

# TOWARDS AN EXPLANATION OF COPULA EFFECTS \*

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**Abstract.** This paper deals with a series of semantic contrasts between the copula *be* and the preposition *as*, two functional elements that both head elementary predication structures. It will be argued that the meaning of *as* is a type lowering device shifting the meaning of its complement NP from the type of generalized quantifiers to the type of properties (where properties are conceived as relations between individuals and situations), while the copula *be* induces a type coercion from (partial) situations to (total) possible worlds. Paired with van der Sandt's (1992) theory of presupposition accommodation, these assumptions will account for the observed contrasts between *as* and *be*.

**Keywords:** Formal semantics, Discourse Representation Theory, Presuppositions, Underspecification

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## 1. Introduction

From a semanticist’s point of view, the preposition *as* is a more or less redundant lexical item. While other prepositions have a clear idiosyncratic lexical meaning, *as* usually doesn’t express anything beyond the relation of predication. The constructions in (1) illustrate this.

- (1) a. As a skeptical person, John expressed doubts.  
 b. We saw John as a priest.

At some level of abstraction, (1a) contains the predication *John is a skeptical person* and (1b) *John is a priest*. Since NPs like *a skeptical person* or *a priest* are usually considered to be predicates at least in one of their readings, *as* does not make an obvious semantic contribution here.

Under certain analyses, the same can be said about the copula verb *be*.<sup>1</sup> So the null theory about the semantics of these two lexical items is that—despite their syntactic differences—they are synonymous, both denoting the identity function over properties, i.e.  $\lambda P.P$ .

From this point of view, it comes as a surprise that complexes of the form “*as* + NP” show a semantic behavior different from copular predicates, i.e. predicates of the form “*be* + NP”. Fernald (2000), who

<sup>1</sup> A note on terminology: Henceforth I will use the term “copula verb” as referring exclusively to *be* and its counterparts in other languages, thus excluding copula verbs in the wide sense like *become* etc. The same holds for “copular constructions” and the like.

discusses some of these effects, christened them “copula effects”. This terminology suggests that it is the behavior of the copula that requires explanation, while the preposition *as* behaves regularly. The proposal that I am going to make here justifies this.

We will focus on three effects:

### 1.1. PERCEPTION REPORTS

PPs headed by *as* may appear as embedded predicate in direct perception reports (in the sense of Barwise 1981), while copular predicates are excluded there.

- (2) a. We saw John as a priest.  
b. We saw John \*be/\*being a priest.

Some comments are in order here. The deviance of (2b) cannot simply be attributed to syntax. Obviously, verbal predicates are generally admitted as complements of verbs of perception, both as naked infinitives and as gerunds:

- (3) a. We saw John walk.  
b. We saw John walking.

So if there were a syntactic constraint which is violated in (2b), it must be one that distinguishes copula constructions from verb phrases as in (3). Candidates would be the distinction between auxiliaries and main

verbs, or between light verbs and full verbs. However, Stump observes that the same kind of contrast that we observe between the verb *be* and the preposition *as* also arise in connection with the verb *have* and the corresponding preposition *with*. While the prepositional and the corresponding verbal predicates are seemingly synonymous, the former are SLPs and the latter ILPs:

- (4) a. We saw John with an umbrella.  
       b. We saw John \*have/\*having and umbrella.

Ideally, an explanation of the differences between *as* and *be* should carry over to the contrast between *with* and *have*. *Have* in (4b) is a main verb though, and there is no obvious way to distinguish the main verb *have* alongside with the copula verb *be* from ordinary main verbs on purely syntactic grounds. The semantic explanation for the difference between *as* and *be* can easily be extrapolated to *with/have*.

Let us return to the discussion of (2a). This kind of construction—*see+as-PP*—has several readings, and it imposes certain restrictions on the context in which it can be used felicitously. In one reading, *see* means something like *expect* or *anticipate*. A typical context would be (5a), which can be paraphrased as in (b).

- (5) a. *The teacher of the village, talking to the mother of his favorite pupil: “He is really exceptional! If he continues to learn with such an ease I already see him as a priest or an officer.*  
       b. I expect him to become a priest or an officer.

This kind of usage is clearly metaphorical and will not concern us any further here.

Next there are two readings under which (2a) entails the truth of *John is a priest*, but in a qualified way. The first one might be dubbed the “costume reading.” Under this reading (2a) would be true for instance if we saw John in a priest’s costume at the carnival, or acting the part of a priest in a theater play. Second there is a “picture reading.” For instance the sentence would be true if we look at a photograph depicting John in a priest’s gown. In these scenarios, (6a) could be false, while (6b) would be true in the carnival scenario and (c) in the picture scenario.

- (6) a. John is a priest.
- b. At the carnival, John was a priest.
- c. At the picture, John is a priest.

Finally, (2a) can be true in a situation where John was a priest at the reference time, we perceived a scene that manifests his priesthood (like baptizing an infant, say), and his being a priest at this time is somehow contrasted to some other state of affairs. Suppose my little daughter knows uncle John from family meetings, but I had a hard time convincing her that he is a priest by profession. In her imagination, priests are solemn and awe inspiring, while uncle John is always funny and plays with her. So I take her to the service in John’s church, point

to John while he starts giving his sermon fully dressed as a priest, and say to her

(7) Look, now you see John as a priest!

Here John's being perceivably a priest is contrasted with his not-very-priestly appearance at other occasions.

Similarly, suppose that John and Bill are twins, John is a priest, and he performs the religious ceremony at Bill's wedding. As a guest of the wedding, I could say later

(8) We saw John as a priest and Bill as a groom.

Apart from the metaphorical expectation reading, all these readings can be subsumed by the paraphrase given in (9). (This is basically a Barwise style analysis of perceptual reports. We will return to this below.)

(9) a.  $A$  sees  $B$  as a  $NP$ .

b.  $A$  sees a situation  $s$ , and  $s$  supports the truth of the claim " $B$  is a  $NP$ ".

The situation that is perceived may be a picture, a stage play, or an ordinary spatio-temporal part of the world. The *see-as* construction furthermore has a felicity condition to the effect that the truth of the complement is contrasted to some contextually given state of affairs, which is not part of the truth conditions though.

Given this, (2a) has exactly the truth conditions that one would expect from (2b) under a standard semantics of perceptual reports like Barwise (1981) or Higginbotham (1983). The contrast in acceptability between (2a) and (b) is thus unexpected and requires an explanation. This contrast was presumably first noticed in Stump (1985). The analysis provided there is unsatisfactory though for several reasons that will be discussed below.

## 1.2. INDIVIDUAL GUISES

Individuals ought to be consistent. Your car, say, cannot be both expensive and inexpensive at the same time. So (10) is pragmatically deviant.

(10) Your car is expensive, and it is inexpensive.

It is possible though to ascribe conflicting properties to one and the same individual if the predication is appropriately qualified:

(11) Compared with Bill's car, your car is expensive, but in comparison to Henry's car, it is inexpensive.

Free *as*-adjuncts are a good way to supply this kind of qualification of a predication.

(12) a. As a toy your car is expensive, but as a car it is inexpensive.  
b. As a judge John is corrupt, but as a janitor he is not corrupt.  
(after Landman 1989)

- c. As an advisor, Gloria is reliable, but as an administrator she is unreliable. (after Katz 1994)

All these examples are consistent. According to a possible analysis (that we will not endorse in the end but which is an intuitively enlightening starting point), individuals come in different guises, and they may have different properties under different guises. Under this perspective, free *as*-adjuncts specify the guise of the (referent of) the subject of the main predication. Copular free adjuncts are unable to do so. All the subsequent examples are inconsistent.

- (13) a. Being a toy, your car is expensive, but being a car, it is inexpensive.  
 b. Being a judge, John is corrupt, but being a janitor, he is not corrupt.  
 c. Being an advisor, Gloria is reliable, but being an administrator, she is unreliable.

### 1.3. FREE ADJUNCTS

Both *as* and *be* are licit as heads of free adjuncts in the sense of Stump (1985). This is illustrated in (14).

- (14) a. As a non-smoker Mary approves the new law.  
 b. Being a non-smoker, Mary approves the new law.



Stump noticed that the class of free adjuncts is divided into two subclasses. The crucial contrast is illustrated in (15) – (17) on the one hand and (18) – (20) on the other (taken from Stump 1985:41):

- (15) a. Wearing that new outfit, Bill would fool everyone.  
b. If he wore that new outfit, Bill would fool everyone.
- (16) a. Standing on a chair, John can touch the ceiling.  
b. If he stands on a chair, John can touch the ceiling.
- (17) a. Taken in the prescribed dosage, it must be very effective.  
b. If it is taken in the prescribed dosage, it must be very effective.

Here the (b)-sentences are paraphrases of one of the readings of the (a)-sentences. Stump calls the adjuncts in these examples **weak**. They are to be contrasted to the following ones:

- (18) a. Being a master of disguise, Bill would fool everyone.  
b. If he were a master of disguise, Bill would fool everyone.
- (19) a. Having unusually long arms, John can touch the ceiling.  
b. If he has unusually long arms, John can touch the ceiling.
- (20) a. Weighing only a few tons, the truck might reach the top of that hill.  
b. If it weighs only a few tons, the truck might reach the top of that hill.

Here the (a)-sentences cannot be paraphrased by the (b)-sentences. These adjuncts Stump calls **strong**. Note though that both weak and strong adjuncts admit a reading that can be paraphrased with the help of *since*; for instance is paraphrasable as (21b).

