

Events and Properties as Semantic Primitives

0. Introduction*

Within the framework of model-theoretic semantics as developed in among others Montague (1973) and Barwise and Cooper (1981), the notion of a domain of interpretation is among the central ones. A domain is a reconstruction of the world the expressions of the language apply to. There are no principled restrictions on the composition of the domain, but in practice, because of the assumed link with some kind of reality, the domain is generally taken to be composed of (concrete) entities such as human beings, animals, houses and cars.

Recently, various proposals have been put forward to extend the domain of interpretation with less concrete entities such as events and properties. The ultimate argument for these extensions is that certain phenomena in natural language can only be described adequately if the domain is extended along the proposed lines. Strictly (or philosophically) speaking, it is questionable whether the new members of the domain are entities, but from a linguistic point of view this question does not arise: since they are the denotations of expressions of a natural language, they can be added to the domain. It is striking that the proposals often imply an extension with either events or properties: the phenomena that can be accounted for in a semantics with events are not the same as the phenomena that can be described adequately in a semantics with properties, which suggests that the domain should contain events as well as properties. The present analysis argues that this is indeed the case.

For the purpose of this paper, the only relevant difference between events and properties is that the former are extensional entities that can be located in space and time, whereas the latter are intensional entities, entities of a more abstract nature that are not bound in space and time. Next to events, there are other extensional entities, such as processes and states. Following Bach (1981), I call these entities 'eventualities'. Next to properties, there are other intensional entities as well, such as relations and propositions. Following Bealer (1989a, 1989b) and Bealer and Mönnich (1989), I call these entities 'PRPs' (for 'Properties, Relations, and Propositions'). I will argue that the domain of interpretation contains eventualities as well as PRPs, and, furthermore, that there is a systematic relation between these entities, which is an instantiation of the realization-relation introduced in Carlson (1977): eventualities are extensional counterparts or stages of PRPs.

1. Eventualities as primitives

The reason for adding eventualities to the domain of interpretation is that certain phenomena in natural language involve reference to or quantification over eventualities. In the case of events, we can think of the following ones. Nouns such as *war*, *accident* and *meeting* in (1) clearly refer to events:

- (1) a. The war between France and Germany lasted for almost a year
- b. The first meeting will take place in Utrecht
- c. Accidents involving nuclear plants occur more and more frequently

Furthermore, entire sentences can denote events as well:

- (2) a. Michael hit Mary with a hammer
- b. Jones buttered the toast with a knife in the bathroom
- c. Michael hit Mary
- d. Jones buttered the toast

In a semantics with events as primitives, we can explain in a rather simple way why (2a) and (2b) imply (2c) and (2d), respectively, by assigning the Logical Forms in (3) to the sentences in (2):¹

- (3) a. $\exists e (\text{hit}^* (\text{Michael}^*, \text{Mary}^*, e) \ \& \ \text{with}^* (\text{a hammer}^*, e))$
- b. $\exists e (\text{butter}^* (\text{Jones}^*, \text{the toast}^*, e) \ \& \ \text{with}^* (\text{a knife}^*, e) \ \& \ \text{in}^* (\text{the bathroom}^*, e))$
- c. $\exists e (\text{hit}^* (\text{Michael}^*, \text{Mary}^*, e))$
- d. $\exists e (\text{butter}^* (\text{Jones}^*, \text{the toast}^*, e))$

Since the second conjunct of (3a) can be deleted, (2a) can be said to imply (2c). In the same way, (2b) can be said to imply (2d). Alternative analyses are unable to account for the implications in (2) in an equally insightful way.

Other phenomena seem to require an analysis in terms of events as well. For example, from (4a) and (4b) we can infer (4c) (cf. Parsons 1989):

- (4) a. In every burning, oxygen is consumed
- b. Mary burned a plank
- c. Oxygen was consumed

This inference can be accounted for if the sentences in (4) are associated with the Logical Forms in (5):

- (5) a. $\forall e (\exists x \exists y (\text{burn}^* (x, y, e) \rightarrow \exists e' (\text{consume}^* (\text{oxygen}^*, e') \ \& \ \text{in} (e', e))))$
- b. $\exists e (\text{burn}^* (\text{Mary}^*, \text{a plank}^*, e))$
- c. $\exists e' (\text{consume}^* (\text{oxygen}^*, e'))$

