Adverbial Quantifiers, Maximal Situations, and "Weak" E-type Pronouns*

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Abstract

This paper argues with von Fintel (1994) and others that adverbs of quantification such as *always* and *usually* are quantifiers over situations, not unselective quantifiers. However, our proposal differs from previous proposals in that it embraces the following ideas: (i) A sentence of the form δ if/when α, β (where δ is a QAdverb) means that δ-many of the maximal situations in which α obtains and throughout which β could conceivably obtain are also β-situations. The domain of quantification for an adverbial quantifier cannot be characterized in term of minimal situations, however the term *minimality* is defined. Moreover, each situation that serves as a counting unit may not be "extended" into a matrix clause situation. (ii) So-called E-type pronouns always receive a "weak" reading (= Indefinite Lazy Reading for Schubert and Pelletier (1989)) equivalent to an indefinite description, not the standard E-type reading. The proposal defended here is couched in Kratzer's (1989) situation-theoretic framework, where situations are parts of worlds. We superimpose temporal and spatial ingredients into her system. A sentence of the form *if/when p, always q* is true iff $\{s_1 \mid p$ is true in s_1 and s_1 is a maximal situation such that at any part of s_1, it is conceivable that *p and q* is true$\} \subseteq \{s_2 \mid$ *p and q* is true in $s_2\}$.

1. Introduction

This paper investigates how to determine the domain of quantification for adverbial quantifiers such as *always* and *usually* and argues against the idea that it is determined in terms of minimal situations in which the restrictive clause is true. We propose, instead, that it is determined in terms of *maximal situations* in which the antecedent is true and throughout which it is conceivable that the consequent clause is true. As is well known, since the beginning of the 1980s, the semantics of adverbs of quantification has been a focus of attention among formal semanticists. Based upon Lewis's (1975) idea that such adverbs can bind multiple variables and hence are "unselective quantifiers," Kamp (1981) and Heim (1982) independently developed a theory referred to as Discourse Representation Theory (henceforth DRT for short). DRT was used to account for donkey sentences, among other things. Although the DRT approach to natural language semantics has produced many interesting research results, it has many empirical problems, which cast doubt upon the validity of the basic idea that DRT embraces: adverbial quantifiers are unselective quantifiers in that they bind unlimited number of free variables that occur within the restrictive clause.

One major problem with DRT is the so-called proportion problem. It is illustrated by example (1) (Kadmon 1987):

(1) Most women who own a cat are happy.

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The classical DRT analysis predicts that (1) is true in the following scenario: among the ten cat-owning women, one owns 100 cats and is happy, whereas the other women own one cat each and are unhappy. This is because 100 woman-cat pairs verify the condition whereas only nine woman-cat pairs fail to do so. However, (1) is intuitively false in the circumstance just described. In terms of DRT, this means that we must modify the theory in such a way that *most* behaves like a selective quantifier that only binds the variable associated with *women* in (1). The desired interpretation is obtained by the traditional generalized quantifier approach to the semantics of NPs coupled with the existential quantifier analysis of indefinite NPs (e.g., Montague 1973). The same problem arises with the conditional variant of donkey sentences. Consider example (2).

(2) If a woman owns a cat, she is usually happy.

In the original DRT analysis, (2) is understood to have the same truth conditions as (1). This is intuitively incorrect. Bäuerle and Egli (1985) suggest that we can account for examples like (1) and (2) on the basis of the following generalizations: (i) when an indefinite NP in the restrictive clause of a quantifier is not anaphorically linked to a pronoun in the nuclear scope of the quantifier, the indefinite NP is interpreted as existentially quantifying; (ii) when an indefinite NP in the restrictive clause is anaphorically linked to a pronoun in the nuclear scope, they are understood as occurrences of the same variable and are caught by the adverbial quantifier.

However, this generalization fails when we look at examples like (3a–b):

(3) a. Drummers mostly live in crowded dormitories. But if a drummer lives in an APARTMENT COMPLEX, it is usually half empty.
 b. If a man has a quarter in his pocket, he usually puts it in the parking meter.

(3a) is due to Heim (1990), and (3b) is discussed by Schubert and Pelletier (1989). (3a) shows that despite the fact that *an apartment complex* in the *if*-clause is anaphorically linked to the pronoun *it* in the matrix clause, the sentence can be interpreted in such a way that *usually* quantifies over the set of drummers. That is, (3a) can receive an interpretation symbolized in (4a). In this case, the pronoun *it* receives an E-type interpretation because *it* is paraphrased as "the apartment that *x* lives in." (3b) is also problematic. Its natural interpretation only requires that each man who has a quarter put at least one quarter in the parking meter, as indicated in (4b).