- (21) a. Weighing only a few tons, the truck might reach the top of that hill.
- b. Since it weighs only a few tons, the truck might reach the top of that hill.

The observation that is crucial for our purposes is the fact that *be*-adjuncts are always strong while *as*-adjuncts are invariably weak. The next example is again Stump's (op. cit. pp. 86).

- (22) a. Being a blonde, Mary might look something like Jane.
- b. As a blonde, Mary might look something like Jane.
- c. If she were a blonde, Mary might look something like Jane.
- (23) a. Being a non-smoker, Mary would approve the new law.
- b. As a non-smoker, Mary would approve the new law.
- c. If she were a non-smoker, Mary would approve the new law.

In these cases, the (b)-sentence but not the (a)-sentence can be paraphrased as in (c).

These observations conclude the initial survey of the issues that will be addressed in the paper. The plan is as follows. In section 2 we will

briefly review Carlson's (1977) treatment of the perception report data. We will propose a modification of his theory that makes crucial use of a situation based ontology, that avoids some shortcomings Carlson's approach faces. In section 3 we will take up the issue of individual guises. We will argue that the effects sketched above arise out of a particular kind of presupposition accommodation and resolution of lexical underspecification. As background theory of presupposition accommodation, we will assume van der Sandt (1992). In this context we will discuss the axioms governing the inferential behavior of *as*-adjuncts that are proposed in Landman (1989). We will argue with Fox (1993) that Landman's axioms require certain minor revisions. In this revised form, the semantics of *as* that we are going to propose renders them valid.

Section 4 puts the pieces from sections 2 and 3 together and presents a natural explanation of Stump's weak/strong contrasts. The explanation rests crucially on preference orderings between different ways of presupposition resolution that are central for van der Sandt's theory.

In the final section we will summarize our findings and mention some issues for further research.

## 2. Stages and individuals, situations and worlds

### 2.1. CARLSON'S TREATMENT OF PERCEPTUAL REPORTS

Carlson (1977) proposes an ontology that is somewhat richer than what is assumed in standard model theoretic semantics. Next to ordinary objects and kinds—which are subsumed under the cover term “individuals”—he assumes stages of individuals as separate entities, i.e. spatio-temporal parts of individuals. Stages and individuals constitute different sorts, and this distinction is inherited by predicates, which may be classified into predicates of stages (“stage level predicates”, SLPs henceforth) and predicates of individuals (“individual level predicates” or ILPs).

The distinction between ILPs and SLPs is crucial for Carlson's analysis of perceptual reports. He treats perception as a relation between stages rather than between individuals. So the sentence

(24) Sally saw Harry.

expresses the fact that there are stages **s** of the individual Sally and **h** of the individual Harry such that **s** is in the seeing-relation to **h**. Infinitive embedding *see* is treated likewise. A sentence like

(25) Sally saw Harry walk.

will receive a similar analysis, with the single complication that the infinite VP is interpreted as a property of the perceived entity. So

according to Carlson, (25) expresses the claim that there is a stage **h** of the individual Harry, this stage of Harry is walking, and some stage of Sally sees **h**.

Note that the infinite VP is predicated over the perceived entity, i.e. a stage. Thus only SLPs are licit here. Hence the complement of perceptual reports is a key diagnostic to distinguish SLPs from ILPs.

As Carlson (1977) points out, it indicates that all copular predicates are ILP, no matter whether the predicative phrase is SLP or ILP.

(26) \*Gulia saw Gulio be {a priest / the referee / intelligent / five feet tall / drunk / in South America}.

If we accept perceptual reports as diagnostic, the preposition *as* behaves conversely to the copula. PPs headed by *as* are always SLP. (This fact was first noted by Stump 1985).

(27) Gulia saw Gulio as {a priest / the referee}.

This approach to the semantics of perceptual verbs is not completely satisfactory. The idea of treating the infinite VP in naked infinitive construction as a secondary predicate of the perceived object has been criticized by Barwise (1981) in general, and his arguments apply here too. This can be illustrated by a scenario that Davidson used in a different context (Davidson 1969). Imagine a metal sphere rotating and simultaneously heating. Suppose you see this sphere and its movement, but the change in temperature has no visible effect. Then the following sentence would be true:

(28) You see the sphere rotate, but you don't see it heat.

However, in the described scenario, every rotating stage of the sphere is also a heating stage. So Carlson's semantics would predict the sentence to be false.

There are certain aspects of Carlson's approach though that are intuitively enlightening and deserve to be maintained even though the theory as such needs to be revised. First of all, it is a striking advantage of his theory that it gives a principled explanation of copula effects to start with. Competing theories about the SLP/ILP contrast like Diesing (1992) or Kratzer (1995) predict that the copula has no impact on the classification of a predicate as stage level or individual level. There these effects would seem entirely mysterious.

Our own proposal will preserve the following features of Carlson's theory:

- The unacceptability of the examples in (26) results from a semantic type mismatch rather than from syntactic constraint violations.
- Objects of perception are partial objects.
- Copular constructions express properties of total objects, while *as*-PPs denote properties of partial objects.
- Therefore *as*-phrases, but not *be*-phrases are acceptable in perceptual reports.

These Carlsonian (and to some degree Stumpian) ideas will be combined with a more recent approach to the semantics of perceptual reports, where objects of perception are assumed to be eventualities rather than individuals.

## 2.2. WORLDS AND SITUATIONS

Barwise (1981) and Higginbotham (1983) present thorough examinations of the syntax and semantics of perceptual reports involving naked infinitives. They both come to the conclusion that a sentence like (29a) should be analyzed as a paraphrase of (29b).

- (29) a. John saw Harry walk.  
b. There is an eventuality  $s$  such that Harry walked in  $s$  and John saw  $s$ .

The above-mentioned authors defend different views concerning the ontological nature of the abstract eventuality  $s$  that is the object of perception here. While Barwise develops a completely new foundation of semantics, situation theory, Higginbotham identifies  $s$  as an event in the sense of Davidson (1967). His ontology is thus entirely classical and extensional.

Both Barwise's situations and Davidson's events are, in a sense, small or partial objects, i.e. they are part of the world and can be localized both locally and temporally. This makes them plausible candidates for objects of perception. Also, they share these properties

with Carlson's stages. If we want to maintain Carlson's insight that the ungrammaticality of copular constructions in the complement of verbs of perception is due to a partiality/totality mismatch, we have to look for total counterparts of (partial) situations/events. Possible worlds are obvious candidates. However, neither Barwise's nor Davidson's ontology considers possible worlds as eventualities, total or not. Davidson's ontology is purely extensional, and Barwise assumes that there is only one possible world—the real world—that is too large (in a set theoretic sense) to be a situation. So to carry through our neo-Carlsonian program, we have to work in an ontological framework that maintains the basic ingredients of the Barwise/Higginbotham analysis while allowing co-existence of worlds and situations. Kratzer's (1989) version of situation theory provides a good starting point. Modifying her proposal slightly, our ontology contains the following basic ingredients (cf. Kratzer (1989:614)):

$S$  a set, the set of *possible situations*

$A$  a set, the set of *possible individuals*

$\leq$  a *partial ordering* on  $S \cup A$  such that at least the following conditions are satisfied:

(i) For no  $s \in S$  is there an  $a \in A$  such that  $s \leq a$

(ii) For all  $s \in S \cup A$  there is a unique  $s' \in S$  such that  $s \leq s'$  and for all  $s'' \in S$ : if  $s' \leq s''$ , then  $s'' = s'$ .

$\mathcal{P}(S)$  the power set of  $S$ , the set of *propositions*



$W$  a subset of  $S$ , the set of maximal elements with respect to  $\leq$ .

$W$  is the set of *possible worlds*.

A few words of comment are in order. In comparison to other situation theories, Kratzer's is conservative in sticking to a bivalent logic. So a proposition is either true or false in a situation, *tertium non datur*. This makes Kratzerian situations similar to Davidsonian events; if we choose a metalanguage that contains variables over situations, we may consider situations as additional arguments of predicates in an extensional type theory. However, Kratzer's situations are unlike events insofar as they are a mereological part of some possible world, so they are not objects in the world like events. Possible worlds are extreme cases of situations themselves. Finally, individuals are parts of situations, and every individual is part of exactly one world. So modal statements involving individuals require a theory of counterparts. We will ignore this aspect as inessential for our purposes.

Kratzer does not discuss the issue of localizability of situations in space and time, but these aspects can easily be accommodated. Staying close to a Davidsonian intuition, we may extend the ontology with

$T$  a set, the *set of time intervals* that is partially ordered by  $\subseteq_T$  (inclusion) and  $\leq_T$  (precedence).

$L$  a subset of  $A$ , the set of locations

- $\tau$  a partial function from  $S$  to  $T$  (temporal location) such that the domain of  $\tau$  is disjoint from  $W$  and  $\tau(s) \not\leq_T \tau(s')$  entails  $s \not\leq s'$
- $l$  a partial function from  $S$  to  $L$  (location in space) such that the domain of  $l$  is disjoint from  $W$

In words, situation may, but need not be located in space and time. For certain situations, like those that support the truth of mathematical statements, such a location does not make intuitive sense. Possible worlds are generally considered to be too large to be located either in space or in time.

