North East Linguistics Society

Volume 14 *Proceedings of NELS 14* Article 5

1984

Configurational Notions in Discourse Representation Theory

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1. Introduction

Recent work by Hans Kamp and others has been devoted to the construction of a new approach to natural language semantics: discourse representation theory. This approach has already provided a number of interesting results in connection with some of the hardest outstanding problems in the domain of nominal and temporal anaphora and it promises to do much more in connection with other fundamental issues such as deixis, intensionality, and belief.

Kamp's discourse representation theory is based on truth conditional (model theoretic) semantics, like Montague grammar (MG). As in MG, a model theoretic interpretation for a fragment of English is carried on indirectly, by mapping English to intermediate structures which are in turn associated with model theoretic objects. In Montague's approach, the intermediate level is the formal language of Intensional Logic (IL). Kamp replaces this level with entities of a novel kind: DRSs (discourse representation structures). DRSs are said to be representations of how the world ought to look on the basis of what is said. An aspect that the two theories have in common is that the intermediate level provides a place where quantifier scope and anaphoric relations are overtly and unambiguously represented.

One place where the two theories seem to diverge is the role of the internal "syntax" of the intermediate structures. In many versions of MG, the syntactic configurations of the intermediate logical language are said to play no non-dispensable role. In

Kamp's theory, on the other hand, appeal is made to a notion of accessibility in characterizing possible anaphoric realations. Accessibility is defined in terms of configurational properties of DRSs. If this is the best possible theory of anaphora, then the internal geometry of DRSs ought to be regarded as a crucial and indispensable component of natural language semantics.

The main point of this paper is that accessibility, contrary to appearance, can be dispensed with in Kamp's theory and that configurationality in this sense does not represent a central point of departure of Kamp's approach from Montague's. A byproduct of our argument is that there is no theoretical or empirical difference between Kamp's notion of discourse referent (or "reference marker") and the notion of variable which is familiar from Tarskian, satisfaction based semantics. This point is also made in Heim(1982), though not directly in the context of DRS theory. Partee(1983b) expresses reservations about whether it is appropriate to describe reference markers in DRS theory as variables.

Let us begin by sketching briefly the basics of Kamp's approach. A discourse representation (DR) consists of a set of reference markers and a set of conditions. For instance, (1b) would be the discourse representation associated with (1a).

(1) a. A man jogs

b.

x. man(x)
x jogs

c. $\exists x[\text{man}(x) \wedge \text{jogs}(x)]$

An algorithm associates DRs, and more generally the more complex structures called discourse representation structures (DRSs), with syntactic trees. For example, it is the indefinite NP a man that prompts the introduction of a discourse referent x in (1b). A recursive definition specifies the conditions under which DRSs can properly be embedded into a model. The recursion is defined on the structure of DRSs. For instance, (1b) is embeddable in a model M iff we can find a function f that maps the marker x into the universe of discourse in such a way that f(x) is a man and f(x) jogs in the model. A sentence is then said to be true in a model M iff there exists a proper embedding of the corresponding DRS into M. Thus (1b) turns out to have the same truth conditions as (1c).

To express the truth conditions associated with conditionals and universally quantified NPs, the more complex DRS representations, which involve structured sets of DRs, are required. An example is given in (2).

(2) a. If a man owns a donkey, he beats it.

b. m_0: [If a man owns a donkey, he beats it.]

⇓

m_1: [x. y.
a man owns a donkey
x owns a donkey
man(x)
x owns y   donkey(y)] ⇒ m_2: [x beats y]

c. Every man who owns a donkey beats it

d. m_0: [Every man who owns a donkey beats it]

⇓

m_1: [x. y.
x owns a donkey
man(x)
x owns y   donkey(y)] ⇒ m_2: [x beats y]

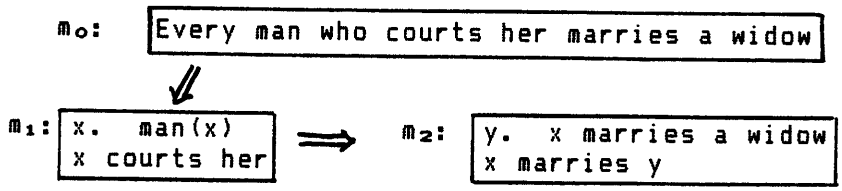
Kamp assumes that the DRs (or "boxes") are ordered in the way indicated by the arrows; the ordering is justified by the role it plays in the processing of pronouns by the translation algorithm.