Finally, sentences with a perception verb and a clausal complement seem to involve reference to or quantification over events as well. We can assign the Logical Forms in (7) to the sentences in (6) (cf. once more Parsons 1989):

- (6) a. Mary sees Michael running up the flag
- b. Mary hears Michael singing the national hymn
- (7) a. $\exists e \exists e' (\text{run up}^* (\text{Michael}^*, \text{the flag}^*, e') \ \& \ \text{see}^* (\text{Mary}^*, e', e))$
- b. $\exists e \exists e' (\text{sing}^* (\text{Michael}^*, \text{the national hymn}^*, e') \ \& \ (\text{hear}^* (\text{Mary}^*, e', e)))$

These examples provide evidence for an extension of the domain of interpretation with events. Similar examples can be given with regard to processes and states.

2. PRPs as primitives

Bealer and Mönnich (1989) argue that there are two ways of talking about PRPs. In the first place, PRPs can be taken to be predicables or instantiables. Properties, for instance, can be predicated of an individual and thus instantiated. This way of talking about properties does not force one to consider properties primitive (non-reducible) elements of the domain of interpretation. We might as well hold that a property is a derived element that is composed of and thus can be reduced to other elements of the domain, as is done in standard model-theoretic semantics, where a property is modelled as the set of elements of the domain of interpretation having that property.

The second way of talking about PRPs in general and properties in particular, by

means of what Bealer and Mönnich (1989) call 'intensional abstracts', yields a more compelling reason for considering PRPs primitives. Among the intensional abstracts are English gerunds and Dutch nominal infinitives. Examples of these kinds of intensional abstracts are given in (8) and (9):

- (8) a. Verliefd zijn is een fijn gevoel
'Being in love is a nice feeling'
- b. Door een rood stoplicht rijden is verboden
'Driving through a red traffic light is forbidden'
- (9) a. Running is tiring
- b. Stealing a bicycle is a crime

These sentences cannot be analyzed as predications over (sets of) eventualities: (9a), for example, can be true even if no one is running in the domain of interpretation. The same holds for the other sentences in (8) and (9). The nominal infinitives in (8) and the gerunds in (9) do not refer to (sets of) eventualities, but to something more abstract, to intensional entities.

In Chierchia (1984), among others, it is argued that within standard model-theoretic semantics an adequate analysis of sentences such as those in (8) and (9) is impossible for principled reasons. Standard model-theoretic semantics is based on a type logic, while one of its basic assumptions is what Chierchia calls the VP=P-hypothesis, which says that a predicate is always assigned the same type of interpretation, no matter where it occurs in a sentence. In standard model-theoretic semantics, a predicate denotes a set of individuals, or a characteristic function of a set, a function of type $\langle e, t \rangle$. (The notions 'set' and 'characteristic function of a set' are equivalent.) According to the VP=P-hypothesis, both in (10a) and in (10b) the predicate *writing an article* has to be interpreted as a function of type $\langle e, t \rangle$.

- (10) a. Michael is writing an article
- b. Writing an article is amusing
- c. Michael is amusing
- d. Being amusing is amusing

Within a type logic, a predicate must be of a higher semantic type than its arguments. This implies that *is amusing* in (10b) is not of type $\langle e, t \rangle$, but of a higher type, i.e. of type $\langle \langle e, t \rangle, t \rangle$. Thus the occurrence of the predicate *is amusing* in (10b) is of another type than the occurrence of the same predicate in (10c), which is of type $\langle e, t \rangle$.² Intuitively, however, the different occurrences of the predicate have the same meaning. In standard model-theoretic semantics, it is impossible to do justice to this intuition. This is an undesirable result. Another undesirable consequence of the analysis is that it gives rise to a multiplication of the system of categories and types to which there seems to be no upper bound. We can nominalize the predicate *is amusing* of type $\langle \langle e, t \rangle, t \rangle$ in (10b), as in (10d). Here, *being amusing* is of type $\langle \langle e, t \rangle, t \rangle$ as well. But then the verb phrase *is amusing* has to be of an even higher type, viz. of type $\langle \langle \langle e, t \rangle, t \rangle, t \rangle$. Nothing prevents this verb phrase from being nominalized, which would result in a verb phrase of a still higher type (cf. Chierchia 1984).³

