Figure Heads in HPSG

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Abstract

Figure heads are words without autonomous content, such as the copula and the infinitival *to*. They pose a challenge for the head-driven semantics of HPSG-94, since the latter requires the CONTENT|NUCLEUS value of a *head-complement* combination to be identical to the one of its head daughter. As a consequence, if the head is semantically vacuous, the combination is —erroneously— predicted to be vacuous as well. In order to repair this, HPSG-94 stipulates that the CONTENT value of a vacuous word is identified with the one of its complement. Technically, this gives the right result, but it leaves a number of issues unresolved. First, if the copula is vacuous, then what happens to the semantic contribution of its tense? Second, what are the criteria for identifying vacuous words? Third, are there any alternatives for the figure head treatment, and if so, what is the kind of evidence that can be used to motivate a choice? In dealing with these questions, I will integrate a DRT style treatment of the tenses in the HPSG framework (section 3), I will define a number of criteria for identifying vacuous verbs (section 4) and I will provide some empirical evidence against the figure head treatment, replacing it with an alternative analysis in which vacuous verbs have no CONTENT feature at all (section 5).

1 Introduction

In the HPSG version of Pollard and Sag 1994 it is not only the syntax which is head-driven but also the semantics. This is clear from the special role which the semantic head plays in the computation of semantic representations (o.c., 322).

> CONTENT PRINCIPLE
> In a headed phrase,
> (Case 1) if the semantic head's CONTENT value is of sort *psoa*, then its NUCLEUS is token-identical to the NUCLEUS of the mother;
> (Case 2) otherwise, the CONTENT of the semantic head is token-identical to the CONTENT of the mother.

CONTENT values of sort *psoa*, which is short for *parametrized-state-of-affairs*, stand for the semantic representations of most verbal, adjectival and prepositional projections. As in predicate logic, they are factored into a list of quantifiers, ordered in terms of scope (QUANTS), and a quantifier-free core (NUCLEUS). The latter's value is shared between the mother and the semantic head.[1] The second clause of the principle applies to the CONTENT values of sort *nominal-object*, i.e. the semantic representations of most nominal expressions. They consist of an

[1] The computation of the QUANTS value is modeled by the QUANTIFIER INHERITANCE PRINCIPLE and the SCOPE PRINCIPLE. The SEMANTICS PRINCIPLE, as defined in Pollard and Sag 1994 (323), is a merger of these two principles with the CONTENT PRINCIPLE.

index, comparable to a Predicate Logic variable, and a set of restrictions on that index.

For the identification of the semantic head Pollard and Sag 1994 (322) employs the following definition.

> The *semantic head* of a headed phrase is
> (1) the adjunct daughter in a head-adjunct structure,
> (2) the head daughter otherwise.

Notice that the semantic head does not always coincide with the syntactic head. What this paper will demonstrate is that such discrepancies also occur in head-complement combinations, more specifically in cases in which the syntactic head does not carry any autonomous content. In the HPSG-94 framework such signs are treated as figure heads: they are assigned the CONTENT value of their complement, and are thus promoted to the status of semantic head. The details of this analysis are presented in section 2.

2 The figure head analysis

In HPSG-94, verbs have CONTENT values of type *psoa* and stand for relations between the denotations of their syntactic arguments. The transitive *own*, for instance, denotes a binary relation between the indices of its subject and its object.

(1)
$$\left[\begin{array}{l}\text{CATEGORY}\left[\begin{array}{l}\text{HEAD}\ \ \textit{verb}\\ \text{SUBCAT}\ \ \langle \text{NP}_{\boxed{1}}, \text{NP}_{\boxed{2}}\rangle\end{array}\right]\\ \text{CONTENT}\left[\begin{array}{l}\text{QUANTS}\ \ \textit{list}\\ \text{NUCLEUS}\ \ \underset{own}{}\left[\begin{array}{l}\text{OWNER}\ \ \boxed{1}\,\textit{ref}\\ \text{OWNED}\ \ \boxed{2}\,\textit{ref}\end{array}\right]\end{array}\right]\end{array}\right]$$

The relation between syntactic and semantic arguments is not always one-to-one. Subject raising verbs, for instance, require a subject, but this subject does not correspond to a semantic argument. A relevant example is the AVM of *tend* (o.c., 135).

(2)
$$\left[\begin{array}{l}\text{CATEGORY}\left[\begin{array}{l}\text{HEAD}\ \ \textit{verb}\\ \text{SUBCAT}\ \ \left\langle \boxed{2}, \text{VP}\left[\textit{inf}, \text{SUBCAT}\left\langle \boxed{2}\right\rangle\right]: \boxed{1}\right\rangle\end{array}\right]\\ \text{CONTENT}\left[\begin{array}{l}\text{QUANTS}\ \ \textit{list}\\ \text{NUCLEUS}\ \ \underset{tend}{}\left[\text{SOA-ARG}\ \ \boxed{1}\,\textit{psoa}\right]\end{array}\right]\end{array}\right]$$

Semantically, *tend* takes only one argument, i.e. the one which corresponds to its VP complement, and the semantic contribution of its subject is part of that VP's CONTENT value.

A small subset of the subject raising verbs shows a more radical discrepancy between syntactic and semantic argument structure. The copula, for instance, takes two syntactic arguments, but neither of these corresponds to a semantic argument. Instead, the copula's CONTENT value is simply identified with the one of its predicative XP complement.

