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A PLURAL REFERENCE INTERPRETATION OF THREE-DIMENSIONAL SYNTACTIC TREES

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Introduction

In my MIT Ph D thesis (Moltmann 1992), I had pursued a three-dimensional syntactic theory of coordination with a particular way of interpreting a three-dimensional syntactic structure. This sort of interpretation was based on a division of a three-dimensional syntactic tree into interpretable units (since three-dimensional syntactic structure allow for two directions of semantic composition: within a plane and across planes). The interpretation of conjunctions of DPs and VPs moreover was cast in terms of plural individuals, given the view that was standard at the time, namely that plural DPs such as *John and Mary* stand for a sum individual composed of John and Mary (Link 1983, Moltmann 1997 among others). The purpose of this note is to point out that three-dimensional syntactic structures go along better with a different way of interpreting conjunctions, namely Plural Reference. Plural Reference is the view that a plural DP such as *John and Mary* does not stand for a single plural individual, a sum or set, composed of John and Mary, but instead refers to John and to Mary at once, or in other words, it plurally refers to John and to Mary. This means, using Russell's phrase, that *John and Mary* stands for a 'plurality as many' (it takes two semantic values at once), rather than standing for a 'plurality as one' (taking a plural individual as a single semantic value).

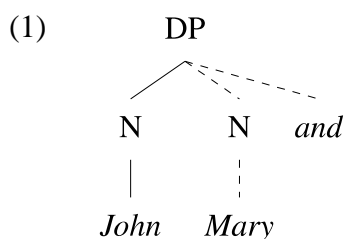
This way of interpreting conjoined DPs within a three-dimensional syntactic analysis may generalize to conjunctions of other sorts of categories, for example conjunctions of adjectival predicates such as *happy and satisfied*. In the spirit of Plural Reference, conjunctions of predicates can be interpreted by simultaneous operations of predication applying to the conjuncts at once. More generally, conjunction would amount to the simultaneous application

of semantic operations to several things at once, rather than the composition of a complex entity from the semantic values of the conjuncts.

Such a way of interpreting conjunction promises a uniform treatment of conjunction, avoiding in particular an ambiguity of *and* as Boolean and as non-Boolean conjunction, as on the standard view. The standard view interprets conjunction DPs as standing for plural individuals and conjunction of predicates such as *happy and satisfied* as involving logical conjunction.

1 The syntax and semantics of three-dimensional syntactic trees

Three-dimensional syntactic analyses of coordination have been motivated by various syntactic phenomena peculiar to coordination, such as ATB extraction, Right Node Raising, and Gapping (Goodall 1985, Muadz 1991, Moltmann 1992). The main idea of such analyses is that while movement may apply to the various planes of a three-dimensional syntactic structure at once (leading to a shared node), syntactic rules and conditions apply to each plane individually. That is, standard syntax applies to individual planes, whereas coordination-specific syntactic rules apply to three-dimensional syntactic structures as such. The central assumption of three-dimensional syntactic analyses of coordinate sentences is that the constituents that are coordinated are not linearly ordered, at least not until the level of Phonetic Form. Rather they form different planes in a three-dimensional syntactic tree. Thus, in the DP *John and Mary*, *John* and *Mary* will be on different planes, though dominated by the same DP node:



