TOPICS IN THE SYNTAX AND SEMANTICS OF INFINITIVES AND GERUNDS

Gennaro Chierchia

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GENNARO CHIERCHIA

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Topics in the Syntax and Semantics of Infinitives and Gerunds

Gennaro Chierchia

ACKNOWLEDGEMENT

Various circumstances in my life prevent me from being a student any longer. For this reason, it was necessary to finish the present dissertation. But this should not be taken to imply that I regard it in any way as a complete piece of work.

The University of Massachusetts at Amherst is a very special place for theoretical linguistics. Many things contribute to make it special: the quality of its faculty, its long peaceful winters, the fact that people working within different frameworks communicate with each other. I benefitted enormously from all this and it is impossible for me to thank individually all the regular and occasional Amherstians who directly or indirectly helped me out through these years.

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Before getting into linguistics I studied philosophy in Italy. On the plane during my first trip to the

States, I decided to say goodbye to hard-core philosophy by reading a paper by Cocchiarella which sat in the back of my mind for a while to pop out again when I began to think about G. Carlson's beautiful theory of bare plurals. Since then, a long correspondence with Cocchiarella and further acquaintance with his work had a tremendous impact on me, which is reflected throughout this work.

I can now confess that it took me a while to get used to Emmon Bach's teaching style. He (with Lyn Frazier) taught me my first syntax class, the hardest (and perhaps most fruitful) I ever took. Then, through more courses and long conversations, I really came to admire Emmon's deep, unconventional, insightful mind. My debts to his work, his teaching and his friendship are enormous.

Barbara Partee's fame among formal semanticists is one of the things that attracted me to Amherst. I was delighted to meet her and enjoyed thoroughly working close to her these years. Her continuous, varied and challenging teaching, her ideas and her friendship were absolutely crucial for me. I think that if I hadn't met her, I wouldn't be in this field today. For, let's face it, there are easier ways of making a living.

In the ideal worlds, students have a privileged access channel to their teachers' time and minds. We know that our world is not very close to the ideal ones. In this regard, however, Amherst is a fragment of an ideal

world. Moving away from it, I regret that I am bound to
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Amherst, Mass. September 1983

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C H A P T E R   I

THEORIES OF PROPERTIES

AND NATURAL LANGUAGE SEMANTICS

It is quite uncontroversial that a semantic theory
for natural languages should specify what properties are
and what it means to attribute a property to an individual
in an act of predication. A theory of properties and
predication seems in fact to be one of the most central
tasks (if not the most central one) that any general
semantics has to face. Montague's semantics provides a
general theory of properties that relies on two major
subcomponents: a possible world analysis of intension-
ality and the theory of simple types.

According to the first of these subcomponents a
property is analyzed as a function from possible worlds
into extensions (sets or characteristic functions of
sets). A consequence of this view is that two properties
having the same extension at all possible worlds will be
identical. So any two necessarily equivalent properties
(such as being autoidentical and being such that 2 = 1 +
1) will be the same entity. While such a notion of

property allows us to model in an interesting way certain types of intensional contexts, it runs into serious problems, as is well known, in connection with propositional attitudes and related notions. We will therefore call a possible world based notion of property (as well as any other theory that identifies necessary equivalents) "weakly intensional".

The second subcomponent of Montague semantics, i.e. the theory of simple types, allows us to generalize the theory of properties sketched above from basic individuals (or urelements) to everything we might possibly want to talk about (including any higher order entities) in a paradox-free way. According to the theory of types, properties have to be ranked in a hierarchy based on the things they can be meaningfully attributed to. So let e be the type of basic entities (as in standard Montague Grammar, MG from now on). A 1-place property of basic entities will be of type $\langle e, t \rangle$.[1] A property of properties of basic entities will have to be of type $\langle \langle e, t \rangle\ t \rangle$. and so on. In general, in a predicative structure of the form $\beta(\alpha)$, β (the predicate) will have to be of a higher type than α (the argument). A consequence of this is that cases of self-application of properties (i.e. predicative structures of the form $\beta(\beta)$) are ruled out once for all as meaningless.

Apart from being a theory of predication, type theory
plays another role within the semantic component of a
grammar. It provides a classificatory device for semantic
universes. Each possible semantic object is classified as
belonging to a certain type. Types are then system-
atically related to syntactic categories. The connection
between categories and types should provide a represen-
tation of how items of different categories differ in
meaning.

The original synthesis of type theory and possible
world semantics developed by Montague has proven to be
able to take natural language semantics out of the foggy
limbo in which it used to be confined. Formal semantics
seems now to be established as a reasonably explicit level
of linguistic theory in which it has been shown that
significant empirical generalizations can be optimally
captured. However, Montague semantics left several major
problems open. Consider, for instance, type theory as a
classificatory device for semantic universes. There is a
quite clear sense in which this role type theory is
inadequate. For one thing, it makes too many distinc-
tions. It individuates classes of entities that no
natural language "uses" as semantic values for items of
any category. No natural language has categories related
to entities of type <t, e>. In some way, though, type
theory also makes too few distinctions. For instance, the

logical type of verbs like <u>try</u> and of adverbs like <u>slowly</u>
turns out to be the same in Montague's system, and it
seems hard to believe that the distinction between these
two classes of items is purely syntactic. Further elabor-
ations of Montague's system have not managed to do any
better in this regard. So type theory provides classi-
ficatory criteria that match rather defectively those that
seem to be operating in a grammar for natural language.

