

Thematic Roles and Semantics

Author(s): David R. Dowty

Proceedings of the Twelfth Annual Meeting of the Berkeley Linguistics Society (1986), pp. 340-354

Please see “How to cite” in the online sidebar for full citation information.

Please contact BLS regarding any further use of this work. BLS retains copyright for both print and screen forms of the publication. BLS may be contacted via <http://linguistics.berkeley.edu/bls/>.

The Annual Proceedings of the Berkeley Linguistics Society is published online via [eLanguage](#), the Linguistic Society of America's digital publishing platform.

THEMATIC ROLES AND SEMANTICS

David R. Dowty
Ohio State University

1. Introduction

The notion of "thematic roles", a more modern term for Fillmore's (1968) *case relations*, Jackendoff's (1972) and Gruber's (1965) *thematic relations*, and Pannini's *karakas*, has been appealed to by contemporary linguists in the statement of natural language generalizations about syntax, morphology, and semantics for some 20 years now. Until recently, thematic roles were invoked only in research that treated semantics non-formally (i.e. not model-theoretically). The level of rigor of semantic analysis behind these notions in this literature can be indicated by the samples in (1) from Andrews (1985) and Jackendoff (1985), which I cite here only because I take them to be quite typical of "definitions" of particular kinds of thematic roles; in fact I believe that significantly more explicit semantic characterizations than these do not exist.

- (1) a. *Agent* - a participant which the meaning of the verb specified as doing or causing something, possibly intentionally. *Examples: subjects of kill, eat, hit, smash, kick, watch.*
- b. *Patient* - a participant which the verb characterizes as having something happen to it, and as being affected by what happens to it. *Examples: objects of kill, eat, smash, but not those of watch, hear, and love.*
- c. *Experiencer* - a participant who is characterised as aware of something. *Example: subject of love, object of annoy.*
- d. *Theme* - a participant which is characterized as changing its position or condition, or as being in a state or position. *Example: object of give, hand, Subject (and also Agent) of walk.*

From Jackendoff (1985):

- e. *Source* - object from which motion proceeds.
- f. *Goal* - object to which motion proceeds.

However, two perennially vexing problems with the appeal to thematic roles are (i) lack of agreement among linguists as to which thematic roles exist, and the absence of any obvious way to decide this question, and (ii) the lack of any definite way to independently justify the assignment of noun phrases to thematic roles in particular sentences. It is unfortunately not at all infrequent for two researchers to propose assigning the same NP in an example to two different thematic roles, the assignments fitting the respective syntactic generalizations each wants to maintain, with no way of resolving the conflict except by choosing whose syntactic generalization is going to be preserved. This suggests that pure pre-theoretic intuitions and definitions like those in (1) are not going to take us very far toward an explicit theory of roles.

It seems obvious that if any independent justification for a substantive, motivated, and reasonably precise theory of thematic roles is going to be found, it will have to come from semantics. Characterizations like those in (1) are manifestly semantic in nature, and I know of no proposed way of characterizing thematic roles that is not equally semantic. It is encouraging that the past two years have seen the appearance of attempts by two formal semanticists (Chierchia 1984, Carlson 1985) to construct model-theoretic accounts of thematic roles. However, I am troubled that some very fundamental questions about the notion of thematic roles have not yet been explicitly raised. In this paper, I will try to explain what these fundamental questions are and why I think they are important, though I cannot begin to really answer all of them. I do not apologize if, by the end of the paper, I have raised more questions about theories of thematic roles than I have resolved.

2. Two Theories of the Predicate-Argument Relation

Here I will contrast two apparently different views of how predicates in natural language are to be associated with their arguments when they are semantically interpreted. The first theory, which I will call the *ordered-argument theory*, is, presumably, the theory we have inherited from formal logic, which persists in all linguistic theories employing Montague Semantics, Situation Semantics, and elsewhere. The other theory we are seeking to understand is a *thematic roles theory*, a theory in which thematic roles like Agent, Patient, Source, Goal, etc. are somehow involved in associating a verb meaning with arguments in semantic interpretation. The problem at hand is to figure out how to formalize these two theories so that they are empirically.

2.1 The Ordered-Argument Theory of Predicates and Arguments

The ordered-argument theory treats a verb as an unsaturated predicate wanting a particular fixed number of arguments to form a sentence. Semantically, a verb denotes an n -place relation, and when the denotations of the proper number of arguments are combined with the relation in an appropriate way, a truth value is denoted, a proposition is expressed, or a situation is described (depending on which semantic theory you use); if too few argument denotations are available, then no truth value (or proposition or situation) can result.

