

playing, the very persistence and utility of such constructs makes it reasonable to entertain them seriously, in spite of the lack of precision with which hypotheses about them can be tested. I only trust that in the future a well worked-out theory of thematic roles will appear; what I have to say here will shed little light on this problem directly. I wish simply to assume them instead, and to consider their place in a grammar which has as one of its components a set of rules of semantic interpretation.

Given a formal semantic system of the sort presented in Montague (1974), there would seem little use for semantic roles in the process of assigning interpretations to sentences. The basic reason is that verbs (and other functors) are treated as n -place functions from (for example) NP denotations to $(n-1)$ -place functions. In order to assign interpretations in this respect, one need only know which NP to apply which function to, a matter that can be determined on the basis of lexical properties of the verb and formal information about sentence structure — syntactic configurations, case markers, prepositions, and so forth. There is no need for another level of information, represented by thematic roles, to assign functions and arguments appropriately. One could, if one so wished, put thematic roles into the system, but they would be essentially superfluous elements, without syntactic or semantic consequence, which could easily be dispensed with. On this view, the intuitions about thematic roles we all seem to have would be attributed to generalizations about the meanings of the verbs themselves, rather than to independent structural or semantic properties. In this sense thematic roles could be treated as epiphenomena, without any theoretically significant standing.

However, I would like to consider an alternative system which, by virtue of the way it is organized, requires precisely the kind of information that thematic roles provide. The type of system I will consider is an 'event-based' system of model-theoretic interpretation, inspired by the work of Whitehead (1920), Davidson (1967), Cresswell (1973), and Kamp (1979), though the more immediate influences have been the 'situation semantics' work of Barwise and Perry (1983) and the unlabeled work of Emmon Bach, extending back to 1976. While these sources present considerably diverging points of view, the unifying idea is that events or similar objects can be taken as basic entities of a model, or of reality, along with or instead of individuals. I wish to sketch briefly a general analysis of a limited class of English sentences presented in the spirit of these works. I will give some motivation, or at least a rationale, for doing things this way rather than in the functional way we find in Montague; I will then show the critical role that thematic roles play in such a system. I conclude with some remarks on the theoretical status of thematic roles and what they may tell us about the nature of semantic interpretation.

1. Advantages of an event-based system

Let us consider the hypothesis that a sentence like 'John kicked the ball' in some sense speaks of an event in which the appropriate thing or things happen. The chief formal determinant of what sort of event is being talked about is the central element of the sentence, the verb. It seems reasonable to think of verbs as denoting the same sort of thing as the (untensed) sentence built up around it in an endocentric manner. This general notion of the centrality of the verb is well grounded both in syntactic work and in semantics as well. For instance, in much recent and past work on aspect, or *Aktionsarten* (e.g. Dahl 1981; Dowty 1979), it is generally recognized that the verb is the most crucial determinant of the aspect of a sentence. 'John ran' is a process because 'run' is a process verb. However, additional elements are also widely recognized as contributing to verb aspect, such as direct objects and subjects, adverbs, and aspect markers in the auxiliary system (or on the verb itself). Thus, 'John ran a mile' is an event, and no longer a process, whereas 'John was running' is a state, and neither a process nor an event. Thus, though the verb has 'inherent' aspect, it would appear that verb phrases and sentences, too, have 'derived' aspect determined by the meanings of their parts. So, aspect would appear to be a property of all the levels built up around the central element of the verb.¹

Let us consider a model which has among its basic elements the members of a (denumerably infinite) set E, the set of *token* events (to include achievements and accomplishments), states, and processes, as well as tokens of whatever other aspectual categories there may be. A set of such tokens of the same aspectual type I am going to call an *eventuality*, following Bach (1977). I will throughout use examples, for the most part, from the class of events, though it should be understood that what I say of events is to hold of all members of the set E; eventualities will be referred to on occasion as types. I do not include among the members of E generic states, for reasons I discuss elsewhere (Carlson 1982). It should also be understood that among the members of E are not only actual events, etc., but all potential ones as well. Hence, E has already built into it a good deal of intensionality.

A verb like *kick* cannot be analyzed as denoting any particular token event in this class, for the simple reason that this same verb can be used to speak of different token events on different occasions, or in different sentences. The most straightforward thing to do is to treat a verb as denoting the characteristic function of some subset of E — an eventuality. Intuitively, the one denoted by *kick*, which we will designate with the expression primed — *kick'*, is the set of all possible events characterized

Thematic roles and their role in semantic interpretation*

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Abstract

The phenomenon of 'case relations' (Fillmore 1968), or 'thematic roles' (Jackendoff 1972) forms a persistent part of generative grammar and is a notion included in several contemporary syntactic theories. But from the standpoint of a system of semantic interpretation as exemplified by Montague (1974), thematic roles would appear to be entirely superfluous elements. In this paper I wish to sketch an alternative system of model-theoretic semantic interpretation which requires precisely the type of information thematic roles provide. Such a system takes events and similar objects as basic rather than derived elements of the model. I conclude by considering the status of thematic roles, whether they should be regarded as syntactic or semantic in nature. It is argued that they have an 'intermediate status' instead, and the paper concludes with a speculative account of what this 'intermediate status' might be.