     In addition to type theory's defects as a classi-
ficatory schema for semantic domains, I believe that
Montague semantics also runs into serious problems because
of its theory of predication. This is the issue that we
are going to take up in some detail in the present chap-
ter. We will point at several major difficulties that
face a weakly intensional, type theoretic notion of
property once we try to base on it a grammar of English
predicative constructions. We will argue that a success-
ful analysis of various linguistic phenomena is only
possible if we go beyond the limits of weak intensionality
and type theory. We will then sketch a theory of proper-
ties, based on work by Nino Cocchiarella, which allows for
a satisfactory treatment of the phenomena that turn out to
be problematic for Montague semantics. Having done this,
we will consider how our novel approach does (in compari-
son with type theory) as a classificatory device for
semantic domains. Finally, we will attempt a first

approximation comparison between the theory we adopt and other available alternatives.

1. <u>Nominalization and the Theory of Types</u>.[2]

In PTQ, Montague proposes that there exists an extremely tight relation between syntactic categories and semantic types. In fact, he claims that such a relation can be characterized as a (type assignment) function. Such a function is recursively specified. First the types associated with primitive syntactic categories are given; then the type of complex categories is specified in terms of the types of their input categories. According to this view, then, by knowing that an expression is, say, a Noun Phrase (NP), we know, by applying the type assignment function to it, what sorts of semantic objects it de- notes. Let us call this the "transparency principle". What we will try to do in what follows is to argue first that on the basis of this principle it is quite difficult to deal with cases of nominalization and second that there is no way to weaken this principle in a fully satisfactory manner. We will not claim that a type theoretic approach to nominalization is altogether impossible, but that a grammar for a sufficiently rich fragment of English based on type theory does not yield the best account of nominal- ization we can construct.

1.1 Infinitives and gerunds.

By nominalization we refer to grammatical processes
whereby expressions that are semantically associated with
properties are transformed into (or better are related to)
noun-like expressions (i.e. expressions that behave more
like names than like predicates). Consider the following
examples:

(1) John forces Bill to be home
(2) John accused Bill of being a communist

To present our argument we have to fill in a few prelimi-
naries concerning the syntactic constituency of the second
underlined expressions in (1)-(2). Within the tradition
of MG (see e.g. the essays in Partee 1976) the underlined
expressions in (1) and (2) would be analyzed as some sort
of verbal constituent. For the sake of explicitness, we
will assume that their category is IV (for intransitive
verb (phrase)) to which we may add a feature specification
such as INF or GER. There are a number of other syntactic
theories which would analyze the structures in question as
some sort of verbal constituent. Examples are recent
developments and extensions of $\bar{\text{X}}$-theories, such as Gener-
alized Phrase Structure Grammar (GPSG, see e.g. Gazdar and
Pullum 1982) or lexical Functional Grammar (LFG, see e.g.
Bresnan 1982). A different hypothesis on the syntactic
constituency of infinitives is put forth within Chomsky's
Government and Binding theory (GB, see Chomsky 1982) and

related frameworks (e.g. Williams 1980). According to
these theories infinitives should be analyzed as being
clausal (i.e. sentential constituents). We will follow
for the moment the former tradition in assuming that
infinitives are essentially verb phrases (VPs) of some
sort. In chapter III we will discuss in greater detail
these various hypotheses on the syntactic constituency of
the constructions in question.

Let us now turn to a first approximation hypothesis
concerning the semantics of the underlined constructions
in (1) and (2). Clearly the infinitive in (1) and the
gerund in (2) are somehow related to the underlined NPs.
This relation looks a lot like the one that obtains in
simple matrix sentences between a predicate and its
subject. There is clearly a sense in which Bill and to be
home in (1) are related to each other in much the same way
in which they are related in Bill is home. So, it seems
fairly natural to hypothesize that infinitives and gerunds
enter some sort of predication relation with some NP in
the sentences where they occur. But what sort of entities
can be predicated of something? Well, properties. This
would suggest that infinitives and gerunds should be
semantically associated with properties. This was, in
fact, the hypothesis adopted by Montague in PTQ and
followed by a number of subsequent developments of the
theory (such as those in Partee 1976). So according to

this hypothesis infinitives and gerunds will denote the
same sort of entities as are denoted by their inflected
counterparts in simple subject/argument constructions.
Hence, VPs would always denote properties: when they
occur in matrix sentences and when they occur in the
complement structure of other VPs. Let us call this the
VP = P(roperty) hypothesis. The question to ask, then,
is: If this hypothesis is right, what consequences follow
from it within Montague's theory of properties and predi-
cation?