Because the problems for standard model-theoretic semantics result from the type logic the semantics is based on, Chierchia (1984) proposes as an alternative to use a type-free semantics with properties as primitives. This choice has some important consequences for the organization of the semantics. When properties are taken to be primitives, we are unable to define the truth-conditions of a sentence in terms of membership of a set: a predicate is no longer interpreted as a set, or as the characteristic function of a set, but as a primitive entity. The truth-conditions have to be defined in terms of a predication relation π : a

sentence is true if and only if π holds between the denotation of the subject and the denotation of the predicate of the sentence.⁴ Formally, this can be pictured as in (11): (11b) contains the truth-conditions of the translation of (11a) into a type logic, while (11c) contains the truth-conditions of that translation into a type-free logic with properties as primitives:

- (11) a. Michael is amusing
 b. amusing* (Michael*) is true iff $I(\text{Michael}*) \in I(\text{amusing}*)$
 c. amusing* (Michael*) is true iff $\pi(I(\text{amusing}*), I(\text{Michael}*))$

The most important difference between a semantics based on a type logic and a type-free semantics is that in the latter properties can occur as arguments of other properties. This means that (10b) and (10c) can be accounted for: in both cases, the subject denotes a property that is an argument of another property:⁵

- (12) a. writing-an-article* (Michael*)
 b. amusing* (writing-an-article*)
 c. amusing* (Michael*)
 d. amusing* (amusing*)

A type-free semantics with properties as primitives does not meet the problems that standard model-theoretic semantics has to face: a predicate such as *is amusing* is not associated with at least two interpretations, and there is no infinite multiplication of the system of categories and types (interpretations). So, a type-free semantics with properties as primitives gives a more adequate analysis of intensional abstracts than standard model-theoretic semantics.

The discussion of the sentences in (8) and (9) has implications for the view on properties as predicables or instantiables. For reasons of theoretical economy, it is necessary to consider properties primitives even if they are looked upon as predicables or instantiables. The same holds for relations and propositions.

Summarizing, I assume that the domain of interpretation contains eventualities as well as PRPs. In what follows, I will a proposal for the way eventualities and PRPs are related to each other. This proposal will be embedded in Carlson's theory on genericity and bare plurals, to which the next section is devoted.

3. Carlson's theory of genericity

Generic sentences express a generalization or a regularity:

- (13) a. Dogs bark
 b. Jet-fighters fly faster than the speed of light
 c. Students are lazy

According to Carlson (1977), the bare plurals in the sentences in (13) refer to a kind, an intensional individual or entity that is not bound in space and time. For (13b) to be true, it is not necessary that there are jet-fighters flying at the time of utterance. Bare plurals can occur in existential sentences as well:

- (14) a. Dogs were crossing my lawn
 b. Jet-fighters fell down into the ocean
 c. Students demonstrated against the war

Carlson (1977) argues that bare plurals always have the same denotation, and that properties of the predicate determine whether a sentence containing a bare plural is interpreted generically or existentially. Certain predicates express a property of individuals (cf. (13)), while others express a property of what Carlson calls stages of individuals, spatially and temporally bound occurrences or extensional counterparts of that individual (cf. (14)). A sentence containing

a stage-level predicate is interpreted existentially, while a sentence with an individual-level predicate is interpreted generically.

In Carlson (1989) it is shown that the theory presented in Carlson (1977) is inadequate, because it is unable to give an analysis of generic sentences with an existentially interpreted subject, such as those in (15):

- (15) a. Hurricanes arise in this part of the Pacific
- b. A computer computes the daily weather forecast
- c. Mice squeak loudly when you pound on this wall

The essence of the analysis proposed in Carlson (1989) is that a sentence is interpreted generically by virtue of the presence of two elements, a non-generically interpreted matrix sentence or predicate containing the main verb of the sentence, and a 'related constituent', which has to be intensional. The subject is the most favoured related constituent, but a locative phrase, as in (15a), a direct object, as in (15b), or a conditional clause, as in (15c), can function as the related constituent as well. This implies that the subject-predicate-analysis of Carlson (1977) cannot be maintained.