0. Introduction

The notion that argument NPs in a sentence have semantic roles associated with them forms a persistent part of generative grammar. Perhaps the most widely known exposition of a syntactic theory based on this idea is to be found in Fillmore's 'Case for case' (Fillmore 1968). The basic hypotheses presented there (and elsewhere) have in the meantime been reinterpreted and considerably refined (e.g. Jackendoff 1972, based on Gruber 1965), and ultimately incorporated into more recent syntactic theories, such as that of Chomsky (1981), and Bresnan and Kaplan's lexical-functional grammar (Bresnan 1983), using the label *thematic roles*. Although there remains no generally accepted set of procedures for distinguishing among thematic roles, leaving open such questions as how many there are or what role a given NP in a given sentence may be

by 'some kicking going on'. (Ultimately, this may provide insufficiently rich structure for adequate interpretation, but it will do for the time.)

There will be various relationships between eventualities of varying degrees of interest. For instance, the eventuality *move'* will be a superset of *kick'*, but *kick'* and *pe'* will be disjoint sets, while *kick'* and *injure'* will have a non-null intersection, and so forth. More complex expressions, too, share such relations. *Kick hard'* will be a subset of *kick'*, as will *kick while singing a song and chewing on a toothpick'*. Likewise, *kick Rover'* will be a subset of *kick'* and *John kick Rover'* will be a subset of that.

Even given this minimal analysis, one can see certain potential advantages in taking untensed verbs and more complex expressions built up around them as denoting eventualities. For example, nominalizations of verbs and more complex expressions can be taken as denoting the eventuality directly, or in some cases a token event directly (or their individual correlates — see Chierchia 1984). So, for example, in (1) *kicking* can quite plausibly be analyzed as denoting (the property set of) an eventuality.

(1) *Kicking* is fun.

On the other hand, a token event of the appropriate type seems a reasonable denotation to assign the subject NP in (2).

(2) *Kicking* causes the plants to fall off the table.

Whether an event or an eventuality is denoted seems to be sensitive to the generic/nongeneric distinction; be that as it may, a model of the sort presented here allows for these nominalizations to denote quite straightforward elements, and to denote the same things the verbs denote (see Chierchia 1982 for discussion).

Probably the chief advantage, though, is that in nominalizations and in other constructions the omission of arguments does not require that extra semantic operations be defined to 'plug' the unbound argument positions, as is required under a functional analysis. *Kicking*, *kicking Bill*, and *John's kicking Bill* all denote eventualities; there is no necessity in treating them all as expressions of differing semantic types (if the vacant argument positions are left unbound), or in treating *kicking* and *kicking Bill* as requiring operations to bind the missing argument positions in order to obtain an appropriate interpretation.

One apparent disadvantage of such an analysis is that it gives no semantic account of why *kicked* by itself does not constitute an indicative English sentence. This line of analysis requires that the incompleteness be attributed to the syntax, or to some notion of subcategorization, however it is to be expressed. As I have not found very persuasive the attempts to

reduce subcategorization phenomena to facts about semantic interpretation, I do not regard this particular consequence as a difficulty with the type of analysis pursued here.

A consequence of some interest is that such an analysis presents a fairly straightforward means of accounting for relations between different verb forms that are problematic under a functional account. Consider, for the moment, the relationship between the transitive and intransitive versions of the verb *eat*.

- (3) a. John ate a sandwich.
b. John ate.

Fodor and Fodor (1980), Dowty (1978), and Bresnan (1983) relate these two senses of the verb by a lexical rule which has the effect of deleting the direct object from the verb's subcategorization frame. However, an additional operation is required of existentially quantifying over the object position in the intransitive version, effectively interpreting the intransitive *eat* as meaning 'eat something'.² The lexical analysis of Bresnan accounts for the 'narrow-scope' interpretation of this existential quantifier introduced by the lexical rule, a matter discussed at length in Fodor and Fodor (1980). However, Bresnan assumes a functional analysis of verbs, and as such must do something to avoid an analysis where the direct object position is interpreted as a free variable, certainly an incorrect analysis.

Under an event-based analysis, though, the existential binding becomes a superfluous operation; the existential import falls out from the meaning of the verb itself. Consider the denotation of *eat* to be the set of all events characterized by eating occurring, and then consider the subset of those events where 'John eat' occurs. In every one of those events there is going to be something or other than gets eaten. That is, simply put, the nature of eating. Hence, 'John eat' will have the same extension in the model as 'John eat something' — they will denote the same set of events. Thus, the version 'John eat something' will both entail and be entailed by 'John eat'. The apparent narrow-scope facts will also fall out from this analysis as a consequence of the system. Consider momentarily how a sentence like 'Everyone laughed' would be analyzed. It would not be a single event, but rather a set of events that would make such a sentence true. Thus, it is equivalent to a set of event-types 'x laughed' for each x in the domain. Now consider 'Everyone ate'. It will be a set of eventualities, each with a member in the real world, where each type is 'x eat' for each value of x in the domain. The event-type 'a eat' (where a is a value for x) will be a set of events containing various things that get eaten — it will NOT be the same thing eaten in each event in the eventuality. Similarly for 'b ate' and

so forth. If the truth conditions of 'everyone ate' are such that each eventuality has a member in the real world in the past, there is no necessity whatsoever in all the events in the world having the same things getting eaten.³ In fact, to gain this result would require additional apparatus. We are thus attributing the apparent existential quantification to the nature of what eating is (or, more formally, its interpretation in the model), and not to any binding operation in the semantics.