Disregarding for the moment intensionality (which is
irrelevant to the point we want to make), the semantic
type of simple properties such as <u>to be home</u> in MG would
be <e, t>, i.e. properties of simple individuals would be
modelled as functions from entities into truth values.
But consider now the following sentences:

(3) a. to be home
     b. being home   is nice
     c. John

On the VP = P hypothesis, <u>to be home</u> and <u>being home</u> in
(3a-b) denote entities of type <e, t> i.e. first order
properties. However, in (3a-b) they are not attributed to
a subject, but rather they are themselves the subject of
predication. Notice that inflected VPs cannot occur as
subjects:

(4) *are home is nice

So, in this regard infinitives and gerunds seem to have
both a verbal and a nominal nature: they can be used to
predicate something of a subject and to be themselves
subjects of predicates. One can put forth, therefore, the
hypothesis that infinitive and gerund formation is a
process that transforms predicative expressions into names
or quasi-names. In this sense such a process might be
regarded, from a semantic point of view, as a case of
nominalization. We will leave this at an intuitive level
for the moment; in chapter III we will try to develop this
hypothesis more precisely. Now, given a type theoretical
approach, the predicate is nice in (3a-b) could not be of
type <e, t>. It would have to be of type <<e, t>, t>.
But in (3c) is nice is attributed to an ordinary indivi-
dual, and so it would have to be of type <e, t>. Hence,
the VP = P hypothesis forces is nice to be associated with
two different functions in (3a-b) and (3c). Furthermore,
if the relation betweenn syntactic categories and semantic
types is a function, then is nice in (3a-b) cannot be of
the same category as in (3c). According to this view it
is a mere accident that the predicate in (3a-c) looks just
the same, since its different occurrences would have to
differ both in meaning and syntactic category. But this
is quite implausible. So the principle of transparency,
the VP = P hypothesis and the theory of types lead us to

counterintuitive results on the nature of certain predi-
cates.

The situation is worse than that, however. Consider,
for instance the following sentence:

(5) being home is extremely nice
(6) John is extremely nice

If the adverb in (5)-(6) is what it looks like, i.e. a
VP-adverb, it will correspond semantically to a function
from properties into properties. The function associated
with the adverb extremely, then, would have to be of
different types in (5) and (6) since it modifies proper-
ties that look alike but, as we have just seen, are very
different. In (5), the adverb would be a function of type
$<<<e, t>, t>, <<e, t>, t>>$, and in (6) of type $<<e, t>,
<e, t>>$. And again granted a functional dependency of
categories-types, the two adverbs in question would have
to be of different syntactic categories. The same argu-
ment could be iterated for adverbial prepositional phrases
(PPs), for adverb-forming prepositions (Ps), and for quite
a number of other categories. So the principle of trans-
parency, the VP = P hypothesis and type theory not only
force us to an otherwise unmotivated duplication of
meanings and syntactic categories for a certain class of
predicates; this duplication, in fact, spreads throughout
the entire categorial system of the grammar. Most verbs,
common nouns, prepositions, etc. have to be split both in

their syntactic and semantic representation into at least

an individual (e-type) level and a predicate ($\langle e, t \rangle$-type)

level.

There are further problems related to the ones just

considered. Take is nice in (3a-b). Presumably, it will

have a gerundive counterpart, i.e. being nice, for there

is no reason to suppose that gerund formation can apply

only to e-level predicates. But gerunds can be themselves

subjects of other predicates, as in e.g.:

(7) being nice is a quality

So the whole affair starts over again; is a quality in (7)

would have to be a VP of level $\langle \langle \langle e, t \rangle, t \rangle, t \rangle$; and by

the reasoning developed above, we can show that this

further increase in type-level spreads throughout the

categorial system of the grammar. And the argument can be

applied over and over again: we can form gerunds like

being a quality, which can then be the subject of other

predicates, etc. There is no clear upper bound to this

process. So, we not only have a duplication in the

syntactic and semantic representation of most items. We

have in fact a multiplication of them potentially ad

infinitum. And each instance of a given item at a given

type theoretic level looks just like every other instance

of that item (just like the is nice's in (3)). Further-

more, nothing prevents a property from applying to its own

gerundive counterpart, as in:

(8) being nice is nice

It is certainly possible to imagine situations where (8)
would even be true. But doesn't type theory ban self-pre-
dictation as meaningless? It does. So, some further
explaining is in order if we are to maintain the VP = P
hypothesis and a type theoretic notion of property. Now,
the arguments given above show that there is probably a
potential infinity of is nice's: one of level <e, t> one
of level <<e, t>, t>, etc. So, it may be that when we
utter (8) we really mean something like:

(9) being nice$_n$ is nice$_{n+1}$, for all n

where n is the number of t's in the type of being nice-
functions. (9) has to be taken as something like a schema
for an infinite number of type theoretically acceptable
predications. Notice, though, that it appears prima facie
not so easy to connect systematically all the being
nice-functions with a plausible system of syntactic
categories. But let us grant that a solution to this
problem can be found. One should ask, then, the following
question: is (9) a plausible representation of the
meaning of (8)? First we should check whether there is
any empirical evidence suggesting that this is the case.
Certainly, there does not seem to be any syntactic evi-
dence. There isn't any overt and systematic correlate of
a ranking of predicates according to a type theoretic

hierarchy in the syntax of any natural language I know

of. And isn't it funny that such a central semantic

distinction would go unmarked in language after language?

Semantic evidence doesn't abound either. For instance, as

pointed out in Parsons (1979), many people would consider the

following a valid inference:

> (10) Every entity has the property of being
> <u>autoidentical</u>
> every entity has a property

This argument is inexpressable in a logic based on type

theory. In such a theory there is no way to speak about

<u>every</u>thing. We can only speak about everything of a given

type. The closest we can get to formulating the conclu-

sion of (10) is by doing something like (9) (i.e. every-

thing $thing_n$ has a property $_{n+1}$). But (9) would not

be a wff in a typed logic such as Montague's IL; at best

it could be a schema in an infinite set of wffs.

What about semantic intuitions? Could we claim that

the semantic representation of (8) provided by (9) matches

out intuitions? If I have at all intuitions about what

sentences like (8) mean, they go in the direction of

something like self-instanciation of properties. As far

as (9) is concerned, I have troubled in understanding what

it should mean even being acquainted with the theory of

types.

