

Lexical Distributivity and Implicit Arguments*

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Popular assumptions about distributive predicates and implicit arguments interact to predict incorrect truth conditions for sentences in which a predicate takes both an implicit argument and an overt distributive argument. This paper argues that the conflict provides evidence for a particular approach to argument structure and in particular to the semantics of implicit arguments: namely, a "neo-Davidsonian" approach, in which thematic roles are analyzed as relations between events and individuals, and existentially interpreted implicit arguments do not appear in the syntax or in logical representation at all. The effect of implicit arguments is produced through the use of meaning postulates guaranteeing that any atomic event of a given type must bear the appropriate thematic relation to some individual.

1. Two types of implicit argument.

Implicit arguments come in at least two distinct types. The claims of this paper should be understood as applying to only one of these types, specifically, to EXISTENTIALLY QUANTIFIED implicit arguments. No claim is made about the separate category of DEICTIC implicit arguments.

A few examples should make the distinction clear. Perhaps the best known and most studied example of an implicit argument is the implicit agent of a short passive, as in (1):

- (1) John was killed.

Here, the agent of the killing is left unmentioned, but we know that if John was killed, there had to be someone or something that killed him. Moreover, the agent is systematically expressed in related constructions like the long passive in (2) and the active in (3):

- (2) John was killed by someone or something.
(3) Someone or something killed John.

*Thanks to Barry Schein, whose correspondence on the issues discussed in this paper helped improve it considerably. (This is not to say that he agrees with the arguments given here, of course.) Remaining errors are my own.

It is somewhat of a fudge to call the implicit argument here an AGENT, since John could have been killed by something with no agentivity at all, such as a falling branch; but it is convenient to use this label anyway, and I will do so throughout this paper.

With few exceptions, the implicit agent of a short passive is interpreted as existentially quantified.¹ That is, a short passive sentence is interpreted as though there were a variable in the argument place of the implicit agent, bound by an existential quantifier. For example, sentence (1) is interpreted essentially as in (4):

(4) $\exists x \text{ kill}(x, j)$

The sentence is true no matter who or what killed John, as long as something did; the implicit argument does not refer to a particular individual, but instead is existentially quantified.

We have a similar interpretation for the implicit object argument of the detransitivized version of the verb *eat*, as in (5):

(5) John ate.

In this case the interpretation is like that of the formula in (6), once again with an existential quantifier:

(6) $\exists x \text{ eat}(j, x)$

As long as John ate SOMETHING, the sentence is true; the implicit argument does not refer to a particular thing, but instead is like a variable bound by an existential quantifier.

We should distinguish this sort of implicit argument from implicit arguments which receive a DEICTIC interpretation. As an example, consider the implicit *than* argument in a comparative construction, as illustrated in (7):

¹In a few odd cases, the implicit agent of a short passive seems to be interpreted deictically rather than existentially. For example, sentence (i) seems better paraphrased as (ii) than as (iii):

- (i) The traps were avoided.
- (ii) The pragmatically relevant individual(s) avoided the traps.
- (iii) There is someone or something that avoided the traps.

No explanation of this fact will be offered here, although the questions such examples raise are fascinating.

(7) John is stronger.

Sentence (7) doesn't just mean that there is SOMETHING that John is stronger than – in this case it would be almost trivially true. Instead, it means that John is stronger than some pragmatically determined individual or measure of strength. For example, in some contexts it might mean that John is stronger than Bill; in other contexts it might mean that he is stronger than his own previous level of strength; but in any case it does not have a meaning like the formula in (8):

(8) $\exists x$ stronger-than(j, x)

Likewise, the implicit location argument of a verb like *arrive* does not receive an existential interpretation. Sentence (9), for example, means that John arrived at the pragmatically relevant location; it doesn't just mean that he arrived *somewhere*, as in the formula in (10):

(9) John arrived.