But there are other verbs with transitive and intransitive versions that appear plausibly related by a lexical rule of object deletion, which on Bresnan's account would require a different analysis. Consider the verb *kick*, and its transitive and intransitive counterparts.

- (4) a. The mule kicked something.
b. The mule kicked.

In this case, if we consider *kick* to denote the set of events characterized by some kicking going on, it is not necessary that in each one of those events there be something that gets kicked. Hence, (4b) does not entail (4a) (though [4a] does entail [4b]). On the type of account Bresnan and others have suggested, the relationship between the two forms of *eat* would have to be handled differently from the relationship between the two forms of *kick*, since *kick* in the intransitive sense does not appear to require an existentially bound direct object. An event-based system, though, will allow a lexical operation of object deletion to represent the relation between the two pairs of lexical items in precisely the same way (assuming, of course, that we want any such rule at all).

Another apparently similar case arises when a transitive verb undergoes passivization, resulting in a structure which may or may not have an associated *by* phrase. Again, it would appear that the underlying subject of a passive sentence lacking a *by* phrase requires (narrow-scope) existential quantification over the missing subject position.

- (5) a. Someone touched the vase.
b. The vase was touched.

In (5b), someone or something touched the vase. Again, we can give the same account as before: an independent operation of binding with an existential quantifier is not necessary. Rather, the apparent quantification falls out from the nature of touching itself — one thing coming in contact with another. This sort of analysis, besides being conceptually somewhat more elegant (in this narrow domain, at least), avoids the technical problems inherent in stating when existential quantification in passives takes place; the binding cannot take place all the time, as in the presence of a *by* phrase one does not wish this to occur — but it must occur in its

absence. See Cooper (1979) for a lengthy discussion of this problem. While technical solutions are feasible, they do tend to get a bit sticky, and it would seem something of an advance if the whole problem were just avoided.

There also appear to be some problematic examples that are better accounted for in an event-based system. Consider the interpretation of (6).

- (6) Martha was left alone.

On one reading of (6), (7) is not at all a convincing paraphrase.

- (7) Someone (or something) left Martha alone.

On this reading (where Martha is not bothered), if I leave Martha alone it does not follow that she was left alone. However, consider what we might take to be the interpretation of the VP *leave alone*: it will be the set of events where there is something or someone who is left alone, unbothered. But in order for such a situation to pertain, everyone must not bother that person. Hence, (6) and (7) on this analysis are not predicted to be paraphrases, which seems correct.

In short, an event-based system offers what I find a more natural and convincing account of nominalizations and 'missing argument' constructions than that offered by the more standard functional analysis. Of course such a narrow comparison as presented here cannot in and of itself be very decisive except in the context of a comparison of reasonably explicit theories applied to a wide range of data. Nevertheless, given that my aim in this section is to establish the plausibility of the sort of analysis suggested, it seems that some reasonably compelling initial arguments can be advanced in favor of an event-based system.

2. Adding arguments and thematic roles

The discussion to this point leaves inexplicit how arguments and other expressions combine with verbs to form more complex expressions also denoting event-types. I will focus here on 'argument' NPs. How the NP denotations should be thought to combine with event-types depends to a large extent on what one takes NP denotations to be. There are many logical possibilities, but here I wish to consider two of the more popular options. The first is to follow Montague and think of NPs as denoting sets of properties. On the account suggested here, a natural transliteration of this notion is to think of an NP, like *John*, as being the set of events which John 'participates in' (a notion I leave undefined, as its intuitive import is

clear enough for present purposes). In other words, such an NP would itself denote a subset of E. Such a subset, however, would not be an eventuality, as it would contain a mixture of states, processes, and events, and hence could not be the denotation of any verb.

Under this analysis, then, the adding of arguments becomes a straightforward matter of set intersection. Suppose $kick' \subseteq E$, and $John' \subseteq E$. The eventuality denoted by the VP *kick John* ($kick' \cap John'$) can be gotten by intersecting $kick'$ with $John'$: $kick' \cap John' = kick' \cap John'$. We can likewise construct an interpretation for *Bill kick John* by intersecting the subset denoted by *Bill*, $Bill' \subseteq E$, with $kick' \cap John'$. Thus, *Bill kick John* is the eventuality denoted by $Bill' \cap kick' \cap John'$.