In this theory, it is important that the syntactic and semantic rules be constructed to combine the argument-denotations with the verb denotation in a fixed arrangement determined by the syntactic arrangement (i.e. by the grammatical relations the arguments bear in the sentence in question), though that semantic arrangement is, in a sense, ultimately arbitrary. Arbitrary, because the choice of relations to be denoted by verbs is likewise open in this theory; the inverse of a two-place relation can carry the same information as the original relation, and similarly each of the the permutations of an n -place relation can carry the same information. It doesn't matter which permutation we chose, as long as the compositional semantic rules match the right syntactic argument with its appropriate semantic "slot" in the interpretation of the verb.

In talking about an ordered-argument theory, I do not distinguish between

syntactic analyses which combine a verb with several or all of its NP arguments "all at once" (as in the syntax of most formal logics) or one at a time (as in categorial grammars and many versions of Montague Grammar), thus treating the denotations of verbs as function-valued functions (or so-called "curried" functions); both of these are ordered-argument theories.

I am also assuming that our semantic theory here allows us to describe entailments of lexical items, whether this is done by meaning postulates, by structural constraints (in situation semantics) or by lexical decomposition. The relationship between lexical entailments and thematic roles will, in fact, be a major concern shortly.

2.2. Thematic-Roles, from an Ordered-Argument Point of View.

Whatever a thematic role theory is, it should be one that differs in some way or other from this classical, "ordered-argument" picture that we are familiar with. Or perhaps I should rather say, I believe that a major interest the phenomenon of thematic roles has for semantic theory lies precisely in the extent to which it suggests or requires an account of the way predicates are associated with arguments that differs from this familiar account. In what follows, I will try to construct such a theory, with the goal of trying to satisfy desiderata of various linguists that have appealed to thematic roles in their grammatical descriptions (from the ability to state *thematic hierarchy constraints*, as in the work of Jackendoff and his followers, to the one-to-one relation between the NP-complements of a verb and the kinds of roles invoked in a sentence, as in GB and LFG), yet still a theory that can be formally distinguished from the ordered-argument theory. (This is of course a hazardous undertaking, for different linguists have had very different ideas as to the role that "thematic roles" play in a grammar.)

Let me mention two things that a thematic-role theory is not. First, it is not a theory in which the only difference is that we use notations like (3) in place of (2):

(2) $give(x, y, z)$

(3) $((predicate\ give), (agent\ x), (theme\ y), (goal\ z))$

That is, I am not just talking about a notation in which the various arguments of a predicate are distinguished not by writing them in a fixed order but by giving each one an arbitrary but distinct label, so that one can write them in any order, but nevertheless a theory in which the labels "agent", "theme", "goal," etc. play no semantically significant part except to index the arguments. Now the notation in (3) may have advantages for certain purposes, but it is not what I'm looking for here.

A second thing that a thematic role theory is not is one in which the terms "agent", "theme", "goal" etc. merely provide a useful, and intuitively mnemonic terminology to distinguish the denotations of arguments of a verb (or if you prefer, the "semantic representations" of the argument NPs) from the linguistic expressions that denote them. Now this may be a very practical and helpful consequence of using this terminology, and I certainly have no objection to lucid terminology that is easy to use, as long as it does not delude us into thinking there is a theory behind

our terminology if in fact there is not.

For purely expository reasons, I will begin with an ordered-argument theory, modifying it in the direction of a thematic role theory. This will be a feasible, since it turns out that the ordered-argument theory is much less restricted than the eventual thematic-role theory.

I have already mentioned that I assume our semantic theory must permit us to describe the lexical entailments of verbs. For example, if a sentence x *builds* y is true, then it is necessarily also true that x performs purposeful actions, that as a result of these actions a structure or other artifact y comes into existence, and so on. It is surely the case that among these entailments, one will find lexical entailments about the subject x of the verb which amount to the criterial properties for being an Agent, and also among them are entailments about the object y of the verb which amount to criterial properties for being a Patient. Indeed, it is difficult to imagine how to describe the meaning of x *builds* y without saying something that directly or indirectly identifies the subject as Agent and the object as Patient. And of course, I believe this state of affairs obtains not just for the verb *build* but for all verbs. Thus we are immediately faced with two options: either we should maintain that thematic roles are determined by and derivative of the lexical meanings of verbs, or else we should say that thematic roles are somehow a separate part of the semantic description of a natural language from lexical meaning—in which case we are in some sense saying that they are redundantly specified in the semantic description of a language. Though Jackendoff long ago endorsed the position that thematic roles should be derivable from lexical semantic representations (Jackendoff 1972), the question of the exact relationship between thematic roles and "the rest of" lexical meaning has, oddly, hardly been further addressed in the large literature on roles, to my knowledge. I will here take the more conservative position that thematic roles are not redundantly specified and are therefore determined completely and solely by verb meanings. Perhaps arguments can be made that thematic roles must be a part of a theory of linguistic meaning quite separately from lexical meaning, but I will have to leave it to others to pursue such arguments, for I have no idea what they could be.