(10) $\exists l$ arrive(j, l)

I will have nothing to say in this paper about why some implicit arguments are interpreted one way and others are interpreted differently, although this is a very interesting question. The distinction between deictic and existential implicit arguments will be of importance mainly in that the problems outlined below arise only in connection with existentially quantified implicit arguments, and not in connection with deictically interpreted implicit arguments. We will set deictically interpreted implicit arguments aside and concern ourselves only with existentially quantified implicit arguments.

2. Two analyses of implicit arguments.

How can a formal analysis give the effect of an existentially quantified implicit argument? The most venerable approach is probably a syntactic one: The implicit argument is taken to be an actual noun phrase, semantically equivalent to *someone* or *something*. To explain why we can't hear this noun phrase when someone utters *John was killed* or *John ate*, we claim either that the noun phrase is phonologically empty, or else that it is present only at some more abstract level of representation.

An alternative approach is to deny that implicit arguments appear as separate constituents in the syntax at all. Instead, the existential quantifica-

tion associated with implicit arguments is taken to form part of the internal semantics of the predicate itself. We understand the passive form of a verb to be a different predicate from the active form; likewise, detransitive forms are different predicates from their transitive counterparts. We can then give a rule like (11), defining the passive form of a verb in terms of its active counterpart, or a rule like (12), defining a detransitivized verb in terms of its transitive counterpart:

- (11) If α is a verb translating as α' , and α_{pas} is the passive form of α , then α_{pas} translates as $\lambda y \exists x \alpha'(x, y)$.
 (12) If α is a verb translating as α' , and α_{detrans} is the detransitivized form of α , then α_{detrans} translates as $\lambda x \exists y \alpha'(x, y)$.

Rules essentially like these can be found in Bach (1980) or Dowty (1982), for example.

The usual argument for adopting this kind of analysis is that it explains why existentially quantified implicit arguments must take narrow scope with respect to overt quantifiers in the sentence. Normally, a noun phrase expressing existential quantification may take wide or narrow scope; so sentence (13), for example, seems to have a wide-scope reading which requires that everyone was killed by the same person, in addition to a narrow scope reading which allows different killers for the different victims.

- (13) Everyone was killed by a crazy guy with a gun.

Of course it is possible to deny that there is an ambiguity here, since the first reading is a special case of the second, but we may set this issue aside; the point is not that the wide scope reading exists, but that even if it does exist, it is NOT available for existentially quantified implicit arguments. So even if (13) has a reading like (14), sentence (15) does not. This can only mean something like (16), with narrow scope for the existential quantifier.

- (14) $\exists x \forall y \text{ kill}(x, y)$
 (15) Everyone was killed.
 (16) $\forall y \exists x \text{ kill}(x, y)$

Given a rule like (11) or (12) and some very basic assumptions about compositionality, the existential quantifier will never take wide scope over a quantifier which forms an independent syntactic element from the predicate, and so we explain something that seems rather mysterious on the assumption that implicit arguments are actual noun phrases.

3. Distributivity.

Despite their advantages, rules like (11) and (12) turn out to be problematic. To see the problems, we must first consider a different kind of example, not involving implicit arguments, but something rather different, namely overt distributive arguments. We will return to implicit arguments in Section 4.

When a plural noun phrase serves as an argument to a predicate, the question arises as to whether this argument is to be interpreted COLLECTIVELY or DISTRIBUTIVELY. In the case of a collective interpretation, the predicate holds of the group denoted by the noun phrase, considered as a whole; it need not hold of the individual members of the group. In the case of a distributive interpretation, however, there is an entailment that the predicate holds of the individual members of the group. For example, sentence (17) means that each individual child was asleep, or at least enough of them that any exceptions are pragmatically disregarable. In contrast, sentence (18), which receives a collective interpretation, does not mean that each individual child is numerous, but rather that the entire group of children, considered as a whole, has the property of being numerous:²

- (17) The children are asleep.
 (18) The children are numerous.