(3)
$$\left[\begin{array}{l}\text{CATEGORY}\left[\begin{array}{l}\text{HEAD}\ \ verb\\ \text{SUBCAT}\ \left\langle \boxed{2}, \text{XP}\left[+\text{PRD}, \text{SUBCAT}\left\langle \boxed{2}\right\rangle\right]: \boxed{1}\right\rangle\end{array}\right]\\ \text{CONTENT}\ \ \boxed{1}psoa\end{array}\right]$$

In other words, the copula does not denote a separate state-of-affairs, but simply inherits the one of its XP complement. This accounts for the synonymy of the copular construction in the first sentence below with the bracketed small clauses in the other sentences.

(4) Noriega is in power.

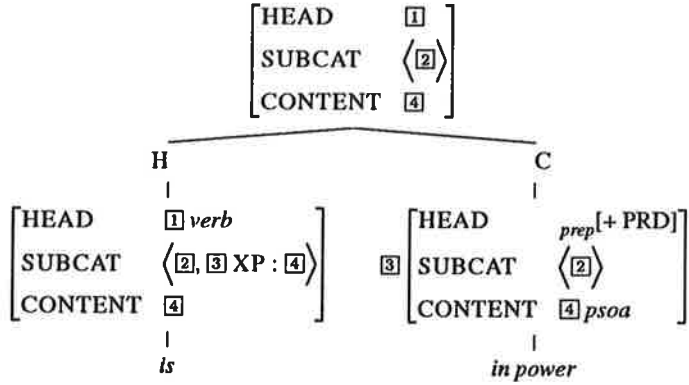
(5) With [Noriega in power], we'll have to cancel our vacation.

(6) We fear [Noriega in power].

The semantic vacuity of the copula is further confirmed by cross-linguistic evidence: in many languages, including Russian, Hungarian and Indonesian, the copula is left out, also in main clauses.

In spite of this semantic vacuity, the copula is the syntactic head of the clause: *is in power*, for instance, is a finite VP, and not a PP. Moreover, since complements cannot be semantic heads in HPSG-94, the copula is also treated as the semantic head, more specifically as a figure head.

(7)



While intuitively plausible, the figure head treatment of the copula raises a number of questions which have so far been ignored in the HPSG literature. First, if the copula is semantically vacuous, then how do we capture the role of its tense?

Second, what are the criteria for identifying semantically vacuous verbs? HPSG-94 mentions the copula and the infinitival *to* as examples, but does not provide any general criteria. Third, is the figure head treatment really the most appropriate one? At first blush, it would seem more plausible to treat such verbs as having no CONTENT value at all. To prepare the ground for a treatment of these issues I will first discuss the semantics of tensed verbs in general.

3 The semantics of tensed verbs

3.1 Event semantics

Like most versions of the Predicate Calculus (PC), the HPSG version of Pollard and Sag 1994 makes use of variables—or rather, indices—for the analysis of nominal objects, but not for the analysis of verbal projections. The semantic representation of *John bought a horse*, for instance, contains only one variable (PC), c.q. referential index (HPSG).

(8) $\exists x$ [horse(x) & bought(john,x)]

In logic, this style of analysis has been challenged by Donald Davidson. Especially for the analysis of action sentences, he argued for the introduction of event type variables (e), as in

(9) $\exists x \exists e$ [horse(x) & bought(e,john,x)]

This treatment has been argued to facilitate the analysis of VP modification, predicate formation and quantification. The addition of a VP modifier, as in *John bought a horse in Egypt*, for instance, is naturally understood as a constraint on the location of the buying event, and not as a constraint on the location of the participants: the transaction may occur in Egypt, also if the buyer and the horse are not in Egypt at the time of the transaction.

(10) $\exists x \exists e$ [horse(x) & bought(e,john,x) & in(e,egypt)]

The event variable is also useful for modeling predicate formation. The logical object of *heard* in *I heard him kill a pig*, for instance, is the event of the killing and not *him*, since the killer may not have uttered any sound. Similarly, the logical subject of *bother* in *it bothers me that Jim snores* is neither *it* nor *Jim*, but rather the entire event or habit of Jim's snoring.

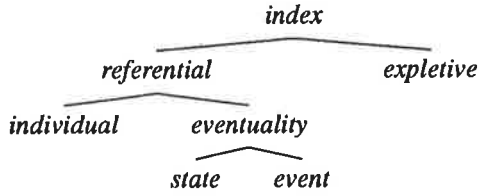
(11) $\exists e \exists e' \exists x$ [heard(e,I,e') & pig(x) & kill(e',him,x)]

(12) $\exists e \exists e'$ [bother(e,e',me) & snore(e',jim)]

Finally, the event variable is useful to model quantification over events, as in *whenever it rains, John sneezes*.

(13) $\forall e$ [rain(e) $\rightarrow \exists e'$ [sneeze(e',john) & at(e,e')]]

For a good survey of the major arguments in favor of the event type analysis, see Parsons 1990 (13-19). Also within HPSG, various authors have argued for the introduction of event type indices, see a.o. Sanfillipo 1990, Badia 1998, Dini 1998, Van Eynde 1998 and Sag and Wasow 1999. Adopting this practice, I will assume that the referential indices come in a variety of sorts.



