual-level predicates that are unaccusatives

belong	< theme, goal >
be known to	<experiencer, theme>

The above examples are at best suggestive. We have seen that the stage-level /individual-level distinction is context-dependent and vague. And the distinction between predicates that are unaccusatives and those that are not is likewise unstable. What is important here is that there are prototypical examples. And that we know which factors contribute to context-dependency and vagueness. And that whatever kind of vagueness and context-dependency we may find will be transmitted to all the grammatical phenomena in which the two

distinctions play a role.
Let us now look at the predictions made by these lexical representations in conjunction with Williams' linking rule. All stage-level predicates have an external argument for spatiotemporal location. In languages like English or German, this argument seems to be implicit, that is it has no realization at deep- or surface-structure. As a consequence, spatial and temporal expressions are adjuncts. They don't fill argument positions. All but the event argument of stage-level predicates are internal, hence they have to be realized within the maximal projection of the predicate in deep-structure. Subjects of stage-level verbs, then, are always base-generated inside of their VP, subjects of stage-level adjectives are always base-generated within their AP and so on. This gives us one part of Diesing's conjecture . Let us now turn to individual-level predicates. Those predicates don't have a Davidsonian argument. Hence some other argument may be external. If there is such an argument, it has to be base-generated externally, and the usual option is the specifier of IP position. If the predicate is unaccusative, its subject will be base-generated within its maximal projection . Individual-level predicates, then, may come in two kinds. One kind has external subjects in deep-structure and the other kind has internal ones. This gives us a slightly different version of the second part of Diesing's conjecture. The following data support this revision.

Individual-level predicates that are not unaccusatives

29(a) weil das fast alle Bürger in dieser Stadt wissen
since this almost all citizens in this town know
since almost all of the citizens in this town know this

(b) *When Mary knows this, she knows a lot

(c) *Neugierige Bürger wissen das viele
nosy citizens know this many
As for nosy citizens, many of them know this

30(a) weil fast alle Bürger in dieser Stadt altruistisch sind
since almost all citizens in this city altruistic are
since almost all of the citizens in this city are altruistic

(b) *When Ann is altruistic, she will give us a hand

(c) *Sanitäter sind viele altruistisch
paramedics are many altruistic
As for paramedics, many of them are altruistic

Individual-level predicates that are unaccusatives

31(a) weil mir fast alle Esel in dieser Stadt gehören
since to me almost all donkeys in this town belong
since almost all of the donkeys in this town belong to me

(b) *When this donkey belongs to Pedro, it is lucky

(c) Esel gehören ihm viele
donkeys belong to him many
As for donkeys, there are many that belong to him

32(a) weil mir fast alle Buchläden hier bekannt sind
since to me almost all bookshops here known are
since almost all of the bookshops here are known to me

(b) *When this fact is known to her, she keeps it secret

(c) Hässliche Gegenbeispiele sind mir mehr als genug bekannt
nasty counterexamples are to me more than enough known
As for nasty counterexamples, there are more than enough that are known to me

The (a) and (b) sentences above establish that we are indeed dealing with individual-level predicates. The main predicate of the sentence has no Davidsonian argument that a locative could relate to. And there is no extra variable that a non-overt quantifier could bind. The (c) sentences are bad for "know" and "altruistic", showing that the subjects of these predicates are sitting in an ungoverned position. But the (c) sentences are good for the unaccusatives "belong to" and "be known to", suggesting that their subjects can appear in a governed position.

What we have seen in this section, is that the presence of a Davidsonian argument can be held responsible for the fact that subjects of stage-level predicates are always internal arguments and are base-generated within the maximal projection of their predicates. In a language like German, they can receive case in their deep-structure position and can stay there. As a consequence, extraction from those subjects is permitted. Subjects of individual-level predicates may or may not be external arguments. Hence they may or may not allow extraction. Assuming , then, that individual-level predicates and stage-level predicates differ in argument structure as proposed here, we can derive certain facts about the syntactic behavior of their subjects, given independently motivated assumptions about the link between argument structure and deep- structure representations.

4. The different readings of bare plurals

The work of Gregory Carlson has shown convincingly that the distinction between stage-level and individual-level predicates plays a crucial role in the interpretation of bare plurals. Carlson's particular approach to bare plurals faces some serious problems, however, most of which are already raised in his dissertation (Carlson 1977). Various attempts to deal with those problems led to various alternatives. In what follows, I will briefly sketch Carlson's analysis as well as the most promising alternative proposal developed independently by Karina Wilkinson (1986) and Claudia Gerstner and Manfred Krifka (1987). I will then point out some apparent difficulties with Wilkinson's and Gerstner and Krifka's approach and argue that a Davidsonian treatment of the stage-level/individual-level distinction might help us to overcome those difficulties.

(a) Carlson's analysis

On Carlson's analysis, bare plurals are always interpreted as names of a kind. The logical counterparts of English stage-level predicates are predicates of stages. A stage is a temporal 'slice' of an individual. Since kinds are not the sort of entity to which a stage-level property can apply, the relationship between kinds and stage-level properties has to be mediated by a "realization relation". The counterparts of English individual-level predicates are predicates of individuals. Individuals may be kinds or objects, as mentioned above. Individual-level properties, then, may apply to kinds directly and no 'mediation' is necessary. To illustrate the details of Carlson's analysis, let us examine the translations for the English adjectives "available" and "altruistic".

(33) available
$\lambda y_i \exists x_s [R (y_i, x_s) \& \textbf{available} (x_s)]$
altruistic
$\lambda y_i [\textbf{altruistic} (y_i)]$

The translations make use of two sorts of variables. Stage variables are subscripted by "s", individual variables are subscripted by "i". The translations for sentences like (34) and (35) will be (34') and (35')

respectively.

(34) Firemen are available
(35) Firemen are altruistic

(34') $\exists x_s$ [R (firemen, x_s) & available (x_s)]
(35') altruistic (firemen)

(34) illustrates the existential reading of bare plurals. (35) represents the generic reading. (34') says roughly that there is a stage x such that x realizes the kind of firemen and x is available. (35') says that the kind of firemen is altruistic. On this proposal, the logical counterparts of "altruistic" and "available" are both predicates with one argument. These arguments are of different sorts, though.

(b) A Lewis/Kamp/Heim analysis

There are a number of problems with Carlson's proposal . Here is an example (Milsark 1974 . See also Carlson 1977 and Carlson (forthcoming)).

(36) Typhoons arise in this part of the Pacific

(36) has two readings. It may mean that it is a typical property of typhoons that they arise in this part of the Pacific. Or else that it is a typical property of this part of the Pacific that there are typhoons that arise there. Carlson's analysis only predicts the first of those readings. The difficulty with the second reading is that the verb "arise" is understood generically, but the bare plural noun phrase "typhoons" can still get an existential reading. On Carlson's proposal, the existential reading of a bare plural can only be provided by a stage-level predicate. But if "arise" in (36) were translated as a stage-level predicate, the resulting translation would mean that typhoons are arising in this part of the Pacific. Difficulties of this sort motivated Wilkinson (1986) and Gerstner and Krifka (1987) to propose that at least certain kinds of bare plurals should be analyzed along the lines of Lewis, Heim, and Kamp (see also Farkas & Sugioka 1983 for an earlier articulation of a similar view, and Schubert &

Pelletier 1987 for an overview and some further developments). The two readings of (36) can now be represented as 36'(a) and (b).

36'(a) G_x [typhoon (x)] $\exists_l$[this part of the Pacific(l) & arise in (x,l)]

(b) G_l [this part of the Pacific(l)] $\exists_x$[typhoon(x) & arise in (x,l)]

These representations are quantifier structures of the sort discussed above. "G" is some kind of adverb of quantification, a generic operator like "typically", whose exact nature is not at issue here (overt quantifiers like "always" or "usually", may be substituted without changing the point of the example). Like other indefinites, bare plurals are treated as predicates introducing variables into the logical representation. The generic reading of "typhoons" arises when "typhoons" appears in the restrictive clause of the quantifier construction. In this position, the variable introduced by "typhoons" can be bound by the non-overt generic operator. The existential reading of "typhoons" arises when "typhoons" appears in the nuclear scope . Recall that the nuclear scope of a logical representation is always existentially closed (Kamp 1981, Heim 1982). If the variable that comes with "typhoons" is introduced in the nuclear scope, it will be 'caught' by existential closure . This is the source of the existential reading.

(c) Too many readings? Diesing's proposal.

Wilkinson (1986) is well aware that while her approach to bare plurals is successful in predicting certain plausible readings of bare plural sentences that Carlson's analysis excludes, it also runs the risk of admitting some very implausible ones. This point is taken up in Diesing 1988. Diesing's main concern is to predict the correct range of available readings for bare plurals. She proposes an analysis of sentences with bare plurals that crucially exploits the fact that subjects of stage-level predicates and subjects of individual-level predicates may be in different positions at the relevant level of representation. I have argued above that this syntactic difference is in fact a consequence of a difference in argument structure. If Diesing's analysis of bare plural sentences is plausible, it can be

understood as yet another piece of evidence for our main hypothesis. Consider sentence(37).

(37) Firemen are available

Diesing argues that a Lewis/Kamp/Heim approach (as advocated by Wilkinson and Gerstner and Krifka) correctly admits at least three possible readings for a sentence like (37).

37'(a) $\exists_{x,l}$ [fireman(x) & available (x,l)]

(b) $G_{x,l}$ [fireman(x) & be (x,l)] [available (x,l)]

(c) G_l [here (l)] $\exists_x$ [fireman(x) & available(x,l)]

37'(a) says that there are firemen available. 37'(b) says that it is a characteristic property of a fireman that he is available. And 37'(b) means that there are typically firemen available around here. While a Lewis/Kamp/Heim approach to bare plurals fares better than Carlson's analysis in allowing at least three possible readings for (37), it must make special provisions to block the impossible (b) reading for (38).