(4) a. $\text{usually}_x\ \exists y$[drummer($x$), apartment complex($y$), x lives in y][the unique apartment complex z in which x lives is half empty] (an E-type reading of *it*)
 b. $\text{usually}_x\ \exists y$[man($x$), quarter($y$), x has y in x's pocket]$\exists z$[quarter(z), x has z in x's pocket, x puts z in the parking meter] (an indefinite lazy reading of *it*, which does not require the presence of a unique quarter for each man.)

Schubert and Pelletier (1989) refer to this reading as an indefinite lazy reading. This poses a problem for any variant of the E-type analysis as long as it seeks to preserve the uniqueness presupposition associated with (so-called) E-type pronouns. We will take up this matter in more detail in the next section.

In order to solve the empirical problems associated with the classical DRT analysis, some researchers (e.g., Berman 1987, Heim 1990, von Fintel 1994) have proposed situation-based analyses of donkey sentences and some related phenomena. The formal theory of situation assumed in these proposals is that of Kratzer (1989). The ontology of Kratzer's theory is given in (5).

(5) Ontology of Kratzer's Situation Theory

- S a set, the set of possible situations
- A a subset of S, the set of possible individuals
- $\leq$ a partial ordering on S, with at least one additional condition: for all $s \in S$ there is a unique $s' \in S$ such that $s \leq s'$ and for all $s'' \in S$, if $s' \leq s''$, then $s''=s'$.
- $\wp(S)$ the power set of S, the set of propositions
- W a subset of S, the set of maximal elements with respect to $\leq$. W is the set of possible worlds. For all $s \in S$, let w_s be the maximal elements s is related to by $\leq$.

The idea underlying the situation-based proposals such as Berman (1987), Heim (1990) and von Fintel (1994) is that quantificational adverbs quantify over one type of object only, i.e., situations. To correctly restrict the domain of quantification for adverbial quantifiers, these proposals hold that they quantify over minimal situations of the relevant sort. When the sentence in question has an overt restrictive clause, for example an *if*-clause, the domain is claimed to be the following set: $\{s \mid s$ is a minimal situation such that *if*-clause is true in s and $s \in C\}$, where C is the set of situations provided by the previous context. For example, in (2) *usually* quantifies over $\{s \mid s$ is a minimal situation such that there is a cat-owning woman x in s and $s \in C\}$. This theory assumes that we can somehow pragmatically select minimal situations that contain a cat-owning women as "counting units" for *usually*.

(6a) contains a new indefinite NP in the nuclear scope and is analyzed as in (6b).

(6) a. If a farmer owns a donkey, he usually sells it to a merchant.
b. usually$_s$ [s is a minimal situation in which a farmer owns a donkey] $\exists s'$[s is part of s', the unique farmer x who owns a donkey y in s sells the donkey x owns in s to a merchant in s']

As indicated in (6b), one is allowed to extend each "minimal situation" to find a situation in which the consequent is true. However, the proposal cannot account for examples like (7) which involve the problem of indistinguishable participants (Heim 1990, von Fintel 1994).

(7) If a man has the same name as another man, he usually avoids addressing him by name.

(7) is problematic under any situation-based proposal that adopts an E-type analysis of pronouns. Note that any (minimal) situation in which the antecedent is true must contain two men. Therefore there is no unique man in such a situation. The theory predicts that the pronouns *he* and *him* have no denotation and therefore (7) is

uninterpretable. However, (7) in fact receives a perfectly coherent interpretation. This is a serious problem for proposals that are based upon minimal situations.

Next, note that most sentences that involve adverbial quantifiers are purely or partially time-sensitive. Nevertheless, previous situation-based proposals have largely ignored temporal matters. Kratzer (1989) abstracts away from temporal issues and pretends that each situation is atemporal for the sake of simplicity. This simplified situation theory does not have enough machinery to fully account for the semantics of adverbial quantifiers. We tentatively propose the following extension of Kratzer's situation theory that incorporates times: Let *I* be the set of intervals defined in the usual way. Let τ be a function (called the "temporal trace function") from situations to intervals. We also posit partial orders $<_t$ (strict temporal precedence) and $\subseteq_t$ (subinterval relation) on the set of intervals. For example, $\tau(s_1) <_t \tau(s_2)$ says 's_1 temporally precedes s_2', and $\tau(s_1) \subseteq_t \tau(s_2)$ means '$\tau(s_1)$ is a subinterval of $\tau(s_2)$'.

(8) a. If a woman buys a sage plant here, she usually buys eight others along with it.
b. Before John visits Mary, he always calls her.
c. If/When a farmer owns a donkey, he usually beats it.