This is exceptionally simple, and also very obviously wrong. The major problem is this: suppose e_1 is an event where Bill gets kicked, and e_1 is also an event in which John is the kicker. If *Bill'* includes the set of events in which Bill is an intuitive 'participant', and likewise for *John'*, then e_1 will be a member of both sets, as well as a member of $kick'$. Hence, the intersection of all these sets will contain e_1 , and thus the sentence should be true with respect to the world if e_1 is in the world (at the appropriate time). In other words, this analysis allows among other things for 'Bill kicked John' to mean 'John kicked Bill'; in fact this analysis makes the claim that these sentences are paraphrases. Obviously, they are not.

A somewhat more subtle problem arises in other quarters. Under the analysis here, true intransitives and intransitives with 'deleted' arguments are not distinguished. Thus, 'The door opened' means the same thing as 'The door was opened', as both are represented as intersecting the same sets with one another, resulting in identical eventualities. However, these examples certainly seem to mean different things and, I believe, are even truth-conditionally distinguishable.

But both of these difficulties can be dealt with, it appears, if we can distinguish among different ways of 'participating' in an event. This seems to be precisely what thematic roles do. The problem with treating 'Bill kicked John' in the way suggested is that we have not distinguished between John as the kicker and John as the one kicked. Once we do this, though, we find that our first difficulty can be avoided quite readily. Let us define a set of functions θ , such that for any member th , th is a function from NP denotations to subsets of those denotations. Intuitively, this is the subset of an NP denotation in which the individual participates in a certain way in those events. So, for example, consider $agent \in \theta$; $agent$ (*John'*) will be that subset of *John'* in which John participates as an agent. Likewise, $theme$ (*Bill'*) will be the subset of *Bill'* in which Bill acts as theme. Now let us consider event e_1 again, where John is the kicker and Bill is the one kicked. e_1 , then, is a member of $kick'$, as well as a member

of *Bill'* and *John'*. e_1 is also a member of $agent$ (*John'*) and a member of $theme$ (*Bill'*). However, e_1 is a member of neither $agent$ (*Bill'*) nor of $theme$ (*John'*). The interpretation of *John kick Bill* is rendered by the following:

$Agent$ (*John'*) \cap $kick' \cap theme$ (*Bill'*)

e_1 will be a member of this set. It will not, however, be a member of the set denoted by *Bill kick John*:

$Agent$ (*Bill'*) \cap $kick' \cap theme$ (*John'*)

Under this analysis, then, 'John kicked Bill' and 'Bill kicked John' come out to differ in interpretation, and, as should be, are not claimed to be synonymous.⁴

Of course, in order to achieve this result, we must have a means of associating the appropriate thematic role with the appropriate NP. As suggestions for how to do this abound, and as I have little to add to them, I will assume that there is a way in which verbs 'assign' thematic roles to their argument NPs. (See Bresnan 1983 for one reasonable and explicit means of doing this.)

We understand, though, that 'assignment' of thematic roles by a verb is to be associated somehow with its meaning, in the sense that verbs assigning different thematic roles should be considered as meaning somewhat different things. Such is the case in the second problem noted above, where 'The door opened' was not distinguished from 'The door was opened', yet it should be. The inclusion of thematic roles offers us a model-theoretic means of doing this. Consider first the verb $open_1$, which takes one argument and has associated with it but one thematic role, a theme (perhaps the 'default' value). Then there is the transitive counterpart, $open_2$, which has two thematic roles associated with it, a theme AND an agent. We can accord these verbs different interpretations along the following lines: $open_1$ will denote the set of all opening events IN WHICH THERE IS A THEME — where there is necessarily at least one participant playing the role of theme. Thus, if $e_1 \in open_1'$, then e_1 is a member of some set denoted by $theme$ (NP) for some NP. On the other hand, $open_2$ denotes an eventuality in which all the member events have BOTH themes and agents. In both cases, the member token events might also have other thematic 'participants' as well. So, for instance, many of the events in $open_1'$ will have agents, but not all. Or many of the events in $open_2'$ (as well as in $open_1'$) will have instruments as participants, but not all. The associated thematic roles tell us what MUST participate in the event but leave open the possibility of additional participants. Thus, $open_2' \subseteq open_1'$. Since the passive form of $open$ is based on $open_2$, the transitive version, and not on $open_1$, the intransitive, $opened$ (the passive participle),

will denote an eventuality in which there are two necessary participants, a theme and an agent. Thus, *The door be opened* denotes an eventuality in which there is a theme, the door, and an agent, which remains unspecified. On the other hand, 'The door open' is an eventuality in which the door participates as theme, but in which there may or may not be an agent.⁵ So, 'the door opened' implies no necessary agent, and 'the door was opened' does. This seems a reasonable account of the intuitive differences between the meanings of these two sentences.

A potential problem with this general account is that we allow interpretations for many sentences that it seems should not be so interpretable. Consider the following:

- (8) a. *Bill was kicked John. (i.e. *by* John)
 b. (*)The door opened a key. (i.e. The door was opened *with* a key)

If we take *John* or *a key* each as denoting a set of events and put them in a position where no θ -role is assigned — assuming they are syntactically possible — then we can still get an interpretation from them as we can still intersect their interpretations with the eventuality to derive a new eventuality and hence an interpretation. There are two ways of dealing with this. The first is to ensure that the syntax itself will not generate such examples in the first place; this is perfectly reasonable, it seems, but it is by no means clearly feasible. The second way to avoid such possibilities is to rule them out semantically. We could, for instance, let NPs denote things which are of the wrong sort to intersect with eventualities to derive new eventualities.

