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Comments on Hintikka's Paper

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In Hintikka's hands, game-theoretical semantics (GTS) is both a technique and a doctrine. The technique consists in exploiting the game-theoretical method of defining truth, both for the sake of technical results in logic and in order to characterize various nonclassical conceptions of truth. The doctrine is that the game-theoretical interpretation of quantifiers and connectives is an illuminating framework within which to analyze quantification, discourse phenomena, and various types of pronominal cross-reference in natural language.

In these comments, I will consider GTS exclusively as a doctrine. Its distinguishing features may perhaps best be brought out by comparing GTS with another point of view, made precise in different ways by different investigators, which I will call for the purposes of this discussion the *standard framework* for the interpretation of quantifiers and pronouns in natural languages. The major issues to be addressed by either framework are these two:

i. What principles determine the types and degrees of ambiguity found in quantificational sentences?
ii. What principles govern the admissibility of anaphoric relations between pronominals and their potential antecedents, particularly quantificational ones; and what are the interpretive possibilities associated with the assignment of such relations?

Consider the familiar ambiguity of sentences of the type of (1):

(1) A man went into every store.

In the standard framework, this ambiguity is regarded as a matter of *scope*; that is, one pictures (1) as built up, from the point of view of its semantic analysis, in either of two ways, corresponding to the relative orders assigned to the quantificational noun phrases (NP's) *a man*, and *every store*. Such an explanation of the ambiguity of (1) involves the positing of a level of structure at which the ordering of quantifiers is explicitly represented. Just what this level

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looks like depends on the details of one's theory. In grammars of the type pioneered by Richard Montague, the relevant level is that of the *analysis tree*, which displays, step by step, the building up of (1) as an English sentence. In a Chomskyan framework, it has been proposed that there is a distinct syntactic level of "logical form", at which (1) comes out structurally ambiguous in just the way you would expect on the basis of its possible paraphrases as a sentence of a first-order language.

Despite differences in execution, the analyses suggested by Montague Grammar and those formulated within Chomsky's type of theory, as well as those stemming from other systems to be found in the literature, all account for the ambiguity of (1) in substantially the same way. Hintikka's method is different: he proposes, without recognizing an intermediate level of syntactic structure, that relative orders of quantificational NP's correspond to relative orders of the moves associated with those NP's in semantical games for sentences. The ambiguity of (1), for instance, would follow from the admissibility of applying the relevant game rules to (1) in either order.

In the standard framework one attempts to account not only for ambiguity, but also for the, occasionally surprising, *absence* of ambiguity in multiply quantified sentences. Sentence (2), for instance:

(2) They saw a man who has solved every problem.

cannot mean: every problem is an x such that they saw a man who has solved x. The NP *every problem* is, for some reason, confined to its own clause, the relative. In the standard framework, this and similar facts are accounted for in various ways; in GTS they are accounted for in terms of principles like (0.comm), which requires that semantical games be played "top-down", and so implies that (G.every) applies only after the object of *saw*, a quantificational relative NP, has been analyzed, using the game rule for the indefinite article.

Notice that there is nothing to prevent the standard framework from being combined with a GTS account of truth, if such an account should be desirable on other grounds. From this point of view, a sentence would already be disambiguated as to scope of quantifiers before any semantical game associated with it was played. Inversely, one can envisage theories in which ordering principles, rather than syntactic disambiguation, are used in conjunction with a classical definition of truth.[1]

The question of ordering principles vs the hypothesis of an intermediate level of relatively disambiguated syntactic structure is, therefore, in large part an issue of syntax. On this score, Hintikka's paper contains one argument in support of his type of view: that the concept of scope in a natural language "does not even make sense", the reason being that "a quantifier phrase can in principle have pronouns or anaphoric the-phrases referring back to it arbitrarily far later in the same sentence and even in the same discourse". Because this argument is so abbreviated, I shall take the liberty of expanding on it a bit. Consider sentences like (3) and (4):

(3) I saw a warbler yesterday, I'll bet you didn't see it.
(4) If you consult two doctors, I'll consult them too.