The embedding conditions for conditionals and universals are the same, for their DRS representations are the same. m_0 in (2) will be embeddable iff every function which properly embeds the antecedent m_1 can be extended to a function which properly embeds consequent m_2. This way of dealing with conditionals and universals not only gives the right truth conditions for the simple cases but, coupled with the independently motivated treatment of indefinites makes the donkey anaphora problem fall into place, as (2) indicates. Indefinites trigger the introduction of a discourse referent in the DRs where they are processed. This discourse referent does not have an intrinsic quantificational force; quantification is built into the embedding conditions for DRSs. An indefinite will turn out to have a universal force in the antecedent of a conditional and an existential force elsewhere. The non-quantificational character of indefinites is also a feature of Heim's analysis of these and related phenomena (Heim(1982)).

A crucial aspect of Kamp's theory is the way pronouns are processed. Simplifying somewhat, we can say that the central idea is that discourse referents corresponding to pronouns must be equated to or identified with referents that are already available, either because they are already present in the DRS, or because they are, as it were, prompted by a deictic act. However, not any reference marker in a DRS, Kamp argues, is a possible antecedent for a pronoun. Only those occuring in a <u>superordinate</u> box can be: pronouns, in other words, can not look down. As support for this claim, Kamp offers evidence such as that in (3). The readings of (3a) and (3c) indicated by the arrows in (3b) and (3d) are impossible; in the theory, this follows from the fact that the antecedent is not superordinate to the pronoun, where this relation is that indicated by the arrows.[2]

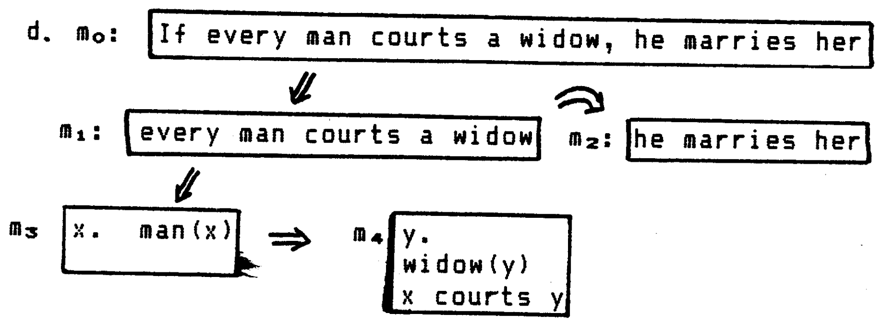
(3)a. Every man who courts her marries a widow

b.



c. If every man courts a widow, he marries her

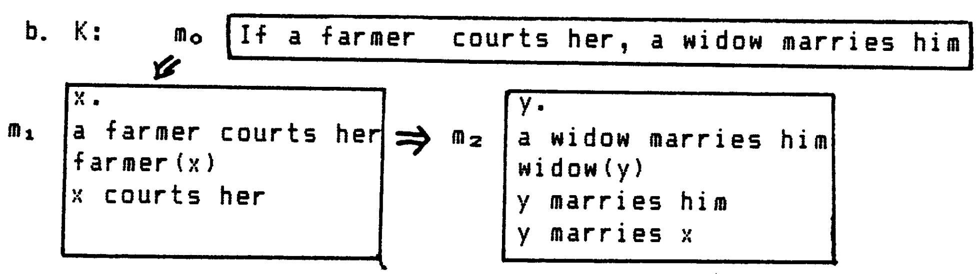
d.