The selection of each relevant situation for (8a) clearly involves temporal considerations. To determine the statistical tendency of how people make purchases of sage plants at a particular store, it is necessary to conduct a survey over a period of time. Thus, it is not possible to avoid the question of time in order to obtain the right interpretation of (8a). Intuitively, multiple sage-plant-buying events can constitute one buying situation only if they are temporally close to one another. For example, if one person buys sage plants on nine different days, these nine buying events normally cannot be grouped together as one buying situation. Obviously, one cannot predetermine how close the events have to be to qualify as one counting unit (situation, for our purposes) for *usually*. We must decide on a case-by-case basis, taking into consideration such factors as people's intentions. Intuitively, (8a) is true iff in most maximal situations *s* such that *s* serves as a "sage-plant-buying-situation" and a woman buys at least one sage plant in *s*, the woman buys nine of them in *s*. However, this is not what the standard situation-based analysis predicts because (8a) involves the proportion problem. Let us present one concrete case. Assume that there are eleven women who buy some sage plants on various occasions. A woman buys twenty sage plants on one occasion, and the other ten women buy a sage plant each. Let us assume that they are the only sage-plant-buying events that are relevant to the evaluation of (8a). Intuitively, *usually* quantifies over the eleven occasions or "situations." Since only one woman buys at least nine sage plants, the sentence is intuitively false. However, there are thirty minimal situations in which a woman buys a sage plant, and twenty of them can be extended to a larger situation in which the same woman buys eight other sage plants.[1] The standard situation-based account therefore fails to do justice to our intuitions associated with example (8a). We shall discuss a solution to this problem in the next section.

It is not obvious how to extend a minimality-based proposal to account for examples involving *before*-clauses or *after*-clauses, but it seems reasonable to propose for (8b) the truth condition described in (9).

(9) $\{s \mid s$ is a minimal situation in which John visits Mary$\} \subseteq \{s_1 \mid \exists s_2 \exists s_3[s_1 \leq s_2$ & $\tau(s_3) \subseteq \tau(s_2)$ & John calls Mary in s_3 & $\tau(s_3) <_t \tau(s_1)]\}$

(9) says that every minimal situation in which John visits Mary can be extended to a larger situation in which John calls Mary before he visits her. Unfortunately, this proposal faces a problem Partee (1984) discusses: it predicts that a single event of John's calling Mary that precedes all events of John's visiting Mary is enough to make (8b) true because each minimal situation associated with the restrictive clause may be extended indefinitely until it incorporates the single event of John's phone call to Mary. This is clearly an incorrect prediction.

It turns out that problems associated with time are more pervasive than they appear at first. No proposal based upon minimal situations can handle the classical donkey sentence (8c), at least not straightforwardly. According to the standard situation-theoretic account, the domain of quantification for *usually* is the following set: $\{s \mid s$ is a minimal situation such that a farmer owns a donkey in s and $s \in C\}$. If we disregard C, this results in the wrong prediction about the truth condition for (8c). Note that the restrictive clause in (8c) is a stative sentence. It is usually assumed (e.g., Bennett and Partee 1972) that stative sentences can be defined in terms of the subinterval property as shown in (10a–b).

(10) a. ϕ is said to have the **subinterval property** iff for any interval t if ϕ is true at t, then ϕ is true at all the subintervals of t.
b. ϕ is a stative sentence iff it has the subinterval property.

Given this assumption, we are obliged to conclude that if there is an interval t at which a stative sentence ϕ is true then there are infinitely many sub-intervals of t at which ϕ is true. If we assume that time is dense, there is no minimal interval at which ϕ is true.[2] Given the mapping relations between intervals and situations posited above, we are obliged to conclude that there is no minimal situation in which ϕ is true. This is a problem for a theory based on minimal situations because it predicts that there is no minimal situation in which the restrictive clause is true. One obvious way out is to rely on the contextually salient situations indicated by C. That is, we can say in principle that the set of contextually salient situations C filters out situations that are too small and selects the right ones that correspond to maximal stretches of a man's having a donkey. However, (8c) is interpretable even when it is uttered out of context. When the context does not restrict the domain of quantification in any way, each minimal situation is presumably determined by the meaning of the restrictive clause alone. Therefore, the fact that a minimal situation in which the restrictive clause is true is non-existent in cases like (8c) significantly weakens the main claim made by the proposals based upon minimal situations.

2. A Proposal Based upon Maximal Situations

Previous situation-based proposals have thus failed to make empirically accurate predictions. However, the simplicity of their approach is very appealing. In many cases, quantificational adverbs simply quantify over times, and it would be nice if we could extend this basic function of these expressions to cover a wider range of cases. The proposal I will advance incorporates an important idea adopted in situation-theory-based proposals, namely that adverbial quantifiers quantify over situations. However, I make the following claims, which are in disagreement with the previous proposals made within a situation-based theory: (i) the domain of quantification for an adverbial quantifier cannot be determined in terms of minimal situations in which the *if*/*when* clause is true; (ii) the correct truth condition cannot be determined by allowing the original situation to be extended into a nuclear scope situation. We must set up the system in such a way that the domain of quantification consists of maximal situations of some sort so that actual or potential main-clause events can occur within them.