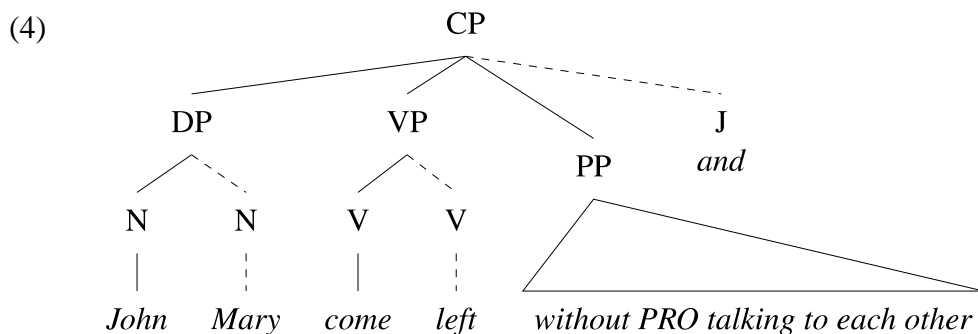
This note will take as its point of departure simply the particular conception of three-dimensional syntactic structures in Muadz (1991) and Moltmann (1992), not updating it with respect to more recent developments of syntactic theory or comparing it to alternative and more recent three-dimensional syntactic theories. Using simple phrase structure rules, coordinate structures thus are introduced as follows:

(2) $A \rightarrow \langle B_1, B_2, B_3, \dots \rangle J$, where B_1, B_2, B_3, \dots are legitimate expansions of A and J is a coordinator.

While the theory of Moltmann (1992) shares the main syntactic ideas with other three-dimensional syntactic theories, it proposed a particular way of dealing with expressions or constructions requiring plural antecedents in coordinate sentences that contain only singular DPs such as (3a-d) below:

- (3) a. *John came and Mary left without talking to each other.*
 b. *On the same day, John watched a movie and Mary a game.*
 c. *A man entered and a woman left that had known each other for ten years.*
 d. *The man and the woman who live in the same building like each other.*

The idea was that within a three-dimensional structure, *John* and *Mary* in (3a), which occupy separate planes (containing *John came* and *Mary left* respectively), are implicitly coordinated, which means they are dominated by the same DP node. Similarly *came* and *left* are implicitly coordinated, dominated by the same V-node. Thus, (3a) will have the structure below:



Such more complex three-dimensional syntactic structures will involve two sorts of logical forms, that is, syntactic structures that are inputs to semantic interpretation. These two logical forms will lead to two partial interpretations of the sentence, which subsequently are unified to form the complete meaning of the sentence. One logical form (LF₁) will be based on the material associated with the explicit coordination, roughly ‘John came and Mary left’, the other (LF₂) will be based on material involving implicit coordination, roughly ‘John (and) Mary came (and) left without PRO talking to each other’. LF₂ permits the coordinated DP to be interpreted as a plural DP referring to the sum of the semantic values of the singular DPs

John and Mary. This sum individual will then provide the semantic antecedent of PRO and of *each other*. Similarly, the implicit coordination of *came* and *left* will describe the sum of an event of coming and of leaving, that is, implicit coordination of *came* and *left* is interpreted just like the explicitly coordinated predicate *come and left*, as a relation between sum events and sum individuals, as below, where ‘ \vee ’ stands for the operation of sum formation:

$$(5) \{ \langle e, d \rangle \mid \exists e' \exists e'' \exists d' \exists d'' (\text{come}(e', d') \ \& \ \text{leave}(e'', d'') \ \& \ e = e' \vee e'' \ \& \ d = d' \vee d'') \}$$

The interpretation of LF₁ neglects the association of John with the coming and Mary with the leaving, but only cares about the two being involved in a complex event of coming and leaving while not talking to each other. The interpretation of LF₂ disregards the contribution of the expression requiring a plural antecedent, that is, of *without PRO talking to each other*.

2 Plural Reference

Let us then turn to the reinterpretation of three-dimensional syntactic trees on the basis of Plural Reference. The interpretation of conjunction in terms of Plural Reference applies to both overt coordination (with *and*) and implicit coordination. Plural Reference, again, is the view that a plural DP refers to several individuals at once, rather than referring to an entity that is a plurality (a sum or collection of individuals). On that view, *John and Mary* refers to John and Mary at once, rather than referring to the sum consisting of John and Mary, and *the children* refers to each individual child at once, rather than referring to the sum of children. Plural Reference has been pursued mainly by philosophical logicians (Boolos 1984, 1984, Oliver/Smiley 2004, 2006, 2013, Yi 2005, 2006, Linnebo 2012, Rayo 2006, McKay 2006, Moltmann 2016).