Clearly, some anaphoric relation can be established between *it* and *a warbler* in

(3), and *them* and *two doctors* in (4). But the scope of *a warbler* would, somehow, have to take in the second clause of (3) in order to bind the pronoun *it*; and in the case of (4) the attempt to understand the pronoun as bound to the expression *two doctors*, given scope over the entire conditional, would yield a palpably wrong interpretation; for (4) does not signify that there are two doctors such that if you consult them so will I.

Now discourses like (3) and sentences like (4) are problematic for the standard framework in that they show that pronouns can be anaphoric to quantificational antecedents even when they are not interpreted as within the scope of those antecedents. So, as I take Hintikka's argument, it constitutes a challenge to the standard framework to account for these cases. The GTS treatment, via subgames, is considered below.

So far I have contrasted the standard framework with GTS on the score of (i) above, the principles governing the ambiguities associated with quantificational sentences, suggesting that the differences between the approaches, pronominal anaphora excluded, are syntactic, not semantic. There is not, I think, at the present stage of development of GTS, very much to say about rule-ordering as against the standard treatment of quantificational ambiguities, because the GTS account has not been given in very great detail. I illustrate, with examples drawn from Hintikka's discussion.

Consider Hintikka's statement of the rule (G.some), repeated here as (5):

(5) If the game has reached the sentence
(*) X – some Y who Z – W
then an individual may be chosen by myself from that subdomain which consists of persons. If this individual does not have a proper name, it is given one. Let the proper name of the individual chosen be "b". The game is then continued with respect to
(**) $X - b - W$, b is a Y, and b Z.

(5) covers only the "special case" in which the relative pronoun is *who*, and it occupies subject position. The context shown in (*), taken literally, is satisfied by any sentence whatever that assigns strings to the variables, at least if (interpreting the hyphens) the phrase *some Y who Z* is an NP. But a moment's thought shows that this will not do; consider (6):

(6) Some person who knows who saw me is here.

Taking $X = \Phi$, Y = *person who knows*, Z = *saw me*, W = *is here*, and applying (5), we obtain (7):

(7) b is here, b is a person who knows, and b saw me.

What we want, of course, is (8):

(8) b is here, b is a person, and b knows who saw me.

But isn't the problem of getting (6) right just a finicky question of syntactic detail? Yes and no. A great merit of the standard framework, as explored by many investigators, is that its analysis of quantification is put forth in conjunction with detailed accounts of syntactic structures, so that the

implications of particular views can be discerned and tested for adequacy. GTS wants further development here, in my opinion.

For a second example of where Hintikka's analysis should be deepened, consider (9):

(9) Each divisor of some number is even.

In (9) the relative scopes of the quantifiers are inverse to their surface order, violating both the ordering principle (O.LR), and the specific principle associated with (O.each) (see Hintikka's paper, p. 227). The explanation of this fact is not particularly difficult; and it could be incorporated into GTS, so far as I can see.[2] But the explanation does involve the syntactic structure of the subject NP in (9); and the conclusion seems inescapable that if Hintikka is to develop his type of account of ambiguity into a general alternative to the more standard approach, far more attention must be given to syntax.

On the positive side, Hintikka's work has called attention to some potential semantic inadequacies for the standard framework, independently of questions of pronominal anaphora. One of these, not given much prominence in the present paper, is the possibility of branching, or partially ordered, quantification; however, such quantification could be added to the standard framework directly. Another, treated in more detail, is the *any*-thesis. I shall comment on Hintikka's discussion of this thesis in the paper under consideration, in general not going beyond what is to be found there; but I think that my remarks will also apply to Hintikka's more extended discussions of the thesis in the papers he cites.