How can we account for this difference in interpretation between (17) and (18)? It obviously has something to do with a difference in meaning between *numerous* and *asleep*, so it makes sense to account for it in the lexical semantics of these adjectives, for example through the use of a meaning postulate like the one in (19):

- (19) $asleep(X) \Leftrightarrow \forall y \in X \text{ asleep}(y)$

According to this postulate, a group of individuals is asleep if and only if each of the individual members of the group is asleep. We assume such a postulate for *asleep*, but not for *numerous*, and this accounts for the relevant difference between the two predicates.

Before proceeding I would like to address three potential objections to the use of meaning postulates like (19). First, some people may find it

²Probably a distributive interpretation is available in principle for sentence (18) as well, but it is nonsensical, and will not be considered as a possible interpretation for an actual utterance of the sentence except in the most unusual contexts.

objectionable to suppose that the quantification over members of the group here is UNIVERSAL quantification. After all, one can use a sentence like (17) even if one or two children are still awake, especially if the total number of children is large and it is not pragmatically relevant whether every last child is asleep. So perhaps what we need is a near-universal quantifier instead of a universal one.

It will hardly matter for the purposes at hand if the quantification does turn out to be near-universal instead of universal; the relevant problems will come up in either case. Even so, it is perhaps worth citing an argument from Kroch (1974, pp. 190-192) that there is universal quantification in this sort of example: Sentences like (20) sound distinctly contradictory, and in this respect differ from corresponding sentences like (21), where near-universal quantification is made explicit.

(20)?? Although the children are asleep, some of them are awake.

(21) Although more or less all the children are asleep, some of them are awake.

Examples like these suggest that lexical distributivity really does involve universal quantification, and that to the extent that a sentence like (17) allows for some children to be awake, it is because in some circumstances these exceptions become pragmatically irrelevant, and not because the truth conditions make explicit allowance for such exceptions.³

A second possible objection to meaning postulates like (19) is that meaning postulates are incapable of handling examples which show an ambiguity between collective and distributive interpretations. Roberts (1987) has given well-known arguments against the use of meaning postulates to account for the distributive reading of ambiguous sentences like (22):

(22) John and Mary built a table.

This example is ambiguous between a distributive reading where John and Mary each built a table, and a collective reading where they built a table

³An interesting question which this claim sets up is why exceptions are more easily allowed in examples like (17) than in examples like (i):

(i) All the children are asleep.

Presumably, we must claim that *all the* differs from *the* in how much pragmatic disregardability it can tolerate. I have no idea how to formalize the difference, but see Dowty (1986) for discussion of related issues.

together. Hoeksema (1983) suggested an analysis of this ambiguity in terms of "optional meaning postulates," an idea which is very hard to make any sense of; Roberts (1987) and Link (1987) suggested the distributivity was due instead to an implicit, adverb-like operator on the predicate, an idea which is conceptually much less problematic.

I certainly agree that meaning postulates are not the way to account for the distributive reading of ambiguous examples like (22). But in cases where there is no ambiguity, where the distributive reading is actually FORCED by the appearance of a particular predicate, the lexical semantics of the predicate seems to be precisely the right place to account for the distributivity. Meaning postulates are a convenient way to describe lexical meaning.

In examples exhibiting an ambiguity between a collective reading and a distributive reading, we may follow Link and Roberts and assume that the distributive reading is due to an operator on the predicate, essentially as in (23):

$$(23) \quad D\alpha = \lambda X \forall y [y \in X \rightarrow \alpha(y)]$$

In examples where there is no ambiguity, and a distributive reading is due to the appearance of a particular predicate, we will assume that the distributivity is a result of the lexical meaning of the predicate itself rather than a separate operator, and will account for that distributivity through the use of a meaning postulate similar to that in (19).