The CONTENT values of verbs are expanded to include the appropriate index, as in the following AVM of *bought*.[2]

(14)
$$\begin{bmatrix} \text{CATEGORY} & \begin{bmatrix} \text{HEAD} & \textit{verb} \\ \text{ARG-ST} & \langle \text{NP}_{\boxed{1}}, \text{NP}_{\boxed{2}} \rangle \end{bmatrix} \\ \text{CONTENT} & \begin{bmatrix} \text{QUANTS} & \textit{list} \\ \text{NUCLEUS} & \begin{bmatrix} \text{INDEX} & \boxed{3} \begin{bmatrix} \text{PER} & \textit{3rd} \\ \text{NUM} & \textit{sing} \\ \text{GEN} & \textit{neuter} \end{bmatrix} \\ \text{PRED} & \textit{buy}\langle \begin{bmatrix} \text{INST} & \boxed{3} \\ \text{BUYER} & \boxed{1} \\ \text{BOUGHT} & \boxed{2} \end{bmatrix} \rangle \end{bmatrix} \end{bmatrix} \end{bmatrix}$$

Besides the indices for the buyer and the thing bought, there is the index for the event of buying. As all indices in HPSG, it is associated with the agreement features PERSON, NUMBER and GENDER.[3] At first sight, this may seem like an unwanted complication, but looking closer, it turns out to be an asset, since it provides a natural account for the agreement relations in

(15) Mary is going out with George. Bill does not like *it*.

(16) None of the directors turned up, *which/*who* I think is a shame.

Apparently, for anaphoric reference to events one uses the [3rd,sing,neuter] pronoun *it*, and relative pronouns with an event type antecedent have to be [neuter].

[2]Following the current practice in HPSG, I use the ARG-ST feature instead of SUBCAT. It specifies the syntactic arguments which the verb takes. The role of the tense is not included yet; this will be done in the next paragraph.

[3]Notice that these features do not concern the distinctions of person and number in the finite verbs, for these apply to the index of the subject argument, i.e. [1]. What is meant here is the agreement values of the verbal index itself, i.e. [3].

Moreover, verbal projections in subject position, both finite and non-finite ones, require a [3rd,sing] finite verb.

(17) [That John snores] bothers/*bother me.

(18) [To make mistakes] is/*are/*am human.

As a consequence, if the event type index of a verbal projection is [3rd,sing,neuter], these agreement phenomena are predicted without further stipulations.

In sum, the use of event type indices is not only motivated by the semantic arguments of Davidson and Parsons, but also by some HPSG-internal considerations. Furthermore, they are also useful for the analysis of the tenses, as will be shown in the next paragraph.

3.2 The tenses

Like the personal pronouns, the tenses are indexical expressions. In terms of the HPSG notation, this implies that their semantics involves a relation between their index and the set of contextual indices, as in the AVM of *I* (Pollard and Sag 1994, 77)

(19)
$$\begin{bmatrix} \text{CONTENT} \mid \text{INDEX} \ \boxed{1} \begin{bmatrix} \text{PER} & \textit{1st} \\ \text{NUM} & \textit{sing} \end{bmatrix} \\ \text{CONTEXT} \mid \text{C-INDICES} \mid \text{SPEAKER} \ \boxed{1}\textit{ref} \end{bmatrix}$$

In words, the index which is introduced by the pronoun is token-identical to the value of the SPEAKER attribute. In a similar way, the index of a past tense verb, such as *bought*, can be related—though somewhat less directly—to the time of utterance.

(20)
$$\begin{bmatrix} \text{CONTENT} \mid \text{NUCLEUS} & \begin{bmatrix} \text{INDEX} & \boxed{1}\textit{event} \\ \text{PRED} & \underset{\textit{buy}}{\begin{bmatrix} \text{INST} & \boxed{1} \\ \text{BUYER} & \textit{ref} \\ \text{BOUGHT} & \textit{ref} \end{bmatrix}} \end{bmatrix} \\ \text{CONTEXT} & \begin{bmatrix} \text{C-INDICES} & \begin{bmatrix} \text{SPEAKER} & \textit{ref} \\ \text{UTT-TIME} & \boxed{2} \end{bmatrix} \\ \text{BACKGROUND} & \{\boxed{1} \prec \boxed{2}\} \end{bmatrix} \end{bmatrix}$$

In words, the event which is denoted by the verb is required to temporally precede the time of utterance. As a representation of the temporal relations, this is somewhat too simplistic, though. For a start, we should make a distinction between the event and its temporal location. This is not only desirable on conceptual grounds, it also provides the means to capture the difference between the interpretations of

(21) John bought a horse yesterday.

(22) Bill was ill yesterday.

As pointed out in Kamp and Reyle 1993, the event type sentence is only true if the event is temporally included in the time of location (the buying event must be temporally included in yesterday), whereas the state type sentence is also true if Bill's illness extends beyond yesterday. For this reason I will follow the lead of Discourse Representation Theory and assume that the relation between the eventuality and the time of utterance is mediated by a time of location.

In order to model this in terms of HPSG I will make use of three implicational constraints. The most general one applies to all verbal projections: it introduces a time of location and requires the eventuality which the verb denotes to overlap that time of location.

(23) $\begin{bmatrix} \text{HEAD} & \textit{verb} \\ \text{INDEX} & \boxed{i}\ \textit{eventuality} \end{bmatrix} \rightarrow \begin{bmatrix} \text{C-INDICES} \mid \text{LOC-TIME} & \boxed{t} \\ \text{BACKGROUND} & \{\boxed{i} \bigcirc \boxed{t}\} \end{bmatrix}$

The second constraint is more specific: it applies to all verbal projections with an index of type *event*, and it adds the requirement that the event be included in the time of location. Since inclusion is a special type of overlap, this constraint does not contradict the first one; it only provides more specific information.