From the point of view of the ordered-argument theory, then, a "thematic role" can and probably must be regarded as a cluster of entailments and presuppositions shared by certain arguments of certain verbs; this has already been pointed out in the model-theoretic literature¹. In this paper, however, I will not be distinguishing presupposition from entailment but will speak as if only entailments are involved.² For example, the thematic role *Agent* might be regarded as a set of properties including "is a rational and sentient being", "acts volitionally in this circumstance" and so on. Let's state this a bit more formally in three steps. First, we will define an *individual thematic role* as in (4):

- (4) Given an n -place predicate δ and a particular argument x_i , the *individual thematic role* α , is the set of all properties α such that the entailment

$$\Box[\delta(x_1, \dots, x_i, \dots, x_n) \rightarrow \alpha(x_i)] \text{ holds.}$$

Thus an individual thematic role is specific to a particular verb and to a particular argument-position of that verb. We might refer to the individual thematic role for the first argument of the verb *build* as the "builder-role", because it is the set of all the things you can conclude about x from knowing that the sentence x *builds* y is true; we can call the individual role of the second argument of *build* the "bildee-role", since it consists of all you can conclude about y from this same sentence.

In (4), I have not yet said what counts as a property, a denotation of α . If we allow properties to be defined quite generally, as for example in Montague's intensional logic (or, in theories in which some properties are primitives, if we allow the properties that can appear in (4) to include properties that are defined by abstraction), then one property that will be trivially entailed will be, for each argument of each verb δ , that property represented by the lambda-abstract in (5):

$$(5) \lambda x_i \exists x_1, \dots, \exists x_{i-1}, x_{i+1}, \dots, \exists x_n [\delta(x_1, \dots, x_i, \dots, x_n)]$$

For example, suppose that in (5) δ is the verb *build* and x_i is the direct object position, corresponding to the build-ee role. Then (5) is the property of being an x such that for some y , y builds x . I will call such a property a *trivial individual thematic role entailment*. This kind of property seems pretty pointless to talk about, but I will have reason to mention such properties later on.

Building on the definition in (4), we proceed to the definition of *thematic-role type* in (6):

- (6) Given a set T of pairs $\langle \delta, i_\delta \rangle$ where δ is an n -place predicate and i_δ the index of one of its arguments (possibly a different i for each δ), a *thematic role type* τ is the intersection of all individual thematic roles determined by T .

In view of (6), for example, the particular thematic role-type that we want to call the Agent role-type will be the set of entailments that are common to all the individual thematic roles of the arguments, of various verbs, that we identify as "agent"-arguments. Of course, (6) defines a thematic-role type as the intersection of *any* set of individual thematic roles whatsoever, and what we are interested in is the possibility that there exists a particular set of thematic role types that plays a special role in linguistic theory—the set that includes Agent, Patient, Source, etc. Let us call this distinguished set the *L-Thematic Role Types*, or, when no confusion can arise, simply the set of *Thematic Roles*.

It should be pointed out that not all linguists who use the terms *thematic role* or θ -role are committed to the existence of a set of L-thematic roles of this sort; for example, van Riemsdijk and Williams (1986), in describing (their version of) GB say " θ -theory, as outlined here, is not committed to ... a system of argument types ... [implied by] terms such as *agent*, *patient* (or *theme*) and *goal*." (p. 241); similarly, cf. Marantz (1984), p. 31-32. For these writers, " θ -role" corresponds to

my "individual thematic role". But since, as I have said, what is of interest to us here is precisely the hypothesis that a set of L-thematic roles exists, I will ignore this literature here; note that many other linguists working in a GB framework do continue to appeal to thematic role types.³ Moreover, it will turn out, as far as I can tell, that a theory employing only individual thematic roles will be indistinguishable from an ordered-argument theory.

How can we further characterize these role-types? Presumably, this set should be non-empty but finite, and rather small; this much is obvious, but not very helpful. From the way thematic roles are used in the literature, I suggest that there are two relationships that the L-thematic role types should have to the relations denoted by natural language verbs:

- (7) (*Completeness*) every individual thematic role contains some L-thematic role type (or as we may equivalently say, every argument position of every verb is "assigned" an L-thematic role type).
- (8) (*Distinctness*) Every argument-position of every verb is distinguished from every other argument-position of the same verb by the L-thematic role types the two arguments-positions are assigned.

(These conditions are of course reminiscent of the θ -criterion of GB, but the conditions play a quite different role in our enterprise.) But I believe that (7) and (8) are implicit, if never explicitly stated, in the use of thematic roles by all linguists who make reference to them. Specifically, this literature often proposes that there exists one or more hierarchies of thematic role types and states conditions to the effect that the NP in the sentence bearing the highest thematic role on the hierarchy has such-and-such properties (cf. for example Jackendoff 1972, Nishigauchi 1984). This sort of statement presupposes that *all* arguments of a verb can be classified by thematic role, which requires the condition (7), and moreover it presupposes that they can be *uniquely* classified by their thematic roles, which presupposes (8).