As a first step toward an improved proposal, let us clarify the relations between situations and spatio-temporal regions. Kratzer's (1989) situation theory is designed to account for what she refers to as the "lumping relation" between propositions. Assuming that Paula painted apples and bananas yesterday evening, Kratzer observes that the fact Paula painted a still life somehow "includes" the fact that she painted apples in the actual world. Put differently, whatever makes (11a) true in the actual world also makes (11b) true.

(11) a. Paula painted a still life.
b. Paula painted apples.

In Kratzer's terms, (11a) lumps (11b) in the actual world. Given this intuition about the lumping relation between (11a) and (11b), Kratzer's situation theory characterizes it as follows: the minimal situation in which (11a) is true includes the minimal situation in which (11b) is true.

In presenting her situation theory, Kratzer (1989) carefully notes that situations cannot be identified with spatio-temporal regions. She points out that if she is hungry and tired at the same time, the minimal space-time chunk in which she is hungry would also be the minimal space-time chunk in which she is tired. Therefore, if situations were just spatio-temporal regions, these two propositions would be expected to lump each other. However, this goes against our intuition. Therefore, Kratzer posits situations as primitive entities. However, the basic intuition about the lumping relation clearly comes from the temporal or spatial inclusion relation between two eventualities. For example, the intuition about lumping Kratzer discusses regarding (11a–b) concerns the temporal (and perhaps spatial) inclusion relation between the two "events" in question. Therefore, although two distinct situations may share the same spatio-temporal region, if two situations are ordered via the "part of" relation $\leq$, we can assume that this is replicated in the temporal domain or in the spatial domain. Given these assumptions, I propose the following. For the purpose of this paper, let us assume that the model contains a set of spaces, each element of which is a set of spatial points that are "connected." On this assumption, the intuitive notion of "spatial sub-part of" can be encoded in terms of the subset relation between two spaces. We posit the function π from situations to spaces, which intuitively indicates the spatial trace of a situation. Then we posit the following mapping relation between situations and spatio-temporal regions that they occupy.

(12) Functions from situations to times and spaces:
For any situations s and s', if $s<s'$ then (i) $\tau(s)\subset\tau(s')$ and $\pi(s)\subset\pi(s')$, or (ii) $\tau(s)\subset\tau(s')$ and $\pi(s)=\pi(s')$, or (iii) $\tau(s)=\tau(s')$ and $\pi(s)\subset\pi(s')$.
Note: "τ" is a function from situation to intervals; π is a function from situations to spaces. "$\subset$" indicates proper subset.

(12) encodes the aforementioned idea, namely that if a situation *s* is included in a situation *s′*, then this is replicated in the temporal domain or in the spatial domain (or both). This means that the following possibilities are disallowed: (i) $s<s'$ and $\tau(s')\subset\tau(s)$; (ii) $s<s'$ and $\pi(s')\subset\pi(s)$. I think these assumptions are intuitive and reasonable. In the tradition of temporal semantics, we say that the proposition *p* is true at an interval *t* when the time slice *t* is just enough to support the truth of *p*. The idea is different from the minimal interval at which *p* is true. For example, if John is in his room from 10 to 11, then (13) is assumed to be true at every subinterval of $\{t \mid 10 \leq t \leq 11\}$.

(13) John is in his room.

Although a similar notion in the spatial domain is not commonly discussed in the literature, we can assume that the same technical notion also applies to the case of space. That is, I assume that a proposition is true "at" a space and can also be true "in" a space.

With this preliminary discussion in mind, we can now characterize the concept of "truth at a situation" as in (14).

(14) "Truth at a time and at a space" is a primitive notion related to "truth in a situation" in the following way: For any proposition *p* and for any situation *s*, if *p* is true at $\tau(s)$ and at $\pi(s)$, we say ***p* is true at *s*** and *p* is true in all situations *s′* such that $s \leq s'$.

The concept of "truth of some proposition *p* at a situation" is not the same as the concept of "minimal situation in which *p* is true." For example, if John stays in his room from 10 to 11, then (13) is true at a situation *s* such that $\tau(s)$ equals this one hour interval. However, this is not a minimal interval at which (13) is true because it is a stative sentence and has the subinterval property. Put informally, the main ideas contained in our proposal can be stated as in (15).

(15) Our proposal: (i) On the assumption that an adverb of quantification is a quantifier over situations, the situations with respect to which the restrictive clause is evaluated must be the same as those with respect to which the nuclear scope is evaluated. (ii) The domain of quantification for the adverbial quantifier *always* in a sentence of the form ***if p, then always q*** is the set of maximal situations in which *p* obtains and throughout which *q*'s being true is conceivable. (iii) Unbound pronouns are always interpreted as if they are indefinite descriptions.