Temporal location together with the partial order  $\leq$  on situations induce a derived partial order:

$$s \sqsubseteq s' \text{ iff } \tau(s) = \tau(s') \text{ and } s \leq s'$$

This ordering relates those situations that take place in the same world at the same time. We postulate that for any  $s$  in the domain of  $\tau$ , there is a unique  $s'$  such that  $s \sqsubseteq s'$  and for all  $s''$ , if  $s' \sqsubseteq s''$  then  $s' = s''$ . Thus we define the domain

$WT$  the set of *world-time slices*, the set of maximal elements with respect to  $\sqsubseteq$

$WS$  the set of *world size situation*, i.e. the set  $\{w | \exists w' \in WT : w' \leq w\}$

Note that the world-time slices are big insofar as they contain everything that is the case in their world in a given interval of time, but they

are small insofar as they are in the domain of  $\tau$ . Still, they are too big to be in the domain of  $l$ , and—central for our purposes—they are too big to be objects of perception. World size situations are at least as big as world time slices, so they are generally too big for perception too.

With this ontological background, we are ready to formulate the neo-Carlsonian premises of our approach to the semantics of perception reports:

- Perception is a relation between an individual and a small situation, i.e. a situation that is in the domain of both  $l$  and  $\tau$
- Copular constructions express propositions that are true only in big situations, i.e. in world size situations.
- The propositions expressed by small clauses headed by *as* may be true in small situations.

It is imperative to admit that (the propositions expressed by) copular constructions may be true in world-time slices and not just in worlds, since copular constructions are compatible with frequency adverbials:

- (30) a. John was a referee several times.  
       b. Harry is the chairperson again.

On the other hand, Maienborn (2001) points out that copular constructions are incompatible with situation external locative modifiers.<sup>2</sup>

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<sup>2</sup> Locative modifiers can also be used as frame setting adjuncts. Maienborn (2001:191) gives the example

- (31) a. \*Mary was tired in the car last night.  
 b. \*Paul is hungry over there.

This observation is accounted for by the assumption that world-time slices are too big to be localized in space.

As a first step towards a compositional development, the *be*-predicate *be a soccer fan* and the PP *as a soccer fan* should be interpreted roughly as follows:

- (32) a. *be a soccer fan*  $\Rightarrow \lambda x \lambda w. w \in WS \wedge x$  is a soccer fan in  $w$   
 b. *as a soccer fan*  $\Rightarrow \lambda x \lambda s. x$  is a soccer fan in  $s$

Next it has to be decided which predicate is more basic. In other words, the predicative NP *a soccer fan* certainly supplies an eventuality argument (that originates from the property *soccer fan*, which is a relation between individuals and eventualities, like every property). The question is whether or not the eventuality argument of the NP ranges over elements of  $WS$ . In the first case, *as* would somehow neutralize this sortal information; otherwise *be* has to be assumed to supply it. We opt for the second version, for two reasons. First, meaning composition is most naturally viewed as a monotonic process where information

- (i) In Argentina, Eva is still very popular

In this construal, a modification of a copular predicate with a locative PP is fine. Maienborn gives extensive evidence that the frame setting reading of locative adverbials is both syntactically and semantically clearly distinguished from the situation external construal, and the latter is excluded in copular constructions.

is composed and not destroyed. Only the second variant follows this strategy. Second, in the situation semantic literature it is commonly assumed that every NP comes with its own situation which might be different both from the described situation and the utterance situation (cf. for instance the discussion in Gawron and Peters (1990) or, in a Kratzerian framework, von Stechow 1994). That this assumption is virtually conceptually necessary can be seen from examples with deictic NPs, as in

(33) This house is larger than this house.

For this sentence to make sense, the referential situations for the subject and the object must be different. They are part of the same world though. Granting every NP its own situation argument is thus independently motivated.

Given this, the semantic contribution of *as* is twofold. First it performs a type lowering from the generalized quantifier type of its NP argument to the type property of the entire PP. Second it makes the situation argument of the complement NP—which we assume to be existentially bound by default—syntactically accessible.

The latter operation is known as “existential disclosure” in the literature (Dekker 1990). It is only definable in a dynamic framework. We chose a compositional version of Discourse Representation Theory (Kamp 1981, Kamp and Reyle 1993), following suggestions developed

in Asher (1993) and Zeevat (1989).<sup>3</sup> There the NP *a soccer fan* will receive the translation<sup>4</sup>

$$(34) \lambda P \lambda s.[x, s' | \text{SOCCERFAN}(s', x), P(s, x)]$$

So the lexical meaning of *as* comes out as (35a), which combines with *a soccer fan* to an expression that is truth-conditionally equivalent to (35b).<sup>5</sup>

$$(35) \text{ a. } as \Rightarrow \lambda T \lambda y \lambda s''. T(s, \lambda z \lambda s'''. [z = y, s'' = s'])$$

$$\text{ b. } as \text{ a soccer fan} \Rightarrow \lambda x \lambda s. [\text{SOCCERFAN}(s, x)]$$

As for the copula, we follow Partee (1986) in the assumption that *be* always applies to a property. NP predicatives are lowered from the generalized quantifier type to the property type by means of a free type shifting operator *BE*. The semantics of *BE* is identical to the semantics of *as* given above. The copula itself only performs a sortal

<sup>3</sup> The recursive model theoretic interpretation is given in the appendix.

<sup>4</sup> We use a linear notation mainly for typographic reasons. The translation into to customary box notation should be obvious; the following structure would come

out as  $\lambda P \lambda s.$ 

$x, s'$
$\text{SOCCERFAN}(s', x)$
$P(s, x)$

.

<sup>5</sup> As in other dynamic type theories like Groenendijk and Stokhof's (1991) Dynamic Intensional Logic,  $\lambda$ -conversion is also licit if a discourse marker that was previously free becomes dynamically bound by this operation. This happens with the occurrence of  $s'$  in (35a) if we apply it to (34) and reduce the resulting expression further to a term that is equivalent to (35b). This is in fact central for the technique of "existential disclosure".

shift from unrestricted situations to world size situations. So its lexical semantics is

- (36) a.  $\text{be} \Rightarrow \lambda P \lambda x \lambda w. [s | P(s, x), w \in WS, s \sqsubseteq w]$   
 b.  $\text{be a soccer fan} \Rightarrow \lambda x \lambda w. [s | \text{SOCCERFAN}(s, x), w \in WS, s \sqsubseteq w]$

Note the similarity between this proposal for the semantics of the copula and Carlson's SLP embedding copula. The main difference is the fact that now the eventuality argument rather than the subject argument is shifted from a partial to a total sort.

The final piece that is to be supplied is the semantics of perceptual verbs like *see*. As mentioned above, objects of perception are small situations, i.e. they must not be members of  $WS$ . So we arrive at the lexical entry

- (37)  $\text{see} \Rightarrow \lambda P \lambda T \lambda x \lambda s. [s' | T(s', P), s' \notin WS, \text{SEE}(s, x, s')]$

After a series of  $\lambda$ -conversions and simplifications, we arrive at the following DRSs for the minimal pair *John saw Harry {as/be} a soccer fan*:

- (38) a.  $\text{John saw Harry as a soccer fan} \Rightarrow$   
 $[x, y, s, s' | \text{JOHN}(x), \text{HARRY}(y), \text{SOCCERFAN}(s, y), s \notin WS,$   
 $\text{SEE}(s', x, s)]$   
 b.  $\text{John saw Harry be a soccer fan} \Rightarrow$   
 $[x, y, s, s', w | \text{JOHN}(x), \text{HARRY}(y), \text{SOCCERFAN}(s, y), w \notin WS,$   
 $w \in WS, s \sqsubseteq w, \text{SEE}(s', x, w)]$

Obviously a copular predicate in a perceptual report results in a contradiction since the perceived situation is required to be big and small simultaneously. This results in unacceptability.<sup>6</sup>

Let us summarize the explanation of the copula effects in perceptual reports that was developed in this section. The key assumptions are the following:

- We adopt a slightly modified Kratzer style situation theory.
- We distinguish between big (i.e. world size) and small (i.e. localizable) situations. Only small situations can be perceived.
- Following Barwise and Higginbotham, we analyze perceptual reports as expressing a relation between the perceiver and a perceived situation that is in turn described by the complement of the verb.
- NP predicatives supply a situation argument of unspecified size.
- The preposition *as* leaves the size of the situation argument unspecified, so the result is consistent with the requirement of the matrix verb that the perceived situation be small.
- The copula *be* absorbs the situation argument from the predicative and returns a world size eventuality argument instead. This results in a conflict with the requirements imposed by the matrix verb.

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<sup>6</sup> Later we will incorporate presuppositions and treat these contradictory requirements as conflicting presuppositions. This will result in outright uninterpretability.



### 3. Guises vs. presuppositions

#### 3.1. LANDMAN 1989

The best known approach to the semantics of *as*-headed adjuncts is given in Landman (1989). There only adnominal *as*-PP are considered. According to our (and Fox's 1993) intuitions, adnominal *as*-adjuncts modifying the subject are synonymous to the corresponding adverbial constructions. In other words, we consider the following two sentences synonymous.

- (39) a. John as a judge is corrupt.  
       b. As a judge, John is corrupt.

We thus restrict our attention to the adverbial use of *as*-PPs.

Landman gives eight axioms that a correct analysis of *as* has to validate.