(24) $\begin{bmatrix} \text{HEAD} & \textit{verb} \\ \text{INDEX} & \boxed{e}\ \textit{event} \end{bmatrix} \rightarrow \begin{bmatrix} \text{BACKGROUND} & \{\boxed{e} \subseteq \boxed{t}\} \end{bmatrix}$

The third constraint concerns the contribution of the past tense: it simply requires the time of location to precede the time of utterance.[4]

(25) $\begin{bmatrix} \text{VFORM} & \textit{past} \end{bmatrix} \rightarrow \begin{bmatrix} \text{C-INDICES} & \begin{bmatrix} \text{UTT-TIME} & \boxed{u} \\ \text{LOC-TIME} & \boxed{t} \end{bmatrix} \\ \text{BACKGROUND} & \{\boxed{t} \prec \boxed{u}\} \end{bmatrix}$

Taken together, the constraints require the index of a past tense verb to overlap a contextually determined time of location, which in its turn precedes the time of utterance; furthermore, if the index is of type event, overlap is narrowed down to inclusion ($\boxed{e} \subseteq \boxed{t}$).

As for the simple present, the temporal relation is of course different, but this is not the only way in which it differs from the simple past, for while the latter combines with all types of verbs, the present only combines with state type predicates, at least in English, see Kamp and Reyle 1993 (536-538). Combinations with

[4] In the full-fledged version of DRT's temporal semantics, the relation between the time of location and the time of utterance is mediated by a temporal point of perspective. The relevance of this extension, though, is limited to the analysis of some rather marked discourse phenomena, such as flashbacks, free indirect speech and inner monologues. For the purpose of this paper, we can assume that the point of perspective coincides with the time of utterance.

an event type predicate are either anomalous or have to be interpreted as implicitly quantified, as in generic or habitual interpretations.

(26) He owns a Porsche.

(27) ? He buys a Porsche.

(28) He buys second-hand cars in the West and sells them in the East.

When referring to an ongoing single event, one has to use the present progressive.

(29) He is buying a Porsche.

This restriction to state type predicates can be wired into the constraint on the present tense.

(30) $\begin{bmatrix} \text{VFORM} & \textit{present} \\ \text{INDEX} & \textit{state} \end{bmatrix} \rightarrow \begin{bmatrix} \text{C-INDICES} & \begin{bmatrix} \text{UTT-TIME} & \boxed{u} \\ \text{LOC-TIME} & \boxed{t} \end{bmatrix} \\ \text{BACKGROUND} & \{\boxed{t} = \boxed{u}\} \end{bmatrix}$

Since the state is required to overlap the time of location by constraint (23), it follows that it also overlaps the time of utterance.

3.3 The aspectual perfect

The present and the past are the only simple tenses in English. Compound tenses, such as the perfect, the future and the progressive, involve the use of at least two verbs. In terms of the present analysis, the AVMs of such combinations contain as many indices as there are verbs. In the case of the present and the past perfect, for instance, there is an index for the auxiliary and another index for its participial VP complement. In the following sentence the state of having found the solution holds by the end of the day and this state results from the previous occurrence of finding the solution.

(31) By the end of the day we had found the solution.

Durational adjuncts, which specify the length of some eventuality, can either apply to the embedded eventuality or to the resulting state.

(32) We have lived in Paris for more than five years.

(33) I have not seen him for at least two years.

In the first sentence the adjunct specifies the duration of our living in Paris (narrow scope), and not the duration of the state which results from it.[5] In the

[5]Kamp and Reyle 1993 (579) claims that this sentence is ambiguous. It can either mean that there is a period of five years in the past in which we lived in Paris, or that the period of five years started in the past and extends up till the time of utterance. The former interpretation is the compositional one, and is also the one which is intended here; the latter is exceptional, and will be discussed in the next section.

second sentence, on the other hand, the adjunct does not specify the duration of my seeing him, but rather of the state of my not having seen him (wide scope).

Since each eventuality is paired with a time of location, there are also two times of location: the state is required to overlap its time of location (t), and the eventuality has to be included in another time of location (t').[6] From this it follows that temporal adjuncts may have different scopes, depending on whether they apply to the location time of the auxiliary or to the one of the participle.

(34) He had already eaten a hamburger at four o'clock.

The temporal adjunct *at four o'clock* can either apply to the time of location of the participle, meaning that the eating of the hamburger took place at four o'clock (narrow scope), or it can apply to the time of location of the auxiliary, meaning that the state of having eaten a hamburger holds at four o'clock (wide scope).

Since the auxiliary is tensed, its time of location is also related to the time of utterance, yielding precedence in the case of the past perfect and identity in the case of the present perfect. The time of location of the participle, on the other hand, is not related to the time of utterance; it is only required to include the eventuality which the participle expresses. How this event relates to the state which is expressed by the auxiliary, can be specified in the AVM of the auxiliary.