(38) Firemen are altruistic

38'(a) G_x [fireman(x)] [altruistic(x)]

(b) $\exists_x$ [fireman(x) & altruistic(x)]

38' (a) says that a fireman is typically altruistic. 38'(b) means that there are altruistic firemen. 38'(a) is, but 38'(b) is not a possible interpretation for (38). Diesing proposes a syntactic solution to this problem. Her proposal says roughly that when sentences like the ones we have been discussing so far are mapped into logical representations, 'material' in the VP goes into the nuclear scope , while 'material' outside of the VP goes into the restrictive clause. For a language like English, we can implement Diesing's proposal as follows.

While all subjects appear in the specifier of IP position at surface structure, subjects of stage-level predicates and subjects of

unaccusative individual-level predicates don't originate there. They have been moved from their deep-structure position within VP, leaving a trace. This distinguishes them from subjects of individual-level predicates that are not unaccusatives. Those subjects are base-generated in the specifier of IP position, hence don't bind a trace within VP. Let us say that a subject in the specifier of IP position that binds a trace within VP appears 'simultaneously' within and outside of the VP. When surface structures are mapped into quantifier structures, those subjects may then be mapped into the restrictive clause or else into the nuclear scope. That the effects of NP movement can be optionally 'undone' in this way is supported by examples like (39) as observed by May (1977).

(39) [A unicorn]$_1$ seems [t_1 to be in the yard]

(39) has two readings. The noun phrase "a unicorn" may have narrower or wider scope than "seems". The narrow scope reading arises through 'undoing' the effects of NP movement at logical form. Subjects of individual-level predicates that are not unaccusatives, then, are always mapped into the restrictive clause. All other subjects have an option. They may be mapped into the restrictive clause or into the nuclear scope. We have seen that within a Lewis/Kamp/Heim approach, bare plurals have no quantificational force of their own. They only introduce a predicate and a variable into the logical representation. If they appear in the nuclear scope, the variable they introduce will be bound by existential closure. Hence the existential reading. If they appear in the restrictive clause, their variable will be bound by a suitable overt quantifier or by the non-overt generic operator. This is the source of the generic reading. "Available" is a stage-level predicate. Diesing's proposal correctly predicts that a bare plural subject of "available" may have an existential or a generic reading. "Altruistic" is an individual-level predicate that is not unaccusative (as shown by the German extraction facts). Diesing's proposal implies that a bare plural subject of "altruistic" cannot get an existential reading through existential closure of the nuclear scope. If this proposal is to exclude the reading 38'(b) for sentence (38), we must be sure that

existential closure operations are indeed limited to nuclear scopes. This is not Heim's or Kamp's view, however. For them, there is a second existential closure operation (or some analogue) affecting texts. Problems with Kamp and Heim's existential closure operation for texts have been pointed out by Kadmon (1987), using examples like (40) (inspired by Evans 1977).

(40) John owns sheep. Harry vaccinates them.

If existential closure of texts applied to (40) as shown in (40'), (40) would be incorrectly predicted to mean that John owns sheep that Harry vaccinates (as before, we are neglecting all specific aspects of plurality).

(40') $\exists_x$ [sheep (x) and own(John,x) and vaccinates (Harry,x)]

To avoid this consequence, Evans proposes to treat pronouns like "them" in (40) as E-type pronouns. E-type pronouns are pronouns that are anaphorically related to quantifier phrases that don't c-command them. They are interpreted as definite descriptions ("the sheep that John owns"). But if we treat pronouns like "them" above as E-type pronouns, we can dispense with the existential closure operation for texts altogether. This means that the only available existential closure operation is existential closure of the nuclear scope. And it also means that a bare plural noun phrase that is base-generated outside of the nuclear scope can never get an existential reading. This is why 38'(b) is not a possible reading for (38).

Diesing's proposal also implies that subjects of unaccusative individual-level predicates might get existential readings. This prediction is borne out. Consider the following examples involving the predicates "belong to" and "be known to" which patterned as unaccusatives with respect to the German extraction data.

(41) PONDS belong to this lot

(42) She thinks that COUNTEREXAMPLES are known to us

Emphasizing the subjects favors an existential reading here. Note, however, that emphasizing the subject in (38), will still not give us an existential reading. This suggests that whatever the precise role of intonation is, it can only help us to choose among the options provided by grammar.

It seems, then, that Diesing's slogan 'material in the VP is mapped into the nuclear scope, material outside of the VP is mapped into the restrictive clause' may indeed be used as a first step towards explaining why sentences like (37) and (38) have the readings they have.

Up to now, our discussion has raised two major issues. The first issue had to do with syntactic differences between stage-level and individual-level predicates. We argued that the two types of predicates differ in argument structure, and that this property may result in a syntactic difference concerning the position of subjects in deep-structure. The second issue addressed the connection between surface-structure VPs and the nuclear scope of quantifier constructions at logical form. We argued that it is nuclear scopes and only nuclear scopes that can be existentially closed. As a consequence, all existential NPs that have no quantificational force of their own have to appear in the nuclear scope at the level of logical form. We found that those NPs are already restricted to certain positions in surface-structure, and this observation led to the hypothesis that there is a tight connection between surface structure VPs and the nuclear scope of quantifier representations. The two issues are closely related, of course, with VP-external versus VP-internal subjects providing the link.

In the remainder of this paper, I am going to pursue both of those issues further. We will look at a diverse body of data jointly supporting the conclusions we have reached so far.

5. Negative quantifiers in German [1)]

In German, plural negative quantifier phrases show unexpected scope interactions with modals (Bech 1955, Lerner and Sternefeld 1985). Consider the following example.

(43) weil keine Beispiele bekannt sein müssen
since no examples known be must
since it is not necessary that examples be known

If "keine Beispiele" were a normal quantifier phrase, we would expect that it is raised at logical form (let us neglect the question of how precisely quantifier raising interacts with the other proposals of this paper) . And if the modal is raised as well, we should find the following readings for (43), neglecting plurality, as usual.

43'(a) no_x [example(x)] [□ known (x)]

(b) □ no_x [example(x)] [known (x)]

43'(a) would give the quantifier phrase wide scope over the modal. 43'(b) would represent the narrow scope reading. Sentence (43), however, has neither of these readings. The only reading of (43) is represented by 43'(c).

43'(c) not □ $\exists_x$[example (x) & known (x)]

This suggests that "keine Beispiele" is not a normal quantifier phrase. It seems to be a particular realization of the string "nicht Beispiele", consisting of the negation adverb "nicht" and the bare plural "Beispiele". The bare plural NP has to receive existential force through existential closure. "Keine Beispiele", then, involves two operators: negation and the existential closure operator. A third operator may intervene. This is what happens in (43) (for some reason, the modal cannot have scope over the negation). If there is no other operator , "nicht" and the existential closure operator jointly give us the effect of "no". That the true source of "keine N" is "nicht" plus a bare plural noun is further supported by the following data.

44(a) * Wir haben nicht Kürbisse gekauft
We have not pumpkins bought
We didn't buy any pumpkins

(b) Wir haben keine Kürbisse gekauft
We have no pumpkins bought
We bought no pumpkins

(c) Kürbisse haben wir nicht gekauft
Pumpkins have we not bought
As for pumpkins, we didn't buy any

44(a) shows that the negation adverb "nicht" cannot appear adjacent to a plural indefinite noun phrase. One way of accounting for this fact is to assume that "nicht" and the zero determiner have to 'merge' so as to yield "keine" as shown in 44(b) (Bech's term for this phenomenon is "Kohäsion"). In 44(c), the indefinite noun-phrase has been moved away from its deep-structure position. It is not adjacent to "nicht" anymore. The unmerged form can appear here, suggesting that it is indeed the unmerged forms that are inserted at deep-structure. The merging of "nicht" with a zero determiner, then, may be a rather superficial phenomenon, perhaps taking place at the level of phonetic form.

There is another argument showing that plural negative quantifier phrases in German originate from "nicht" plus a bare plural NP. Suppose that just like its English counterpart "not", "nicht" is base-generated somewhere between the subject and the VP, the usual position for sentence adverbs (an assumption like this seems justified in the light of Webelhuth (in progress)).

If "nicht" is to merge with the zero determiner of an adjacent bare plural NP to its right, this NP has to be within VP. We now expect that plural negative quantifier phrases in German must be VP-internal, and this is exactly what we find. Consider the following data.

Objects

(45) weil wir keine Birnbäume haben
since we no pear trees have
since we have no pear trees

(46) weil wir keinen Bären begegnet sind
since we no (dat.) bears (dat.) come upon are
since we didn't come upon any bears

Subjects of stage-level predicates

(47) weil uns keine Freunde helfen
since us no friends help
since no friends are helping us

(48) weil hier keine Fliederbäume wachsen
since here no lilacs grow
since no lilacs are growing here

Subjects of unaccusative individual-level predicates

(49) weil ihr keine Fahrräder gehören
since to her no bicycles belong
since she owns no bicycles

(50) weil keine Beispiele bekannt sind
since no examples known are
since no examples are known

Subjects of individual-level predicates that are not unaccusatives

(51) * weil keine Ärzte altruistisch sind
since no physicians altruistic are
since no doctors are altruistic

(52) * weil keine Kandidaten die Antwort wissen
since no candidates the answer know
since no candidates know the answer

These data show again the by now familiar behavior of subjects. Subjects of stage-level predicates and subjects of unaccusative individual-level predicates can be VP-internal, but subjects of individual-level predicates that are not unaccusative cannot. Before we close this section, we should add a few remarks on singular negative quantifier phrases. In German, singular and plural negative quantifier phrases have quite different properties. (This doesn't concern phrases like "no gold", where the noun is a mass noun. Mass nouns pattern with bare plurals in all important respects. See Carlson 1977, chapter VII.) Consider the following examples illustrating the scope possibilities of a singular negative quantifier phrase with respect to a modal.