There are actually various versions of (8) that could be adopted: (8a),

- (8a) No two argument-positions of the same verb are assigned the same L-thematic role type, and every argument position is assigned only one L-thematic role type.

which is the strong condition that the GB θ -criterion adopts, or the weaker conditions (8b) and (8c),

- (8b) No two argument-positions of the same verb are assigned the same L-thematic role type.
- (8c) No two argument-positions of the same verb bear exactly the same set of L-thematic role types.

I include the last two because some linguists have proposed analyses in which a certain argument bears two thematic-role-types simultaneously: (8b) would for example allow the subject of the verb *buy* to be both Agent and Source (as once

proposed by Jackendoff), as long as neither of these two roles are assigned to other arguments of the same verb. The still weaker (8c) would permit two arguments of a verb to have one or more roles in common as long as they did not share exactly the same set of roles. (8c) would be needed if, as is sometimes proposed, we allow thematic-role-types which are sub-types of other roles, e.g. if the roles Source and Goal are to be considered subtypes of the role Directional, as suggested by Andrews (1985, p. 70).

Before going any further, I should note that I have individuated both individual roles and role-types above in terms of "argument positions", rather than in terms of the entities that are denoted in each argument-position (as in, for example, Chierchia's (1984) formal definition of thematic roles). That is, I do not classify the person John himself (or if you prefer, his "individual semantic representation") as Agent in *John sang*, but rather the subject argument position of *sing* as Agent. This is quite deliberate, however. For a complete discussion of this point I must refer the reader to Dowty (1987), but I can briefly hint at the point by calling attention to examples like *John killed himself*. If roles were defined only with respect to persons/entities referred to by arguments (the "bearers of the role") rather than in terms of argument positions, we would have to classify John as both Agent and Patient in such examples as this, which would cause us problems in explicitly defining *Distinctness* (in any of its three versions (8a)-(8c)). But surely there is a clear intuitive sense of distinctness which such reflexive examples do not violate, but to state it precisely, we must distinguish the entailments which accrue to John in *John killed himself* by virtue of reference to him as subject of *kill* (i.e. the Agent entailments) from those that accrue to him by virtue of reference to him as object (the Patient entailments). Thus semantic Distinctness in role holds for argument positions, but not their referents. With this approach, we can if desired go on to reconstruct the notion of the individual referred to in a certain thematic role position in a given sentence (i.e. reconstruct it from the definitions I have given), and to avoid confusion, I will refer to such an individual as the *bearer* of that thematic role. (Again, see Dowty (1987) for a complete discussion.)

However, I believe we still have not achieved the intended semantic content of L-thematic role types. To see this, note that nothing we have said so far excludes the existence of a hypothetical L-thematic-role-type X that is assigned by the subject of the verb *kill*, the object of the verb *build*, the indirect object of the verb *give* and the object of the verb *inhabit*. We could simply define the (only) entailment in the role X as the disjunction of all the trivial individual thematic role entailments of the relevant argument positions of these verbs, that is, a property equivalent to (9):

$$(9) \lambda x[\exists y\textit{kill}'(x, y) \vee \exists y\textit{build}'(y, x) \vee \exists y\exists z\textit{give}'(y, z, x) \vee \dots]$$

The problem here, I believe, is that we have not excluded the possibility of referring to meanings of particular verbs in defining L-thematic role types; hence we might collect arbitrary argument positions together into one disjunctively defined thematic role type as in (9). But I think it is clear that linguists will insist that whatever criterion individuates thematic roles must be independent of the particular kind of relation (and particular verb denoting that relation). In other words, whatever criterion identifies an Agent semantically, that criterion should be a set of properties that are common to agents of *all* verbs, that is, properties that can be recognized

independently of knowing exactly which verb we are identifying an Agent of. Let us describe this requirement as in (10):

- (10) (*Independence*) The properties in an L-thematic role type must be characterizable independently of the relations (denoted by natural language verbs) that entail them.

Note incidentally that although Chierchia's (1984) way of defining thematic roles treats them as functions on events, events are for him sequences, one element of which is the particular relation denoted by some verb, so his definition as it stands also appears not to rule out "bizarre" thematic roles such as (9) that depend in an idiosyncratic way on particular verbs.

Perhaps (10) is really stronger than what we want. For example, it is sometimes suggested that the roles Source and Goal have a literal characterization "place from which/ to which something moves" with motion verbs as in (11), but only an abstract or metaphorical origin/terminus of movement with verbs like (12):

(11) John rolled the ball *to the fence*.

(12) Mary explained the idea *to John*.