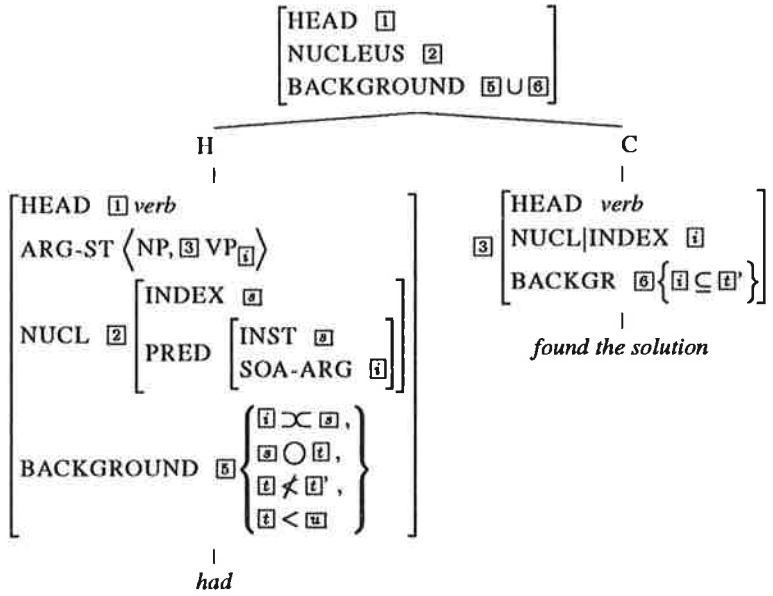
(35)
$$\left[\begin{array}{ll} \text{CATEGORY}\,|\,\text{ARG-ST} & \left\langle \boxed{1}, \text{VP}\left[psp, \text{SUBJ}\left\langle \boxed{1} \right\rangle\right]_{\boxed{i}} \right\rangle \\ \text{CONTENT}\,|\,\text{NUCLEUS} & \left[\begin{array}{ll} \text{INDEX} & \boxed{s}\ state \\ \text{PRED} & \underset{result}{\left[\begin{array}{ll} \text{INST} & \boxed{s} \\ \text{SOA-ARG} & \boxed{i} \end{array}\right]} \end{array}\right] \\ \text{CONTEXT}\,|\,\text{BACKGROUND} & \left\{ \boxed{i} \prec\!\!\!\succ \boxed{s} \right\} \end{array}\right]$$

In words, the auxiliary is a subject raising verb and the state which it introduces in the discourse results from the eventuality which is introduced by its participial VP complement. Semantically speaking, it is a one-place predicate, just like *tend*. Since the result necessarily follows the eventuality which brought it about, we can furthermore add the condition that $\boxed{i}$ abuts $\boxed{s}$. From this it follows that the location time of the auxiliary cannot precede the one of the participle: $\boxed{t} \not\prec \boxed{t'}$.

When the auxiliary is combined with a specific VP, the resulting AVM looks as follows.

[6]Notice that overlap is not sufficient in the case of the past participle. Even if its index is not of type *event*, it does require inclusion. This reflects the intuition that the past participle presents an eventuality as completed.

(36)



The propagation of the CONTENT values is in accordance with the CONTENT PRINCIPLE, and the propagation of the BACKGROUND values conforms to the

> PRINCIPLE OF CONTEXTUAL CONSISTENCY
> The CONTEXT|BACKGROUND value of a given phrase is the union of the CONTEXT|BACKGROUND values of the daughters.

Because of this principle (Pollard and Sag 1994, 333) the BACKGROUND values of the auxiliary and the participle are both present in the BACKGROUND value of the VP. Having gone through the details of the analysis I will now briefly compare it to the one of Reichenbach 1947. Crucial for the latter is the distinction between time of reference and time of event. While these coincide in his analysis of the simple tenses (E = R), they are distinct in the case of the perfect (E $\prec$ R). In combination with the constraints on the past tense (R $\prec$ S) and the present tense (R = S), where S stands for the time of speech, this yields the following analyses for the past perfect (E $\prec$ R, R $\prec$ S) and the present perfect (E $\prec$ R, R = S). In terms of my analysis of the perfect, the time of reference corresponds to the location time of the auxiliary and the time of event to the location time of the participle. Unlike Reichenbach, though, I do not require the former to precede the latter; all that is required is that the former does not follow the latter, which is a weaker constraint. A second difference concerns the simple tenses: instead of postulating a time of reference and then requiring that it coincide with the time of event, I employ only one time of location, which in Reichenbach's terms would be the time of event, and relate it to the time of utterance (or speech) directly. This is not only simpler, it is also more compositional, since it employs one time of location per verb.

4 Vacuous verbs

Having introduced a general format for the semantic analysis of tensed verbs, we are now in a position to define the distinctive characteristics of vacuous verbs. In a nutshell, a verb will be said to be vacuous if it does not introduce a new eventuality in the discourse. This lack of an autonomous index has various empirical consequences.

First, in a combination [V + *not* + VP], there can be a scope ambiguity if V and VP have different indices, as in *he may not speak*, where the negation can either have narrow scope and apply to *speak*, or wide scope and apply to *may speak*. If V lacks an index, though, such ambiguities cannot arise.

Second, since the introduction of location times is dependent on the presence of an eventuality, it follows that vacuous verbs also lack a time of location. As a consequence, if one adds a temporal adjunct to a [V + VP] combination, one may get scope ambiguities if V has its own index, but not if V lacks an index, for in that case there is only one location time to which the adjunct can apply.

Third, since the constraint on the interpretation of the present explicitly requires the presence of a state type index, it follows that vacuous verbs are not necessarily subject to this restriction.

Employing these three criteria, it can now be shown that the copula is not the only English verb which qualifies as vacuous.

4.1 Auxiliary *do*

The prime example of a vacuous verb is the auxiliary *do*. It is typically used in inverted and negated sentences with a non-auxiliary main verb.

(37) Did he make a phone call before leaving?

(38) He does not come at four o'clock.

Intuitively, such sentences are about one eventuality, and this intuition is confirmed by the tests. First, the second sentence is not ambiguous, depending on whether the negation is applied to *come* or *does come*. Second, there are no scope ambiguities in the interpretation of the temporal adjuncts *before leaving* and *at four o'clock*. Third, the present tense forms *do* and *does* are not subject to the restriction to state type predicates: neither *do(es)* itself nor its VP complement need be stative in order to give rise to a felicitous non-quantified interpretation. Compare

(39) ? John runs the mile now.