A common assumption is to treat (singular) NPs as denoting individuals, for example. Thus, *John* will denote the individual John, *the cat* will (in a given context) denote some cat, and so forth. We can for the moment consider plural NPs to denote sets of individuals; for a compatible treatment of indefinites, see Heim (1982). Under an analysis of NPs along these lines, thematic roles can be looked upon as functions which map individuals to sets of events — the events in which that individual participates in that particular way. So, for instance, *theme* (j) will be the set of events in which John functions as theme. What is wrong with a sentence like (8a), then, is that the intersection of the individual John and the event-type *kick* will be (necessarily) null, as j is not an event; it does not seem unreasonable to associate an expression denoting the null set with intuition of 'strangeness' or 'something wrong'. So, under this conception of NP denotations, thematic roles take on the function of making it possible for NPs to combine with event-type expressions to build up other expressions also denoting event-types; thematic roles make

an NP into an *argument* NP. Again, I am not offering an analysis of NP denotations; that is well beyond the scope of this present study. My point is that if one countenances such a theory of NPs, thematic roles would play this part in such a scheme.

Whichever of these NP analyses we choose, an interesting matter is to consider the relationship between prepositions in languages like English and thematic roles, for there seems an obvious connection which in the semantic role literature is discussed time and again. One particular problem noted is that verbs may idiosyncratically select certain prepositions, and these prepositions themselves do not appear to bear any meaning above and beyond the meaning inherent in the verb. For example:

- (9) a. John looked *at* Bill.
 b. I will not put up *with* this any longer.
 c. He believes *in* the existence of extraterrestrials.
 d. Judy choked *on* her peanut butter sandwich.

Attempts to assign general and constant meanings to such prepositions as we find in (9) which intuitively seems to include the 'meanings' they have in (9) and elsewhere are quite unsuccessful. However, Bresnan (1978) offers the insight that such prepositions might be playing a purely structural role in these cases in the sense that they function as transitivizers — ways of making intransitive expressions transitive. The perspective on thematic roles here also allows a rationale for the appearance of these prepositions and an account of their meanings here as well. If thematic roles are functions from NP denotations to subsets of E, a preposition assigned the 'meaning' of a thematic role would, in a compositional system, be capable of performing precisely this function. For example, the preposition *at* in (9a) might well be assigned the 'meaning' of the appropriate thematic role, a role which is already a part of the verb's meaning in that the preposition will not take on this meaning unless, in some way, controlled by the verb. What a verb like *look* lacks, that a verb like *view* does not, is the ability to perform the appropriate semantic function on an NP (i.e. to be transitive verb). A surrogate preposition must be employed with *look*. This cannot, of course, be the whole story, but it seems a plausible beginning in trying to account for such constructions in a variety of languages; it does not seem unreasonable to entertain similar thought about postpositional and case-marking languages as well. This returns to Fillmore's point of view, of course, though at present from a model-theoretic standpoint. Again, further discussion of this point lies well beyond the scope of this paper.

To this point, then, we have outlined a system of interpretation in which thematic roles play a crucial part, functioning as integral parts of

the system as a whole. Let us now turn our attention to consideration of the place of thematic roles in a view of grammar as consisting of an independent syntax and a set of rules of model-theoretic interpretation.

3. The 'intermediate' status of θ -roles

Let us begin by asking whether thematic roles should be considered syntactic phenomena. Under the general understanding of syntax as inherited from the structuralist tradition, the answer would appear to be, quite plainly, no. Thematic roles themselves do not seem to be required over and above a set of notions including 'constituent', 'case', 'government', 'preposition', and so forth. They do not show up, for instance, as consistent morphemes in any language I am aware of in the same way as notions like gender or plurality or inalienable possession may appear. They do not seem to be required to account for the formal structure of sentences in any particularly straightforward way.

Much more subtle arguments, though, might be advanced for their inclusion in the syntax at some level. In Chomsky (1981), for instance, thematic roles play a crucial role in the syntax; in Bresnan (1983) and Zaenen and Maling (1983) they play a crucial role in determining the applicability of lexical rules. However, in none of these cases is it clear to me that the overall effect of the thematic roles cannot be just as easily accounted for by removing them from the syntax and treating them as elements of the semantic interpretation, along the lines suggested here. This would of course require a certain amount of theoretical reformulation, but I do not know that too much violence would result.