Thus perhaps such roles should have one criterion for motion verbs and a different one for other verbs. However, I have no idea at present how to go about constructing a criterion that permits thematic roles to depend on what we might call natural classes of verb meanings, as illustrated by (11) and (12), without permitting quite arbitrary dependence on verb meaning, as in (9), so for now I will let (10) stand in for the independence criterion we ultimately seek.

One way of insuring (10) would be to keep our present approach and stipulate that the properties contained in L-thematic roles be taken from the set of "natural properties" suggested by Chierchia (1984) and Cocchiarella (1983) or from some other designated set. However, now that we have identified the three criteria of completeness (7), distinctness (8) and independence (10), I believe we are in a position to see that there is a quite different way of constructing a thematic role theory from which these criteria arise, if not automatically in all three cases, at least quite naturally.

3. A Neo-Davidsonian Theory of Thematic Roles

I will call this other approach to thematic roles a *Neo-Davidsonian Theory* of thematic roles because of its similarity to Davidson's (1967) familiar theory of adverbs in action sentences. Davidson suggested that event-sentences quantify over events and that adverbs are essentially predicates of events, as in, for example, the formula in (13b):

(13) a. Jones buttered the toast at midnight in the bathroom.

b. $\exists e$ [buttered(Jones, the-toast, e) & at-midnight(e) & in-the-bathroom(e)]

What I will propose is that to construct a theory of thematic roles, we should stipulate that not only the modifiers but also the arguments of verbs are actually predicates of events; more precisely, thematic roles are relations between individuals and events. Hence the verb of any sentence has no arguments of its own, other than an event variable, and is likewise a one-place predicate of events, rather than something that denotes a relation. That is, example (13a) is instead to be interpreted as (14):

(14) $\exists e[\text{battered}(e) \ \& \ \text{Agent}(\text{Jones}, e) \ \& \ \text{Patient}(\text{the-toast}, e) \ \& \ \text{at-midnight}(e) \ \& \ \text{in-the-bathroom}(e)]$

If thematic roles relating events to their participants are the only way we can express what we were formerly thinking of as "relations" in natural language, the three conditions on thematic-role-types we developed above will now follow: *Completeness*—the requirement that every argument entails some thematic-role—follows because there is no way in this theory to state that an individual is a participant in an event except by relating it to the event via some thematic role.

Distinctness—the requirement that all arguments of a verb are distinguished from one another by the thematic roles they bear, also follows automatically in this approach, for if two participants in an event are to be given any semantically distinct status at all in this method, it will have to be by means of different thematic roles which relate them to the event in question. On the other hand, one might wonder about the possibility of predicating the same role of two different individuals, as in (15); I will later have reason to rule such cases out entirely (and, incidentally, be thereby committed to (8a) rather than (8b) or (8c)).

(15) $\exists e[\text{verb}(e) \ \& \ \exists y \exists z[\text{THR}_1(y, e) \ \& \ \text{THR}_1(z, e) \ \& \ y \neq z]]$

Independence—the requirement that thematic roles be semantically characterizable independently of the meaning of the verb describing the event—also follows naturally here from the fact that statements have the form of conjunctions of predications about an event: the truth conditions of each conjunct will have to be determinable independently of the other conjuncts. True, we still will need to stipulate that the relations denoted by thematic roles be something like natural properties, to be absolutely sure of ruling out exotic definitions which amount to (9), but such a requirement seems more motivated under the Neo-Davidsonian approach, since thematic roles, not verbs, denote the compositionally basic relational terms we are working with. (Under the ordered argument theory, by contrast, thematic roles are secondary (and second-order) notions, derived from verb denotations by intersecting entailments.)

A brief historical note is in order here. First, some people, for example Chomsky (1981, p. 35) seem to have thought that the theory implied by (14), rather than that implied by (13a), is what Davidson *did* propose. However, I find no justification for this attribution in Davidson's writings themselves, in fact Davidson argued *against* (14) in Davidson (1967a). The theory implied by (14) was, on the other hand, explicitly proposed as a modification of Davidson's by Terence Parsons (1980), and the theory of thematic roles in Carlson (1985) is, as far as I can tell,

equivalent to Parsons' proposal and mine. While I certainly owe a debt to both these papers, I might point out that neither Parsons nor Carlson observe that the three requirements of Completeness, Distinctness and Independence motivate the Neo-Davidsonian analysis; also, I will propose that the Neo-Davidsonian analysis applies to a different domain in natural languages from what Parsons and Carlson have assumed.