It appears, then, that representing (8) as (9) might

just be a regimentation of natural languages forced upon

us by the principle of transparency, the VP = P hypothesis and the theory of types. Such a regimentation, if we are right, lacks any independent support. It should be noted that on the VP = P hypothesis, sentences like (8) are problematic not only for the theory of types. Suppose we wanted to provide the semantics of English by translating it not into a typed language, such as Montague's IL, but into an untyped one as, say, Zermelo-Fraenkel set theory. Suppose, furthermore, since we are ignoring intensions, that we represent properties in terms of the set of things that bear them (in a specified situation). Then (8) would turn out to mean something like "the set of nice things belongs to itself". But no set can belong to itself in ZF. So there is no simple account of something like (8) even outside of the theory of types. And it should be evident that turning to a weakly intensional represen-tation of properties in terms of possible worlds would not help at all.

To sum up, an analysis of infinitives and gerunds based on the transparency principle, the VP = P hypothesis and the theory of types runs into a host of pretty serious difficulties. Now, it would seem that the problem is independent from Montague's transparency principle. For assume we give it up. Still the meaning (if no longer the syntactic category) of most expressions of a natural language would have to be multiplied ad infinitum. The

central mechanism of type-theoretic predication forces
properties that apply to urelements and properties that
apply to higher order entities to be distinct. Given the
recursive character of gerund formation and the inter-
connection among meanings of expressions, this effect
cannot be confined to a limited set of cases but invests
the entire semantic system. Virtually all the meanings of
natural language expressions end up being split and
scattered throughout an infinite hierarchy of types. And
there is no empirical evidence that this should be the
case. Most relevant semantic distinctions have reflexes
in the syntax of some natural language or other; the
ranking of predicates characteristic of type theory
doesn't. Furthermore, even if we weaken Montague's
transparency principle, the multiplication of meanings
induced by the theory of types is bound to have reflexes
in the syntax, if syntax and semantics are related to each
other. In fact, in the case of Montague's proposal of a
functional dependency between categories and types, this
influence appears to be devastating. But on any way of
casting the category-type relation, we will have to encode
in the syntax a mechanism to keep track of the semantic
typing of meanings. We will consider later an instance of
such an attempt due to T. Parsons. However, it seems
legitimate to suspect that any such mechanism would build
into the syntax a device that lacks any independent

syntactic support. Hence, everything else being equal, a theory that can handle gerunds and infinitives without forcing us to do so would appear to be preferable. We can conclude, then, that the principle of transparency is not responsible for the kind of problems we are considering.

It may be, however, that the VP = P hypothesis is the culprit, rather than type theory. For instance, if infinitives and gerunds are associated semantically with propositions the problem, in this devastating form, would not arise. Now, there are various reasons why this proposal has been put forth. In the rest of this work we will consider several (hopefully, most) such reasons and try to argue that they are inconclusive. In fact, we will try to argue that the best possible account of the proper-ties of infinitives and gerunds must be given in terms of the VP = P hypothesis. But then the thing responsible for the problems considered here is just type theory.

But even if the VP = P hypothesis should turn out to be wrong, still I believe the problems pointed out above in connection with nominalization would arise. There are in fact other phenomena that can (and, I think should) be analyzed as processes whereby predicates are somehow turned into (or looked at as) individuals. We will now consider some such cases.

1.2 <u>Other nominalization phenomena</u>.

Plural NPs often give rise to group readings, as in:

(11) Tom and Harry lifted the piano

How are groups to be analyzed? A natural thing to do
would be to regard them as sets. In fact, this proposal
has been made, among others, by Cresswell (1973) and
Bennett (1976), which still constitute the most complete
treatment of plurality within MG.[3] Now, sets correspond
to properties in extension, whose type in Montague's IL is
<e, t>. But if a group is analyzed as an entity of type
<e, t>, a property of a group on a type-theoretical
approach must be of type <<e, t>, t>. So, <u>lift the piano</u>
will have to belong to two different types when it applies
to ordinary individuals and when it applies to groups. We
face, therefore, the very same problems as in section
1.1. It should also be noted that in the same way as we
speak about groups, we can speak about groups of groups,
groups of groups of groups, etc. It might also be that
there are groups that belong to themselves. So, again,
there is no evident upper limit to this process.

A related problem arises also in connection with bare
plurals, i.e. constructions like the following:

(12)   extinct
                        mammals
        whales are   numerous
                        in short supply
                        loved by John

Carlson (1977) has argued that bare plurals are syntacti-
cally NPs derived from plural common nouns and behave
pretty much like proper names (with respect to anaphora
and scope phenomena). To account for this, he proposes to
analyze bare plurals as names of kinds. So the formation
of bare plurals out of plural common nouns (see Bennett
1976 for an analysis of the latter) would amount to
turning a predicate into something like a proper name of a
kind. Now, in the philosophical literature it has been
proposed, most prominently in Cocciarella (1976), to
regards kinds as (nominalized) properties.[4] If this
proposal is correct, then we would have the following
situation. Consider:

   (13) Moby Dick and Moby Dick Jr. are whales
In (13) whales is used as a predicative expression in
order to attribute to the Moby Dick's the property of
belonging to a certain kind. In (12) whales is used as a
proper name of the kind and is the subject of a predica-
tion act. Now, if we stick to a type theoretic notion of
property, the CN whales in (13) will have to denote
something of type $\langle e, t \rangle$; if such a CN is then turned into
an NP with singular reference, the properties which are
predicated of it (as in (12)) will have to be of a higher
type. This will get us into the by now familiar kind of
trouble.