A consideration of importance is that in the 'government and binding' (GB) framework, nothing of significance to the syntax rests on WHICH thematic role a given NP is assigned. All that ever really matters is that SOME thematic role OR OTHER be assigned. So, in this sense, thematic roles act as 'OK' marks in the theory, or, more accurately, as indicators of argument-hood. But this is almost precisely what the present account of thematic roles is aimed at dealing with, though the system here is defined as a function of semantic interpretation, without employing thematic roles as elements of the syntax itself. It would be a theoretically interesting situation indeed to have some category, like thematic roles, of significance to the syntax, yet the members of the category itself not of relevance, and the possibility remains. For the moment, though, I take this as an indication that thematic roles should not be regarded as elements of the syntactic vocabulary necessary to account for the form of language.⁶

On the other hand, considering them to be purely semantic phenomena

raises interesting difficulties as well. Though clearly of relevance in determining truth-conditions of sentences (e.g. 'John was smoking' with plausibly one syntactic analysis — but see Burzio 1981 — is true or false depending on whether the subject is theme or agent), thematic roles have certain properties that are puzzling under the usual set of assumptions about the nature of model-theoretic semantic interpretation. Recall that much of the advantage of the system relies on what Barwise and Perry call 'structural constraints' — that kissing entails touching, for instance, because of what kissing is. One view of these constraints is that they follow from the nature of the world itself. One cannot kiss without touching because the physical world is so constructed, constraining the interpretations of the elements of the language. There are, however, apparent constraints on thematic roles that we are hard pressed to attribute to the structure of the real world. One type of constraint, for instance, is the set of generalizations concerning which thematic role a subject NP can have associated with it. See Fillmore (1968), Quirk and Greenbaum (1973), and Faarlund (i.p.) for discussion. But one of the more fundamental constraints is that of 'thematic uniqueness' — that no verb seems to be able to assign the same thematic role to two or more of its arguments. There are, for example, no verbs like 'stouch' below which assign theme to both subject and object; 'stouch' would designate an eventuality in which both the subject and object get touched, for instance.

(10) John stouched Bill.

There seems no reason whatsoever for thinking that such events do not or cannot occur. Or another example of a slightly different type is exemplified in (11), in which 'skicked' means that the subject is agent and the two objects are both location:

(11) John skicked Bill's leg Bill's shin.

(Meaning: John kicked Bill on the shin part of his leg.)

Clearly, such events as discussed in (11) DO exist if any exist at all, but for some reason we are not allowed to TALK about them in that way. And it seems to have nothing to do with the nature of 'reality'. A system that did not observe thematic uniqueness would be easily definable (e.g. a function-argument system), with perfectly explicit interpretations being assigned to all of the expressions without any significant loss of explicitness, generality, or plausibility. To put it another way, if the language countenanced verbs like 'stouch' and 'skick', we would find little cause for amazement. After all, what in reality is there to preclude relations between elements of an event that play the same role? One could even point to the existence of 'reciprocal' events like kissing one another or

busses colliding with one another, and so forth, to support our point of view. Furthermore, it is quite obvious that any given event can be described in a number of different ways, and it would be foolish to think we should NOT have verbs like 'skick' since such events, obviously, do occur. Furthermore, we would persist, what of complex events that obviously have a multiplicity of participants, all playing the same role? How many goals in a senatorial debate, or agents in a riot, or themes in an event of car-washing?

At some risk of misjudging the depth of the constraint, I am willing to consider, in the face of such arguments, why there would be any such constraint at all. One account, suggested by Bresnan (1980), attributes this uniqueness to a constraint on the polyadicity of a verb — the kinds and number of arguments a verb may take. In this sense, the uniqueness constraint follows from purely linguistic, almost syntactic, constraints on word meanings (and, in Bresnan's account, it is syntactic).

But this will not do, as I argue in Carlson (1983). The notion of polyadicity is a notion not too unlike that of subcategorization. Each verb has a number of different 'slots' into which appropriate NPs (and PPs) may fit. The uniqueness constraint results from there not being enough 'slots' for the number of arguments one wished to put in, in examples like (10) and (11) above. However, this structural notion fails to account for examples where there are two verbs, each allowing an argument playing a given role independently, but in combination allowing but one such argument. So, for example, *try* is a verb that allows an instrumental role, as is *open*:

- (12) a. John tried it with an ax.
b. John opened the present with an ax.

However, the example in (13) allows but one instrument expression, even though there are two verbs in the construction each allowing an instrument independently:

- (13) a. John tried to open the present with an ax.
b. *John tried, with a sharp instrument, to open the present with an ax.

Here, even though 'an ax' and 'a sharp instrument' could indefinitely denote the same object, only one such expression is allowed.

Of course, under other circumstances, each verb allows an instrument expression:

- (14) Before trying it with an ax, John opened the present with a sharp instrument.

The difference between (13a) and (14) is that the verbs are 'independent' in (14), whereas they are not in (13a). But in what sense? The difference, I think, is that in (14) one has a single sentence expressing relationship between two events (the one in the 'before' clause possibly intensional); on the other hand, in (13a) there is no such relation between events. Rather, *try* combines with its infinitival complement to form an expression that denotes itself an eventuality, but it is not a relation between events. To put it more plainly but crudely, in (14) there are two events, but in (13) only one. What I am suggesting, then, is that the constraint on thematic uniqueness is a property of eventualities themselves, and not a linguistic property of the verb, in any structural sense.