So the idea seems to be the following. The representation of certain constructions (including at least universals and conditionals) involves the creation of DRSs which have internal articulation; the conditional requires a box for the antecedent and a box for the consequent. This articulation provides the basis for establishing a notion of subordination among DRs. However, Kamp's presentation suggests that the internal structure of DRSs does not automatically determine the subordination relation, although it provides a basis for it. He for instance discusses examples like the one in (4), which is analogous to (3a).

(4)a. If a $farmer_k$ courts her_i, a $widow_i$ marries him_k

b. K:



(4) on the reading indicated by the coindexing is bad.

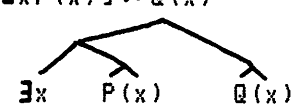
Thus, if we want to maintain that it is bad for the same reason that (3c) is, namely that pronouns can only look upwards, we have to say that the consequent is subordinate to the antecedent, but not vice versa. This seems to be a matter of stipulation. The construction of DRSs must be accompanied by a specification of what is subordinate to what. Then we can use subordination to state a domain condition on anaphora. Kamp implements this domain condition by building it into the DR-construction rule which processes pronouns; a pronoun must be mapped to a reference marker which is equated with a superordinate reference marker. In this sense, Kamp's approach would seem to be crucially geometrical, where the relevant geometry is provided by the syntax of discourse representations.

2. Truth Conditions and Compositionality

At this point, however, a question might and we think should be raised. DRSs are provided with conditions of embeddability into models, a close analogue of truth conditions. Typically, by associating truth conditions to sentences, we automatically get a definition of scope. The specification of truth conditions has to recur on the way sentences are put together and is thus sensitive to syntactic configurations. In particular, if we do semantics indirectly, by mapping English into structures for which a definition of truth is provided, this definition will obviously take the form of a function on these structures, and will thus be sensitive to them. But no separate stipulation about what can bind what is needed. Let us illustrate this with a example, a first order formula:

(5)a $[\exists x P(x)] \wedge Q(x)$ (with an arrow drawn from the second x to $\exists x$)

b



(5b) displays the syntactic structure of (5a). Given the standard Tarskian semantics for first order logic, the binding relation indicated by the arrow is impossible; the second occurrence of x is free in (5a). We could describe this by saying that such a relation is impossible because the scope of a quantifier is what it c-commands. But this is a matter of description, not principle. The impossibility of such bindings follows from the recursive definition of truth, and the structure over which this recursion is defined. In other words, if you are willing to concede that meaning is related to truth, then a number of things about meaning and in particular about scope will follow.

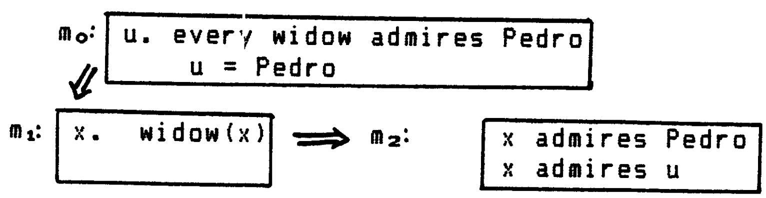
Why then are stipulations fully parallel to the one discussed in connection with (5) required in DRS theory? In fact, it turns out that they are not. We can describe the behavior of pronouns by saying that they can not be associated with a non-superordinate antecedent. But this is not an independent axiom on possible bindings any more than saying that a variable in a first order formula like (5) must be c-commanded by a quantifier in order to be bound by it is an independent axiom. The subordination relation need not be stipulated, since it is implicit in the embeddability definition.

Actually, there is a technical problem with the only fully explicit definition of embeddability for DRSs thus far available (Kamp(1981)) that clouds issues somewhat. Consider the truth condition for conditionals and universals, where U_m is the set of discourse referents of a DR m, and U_M is the universe of the model M:

(6) Suppose φ is an occurence of a conditional or universal sentence in a DRS K. Then K will contain a unique pair of boxes $\langle m_1, m_2 \rangle$ which represents φ. φ is true in M under f, given K, relative to g iff every map h from U_{m_1} into U_M which is compatible with $g \cup f$, and which verifies m_1 in M given K relative to $g \cup f$, can be extended to a function k from U_{m_2} into U_M which verifies m_2 in M given K relative to $g \cup f$.