1. John as a judge is still John
2. John as a judge is a judge
3. John as John is John
4. If John as a judge is corrupt and John as a judge is well paid then  
    John as a judge is corrupt and well paid.
5. If John as a judge takes bribes and taking bribes implies being  
    corrupt, then John as a judge is corrupt

- 6. It is not the case that John as a judge both is and is not corrupt
- 7. John as a judge either takes or doesn't take bribes
- 8. If John as a judge is corrupt, John is a judge

These axioms sound innocuous, and as they stand, they are consistent. They are intended as axiom schemes, however. If you replace *John* by any other name or *being a judge*, *being corrupt*, *taking bribes* etc. by any other predicate, the results should still be axioms. Now consider axioms 1 and 8. Replacing *being corrupt* in 8 by *being John*, we arrive at

- 8a. If John as a judge is John, John is a judge

The protasis of this conditional is axiom 1, so we may infer the conclusion

- 8b. John is a judge

By the same kind of reasoning, we may also infer that John is a non-judge. In other words, Landman's axiom schemes imply that John (and any other individual) has all properties; they are inconsistent.<sup>7</sup>

Still, these axioms sound plausible, so we should ask which minimal adjustments have to be made to render them consistent. I think that the only problematic aspect is the status of axiom 8. Landman presents this inference as an ordinary implication. Instead, I follow Umbach (1996)

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<sup>7</sup> This was first pointed out in Fox (1993).

to interpret it as a presupposition. So axiom 8 should be strengthened to

8'. *John as a judge is corrupt* presupposes that John is a judge

Given this, the axioms 1, 2, and 4 – 7 have a tautological assertoric part, but according to the laws of presupposition projection, they all have a non-trivial presupposition, namely that John is a judge. So it is no surprise that we may infer from axiom 1 that John is a judge. To transform axioms 1, 2, and 4 – 7 into ordinary tautologies, we have to prefix them each with “If John is a judge ...”.

It goes without saying that under this perspective, an adequate account of the semantics of *as*-headed adjuncts requires a theory of presuppositions. Here we will largely follow the theory developed in van der Sandt (1992).

### 3.2. *As*, *be*, AND WHAT THEY PRESUPPOSE

Van der Sandt extends DRT with a theory of presupposition resolution that aims at treating anaphora and presupposition as two forms of the same phenomenon. It is fairly well-established and therefore we confine ourselves to recapitulate its basic features fairly briefly. The interested reader is referred to Geurts (1999) for an excellent introduction and to Beaver (1997) and Asher and Lascarides (1998) for critical discussion.

In van der Sandt’s theory, presuppositions are conceived as a special kind of sub-DRS which are placed at some level of embedding by the

sentence semantics. We mark presupposed DRSs by including them into curly brackets henceforth. Presupposed DRSs cannot be interpreted directly, but they have to be resolved first. The preferred resolution strategy is **presupposition binding**. This amounts to renaming the discourse markers that are introduced by the presupposition in such a way that the presupposition as a whole is entailed in its local context. If this is impossible, a presupposition can be accommodated. This amounts to merging the presupposition with some DRS that is accessible from the position where the presupposition originates. This process is non-deterministic in the general case. If there are several options, accommodation at the highest possible level is preferred. However, a presupposition may contain bound discourse markers in its body. Accommodation must never lead to the unbinding of such discourse markers.

The preference ordering of the different resolution options can be conveniently summarized as an OT style constraint system (see Blutner 2001 for a further exploration of this idea). The relevant constraints, in order of their importance, thus are

1. Do not unbind discourse markers!
2. Do not accommodate!
3. Accommodate high!

Van der Sandt assumes further constraints pertaining to local and global informativity. We ignore them here for ease of presentation since

they play no role in the sequel. Furthermore he assumes that there is a preference for deep over high binding, i.e. if there are several potential binders at different levels of embedding around for a presupposed discourse marker, binding on a deeper level of embedding will be preferred. To take an example, in (40), the system (correctly) predicts that binding *it* to the second occurrence of *a dog* is the preferred reading.

(40) There is a dog, and if Fido sees a dog, he attacks it.

On the other hand, it is fairly easy to construct examples where high binding is pragmatically preferred, as in (41).

(41) If John doesn't lock his car, someone might steal his radio.

In the preferred reading, the pronoun *his* is understood as being bound by *John* rather than by *someone* (even though the latter reading would also be informative and consistent). So rather than adopting van der Sandt's preference for deep binding, I assume that the presupposition resolution module does not induce a ranking between different binding possibilities. Of course this does not exclude the possibility that certain binding options are preferred over others due to the requirements of overall discourse coherence.

After thus having set the stage, we can start to look at the anaphoric aspects of the adjunct constructions we are interested in. First a pragmatic stipulation: we assume that our discourse representation at the beginning of a discourse is never completely empty. There will always be at least an evaluation index  $w_0$  which is known to be world sized.

More formally, our initial DRS will be at least  $[w_0|w_0 \in WS]$ . We tacitly assume that  $w_0$  has to be anchored to the world of evaluation.<sup>8</sup> Next, we assume that the information  $w \in WS$  that occurs in the lexical entry of the copula in (36a) should be considered a presupposition. Furthermore we stipulate that the situation argument of a sentence is filled with an anaphoric situation anaphor after semantic composition is completed. So the initial representation of (42a) is (42b), which after merging with the default context leads to (42c) via presupposition resolution.

- (42) a. John is a judge.  
 b.  $[s, x|JOHN(x), JUDGE(s, x), s \sqsubseteq w/\{[w \in WS], [w] \}]$   
 c.  $[w_0, s, x|w_0 \in WS, JOHN(x), JUDGE(s, x), s \sqsubseteq w_0]$

Furthermore we assume that the adjuncts that are discussed in this paper are generally frame setting in the sense of Maienborn (2001). We adopt two crucial features of Maienborn's analysis here. First, Maienborn assumes that frame setting adjuncts are topical. While a discussion of topic/comment structure lies outside the scope of this paper, it is certainly congenial to Maienborn to assume that topical material is old material, i.e. presupposed.

Second, Maienborn suggests that the eventuality argument of frame setting adjuncts is freely supplied by pragmatics. Translated into the current framework, this means that the situation argument of these

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<sup>8</sup> The formal implementation given in the appendix guarantees that this is always the case.

adjuncts is filled by a situation anaphor. Under these assumptions, (43a) is translated as (43b) and thus interpreted either as (43c) or (d). (Since both are logically equivalent under the proviso that JUDGE and CORRUPT are persistent predicates, we do not have to chose between them).

- (43) a. John as a judge is corrupt.
- b.  $[s, x | \text{JOHN}(x), \text{CORRUPT}(s, x), s \sqsubseteq w / \{[w \in WS], [w] \},$   
 $[[\text{JUDGE}(s', x), [s' | ]]]]$
- c.  $[w_0, s, x | w_0 \in WS, \text{JOHN}(x), \text{CORRUPT}(s, x), s \sqsubseteq w_0,$   
 $\text{JUDGE}(w_0, x)]$
- d.  $[w_0, s, x | w_0 \in WS, \text{JOHN}(x), \text{CORRUPT}(s, x), s \sqsubseteq w_0,$   
 $\text{JUDGE}(s, x)]$

With this background, we can have another look at Landman's axioms. The (a) versions give an English formulation of the respective axiom under the modifications that have been motivated above. The (b) sentences give their underspecified representation, while (c) represents the final interpretation.

- (44) a. If John is a judge, John as a judge is John.
- b.  $[x | \text{JOHN}(x), [s | \text{JUDGE}(s, x), s \sqsubseteq w / \{[w \in WS], [w] \}] \Rightarrow$   
 $[s_1 | \text{JOHN}(x), s_1 \sqsubseteq w / \{[w \in WS], [w] \}, [[\text{JUDGE}(s_2, x),$   
 $[s_2 | ]]]]$
- c.  $[w_0, x | w_0 \in WS, \text{JOHN}(x), [s | \text{JUDGE}(s, x), s \sqsubseteq w_0] \Rightarrow$   
 $[s_1 | \text{JOHN}(x), s_1 \sqsubseteq w_0]$

- (45) a. If John is a judge, John as a judge is a judge.
- b.  $[x|\text{JOHN}(x), [s|\text{JUDGE}(s, x), s \sqsubseteq w/\{[w \in WS], [w] \}]] \Rightarrow$   
 $[s_1|\text{JUDGE}(s_1, x), s_1 \sqsubseteq w/\{[w \in WS], [w], [\text{JUDGE}(s_2, x),$   
 $[s_2] \}]]]$
- c.  $[w_0, x|w_0 \in WS, \text{JOHN}(x), [s|\text{JUDGE}(s, x), s \sqsubseteq w_0]] \Rightarrow$   
 $[s_1|\text{JUDGE}(s_1, x), s_1 \sqsubseteq w_0]$
- (46) a. John as John is John.
- b.  $[s, x|\text{JOHN}(x), s \sqsubseteq w/\{[w \in WS], [w], [\text{JOHN}(x), [s']] \}]]$
- c.  $[w_0, s, x|w_0 \in WS, \text{JOHN}(x), s \sqsubseteq w_0]$
- (47) a. If John is a judge, John as a judge is corrupt and John as a judge is well paid, then John as a judge is corrupt and well paid.
- b.  $[x|\text{JOHN}(x), [s_1, s_2, s_4|\text{JUDGE}(s_1, x), s_1 \sqsubseteq w_1, \text{CORRUPT}(s_2, x),$   
 $s_2 \sqsubseteq w_2, \text{WELL\_PAID}(s_4, x), s_4 \sqsubseteq w_3/\{[w_1 \in WS], [w_1],$   
 $[w_2 \in WS], [w_2], [\text{JUDGE}(s_3, x)], [s_3], [w_3 \in WS], [w_3],$   
 $[\text{JUDGE}(s_5, x), [s_5] \}]] \Rightarrow [s_6|\text{CORRUPT}(s_6, x),$   
 $\text{WELL\_PAID}(s_6, x), s_6 \sqsubseteq w_4/\{[w_4 \in WS], [w_4],$   
 $[\text{JUDGE}(s_7, x), [s_7] \}]]]$
- c.  $[w_0, x|w_0 \in WS, \text{JOHN}(x)$   
 $[s_1, s_2, s_4|\text{JUDGE}(s_1, x), s_1 \sqsubseteq w_0, \text{CORRUPT}(s_2, x), s_2 \sqsubseteq w_0,$   
 $\text{WELL\_PAID}(s_4, x), s_4 \sqsubseteq w_0]] \Rightarrow [s_6|\text{CORRUPT}(s_6, x),$   
 $\text{WELL\_PAID}(s_6, x), s_6 \sqsubseteq w_0]$