It is arguable that the right notion is neither "minimal situation" nor "maximal situation." That is, an adverbial quantifier quantifies over a set of situations such that the size of each such situation totally depends upon the context of use. However, as mentioned earlier some sentences that involve an adverb of quantification are uttered out of context and yet interpretable. This means that we somehow determine the "counting units" correctly from the content of the sentence alone. I argue that the correct counting units are characterized as maximal situations in which the adverbial clause is true and throughout which the truth of the matrix clause is conceivable.

In order to interpret unbound variables as disguised indefinite descriptions, I posit the following rules.

(16) a. Assign a numerical index to each NP.
b. Adjoin each non-pronominal NP to the minimal S that contains it.
c. Copy the restrictive clause to the nuclear scope. Schematically, any sentence of the form δ*, if/when* α*, then* β (where δ is an adverb of quantification) converts into δ*, if* α*, then [*α *and* β*]*.
d. Existentially close both the restrictive clause and the nuclear scope.

This proposal is based upon a preliminary analysis presented by Chierchia (1992), who refers it to Heim (personal communication).[3, 4] We shall see that the rules (16a–d) make the right predictions with regard to the examples we considered so far. Our implementation is different from Chierchia's in that it is situation-based and all indefinite NPs are existentially quantifying. In Chierchia's formulation, some indefinite NPs are singled out by the rule of topic selection and get bound by an adverbial quantifier. It is not clear how time is dealt with in Chierchia's (1992) proposal. Since an adverbial quantifier is a selective quantifier for Chierchia, it may or may not bind a time variable that occurs in the restrictive clause. Either way, we will encounter a problem. If a time variable is caught by the quantifier, we run into the problem pointed out above. That is, as soon as we find one instantiation of the time variable that makes the restrictive clause true, there are an infinite number of them. On the other hand, if a time variable is not caught by the quantifier, then it is caught by the existential quantifier. This also gives us the wrong result. For example, if one and the same woman got pregnant twice, these two pregnancies would not count as two counting units with regard to (17).

(17) If a woman gets pregnant, she usually sees a doctor immediately.

Thus, we must deal with the problem associated with time anyway, and I believe that our proposal is a step in the right direction.

Thus, we adopt (16) to account for the semantics of donkey pronouns. On the basis of (16), any sentence of the form (18a) is transformed into a structure given in (18b).[5]

(18) a. If *p*, then always *q*.
b. always, if $\exists$[*p*], then $\exists$[*p and q*]

(18b) is not enough to predict the right truth conditions for (18a). To obtain the right domain of quantification for *always* (and other adverbial quantifiers), (18b) is further modified as in (19a), which yields the truth conditions described informally in (19b).

(19) a. always$_s$, if *s* is a maximal situation such that $\exists$[*p*] in *s* & $\forall s_1[s_1 \leq s \rightarrow [\Diamond\, [\exists[p\ and\ q] \text{ at } s_1]]]$ & $s \in$ C, then $\exists$[*p and q*] in *s*
Note: "$\Diamond$ *p*" reads 'it is conceivable that *p*.'
b. $\{s \mid \exists[p]$ is true in *s* and *s* is a maximal situation such that at any sub-situation of *s* it is conceivable that $\exists$[*p and q*] is true and $s \in C\}$ $\subseteq \{s \mid \exists[p\ and\ q]$ is true in $s\}$

The semantics of $\Diamond$ is not explicitly provided here, and we will discuss it below.

Armed with the proposal just presented, we shall re-examine (2), repeated here as (20).

(20) If a woman owns a cat, she is usually happy.

(20) is transformed as in (21).

(21) a. If a $woman_1$ owns a cat_2, she_1 is usually happy.

b. usually, if $[_S[_{NP}$ a $woman]_1[_S[_{NP}$ a $cat]_2[_S$ e_1 owns $e_2]]]$, $[_S[_{NP}$ a $woman]_1[_S[_{NP}$ a $cat_2][_S$ e_1 owns $e_2]]]$ and she_1 is happy

c. usually, if $\exists_{1,2}[_S[_{NP}$ a $woman]_1[_S[_{NP}$ a $cat_2][_S$ e_1 owns $e_2]]]$, $\exists_{1,2}[[_S[_{NP}$ a $woman]_1[_S[_{NP}$ a $cat]_2[_S$ e_1 owns $e_2]]]$ and she_1 is happy]

d. $usually_s$, if $\exists_{1,2}[_S[_{NP}$ a $woman]_1[_S[_{NP}$ a $cat]_2[_S$ e_1 owns $e_2]]]$ in s & $\forall s_1[s_1 \leq s \rightarrow [\Diamond[\exists_{1,2}[[_S[_{NP}$ a $woman]_1[_S[_{NP}$ a $cat]_2[_S$ e_1 owns $e_2]]]$ and she_1 is happy] at $s_1]]]$ & $s \in C$, $\exists_{1,2}[[_S[_{NP}$ a $woman]_1[_S[_{NP}$ a $cat]_2[_S$ e_1 owns $e_2]]]$ and she_1 is happy] in s