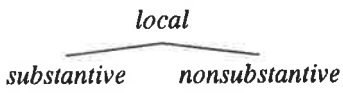
(40) Does John run the mile now?

In sum, the auxiliary *do* clearly qualifies as vacuous. In terms of the figure head treatment, this implies that its CONTENT value is identified with the one of its VP complement.

(41)
$$\begin{bmatrix} \text{CATEGORY} & \begin{bmatrix} \text{HEAD} & _{verb}\begin{bmatrix} +\,\text{AUX} \end{bmatrix} \\ \text{ARG-ST} & \left\langle \boxed{1}, \text{VP}\begin{bmatrix} \text{SUBJ} & \left\langle \boxed{1} \right\rangle \end{bmatrix} : \boxed{2} \right\rangle \end{bmatrix} \\ \text{CONTENT} & \boxed{2}\,psoa \end{bmatrix}$$

However, when this AVM interacts with the—independently motivated—constraints which were introduced in the previous section, there are various complications. First, if the AVM of the auxiliary contains the CONTENT value of its complement, then it also has an index, and if it has an index, then it will be assigned a time of location (t), thus contradicting one of the defining characteristics of the vacuous verbs. It would, admittedly, be possible to add further constraints which require this time of location to be identical to the one of the VP, involving some structure sharing in the CONTEXT values, but this is clearly less elegant than an analysis in which the auxiliary has no index, and hence no location time, at all. Second, if the AVM of the auxiliary has the same index as the one of its complement, then its present tense forms will only be assigned an interpretation if the index is of type *state*. For combinations in which the complement denotes an event, we would then need a separate constraint, which only applies to *do(es)*. This difference in treatment, though, does not correspond to any linguistically motivated distinction: there is no empirical evidence for making a distinction between *do* with a state type complement and *do* with an event type complement.

As an alternative, let us assume that the auxiliary does not inherit the CONTENT value of its complement, but that it simply lacks the CONTENT feature altogether. To model this in terms of the HPSG sort hierarchy, I will distinguish between two kinds of LOCAL values.



While all objects of type *local* have got CATEGORY and CONTEXT attributes, only the substantive ones have got a CONTENT attribute.

$$_{local}\begin{bmatrix} \text{CATEGORY} & category \\ \text{CONTEXT} & context \end{bmatrix} \qquad _{substantive}\begin{bmatrix} \text{CONTENT} & content \end{bmatrix}$$

As a consequence, if the auxiliary *do* is not substantive, then it lacks the CONTENT feature, and hence also an index and a time of location. The contribution of its tense, though, is not lost, since it is part of the CONTEXT attribute. For the interpretation of *did*, it suffices to apply the general constraint on the past tense, but for the interpretation of *do(es)* the general constraint on the present tense should not apply, since it is not subject to the restriction to state type predicates. Interestingly, this non-application does not have to be stipulated, since it follows from the absence of an index. Instead, what is needed for the interpretation of *do(es)* is an extra lexical constraint.

(42)
$$\begin{bmatrix} \text{CAT} & \begin{bmatrix} \text{HEAD} & \underset{verb}{\begin{bmatrix} \text{VFORM} & \textit{present} \end{bmatrix}} \\ \text{ARG-ST} & \left\langle \boxed{1}, \text{VP}\begin{bmatrix} \text{SUBJ} & \langle \boxed{1} \rangle, \text{LOC-TIME} & \boxed{t} \end{bmatrix} \right\rangle \end{bmatrix} \\ \text{CONTEXT} & \begin{bmatrix} \text{C-INDICES} \mid \text{UTT-TIME} & \boxed{u} \\ \text{BACKGROUND} & \{\boxed{t} = \boxed{u}\} \end{bmatrix} \end{bmatrix}_{nonsubst}$$

In contrast to the present tense forms of the substantive verbs, the ones of *do* do not relate their own time of location to the time of utterance, but rather the one of their VP complement. As a consequence, these forms require a special treatment, just as in the figure head analysis, but while the stipulations in the figure head analysis were entirely ad hoc, making an otherwise unmotivated distinction between two types of auxiliary *do*, the stipulations in the nonsubstantive analysis do not rely on any such distinctions: they simply reflect the idiosyncratic nature of the present tense forms of *do*.

4.2 Future *will*

Another vacuous verb is the future *will*.[7] Notice, for instance, that there is no semantic difference between a wide and a narrow scope interpretation for the negation in

(43) We will not give in.

In the words of Palmer, "there is no independent semantic marking of auxiliary and main verb in terms of negation" (Palmer 1987, 145). Similarly, there is no scope ambiguity for the temporal adjunct *after dark* in

(44) They will come after dark.

The vacuity is further confirmed by the fact that *will* should be exempted from the constraint on the present tense, for—in spite of the fact that it is formally a present tense—the temporal relation which it expresses is not simultaneity but rather futurity. As in the case of *do*, this can be achieved by treating *will* as nonsubstantive and by stipulating that its present tense form expresses futurity.