(48) a. If John is a judge, John as judge takes bribes, and taking bribes implies being corrupt, then John as a judge is corrupt.

$$\begin{aligned} \text{b. } & [x|\text{JOHN}(x), [s_1, s_2|\text{JUDGE}(s_1, x), \text{TAKE\_BRIBES}(s_2, x), \\ & s_1 \sqsubseteq w_1, s_2 \sqsubseteq w_2[s_3, y|\text{TAKE\_BRIBES}(s_3, y)] \Rightarrow \\ & [[\text{CORRUPT}(s_3, y)]/\{[w_1 \in WS], [w_1|], [w_2 \in WS], [w_2|], \\ & [\text{JUDGE}(s_4, x)], [s_4| ]\}] \Rightarrow [s_5|\text{CORRUPT}(s_5, x), s_5 \sqsubseteq w_3/ \\ & \{[w_3 \in WS], [w_3| ], [|\text{JUDGE}(s_6, x)], [s_6| ]\}]] \end{aligned}$$

$$\begin{aligned} \text{c. } & [w_0, x|w_0 \in WS, \text{JOHN}(x), [s_1, s_2|\text{JUDGE}(s_1, x), \\ & \text{TAKE\_BRIBES}(s_2, x), s_1 \sqsubseteq w_0, s_2 \sqsubseteq w_0, [s_3, y| \\ & \text{TAKE\_BRIBES}(s_3, y)] \Rightarrow \\ & [[\text{CORRUPT}(s_3, y)]] \Rightarrow [s_5|\text{CORRUPT}(s_5, x), s_5 \sqsubseteq w_0]] \end{aligned}$$

(49) a. If John is a judge, then it is not the case that John as a judge both is and is not corrupt.

$$\begin{aligned} \text{b. } & [x|\text{JOHN}(x), [s_1|\text{JUDGE}(s_1, x), s_1 \sqsubseteq w_1/\{[w_1 \in WS], [w_1| ]\}] \\ & \Rightarrow [[\neg[s_3|\text{CORRUPT}(s_3, x), s_3 \sqsubseteq w_2, \neg[s_4|\text{CORRUPT}(s_4, x), \\ & s_4 \sqsubseteq w_3/\{[w_3 \in WS], [w_3| ]\}]/\{[|\text{JUDGE}(s_2, x)], [s_2| ], \\ & [w_2 \in WS], [w_2| ]\}]]] \end{aligned}$$

$$\begin{aligned} \text{c. } & [w_0, x|w_0 \in WS, \text{JOHN}(x), [s_1|\text{JUDGE}(s_1, x), s_1 \sqsubseteq w_0] \Rightarrow \\ & [[\neg[s_3|\text{CORRUPT}(s_3, x), s_3 \sqsubseteq w_0, \neg[s_4|\text{CORRUPT}(s_4, x), \\ & s_4 \sqsubseteq w_0]]]] \end{aligned}$$

(50) a. If John is a judge, John as a judge either takes or does not take bribes.

- b.  $[x|\text{JOHN}(x), [s_1|\text{JUDGE}(s_1, x), s_1 \sqsubseteq w_1/\{[w_1 \in WS], [w_1] \}]]$   
 $\Rightarrow [[s_3|\text{TAKE\_BRIBES}(s_3, x), s_3 \sqsubseteq w_2/\{[w_2 \in WS], [w_2] \}] \vee$   
 $[[\neg[s_4|\text{TAKE\_BRIBES}(s_4, x), s_4 \sqsubseteq w_3/$   
 $\{[w_3 \in WS], [w_3] \}]]/\{[\text{JUDGE}(x, s_2)], [s_2] \}]]$
- c.  $[w_0, x|w_0 \in WS, \text{JOHN}(x), [s_1|\text{JUDGE}(s_1, x), s_1 \sqsubseteq w_0] \Rightarrow$   
 $[[s_3|\text{TAKE\_BRIBES}(s_3, x), s_3 \sqsubseteq w_0] \vee$   
 $[[\neg[s_4|\text{TAKE\_BRIBES}(s_4, x), s_4 \sqsubseteq w_0]]]]$

(51) a. If John as a judge is corrupt, John is a judge.

- b.  $[x|\text{JOHN}(x), [s_1|\text{CORRUPT}(s_1, x), s_1 \sqsubseteq w_1/\{[w_1 \in WS],$   
 $[w_1] \}], [\text{JUDGE}(s_2, x)], [s_2] \}] \Rightarrow [s_3|\text{JUDGE}(s_3, x), s_3 \sqsubseteq w_2, /$   
 $\{[w_2 \in WS], [w_2] \}]]$
- c.  $[w_0, x|w_0 \in WS, \text{JOHN}(x), [s_1|\text{CORRUPT}(s_1, x), s_1 \sqsubseteq w_0,$   
 $\text{JUDGE}(s_1, x)] \Rightarrow [s_3|\text{JUDGE}(s_3, x), s_3 \sqsubseteq w_0, ]]$

(Note that the last axiom is actually ambiguous, depending on whether  $s_2$  is bound to  $s_1$  or  $w_0$ . In the latter case, global accommodation of JUDGE is licit and we derive an (existing) reading where John's being a judge is entailed.)

It is easy to see that all these axioms are truth conditionally equivalent to the DRS  $[w_0, x|w_0 \in WS, \text{JOHN}(x)]$ . This is not a tautology, but if one grants that John exists in all models, then the modified version of Landman's axioms are in fact valid according to the semantics for DRT given in der Appendix.

## 3.3. CONSISTENCY AND UNDERSPECIFICATION

The really interesting point about *as*-headed adjuncts is the fact that they render else inconsistent statements consistent. We repeat the example Landman (1989) uses to illustrate this effect:

(52) John as a judge is corrupt, but John as a janitor is not corrupt.

According to the semantics of *as* developed so far, this will still come out as a contradiction. However, a closer examination of the example reveals that it does not involve two contradictory properties in any way. As Bartsch (1987) points out, the *as*-PPs supply values for underspecified parameters of the main predicate. So (52) can be paraphrased as<sup>9</sup>

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<sup>9</sup> Here we tacitly assume that in constructions where an underspecified adjective is used attributively, the head noun supplies the value for the underspecified parameter of the adjective. So a corrupt judge is somebody who is a judge and who is corrupt in his duties as a judge. This is only a default rule though; in the appropriate contextual setting the parameter value of the attribute might be different from the meaning of the head noun. Pollard and Sag (1994) make this point with the following example:

- (i) The Linguistics Department has an important volleyball game coming up against the Philosophy Department. I see the Phils have recruited Julius to play with them, which means we are in real trouble unless we can find a good linguist to add to our team in time for the game.

(from Pollard and Sag 1994, p. 330)

- (53) John is a corrupt judge, and he is a janitor, but he is not a corrupt janitor.

This sentence is perfectly consistent. If Bartsch’s suggestion points into the right direction, we expect that the consistency effect disappears if the main predicate is not underspecified in a way that could be resolved by the *as*-phrase. This is in fact borne out.

- (54) John as a student was exactly 6 feet tall yesterday at noon, but as an athlete he was exactly 5 feet tall at that time.

This sentence is in fact inconsistent.<sup>10</sup>

Here *good linguist* means “linguist that is a good at playing volleyball”. I thank an anonymous reviewer for drawing my attention to this point.

<sup>10</sup> I think that a similar explanation will also account for the failure of substitutivity in the subject position of underspecified predicates that Landman discusses. Take the following example (Landman’s (6) – (8)):

- (i) The judge is on strike.
- (ii) The judge is the hangman.
- (iii) The hangman is on strike.

As Landman points out, we cannot conclude from (i) and (ii) that (iii) holds. While he explains this fact by assuming that the same property, “to be on strike”, applies to different aspects of the same individual, I rather assume that the underspecified predicate *be on strike* is resolved differently in (i) and (ii), namely as “be on strike in the function of a judge” and “be on strike in the function of a hangman” respectively. That the value for the underspecified parameter is preferably supplied by the head noun of the subject here is evidently due to a different mechanism than in the adjunct construction that are our main focus of interest. This can be seen from the

So the picture that arises is the following: Contrary to what Landman suggests, the interpretation of the subject in a sentence like

(55) John as a judge is corrupt.

is entirely standard and classical; the sentence is a statement about the individual John, and this individual is absolutely consistent. There is no need for an ontology of “individuals under guises”. Rather, *as*-phrases play a role in the process of the resolution of underspecification. The consistency effects are a pure side effect of this. What has to be clarified is how exactly syntax, semantics and pragmatics interact to bring about this effect.