Constructions that behave much like bare plurals are those involving mass nouns; consider:

(14) a. This ring is gold
     b. Gold is an element

(14a) attributes to a ring the property of being made of a certain substance. So in (14a) the CN gold is used as a property-denoting item; in (14b) on the other hand gold seems to be used as a referring NP (maybe the name of a substance) of which we say that it is an element. We run again into the same pattern: a predicative expression can also act somewhat like a name. If gold in (14a) is a genuine predicate, its type will be <e, t>. But what is the entity that the NP gold purports to refer to in (14b)? Ter Meulen (1980) proposes to analyze mass NPs as names of the property associated with the corresponding CN (i.e. as nominalized properties). On a type theoretic approach, this will entail that predicates that apply to mass NPs will have to be of a higher type than predicates that apply to ordinary individuals. But this again leaves open the puzzle of how to deal with predicates that apply indifferently to ordinary individuals and to substances, as e.g.:

(15) I love   gold
       touched John

By the usual argument, the verb love would have to be of a different type when it applies to John or to gold. And

this would have the usual effects on the overall organi-
zation of the grammar.

Similar problems might be argued to arise in connec-
tion with nominalization of propositions. Consider pairs
like the following:

(16) a. John is a little strange
     b. That John is here is a little strange
     c. New York is a little strange

On the assumption that ordinary individuals like John and
propositions are of a different type, then <u>to be a little</u>
<u>strange</u> must have different meanings in (16a) and (16b).
Note, however, that if cities are basic entities (like
humans and unlike propositions) then <u>to be a little</u>
<u>strange</u> would be the same function in (16a) and (16c).
What motivates drawing the line exactly where type theory
does?

Other cases that look like cases of transformation of
predicative expressions into names involve adjectives.
Consider the following examples:

(17) a. This dress is red
     b. Red is my favourite colour

(18) a. John is good
     b. Goodness is disappearing from this world

In (17a) the adjective <u>red</u> is used as a predicate; in
(17b) as a name of an entity (a colour). In (18a) the
property of being good is attributed to John; in (18b) the
adjective <u>good</u> is turned into an NP, presumably denoting
something like a quality. It is not implausible that

these processes might be analyzed in a similar way to the
one sketched above in connection with mass and plural
nominals. If this hypothesis is correct, their analysis
would turn out to be problematic for a type theoretical
approach in just the same way the cases considered above
do.

Even in this very sketchy form, what we have said
should be sufficient to show that problems analogous to
those pointed out in connection with infinitives and
gerunds arise (or are likely to arise) also in connection
with other grammatical phenomena, given some reasonable
assumptions. This gives us further grounds for believing
that the difficulties in question are not an artifact of
the VP = P hypothesis. Rather they seem to arise as a
consequence of the idea that properties should not be
treated on a par with their arguments, which is the
central tenet of a type theoretic approach to predication.

1.3 Conclusions.

There are a number of grammatical phenomena whereby
predicative expressions of English (VPs, CNs, ADJs, etc.)
are turned into noun-like items, i.e. items that purport
to have singular references like proper nouns do. In a
type theoretic semantics properties have to be ranked on
the basis of the "level" of their arguments (i.e. accord-
ing to whether they apply to urelements, properties of

urelements, properties of properties of urelements,
etc.). So, properties of basic elements and properties of
(nominalized) properties will have to be different enti-
ties. This seems counterintuitive. Furthermore it has
undesirable effects on the overall organization of a
grammar (both in the semantics and in the syntax), which
are totally unsupported from an empirical point of view.
We are led to conclude that type theory provides an
unsatisfactory basis for a linguistically adequate notion
of property and predication. If we can provide a notion
of property that allows us to do anything we can do in
standard MG and can also deal with nominalizations without
running into difficulties such as those we have consi-
dered, it would seem to provide a better basis for natural
language semantics.

2. On Weak Intensionality.

One of the most serious problems for Montague seman-
tics concerns the treatment of propositional attitudes and
related phenomena. If believing is a relation between
individuals and propositions and if logically equivalent
propositions are identical (as they are bound to be on a
possible world approach), then we are committed to the
validity of many arguments that do not seem to be valid.
So, such a semantics fails in providing an adequate
account of the notion of logical consequence, once propo-

sitional attitudes are brought into consideration. Since
it is possible to regard propositions as o-place proper-
ties, the problem of propositional attitudes can be viewed
as a consequence of the identification of logically
equivalent properties, i.e. the adoption of weak inten-
sionality in general. There seems to be, in fact, growing
consensus on the idea that one of the sources of trouble
(maybe the source of trouble) is the attempt to handle
propositional attitudes by employing an insufficiently
intensional notion of property (e.g. see Bealer 1982,
Barwise and Perry 1981, Thomason 1980).

Now, suppose we had a theory equivalent in empirical
coverage to Montague semantics, but not committed, unlike
the latter, to weak intensionality. Such a theory would
be a priori more appealing, since even though it might not
solve automatically the propositional attitudes problem,
it would certainly provide a framework within which such a
problem might be tackled with greater hope of success.
The theory we are going to propose in the next section is
not committed to weak intensionality, though, as we will
see, it is consistent with it. So, within such a theory,
you don't have to identify properties with functions from
possible worlds into sets, but you can if you want to.