To fill out our Neo-Davidsonian theory, we will apparently need two more things. First, we may want to assume that various kinds of events are entailed to have certain collections of participants (i.e. entailed via the lexical meaning of the verbs denoting them). For example, if events of giving always have three participants, a Source, a Theme and a Goal, then we would need to be able to state that (16) is an entailment for events named by this verb, and similarly for other verbs.

$$(16) \forall e \square [\text{giving}(e) \rightarrow \exists x \text{Agent}(x, e) \ \& \ \exists y \text{Source}(y, e) \ \& \ \exists z \text{Goal}(z, e)]$$

Also, there will seemingly be entailments about event participants that are specific to individual verbs, entailments above and beyond those that follow from the thematic role predicate itself. For example, if a person is the agent of an event of singing, then that person's vocal cords are (mostly) in motion, he is exhaling air, etc. If he is Agent of an event of whistling, then he is exhaling but his vocal cords are *not* moving. To describe these, we apparently need meaning postulates like (17):

$$(17) \forall e \forall x \square [(\text{singing}(e) \ \& \ \text{Agent}(x, e)) \rightarrow \text{moving-vocal-cords}(x)]$$

Such entailments as these will correspond, in the ordered-argument theory, to entailments of individual thematic roles that are not part of any L-thematic-role type. I will return to the status of entailments like (16) and (17) below.

Finally, we may want to impose a uniqueness requirement on the individuals asserted to bear thematic roles in events, to the effect that no individual other than the one mentioned bears that same role in that same event:

$$(18) \text{ (Uniqueness of role-bearer) For all thematic roles } TH_i:$$

$$\forall e \forall x \square [TH_i(x, e) \rightarrow \forall y [TH_i(y, e) \rightarrow x = y]]$$

Both Carlson (1985) and Chierchia (1984) assume such a condition will hold; in Chierchia's formulation, it follows because thematic roles are defined as functions into the set of individuals, rather than relations. However, note that uniqueness is a different condition from distinctness; distinctness only requires that the set of entailments relative to a given argument position are distinct from that of other argument-positions. Uniqueness requires that the individual denoted by the argument in this position is the only one that bears this thematic role. Finally, note that uniqueness does not really commit us to Chierchia's (1984) position that thematic roles are functions into the set of individuals: uniqueness as in (18) means each thematic role has only one bearer, but does not rule out the possibility that the same individual may be bearer of more than one thematic role.

It might seem that this condition would cause problems with plural sentences, such as *John and Mary sang*. However, I think it need not do so, if we adopt the theory of plurals proposed in Scha (1981), Hoeksema (1983) and elsewhere, which holds that plural NPs consistently denote groups (i.e. non-singleton sets), and that distinctions between collective and distributive interpretations, as in (19), are not differences in the types of NP denotations but only differences in lexical entailments of verbs:

- (19) a. John and Mary sang, fell asleep. (*distributive*)
- b. John and Mary painted the house, bought the car. (*distributive or collective*)
- c. John and Mary met, are alike. (*collective*)

That is, all three examples predicate something about the group consisting of John and Mary; however, with a distributive predicate it is entailed that whenever the predicate is true of a group, it is also true of all the members of the group individually; with a collective predicate, it is entailed that the predicate is never true of the individuals making up the group, and that with predicates like those in (19b), it is not entailed that the predicate either is or is not also true of the individuals in the group; i.e. such predicates are usually unspecified, rather than ambiguous, between group and individual predication.

If we assume that the variable x in (18) ranges over a domain of discourse that contains groups as well as individuals, then it seems to me to give sensible results with this theory of plurality, if we pay careful attention to the way events must be individuated when we invoke the distributivity axioms. It is required that in the case of (19a), three events are entailed to exist: the event of John and Mary's singing (which will have a group as Agent), plus the distinct event of John's singing and the event of Mary's singing: each of the last two has only an individual Agent. In example (19c), only one event of meeting is involved, and this one has as Agent the group with John and Mary as members, though neither John nor Mary can separately be Agents of this event (though we may be able to conclude that they are agents of *other* events, e.g. events of moving to some place, etc.) Though these ways of individuating events may be novel, I am not aware of any problems that they involve us in.

4. Relative Expressive Capacity of the Two Systems

We can now consider the question whether the two theories of predicate-argument association are equivalent in expressive capacity, or whether one is stronger than the other. First of all we must address the question whether the meanings of natural language verbs really are such that all their arguments can be semantically distinguished by a system of roles meeting criteria of Completeness (7), Distinctness (8), Independence (10), and possibly Uniqueness of Bearer (18), for this hypothesis is an empirical one which might turn out to be false. If it is false, then only an ordered-argument system (or some yet-to-be discovered intermediate one) is expressively rich enough to build what I called a *strong* thematic roles theory (in 2.2 above) on. (For some reasons to be skeptical of the hypothesis and some reasons to be interested in "weaker" theories of roles, see Dowty (1987), section 4.) If on the other hand natural language verbs are so characterizable, then

in principle it seems that equivalences between ordered-argument descriptions of events and the corresponding Neo-Davidsonian descriptions should hold for all verbs, for example *give* as in (20):

- (20) $\forall x \forall y \forall z \square [give(x, y, z) \leftrightarrow \exists e [giving(e) \ \& \ occur(e) \ \& \ Source(x, e) \ \& \ Theme(y, e) \ \& \ Goal(z, e)]]$