Bartsch (1987) suggests to bake the underspecification resolving function of *as*-phrases right into the syntax-semantics interface. Such an approach strikes me unattractive for two reasons. First, *as*-phrases have other functions as well, as the discussion in the other sections of this article demonstrates. Ideally, one approach should cover as many usages as possible. Second, the effect under discussion is defeasible. If the context supplies a better value for the underspecified parameter of the main predicate, the *as*-phrase may be turned into an ordinary presupposition. This is illustrated in (56).

fact that in case of a competition, an *as*-adjuncts wins over the subject head noun, c.f.:

(iv) As a musician, the professor is exceptional.

In the preferred reading, the person in question is an exceptional musician, not an exceptional professor.

- (56) *The head of the oceanology search committee, considering the application of Dr. Graham:* I don't know Graham personally, but as a Harvard graduate, he must be excellent.

In the preferred reading, this means that Harvey is an excellent oceanologist, not necessarily an excellent Harvard graduate. Since this kind of non-monotonicity is characteristic of pragmatics rather than for the “hard-wired” syntax-semantic interface, a pragmatic approach has some initial plausibility.

To be somewhat more specific, we believe that the underspecification resolving effect of *as*-adjuncts is just a side effect of their presuppositional nature. In other words, in the examples in question two dimensions of underspecification are involved: unresolved presuppositions and underspecified parameters originating from lexical semantics. Along both dimensions, resolution candidates are ranked by certain pragmatic preference measures. Van der Sandt's principles “Binding is better than accommodation” and “Accommodate as high as possible” are some, but not all aspects that play a role here. Crucially, we assume that resolution alternatives along both dimensions of underspecification wind up being in the same reference set. In other words, resolution candidates that differ only in the choice of a lexical parameter might be ranked differently because one requires presupposition accommodation while the other can do with presupposition binding.

How is lexical underspecification to be handled in the van der Sandt style version of DRT? We suggest that the sentence (57a) is equivalent

to (57b) at some level of representation, where “**P**” is an underspecified parameter. Formally, we treat parameters as constants, so resolution comes down to a choice between models that map parameters to different denotations.

- (57) a. John is corrupt.  
 b. John is a corrupt **P**.

However, the choice of a value for **P** is not entirely free; it has to be supplied by the context. This means that **P** is anaphoric in a sense. In van der Sandt’s framework, this amounts to saying that John’s being **P** is presupposed. So an adequate representation of (57a) would be (58).<sup>11</sup> Here the third argument of the predicate `CORRUPT` indicates the dimension of corruption.

$$(58) [w_0, x, s | w_0 \in WS, \text{JOHN}(x), \text{CORRUPT}(s, x, \mathbf{P}), s \sqsubseteq w_0 / \{[\mathbf{P}(s, x)]\}]$$

So we assume that the sentence presupposes John’s being **P**, and furthermore we assume that John’s being **P** and John’s being corrupt as a **P** are inseparable, i.e. they are true in the very same situation *s*. Without further contextual information, this presupposition is locally accommodated, so the final interpretation is (59), as far a sentence grammar is concerned. The value for **P** has to be supplied by extra-sentential information.

<sup>11</sup> For better readability, we preprocess the presuppositions concerning the eventuality argument.

$$(59) [w_0, x, s | w_0 \in WS, \text{JOHN}(x), \text{CORRUPT}(s, x, \mathbf{P}), s \sqsubseteq w_0, \mathbf{P}(s, x)]$$

Now reconsider the critical (60a), which receives the initial representation (60b).

$$(60) \text{ a. John as a judge is corrupt.}$$

$$\text{ b. } [w_0, x, s_1 | w_0 \in WS, \text{JOHN}(x), \text{CORRUPT}(s_1, x, \mathbf{P}), s_1 \sqsubseteq w_0 /$$

$$\{[\mathbf{P}(s_1, x)], [\text{JUDGE}(s_2, x)], [s_2 | ]\}]$$

Now we have to consider three options.

1.  $\mathbf{P}$  receives some contextual value different from  $\text{JUDGE}$ . Then the remaining presupposition does not find an antecedent and is thus accommodated, yielding the representation (61a) or (b), (depending on whether  $s_2$  is bound to  $w_0$  or  $s_1$ ).

$$(61) \text{ a. } [w_0, x, s_1 | w_0 \in WS, \text{JOHN}(x), \text{CORRUPT}(s_1, x, \mathbf{P}), s_1 \sqsubseteq w_0,$$

$$\text{ JUDGE}(w_0, x), \mathbf{P}(s_1, x)]$$

$$\text{ b. } [w_0, x, s_1 | w_0 \in WS, \text{JOHN}(x), \text{CORRUPT}(s_1, x, \mathbf{P}), s_1 \sqsubseteq w_0,$$

$$\text{ JUDGE}(s_1, x), \mathbf{P}(s_1, x)]$$

2.  $\mathbf{P}$  is instantiated as  $\text{JUDGE}$  and  $s_2$  is bound to  $w_0$ . The two remaining presuppositions have identical descriptive content. Still they must be accommodated separately since their situation index is different, yielding

$$(62) [w_0, x, s_1 | w_0 \in WS, \text{JOHN}(x), \text{CORRUPT}(s_1, x, \text{JUDGE}), s_1 \sqsubseteq w_0,$$

$$\text{ JUDGE}(s_1, x), \text{JUDGE}(w_0, x)]$$



3. **P** is instantiated as JUDGE and  $s_2$  is bound to  $s_1$ . These resolution steps give us (63). Now the presupposition triggered by *corrupt* can be **bound** (to the presupposition triggered by the *as*-phrase), so one accommodation step can be avoided. This results in the resolved DRS

$$(63) [w_0, x, s_1 | w_0 \in WS, \text{JOHN}(x), \text{CORRUPT}(s_1, x, \text{JUDGE}), s_1 \sqsubseteq w_0, \\ \text{JUDGE}(s_1, x)]$$

Crucially, the first two options have to take resort to presupposition *accommodation*, while the third option can do with presupposition *binding*. Since binding is *ceteris paribus* preferred over accommodation, instantiating **P** with JUDGE is preferred over any other instantiation. Generally, taking the value for a presupposed underspecified parameter from another presupposition saves one accommodation step and is thus preferred. Of course this preference ordering is defeasible; if another instantiation of **P** leads to a configuration where binding is also possible (as in (56)), such a reading would not be blocked.

This also explains certain cases where *as*-phrases are not suitable to supply a value for underspecified parameter of the main predicate. For instance, the sentence (64a) cannot mean (b).

(64) a. As a basketball player, John is short.

b. John is short in comparison to normal basketball players.

Like *corrupt* and similar predicates, dimensional adjectives are underspecified; the context has to supply a standard of comparison.<sup>12</sup> However, this standard of comparison need not be a property, and even if it is a property, the argument of the adjective in question need not fall under the extension of the property, as can be seen in

(65) Compared to elephants, this mouse is small.

This does not entail (or presuppose) that the mouse in question is an elephant. Applied to the analysis of (64a), this means that the presupposition “John is a basketball player” has to be accommodated, no matter what the standard of comparison for *short* is. There is thus no bias towards identifying this standard with basketball players.

To sum up so far, our explanation of the consistency effects runs as follows:

- In the critical examples, the main predicate (like *corrupt*) is underspecified; it contains an open parameter for a property.
- It is presupposed that this unspecified property holds of the subject.
- *As*-adjuncts trigger a presupposition that their complement predicate holds of the subject.

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<sup>12</sup> See for instance Bierwisch (1989) for a thorough discussion.

- Identifying the unspecified property parameter with the content of the *as*-phrase leads to a configuration where accommodation is required only once; otherwise accommodation is required twice.
- The derivation with the least number of accommodation steps wins.

Finally it should be remarked that this analysis of consistency effects is not confined to predicative adjuncts. Frame setting modifiers are generally capable of rendering else contradictory statements consistent. It was already mentioned in passing that the preposition *with* displays similar characteristics as the preposition *as*, and locative modifiers can assume a similar function (as pointed out by an anonymous reviewer).

- (66) a. With beard John looks old, but without beard he appears to be rather young.
- b. In Germany Harald Juhnke is famous, but anywhere else he is virtually unknown.

### 3.4. COPULAR ADJUNCTS

From what we said in the previous subsection, one would expect that frame setting *be*-headed adjuncts behave exactly the same way. Since all frame setting adjuncts are assumed to be presuppositional, an appropriate choice of value for the lexical presupposition of the main predicate should help to avoid accommodation here as well. This expectation is

not confirmed by the facts though. Consider the following example, which is obtained from (60a) only by replacing *as* with *being*.

(67) Being a judge, John is corrupt.