(45)
$$\begin{bmatrix} \text{CAT} & \begin{bmatrix} \text{HEAD} & \underset{verb}{\begin{bmatrix} \text{VFORM} & \textit{present} \end{bmatrix}} \\ \text{ARG-ST} & \left\langle \boxed{1}, \text{VP}\begin{bmatrix} \text{SUBJ} & \langle \boxed{1} \rangle, \text{LOC-TIME} & \boxed{t} \end{bmatrix} \right\rangle \end{bmatrix} \\ \text{CONTEXT} & \begin{bmatrix} \text{C-INDICES} \mid \text{UTT-TIME} & \boxed{u} \\ \text{BACKGROUND} & \{\boxed{t} > \boxed{u}\} \end{bmatrix} \end{bmatrix}_{nonsubst}$$

[7] The future *will* should be distinguished from the modal *will* and from the main verb *to will*.

Also here, it is not the location time of the verb itself which is related to the time of utterance, but rather the one of its VP complement. A figure head treatment of the future *will* would lead to various kinds of complications: without further stipulations it would yield an inappropriate interpretation for the combination with a stative VP and no interpretation at all for the combination with an event type VP.

4.3 Non-aspectual *have*

As mentioned in footnote 5, there is a use of the present perfect in English, which does not fit the mould of the standard aspectual perfect. A relevant example is

(46) We have lived here for five years now.

This sentence does not denote a state which results from some completed eventuality. Instead, it denotes a state which has a duration of five years and which includes the time of utterance. In order to accomodate such cases, Kamp and Reyle 1993 (587) stipulates that the result state does not start when the eventuality is finished, but rather when the eventuality itself starts, so that the states of the auxiliary and of the participle are in fact co-extensional. A simpler way to capture this fact is to assume that the auxiliary is vacuous in such combinations, so that there is only one eventuality to start with.

Assuming then that the AVM of *have lived here for five years now* contains only one index of type *state*, the figure head treatment can again be shown to raise some problems. For, since the past participle requires the state to be included in the location time, and since the general constraint on the present tense requires identity of the location time with the time of utterance, it follows that the state has to be included in the time of utterance, which is clearly too restrictive. In the sentence above, for instance, the period of our living here is not interpreted as part of the utterance time, but rather as starting in the past and including the utterance time. In order to accommodate this interpretation while sticking to the figure head treatment, one would have to relax the constraint on the past participle, requiring overlap instead of inclusion, but this would create an otherwise unmotivated ambiguity for the participle. Alternatively, we can adopt the nonsubstantive analysis, stick to the standard interpretation of the participle, and add a separate AVM for the present tense of vacuous *have*.

(47)
$$\left[\begin{array}{l} \text{CAT} \left[\begin{array}{l} \text{HEAD}\ \underset{verb}{\left[\text{VFORM}\ \textit{present}\right]} \\ \text{ARG-ST}\ \left\langle \boxed{1}, \text{VP}\left[\text{SUBJ}\ \left\langle \boxed{1} \right\rangle, \text{LOC-TIME}\ \boxed{t}\right] \right\rangle \end{array}\right] \\ \text{CONTEXT} \left[\begin{array}{l} \text{C-INDICES} \mid \text{UTT-TIME}\ \boxed{u} \\ \text{BACKGROUND}\ \left\{ \boxed{t} \supseteq \boxed{u} \right\} \end{array}\right] \end{array}\right]_{nonsubst}$$

This neatly captures the extended-now use of the present perfect.

4.4 Progressive *be*

Not surprisingly, the small set of vacuous verbs also includes the progressive *be*. Its semantic vacuity becomes clear when it is compared with other verbs which take a VP[*ing*] complement, such as *stop*.

(48) He stopped smoking when he felt bad.

(49) He was smoking when I entered.

In the first sentence, there is a clear semantic difference between the wide scope and the narrow scope interpretation of the adjunct. On the first reading, there was a time at which he felt bad and at which he stopped smoking; on the second reading he stopped smoking at times that he felt bad, and perhaps continued smoking when he felt well. In the second sentence, there is no such ambiguity: whether the *when*-clause applies to *smoking* or to *was smoking* does not make any semantic difference. Similarly, there is no difference between wide scope and narrow scope for the negation in

(50) They are not coming.

The interaction with the present tense provides further evidence: in contrast to the simple present, the present progressive can have a futurate non-quantified interpretation.

(51) ? They come tomorrow.

(52) They are coming tomorrow.

Once again, the figure head treatment is ill-suited to model this, whereas the nonsubstantive analysis captures it in a rather straightforward manner. All we need is a separate AVM for the present tense of progressive *be*.

(53)
$$\left[\begin{array}{l} \text{CAT} \left[\begin{array}{l} \text{HEAD} \; _{verb}\left[\text{VFORM} \;\; present\right] \\ \text{ARG-ST} \left\langle \boxed{1}, \text{VP}\left[\text{SUBJ} \left\langle \boxed{1} \right\rangle, \text{LOC-TIME} \;\; \boxed{t}\right] \right\rangle \end{array}\right] \\ \text{CONTEXT} \left[\begin{array}{l} \text{C-INDICES} \mid \text{UTT-TIME} \;\; \boxed{u} \\ \text{BACKGROUND} \;\; \left\{ \boxed{t} \not< \boxed{u} \right\} \end{array}\right] \end{array}\right]_{nonsubst}$$

At first sight, the vacuous nature of the progressive *be* could simply be attributed to the lack of content of the copula in general, see section 2. This, however, would be too crude a statement, since the copula can also be used as a substantive verb. When the predicate complement is a pronoun or a proper noun, for instance, the copula is the only constituent which can be said to express a state of affairs.

(54) It is her.

(55) The man with the grey hat is Mr. Bloom.