Plural Reference contrasts with Reference to Plurality, the view that definite plurals stand for single plural individuals, such as mereological sums or sets. Reference to a Plurality clearly had become the standard view in linguistic semantics (Link 1983, 1984, Landman 1989, Laserson 1995, Ojeda 1993, Schwarzschild 1996, Moltmann 1997) (with Schein 1995 being an exception). It is a view that receives intuitive support from various apparent parallels between singular count, mass, and plural DPs and has been applied to a great range of linguistic phenomena, including distributivity and plural quantifiers and plural-related adverbials of various sorts. By contrast, Plural Reference has hardly been explored for the

range of linguistic phenomena in natural language that involve plurals. However, there are good empirical linguistic reasons to prefer Plural Reference to Reference to a Plurality, coming especially from the acceptability and interpretation of different sorts of predicates with singular and plural DPs as well as the impossibility of substituting plural DPs by singular collective DPs in many contexts (Moltmann 2016). Plural Reference accounts for the rather strong intuition that a sentence like *John and Mary are nice* evaluates just John and Mary, not their sum, and it accounts for the truth of *John and Mary are two*, which is hard to account for if *John and Mary* stands for a single entity, a sum. This note adds another argument in favor of Plural Reference, coming from the interpretation of three-dimensional syntactic trees.

Plural Reference provides a straightforward compositional semantics of three-dimensional syntactic structures. In fact, one can say that Plural Reference provides the ‘literal’ interpretation of conjoined DPs on a three-dimensional syntactic analysis. On a three-dimensional analysis, *John and Mary* will be dominated by a single DP node, but the two conjuncts *John* and *Mary* will belong to different planes. Those two planes contain just ordinary singular DPs (*John* and *Mary* respectively) whose interpretations will yield two single individuals, a plurality ‘as many’. The semantic values of the two planes taken together thus already make up the Plural Reference interpretation of the entire conjoined DP, which will come out as standing for the two individuals John and Mary at once. That is, *John and Mary* is interpreted as plurally referring to both John and Mary simply by assigning the conjoined DP the interpretations of both of its planes at once.

This generalizes to conjunctions of expressions other than referential DPs by interpreting them as multiple applications of semantic operations at once. For example in the case of the conjunction of adjectives *happy and satisfied*, this would be the simultaneous attribution of the predicates *happy* and *satisfied* to the subject referent. This promises a unified treatment of coordination with *and*, which unlike the standard view based on Reference to a Plurality need not distinguish between *and* expressing sum formation (for conjoined referential DPs) and *and* expressing logical conjunction.

On the extended Plural Reference account of conjunction, *and* itself does not make a particular semantic contribution, neither expressing sum formation nor logical conjunction. This also means that both the explicit coordination *John and Mary* and the implicit coordination in which *and* is absent but *John* and *Mary* are dominated by a single DP node can be interpreted in the very same way, namely as a DP plurally referring to John and Mary at once. That is, the semantic values of *John and Mary* and well as the implicit coordination of *John* and *Mary* consist of both John and Mary, a plurality ‘as many’.

The predicate will then enter a single relation of predication (or theta-role assignment) to that DP. Semantically, this means that the predicate will be applied to the semantic values of the DP at once, that is, it will be interpreted as being true of John and Mary at once. Given the way Plural Reference is generally understood, this applies to both collective and distributive predicates (Oliver/Smiley 2013, Moltmann 2016).