(53) weil kein Beispiel bekannt sein muss
since no example known be must
(a) Since there is no example that must be known
(b) Since it is not necessary that an example be known

53'(a) $\mathbf{no_x[\ example(x)\ ]\ [\ \Box\ known\ (x)\ ]}$

(b) $\mathbf{not\ \Box\ \exists_x\ [\ example(x)\ \&\ known\ (x)]}$

Unlike (43) above, sentence (53) has two readings. The first reading is expected if "kein Beispiel" is a 'true' quantifier phrase that is raised at logical form. For reasons that don't have to concern us here, this quantifier phrase can only have wider scope than the modal "muss". The second reading of (53) is the reading that we encountered with plural negative quantifiers. It requires "kein Beispiel" to be analyzed as consisting of the negation adverb "nicht" and the indefinite noun phrase "ein Beispiel". This reading is given in 53'(b). Since "ein Beispiel" has no quantificational force of its own, 53'(b) involves the existential closure operator. The phrase "kein Beispiel", then, may be a genuine quantifier phrase or else a string resulting from "negation merging". That singular indefinites, too, are subject to negation merging is further supported by the following examples.

54(a) * Wir haben nicht einen Kürbis gekauft
We have not a pumpkin bought
We didn't buy a pumpkin

(b) Wir haben keinen Kürbis gekauft
We have no pumpkin bought
We bought no pumpkin

(c) Einen Kürbis haben wir nicht gekauft
A pumpkin have we not bought
As for a pumpkin, we didn't buy one

If singular negative quantifier phrases can optionally be 'true' quantifiers, they should be able to appear as subjects of individual-level predicates that are not unaccusatives. They can indeed, as shown by the following examples.

(55) weil kein Arzt altruistisch ist
since no physician altruistic is
since no doctor is altruistic

(56) weil kein Kandidat die Antwort weiss
since no candidate the answer knows
since no candidate knows the answer

Unlike sentences (51) and (52), sentences (55) and (56) are fully grammatical.

We have shown in this section that German plural negative quantifier phrases provide another piece of evidence that stage-level predicates and certain individual-level predicates (those that are not unaccusatives) differ with respect to the base-position of their subjects. We have also seen that existential closure plays a crucial role in the interpretation of those "false" quantifier phrases. This lends further support to the assumption that there is a process of existential closure tied to VPs.

The properties of plural negative quantifier phrases in German are reminiscient of the genitive of negation construction in Russian (Babby 1980, Pesetsky 1982). Further research will have to show

whether the genitive of negation phenomenon is amenable to an analysis where an existential closure operation linked to VPs (rather than quantifier raising and the ECP as proposed by Pesetsky) carries the main burden of explanation.

6. Objects and existential closure

We have seen that on Diesing's analysis, bare plurals (and other indefinites without quantificational force) can be interpreted existentially only if they end up in the nuclear scope at logical form. This is where the variable they introduce can be bound by existential closure. We have also seen that Diesing assumes that quite generally, VPs are mapped into nuclear scopes. In a language like English, objects always appear within VP (we may neglect topicalization). We expect, then, that whenever a variable is introduced by an indefinite object in English, it will be bound by existential closure (Heim's Novelty Condition prevents it from being bound by any other quantifier). As a consequence, all indefinite objects should be interpreted existentially . In what follows, I am going to show that these predictions hold for some objects, but not for others. I will then argue that the main features of Diesing's analysis can still be maintained, provided we allow objects to be scrambled at logical form.

(a) Well-behaved indefinite objects

Let us start this section with another set of "when"-conditionals. The conditionals all contain an individual-level predicate in the "when"-clause. This insures that they can only satisfy the prohibition against vacuous quantification if a variable is introduced by an indefinite noun phrase. All conditionals considered are arranged in pairs. The (a)-sentences contain indefinite subjects, the (b)-sentences contain indefinite objects. The (a) sentences are grammatical, the (b)-sentences are not.

57 (a) When a proof contains this line of argumentation, it is seriously flawed
(b) *When this proof contains a mistake, Mary will point it out to us

58 (a) When a proposal requires his formal approval, it is doomed to failure
(b) *When this proposal requires a formal approval, we will try to obtain it soon

59 (a) When a lot is close to Lawrence Swamp, it is subject to many restrictions
(b) *When this lot is close to a swamp, construction must be kept 200 feet away from it

60 (a) When a farmer has a donkey, he beats it
(b) *When Pedro has a donkey, he beats it

The (b) -conditionals above are all ungrammatical, provided that the main predicates in their antecedents are interpreted as true individual-level predicates. I emphasized above that most individual-level predicates can also be used as stage-level predicates. Take sentence 57(b), for example. Imagine that you and Mary are going through a long proof together. On this scenario, you might find 57(b) much more acceptable. But then you are talking about a proof containing mistakes here right now or there a little bit later. You are using "containing a mistake" as a stage-level predicate.

Why are the (b) sentences bad? The discussion of bare plurals in section 4 suggests an answer to this question. Recall Diesing's slogan 'material outside of the VP goes into the restrictive clause,

material inside of the VP goes into the nuclear scope'. This procedure (properly formalized) splits a sentence into two parts when it is mapped into a logical representation. In the examples discussed in earlier sections, the two parts always ended up as the restrictive clause and the nuclear scope of a tripartite quantifier structure. This doesn't have to be the only possibility, however. Consider the following sentence.

(61) Pedro has a donkey

If Diesing's proposal is a general procedure for dividing sentences into two parts, (61) will be divided into a restrictive clause and a nuclear scope as well. Since there is no quantifier, the result is a bipartite structure, rather than a tripartite one. Let us assume that in cases like this, restrictive clause and nuclear scope are conjoined by "&". The logical representation of (61), then, might be something like (61').

(61') [be now (Pedro$_3$)] & $\exists_x$ [donkey (x) & have (he$_3$,x)]

In (61'), "Pedro" (with a suitable predicate, see section 7) appears in the restrictive clause, since it is realized outside of VP at surface-structure. The VP itself is mapped into the nuclear scope. (Recall that there are insecurities concerning the treatment of proper names and referential pronouns throughout this paper. In (61'), we use indices to indicate coreference between directly referential expressions). If sentences like (61) are part of other sentences, the corresponding logical forms might become rather complex. We may now have embedded restrictive clauses and nuclear scopes. Take sentence 60(b) from above. The antecedent of 60(b) is

(61). At the level of logical form, (61') is the restrictive clause of the whole sentence. But this restrictive clause contains another restrictive clause and a nuclear scope as parts. The consequent of 60(b) is mapped into the nuclear scope of the whole sentence. This nuclear scope is complex again, since the consequent of 60(b) is split up according to Diesing's slogan as well. The result is something like 60'(b).

60'(b) *Always [be now ($Pedro_3$) & $\exists_x$ [donkey(x) &
have (he_3,x)]] $\exists_1$ [location (1) &
[beat (he_3, ιx [donkey (x) & have (he_3, x)] ,1)]]

With existential closure binding the variable introduced by "a donkey", the pronoun "it" cannot be a bound variable. It is then interpreted as an E-type pronoun. E-type pronouns are interpreted as definite descriptions. That is, the E-type pronoun "it" above is analyzed as "the donkey Pedro has" (for details see Evans 1977, 1980, Cooper 1979, Partee 1978. See also Kadmon 1987, Heim 1987). 61'(b) is not well-formed, since the quantifier "always" doesn't bind a variable.
Given representations of this kind, we expect the following. Subjects always have the possibility of becoming part of a restrictive clause. As long as objects stay in their VP, however, they have to go into a nuclear scope. If nuclear scopes are existentially closed, variables introduced by indefinite objects will be bound by the existential closure operator. In all of the above sentences, then, variables introduced by indefinite objects are bound by existential closure, while variables introduced by indefinite subjects are not. These variables can now be bound by the implicit adverb of quantification

that is restricted by the "when"-clause . The resulting representation is well-formed if no vacuous quantification occurs. Vacuous quantification occurs in the (b)-examples, but not in the (a)-examples.
We have already discussed a (b)-example. A representative (a)-example is 61'(a), which has the following logical representation.

61'(a) Always_x [farmer(x) & $\exists_y$ [donkey(y) & have (x, y)]] $\exists_1$ [location (l) & [beat (x, ιy [donkey(y) & have (x,y)], l)]]

61'(a) is well-formed since the quantifier "always" binds an occurrence of "x" in its restrictive clause and in its nuclear scope. As before, the pronoun "it" is interpreted as an E-type pronoun. Simply interpreting "it" as an E-type pronoun doesn't give us the desired interpretation for 61(a), however. 61(a) doesn't imply that whenever a farmer has a donkey, he has only one. Heim proposes to treat this case as a case of presupposition accommodation (Heim 1983, Heim 1987, see also Lewis 1975). Quite generally, presuppositions of the nuclear scope can be accommodated into the restrictive clause (nice examples are Schubert and Pelletier's " cats always land on their feet" or "Robin Hood never misses" , Schubert & Pelletier 1987). After accommodating the uniqueness presupposition introduced by the E-type pronoun in 61(a), we have the following:

61''(a) Always_x [farmer(x) & $\exists!_y$ [donkey(y) & have (x, y)]] $\exists_1$ [location(l) & [beat (x, ιy [donkey(y) & have (x,y)], l)]]

The status of 61''(a) is still controversial. Are we really considering only those farmers who have exactly one donkey? I will return to this point below.

(b) Ill-behaved objects

The indefinite objects discussed in the previous section behaved as we expected them to. There was evidence that they were indeed caught by existential closure. Not all kinds of objects are as well-behaved, however. Here are some examples of ill-behaved ones.

62 (a) When Sue likes a movie, she recommends it to everyone
(b) When Ann appreciates a paper, she tries to really understand it
(c) When Mary knows a foreign language, she knows it well
(d) When Robin isn't responsible for a mistake, he won't correct it
(e) When this assignment is too hard for a student, you may offer to help him
(f) When these dresses don't fit a customer, we will alter them for her

All predicates in the antecedents of those conditionals are individual-level predicates. This is shown by the ungrammaticality of the following examples.