If the copula were treated as vacuous in such clauses, the CONTENT value of the clause would simply consist of two nominal objects without any relation between them. Hence, in order to arrive at a coherent interpretation, there are contexts in which the copula had better be treated as substantive.

4.5 Secondary properties of nonsubstantive verbs

A salient property of the nonsubstantive verbs is that they all have substantive homonyms: the vacuous auxiliary *do* is homonymous with the substantive main verb *do* (as in *do the dishes*), the vacuous future *will* is homonymous with the substantive modal *will*, the vacuous auxiliary of the present perfect is homonymous with the aspectual perfect, and the auxiliary of the progressive is homonymous with the copula in its substantive uses. Diachronically speaking, the nonsubstantive uses could be characterized as the result of a loss of meaning of the originally substantive verbs.

An interesting cross-linguistic generalization about the vacuous verbs is that they tend to lack translational equivalents. The auxiliary *do*, for example, does not correspond to any particular verb in other languages, not even in such closely related languages as Dutch and German: what is expressed by two verbs in *do you come*, is expressed by just one verb in the Dutch *kom je* and the German *kommst du*. Similarly, the present progressive typically corresponds to a simple present in languages like Dutch and German, and the same applies to the nonsubstantive present perfect. The equivalent of *we have lived here for five years now* has a simple present in both Dutch and German.

(56) We wonen hier nu al vijf jaar.

(57) Wir wohnen hier jetzt seit fünf Jahren.

Even if there is also an auxiliary in the other language, it is often implausible to treat it as a translational equivalent. The future *will*, for instance, corresponds to the German *werden* (*become*), but *werden* does not qualify as a translational equivalent of *will*. Notice, for instance, that *will* belongs to the modal auxiliaries, whereas *werden* belongs to the copular verbs. Similarly, the Italian progressive is expressed by *stare* followed by a gerund, but *stare* is not the translational equivalent of the English *be*; if the latter has a translational equivalent in Italian it would be *essere*.

4.6 Summing up

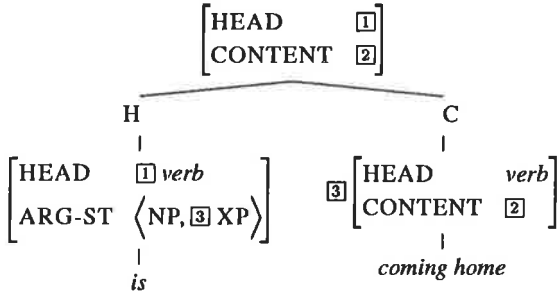
In this section we have provided a general criterion and three empirical tests for identifying vacuous verbs. Applying these tests to a number of English auxiliaries, we have shown that some—but not all—of them have nonsubstantive uses. We have also argued that these nonsubstantive (uses of) verbs had better not be treated as figure heads, since this leads to various complications in the interaction with the

general constraints on the tenses, esp. the present tense. As an alternative, we have proposed a treatment in which the vacuous verbs simply lack a CONTENT value. The consequences of this analysis for the *Content Principle* will be sketched in the concluding section.

5 Conclusion

In the nonsubstantive analysis, the vacuous verb does not share its CONTENT value with the mother; instead, the CONTENT value propagates directly from the mother to its complement daughter, as in the following AVM of *is coming home*.

(58)



In a sense, the simplicity of this propagation is one more argument in favour of the nonsubstantive analysis. At the same time, it complicates the identification of the semantic head, since the latter can now be either the head daughter or the complement daughter, whereas in the figure head analysis it is always the head daughter (in head-complement combinations). The relevance of this objection, however, is dependent on the role which one attributes to the semantic head. If the propagation of the CONTENT value (and its various subparts) is meant to be head-driven, then the nonsubstantive analysis introduces a serious complication, but in some more recent developments in HPSG, the role of the semantic head has become less prominent. In Sag and Wasow 1999 (116), for instance, the head does not share its entire NUCLEUS or CONTENT value with the mother, but only its MODE and INDEX values.

> SEMANTIC INHERITANCE PRINCIPLE
> In any headed phrase, the mother's MODE and INDEX values are identical to those of the head daughter.

The MODE attribute takes values such as *reference*, *proposition*, *question* and *directive*. It is not of direct concern in the context of this paper, but the INDEX attribute obviously is. Given the outcome of our investigation of the vacuous verbs, the principle which controls its propagation should be limited to *substantive* heads, and supplemented with a special clause for nonsubstantive heads.

> INDEX INHERITANCE PRINCIPLE
> In any headed phrase, the mother's INDEX value is identical to that

of the substantive head daughter if any, and to that of the most oblique complement daughter otherwise.

In a [V + ... + VP] combination with a nonsubstantive V, the index of the entire VP will hence be identical to the one of the embedded VP, since verbal projections are treated as more oblique than nominal or prepositional projections.

On the whole then, the complication which the nonsubstantive analysis necessitates, turns out to be rather small, especially if it is compared to the complications which the figure head treatment requires in order to get the facts right in the interaction with the tenses (see section 4). Furthermore, even if one wants to stick to the figure head treatment anyway, and prefers to make the various adjustments which will be needed in order to deal with their present tense forms, the results reported in this paper do not lose their relevance, for—on a conceptual level—it has contributed to the understanding of what a vacuous verb is, providing theory-neutral criteria for identifying them, and—on a more technical level—it has shown where the problems lie in dealing with these verbs.

As a final remark, it may be worth mentioning that the nonsubstantive treatment can be extended straightforwardly to other parts of speech. Van Eynde 1998 (222-223), for instance, shows how it can be applied to the case marking prepositions.

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