Generalized to other coordinate structures this means that multiple simultaneous semantic values will be the unmarked interpretation of conjunctive coordinate structures. For example, the very same sort of interpretation can be applied to conjoined predicates dominated by a single category node, as in *the child is happy and satisfied*. Here the coordinate predicate phrase will enter the relation of predication to the subject DP, which means applying the conjunct predicates to the semantic value of the DP at once in order for the sentence as a whole to be evaluated as true or false. Similarly, *the happy and satisfied child* will involve multiple applications of the semantic operation of intersection at once, that is, intersection of the extension of *happy* and the extension of *satisfied* with the extension of *child*. Such multiple applications of a semantic operation at once amounts to a *plural application* of semantic operations (such as predication or intersection). Again, implicitly coordinated modifiers or predicates can be interpreted in the very same way, by plural application of the relevant semantic operation.

Plural reference and a plural application of a semantic operation obviously is restricted to coordination with conjunction. Coordinate structures with disjunction will be interpreted differently, let's say in the standard way. (Note that disjunction interpreted in the standard way does not raise the issue that Boolean and Non-Boolean uses of *and* raise.)

Conjunction will thus go along with the 'unmarked' interpretation of coordination, that is, plural reference or plural application of a semantic operation, an interpretation that is not based on a particular semantic contribution of *and*. This is supported by the observation that a conjunctive interpretation of a coordinate structure need not be based on the presence of an explicit conjunction. Thus, in many languages, for example English, an overt conjunction is not needed for a conjunctive interpretation of a coordinate structure:

(6) a. *John, Mary, Bill, Sue might be there.*

b. *John arrived, looked around, left.*

By contrast, for a disjunctive interpretation an explicit disjunction is required.

Plural application of a semantic operation also applies to other cases of coordination, for example conjoined predicates as in *the child is happy and innocent*. The conjunction here will be interpreted as multiple simultaneous application of conjunct predicates to the subject referent. Again implicitly coordinated predicates can be interpreted in the very same way.

There are some coordinate structures that admittedly are more challenging for the account. For example, *that*-clauses with coordinated IPs cannot be treated like coordinated CPs, plurally referring to several propositions. Thus, *John regrets that he bought the book and did not read it* is not equivalent to *John regrets that he bought the book and that he did not read it*. The standard view would treat a conjoined IP as expressing a conjunctive property of possible worlds. Of course, the possible-worlds account of embedded sentences need not necessarily be adopted; but it remains to be seen how conjoined IPs can be subsumed under the general account proposed here.

Another case is conjoined plural or mass nouns, as in *the men and women*, which involves the formation of a complex plural predicate *men and women*. Within Plural Reference such a complex plural predicate should have the denotation below, where ‘dd’, ‘dd’ ... are plural variables able to stand for several individuals at once and < is the ‘some of’-relation (which includes the case of ‘is one of’), a relation that holds between two pluralities ‘as many’ (with an individual being one such case of a plurality as well):

$$(7) \{dd \mid \exists dd' \exists dd'' (men(dd') \& women(dd'') \& dd' < dd \& dd'' < dd \& \forall d''' (d''' < dd \rightarrow d''' < dd' \vee d''' < dd''))\}$$

Also *come (and) leave* as in (3a) would require this sort of interpretation. Given Plural Reference, *come and leave* would have the extension below, where < is the relation ‘are some of’:

$$(8) \{ \langle ee, dd \rangle \mid \exists ee' \exists ee'' \exists dd' \exists dd'' (ee' < ee \& come(ee', dd') \& ee'' < ee \& leave(e'', dd'') \& \forall e''' (e''' < ee \rightarrow e''' < ee' \vee e''' < ee'') \& dd' < dd \& dd'' < dd \& \forall d''' (d''' < dd \rightarrow d''' < dd' \vee d''' < dd'')) \}$$

But (7) and (8) can hardly be obtained by way of a multiple simultaneous application of a semantic operation. The generalization of the Plural Reference interpretation of three-dimensional conjunctive structures thus is not as straightforward as it first might have seemed.

Nonetheless, it promises a novel, unified interpretation of conjunctive structures within a three-dimensional syntactic analysis and adds a significant argument for Plural Reference, an approach that has received increasing attention from philosophical logicians as well as, more recently, semanticists.

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