Whether such equivalences will actually hold depends on two further matters: whether we decide to include postulates like (16) or (17) above in our thematic role system (which entail that events of a certain type always involve certain role-bearers as participants, or which entail that role-bearers in an event-type are entailed to have properties other than just those of the role itself). As long as we do not, then these entailments about participants "above and beyond" what the thematic role predicates entail about them cannot be described in the Neo-Davidsonian theory, so it would be expressively weaker under these conditions. (As I suggest in Dowty (1987), there might be reason to view the neo-Davidsonian method as a part of a theory of how our knowledge of the entailments of event-verbs grows with cognitive and linguistic maturation: initially, it is a system in which entailments like (16) and (17) are absent, and thus a weaker system than the ordered-argument system, but later, when these kinds of entailments are fully understood, either a system where equivalences to ordered-argument descriptions hold generally, or possibly an ordered-argument system of even greater expressive power than a Neo-Davidson system, if "non-Neo-Davidsonian" verb meanings exist.)

5. Further Questions to be Answered

This completes the sketches of the two formal theories of thematic roles. The next steps in this inquiry are, therefore, to try to answer the following:

- (21) a. What linguistic evidence can be found motivating one or the other of the two theories of thematic roles? Or, if neither appears wholly adequate for natural languages, is there evidence that the two theories apply to two different domains in natural languages?
- b. Is the fundamental empirical hypothesis correct that underlies both theories of role-types—i.e. that all verbs in all natural languages have meanings characterizable by a small finite set of role types meeting the conditions of completeness (7), distinctness (8), and independence (14)?
- c. If hypothesis (b) is not correct, how should we interpret the linguistic literature that purports to show syntactic generalizations in terms of thematic roles and hierarchies of role-types? In particular:
- d. Is it reasonable to speculate about psychological explanations for the tendency of verb-argument entailments to cluster into apparent thematic-role types, explanations from language acquisition and/or the cognitive classification of events?
- e. Are thematic roles in the world, in the language, or in the head?

Although these are ultimately of more interest to the linguist than the formal theories sketched out above, time limitations (and published space limitations) imposed by the format of this conference do not permit these to be pursued any further here. However, these questions are discussed in some detail in Dowty (1987). In regard to (a), it is there proposed that the ordered-argument theory is more likely to characterize the way verbs are associated semantically with their subcategorized arguments, while the Neo-Davidsonian theory is more likely to characterize the way verbs are semantically associated with adjuncts and the way all arguments of (derived) nominals referring to events are associated with these nominals. (Rappaport 1983 has proposed a similar hypothesis.) While the question (b) will surely not be settled to everyone's satisfaction for some time to come, it is proposed in Dowty (1987) that there are reasons for skepticism about this empirical hypothesis. Consequently, question (c) is then addressed, and it is speculated (d) that the language acquisition situation and (in apparent agreement with Carlson 1986) the preliminary cognitive classification of events may be the place to look for the source of the "thematic role" phenomenon. Finally, it is shown why (d) represents a very fundamental question about the analysis of thematic roles that must be resolved before a model-theoretic semantic treatment of thematic roles will be on a sure footing, and this question has not previously been addressed; even in the theoretical and descriptive linguistic literature on roles, an apparent bifurcation among linguists can be found according to how this question is implicitly answered.

ACKNOWLEDGEMENTS

I would like to thank Gennaro Chierchia and Greg Carlson for their very helpful comments, without of course implying that they agree with any or all conclusions in this paper. Earlier versions of this material were also presented orally at Stanford University, the Microelectronics and Computer Technology Corporation, and the University of Massachusetts at Amherst, and I would like to thank also the members of those audiences for their comments.

NOTES

¹At least Chierchia (1984, ms.), Dowty (1985), and Ladusaw and Dowty (1985) have explicitly suggested that thematic roles be regarded, in a model-theoretic semantic theory, as sets of entailments of lexical items.

²If some thematic role "entailments" actually are presuppositions, and if presuppositions are treated along the lines of Karttunen and Peters (1979), then the method of describing such presuppositions would not seem to differ greatly from that of the entailments discussed in this paper.

³It is often pointed out that in "standard" Government-Binding Theory, the only essential thing about thematic roles is the (one-place) predicate *is assigned a θ -role*, which serves to distinguish non- θ NPs, the dummies *there* and *it*, from other NPs. (In Dowty (1981), it is shown how the semantics of these NPs can be treated systematically in a model-theoretic rule-to-rule semantics based on a mono-stratal syntax: although such NPs have real enough denotations, the so-called "null θ -role"

they are assigned in GB turns out to correspond semantically simply to the complete absence of entailments generated in these argument positions, hence it matters not at all what their denotations are.) Since, as pointed out in the text above, current "standard" GB does not wish to commit itself to the assumption that role-types exist at all, and since only the one-place predicate "is assigned a θ -role" plays a significant part in the GB theory, I can think of nothing that distinguishes the GB theory semantically from an ordered-argument theory, where the GB predicate *is assigned a θ -role* is understood to mean "is an NP interpreted semantically as an argument or adjunct of the verb", and *is not assigned a θ -role* understood as "is an NP receiving no (normal compositional) semantic interpretation".