Hintikka maintains the view, which can be defended much more vigorously than its critics usually give it credit for, that *any* can always be taken to have the force of a universal quantifier. Unfortunately, examples by Ladusaw [5] and Carlson [1], and some others of my own, seem to me to show that this thesis cannot ultimately be sustained. The formula behind the types of examples due to Carlson and Ladusaw emerges if we reflect on how the *any*-as-universal thesis is defended against putative counterexamples such as (10):

(10) If anybody contributes, I'll be surprised.

The apparent existential force of *any* in (10), suggested by the adequacy of the first-order paraphrase (11):

(11) ($[\exists x]$ x contributes) $\supset$ I'll be surprised.

is an appearance easily dispelled, in view of the logical equivalence of (11) to the paraphrase (12):

(12) $[\forall x]$ (x contributes $\supset$ I'll be surprised).

But now we have only to find a context in which the appearance cannot be dispelled in this way. So consider (13):

(13) That teacher rarely fails anybody.

Again *any* seems to have existential force, as shown, in rough form, by (14):

(14) Rarely is it the case that ($[\exists x]$ that teacher fails x).

(14) is logically independent of the paraphrase (15):

(15) [$\forall x$] rarely is it the case that that teacher fails x.

So the device available for (10) cannot be applied in this case.

Another type of example is afforded by conditionals in indirect questions, as in (16):

(16) John will know if anybody left.

Again the interpretation of *any* as universal, with whatever scope, fails to assign the proper interpretation to the sentence.

The question of which types of occurrences of *any* are universal, and which existential, is still a tangled one; but many linguists have taken the view that the principles governing its distribution are syntactic. This view, according to Hintikka, is mistaken. Possibly he is right; but he does not in his paper do justice to the hypotheses that have been offered. The most promising of these (though not without its limitations, as noted in Ladusaw) is that *any* is licensed only within the scope of an item of an appropriately "negative" sort, or else a modal. Hintikka's (16), given below as (17):

(17) If Chris trained hard she has by this time won any match.

is thus ungrammatical, because the item *if*, while licensing *any*, is embedded within a subordinate clause. (17) contrasts appropriately with (18):

(18) If she won any match, Chris trained hard.

Hintikka's (16), therefore, is no counterexample. As for his (18), repeated here as (19):

(19) If Chris trained hard, she can win any match.

it is explicable too, independently of the semantics: it is the modal in the main clause, absent in (17), that permits *any*. Contrast (20) and (21):

(20) John can do anything.
(21) *John did anything.

The *any*-thesis says, nearly enough, that only those sentences with *any* are acceptable that are both otherwise admitted by grammar and contrast in meaning with the result of replacing *any* by *every*. Is the thesis true? It is no clearer than the relevant notion of "contrast in meaning". Simple examples show that logical equivalence cannot be taken as a sufficient condition for *sameness* of meaning, in the sense pertinent to the *any*-thesis (see [2], p. 274, citing an example due to Lauri Carlson); and Hintikka's own example (17), repeated here as (22):

(22) *Not any girl has been dated by Bill.

is anomalous for his view as well as for the syntactic accounts, since (22) could be expected to contrast in meaning with the grammatical (23):

(23) Not every girl has been dated by Bill.

I am not, in fact, entirely clear that Hintikka's own formulation of the *any*-thesis, as a *semantic* criterion of acceptability, is coherent. Hintikka writes (p. 229):

> . . . in order to reject X – any – Y in those cases where X – every – Y is acceptable, we have to compare the meanings of the two sentences and hence to assign a meaning to the ill-formed string X – any – Y. This illustrates a recurring phenomenon uncovered by GTS, viz. that syntactical well-formedness and semantical interpretability frequently don't go together. This deprives generative syntax of much of its central theoretical interest.

The question is: what form does the supposed "comparison of meaning" take in determining our decision that given instances of X – any – Y are acceptable or unacceptable? If it takes the form of comparing *representations* of meaning (checking, for example, whether each representation is logically derivable from the other) then there does not seem to be any reason to withhold saying that the *any*-thesis is syntactical. But what could "comparison of meaning" signify otherwise?