63 (a)* When Sue likes "Wings of Desire", she recommends it to everyone
(b)* When Ann appreciates this paper, she tries to really understand it
(c)* When Mary knows French, she knows it well
(d)* When Robin isn't responsible for this mistake, he won't correct it
(e)* When this assignment is too hard for Chris, you may offer to help him
(f)* When these dresses don't fit your daughter, we will alter them for her

If all predicates in the antecedents of the conditionals 70(a) to (d) are individual-level predicates, the prohibition against vacuous quantification can only be satisfied if their indefinite objects can move into the embedded restrictive clause (of the main restrictive clause) when logical forms are constructed.
We have to assume, then, that in English, objects can sometimes leave their VPs at the level of logical form. Transformations that move objects out of their VPs have been studied for a number of languages. These are the scrambling transformations that play a crucial role in configurational analyses of so-called "non-configurational" languages like Japanese (Saito 1985) or German (Webelhuth 1985, Webelhuth (in progress), von Stechow and Sternefeld 1988). Scrambling is a transformation that adjoins a constituent to IP (and maybe to other maximal projections). It is an instance of "move α ", hence has all the usual properties of transformations. As a consequence, scrambling may move a constituent out of VPs, but it could never move a constituent into VPs, for example. If it is scrambling that saves sentences 62(a) to (f), scrambling must be possible for some indefinite objects, but not for others. If scrambling were always possible, no indefinite object would have to be caught by existential closure. Scrambling, then, must discriminate between 'well-behaved' and 'ill-behaved' indefinite objects. If this is so, we expect that surface-structure scrambling in German and Japanese should be sensitive to this distinction . The following examples with scrambled indefinite objects confirm this expectation for German. In sentences 64(a) to (d) 'well-behaved' indefinite objects have been scrambled to the left of the negation "nicht". The result is ungrammatical. In 65(a) to (f) 'ill-behaved' indefinite objects have been scrambled. The result is grammatical. Note that in all of those cases, the indefinite object could appear to the right of "nicht". It would then have to undergo negation merging, though.

Indefinite objects that cannot be scrambled

64(a) *Wenn ein Beweis einen Fehler nicht enthält
if a proof a mistake not contains

(b) *Wenn ein Projekt eine Genehmigung nicht erfordert
if a proposal an approval not requires

(c) *Wenn ein Grundstück an einen Sumpf nicht grenzt
if a lot on a swamp not borders

(d) *Wenn ein Bauer einen Esel nicht hat
if a farmer a donkey not has

Indefinite objects that can be scrambled

65 (a) Wenn ein Kritiker einen Film nicht mag
if a critic a movie not likes

(b) Wenn ein Leser einen Artikel nicht schätzt
if a reader a paper not appreciates

(c) Wenn ein Dolmetscher eine Fremdsprache nicht beherrscht
if an interpreter a foreign language not knows

(d) Wenn ein Kollege für einen Fehler nicht verantwortlich ist
if a colleague for a mistake not responsible is

(e) Wenn ein Übungsblatt einem Schüler nicht schwerfällt
if an assignment to a student not hard is

(f) Wenn ein Kleid einer Kundin nicht passt
if a dress to a customer not fits

In the above sentences, an indefinite object precedes the negation "nicht". If the negation "nicht" is placed somewhere between the specifier of IP position and the VP (an assumption we made earlier), the object (as well as the subject) must have been scrambled. Scrambling of 'ill-behaved' indefinite objects is permitted, but scrambling of 'well-behaved' indefinite objects is not.
We don't know yet what makes an indefinite object 'well-behaved' or 'ill-behaved' with respect to scrambling. And we will make no attempt at an explanation. There are probably several factors involved. Apart from the type of verb, the type of noun phrase seems

to play a role. For our present purposes, it is sufficient that we found a relevant correlation. Whenever an indefinite object can scramble at surface-structure in German, it can scramble at logical form in English (and the other way round). The 'ill-behaved' indefinite objects, then, present no real challenge to Diesing's way of explaining why bare plurals have the readings they have. VPs are always mapped into nuclear scopes. But there may be some scrambling first.

We are now in the position to make some predictions about possible readings of indefinite objects in English. Indefinite objects in English should always have an existential reading. In the presence of a suitable operator a generic reading might also be available. We expect that a generic reading will be available in precisely those cases where surface-structure scrambling is possible in German. The following examples confirm this expectation.

Indefinite objects that cannot be scrambled

66 (a) weil Anton meistens einen Anzug trägt
since Anton usually a suit wears
(b)* weil Anton einen Anzug meistens trägt
since Anton a suit usually wears
(c) since Anton usually wears a suit

67 (a) weil Paula meistens Tulpen pflanzt
since Paula usually tulips plants
(b)* weil Paula Tulpen meistens pflanzt
since Paula tulips usually plants
(c) since Paula usually plants tulips

68 (a) weil diese Zeitung meistens einen schlechten Artikel enthält
since this paper usually a bad article contains
(b)* weil diese Zeitung einen schlechten Artikel meistens enthält
since this paper a bad article usually contains
(c) since this paper usually contains a bad article

Indefinite objects that can be scrambled

69 (a) weil sie immer Briefe aus Europa beantwortet
since she always letters from Europe answers
'she is always engaged in answering letters from Europe'

(b) weil sie Briefe aus Europa immer beantwortet
since she letters from Europe always answers
'she never leaves a letter from Europe unanswered'

(c) since she always answers letters from Europe

70 (a) weil wir immer ein gutes Projekt fördern
since we always a good project sponsor
'there is always a good project that we sponsor'

(b) weil wir ein gutes Projekt immer fördern
since we a good project always sponsor
'we sponsor any good project'

(c) since we always sponsor a good project

71 (a) weil ein Pianist immer eine Sonate auswendig kann
since a pianist always a sonata by heart knows
' there is always a sonata that a pianist knows by heart'

(b) weil ein Pianist eine Sonate immer auswendig kann
since a pianist a sonata always by heart knows
'a pianist knows any sonata (he plays) by heart'

(c) since a pianist always knows a sonata by heart

The (a) sentences above are German sentences with an indefinite object following a sentential adverb like "meistens" or "immer". These objects are not scrambled and can only have an existential interpretation. The (b) sentences are like the (a) sentences, except that the indefinite object has been scrambled out of its VP and precedes the adverb (the subject must have been scrambled as well, but this is not relevant here). The result is grammatical for some indefinite objects, but not for others. If the (b) sentences are

grammatical, the indefinite object can only have a generic interpretation. The (c) sentences give the closest English equivalent to the German (a) and (b) sentences. The objects of all (c) sentences have an existential reading. The objects of 69(c), 70(c), and 71(c) also have a generic reading. What is important is that the English (c) sentences have a generic reading in precisely those cases where the corresponding German (b) sentences are grammatical. And this shows again that the English indefinite objects can be scrambled at logical form in precisely the cases where the German indefinite objects can be scrambled at surface-structure. Indefinite objects that cannot scramble must stay in their VPs. They are then mapped into nuclear scopes and are caught by existential closure.

7. Where does the Davidsonian argument go?

In the preceding sections, we investigated how surface-structure subjects and objects are mapped into logical representations. This section will present some thoughts about the logical form representation of Davidsonian arguments.

We assumed above that Davidsonian arguments are implicit arguments in languages like English or German. Diesing's proposal, then, does no affect it. At surface structure, Davidsonian arguments don't appear within VP. Nor do they appear outside of VP. In fact, they don't appear anywhere. They will be present at the level of logical form, though. For them to be present there, they need a predicate that takes them as an argument. Stage-level predicates of all kinds are one possibility. Wherever a stage-level predicate appears at logical form, a variable ranging over spatiotemporal locations will be present. Locatives are another possibility. In his comments on Davidson's paper , E.J. Lemmon (1967) proposes to treat tense predicates like 'is before now', 'is now', 'is after now' as expressing properties of spatiotemporal locations (space-time zones). Tense predicates, then, are yet another tool for introducing a Davidsonian argument into a logical representation. Tense is realized by the inflectional element I(NFL) at surface-structure. Hence tense

predicates are realized outside of VP, and have to appear in the restrictive clause at logical form. Let us look at an example.

(72) Firemen were available

A possible logical form of (72) is (72') (this is a slight revision of the analysis of a similar example in section 4).

(72') [before now(l)] & $\exists_x$ [fireman(x) & available(x,l)]

"Past" is the tense predicate of (72'). It introduces an occurrence of the variable "l" into the restrictive clause. Being introduced in the restrictive clause, the variable "l" cannot be bound by existential closure. If there is no other quantifier to bind it, the context of use has to supply a value. This consequence is welcome. In an influential paper, Partee (1965) argues that sentences like (72) do not mean that there was some time in the past when firemen were available. We are talking about a particular occasion here, and this is just what our proposal implies. Note that something has to prevent the second occurrence of the variable "l" in (72') from being caught by existential closure. It seems reasonable to stipulate that whenever one occurrence of a variable is supplied with a value by the context of use, then all other occurrences of the same variable are supplied with the same value. They are then "context bound" and cannot be caught by existential closure.

Tense is not just a property of sentences where the main predicate is stage-level. Consider the following example.

(73) Henry was French

(73) has two possible interpretations. On the first interpretation, we are treating "be French" as a stage-level predicate. Imagine that Henry used to be French, but he is now an American citizen. The past tense is an effective tool for turning individual-level predicates into

stage-level predicates. In this case, the tense predicate is a predicate for a Davidsonian argument as expected. On the second interpretation, "be French" stays an individual-level predicate. The tense predicate now applies to the unique argument of "be French". (73') gives a suitable logical form.

(73') [before now (Henry$_3$)] & [French (he$_3$)]

In (73'), the property of being before now is not predicated of a spatiotemporal location, but of the individual denoted by the subject. (73') says that the individual Henry is located in the past and has the property of being French. We may conjecture that the tense predicate always relates to the external argument of the main predicate. This gives us an interesting prediction. Take my aunt Theresa, for example. She is an almost perfect clone of my grandmother. Yet unlike my poor grandmother, aunt Theresa is still alive. In this situation, 74(b) and (c) are true. 74(a) and (d), however, are either false or are cases of presupposition failure. (There is a close connection between restrictive clauses and presuppositions , a topic that we cannot go into here .)