On the basis of (21d), the domain of quantification for *usually* is obtained as follows: {*s* | a woman owns a cat in *s* and *s* is a maximal situation such that at any sub-situation of *s* it is conceivable that a woman who owns a cat is happy and $s \in C$}. In this case, it seems reasonable to use the set of maximal situations at which a woman owns a cat as the domain of quantification. If the same woman owns a cat at two discontinuous situations (i.e., at different intervals), we must evaluate these situations separately. This possibility is usually not considered in conjunction with this example, but this is in fact the right empirical generalization.

Let us see how (16a–c) apply to example (3b), repeated here as (22).

(22) If a man has a quarter in his pocket, he usually puts it in the parking meter.

(23) a. if [a $man]_1$ has [a $quarter]_2$ in his_1 pocket, he_1 usually puts it_2 in the parking meter.

b. usually, if $[_S[$a $man]_1[_S[$a $quarter]_2[_S$ e_1 has e_2 in his_1 pocket]]], $[_S[$a $man]_1[_S[$a $quarter]_2[_S$ e_1 has e_2 in his_1 pocket]]] and he_1 puts it_2 in the parking meter

c. usually, if $\exists_{1,2}[_S[$a $man]_1[_S[$a $quarter]_2[_S$ e_1 has e_2 in his_1 pocket]]], $\exists_{1,2}[[_S[$a $man]_1[_S[$a $quarter]_2[_S$ e_1 has e_2 in his_1 pocket]]] and he_1 puts it_2 in the parking meter]

d. $usually_s$, if s is a maximal situation such that $\exists_{1,2}[_S[$a $man]_1[_S[$a $quarter]_2[_S$ e_1 has e_2 in his_1 pocket]]] in s & $\forall s_1[s_1 \leq s \rightarrow \Diamond[[\exists_{1,2}[[_S[$a $man]_1[_S[$a $quarter]_2[_S$ e_1 has e_2 in his_1 pocket]]] and he_1 puts it_2 in the parking meter]] at $s_1]]$ & $s \in C$, $\exists_{1,2}[_S[$a $man]_1[_S[$a $quarter]_2[_S$ e_1 has e_2 in his_1 pocket]]] and he_1 puts it_2 in the parking meter in s

According to (23d), (22) receives the following interpretation: most maximal situations in which a man has a quarter and throughout which it is conceivable that a man who has a quarter puts a quarter he has in the parking meter are situations in which a man who has a quarter puts a quarter he has in the parking meter. On this proposal, we can represent our intuition about how to find the domain of quantification in terms of maximal situations. For example, with regard to times, we can easily identify maximal intervals in terms of whether some person is at the parking meter continuously. The idea is that if a situation does not contain a person who has a quarter standing near the parking meter, we assume that it is not conceivable that someone puts a quarter in the parking meter in this situation. This enables us to do justice to our intuition that in (3b) *usually* quantifies over maximal situations *s* throughout which a man who has a quarter in his pocket stands near the parking meter.

Consider now (7), repeated here as (24).

(24) If a man has the same name as another man, he usually avoids addressing him by name.

It is syntactically analyzed as in (25).

(25) a. if [a man]$_1$ has the same name as [another man]$_2$, he$_1$ usually avoids addressing him$_2$ by name
b. usually, if [$_S$[a man]$_1$[$_S$[another man]$_2$[$_S$ e$_1$ has the same name as e$_2$]]], [$_S$[a man]$_1$[$_S$[another man]$_2$[$_S$ e$_1$ has the same name as e$_2$]]] and he$_1$ avoids addressing him$_2$ by name
c. usually, if $\exists_{1,2}$[$_S$[a man]$_1$[$_S$[another man]$_2$[$_S$ e$_1$ has the same name as e$_2$]]], $\exists_{1,2}$[[$_S$[a man]$_1$[$_S$[another man]$_2$[$_S$ e$_1$ has the same name as e$_2$]]] and he$_1$ avoids addressing him$_2$ by name]
d. usually, if *s* is a maximal situation such that $\exists_{1,2}$[$_S$[a man]$_1$[$_S$[another man]$_2$[$_S$ e$_1$ has the same name as e$_2$]]] in *s* & $\forall s_1[s_1 \leq s \rightarrow \Diamond$ [[$\exists_{1,2}$[[$_S$[a man]$_1$[$_S$[another man]$_2$[$_S$ e$_1$ has the same name as e$_2$]]] and he$_1$ avoids addressing him$_2$ by name]] at s_1]] & $s \in$ C, $\exists_{1,2}$[[$_S$[a man]$_1$[$_S$[another man]$_2$[$_S$ e$_1$ has the same name as e$_2$]]] and he$_1$ avoids addressing him$_2$ by name] in *s*