By far the most dubious feature of Hintikka's *any*-thesis, however, is that it uses the notions "well-formed" and "acceptable" interchangeably. The most common usage of the notion *acceptable* contrasts it with well-formedness. The acceptability of a sentence, or of a sentence in a context, is a matter of one's dispositions, say to let it get by in that context without comment on propriety of expression. Well-formedness, by contrast, is a theoretical notion. There are plenty of well-formed but unacceptable sentences (e.g., the notorious cases of center-embedding); and any record of casual conversation will show acceptable expressions that are not well-formed. As for the distinction between well-formedness and interpretability, that too has been noted; one has only to think of deviant sentences with unique interpretations, as in (24):

(24) The man looks walking.

Hintikka may mean to raise the question how much grammatical well-formedness, now understood as a purely syntactical notion, determines acceptability; his thesis, if true, would show an area in which well-formedness is not sufficient for acceptability, the unacceptability now having a semantic basis. To this end, however, there are other, less controversial examples. Consider sentences of the form (25), similar to ones discussed a number of years ago by Paul Postal:

(25) N of my M friends betrayed me.

These will be unacceptable (or at least will elicit stares) if N is seen to exceed M. But all are well-formed. Do these or Hintikka's examples "deprive generative syntax of much of its theoretical interest"? I do not see why.

I have commented at some length on the *any*-thesis because of its prominence in Hintikka's paper. The question of the interpretation, or space of interpretations, of the English copula in GTS and the standard framework is another to which Hintikka directs our attention. I agree with him that it is at best extremely implausible that the copula in English is ambiguous as between identity, predication, existence, and general implication; but the standard

framework, I believe, is not necessarily committed to such ambiguity, or at least not to the full range of ambiguity that Hintikka identifies.

I am inclined to believe that the *is* of existence, as in *God is,* or *There are horses,* is a predicate in its own right, and in fact a predicate true of everything.[3] The supposed *is* of general implication seems to me illusory; the peculiarity of Hintikka's example, reproduced here as (26):

(26) A whale is a mammal.

is the "generic" nature of the predication, seen also in (27):

(27) A whale eats marine life.

This peculiarity is independent of the copula. This leaves us with *is* as heading up various predicate phrases, which may be completed by phrases of any major category, except verb phrases.[4] That is, the completion can be by an NP (*is Jack, is a lawyer*), an adjective phrase (AP) (*is tall, is too stubborn to talk to*), or a prepositional phrase (PP) (*is in the kitchen, is without hope*). In many languages (e.g., Chinese) expressions of these categories can serve as main predicates by themselves; no support from anything resembling a copula is required. Such facts strongly suggest that the copula, apart from its use as predicating existence, is required in these constructions just because English sentences have to have verbs; i.e., it suggests that *is* is pleonastic, semantically speaking.

The above suggestion is not new; something like it is to be found in Frege, I believe ([4], pp. 61-67; see also [8], p. 89). It would lead us to say that the logical form of (28):

(28) Sue's brother is Jack.

predicates *being Jack* of Sue's brother, the predicate being true of Jack and nothing else. I cannot expand on the consequences of this view here; if it is on the right track, then it tends to sustain Hintikka's doubts about the ambiguity of *is*, but not his further suggestion that the standard framework is inadequate (although it does count against a certain version of that framework).

I turn now to Hintikka's criticisms of compositionality. For lack of space, and also because I am not entirely sure how his arguments will go in some cases that he cites, I will indicate but one point that ought to be considered. The upholder of compositionality within the standard framework will take this principle to apply, not to surface strings, but to their abstract syntactic representations; it is to a theory in this form that counterexamples should be directed. Again, in those theories that take the derivation of *T*-sentences to be a *desideratum* of semantics, the ambiguities that appear at the abstract syntactic level must be adjusted for within the theory of truth itself. From this point of view, the failure of the *T*-schema, for instance in the *any*-sentences of the type Hintikka notes, is not surprising; it merely reflects the fact that instances of the *T*-schema, as sentences of English, are subject to the same rules of grammar as other sentences of English.