Within the limits of the present work it is impos-
sible to go in any depth into the propositional attitudes
problem. What I would like to do, instead, is to point

out some more specific problems for linguistic theory that
arise if one adopts a weakly intensional notion of pro-
perty. We would like to individuate areas in the grammar
where choosing between a weakly and a strongly intensional
theory of properties has clearly noticeable and inter-
esting empirical consequences. The structure of the
arguments we will consider is the following. Suppose we
have two competing linguistic analyses of the same range
of facts. It can turn out to be the case that while
strong intensionality is compatible with both, weak
intensionality is compatible only with one. Through the
lens of a weakly intensional semantics, we just cannot see
one of the two analyses. If the analysis compatible with
weak intensionality is the "best one" on purely internal
linguistic grounds (i.e. according to the evaluation
metric set up by universal grammar), this would strongly
support weak intensionality. If the contrary is the case,
we would have instead disconfirming evidence for such a
thesis. The cases we will consider all turn out to be
problematic in this sense for weak intensionality, at
least according to some current proposals.

2.1. Conjunction.

In a number of recent works (Gazdar 1980, Keenan and
Faltz 1978, Cooper 1983, Rooth and Partee 1983) it has
been argued that virtually all uniform syntactic consti-

tuents can be directly conjoined. So, in particular,
gerunds can. On the VP = P hypothesis, all the analyses
of generalized conjunction mentioned above would assign to
conjoined gerunds such as, say walking and talking, (at
least on one reading) the property of being an x such that
x walks and x talks. Let us denote such a property by
walking'⊓ talking'. Take now a verb phrase denoting a
property that everything has necessarily, such as, say,
the property of being self identical. On a weakly inten-
sional notion of property the result of conjoining any
property P with the universal property would have to be P
itself. So, for instance, the result of conjoining the
property of, say, jogging with the property of being
selfidentical is the same as the property of jogging; i.e.
jogging'⊓ being selfidentical' = jogging'. But on the
analysis of conjunction sketched above, this predicts that
there is a reading of (19) which is synonymous with (20):

    (19) John likes jogging
    (20) John likes jogging and being selfidentical

The reading of (19) which is equivalent to (20) would be
the one which is not gotten by (an analogon of) a "con-
junction reduction" rule (see Rooth and Partee 1983, for
discussion). Such a reading would be represented as:

    (21) like' (jogging'⊓ being self identical')(John')

However there does not seem to be any sense in which (20)
can be taken to be even equivalent to (21). Examples of

this kind (possibly also more convincing ones than the one
I presented) can be generated ad libitum. So something
has gone wrong either with the VP = P hypothesis, or with
the analysis of conjunction, or else with weak intension-
ality. To the extent that the former two appear to be
sufficiently motivated from a linguistic point of view,
the source of the problem would appear to be located in
the third hypothesis.

2.2 Passive.

In the tradition of generative grammar, discussions
concerning the analysis of passive have played a crucial
role in the development of various frameworks. Within MG,
the analysis of passive in general most adopted is in two
stages; one passive rule takes care of agentless passive
and one of passive with agent. Briefly, here is how the
analysis goes. The agentless passive rule can be viewed
as a process that maps transitive verb phrases into
intransitive ones (by applying to them passive morpho-
logy); the semantic side of the rule would amount to an
existential quantification over subject position. A
purely illustrative version of the agentless passive rule,
together with an example is given in what follows:

(22) Agentless passive (AP): if $\alpha \in$ TVP, then PAS
(α) $\in$ IV[+PAS], where PAS (α) = be αed
PAS (α)' = $\lambda x \exists y \ \alpha'(x)(y)$.

(23) kick $\rightarrow$ be kicked
be kicked' = $\lambda x \ \exists y[kick'(x)(y)]$

For passive with agent there is a rule that syntactically
combines transitive verbs with by-phrases, yielding a
passive VP; semantically such a rule inserts the NP
meaning of the argument of <u>by</u> in the 'subject' slot. This
is illustrated in what follows:

> (24) Passive with agent (PWA): if $\alpha \in$ TVP and $\beta \in$ NP,
>   then PAS (α) by $\beta \in$ IV[+PAS]
>   If $\alpha \in$ TVP and $\beta \in$ NP, then PAS(α) by β
>   translates as $\lambda x[$ $\alpha'(x)(\beta')]$.

> (25) kick, John $\Longrightarrow$ kicked by John
>   kicked by John'= λx kick'(x)(John')

A detailed discussion and motivation for this analysis can
be found in Bach (1980a). Against it there are a number
of arguments that might be raised. For instance, on the
basis of (22) and (24) a grammar of English would not look
more complicated if the passive morphology brought about
by AP and PWA looked totally different. The evident
identity between the two would appear to be accidental.
Furthermore, by-phrases can attach also to NPs (as in <u>a</u>
<u>book by John</u>, etc.), to which they seem to add an agentive
argument, just like they do with passive VPs. It is not
clear how this evident relatedness between the two con-
structions might be captured on an analysis based on (22)
and (24). These simple minded linguistic objections to a
two-rules analysis of passive, however, are not conclusive
and can be countered in various ways (see the discussion
in Bach (1980)). Nevertheless several authors have
pointed out undesirable empirical consequences of a