A third objection was raised by James Higginbotham.⁴ By using meaning postulates in this way, we apparently make a prediction that negation must always take scope over the universal quantifier which forms part of the lexical meaning of the predicate. Thus, a sentence like (24) must have a meaning essentially like the formula in (25):

(24) The children are not asleep.

(25) $\neg \forall x \in C \text{ asleep}(x)$

If, for example, the majority of children are asleep, but one or two exceptional children are awake, sentence (24) is predicted to be true. However it is not immediately clear that a small number of exceptionally awake children is really enough to make (24) automatically true. Instead,

⁴In the question period after the talk.

in many contexts, (24) seems to imply that all or nearly all the children are awake.

I would suggest that sentences like (24) are actually ambiguous. We can obtain the apparently problematic reading by applying the distributivity operator to a predicate formed by lambda-abstracting across negation, as in (26):

$$(26) \text{ } ^D\lambda x[\neg \text{asleep}(x)](C)$$

In addition to this reading, I think that (24) does have a reading which is accurately rendered by (25). Suppose that John and Mary have a policy of never discussing their children unless they are asleep. One evening, they send the children upstairs to bed. After a while, Mary starts to discuss the children's recent behavior. At that very moment, they hear some noise coming from upstairs. In this situation, I think John could reasonably and truthfully say "Wait, the children aren't asleep," even though it may just be a single child who is awake.

Having met these three objections to (19), let us turn to the question of how to generalize this sort of approach to other predicates. The meaning postulate in (19) is of the general form in (27), and we might actually DEFINE distributivity in such a way that a predicate α is distributive if and only if it satisfies (27):

$$(27) \alpha(X) \Leftrightarrow \forall y \in X \alpha(y)$$

However, (27) only deals with one-place predicates. We must also concern ourselves with multi-place predicates, and account for distributivity in these cases as well.

A multi-place predicate can be distributive in one argument place without being distributive in its other argument places. For example the verb *kill* is potentially collective in its subject argument, but it is always distributive in its object argument: you can't kill a group of individuals without killing the individuals themselves. Therefore, we need a notion of DISTRIBUTIVITY RELATIVE TO A PARTICULAR ARGUMENT PLACE, rather than simply classifying whole predicates as either distributive or collective. A first stab at defining this notion might look something like (28):

$$(28) \alpha \text{ is distributive in its } i^{\text{th}} \text{ argument place iff whenever } x_i \text{ is plural:} \\ \alpha(x_1, \dots, x_i, \dots, x_n) \Leftrightarrow \forall y [y \in x_i \rightarrow \alpha(x_1, \dots, y, \dots, x_n)]$$

That is, a group can stand in the i^{th} argument place of a predicate α if and only if each of its individual members stands in that same argument place.

4. A problem with scope.

The definition in (28) seems like a natural extension of (27). However, it leads to problematic results when combined with either of the two theories of implicit arguments outlined in Section 2, above. Consider sentence (29):

(29) The soldiers were killed.

According to the rule for interpreting passives in (11), this sentence should get a translation into logical notation like (30). An analysis in which implicit arguments are actual noun phrases will presumably yield an equivalent representation:

(30) $\exists x \text{ kill}(x, S)$

But then, given that *kill* is distributive in its second argument place, (28) will make this equivalent to (31):

(31) $\exists x \forall y[y \in S \rightarrow \text{kill}(x, y)]$

This seems wrong, since it requires the same killer for all the soldiers; it does not allow for the possibility that the different soldiers were killed only by different agents. What we want is something more like (32), with the existential quantifier inside the scope of the universal:

(32) $\forall y[y \in S \rightarrow \exists x \text{ kill}(x, y)]$

The source of the problem here is that the existential quantifier comes from the rule in (11), which effectively just attaches it to the front of the predicate, even while the predicate itself has a kind of internal universal quantifier associated with its distributive argument place. As long as the rule for interpreting passives takes the predicate as its input, and attaches an existential quantifier in front of the predicate, this problem apparently must result. This is the case whether we use the actual rule in (11) or instead take the implicit argument as an independent noun phrase; neither approach has any way of giving the existential quantifier “super-narrow” scope inside the internal, lexical semantics of the predicate, which is what appears to be called for.