74 (a) Aunt Theresa resembled my grandmother
(b) My grandmother resembled aunt Theresa
(c) Aunt Theresa resembles my grandmother
(d) My grandmother resembles aunt Theresa

These facts are easily explained if the tense predicate of the above sentences applies to the external argument of the main predicate. Note also that the data displayed under (74) seem to argue against those neo-Davidsonian approaches that assume the presence of state arguments for verbs like "resemble". The tense predicate in the sentences above would then apply to a state argument and the asymmetry observed in (74) would be unaccounted for. 74(a) and 74(b) would both be claimed to mean that there was a contextually

specified state in the past that consisted in my aunt and my grandmother's resembling each other.
Other relationships between the tense predicate and the external argument of the main predicate are possible. Here is an example.

(75) All applicants were French

The most likely reading of (75) is (75').

(75') **All_x [applicant (x,l) & before now(l)] [French(x)]**

In (75'), the tense predicate relates to the Davidsonian argument of the predicate "applicant". (75') says that everybody who applied at a particular occasion in the past has the individual-level property of being French.
If the tense predicate always relates to the external argument of the main predicate of the sentence, it follows that a variable ranging over spatiotemporal locations must appear in the restrictive clause of every tensed sentence whose main predicate is stage-level. This fact is important for our discussion of "when"-clauses throughout this paper. Take the following example from section 2.

(76) When Mary speaks French, she speaks it well

A possible logical representation of (76) is (76').

(76') **$Always_l$ [location (l) & [speak (Mary, French, l)]]**
[location(l) & [speak well (Mary, French,l)]]

(76') is well-formed, since the quantifier "always" binds the variable "l" in both its restrictive clause and its nuclear scope. The tense of (76) is what we may call "generic tense". One way of thinking about generic tense is that it introduces predicates of the most general kind. In (76') the tense predicate expresses nothing but the sortal

property 'is a spatiotemporal location'. If there weren't a tense predicate in (76), the variable"l" would only appear in the nuclear scope. It would then be bound by existential closure, and the whole structure would be ruled out as a violation of the prohibition against vacuous quantification.

The preceding sections gave a rough idea of some basic principles guiding the mapping from surface-structures to logical forms. The remainder of the paper will use the insights gained so far for a fresh look at some of the hardest problems surrounding the analysis of so-called "donkey sentences".

8. Uniqueness and proportions

(a) A dilemma

The proportion problem for the Lewis-Kamp-Heim approach to adverbs of quantification and indefinites has been noted and discussed by a number of scholars (Partee 1984 , Bäuerle & Egli 1985, Heim 1987, Kadmon 1987, Berman 1987 and others [2]). The problem is illustrated by the following sentence.

(77) When a house has a fireplace it (the house) is usually old

The classical Lewis-Kamp-Heim analysis of sentences like (77) is given in (77').

(77') $\textbf{Usually}_{x,y}$ **[house(x) & fire place (y) & have (x,y)] [old (x)]**

(77') is true if and only if most pairs of individuals that satisfy the restrictive clause of (77') also satisfy its nuclear scope. Imagine now a situation with fifty houses. 20 of the houses are old , 30 are new. Each of the old houses has five fire places. The new houses have only one. This means that there are 130 house/fire place pairs that satisfy the restrictive clause of (77'). Out of those 130 pairs, 100 satisfy the nuclear scope. The classical Lewis-Kamp-Heim analysis, then, predicts that sentence (77) should be true in the

situation given . But it is not.
The antecedent of (77) was constructed in such a way that the main predicate is a relatively clear case of an individual-level predicate, and the object is hard to scramble. On our analysis , then, the logical form of (77) should be (77") rather than (77').

(77") Usually_x [house (x) & $\exists_y$ [fireplace (y) & have (x,y)]] [old (x)]

In (77"), the restrictive clause of the quantifier "usually" is split into two parts conjoined by "&" as proposed above. The subject appears in the first conjunct (an embedded restrictive clause), since it was base-generated outside of VP. The object must appear in the second conjunct, since it cannot be scrambled. The second conjunct is an embedded nuclear scope, hence is existentially closed. (77") is true if and only if most individuals that satisfy the restrictive clause of the whole sentence also satisfy its nuclear scope. On our scenario, there are 50 individuals that satisfy the restrictive clause. But out of those, only 20 satisfy the nuclear scope. Sentence (77), then, is correctly predicted to be false in such a situation.
Consider next the following example, which is a version of Heim's famous sage plant example (Heim 1982).

(78) When a house has a barn, it often has a second one right next to it (the first barn)

As before, the main predicate of the antecedent of (78) is individual-level, and the object cannot be scrambled. The logical form of (78) should then be (78').

(78') Often_x [house (x) & $\exists!_y$ [barn (y) & have (x,y)]] $\exists_z$[barn(z) & have(x,z) & $z \neq \iota y$ [barn (y) & have (x,y)] & next to (z,ιy [barn (y) & have (x,y)])]

(78') says that often, if there is a house with exactly one barn, the

house has a second barn right next to the first one. But this is absurd. And it is not what (78) means. We are not assuming that we are only talking about houses with exactly one barn. Yet our approach seems to commit us to some such assumption. Let us briefly review why. "A barn" is an object that cannot be scrambled, hence is caught by existential closure.The phrase "a second one" is best analyzed as "a barn different from it". The implicit pronoun "it" here (as well as the explicit occurrence of "it" in "next to it") is anaphorically related to "a barn" in the antecedent of the conditional. Since "it" cannot be bound by the same quantifier, it has to be analyzed as an E-type pronoun. Following Evans and Cooper, E-type pronouns are treated as definite descriptions. Definite descriptions carry uniqueness presuppositions. In our case, the uniqueness presupposition is incorporated into the restrictive clause of "often" through presupposition accommodation.

Sentence (78) throws us into a real dilemma. It is sentences like (78) that motivated Heim (1982) to pursue what we may now call "the classical Lewis-Kamp-Heim analysis".

(78'') $\text{Often}_{x,y}$ [house (x) & barn (y) & have (x,y)]
$\exists_z$[barn(z) & have(x,z) & z ≠ y & next to (z,y)]

But giving (78) the analysis (78'') will immediately bring back the proportion problem. Here it is. Suppose we have a total of thirty houses. Ten of those houses have five barns each, nicely placed next to each other. The remaining twenty houses have only one barn. Analysis (78'') predicts sentence (78) to be true in such a situation. But it is false.

It seems, then, that there is no way out. We seem to be either stuck with the proportion problem or else be committed to absurd uniqueness assumptions.

Let us not give up that fast.The approach taken in this paper tells us that we should opt for representations like (78') under any circumstances. These representations are independently motivated

and avoid the proportion problem. We must then find a way of getting rid of unwelcome uniqueness assumptions.

We have been following Evans and Cooper in treating E-type pronouns as definite descriptions. Evans and Cooper both adopted Russell's treatment of definite descriptions. And so did we. Out of habit. I think that we should continue to treat E-type pronouns as definite descriptions. But we should adopt Heim's theory of definite descriptions (Heim 1982). The consequences of such a move are far-reaching and cannot be properly explored here. Yet we may pursue the proposal up to a point where we can see its promise. On Heim's approach , definite and indefinite noun phrases are treated very much alike. They both introduce a predicate and a variable into logical representations. All by themselves, they are neither quantificational nor referring. The variable introduced has to be a new variable for indefinite NPs and an old variable for definite NPs. And there is a difference in presuppositions. Definite NPs presuppose their descriptive content, but indefinite NPs don't. Let us look at two simple examples .

79 (a) Harry vaccinated a sheep. He owns it.
(b) Harry vaccinated a sheep. He owns the sheep he vaccinated.

80 (a) Mary always wears a dress. Usually, it has polka dots.
(b) Mary always wears a dress. Usually, the dress she wears has polka dots.

The (a) dialogues both contain an E-type pronoun "it". In the (b) dialogues, the E-type pronoun is replaced by a suitable definite description as proposed by Evans and Cooper (assume we know how to get a suitable description). Using Heim's analysis of definite descriptions , we arrive at the following logical representations for (79) and (80).

(79') past(1) & $\exists_y$[sheep(y) & vaccinate ($Harry_3$,y,1)] .
[sheep(y) & vaccinate ($Harry_3$, y, 1) & past(1)] &
[own(he_3,y)] .

(80') $Always_1$ [location (1) & at ($Mary_3$,1)] $\exists_y$ [dress (y) &
wear (she_3,y,1)] .
$Usually_{y,1}$ [dress (y) & wear (she_3, y, 1)]
[have polka dots (y)] .

The second part of (79') consists of a restrictive clause and a nuclear scope conjoined by " &". As a result of presupposition accommodation, the restrictive clause contains the descriptive content of the definite description "the sheep Harry vaccinated". The variable "y" occurs free in the restrictive clause and in the nuclear scope of the second part of (79'). It has to receive a value by the context of use. A suitable value is not difficult to find. The first part of (79') conversationally implicates that Harry vaccinated exactly one sheep at the time under consideration (see Kadmon 1987 for a very detailed discussion of this point). The unique sheep Harry vaccinated, then, will be the value for "y". If a free variable receives a referent from the context of use, the referent has to be familiar in that context. Definiteness in English indicates familiarity. Indefiniteness indicates lack of familiarity. It follows that variables introduced by definite noun phrases can, but variables introduced by indefinite noun phrases can not receive a value from the context of use. (This is important. "Firemen are altruistic" can not mean that some contextually specified firemen are altruistic.)
The second part of (80') is a tripartite quantifier construction. As before, the restrictive clause contains the descriptive content of the definite description . This time, the adverbial quantifier "usually" binds all variables that occur free in the sentence, and no recourse to contextually supplied values is necessary. A scalar implicature and

world knowledge suggest that Mary wears exactly one dress at each occasion.
Combining Evans and Cooper's analysis of E-type pronouns with Heim's theory of definite descriptions , then, seems to yield the appropriate analysis for sentences like (79) or (80).
Let us now return to example (78). After some simplifications (eliminating stacked nuclear scopes, for example), its final logical form will be (78''') .