In my opinion, Carlson's revised analysis is in essence an extension of his original one in which generic sentences with a non-generic subject can be analyzed as well. In the revised analysis, the 'existential' reading of bare plurals still corresponds to "a pure extension (i.e. a stage)", while the 'universal' (i.e. generic) reading corresponds to an intensional entity (Carlson 1989, p. 184). This suggests that the original analysis can still be applied to the sentences in (13). As far as these sentences are concerned, the main difference between the original analysis and the revised analysis seems to be that according to the latter bare plurals can be interpreted extensionally as well as intensionally, which means that they do not receive a uniform treatment anymore. In a generic sentence such as (13a) the bare plural denotes an intensional entity or a kind, while in an existential sentence such as (14a) it denotes an extensional entity or a stage. This means that in the revised analysis the quantification over stages is not introduced by the predicate, as in the original analysis, but by the (existentially interpreted) bare plural subject itself. In a type-free semantics, the revised analysis of the sentences in (16) can be represented as in (17), where Gn is an operator changing stage-level predicates into individual-level predicates (cf. Carlson 1977) and where π_R is a special kind of predication relation, viz. the realization-relation:⁶

- (16) a. Dogs bark
- b. Dogs are barking
- (17) a. $Gn(bark^*)(dog^*)$
- b. $\exists x(\pi_R(dog^*,x) \ \& \ bark^*(x))$

Carlson (1989) suggests that his theory of genericity can be applied to gerunds as well. In the next section this suggestion will be worked out in some detail.

4. Carlson's theory applied to gerunds and nominal infinitives

Just like bare plurals, gerunds can occur in generic as well as existential sentences, as is shown in (18) and (19), taken from Carlson (1989):

- (18) a. Riding on the merry-go-round is making Bill sick
- b. Repairing Janet's bike took several hours
- c. Getting a hand stuck in the snow-blower cost Bob two fingers

- (19) a. Riding on a merry-go-round makes Bill sick
- b. Repairing Janet's bike takes several hours
- c. Getting a hand stuck in the snow-blower requires very little concentration

The gerunds in (18) denote an eventuality, while those in (19) denote a PRP. In terms of Carlson's theory of genericity, the gerunds in (19) denote an intensional entity or a kind, while those in (18) denote an extensional entity or a stage. Furthermore, the denotations of the gerunds in (19) are realizations of the denotations of the gerunds in (18). Eventualities are thus realizations of PRPs. Dutch nominal infinitives show the same behaviour as English gerunds: the nominal infinitives in (20) denote extensional entities or stages, while those in (21) denote intensional entities or kinds. Once more, the stages denoted by the nominal infinitives in (20) can be considered realizations of the kinds denoted by the nominal infinitives in (21):

- (20) a. Het schrijven van een artikel kostte mij veel tijd
 'the writing of an article took me a lot of time'
- b. Het mishandelen van proefdieren werd door de rechter veroordeeld
 'the maltreating of laboratory animals was condemned by the judge'
- (21) a. Het schrijven van een artikel kost mij veel tijd
 'the writing of an article takes me a lot of time'
- b. Het mishandelen van proefdieren komt steeds vaker voor
 'the maltreating of laboratory animals occurs more and more frequently'

As mentioned earlier, one can distinguish three kinds of intensional entities (properties, relations and propositions) as well as three kinds of extensional entities (events, processes and states). The question then arises as to whether the claim that eventualities are the realizations of PRPs can be made more precise. I assume that properties, relations and propositions can be realized as eventualities. There are, however, clear differences between the realizations of the various kinds of PRPs. A proposition is always realized as an eventuality in which all the participants can be identified. Properties and relations are realized as eventualities in which one or more participants cannot be identified. This is illustrated in (22) and (23):⁷

- (22) a. Het mishandelen van proefdieren door deze onderzoeker moet worden verboden
 'the maltreating of laboratory animals by this researcher should be forbidden'
- b. Het mishandelen van proefdieren moet worden verboden
 'the maltreating of laboratory animals should be forbidden'
- c. Het mishandelen moet worden verboden
 'the maltreating should be forbidden'
- (23) a. Het mishandelen van proefdieren door deze onderzoeker werd door de rechter veroordeeld
 'the maltreating of laboratory animals by this researcher was condemned by the judge'
- b. Het mishandelen van proefdieren werd door de rechter veroordeeld
 'the maltreating of laboratory animals was condemned by the judge'
- c. Het mishandelen werd door de rechter veroordeeld
 'the maltreating was condemned by the judge'

The nominal infinitive in (22a) denotes a proposition, the nominal infinitive in (23a) a realization of this proposition, an event in which all the participants are identifiable. The nominal infinitive in (22b) denotes a property, the one in