There are various ways we might try to solve this problem. The solution I would like to advocate will be presented in Section 5. In the remainder of the current section, I would like to consider an alternative that was suggested by Barry Schein (personal communication). Schein suggests that we can maintain that formulas such as (30) are adequate, despite the placement of the existential quantifier. The key is to claim that if the soldiers were killed, even by different agents, then there is something that killed (all) the soldiers, namely the group whose members are all the killers of the individual soldiers. For example, if John killed half the soldiers, and Mary killed the other half, then there is some x such that x killed the soldiers; namely, the group of John and Mary is such an x . It looks in that case like (30) is not so problematic after all.

What do we have to do formally to make this work? Schein suggests we replace the definition of distributivity in (28) with (33):

$$(33) \quad \alpha \text{ is distributive in its } i^{\text{th}} \text{ argument place iff: } \alpha(x_1, \dots, x_i, \dots, x_n) \Leftrightarrow \forall y \\ \exists z_1, \dots, z_{i-1}, z_{i+1}, \dots, z_n [y \in x_i \rightarrow [z_1 \subseteq x_1 \ \&\dots\ \&z_{i-1} \subseteq x_{i-1} \ \& \ z_{i+1} \subseteq x_{i+1} \ \&\dots\ \& \\ z_n \subseteq x_n \ \& \ \alpha(z_1, \dots, z_{i-1}, y, z_{i+1}, \dots, z_n)]] \ \& \ \forall z_1, \dots, z_{i-1}, z_{i+1}, \dots, z_n \exists y, \\ w_1, \dots, w_{i-1}, w_{i+1}, \dots, w_n [[z_1 \in x_1 \ \&\dots\ \& z_{i-1} \in x_{i-1} \ \& \ z_{i+1} \in x_{i+1}, \dots, z_n \in x_n] \\ \rightarrow [y \in x_i \ \& \ z_1 \in w_1 \ \&\dots\ \& z_{i-1} \in w_{i-1} \ \& \ z_{i+1} \in w_{i+1} \ \&\dots\ \& z_n \in w_n \ \& \ w_1 \subseteq x_1 \\ \&\dots\ \& w_{i-1} \subseteq x_{i-1} \ \& \ w_{i+1} \subseteq x_{i+1} \ \&\dots\ \& w_n \subseteq x_n \ \& \ \alpha(w_1, \dots, w_{i-1}, y, w_{i+1}, \dots, w_n)]]$$

As Schein puts it, “the formula is more complex than the underlying intuition.” The effect of (33) is best understood by example: according to (33), a sentence like (34) will be true if and only if each soldier was killed by some subset of the guerillas, and each guerilla was a member of some group that killed at least one soldier, as in (35):

(34) The guerillas killed the soldiers.

$$(35) \quad \forall y \in S \ \exists z \subseteq G \ \alpha(z, y) \ \& \ \forall z \in G \ \exists y \in S \ \exists w \subseteq G \ [z \in w \ \& \ \alpha(w, y)]$$

Perhaps we could quibble with the details here – for instance with the requirement that each guerilla has to be a member of some group that kills at least one soldier; but such quibbles would be beside the point. The crucial fact is that a rule like (33) allows us to “gather up” the individuals that stand in a relation to the members of some group, and say that these gathered-up individuals collectively stand in that same relation to the other group as a whole. For example we might gather up the individuals that killed soldier 1, the individuals that killed soldier 2, the individuals that killed soldier 3, and so on, and say that this group of gathered-up individuals killed “the soldiers.” The basic idea here is not new; although to my

knowledge no one has previously suggested a precise equivalent to (33), interesting comparisons can be made to Langendoen (1978) and Scha (1981).