(78''') Often_x [house (x) & $\exists_y$ [barn (y) & have (x,y)]]
$\exists_{z,y}$[barn(z) & have(x,z) & barn(y) & have (x,y) &
z ≠ y & next to (z,y)]

(78''') correctly captures the meaning of (78). The important part is " barn(y) & have (x,y)" in the nuclear scope. This part constitutes the descriptive content of the definite description replacing the two occurrences of E-type pronouns. Since the variable "y" is not bound from outside the nuclear scope, it is caught by existential closure. The logical representation (78''') corresponds to the "Indefinite Lazy Reading" of donkey pronouns in the terminology of Schubert and Pelletier (forthcoming). On our approach, such a reading can only arise under very special conditions. The donkey pronoun has to be an E-type pronoun and the variable it introduces must be caught by existential closure.
Heim's theory of definite descriptions, then, is a very promising candidate for solving traditional problems with uniqueness in donkey sentences. We are now free to dedicate the remaining pages to proportions. Our approach makes a number of very concrete predictions here, which should not go unmentioned.

(b) Experiments with donkey sentences and proportions
Experimenting with donkey sentences and proportions is a subtle affair. Fragile phenomena like unaccusativity, the stage-level/individual-level distinction, scrambling possibilities,

and the topic-focus organization of the sentence will all influence the outcome. Yet the task is not an impossible one. We know the main factors influencing judgements here and will try to keep them under control.

In this section, we examine a special brand of donkey sentences. They are all conditionals with antecedents restricting an adverb of quantification. And the main predicates of the antecedents are always transitive individual-level predicates with indefinite subjects and objects. Following Kadmon (1987), let us distinguish three possible interpretations for such sentences. The three interpretations correspond to the following three types of logical forms.

(81) Symmetric

$\textbf{Usually}_{x,y}$ [subject (x) & object(y) ....] [.....]

Quantification is over pairs <a,b> such that a satisfies the subject predicate and b satisfies the object predicate

(82) Subject asymmetric

$\textbf{Usually}_{x}$ [subject(x)... & $\exists_{y}$ [object(y).....]] [.....]

Quantification is over individuals a such that a satisfies the subject predicate and there is an individual b satisfying the object predicate

(83) Object asymmetric

$\textbf{Usually}_{y}$ [object(y)... & $\exists_{x}$ [subject(x).....]] [.....]

Quantification is over individuals b such that b satisfies the object predicate and there is an individual a satisfying the subject predicate

These logical forms are tripartite quantifier structures with the quantifier "usually", a restrictive clause, and a nuclear scope. We are interested in the position of subjects and objects within the

restrictive clause. Our previous discussion has shown that the restrictive clause itself is split into an embedded restrictive clause and a nuclear scope. On the symmetric reading, subject and object are part of the embedded restrictive clause. On the subject asymmetric reading, the subject is part of the embedded restrictive clause, and the object is part of the embedded nuclear scope. On the object asymmetric reading, it is the other way round. Note that these three possibilities are the only possibilities, given just one object. The fourth conceivable possibility (84) is excluded by the prohibition against vacuous quantification (recall that we are only considering individual-level predicates).

(84) Impossible

Usually [..... $\exists_{x,y}$ [subject(x) & object(y)...]] [.....]

Given our assumptions about how surface-structures are mapped into logical forms, we are committed to a number of predictions concerning the possible interpretations of English donkey sentences of the sort considered here. If the main predicate in the antecedent is not unaccusative, its subject is base-generated outside of VP and has to be mapped into the embedded restrictive clause at logical form (recall again that we are only talking about individual-level predicates here). If the object is not scrambled, we get the subject asymmetric interpretation. If the object is scrambled, we have the symmetric interpretation. If the predicate is unaccusative, its subject appears outside of VP at surface structure. But it binds a trace within VP, hence it can optionally appear in the embedded restrictive clause or in the embedded nuclear scope at logical form. If it appears in the restrictive clause and the object is not scrambled, we arrive at the subject asymmetric interpretation. If the object is scrambled, we have the symmetric interpretation. If the subject appears in the nuclear scope, the object has to be scrambled, which gives us the object asymmetric interpretation. Here is a summary of all the predictions.

(85) Predictions
(a) A subject asymmetric interpretation is possible with any individual-level predicate
(b) A symmetric interpretation is only possible if the object can be scrambled
(c) An object asymmetric interpretation is only possible if the predicate is unaccusative and the object can be scrambled

These predictions are predictions about the possibilities permitted by grammar. If we want to test them, we have to be aware that for each interpretation, there are intonational properties favoring that particular interpretation (see Kadmon 1987, Heim 1987 for discussion). That is, if grammar allows several interpretations for a given sentence, intonation may bias us towards one of them. Quite generally, deaccenting is tied to restrictive clauses, and accenting is tied to nuclear scopes. Here is an overview.

(86) Favorable intonation conditions
(a) Symmetric
Deaccent subject and object
(b) Subject asymmetric
Deaccent subject, emphasize object
(c) Object asymmetric
Deaccent object, emphasize subject

For each interpretation, there are also specific anaphora conditions that favor that particular interpretation (see Bäuerle & Egli 1985, Kadmon 1987, Heim 1987 for the relevant observations). That is, for each interpretation, there is a particular configuration of donkey pronouns that facilitates that interpretation. (A "donkey pronoun" is any pronoun in the consequent of a conditional that is anaphorically related to an indefinite noun phrase in the antecedent.) For our present purposes, it is not important to know why certain donkey

pronoun configurations facilitate certain interpretations. Likewise, we don't have to know why certain intonation conditions bias us towards certain readings. At this point, we only have to know that there are additional factors influencing interpretations. This will help us to design appropriate proportion experiments. The following table summarizes the crucial facts about donkey pronoun configurations.

(87) Most favorable donkey pronoun configurations

(a) Symmetric
Two donkey pronouns. One related to antecedent subject, the other one related to antecedent object

(b) Subject asymmetric
One donkey pronoun. Related to antecedent subject

(c) Object asymmetric
One donkey pronoun. Related to antecedent object

We are now in the position to test a few selected predictions. Out of the three possible interpretations, the object asymmetric interpretation is predicted to be the most constrained. We should only find it with unaccusative predicates. How can we tell that a predicate doesn't permit an interpretation? I think a relatively safe method is to create the most favorable conditions for the reading we are after. If the reading doesn't emerge under those optimal conditions, we may conclude that it is not available.
Let us first examine the verb "adore": "Adore" is individual-level, it is not unaccusative, and its object can be scrambled. All of those properties can be established with the help of the tests discussed earlier in the paper. We expect, then, that the symmetric and the subject-asymmetric interpretation should be possible for a donkey sentence involving this verb in the antecedent, but the object asymmetric interpretation should be excluded. Let us check this last prediction. Consider the following sentence .

(88) When a SICILIAN adores a piece of music, it is rarely a Bellini opera.

In (88), the intonation and anaphora conditions are set up as to be most favorable to the object asymmetric reading. Does (88) have this reading? Suppose we have 300 Sicilians. The following list gives an overview of their favorite pieces of music.

(89)

Bellini operas	
Norma	80
La Sonnambula	150
I Puritani	50
Other pieces of music	
Piano concerto "Jeunehomme"	1
Archduke Trio	1
Trout Quintet	1
Kreutzer Sonata	1
Mozart piano concerto K. 414	5
Brahms sextet op. 18	1
Lieder eines fahrenden Gesellen	1
Schubert string quintet C major	1
String quartets "Rasumowsky"	1
Stadler quintet	1
Cantata BWV 106 "Gottes Zeit"	5
Cantata BWV 82 "Ich habe genug"	1
Don Giovanni	0
Le Nozze di Figaro	0
Tannhäuser	0

On this scenario, sentence (88) is intuitively false. Yet the object asymmetric interpretation predicts it to be true. All in all, fifteen pieces of music are adored by at least one Sicilian. And very few of those pieces are Bellini operas. Since the conditions were optimal for an object asymmetric reading to arise, we may conclude that verbs like "adore" can't give rise to such readings at all. We have to be careful, though. Take the following sentence.

(90) When a SICILIAN adores a piece of music, we usually include it in our "Morning Pro Musica" program

It seems that the policy expressed in (90) has to lead to the inclusion of a certain percentage of non-Bellini music in the program. As long as there is one Sicilian adoring a piece of music, the piece counts. But then (90) seems to have an object asymmetric reading. Note, however, that there is a crucial difference between (88) and (90). The main predicate in the consequent of (88) is individual-level, while the main predicate in the consequent of (90) is stage-level. This seems to have an effect on how to interpret the main predicate in the antecedent. (90) suggests that we have a pile of letters from listeners on the basis of which we make our decisions. Whenever a Sicilian expresses her adoration for a piece of music, the piece is given consideration. But this means that the verb "adore" is being pushed towards a stage-level predicate.

Let us now examine an unaccusative case. Take the verb "belong to". The tests proposed earlier establish that it is individual-level, unaccusative, and that its object can be scrambled. The following sentence expresses a generalization from real estate catalogues.

(91) When a LAKE belongs to a lot, it (the lot) is usually in Minnesota.

As before, intonation and anaphora conditions are chosen as to bias us towards an object asymmetric interpretation. This time, we predict that the interpretation will emerge. And it does. Suppose we have a total of thirty lots being offered. Out of those thirty lots, ten are in Minnesota and they have five lakes each. The remaining twenty lots are all in the Adirondacks, and they have just one lake. In this situation, (91) is intuitively false, and the object asymmetric interpretation is the only interpretation that predicts this. A verb like "belong to", then, can give rise to the object asymmetric interpretation as expected. It should be able to give rise to the other two kinds of interpretations as well, if only we create the right

conditions. Take the following example.

(92) (When a linguist merely attends the CONFERENCES of a professional organization, she often doesn't care about its other activities. But) when a linguist BELONGS to a professional organization, she usually identifies with its political stand.

In (92), the stretch within brackets is meant to evoke a context for the conditional we are interested in. The intonation and anaphora conditions bias us towards a symmetric interpretation. Imagine now the following scenario.
We have twenty linguists. They are all members of the Linguistic Society of America, of GLOW, and the Deutsche Gesellschaft für Sprachwissenschaft. They don't care about the politics of any of those organizations, however. Each of the linguists is a member of a fourth professional organization, and this is the organization she really identifies with. Here is a list of the linguists (represented by numbers) and their primary professional organization.