REFERENCES

- Andrews, Avery (1985) 'The Major Functions of the Noun Phrase', *Language Typology and Syntactic Description, vol. I: Clause Structure*, edited by Timothy Shopen, Cambridge: Cambridge University Press, pp. 62-154.
- Carlson, Greg (1984) 'On the Role of Thematic Roles in Linguistic Theory', *Linguistics* 22, pp. 259-279.
- Chierchia, Gennaro (1984) *Topics in the Syntax and Semantics of Infinitives and Gerunds*, University of Massachusetts dissertation (to be published in revised form as *Predication in Natural Language*, Cambridge: MIT Press).
- Chierchia, Gennaro (ms.) 'Non-Existent Subjects', unpublished paper, Brown University, 1985.
- Chomsky, Noam (1981) *Lectures on Government and Binding*, Dordrecht: Foris Publications.
- Cocchiarella, N. (1983) *Logical Investigations of Predication Theory and the Problem of Universals*, Naples: Bibliopolis.
- Davidson, Donald (1767a) 'Reply to Comments', *The Logic of Decision and Action*, edited by Nicholas Rescher, Pittsburgh: The University of Pittsburgh Press, pp. 115-120.
- Davidson, Donald (1967) 'The Logical Form of Action Sentences', *The Logic of Decision and Action*, edited by Nicholas Rescher, Pittsburgh: University of Pittsburgh Press, pp. 81-95.
- Dowty, David (1985) 'On Recent Analyses of the Semantics of Control', *Linguistics and Philosophy* 8.3, pp. 1-41.
- Dowty, David R. (1987) 'On the Semantic Content of the Notion "Thematic Role", to appear in *Property Theory, Type Theory and Semantics* (Proceedings of the 1986 University of Massachusetts Conference), edited by G. Chierchia, B. Partee, and R. Turner, Dordrecht: D. Reidel.
- Fillmore, Charles (1968) 'The Case for Case', *Universals in Linguistic Theory*, edited by Emmon Bach and Robert T. Harms, New York: Holt, Rinehart and Winston, pp. 1-90.
- Gruber, Jeffrey S. (1965) *Studies in Lexical Relations, Doctoral Dissertation, MIT, distributed by the Indiana University Linguistics Club*.
- Hoeksema, Jack (1983) 'Plurality and Conjunction', *Studies in Model-Theoretic Semantics (Groningen-Amsterdam Studies in Semantics, v. 1)*, edited by Alice G. B. ter Meulen, Dordrecht: Foris Publications, pp. 63-84.
- Jackendoff, Ray (1972) *Semantic Interpretation in Generative Grammar*, Cambridge: MIT Press.

- Jackendoff, Ray S. (1985) The Role of Thematic Relations in Linguistic Theory, , paper presented at the Symposium on Thematic Roles, 1985 Annual Meeting of the Linguistic Society of America, December 27-30, 1985.
- Karttunen, Lauri and Stanley Peters (1979) 'Conventional Implicature', *Syntax and Semantics 11*, edited by Choon-Kyu Oh and David Dineen, New York: Academic Press, pp. 1-56.
- Ladusaw, William, and David Dowty (1985) 'Towards a Non-Semantic Account of Thematic Roles', paper presented at the 1985 Southern California Conference on General Linguistics, UC San Diego, May 1985 (copies of this paper can presently be obtained by writing to either co-author).
- Marantz, Alec P. (1984) *On the Nature of Grammatical Relations*, Cambridge: MIT Press.
- Nichigauchi, Taisuke (1984) 'Control and the Thematic Domain', *Language* 60, pp. 397-414.
- Parsons, Terence (1980) 'Modifiers and Quantifiers in Natural Language', *Canadian Journal of Philosophy* Supplementary Volume VI, pp. 29-60.
- Rappaport, Malka (1983) 'On the Nature of Derived Nominals', *Papers in Lexical-Functional Grammar*, edited by L. Levin, M. Rappaport, and A. Zaenen, Bloomington: Indiana University Linguistics Club.
- Riemsdijk, Henk van, and Edwin Williams (1986) *Introduction to the Theory of Grammar*, Cambridge: MIT Press.
- Scha, Remko (1981) "Distributive, Collective and Cumulative Quantification", *Formal Methods in the Study of Language*, edited by J. Groenendijk, T. Janssen and M. Stokhof, Amsterdam: Mathematical Centre Tracts, pp. 483-512.