A rule like (33) works well for predicates like *kill*. Unfortunately, it will not work as a general definition of distributivity. Other predicates turn out to be problematic. Consider the verb *know*, for instance, as in *to know a song*. This verb is distributive in its object argument place; you can't know some songs unless you know the individual songs themselves. However, *know* does not allow, as a matter of general principle, the kind of "gathering up" in subject position that we saw with *kill*. Consider the following context: John is organizing a children's pageant, in which a group of children are supposed to perform various songs. Some of the children may know some of the songs, and others of the children may know others of the songs, and still more of the children may know the rest – so that every song is known by at least some of the children; but unless all the children know all the songs they are supposed to, at least to the point where exceptions become pragmatically irrelevant, John cannot truthfully assert (36):

(36) The children know the songs.

One cannot, as a matter of general principle, freely gather up the individuals that know subsets of the songs, put them all in a group, and say of that group that it knows the songs. Hence (33) is not an accurate characterization of the semantics of distributive predicates in general.

Without (33), agentless passives retain their problematic status. Although (36) is false in the context described, it does still seem true in that context that every song IS KNOWN, even if not by the right people, so the agentless passive sentence (37) is true:

(37) The songs are known.

In contrast, the formula in (38) (*cf.* (30)) may still be false; the songs may be known even if there is no *x* such that *x* knows (all) the songs:

(38) $\exists x \text{ know}(x, S)$

We may conclude that (38) is an inadequate representation of the truth conditions of (37), hence that a passive rule like (11) is also incorrect, since it produces exactly this formula. Once again, the problem is that the passive rule gives the existential quantifier associated with the implicit agent automatic wide scope over any quantifiers which form part of the internal,

lexical semantics of the predicate, including any quantifiers associated with distributive argument places.

Schein suggests that a defender of (33) might meet these objections by claiming that in (36), the noun phrase *the songs* may be interpreted contextually as *the songs they were supposed to*. In addition, the verb phrase is modified by a D-operator (see (23)), so that the subject is interpreted distributively. In this case, the sentence means that each child knows the songs he or she is supposed to. Since *know* is distributive in its object argument, this means that each child knows EACH of the songs he or she is supposed to, which is more-or-less what (36) really means.

However, we still encounter some problems. Suppose that the songs involve fairly complex choral arrangements where the different children sing different parts, even of a given song. In this case, (36) can be true even if no child actually knows a whole song, as long as they each know their parts. Should we now claim that *the songs* may be contextually interpreted as *those portions of the songs they are supposed to*? In my opinion, this would go just too far in allowing a contextual effect on the compositional semantics of the noun phrase; we are no longer just restricting the class of songs which we quantify over, but instead are completely reinterpreting the sense of the noun phrase.

To conclude: Trying to maintain that the existential quantifier associated with implicit arguments really does have wide scope relative to the universal quantifier from distributive arguments is not a very attractive, or perhaps even tenable, position. What we should look for is some way of obtaining narrow scope.

5. Implicit arguments in an event-based theory of thematic roles.

If we assume that implicit arguments are independent noun phrases, or if we use rules like (11) or (12), it is very difficult to see how we could obtain sufficiently narrow scope for implicit arguments. However, narrow scope falls out almost automatically in the third major way (that I know of) for analyzing implicit arguments. This third way involves what is sometimes

called a “neo-Davidsonian”⁵ decomposition of verbs into an event predicate and a series of thematic relations, as in (39):

(39) *Kill* translates as $\lambda y \lambda x \lambda e [\text{kill}(e) \ \& \ \text{AGENT}(x,e) \ \& \ \text{PATIENT}(y,e)]$

The idea is that the verb has a corresponding one-place predicate of events; the subject and object of the verb are related to these events via thematic roles, which are taken to be two-place relations between an event and its participants. The event argument is normally required to be an existentially bound variable, so that sentence (40), for example, will receive the logical translation in (41):

(40) John killed Bill.