(93)

1	Acoustical Society of America
2	American Anthropological Society
3	American Association of Applied Linguistics
4	American Dialect Society
5	American Sociological Association
6	Asociacion Venezolana de Linguistica
7	Association for Computational Linguistics
8	Association for Symbolic Logic
9	Australian Linguistic Society
10	Berkeley Linguistic Society
11	Canadian Linguistic Association
12	Chicago Linguistic Society
13	Indiana University Linguistics Club
15	International Society of Phonetic Sciences
16	Linguistic Society of India
17	Linguistic Society of the Philippines
18	Linguistic Association of Great Britain
19	Modern Language Association of America
20	Societas Caucasologica Europea

I think that sentence (92) is intuitively false , given our scenario. The only interpretation that predicts it to be false is the symmetric interpretation. We have eighty linguist-organization pairs such that the linguist is a member of the organization. But we only have twenty linguist-organization pairs such that the linguist identifies with the politics of the organization. The subject asymmetric interpretation predicts the sentence to be true, since each linguist is a member of an organization she identifies with. The object asymmetric interpretation predicts the sentence to be true as well, since for most organizations, there is a member who cares about its politics.

We have seen that a verb like "belong" can have an object asymmetric and a symmetric interpretation. The next example shows that, as expected, it can also have a subject asymmetric interpretation. As before, intonation and anaphora conditions are chosen to fit.

(94) When a linguist belongs to a professional ORGANIZATION, she is usually not affiliated with a university

Imagine that we have forty linguists. Twenty of them are the linguists from the previous example, so we know about their involvement in professional organizations. None of them is affiliated with a university. The remaining twenty linguists are members of the Linguistic Society of America, and belong to no other professional organization. They are all affiliated with some university. In this situation, (94) is intuitively false, and the subject asymmetric interpretation is the only interpretation that predicts it to be false.

An unaccusative verb like "belong to", then, can indeed give rise to three interpretations, whereas the readings for a verb like "adore" are more constrained. While we didn't check all possible predictions, of course, the results obtained so far are encouraging and lend further support to our conception of the link between surface-structure and logical form representations.

(c) Stage-level predicates and proportions

In this section, we will continue our investigation of donkey sentences and proportions. This time, we will only consider conditionals with stage-level predicates in the antecedent. As before, we will be quite selective as to the issues discussed and mainly open up questions for further research. The following example is inspired by an example of Bäuerle & Egli (1985). A similar example plays a crucial role in Berman (1987).

(95) When a birder spots an owl, it is usually night

Since we are interested in proportions, we are interested in the antecedent of (95). The antecedent of (95) is repeated as (96).

(96) .....a birder spots an owl.....

Four possible logical forms for (96) are permitted by the approach we have been arguing for in this paper.

96' (a) $\text{location}(l) \& \exists_{x,y}[\text{birder}(x) \& \text{owl}(y) \& \text{spot}(x,y,l)]$

(b) $\text{location}(l) \& \text{birder}(x) \& \exists_{y}[\text{owl}(y) \& \text{spot}(x,y,l)]$

(c) $\text{location}(l) \& \text{birder}(x) \& \text{owl}(y) \& [\text{spot}(x,y,l)]$

(d) $\text{location}(l) \& \text{owl}(y) \& \exists_{x}[\text{birder}(x) \& \text{spot}(x,y,l)]$

In all four logical representations, a variable for spatiotemporal location is present in the restrictive clause. It has to be present there, since it is introduced by the tense predicate, and the tense predicate is base-generated outside of VP. Both the subject and the object of (96) can optionally appear in the restrictive clause. The subject can appear in the restrictive clause, since it appears outside of VP at surface-structure. It can also appear in the nuclear scope, since it binds a trace within VP. The object can appear in the nuclear scope since it appears within VP at surface-structure. And it can also appear in the restrictive clause, since it is the sort of object

that can scramble. The free variables in 96'(a) to (d) may become bound by a quantifier, if the sentences are embedded into more complex structures. In fact, the variables introduced by the subject or object have to be bound. Being indefinite, the variable they introduce cannot receive a value from the context of use.
Let us now examine the possible logical forms for (95).

95'(a) Usually_{l} [location (l) & $\exists_{x,y}$[birder(x) & owl(y) & spot(x,y,l)]] [night(l)]

(b) $\text{Usually}_{l,x}$ [location(l) & birder(x) & $\exists_{y}$[owl(y) & spot(x,y,l)]] [night(l)]

(c) $\text{Usually}_{l,x,y}$ [location(l) & birder(x) & owl(y) & [spot (x,y,l)]] [night (l)]

(d) $\text{Usually}_{l,y}$ [location(l) & owl(y) & $\exists_{x}$[birder(x) & spot (x,y,l)]] [night(l)]

All four representations 95'(a) to (d) involve quantification over spatiotemporal locations. While quantification over spatiotemporal locations is a topic that we cannot seriously pursue here, we should at least add a few remarks as to its main properties. Spatiotemporal locations are related to each other by part-whole relationships, and this means that we must be careful with quantification. Quite generally, any sort of quantification seems to require that the domain of quantification is set up in such a way that its elements are truly distinct. Take the objects in this room. There are two tables, two chairs, and a bed. There are at least five objects, then. Each of those pieces of furniture has four legs. Can we conclude that there are at least 25 objects in this room? No way. This is not how counting works.
Let us now return to the conditionals 95'(a) to (d). How do we

manage to quantify over spatiotemporal locations here? Well, we have to make sure that the main restrictive clauses of those conditionals specify appropriate domains. One way of guaranteeing this quite generally is through the interpretation mechanism for sentences with a free Davidsonian variable. We expect the impact of different aktionsarten here, an issue we will have to delegate to another occasion. As an illustration take (97), which contains the achievement verb "spot".

(97) **spot (Megan, Bubo, l)**

We are looking for an interpretation of (97) that makes sure that the set of spatiotemporal locations satisfying (97) constitutes an appropriate domain of quantification. A requirement of this kind is needed in view of sentences like "When Megan spots Bubo, it is usually night" or "Megan has spotted Bubo twice". We know that a domain of quantification is never appropriate if there are part-whole relationships holding among its members. There are two part-whole relationships to watch out for in our case. The first one is spatial in nature. Whenever Megan spots Bubo on Mulholland Drive, she also spots Bubo in Los Angeles. The second one is temporal. If Megan spotted Bubo yesterday, she also spotted Bubo in 1988. If the set of entities satisfying (97) has to consist of distinct members, then we should say that (97) is satisfied by any spatiotemporal location l such that l is a minimal location where a spotting of Bubo by Megan takes place.

A representation like 95'(a) will now be true if and only if most minimal spatiotemporal locations l such that a spotting of an owl by a birder takes place in l are locations where it is night. These are the correct truth-conditions for 95'(a) (see Berman 1987 for a parallel proposal within situation semantics).

We are now in the position to return to our main topic, donkey sentences and proportions. We have argued that grammar allows four possible representations for (95). What I want to show next is that

these four representations all mean the same, given some plausible assumptions. Compare 95'(a) and (c), for example, which are repeated here.

95'(a) Usually_{l} [location (l) & $\exists_{x,y}$[birder(x) & owl(y) & spot(x,y,l)]] [night(l)]

(c) $\text{Usually}_{l,x,y}$ [location(l) & birder (x) & owl(y) & [spot (x,y,l)]] [night(l)]

In 95'(c), quantification is over triples. The set of triples satisfying the main restrictive clause of 95'(c) has very special properties, however. Whenever two triples <l, a, b> and <l, c, d> are in the set, then a = c and b = d. Why is this? The main restrictive clause of 95'(c) is satisfied by any triple <l ,a, b> such that a is a birder and b is an owl and l is a minimal spatiotemporal location where a spots b. If l is to be a minimal spatiotemporal location where a spots b, then a and b have to be at l, but there couldn't be other birders or owls at l. If there were, the location wouldn't be minimal any more. It is now easy to establish that there is a one to one correspondence between the locations satisfying the main restrictive clause of 95'(a) and the triples satisfying the main restrictive clause of 95'(c). Whenever a location l satisfies the main restrictive clause of 95'(a), then there is a unique pair <a,b>, such that <l,a,b> satifies the restrictive clause of 95'(c). And whenever a tripel <l,a,b> satisfies the main restrictive clause of 95'(c), then l satisfies the main restrictive clause of 95'(a). It can now be shown that a location satisfies the main restrictive clause and the main nuclear scope of 95'(a) if and only if the corresponding triple satisfies the main restrictive clause and the main nuclear scope of 95'(c). But this means that 95'(a) is true if and only if 95'(c) is. Similar arguments can be made to show that all four representations 95'(a) to (c) are assigned the same meaning. But then we shouldn't get any 'true' proportion effects with sentences like (95) at all. The interpretation of those sentences

should always amount to something that looks like the symmetric interpretation we discussed for individual-level predicates. It isn't, of course. We only get a similar effect by quantifying over locations.

The discussion in Bäuerle & Egli (1985) suggests that this last expectation might not be quite right. Suppose we have a hundred birders. They go bird watching on Mulholland drive. One half of the bird watchers goes in groups of ten. The other fifty birders go on individual outings . Each party takes off on a different day and spots exactly one owl. The five groups of ten spot their owl during the day. The fifty individual bird watchers spot their owl at night. On this scenario, (95) is intuitively true. Yet it seems that our analysis predicts it to be false. There are fifty minimal spatiotemporal locations l such that a birder spots an owl at l and l is a day time location. And there is not more than an equal number of minimal spatiotemporal locations l such that a birder spots an owl at l and l is a night location. Using examples of this kind, Berman (1987) argues that there is a certain leeway as to what a minimal location (situation in his framework) is. In our case, he would reason that if a birder is part of a group, the minimal location in which she spots an owl might sometimes be taken to be identical with the minimal location in which the whole group spots the owl. This is what it means to spot an owl together. Likewise, should a birder spot several owls at the same time, we would sometimes want to treat those owls as a group. The minimal spatiotemporal location where the birder spots one owl would then be identical with the minimal spatiotemporal location where he spots the whole group .