Let us assume for the moment that this story is somewhere near right: that there is a constraint somewhere that amounts to thematic uniqueness, and that it is not a purely SYNTACTIC constraint, nor does it seem to be a constraint dictated by the nature of reality — what language denotes. Instead, it appears to have an intermediate status. In the remainder of this paper I wish to outline a tentative line of thought which characterizes this 'intermediate status' in a way that seems to me to be of potential general interest.

4. θ -roles and the individuation of events

One notion that has cropped up time and again in philosophy and semantics, though not now enjoying a particularly privileged status, is that syntactic categories have associated with them particular types of meanings. Much recent work, for example, has centered around the question of what a noun means — Gupta (1980) and Cocchiarella (1977) present two quite similar theories of noun meanings (they actually concern themselves with count nouns). Using Gupta's terminology, noun meanings consist of two components. First there is what he calls a *principle of application* — this is the content of any predicate: it sorts things into two piles — those included and those not. Thus, *dog* can be thought of as a function mapping dogs to 'yes' and everything else to 'no'. But there is more to the meaning of a noun than that: the second component of its meaning is what Gupta calls a *principle of identity*, paralleling what others call a *principle of individuation*.

A principle of individuation tells you what the individuals of that kind 'look like' and allows for determining how many there are. For instance, suppose you ask a man if the cape he is wearing is the same as the one he was wearing yesterday; if you ask instead if the piece of cloth the man is wearing is the same piece of cloth he was wearing yesterday, you are

asking something quite different. Consider a situation where the man last night took a coat that he had been wearing that day and made it into a cape.

There are various means of defining 'principle of individuation' in a model-theoretic framework. Gupta, for instance, assumes that the possible-worlds model contains a set of 'basic' individuals (roughly, an individual in a world), and that a principle of identity defines certain classes of these basic individuals as equivalent — the same individual.

However, there is an alternative way of construing this notion, as recently urged by Ray Jackendoff (1983) and Alice ter Meulen (1984, i.p.) (the latter assumes a formal semantics framework). Both wish to dispute the commonly held belief that model-theoretic interpretation must assume that the domain has a fixed, absolute, individuated structure, independent of and prior to the interpretation assigned to expressions in language. Rather, language should be viewed as capable of projecting a structure onto a domain with little or very different inherent structure. Given such a view as this, a principle of individuation can be looked upon as a means of projecting onto a domain an individuated structure it may not 'have' of its own right. An analogy would be that of measurement. Most of us do not really think that, say, a tub of water consists of prepackaged things called gallons (or pints, liters, deciliters, and so forth). We nevertheless have the capability of taking out and identifying, and discriminating from one another, things called liters of water. We can speak of *this* liter, and *that* one, just as if they are real individuals. But this individuation is a projection onto a continuous mass, using the key term 'liter'.

We could well think of event-donating descriptions in much the same way, portioning out certain sections of perceived reality as events, individuated in such a way that we can speak of *this* event, and *that* event. In addition, if the truth conditions of a sentence require reference to real events, the events must be individuated in order to assess truth values of sentences. This, however, presupposes that the individuation is carried out on the basis of certain principles. It seems plausible to think that thematic roles play a crucial role in a theory of these principles — that thematic roles are among the factors used in discriminating events from one another. Thematic uniqueness forms the basis: if there is a proposed event with, say, two themes, then there are (at least) two events and not one; if there are three sources, then there are at least three events; and so forth. Thematic uniqueness provides a means of telling how many distinct events you have. If there were no principle of thematic uniqueness, of course, it could play no such role.⁷ Naturally, there is more to the meaning of a verb than that — some element of meaning corresponding

to 'cognitive meaning' or a 'principle of application' is also necessary. However, let me in concluding continue to focus on thematic uniqueness and some of its consequences for an event-based theory of semantics.

One immediate consequence is that it appears to be necessary to countenance groups or sets as being able to play thematic roles. Thus, the sentence 'John and Bob threw the chest into the ocean' can be interpreted as having John and Bob act in concert (e.g. each takes one end of the chest, and together they throw it into the ocean). It also can be interpreted as a report of two (or more) events, one where Bob throws it, and another where John throws it (and hence is equivalent to 'John threw the chest into the ocean and Bob threw the chest into the ocean'). The former reading seems very aptly represented by having the group consisting of John and Bob playing the role of agent — hence there is but one agent, and one event. Group readings of plural noun phrases seem very naturally handled in such a way.⁸

However, in such a case, both John and Bob are doing something, as individual agents. This would seem to indicate that an event like 'John and Bob throw a chest into the ocean' must have three agents in it: John, Bob, and the group consisting of John and Bob.

But in so saying one is individuating the phenomenon in different ways: an important distinction is being missed. It is reasonable to think that most events have internal structure, sometimes relatively simple (John moved), and at other times more complex (John built a house). However, this does not entail that in referring to an event we are also referring to its internal structure. Consider determining, by way of analogy, how much a car weighs. One is interested in the weight of the car itself — how its parts are individuated and what each weighs is irrelevant. In fact, it is so irrelevant that, in order to determine the weight of a car, ITS PARTS NEED NOT BE INDIVIDUATED AT ALL. So it is with events. In asking how many themes in an event, we are not asking about the event's internal parts, but about that event itself and ITS participants. So, if Bob washes a car, the car is the theme of the event, NOT the car's window, fenders, hood, and so forth. If we ask how many times Bob washed a car, he might have done that once, though many (perhaps all) parts may well have been washed two or more times. So in talking about the thematic participants of an event, we are not talking about thematic participants of the PARTS of the event.