The problem we detect in (6) can be illustrated by DRSs such as (7):

(7)



(6) requires the existence of certain functions k with domain U_{m_2}, which are to verify m_2. Since U_{m_2} is the empty set,[3] there is exactly one function with domain U_{m_2}, the empty function. According to the truth definition for atomic formulas, k verifies x admires u iff the pair $\langle k(x), k(u) \rangle$ is in the extension of admires. In the present case, this condition can not be evaluated, since neither x nor u is in the domain of k. Hence in any model, the DRS above has no truth value, or is false (depending on the interpretation of the defintion). Clearly Kamp intends that u and x be the domain of k. One way of achieving this, motivated by this example and others, is to make the the functions employed in the truth definition strictly cumulative. Our proposed modification is given in (8). The truth definition employs the set-theoretic notion S-extends given in (8a).

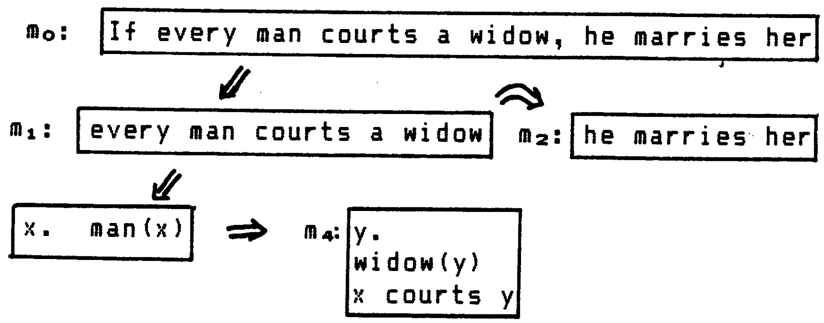
(8)a Let f,g: V --> A (partial), $S \subseteq V$. Then g S-extends f iff g extends f (i.e. $f \subseteq g$) and the domain of $g-f$ is S

b Let K be a DRS with maximal DR m_0. Then K is true with respect to d iff for some f which U_{m_0}-extends d, f verifies m_0.

c Let $\langle m_1, m_2 \rangle$ represent the conditional or universal φ
φ is true with respect to f (in M with respect to K) iff
$(\forall g)[g\ Um_1\text{-extends } f \text{ and } g \text{ verifies } m_1 \longrightarrow$
$(\exists h)[h\ Um_2\text{-extends } g \text{ and } h \text{ verifies } m_2]]$

Let us see how this works out in the problematic example (7). Suppose that the truth of (7) is evaluated with respect to the empty function, using this modified definition. According to (8b), the domain of a verifying function f for m_0 is to be {u}. According to (8c), the domain of a verifying function g for m_1, and of a verifying function h for m_2, is {u,x}. Hence u and x are in the domain of the verifying functions for h, as desired. Notice that we have dispensed with the second assignment function preceded by "relative to" in Kamp's definitions. This function, which is used to ensure that the embedding functions are consistent, would be redundant in our version.

We now return to Kamp's accessibility condition on discourse referents. (3d), repeated in (9), was a case where the accessibility condition on discourse referents was not satisfied.

(9)


Since m_3 is not superordinate to m_2, the discourse referent x should not be substituted for he in m_2, according to Kamp's DR construction rule for pronouns. Similarly, since m_4 is not superordinate to m_2, the discourse referent y should not be substituted for her in m_2. Suppose now that we ignore the restriction, allow x marries y to be added to to m_2, and evaluate the resulting DRS with respect to the empty function, using the modified truth condition. According to definition (8b), the domain for a verifying function for m_0 will be the empty set. According to definition (8c), the domains for verifying functions for m_2 and m must be the empty set as well. It follows that the truth value of x marries y with respect to verifying functions for m_2 examined by the recursion (there can only be one, the empty function), can not be determined. Hence the recursive truth definition blocks.