Here the dimension of corruption is entirely open; the adjunct provides a reason for John's being a corrupt **P**, but it does not supply a value for **P**.<sup>13</sup>

Let us see what the formal theory predicts. Putting the pieces from this and the last section together, we arrive at the initial representation (68) for (67). Note that now the situation argument of *judge*,  $s_2$  is existentially bound by the copula, and an additional world size argument is introduced.

$$(68) [w_0, x, s_1 | w_0 \in WS, \text{JOHN}(x), \text{CORRUPT}(s_1, x, \mathbf{P}), s_1 \sqsubseteq w_0 / \\ \{[\mathbf{P}(s_1, x)], [s_2 | \text{JUDGE}(s_2, x), s_2 \sqsubseteq w_1, / \{w_1 \in WS\}], [w_1 | ]\}]$$

The next three resolution steps are fully deterministic; first we bind  $w_1$  to  $w_0$ , second we bind the sortal restriction  $[w_0 \in WS]$ , and finally we

<sup>13</sup> In the appropriate contextual setting, the hidden parameter of *corrupt* may of course be specified as **JUDGE**, as in

- (i) You cannot trust any politician in this country. They all take bribes. Mr. Smith might be an honest man in is personal life, but being a politician, he is certainly corrupt.

This discourse has a reading where *corrupt* means “corrupt politician”. What is important for the present discussion is that in *as*-constructions like (60a), there is a strong bias towards identifying the parameter of the main predicate with the meaning of the *as*-phrase, and this is not the case with copular adjuncts.

accommodate the remaining presupposition that originates from the adjunct.

- (69) a.  $[w_0, x, s_1 | w_0 \in WS, \text{JOHN}(x), \text{CORRUPT}(s_1, x, \mathbf{P}), s_1 \sqsubseteq w_0 /$   
 $\{[\mathbf{P}(s_1, x)], [s_2 | \text{JUDGE}(s_2, x), s_2 \sqsubseteq w_0, / \{w_0 \in WS\}]\}]$
- b.  $[w_0, x, s_1 | w_0 \in WS, \text{JOHN}(x), \text{CORRUPT}(s_1, x, \mathbf{P}), s_1 \sqsubseteq w_0 /$   
 $\{[\mathbf{P}(s_1, x)], [s_2 | \text{JUDGE}(s_2, x), s_2 \sqsubseteq w_0]\}]$
- c.  $[w_0, x, s_1, s_2 | w_0 \in WS, \text{JOHN}(x), \text{CORRUPT}(s_1, x, \mathbf{P}), s_1 \sqsubseteq w_0,$   
 $\text{JUDGE}(s_2, x), s_2 \sqsubseteq w_0 / \{[\mathbf{P}(s_1, x)]\}]$

Note that now, JUDGE and  $\mathbf{P}$  have different situational arguments. So the remaining presupposition has to be accommodated, no matter which value we choose for  $\mathbf{P}$ . We always end up with the structure

- (70)  $[w_0, x, s_1, s_2 | w_0 \in WS, \text{JOHN}(x), \text{CORRUPT}(s_1, x, \mathbf{P}), s_1 \sqsubseteq w_0,$   
 $\text{JUDGE}(s_2, x), s_2 \sqsubseteq w_0, \mathbf{P}(s_1, x)]$

So with copular free adjuncts, every value for  $\mathbf{P}$  gives rise to the same number of accommodations, and thus sentence grammar gives no clue how this underspecification is to be resolved.

It should be noted though that the interpretation of (67) is stronger than what (70) expresses; it can be paraphrased as *Because John is a judge, he is corrupt*. This is an instance of a more general phenomenon that is thoroughly discussed in Asher and Lascarides (1998). They develop a theory of presupposition resolution that generalizes van der Sandt's in several respects. Most importantly, resolution does not

simply mean adding the content of a presupposition to some host DRS under this view. Rather, the DRS corresponding to a presupposition has to be linked to its antecedent via some discourse relation. The antecedent for resolution must be some suitable DRS in the previously established discourse representation—including the DRS that corresponds to the assertive meaning of the very sentence that contains the presupposition trigger. Presupposition binding is a special kind of accommodation in this theory—it arises if the antecedent of the presupposition subsumes the content of the presupposition, and the nexus between antecedent and presupposition is “*Def-Consequence*” (defeasible consequence).

Arguably, the *because*-nexus between presupposition and assertion in the interpretation of (67)—and in the factive reading of free adjuncts in general—results from this very mechanism. Here the assertive part of the sentence serves as host for its presupposition (which is licit in Asher and Lascarides’ framework), and the discourse relation connecting them is resolved as “Explanation”.

This line of thinking is supported by the observation that the *because*-nexus can be overridden by lexically specifying another discourse relation as for instance “Contrast”, which is part of the lexical meaning of the conjunction *despite*:

(71) Despite being a judge, John is corrupt.

These considerations are still rather tentative, and several things remain to be explored, especially why there is such a seemingly non-

defeasible preference for “Explanation” in constructions like (67). However these issues will eventually be settled though, the assumptions that are made in this paper—preference for binding over accommodation and for high over deep accommodation—are firmly established and are thus likely to be incorporated into a more fine-grained theory of discourse interpretation.

To summarize the discussion in this section, free adjuncts may supply a value for underspecified parameters of the main predicate due to their presuppositional character. Information flow between adjunct and main predicate is provided by the presupposition resolution module. However, this information flow is situated. Only information about the same situation may be shared between different presuppositions. Copular adjuncts come with their own situation; thus information flow is blocked there.

#### 4. Weak and strong adjuncts

As mentioned in the introduction, Stump (1985) noted that some but not all free adjuncts may be interpreted as part of the restrictor of some superordinate functor. One of Stump’s minimal pairs is:

- (72) a. Being a sailor, John sometimes smokes a pipe.  
b. Lying on the beach, John sometimes smokes a pipe.

While (72b) may be interpreted as *Sometimes when he is lying on the beach...*, no such interpretation is possible in (72a). Here the adjunct is interpreted factively and linked to the main predication via the discourse relation “Explanation as in the examples discussed in the previous section. In Stump’s terminology, a free adjunct is “strong” if and only if it only admits a factive interpretation in such a construction. Adjuncts that allow a restrictive interpretation are called “weak”. It should be noted that the distinction between weak and strong adjuncts is stable across all kinds of binary operators. Next to all adverbs of quantification, the implicit generic operator, modal operators etc. induce exactly the same categorization.

This distinction is relevant for our topic because *as*-adjuncts are always weak while copular adjuncts are generally strong. In the sequel it will be demonstrated that this contrast is in fact predicted under the assumptions made above without further stipulations.

Consider the following example

(73) As a tourist, John always smokes.

Following standard practice, I assume that an adverb of quantification like *always* (a) creates a duplex condition where the rest of the clause ends up in the nuclear scope, and (b) it binds the situation argument of the modified sentence (rather than a temporal argument, cf. Lewis 1975). Formally, the lexical entry of *always* thus is

(74)  $\lambda P \lambda w. [[\text{ALWAYS}([s|s \sqsubseteq w], [[P(s)])] / \{[[w \in WS]]\}]$



So the initial representation of (73) comes out as

$$(75) [w_0, x | w_0 \in WS, JOHN(x), ALWAYS([s_1 | s_1 \sqsubseteq w_0], [[SMOKE(s_1, x) / \{[[TOURIST(s_2, x)], [s_2 | ]]]]])]$$

In the next resolution step, the situation anaphor  $s_2$  has to be bound. Binding may take place at a low level, so  $s_1$  in the restrictor is a possible binder. If one chooses this option, the intermediate representation is

$$(76) [w_0, x | w_0 \in WS, JOHN(x), ALWAYS([s_1 | s_1 \sqsubseteq w_0], [[SMOKE(s_1, x) / \{[[TOURIST(s_1, x)]]]])]$$

There is no antecedent for the remaining presupposition; it has to be accommodated. The accommodation site should be as high as possible *provided no bound discourse markers become unbound*. Here the discourse marker  $s_1$  is bound in the restrictor, thus global accommodation is blocked. Intermediate accommodation is the preferred option, i.e.

$$(77) [w_0, x | w_0 \in WS, JOHN(x), ALWAYS([s_1 | s_1 \sqsubseteq w_0, TOURIST(s_1, x)], [SMOKE(s_1, x)])]$$

Note that there is also a—perhaps less preferred—option for global accommodation if we bind  $s_2$  to  $w_0$ .

Now let us compare this with the strong construction

$$(78) \text{ Being a tourist, John always smokes.}$$

The initial representation is as above, apart from the fact that the copula binds the situation variable of *tourist* and replaces it by a world variable.

$$(79) [w_0, x | w_0 \in WS, JOHN(x), ALWAYS([s_1 | s_1 \sqsubseteq w_0], [[SMOKE(s_1, x) / \{[s_2 | s_2 \sqsubseteq w_1, TOURIST(s_2, x) / \{w_1 \in WS\}], [w_1 | ]]]]]]$$

The world anaphor  $w_1$  could be bound to the situation  $s_1$ . However, this would enforce intermediate accommodation of the sortal information  $w_1 \in WS$ . Binding  $w_1$  to  $w_0$ ,  $w_1 \in WS$  need not be accommodated at all but can be bound at the global level. Thus binding of  $w_1$  to  $s_1$  is blocked. So the only option for resolution of  $w_1$  is high binding, which leads to

$$(80) [w_0, x | w_0 \in WS, JOHN(x), ALWAYS([s_1 | s_1 \sqsubseteq w_0], [[SMOKE(s_1, x) / \{[s_2 | s_2 \sqsubseteq w_0, TOURIST(s_2, x)]}]]]]]$$

Again the remaining presupposition must be accommodated,<sup>14</sup> but this time nothing blocks global accommodation, so the final representation is the strong