A final point. I have suggested that we must take into account how an event is referred to before we can discuss matters of thematic participation — if the thematic roles themselves represent a part of the means by which we refer to them in the first place. But let us now ask such questions as: How many goals in a senatorial debate? What is the theme of last night's

party? Or the theme of World War I? First, we must recall that the question is about the events, and not their parts. This in mind, such questions cannot be answered. Note here that we are using NOUNS here to refer to these events, and not verbs (or sentences). If one uses sentences and verbs to refer to them (e.g. Sen. Jones debated Sen. Smith; John threw a party last night), then questions about thematic roles become relevant. What this would appear to entail, given that the nouns can be used to individuate things including events like last night's party, is that nouns and verbs have as parts of their meanings different means of individuation. On the one hand, we have what I'll call NOMINAL individuation. This is presumably a very general sort of individuation and constitutes the vast majority of the subject matter of the numerous philosophical works on individuation. But I am also suggesting that there is another more specific sort of individuation associated with verbs (or verbal elements) which makes critical use of the notion of thematic uniqueness; thus noun meanings and verb meanings differ. This would appear to be a hypothesis that accounts for the 'intermediate' status of thematic roles in a principled way.

5. Conclusion

Whether this is anywhere near correct obviously remains a matter for further research. Nevertheless, such a view of thematic roles appears promising insofar as it gives a nontrivial account of their properties, as well as providing us with an interesting perspective from which to further investigate their nature. Nevertheless, it is quite clear that thematic roles find a very natural place in an event-based system of interpretation, and a deeper understanding of θ -roles is plainly needed.

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Notes

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1. I am assuming that aspect is wholly independent from tense, and that in principle each tense should allow for the full range of aspectual interpretations. However, see note (8).
2. For the equivalence to hold, it is necessary to be able to substitute the denotation of a mass term for the variable bound by 'something'. Thus, 'John was eating apple' implies 'John ate' but not 'John ate something' unless you can substitute for 'something' the mass term 'some apple', or perhaps 'a part of an apple'. It seems to me that one can understand 'something' as a mass term. For example, 'something is more widespread than oxygen' allows the substitution 'hydrogen', and 'John mopped something up off the floor' allows the substitution 'milk'.
3. I assume a model which contains real elements and has as a part spatial and temporal structure. A (nongeneric) sentence is true, then, if a member of the eventuality occurs in the model. What tensing a sentence does is to constrain the portion of the model in which the eventuality is claimed to have a member: negation is the assertion that no such member is to be found in the appropriate portion of the model's spatiotemporal structure.
4. It might appear at first sight that adverbs might be treated as sets of events, and that modification by an adverb is simply a matter of set intersection. However, adverbs have an 'intensional' character — even extensional adverbs — which is not accounted for under this hypothesis. Consider where 'John signal to the spy' and 'John raise his left hand' have the same extension (i.e. where John signaled by raising his hand). It seems certainly possible, though, for John to have slowly raised his hand, but in so doing speedily signal to the spy. Or suppose 'John frighten Bill' and 'John yell at Bill' have the same extension; John can yell at Bill *loudly*, but he cannot *frighten* him *loudly*. I know of no corresponding phenomena for extensional interpretations of argument NPs, though. Ultimately one would like to make the connection between thematic roles and human perception of events, but I currently have nothing to offer on this matter.
5. It is conceivable, perhaps even plausible, that thematic roles do play a syntactic role at an autonomous level of logical form, though such a level would not be a part of the syntax of the language proper. See Chierchia (1984) for discussion along these lines.
6. Of course we cannot put the full weight of individuation of events on the principle of thematic uniqueness. This will not be of use in determining when one event ends and another begins, for instance. Other principles must be invoked to do this. Thematic uniqueness will be of benefit, though, in making a determination of how many distinct events co-occur at a given point in time. See, for instance, Davidson (1967).
8. One referee points out that the simple past-tense sentence 'John smoked two cigarettes' allows an interpretation where John smoked each at a different time. However, the same sentence in the progressive aspect does not allow for such an interpretation: 'John was smoking two cigarettes' allows only that he was smoking them at the same time. This does not mean that there is only one event occurring at that time; clearly events can occur simultaneously, even events of the same type. As noted by Quirk and Greenbaum (1977: 45), the past (as well as the future) progressive is understood as occurring at the same time as some other, normally contextually determined, event was occurring. Presumably this is what is behind the 'simultaneous' reading of the progressive example above. Note also that independent sentences in the progressive, understood as part of a discourse, also may allow only a simultaneous reading. Compare
 - (i) John was smoking a cigarette and Bill was smoking a cigar.
 - (ii) John smoked a cigarette, and Bill smoked a cigar.

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