This confirms the expectation that the truth definition should induce a notion of scope according to which he is not in the scope of a man in (9). In this and other relevant cases, if a non-superordinate discourse referent is substituted for a pronoun, the truth definition will block.

3. Discourse Referents vs. Variables

Is this result an artifact of the way in which embeddability is defined, or worse, are we simply building a configurational condition into the mechanics of the truth definition? In our modification of Kamp's theory, certain discourse representation structures seem to be uninterpretable, independent of what the model is like. Isn't this an objectionable kind of semantic filtering? Regardless of the answer to this question, we think that the blocking effect is no accident. To show this, we provide a Tarski-style satisfaction condition for discourse representation structures. Kamp's definition, and our modification of it, employed partial embedding functions. Earlier we noted that in a Tarskian truth definition for first order logic, the value of a free variable in a formula is fixed by the assignment function, which is total. We would like to have a truth definition for DRSs which mimics this treatment of free variables.

The new truth definition, like the previous one, is based on thinking of the DR universe constructed by Kamp's translation algorithm as the set of quantified variables. In the cumulative partial functions approach, the function f with respect to which a DR m is to be evaluated was extended to include in its domain the set of quantified variables for m. In the total functions approach, the value of f on the set of quantified variables for m is allowed to vary. The modified definition given in (10) employs the notion of equivalence of two functions modulo a set. f is equivalent to g modulo S if they differ only on S.

(10)a Let $f,g: V \longrightarrow A$ (total), $S \subseteq V$. f is equivalent to g modulo S iff $(\forall x)[x \in V-S \longrightarrow f(x)=g(x)]$

b A DRS K is true in M with respect to f iff some g equivalent to f modulo Um_0 verifies m_0, where m_0 is the maximal box in K.

c f verifies a box m in M given K iff each unreduced formula (i.e. each atomic, conditional or universal formula) in m is true with respect to f

d A conditional or universal represented in K by the pair of boxes $\langle m_1,m_2\rangle$ is true with respect to f given K iff $(\forall g)$(g is equivalent to f modulo Um_1 and g verifies m_1 in m given K $\longrightarrow$ $(\exists h)$(h is equivalent to g modulo Um_2 and h verifies m_2))

Suppose (9) is evaluated with respect to an arbitrary function f. According to (10b), (9) is true wrt f iff some g equivalent to f modulo $\emptyset$ (the empty set) verifies m_0, i.e. iff f itself verifies m_0. By (10c), f verifies m_0 iff the conditional in it is true wrt f. The clause for conditionals (10d) then requires that for every function g equivalent to f modulo $\emptyset$ that verifies $\mathfrak{m}_1$, there exist an h equivalent to g modulo $\mathscr{X}$ that verifies $\mathfrak{m}_2$. Hence f = g = h. Hence the truth of $\mathfrak{m}_2$ will have to be evaluated with respect to f, the arbitrary function we began with. The sole value for x in $\mathfrak{m}_2$ considered by the recursion is f(x); the value of x is fixed by the assignment function, and is independent of values assigned to the occurrence of x in $\mathfrak{m}_3$.

This is of course perfectly general, and applies to all the relevant structural configurations. Furthermore it is not a matter of stipulation; it is the only way to get the truth conditions right. We thus see that the blocking effect obtained by using partial functions is not an artifact; when total functions are used, the blocking effect disappears, but still pronouns cannot be bound by NPs in a non-superordinate position.

The Tarskian truth definition for DRSs also underlines vividly the more than close connection between the notions 'reference marker' and 'variable'. In Heim's theory, indefinites are explicitly treated as variables. It seems that, on this point, Kamp's theory differs from Heim's only in notation. This of course does not imply that the two theories are notational variants.