On the basis of (25d), one can arrive at the following truth conditions for the sentence (24): most maximal situations in which a man has the same name as another man and throughout which it is conceivable that a man *x* who has the same name as another man *y* avoids addressing *y* by name are also situations in which a man *x* who has the same name as another man *y* avoids addressing *y* by name. The domain of quantification in this case consists of maximal situations throughout which two men have the same name and they know each other because in such situations it is conceivable that they avoid addressing each other by name.

Let us now consider some complex and crucial examples. (8a–c) are repeated here as (26a–c).

(26) a. If a woman buys a sage plant here, she usually buys eight others along with it.
b. Before John visits Mary, he always calls her.
c. If/When a farmer owns a donkey, he usually beats it.

Our proposal analyzes (26a) as in (27).

(27) a. usually, if $\exists_{1,2}[_S[$a woman$]_1[_S[$a sage plant$]_2[_S\ e_1$ buys e_2 here]]], $\exists_{1,2}[[_S[$a woman$]_1[_S[$a sage plant$]_2[_S\ e_1$ buys e_2 here]]] and she_1 buys eight others along with it_2]

b. usually_s, if *s* is a maximal situation such that $\exists_{1,2}[_S[$a woman$]_1[_S[$a sage plant$]_2[_S\ e_1$ buys e_2 here]]] in *s* & $\forall s_1[s_1 \leq s \rightarrow \Diamond[[\exists_{1,2}[[_S[$a woman$]_1[_S[$a sage plant$]_2[_S\ e_1$ buys e_2 here]]] and she_1 buys eight others along with it_2]] at s_1]] & $s \in$ C, then $\exists_{1,2}[[_S[$a woman$]_1[_S[$a sage plant$]_2[_S\ e_1$ buys e_2 here]]] and she_1 buys eight others along with it_2] in *s*

(27b) receives the following interpretation: most maximal situations in which a woman buys a sage plant here and throughout which it is conceivable that a woman buys some sage plant *x* here and buys eight others along with *x* are situations in which a woman buys some sage plant *z* here and also buys eight others along with *z*. This provides the right truth condition for (26a).

(26b) is an example that makes a different point. As pointed out earlier, previous situation-based proposals allow for the possibility that each restrictive clause situation is expanded into a consequent situation, and this yields the wrong result. In our proposal, each counting unit is determined in part by the main clause, and it is used to evaluate the nuclear scope of an adverbial quantifier. This makes the right predictions. I assume here that a *before*-clause is used to characterize situations that are located immediately before a situation at which the *before*-clause is true. The domain of quantification for *always* is the following set of situations: {*s* | John visits Mary immediately before *s* and *s* is a maximal situation such that at any sub-situation of *s* it is conceivable that John calls Mary before he visits her}. Thus, (26b) is true iff {*s* | John visits Mary immediately before *s* and *s* is a maximal situation such that at any sub-situation of *s* it is conceivable that John calls Mary before he visits her and $s \in C$} is a subset of {*s* | (John visits Mary immediately before *s* and) John calls Mary in *s*}.

Lastly, let us discuss how to characterize the concept of “conceivably true,” which is admittedly a fuzzy concept. We are talking about some type of possibility here, and I offer the characterization in (28) as a first approximation.

(28) For any situation *s*, $\Diamond\ [\phi$ at $s]$ is true iff there is a proposition ψ such that the truth of ψ significantly increases the chances of ϕ’s being true and ψ is true at *s*.

The idea is that any situation *s* that could be used as a “counting unit” is a maximal *s* such that some relevant proposition is true throughout *s*. For example, with regard to (22) we can use a maximal situation throughout which (29) is true.

(29) A man is standing in front of the parking meter with a quarter in his pocket

It seems natural to assume that the truth of this proposition significantly increases the chances of satisfying the condition given in the nuclear scope. Although this characterization is still very informal and rough, I hope it helps to make my idea clear to the reader.

3. Remaining Problems and Issues

It has been pointed out in the literature that examples like (30) (Heim 1990) receive "unselective binding" readings. In fact, it is difficult to interpret (30) in any other way.

(30) Most people who owned a slave owned his children and grandchildren too.