(23b) a realization of this property, an event in which one of the participants cannot be identified. Finally, the nominal infinitive in (22c) denotes a relation, while the nominal infinitive in (23c) denotes a realization of this relation, an event in which none of the participants can be identified. As for the Logical Forms of the sentences in (18)-(23), I adopt the analysis proposed in Bealer and Mönnich (1989), but I also follow Davidson (1967) a.o. in assuming that verbs have an additional argument, an event-variable. This means that the nominal infinitives in (22) will be associated with the Logical Forms in (24):⁸

- (24) a. $[\text{mishandelen}^* (\text{deze onderzoeker}^*, \text{proefdieren}^*, e)]_e$
 b. $[\text{mishandelen}^* (x, \text{proefdieren}^*, e)]_{x,e}$
 c. $[\text{mishandelen}^* (x, y, e)]_{x,y,e}$

The denotations of the nominal infinitives in (23) are realizations of the denotations of the nominal infinitives in (22). Their Logical Forms can be represented as in (25):

- (25) a. $\exists e' \pi_R ([\text{mishandelen}^* (\text{deze onderzoeker}^*, \text{proefdieren}^*, e)]_e, e')$
 b. $\exists e' \pi_R ([\text{mishandelen}^* (x, \text{proefdieren}^*, e)]_{x,e}, e')$
 c. $\exists e' \pi_R ([\text{mishandelen}^* (x, y, e)]_{x,y,e}, e')$

In the representations in (25), the variables correspond to the participants that cannot be identified. The analysis allows Logical Forms such as (26b), the translation of the nominal infinitive in (26a), in which *deze onderzoeker* ('this researcher') denotes the agent of the maltreating:

- (26) a. *het mishandelen van/door deze onderzoeker (werd door de rechter veroordeeld)*
 'the maltreating of/by this researcher (was condemned by the judge)'
 b. $\exists e \pi_R ([\text{mishandelen}^* (\text{deze onderzoeker}, x)]_x, e)$

In the event denoted by the nominal infinitive in (26a), the participant that cannot be identified is not the subject of the predicate *mishandelen* ('to maltreat'), but the object. I assume that this event is a realization of the property expressed by the passive predicate *mishandeld worden door deze onderzoeker* ('being maltreated by this researcher').

Summarizing, I have argued that Carlson's theory of genericity can be applied to gerunds and nominal infinitives as well. I have shown that these intensional abstracts are like bare plurals in that they can be interpreted both generically (intensionally) and existentially (extensionally). When interpreted generically, a gerund or a nominal infinitive denotes a PRP. When interpreted existentially, it denotes an eventuality. There is a systematic relation between eventualities and PRPs: the former are extensional counterparts or stages of the latter.

5. Alternative approaches

In this section I will discuss briefly two analyses of the semantics of gerunds, viz. those presented in Chierchia (1984) and in Zucchi (1989). Chierchia (1984) discusses four types of gerundive nominals, exemplified in (27).

- (27) a. the soprano performing the song
 b. performing the song
 c. the soprano's performing the song
 d. the soprano's performing of the song

Chierchia argues that gerunds such as (27a) are semantically associated with nominalized propositions. In Chierchia's framework, a nominalized proposition is an eventuality. Chierchia, however, uses the term 'eventuality' in another sense

as is done in this paper: he assumes that an eventuality is the individual counterpart of a proposition (cf. note 5), and thus an intensional entity. Gerunds such as (27b) denote nominalized properties, i.e. individual correlates of properties. These gerunds can be related to a subject, as in (27c), in which the possessive NP is to be looked upon as a predication marker. In this case, the gerund denotes a state of affairs or an eventuality as well. Finally, a gerund such as (27d) denotes a set of events, processes or states.

Chierchia's analysis is descriptively inadequate: he assumes that gerunds such as (27b) and (27c) denote intensional entities, while the gerunds in (28) clearly denote extensional entities (events):

- (28) a. the soprano's performing the song took place at 9.00
 b. performing the song took several hours

Furthermore, Chierchia's analysis does not relate the events denoted by the gerund in (27d) to the eventuality denoted by the gerund in (27a) or the nominalized properties in (27b) and (27c), something the present analysis does.