Speaking of notation, it might be worthwhile to point out that it is quite straightforward to define a first order language, call it L_K, which can be used in the place of DRSs, we think without any loss of generality or intuitiveness. We provide a formulation of L_K in (11). The non-standard part of this language is the notation for universal quantification (11biii) and existential quantification (11biv). We use subscript variables written before a formula to represent Kamp's DR universes (i.e. the quantified variables). The interpretation of the language is a straightforward modification of (8) or (10). DRS construction rules can also be straightforwardly modified to yield rules that generate formulas of L_K.

(11)a basic symbols
- n-place predicates $R^i{}_k$, $P^i{}_k$, ...
- individual variables x_1, x_2, ...

b formation rules
- (i) If R is an n-place predicate and $a_1, \ldots; a_k$ are individual variables, then $R(a_1, \ldots, a_k)$ is a formula.
- (ii) If φ and ψ are formulas, then $\varphi \wedge \psi$ is a formula.
- (iii) If φ and ψ are formulas, and $a_1, \ldots, a_j$, $b_1, \ldots, b_k$ are variables, then ${}_{a_1} \ldots {}_{a_j}[\varphi]_{b_1} \ldots {}_{b_k}[\psi]$ is a formula.
- (iv) If φ is a formula, and $a_1, \ldots, a_k$ are variables, then ${}_{a_1} \ldots {}_{a_k}[\varphi]$ is a formula.
- (v) Note: ${}_{a_1} \ldots {}_{a_k}[\psi] = {}_{a_1}[a_1{=}a_1]\ {}_{a_1} \ldots {}_{a_k}[\psi]$

c Examples

(i) A man walks $_u[man(u) \wedge walk(u)]$

(ii) If Pedro owns a donkey, he beats it.

$_{u,v}[donkey(u) \wedge v=Pedro \wedge own(v,u)][beat(v,u)]$

4. Further issues and questions

Let us now try to sum up what we have been doing and point out several related open issues. What appears to be crucial about Kamp's theory is (a) the way indefinites, conditionals and universals are treated (which is similar to Heim's) and (b) the weakening of compositionality that (a) induces. The rule by rule constraint on the syntax-semantics map is, as it were, displaced to the level of DRSs, which are compositionally interpreted. What doesn't seem so crucial as far as we can see is the DRS notation, for it maps quite directly into a first order language like the one in (11). We conjecture that a characterization of logical consequence for DRSs and for L_K (based on the respective definitions of truth) would turn out to be equivalent. Furthermore no crucial difference is detectable between the two in the treatment of donkey anaphora.

What about the spirit of Kamp's enterprise? Are we betraying it by regarding DRSs as formal languages of a sort? On the face of Kamp's own words it may seem so, when he states that the representations he postulates are "similar in structure to the models familiar from model theoretic semantics" (Kamp 1981). How is the phrase "similar in structure" to be taken here? How, for instance, does it apply to complex DRSs like, say, (2b)? It is not obvious. Suppose that the real world is indeed a model for this DRS. What bit of the real world has the same structure as (2b)? It appears to us that DRSs can be regarded as pictures (or models) no more and no less than other more standard logical forms. They are languages designed to mimic the structure of the world which is relevant for various purposes. It is precisely this feature of logics that is exploited in various techniques of proof that show how to build models out of the language itself (e.g. Beth's tableaux or Henkin style completeness proofs). Thus where DR theory seems to depart more radically from classical MG is in the weakening of the rule by rule hypothesis, a route which is certainly worth pursuing, for it appears to give interesting results. It may well be that the notion of compositionality which Montague seems to have proposed is just not suited for natural languages (c.f. e.g. Partee (to appear a.) and references cited therein). Of course, once we drop the rule by rule hypothesis we have to replace it with something else. For instance, at some point or other one would like answers to questions like: what is a possible DR-construction rule? or: what is the meaning of NPs like _a man_ or _every man_ in a theory like Kamp's? These NPs are associated with particular DR-construction rules. But their meaning can not be taken to be simply some such rule. The embeddability conditions defined on DRSs must play a role. Yet, at the level where embedding conditions come into play, there is no single "constituent" that corresponds to every man, just like there is none in standard first order logic. So, as things stand now, on Kamp's approach it seems difficult to assess what the meaning of every man is going to be.