two-rule analysis (Bresnan (1982), Halvorsen (1982), Abe
(forthcoming)) and argued in favour of a one rule analy-
sis. Now, within the framework we are considering a one
rule analysis could be developed along the following
lines. It seems plausible to assume that by-PPs are just
predicate modifiers (which on independent grounds we know
can attach to both CNs and VPs) that in some sense add an
agent to both VPs and NPs. The relation between passive
VPs and their active counterpart might be captured by
resorting simply to a meaning postulate like the following:

$$(26)\ \text{by}'(x)(P)(y) \longleftrightarrow \exists R[P = {}^{\wedge}\lambda x\ \exists y[\ {}^{\vee}R(x)(y)]\ \&$$
$${}^{\vee}R(y)(x)]$$
    where P and R are variables of type $\langle s, \langle e, t \rangle\rangle$
    and $\langle s, \langle e, \langle e, t \rangle\rangle\rangle$ respectively

It should be noted that the meaning postulate in (26) is
limited to VPs. However, the present approach could be
generalized, in principle, to an analysis of the by-PP
modifiers of CNs, roughly as follows:

$$(27)\ \text{by}^{+}(x)(CN')(y) \longleftrightarrow [CN'(y)\ \&\ \text{by}'(x)(\text{brought}$$
    about')(y)]
    where by' is as in (26)

So agentive modification of CNs could be defined in terms
of agentive modification of VPs, which is a plausible
first approximation towards capturing the relatedness
between the two.

An analysis along the preceding lines was in fact
considered in the early times of MG (see e.g. the remarks
on this in Dowty 1978). It had, though, to be abandoned,

for the following reasons (pointed out originally by R.

Thomason). There are in natural languages items related

as follows:

(28) a. □[buy'(x)(y)(z) ↔ sell'(z)(y)(x)]
     b. □[lend'(x)(y)(z) ↔ borrow'(z)(y)(x)]

I am assuming that the PPs subcategorized for by these

verbs are in fact internal arguments; i.e. we analyze the

verbs in question as 3-place predicates (ditransitives).

To assume that a PP is an internal argument of a verb

amounts to claiming that such a PP has an NP meaning and

its preposition acts somewhat as an overt case marker.

The present assumption is made only for sake of simpli-

city, and the following argument would go through even if

from- and to- PPs in (28) were predicate modifiers. The

oblique argument of buy and sell can be deleted by a very

general process ('argument drop') which in the case at

hand would map ditransitive verbs into transitive ones and

existentially quantify over the position of the argument

that is deleted.[5] The result of applying argument drop

to buy and sell will give:

(29) $\text{buy'}_{TV} = \lambda x \lambda y \exists z\ [\text{buy'}_{TTV}(z)(x)(y)]$
     $\text{sell'}_{TV} = \lambda x \exists y \exists z\ [\text{sell'}_{TTV}(z)(x)(y)]$

One can then apply passive (i.e. AP) to buy_{TV} and

sell_{TV}, thereby obtaining:

(30) a.   be bought' $= \lambda x \exists y \exists z\ [\text{buy'}_{TTV}(z)(x)(y)]$
     b.   be sold' $= \lambda x \exists y \exists z\ [\text{sell'}_{TTV}(z)(x)(y)]$

An agentive by-phrase (say, by John) could then apply to
(30a) and (30b). However, in virtue of (28), be sold' and
be bought' turn out to have the same intension; hence by
weak intensionality, they have to be the very same entity
(the very same function from worlds into sets). This
gives us the following results:

(31) a.   ^be sold' = ^be bought'
     b.   by' (John') (^be bought') = by' (John')
          (^be sold')

So the property of being bought by John and being sold by
John should be the very same property. But this is
absurd. Something has gone wrong either with the one-rule
analysis of passive, or with weak intensionality. If we
want to stick to weak intensionality, we are forced to
adopt a two rule-analysis of passive. This seems to
provide us with a rather clear case where a semantic
theory constrains syntactic analysis, and heavily so.
Does it constrain syntax in the right direction?

By contrast, if we adopt a strongly intensional
property-theory, it is easy to see that we could maintain
a one rule-analysis of passive, for according to such a
theory two properties may be distinct even if they have
the same extension at all worlds. So be bought' and be
sold' could be equintensional but distinct properties, and
thus by-PPs can yield different outputs when applied to
them. To the extent to which a one-rule approach would
appear to be better motivated on purely internal linguis-

tic grounds, the thesis of weak intensionality would turn
out to be disconfirmed.

2.2 Predicate modifiers.

    It might be argued that the case made for passive can
be extended to the analysis of predicate modifiers in
general. Predicate modifiers in standard MG are grouped
into two main categories, that of verb modifiers (IV/IV),
which contains mainly adverbs and adverbial PPs, and that
of common nouns modifiers (CN/CN), which contains adjec-
tives and PPs. Semantically, predicate modifiers are
analyzed uniformely as functions that map properties into
new properties. It follows, then, that an adverbial
applied to two different VPs that denote the same property
should yield the same output. But take again pairs like
be bought and be sold or be lent and be borrowed, and
consider the following examples:

    (32) a.   This book was bought in a hurry
         b.   This book was sold in a hurry

    (33) a.   This book was borrowed with interest
         b.   This book was lent with interest

If the PPs in (32)-(33) are IV/IVs, these examples are
problematic for weak intensionality, for the a-variant of
each pair would have to be synonymous with the b-variant,
while they don't even have the same truth conditions.