Zucchi (1989) discusses two types of gerundive nominals, the ones exemplified in (27c) and (27d). Zucchi adopts a semantics for gerunds which is based on Kratzer's (1989) version of situation semantics. In Zucchi's analysis, the gerund in (27d) denotes a situation in which the soprano performs the song, while the gerund in (27c) denotes the proposition that the soprano performs the song. A proposition is a set of (possible) situations. The proposition that is denoted in (27c) is the set of (possible) situations in which the soprano performs the song. This implies that the denotation of the gerund in (27d) is a member of the denotation of gerund in (27c). This quantificational analysis is inadequate for the same reasons that a quantificational analysis of bare plurals is inadequate (cf. Carlson 1977). Next, Zucchi's analysis is unable to deal with gerunds such as (27b). In the first place, (27b) cannot be generated by any of the syntactic rules Zucchi offers. More importantly, it is unclear how (27b) is to be interpreted within Zucchi's semantics, which contains only situations and individuals as primitives. Furthermore, Zucchi's semantics is based on a type logic. This means that the analysis faces the same problems as standard model-theoretic semantics (cf. section 2). The present analysis does not suffer from the shortcomings just outlined and is thus preferable.

6. Conclusion

I have argued that an adequate analysis of certain phenomena in natural language presupposes an extension of the domain of interpretation with eventualities as well as PRPs. This extension implies a reformulation of the truth-conditions of sentences in terms of a predication relation π . Furthermore, I have argued that eventualities and PRPs are systematically related to each other: eventualities are extensional counterparts or stages of PRPs. I have shown that my proposal has a number of advantages over some alternative approaches.

Notes

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1. The representations in (3) are examples of Davidson's (1967) analysis, according to which predicates have an extra argument that corresponds to an event variable. The asterisk indicates that we are facing the translation of an expression of a natural language (i.c. English) into a formal language (i.c. the language of predicate logic). *e* is Davidson's event variable. Logical Forms such as those in (3) are the input for a model-theoretic interpretation.

2. Note that the analysis itself is incompatible with the VP=P-hypothesis. Even if this hypothesis is dropped, the problems Chierchia signals remain.

3. Sentences such as those in (10) could be analyzed by means of type-shifting rules, as argued for in e.g. Partee (1987). An argument in favour of such an analysis would be that not any pair of NPs is conjoinable, as (i) shows:

(i) *Mary and walking are amusing

I will not pursue this line of analysis here.

4. Certain restrictions have to be imposed on the pairs of entities between which the predication relation π can hold. The first entity of these pairs must be either a property or a relation, the second can be any entity. This implies that the domain of interpretation has to be divided into a number of subdomains, among which are a domain of properties and a domain of 'ordinary' individuals. According to Chierchia (1984), the predication relation π can be considered a primitive notion in the same way in which set-membership is a primitive notion in set-theory (and thus in standard model-theoretic semantics).

5. Chierchia (1984) argues that next to properties there are individual property correlates. An individual correlate of a property is an individual that is systematically related to that property. While the gerund in (i) denotes the individual correlate of a property, the verb phrase in (ii) refers to the property itself:

(i) Walking is fun

(ii) Mary is walking

The individual correlate of a property is not the extensional counterpart of a property. An individual correlate is itself an intensional entity which can have (in our terms) extensional counterparts. In this paper, I follow Bealer (1989a, 1989b) and Bealer and Mönlich (1989) in assuming that the gerund in (i) and the verb phrase in (ii) denote the same entity, viz. a property, which is to be considered an element of the domain of interpretation. Although Chierchia takes properties to be primitives, he assumes that they are modelled as functions from worlds into sets. See Bealer (1989a) for arguments against this view.

6. The representations in (17) serve expository purposes only. Carlson's revised analysis has not yet been formalized adequately.

7. As for the other part of the question, I assume that the aspectual properties of the verb together with certain properties of the noun phrases in the nominal infinitive determine whether a PRP is realized as an event, a process or a state (cf. Verkuyl 1989 for a discussion of the relevant properties of verbs and noun phrases).

8. In the formal language presented in Bealer and Mönlich (1989), one of the syntactic rules is: if *A* is a formula and v_1, \dots, v_m ($m \geq 0$) are distinct variables, then $[A]_{v_1, \dots, v_m}$ is a term. $[A]_{v_1, \dots, v_m}$ denotes a proposition if $m=0$, a property if $m=1$, and an *m*-place relation if $m \geq 2$.

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