With stage-level predicates in the antecedent, then, we may get group effects in donkey sentences. These group effects have been mistaken for 'true' asymmetric readings. And 'true' asymmetric readings have been misinterpreted as group effects . Within a Davidsonian framework, the latter proposal would require that individual-level predicates have a Davidsonian argument (an eventuality argument),

too. While this approach is attractive and is found in the donkey sentence literature , the evidence accumulated in this paper argues against such a move.
For the sake of argument, suppose that , contrary to what we have argued before, individual-level predicates have a Davidsonian argument after all. Would it then be plausible to analyze all asymmetric readings as group effects as proposed by Berman?
I think not. A major difficulty for such a proposal would be to account for missing asymmetric readings with individual-level predicates, for example. Recall the case of the Sicilians adoring Bellini operas. There is no conceptual reason that could prevent us from regarding the fans of a particular piece of music as a group. Otherwise, we couldn't have sentences like (98).

(98) They adore the same piece of music

Properties like 'adoring the same piece of music' can only apply to plural individuals or groups. But then it should be conceptually possible to consider all the Sicilians who adore a piece of music as a group. And we should get the effect of an object asymmetric reading for sentence (99) (repeated from above).

(99) When a SICILIAN adores a piece of music, it is rarely a Bellini opera

We have seen that an object asymmetric reading is not possible for (99). And we have given a syntactic explanation for this fact. The preceding thoughts suggest that the syntactic explanation given cannot be reduced to a simple 'conceptual' one. If this line of reasoning is on the right track, then there are two sources for what looks like asymmetric readings in donkey sentences. The source is syntactic with individual-level predicates, and 'conceptual' with stage-level predicates. This means that Kadmon's account of asymmetric readings seems to be correct for individual-level

predicates. And the proposal of Berman (1987) is likely to turn out to be the adequate account for stage-level predicates.

(d) Comparisons and concluding remarks

Several recent discussions of donkey sentences have considered the possibility of going back to a position where all indefinites are uniformly treated as existential quantifiers (Heim 1987, Groenendijk & Stokhof 1987, Chierchia 1988, Schubert & Pelletier (forthcoming)). All of those proposals were intended to overcome some apparent shortcomings of the original Lewis-Kamp-Heim proposal. Major concerns include the proportion problem and a commitment to implausible readings for sentences like the following (almost Schubert & Pelletier's sentence)

(100) If I find a quarter in my pocket, I'll put it in the parking meter

Schubert & Pelletier argue that on its most plausible reading, a sentence like (100) doesn't mean that all quarters that I will find in my pocket will have to go into the parking meter. This intuition seems right, contrary to what the classical Lewis-Kamp-Heim approach predicts.

In this concluding section, I will briefly address the major issues raised by these new proposals. And I will conclude that the slight amendments to the classical Lewis-Kamp-Heim approach that we have been arguing for in this paper are to be preferred.

If all indefinite noun phrases in the antecedents of donkey sentences are treated as existential quantifiers, all donkey pronouns are E-type pronouns. They are pronouns that are anaphorically related to a quantificational NP that doesn't c-command them. We considered two possible analyses of E-type pronouns. The standard analysis takes them to be Russellian definite descriptions. Our own analysis treats them as Heimian definite descriptions. This means that they are like

indefinite descriptions if they are caught by existential closure. Heim 1987 critically examines the first proposal for donkey pronouns. The analysis of Chierchia 1988 can be seen as a version of the second proposal. Both Heim and Chierchia rely on a neo-Davidsonian framework where all predicates have an eventuality argument. Here is a sketch of the essence of the two types of analyses for a simple donkey sentence (let us call these analyses "E-type only" analyses).

(101) When a donkey is stubborn, it is usually from Andorra

E-type pronouns as definite descriptions
For most minimal eventualities e such that there is a stubborn donkey in e there is an eventuality e' such that the unique donkey that is stubborn in e is from Andorra in e'.

E-type pronouns as indefinite descriptions
For most minimal eventualities e such that there is a stubborn donkey in e there is an eventuality e' such that a donkey that is stubborn in e is from Andorra in e'.

Assuming that quantification in (101) is over minimal eventualities where a donkey is stubborn (as it has to be, given the arguments above), the two analyses yield the same truth-conditions for (101). Every minimal eventuality where a donkey is stubborn is an eventuality where exactly one donkey is stubborn. There are other sentences, however, where the two types of analyses make different predictions. The following type of example is an individual-level version of a parallel stage-level example ascribed to Hans Kamp ("when a bishop meets another man, he blesses him", Mats Rooth, personal communication).

(102) When a man resembles another man , he tries to avoid him

E-type pronouns as definite descriptions
For every minimal eventuality e such that a man resembles another man in e, there is an eventuality e' such that , in e', the unique man who resembles another man in e tries to avoid the unique man who resembles another man in e.

E-type pronouns as indefinite descriptions
For every minimal eventuality e such that a man resembles another man in e, there is an eventuality e' such that in e', a man who resembles another man in e tries to avoid a man who resembles another man in e.

Neither 'E-type only' analysis gets the truth-conditions for (102) right. Given that 'resemble' is a symmetric relation, the first analysis makes (102) true in all worlds in which no man resembles another man and false in all other worlds. There simply cannot be a unique man who resembles another man. The second analysis doesn't capture the fact that (102) says that whenever two men resemble each other they both try to avoid the other. It only requires that one of the two men tries to avoid the other.
Examples like (102) provide one of the strongest arguments in favor of a Lewis-Kamp-Heim analysis. Since our proposal preserves the essential features of this analysis, it is able to treat those examples correctly. Depending on whether the object "another man" in the antecedent of (102) is scrambled or not, our approach admits the following two logical representations .

(102') $\text{Always}_x[\text{man}(x) \& \exists_y[\text{man}(y) \& x \neq y \& \text{resemble}(x,y)]]$
$\exists_y[\text{man}(y) \& x \neq y \& \text{resemble}(x,y) \& [\text{try to avoid}(x,y)]]$

(102'') $\text{Always}_{x,y}[\text{man}(x) \& \text{man}(y) \& x \neq y \& [\text{resemble}(x,y)]]$
$[\text{try to avoid}(x,y)]$

Both representations predict that whenever two men resemble each other they both try to avoid the other.
Example (102) shows that 'E-type only' analyses of donkey sentences face serious empirical problems that our version of the Lewis-Kamp-Heim analysis avoids . Let us now turn to some of the problems with the classical Lewis-Kamp-Heim approach that 'E-type only' analyses are designed to overcome. We have already discussed the proportion problem. One important point to keep in mind is that the task here is not just to overcome a problem. An adequate analysis has to be able to actually predict the subtle proportion facts we encountered above. An approach that treats all indefinite noun phrases uniformly as existential quantifiers and all donkey pronouns uniformly as E-type pronouns is unlikely to achieve this. Let us finally examine sentence (100), which is repeated here.

(100) If I find a quarter in my pocket, I will put it in the parking meter.

Recall that Schubert & Pelletier observe that on the prominent reading of (100), not all quarters that I find in my pocket have to go into the parking meter, contrary to what the classical Lewis-Kamp-Heim analysis seems to require. The reading of (100) that Schubert & Pelletier are interested in, is the reading where "if" cannot be replaced by "when". We have argued above that in this case, the "if"-clause restricts an epistemic modal. We have also seen that epistemic modals cannot bind variables. Our approach now permits

the following logical form for (100).

(100') **Must [location(l) & $\exists_x$ [quarter(x) & in my pocket(x,l)]**
$\exists_{l',x}$[after now(l') & quarter(x) & in my pocket(x,l) &
[put (I, x, parking meter, l')]]

In (100'), the variable "l" is left free , since "must" cannot bind it. It will have to receive a value from the context of use, hence has a definite interpretation. The indefinite noun phrase "a quarter" has to be mapped into the embedded nuclear scope of the main restrictive clause, where the variable it introduces can be caught by existential closure. If it were mapped into the embedded restrictive clause of the main restrictive clause, the variable could not be bound. Nor could it receive a value from the context of use (due to the indefiniteness of "a quarter"). The donkey pronoun "it" must be interpreted as an E-type pronoun ("the quarter in my pocket"). It is analyzed as a Heimian description, and the variable it introduces is caught by existential closure. The result is precisely the reading Schubert & Pelletier want to get for (100). If I find a quarter in my pocket, I will put a quarter from among the quarters I find in my pocket in the parking meter. The other examples that Schubert & Pelletier use to show that a Lewis-Kamp-Heim analysis is "plain wrong" can be treated in the same way.

It seems, then, that the slight amendments to the classical Lewis-Kamp-Heim approach that we have been advocating in this paper not only overcome the problems of the original proposal, but also avoid the empirical shortcomings of the 'E-type only' theories that were intended to be its successors.

Acknowledgements

Research for this paper was supported in part by NSF grant BNS 87-19999. Previous versions of the paper were read at the Seminar für Natürlichsprachliche Systeme in Tübingen , at CSLI in Stanford, at the MIT Center for Cognitive Science, and at Cornell University. I'd like to thank the organizers of these talks for the opportunity to present my thoughts, and I am grateful for the comments and suggestions I received from the various audiences. I'd also like to thank my colleagues Emmon Bach and Barbara Partee for very helpful conversations in connection with our NSF grant. During the past years, I have been working with Karina Wilkinson, Nirit Kadmon, Steve Berman, and Molly Diesing on related topics, and their insights and proposals had a considerable and visible influence on the present work. Lisa Selkirk, Irene Heim, and Arnim von Stechow all gave me detailed and much appreciated comments on various drafts. Very special thanks go to David Pesetsky for his sustained interest and invaluable feedback during all stages of the research that led to the final version of this paper.

Footnotes

1) I think it was Irene Heim who made me first aware of the special properties of plural negative quantifiers in German.
2) Irene Heim discussed the proportion problem in an earlier draft of her dissertation. She also proposed a technical solution, but then became dissatisfied with it, and discarded the whole section in the final version.

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