(41) $\exists e [\text{kill}(e) \ \& \ \text{AGENT}(j, e) \ \& \ \text{PATIENT}(b, e)]$

Once we assume that composition of predicates with their arguments is mediated by thematic relations in this fashion, we should define a notion of DISTRIBUTIVITY RELATIVE TO A THEMATIC ROLE, rather than retaining our old notion of distributivity relative to an argument place. The definition is given in (42); ‘<’ represents the proper part relation on events.⁶

(42) α is distributive with respect to θ iff:
 $[\alpha(e) \ \& \ \theta(X, e)] \Leftrightarrow \forall y \in X \exists e' < e [\alpha(e') \ \& \ \theta(y, e)]$

That is, where a predicate α is distributive with respect to a role θ , a group X bears role θ in an α event e if and only if for each member y of X , e

⁵The term Neo-Davidsonian is from Dowty (1989). The format of (39) follows suggestions of Parsons (1980, 1985, 1990) and related work. For our purposes, the crucial feature of this decomposition is that it produces a separate logical clause for each thematic role, an idea reminiscent of Davidson’s (1967a) use of separate logical clauses for adverbial expressions. Some authors appear to attribute the extension of this technique to thematic roles to Davidson himself (e.g. Parsons 1980, p. 33; Chomsky 1981, p. 35; Schein to appear, Ch. 2), but as Dowty points out, Davidson (1967b) actually argued AGAINST this idea, not for it. To my knowledge the idea actually originates with Castañeda (1967), though perhaps a historical analogue can be seen in pre-Fregean attempts to reduce transitive sentences to simple subject/predicate structures. Although Castañeda argued for the use of separate clauses corresponding to different thematic roles, he did not explicitly treat thematic roles as relations between events and individuals as (39) does, nor did he argue for the use of a one-place event predicate corresponding to the verb as in (39); so far as I know, these ideas originate with Parsons (1980).

⁶The variable X here (and throughout) should be understood as ranging over groups – which, for the sake of simplicity, we may take to be sets of cardinality 2 or greater.

has a smaller subevent e' as a part, which is also an α event, in which y bears θ .

For example, *kill* is distributive with respect to its patient role, so in any event where the soldiers are killed, there will be for each soldier, a subevent where that soldier was killed. Of course this should not be taken to mean that the soldiers were killed separately, or anything of the sort; even if all the soldiers were killed by a single bomb, for example, we may view the death of each individual soldier as an event in its own right.

Because of the separation of thematic relations from the main predicate, (42) is able to avoid reference to any roles other than the one being defined as distributive. In this respect it contrasts with our earlier definitions of distributivity in (28) and (33), which were forced to mention all the arguments of the predicate, even though it was only the i^{th} argument whose status as distributive or non-distributive was being considered. This feature of (42) will prove very helpful in avoiding some of the problems with (28). Suppose that some group of soldiers S is killed in an event e – that is, $\text{KILL}(e) \ \& \ \text{PATIENT}(S, e)$. In this case, (42) requires for each individual soldier y in S , a corresponding event e' , a part of e , such that $\text{KILL}(e') \ \& \ \text{PATIENT}(y, e')$. But nothing requires that these smaller events corresponding to the individual soldiers must all have the same agent. This fact will play a crucial role in solving the scope problem for existentially quantified implicit arguments.

The use of a Neo-Davidsonian theory of thematic roles allows an interesting account of implicit arguments, significantly different from those discussed in Section 2. Parsons (1990) suggests that the clause corresponding to an implicit argument may simply be left out of logical translation. For example, sentence (43) will receive a representation like (44), with no mention of the agent argument at all:

(43) The soldiers were killed.