A further very important area of application of DR-theory is temporal discourse (Kamp(1982), Hinrichs(1981), Partee(to appear b.)). This is an extremely complex topic, and it is not our purpose to attempt to evaluate the DR theory of tense and aspect. We do think, however, that our points (the non-primitive character of the subordination relation, the equivalence of DR-notation and L_κ) hold also for DRSs representing tense, as they have been developed thus far. Let us try to sketch briefly our reasons for believing so. The basic idea underlying DRSs with tense is that propositions identify eventualities, i.e. events, processes, states and the like. Eventualities work as points of reference (i.e. determine reference times) in terms of which clauses are evaluated. The rules for constructing tensed DRSs instruct us as to how the eventualities that the discourse is about are ordered by precedence and overlap relations.

Thus temporal discourse will require the introduction of discourse referents corresponding to eventualities (and possibly to intervals; see Kamp(1982)). If we are right, there is no substantive empirical or theoretical difference between this kind of discourse referents and variables ranging over eventualities (or intervals, depending on the choice of primitives).

In (13) we give the tensed DRS associated by Hinrichs and Partee (she goes on to modify it) with the discourse (12). In (14) we give the easily predictable translation of (13) in L_κ. Truth (or embeddability) conditions for (13) or (14) are straightforward extensions of those already provided. e's are variables over events, and r's are variables over reference times. Reference times can be regarded as either intervals (Partee to appear b.) or events of some sort (Hinrichs 1981). The construction rules that process tenses and aspectual features prompt the introduction of reference times and their ordering with respect to events in terms of $<$ ('totally precedes') and $\subseteq$ ('is included in').

(12) Mary turned the corner. When John saw her, she crossed the street.

(13)

r_0 e_1 r_1 u e_2 r_2 v e_3 r_3 w

$e_1 < now$
$e_1 \subseteq r_0$
$e_1 < r_1$
$r_1 < now$
e_1: [v = the corner; u turn v]

u = Mary
$e_2 < now$
$r_2 < now$
$r_1 < r_2$
$e_2 \subseteq r_2$

e_2: [y see u]

y = John
$e_3 < now$
$r_3 < now$
$e_3 \subseteq r_2$
$e_3 < r_3$

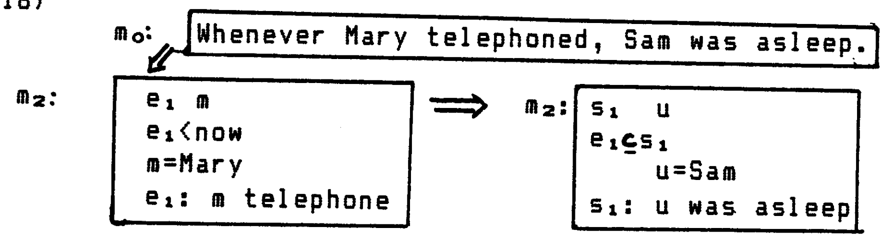
e_3: [w = the street; u cross v]

(14) $r_0,e_1,r_1,u,e_2,r_2,v,e_3,r_3,w[e_1<now \wedge e_1 \subseteq r_0 \wedge e_1<r_1 \wedge$
$r_1<now \wedge$ v=the-corner $\wedge$ turn$(u,v,e_1) \wedge$ u=Mary $\wedge e_2<now \wedge r_2<now$
$r_1<r_2 \wedge e_2 \subseteq r_2 \wedge$ see$(y,u,e_2) \wedge$ y=John $\wedge e_3<now \wedge$
$r_3<now \wedge e_3 \subseteq r_2 \wedge e_3<r_3 \wedge$ w=the-street $\wedge$ cross$(u,v,e_3)]$

In (16) we present Partee's DRS for (15), which displays a tense analogue of donkey anaphora. In (17) we provide the L_K translation of (16). Our argument concerning the non-configurational character of Kamp's theory applies here without modification.

(15) Whenever Mary telephoned, Sam was asleep.