    However, the little that is known about the semantics
of adverbs is not sufficient to grant the preceding

conclusions. Even though the issues involved are extreme-
ly complicated, it is worth considering them in some more
detail, for I believe that the area of adverbial modifi-
cation might be a serious source of problems for weak
intensionality. What we can do within the limits of the
present work is to sketch a couple of current approaches
to the semantics of adverbs and to point out how they
would inherit the be sold-be bought problem.

One possibility put forth by Keenan (1980), among
others, would be to analyze the adverbs in (32)-(33) as
TVP-modifiers; passive would have then to apply to the
already modified TVP (e.g. buy in a hurry). This move
could be motivated on the basis of the fact that we need
to find a systematic way of relating adverbs with the
arguments of the verbs they modify. Consider the follow-
ing valid entailments:

(34) John kicked Bill at the party $\Rightarrow$ Bill was at the
          killed   party
          washed $\not\Rightarrow$ John was at the
                                           party

(35) John saw   Bill from the roof $\Rightarrow$ John was on
          signalled   the roof
          attacked $\not\Rightarrow$ Bill was on
                                           the roof

So, locative and source adverbials seem to differ in their
entailment properties; locatives seem to apply to objects
and source-adverbials to subjects. On the basis of these
data, Keenan seems to suggest that adverbials that "apply
to" objects should, in general, be regarded at TVP-modi-

fiers and adverbials that "apply to" subjects should be
regarded as IV-modifiers.[6] But then by this criterion
the adverbials in (32) and (33) should be regarded as
IV-modifiers (cf. John bought this book in a hurry) and
the be sold-be bought problem would arise again.

Halvorsen (1982) has made in this regard an interest-
ing proposal. His idea is that adverbs might be regarded
uniformly in the semantics as being property-modifiers.
The difference between subject oriented and object orient-
ed adverbs could then be accounted for by assuming that
adverbs are somehow sensitive to thematic relations (cf.
for a related proposal, Jackendoff (1972), among others).
For instance, one might try to say, in first approxi-
mation, that locative adverbials (such as <u>at the party</u>)
require themes to be at the relevant location, while
source-adverbials would require sources to be at the
relevant location. This would account for the data in
(34)-(35). In general, then, the format of entailments
licensed by adverbials would look like the following:

(36) $\gamma [(\beta)(\alpha_1)..(\underset{\theta}{\alpha_i})..](\alpha_n) \rightarrow \gamma'(\alpha_i)$

where γ' is the 'predicative' meaning
           associated with γ
           β is a VP-meaning
and θ ranges over thematic relations.

What (36) states is that an adverbial γ "applies" to
the argument of β which bears to it the relation θ. Of
course, this analysis relies crucially on θ-relations,

notions regarded as murky by many. We will discuss at
some length the status of θ-relations within model theo-
retic semantics in chapter IV. At any rate, it is quite
evident that if Halvorsen's proposal can be worked out,
then the uniform analysis of adverbials as VP-modifiers
would give rise to some version of the be bought-be
sold-problem on a weakly intensional theory of properties.

One of the most interesting recent discussions of the
logic of adverbial modification can be found in
McConnell-Ginet (1982). She argues that a bipartition of
adverbs between IVP and TVP modifiers (aside from
S-adverbs) is insufficient and argues for a different way
of classifying predicate modifiers. According to her, the
latter group divides up into what she proposes to call
Ad-verbs and IV/IVs. Ad-verbs are basic entities which
should not be regarded as functions on predicates but
rather as internal arguments of predicates. To accomodate
this view, she formulates the notion of 'admissable
augmentation' of an n-place predicate. An admissable
augmentation of an n-place predicate R is an n + 1 pre-
dicate $R^+ = R \cup S$, where $S \subseteq R \times Y$ and Y is the type of
the Ad-verb (i.e. a manner, a rate, a place, etc.). For
example, a given Ad-verb such as <u>quickly</u> can modify a
verb, say <u>run</u>, only if there is an admissible augmentation
of <u>run</u> which has a rate as one of its arguments. IV/IV-

modifiers are then derived from Ad-verbs through the
following schema:

> (37) If ξ is an Ad-verb, ξ' is an IV/IV, and for
> any β in IV, $\xi'(\beta) = $ act ξ to β

On the basis of this hypothesis, McConnell-Ginet is able
to provide a plausible explanation for a quite intricate
set of facts in the behavior of adverbs, including, e.g,
the ambiguity in:

> (38) a.   Lisa rudely departed
> b.   Lisa departed rudely

(38a) can mean that given the circumstances it was rude
that Lisa departed (independently of the manner of Lisa's
departure); in (38b), however, the 'locus' of the rudeness
must be in the way Lisa's departure took place. _Rudely_,
it should be noted, according to standard tests could not
be regarded as an S-adverb (see on this Thomason and
Stalnaker 1973); given that _depart_ is intransitive one
cannot blame the ambiguity in (38) on a IVP- TVP-modifiers
distinction either. McConnell-Ginet argues that in (38b),
rudely is an Ad-verb in her sense, while in (38a) it is an
IV/IV-modifier. She also applies her theory to passive
sensitive adverbs, such as:

> (39) Fido was sold reluctantly (by John)

In this example, the pleasure in the selling might belong
either to the patient or to the agent. She accounts for
this by claiming that the agent sensitive reading within
her system must be the one gotten through the Ad-verb