I believe that this type of reading is not an independent interpretation assigned to the sentence by the semantic component but is forced upon us by some pragmatic factors. Our proposal only assigns a weaker interpretation to (30): Most people who own a slave owned the children and grandchildren of a slave they owned. I contend that this is in fact the only interpretation that (30) receives. Since it is very odd to assume that one owns several slaves but does not own the children and grandchildren of all of them, one tends to "assign" an unselective reading to (30). To see that this view is plausible, consider (31), which has the same structure as (30) in the relevant respects.

(31) Most people who use a credit card for purchases use it for cash advances too.

(31) does not have an "unselective" interpretation, at least not obligatorily. The most natural interpretation of (31) is the reading predicted by our proposal. That is, it is enough for someone to use a credit card for purchases and to use a different credit card for cash advances to satisfy the condition described by the sentence. Thus, I think we can conclude that the weaker interpretation is in fact the only interpretation available to unbound pronouns linked to indefinite NPs.

I believe that the main idea incorporated in our proposal can be recast in terms of a different framework. For example, it should be possible to reinterpret situations in terms of tuples that involve (at least) times, spaces, and objects. However, the central claims made in this paper are valid all the same because any framework must deal with time. That is, the claims made in this paper regarding situations translates into the following claims about times: (i) the domain of quantification for an adverbial quantifier should be determined in terms of maximal intervals, rather than minimal intervals; (ii) each interval that serves as a "counting unit" for an adverbial quantifier may not be extended when the nuclear scope is evaluated.

Endnotes

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[1] Obviously, we can let the context filter out those situations that are too small to serve as counting units for *usually*, but there is no principled way of predicting the right interpretation for any given case.

[2] Time is dense iff for any two distinct times t_1 and t_2 such that $t_1 <_t t_2$, there is a time t_3 such that $t_1 <_t t_3 <_t t_2$, where $<_t$ is used to indicate strict temporal precedence.
[3] Chierchia's (1992) official proposal is couched in a dynamic semantic system and differs from the preliminary proposal considered here.
[4] Kratzer (1988) shows that this analysis can be seen as the E-type analysis of pronouns coupled with the Heimian proposal about definite descriptions.
[5] Adverbial quantifiers are preposed to create a tripartite structure.

Bibliography

Bäuerle, Rainer and Urs Egli (1985) "Anapher, Nominalphrase und Eselssätze," Papier 105 des Sonderforschungsbereichs 99, Universität Konstanz.

Berman, Steve (1987) "Situation-based Semantics for Adverbs of Quantification," in J. Blevins and A. Vainikka (eds.), *University of Massachusetts Occasional Papers* **12**, University of Massachusetts, Amherst.

Bennett, Michael and Barbara Partee. (1972) 'Toward the Logic of Tense and Aspect in English'. Distributed by Indiana University Linguistics Club, Bloomington.

Chierchia, Gennaro (1992) "Anaphora and Dynamic Binding," *Linguistics and Philosophy* **15**, 111–183.

Heim, Irene (1982) *The Semantics of Definite and Indefinite Noun Phrases*, Ph.D. dissertation, University of Massachusetts, Amherst.

Heim, Irene (1990) "E-type Pronouns and Donkey Anaphora," *Linguistics and Philosophy* **13**, 137–177.

Kamp, Hans (1981) "A Theory of Truth and Semantic Representation," in J. Groenendijk et al. (eds.), *Truth, Interpretation and Information*, Foris, Dordrecht.

Kadmon, Nirit (1987) On Unique and Non-unique Reference and Asymmetric Quantification, Ph.D. dissertation, University of Massachusetts, Amherst.

Kratzer, Angelika (1988) "Stage-Level and Individual-Level Predicates ," in M. Krifka (ed.), Genericity in Natural Language, 247–284. SNS-Bericht 88-42, University of Tübingen.

Kratzer, Angelika (1989) "An Investigation of the Lumps of Thought," *Linguistics and Philosophy* **12**, 607–653.

Lewis, David (1975) "Adverbs of quantification," in Ed. Keenan (ed.), *Formal Semantics of Natural Language*, Cambridge University Press, Cambridge.

Montague, Richard. (1973) 'The Proper Treatment of Quantification in Ordinary English', in Jaakko Hintikka, J. M. E. Moravcsik and Patrick Suppes (eds.), *Approaches to Natural Language*, *Proceedings of the 1970 Stanford Workshop on Grammar and Semantics*, D. Reidel, Dordrecht.

Partee, Barbara (1984) "Nominal and Temporal Anaphora," *Linguistics and Philosophy* **7**, 243–286.

Schubert, Lenhart K. and Francis J. Pelletier (1989) "Generically Speaking, or, Using Discourse Representation Theory to Interpret Generics," in Gennaro Chierchia, et al. (eds.), *Properties, Types and Meaning, Volume II: Semantic Issues*, Kluwer, Dordrecht.

von Fintel, Kai (1994) *Restrictions on Quantifier Domains*, Ph.D. dissertation, University of Massachusetts, Amherst.

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