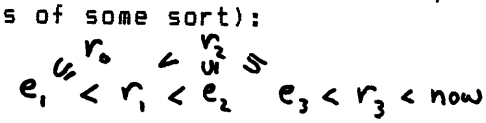
(16)



(17) $_{e_1,m}[e_1 < now \wedge m=Mary \wedge telephone(m,e_1)]_{s_1,u}[e_1 \subseteq s_1 \wedge u=Sam \wedge was\text{-}asleep(u,s_1)]$

Kamp has argued for the indispensability of DRSs in connection with the analysis of various temporal phenomena. One such phenomenon is the role of aspectual classes in determining the way we order eventualities in discourse. In this regard, Dowty(1982) has objected that aspectual classes of expressions cannot be used in constructing DRSs as Kamp proposes, for they are determined by compositional semantic properties of expressions, which in Kamp's theory can be accessed only after DRSs have been constructed. Dowty proposes an alternative principle of discourse construal that does not face this difficulty.

Another application of DR theory where Kamp suggests that their syntax plays a crucial role has to do with the analysis of contrasts such as that between simple past and imperfect in Romance. Although the issue is quite complex, let us try to present its essential aspects. Traditional grammars often point out that the imperfect tends to convey durativity, while the simple past conveys punctuality. Kamp argues that the relevant contrast cannot be a real world one: it is simply false that an event reported in the simple past has to be really punctual. He then proposes that it is possible to make precise the insight contained in traditional grammars along the following lines. A (tensed) DRS yields an event structure. For instance, the event structure associated with (13) could be diagrammed as follows (assuming, following Hinrichs, that reference times are also events of some sort):

(18) 

Event structures such as (18) can be mapped to time structures of instants by applying to them a construction due to Russell and Wiener, where instants are reconstructed as maximal sets of pairwise overlapping events. Kamp suggests that the constraint on simple past in Romance can be regarded as a constraint on the time structure associated (via the Russell-Wiener construction) with DRSs. In other words, take a temporal discourse which displays a (set of) imperfect - simple past contrasts, and associate with it a DRS. Take the event structure which such a DRS yields and turn it into a structure of instants. It is in the structure so obtained that sentences in the simple past have to be punctual (while in the model they need not be). This proposal is certainly very interesting and appealing. However, it does not appear to us that geometrical properties of DRSs play a crucial role, or that the DR-notation as such is crucial. It would seem that what is crucial is the partial character of the information that a discourse conveys. Any way of getting at this information would get at the same results. Thus we have no reason to believe that configurational notions should play a role in the analysis of this kind of problem.

In conclusion, Kamp's appeal to a subordination (or accessibility) relation in DR-theory can be dispensed with. It should not be taken as a primitive of the theory but is rather determined by the embedding (or truth) conditions that one needs anyhow. Furthermore the DR-notation would seem to be directly mappable into a first-order language without significant losses. The heart of Kamp's proposal seems to lie in the treatment of indefinites and conditionals, a treatment which apparently involves weakening the compositionality requirement which is typical of the MG tradition. Here it is of interest to note that the related approach to indefinites and anaphora of Heim(1982) also employs an intermediate level of logical form. Whether the departure from compositionality and the related absence of uniformity in NP translations really is an essential feature of these very successful theories of indefinites, quantification, and anaphora is a question which we will not attempt to answer here.

Footnotes

[1] The nucleus of this paper was a discussion in Hans Kamp's spring 1983 seminar at UMASS. We thank him and other participants. Barbara Partee and Jae Choe contributed comments and corrections on a draft. The work of the second author was supported by NSF grant IST 8314396.

[2] Possibly (3) has a reading where a widow has maximal scope. This is not the reading where an anaphoric link is claimed to be impossible.

[3] We might be wrong about this. Kamp gives two DRS construction algorithms. In the first algorithm but not the second and more formal one, the consequent box representing a universal or conditional is an extension of the antecedent box. If the first algorithm were used, U_{m2} in (7) would have x in its domain. For this to work in general, the domains of the boxes would have to be cumulative vertically as well as horizontally.

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