In comparing GTS to the standard framework, I have thus far concentrated entirely on question (i), concerning the principles that govern quantifica-

tion in natural languages, and certain auxiliary matters. I will conclude with a brief discussion of question (ii), the question of what principles govern the distribution and semantic import of the assignment of anaphoric relations between pronominals and their antecedents. This whole area is tangled and complex; what follows reflects only my own general view of current research.

Theories promoted within the standard framework have often concentrated on pronouns taken as bound variables, considering both the conditions on pronominal binding that are determined by properties of syntactic structures, and the question of interpretation of the sentences exhibiting such binding. In this area, it seems to me, GTS has not reached a high level of detail. But there are other pronominal-antecedent relations to which Hintikka calls attention in his paper. One is the "pronoun of laziness", the other the relation between quantificational antecedents and pronominals that are somehow connected to them, but not bound by them. I will call the latter *unbound anaphora* for the purposes of discussion. Working out pronouns of laziness seems to be substantially a problem for syntax; there is no difficulty saying what the lazy pronouns signify. The cases of unbound anaphora, exemplified by conditionals like (4) above, repeated here:

(4) If you consult two doctors, I'll consult them too.

and, notoriously, by the "donkey" sentences such as Geach's example (29):

(29) Every man who owns a donkey beats it.

are much the more interesting, semantically speaking.

Hintikka's article with Lauri Carlson, cited in the references to his paper, is a contribution to the semantic analysis of sentences like (4) and (29). The essential idea, explained most easily in the case of (4), is that its curious universal force is captured by a game-theoretical truth-definition for conditionals that produces, for every strategy in which the antecedent turns out true, objects that appropriately instantiate the quantifier-phrase—two doctors, in this case. These objects then become the elements to which the unbound anaphor *them* is instantiated in the semantical game associated with the consequent.

Attractive as Hintikka and Carlson's idea is, there are several points that I believe have not been adequately treated, of which I will mention one here (first pointed out, to my knowledge, by Hans Kamp). Consider (30):

(30) If everybody else consults two doctors, I'll consult them too.

The fact is that *them* can have *two doctors* for its antecedent only on that interpretation of the antecedent of the conditional that assigns *two doctors* wide scope. In other words, although (31) is ambiguous, owing to the ambiguity of its antecedent:

(31) If everybody else consults two doctors, I would be surprised.

that same antecedent is unambiguous if *them* is taken to be anaphoric in (30). This is problematic for GTS, which must explain the interaction between ordering rules in the antecedent-game, and anaphoric relations that need only be considered if the game for the consequent is played (that is, if (30) does not turn out true by falsity of antecedent).

For the standard framework no less than for GTS many of the properties of unbound anaphora pose intricate problems of description and explanation. Let me conclude by remarking that whether the GTS discussion is ultimately acceptable, Hintikka and his associates have significantly advanced our understanding in this and other areas of semantics.

NOTES

1. The appropriate style of truth-definition would, in this case, employ free parameters, as in [6], pp. 54ff. Evans [3] advocated an account along these lines.
2. See [7] for an analysis of (9) and the like in a Chomskyan framework.
3. The *is* of existence, apart from archaisms such as *God is,* is restricted in modern English to *there*-constructions, the word *there* serving merely as a dummy subject. In logical form, it is replaced by a variable. Thus sentences like (i) and (ii) come out as (iii) and (iv) respectively:

   (i) There are at least three oceans.
   (ii) There are no unicorns.
   (iii) [At least three x: x is an ocean] x is.
   (iv) [No x: x is a unicorn] x is.

   On the normal interpretations of *at least three x* and *no x* as restricted quantifiers, and taking *is* as true of everything, these forms get the truth conditions of (i) and (ii) right.
4. We exclude the auxiliary *is* that triggers the progressive, as in *John is running.*

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