(44) $\exists e[\text{kill}(e) \ \& \ \text{PATIENT}(S, e)]$

If passive sentences are to be represented as in (44), we will need a passive rule essentially as in (45):

(45) If α is a verb translating as $\lambda y \lambda x \lambda e[\alpha'(e) \ \& \ \theta_1(x, e) \ \& \ \theta_2(y, e)]$, and α_{pas} is the passive form of α , then α_{pas} translates as $\lambda y \lambda e[\alpha'(e) \ \& \ \theta_2(y, e)]$.

The main effect of this rule is just to suppress the subject thematic role.

By itself, (45) will not give us an existential interpretation for implicit arguments – in fact, it won't give us the effect of an implicit argument at all. Consider the formula in (44); by itself, this formula will not guarantee that anything killed any of the soldiers; just that they were killed. Of course if the soldiers were killed, something must have killed them, so we need to say something more. A meaning postulate like (46) will do the trick: any atomic killing event must have an agent.

$$(46) \quad \forall e[\text{ATOM}(\text{kill}, e) \rightarrow \exists x \text{AGENT}(x, e)]$$

We define an event as atomic with respect to a predicate as in (47): it must have no proper subevents to which that predicate also applies.

$$(47) \quad \text{ATOM}(\alpha, e) \Leftrightarrow [\alpha(e) \ \& \ \neg \exists e' < e \ \alpha(e')]$$

The reference to atomic events in (46) is crucial; it should not be required that the whole, complex event in which all the soldiers are killed must have a single agent, for example.

It should be noted that (46) is not something special which we invoke just for passives or other cases of implicit arguments; something like this is needed anyway, if only to say which roles the predicate assigns. It does not in any sense form part of the passive rule, which is back in (45); instead, it is part of our characterization of the lexical meaning of the verb.

This approach to implicit arguments provides a way out of our central problem, namely that the existential quantifier associated with an implicit argument must take scope over the universal quantifier associated with a lexically distributive argument – a problem which seems inevitable in either of the approaches outlined in Section 2. In fact, the existential quantifier is now guaranteed to be effectively inside the scope of the universal, at least for any predicate subject to a postulate similar to (46). Suppose that some predicate α translates as $\lambda y \lambda x \lambda e[\alpha'(e) \ \& \ \theta_1(x, e) \ \& \ \theta_2(y, e)]$, is distributive with respect to θ_2 , and subject to the meaning postulate in (48) (cf. (46)):

$$(48) \quad \forall e[\text{ATOM}(\alpha', e) \rightarrow \exists x \theta_1(x, e)]$$

Given an event e and group X such that $\alpha'(e)$ and $\theta_2(X, e)$, the definition in (42) will require a proper subevent e' of e such that $\alpha(e')$ for each of the member of X ; the larger event e in which the group as a whole participates therefore cannot be atomic. Because e is not atomic, (48) will not be relevant to determining if anything bears θ_1 to it. Regarding the smaller events from which this big one is composed, however, any of these

which are atomic will be subject to (48); but nothing will require that the different atomic events must bear θ_1 to the same individual. By limiting the quantification to atomic events in this way, we allow that *The soldiers were killed* could be true even though the killing of each individual soldier has its own agent, for example, rather than requiring that there be a single agent for the larger, complex event of killing all the soldiers. Similarly, and perhaps more importantly, we allow *The songs are known* to be true even if each song is known by its own child or group of children, without requiring that there be some group which knows all the songs.

6. Conclusion.

To summarize: If we take implicit arguments to be independent noun phrases, they are assigned too wide a scope. If we use rules like (11) or (12), whose selling point traditionally has been that they give narrow scope to the existential quantifier associated with implicit arguments, this quantifier is still assigned too WIDE a scope with respect to the universal quantification associated with lexically distributive arguments. If, however, we assume the view of implicit arguments suggested by a neo-Davidsonian decomposition, where implicit arguments are completely unrepresented in the logical translation and the existential effect is given in the lexical semantics of the predicate rather than the rule which suppresses the argument, the right scope relations become available.

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