<sup>14</sup> An anonymous reviewer points out that there is an alternative resolution strategy. If one assumes with von Stechow (1994) (and many others) that quantifiers always come with an underspecified domain restriction, that it would be licit to fix this restriction to  $TOURIST(s_1, x)$ . This would transform (80) into

$$[w_0, x | w_0 \in WS, JOHN(x), ALWAYS([s_1 | s_1 \sqsubseteq w_0, TOURIST(s_1, x)], [[SMOKE(s_1, x) / \{[s_2 | s_2 \sqsubseteq w_0, TOURIST(s_2, x)]}]]]]]$$

This allows (intermediate) binding of  $s_2$  to  $s_1$ , which results in the fully resolved DRS (77). In other words, the weak reading of the copular adjunct should be possible as well. Note though that the implicit restriction of a quantifier domain is not arbitrary but has to be made salient by the context. For the example in question, this would be the case in a context like the following:

$$(81) [w_0, x, s_2 | w_0 \in WS, s_2 \sqsubseteq w_0, \text{TOURIST}(s_2, x), \text{JOHN}(x), \\ \text{ALWAYS}([s_1 | s_1 \sqsubseteq w_0], [\text{SMOKE}(s_1, x)])]$$

To formulate the underlying idea on a somewhat coarser level, our explanation for the weak/strong contrast between *as* and *be* runs as follows:

- Binary operators like adverbs of quantification quantify over situations.
- *As*-adjuncts supply a situation argument that can either be bound by the operator or be identified with the evaluation index.
- *Be*-adjuncts supply a world argument that cannot be bound by the operator but has to be identified with the evaluation index.
- The presupposition of the nuclear scope is accommodated to wherever its eventuality argument is bound. This is either the restrictor of the operator of the matrix context for *as*-adjuncts, but always the matrix context for *be*-adjuncts.

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**A:** Some people really change when they travel, but John is such a dull person, I'm sure he even wears a tie when he is on the beach! You know him better, so how is he when he is a tourist?

**B:** He is a bit more relaxed as a tourist. For instance, *being a tourist he always smokes*. But generally you are right, he is a rather quiet person.

In this setting, the critical sentence does in fact neither entail that John is a tourist nor that he smokes when he is not a tourist. In other words, the copular adjunct is bound at the intermediate rather than the global level here.

We conclude this section with pointing out an interesting consequence of the theory sketched here that connects two of the three intended applications.

According to Stump, weak adjuncts are interpreted as part of the restrictor. So (82a) should be equivalent to (82b).

- (82) a. As a judge, John is always corrupt.  
 b. When John is a judge, he is always corrupt.

Yael Sharvit (p.c.) notes that this equivalence is not complete. A more adequate paraphrase of (82a) is (83).

- (83) When John is a judge, he is always a corrupt judge.

So the *as*-adjunct in (82) serves two purposes: it restricts the adverbial operator, and it supplies a value for the underspecified dimension of corruption. This is exactly what our theory predicts: (82a) receives the initial underspecified DRS (84a), which is transformed to (b) or (c), depending on whether **P** is or is not instantiated with JUDGE. Since the former admits binding while the latter requires accommodation, (b) represents the preferred reading, which is equivalent to (83).

- (84) a.  $\lambda w_1.[x|w_1 \in WS, \text{JOHN}(x), \text{ALWAYS}([s_1|s_1 \sqsubseteq w_2],$   
 $[[\text{CORRUPT}(s_1, x, \mathbf{P})/\{[w_2 \in WS], [w_2| ], [[\mathbf{P}(s_1, x)],$   
 $[[\text{JUDGE}(s_2, x)], [s_2| ]\}]]]$   
 b.  $[w_0, x|w_0 \in WS, \text{JOHN}(x), \text{ALWAYS}([s_1|s_1 \sqsubseteq w_0,$   
 $\text{JUDGE}(s_1, x)], [[\text{CORRUPT}(s_1, x, \text{JUDGE})]])]$

- c.  $[w_0, x | w_0 \in WS, \text{JOHN}(x), \text{ALWAYS}([s_1 | s_1 \sqsubseteq w_0, \mathbf{P}(s_1, x),$   
 $\text{JUDGE}(s_1, x)], [\text{CORRUPT}(s_1, x, \mathbf{P})])]$

## 5. Conclusion and further research

Let us briefly summarize our findings. We started the discussion with the fact noted by Stump that *as*-PPs are admitted in the complement of verbs of perception while copular predicates are excluded there. Stump analyzed this fact in a Carlsonian fashion by classifying *as*-PPs as SLPs and copular predicates as ILPs.

We argued that the Carlsonian approach to the semantics of verbs of perception is insufficient for independent reasons. We proposed a modification that maintains some of Carlson's intuitive approach. We agree with Carlson that perception involves partial objects, and thus predicates ranging over total objects are excluded in the complement of *see*. However, we shift the partial/total contrast from the domain of individuals to the domain of eventualities. To this end we employed an Kratzer style ontology where abstract objects may be classified as possible situations or possible worlds. The contrasts between *as* and *be* was explained by the assumption that *as*-PPs denote properties that have a situation argument (inherited from the NP complement), while the copula induces a sortal shift from situations in general to

possible worlds. Therefore copular predicates are excluded in perception constructions.

Next we turned attention to free adjuncts. Following suggestions from Maienborn, we analyze free adjuncts as frame setting, i.e. topical adverbials. As such they are presuppositional. We embedded this idea into the overall semantic/pragmatic framework by van der Sandt. There presupposition resolution is considered a non-deterministic transformation over discourse representations. The possible outcomes are evaluated according to several criteria. The principle “Presupposition binding is better than presupposition accommodation” turned out to be crucial for the analysis of the phenomena under investigation. *As*-adjuncts may supply a value for underspecified aspects of the meaning of the main predicate because this parameter setting avoids one accommodation step. This only works if the main predicate and the free adjunct share a situation argument. Therefore this effect is not observed with copular free adjunct; the copula introduces its own situation argument, thus information flow between the predicates is blocked.

Finally we demonstrated that the weak/strong contrast between *as*-adjuncts and *be*-adjuncts falls out from these assumption without further ado. The situation argument of an *as*-adjunct may be bound by an adverb of quantification or a similar operator. The world argument of a *be*-adjunct can only be identified with the index of evaluation. Since in van der Sandt’s model, presuppositions are always accommodated as high as possible, *as*-adjuncts are ambiguous between

intermediate and global accommodation, i.e. they undergo a weak construal, while copular adjuncts must be interpreted strong/ via global accommodation.

Let us conclude with pointing out some possible continuations of this line of research. As pointed out in Jäger (2001), Carlson overgeneralizes in subsuming several contrasts under the heading “SLP/ILP” that are better kept apart. However, if the basic idea laid down here is right, the contrasts observed in the complement of perceptual reports, Stump’s weak/strong distinction, and Maienborn’s distinction between stative and non-stative predicates should coincide. It remains to be seen whether this is borne out.

We restricted attention to frame setting adverbials here. *As*-PPs occur in other syntactic configurations as well, as the following examples may illustrate.

- (85) a. John works as a judge.  
b. John acted as a judge.  
c. John was disguised as a judge.

If our situation based approach to the semantics of *as* is correct, it should provide insights into the semantics of these and related constructions as well.

Last but not least, cross-linguistic investigations are called for. Several languages (Celtic languages, Hebrew, Spanish etc.) have more than one copula. Do they behave uniformly with respect to the world/situ-

ation contrast? If not, what consequences are predicted, and are these predictions confirmed? As for *as*, how do its cross-linguistic counterparts behave? Russian seems to be a particularly interesting case here, since instrumental case—which corresponds to English *as* in many contexts—may occur in copular constructions (cf. Geist 1998, Partee 1998). So here we can observe a direct interaction between the two modes of predication that were treated as complementary in this paper.

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## Appendix: Compositional DRT

### SYNTAX

The language of compositional DRT used in this paper is basically an extension of standard DRT syntax with  $\lambda$ -abstraction. Every well-formed expression has a type, where types are formed from the basic types  $t$  (update) and  $e$  (entity) by means of function space formation in the standard Montagovian fashion. There are infinitely many variables and constants of each type. Furthermore there is a distinguished infinite set  $DM$  of constants of type  $e$ , the discourse markers. We use boldface lowercase Latin letters as meta-variables for discourse markers (except for the distinguished discourse marker  $w_0$  that is anchored to the world of evaluation). The syntax is defined by the following rules:

DEFINITION 1. (Syntax of Compositional DRT).

1. All variables and constants are expressions of their respective type.
2. If  $\phi$  has type  $\langle A, B \rangle$  and  $\psi$  has type  $A$ , then  $\phi(\psi)$  has type  $B$ .
3. If  $v$  is a variable of type  $A$  and  $\phi$  has type  $B$ , then  $\lambda v.\phi$  has type  $\langle A, B \rangle$ .
4. If both  $\phi$  and  $\psi$  have type  $A$ , then  $\phi = \psi$  has type  $t$ .
5. If  $\mathbf{x}_1 \cdots \mathbf{x}_n$  are discourse markers and  $\phi_1 \cdots \phi_m$  have type  $t$ , then  $[\mathbf{x}_1 \cdots \mathbf{x}_n | \phi_1, \dots, \phi_m], \neg\phi_1$  have type  $t$ .

#### SEMANTICS

A model  $M = \langle \mathcal{K}, \Sigma, F, w_0 \rangle$  consists of a Kratzer frame  $\mathcal{K}$  in the sense defined in the text (a set of individuals  $A$ , a set of situations  $S$ , an ordering of situations etc.), a state space  $\Sigma$ , i.e. a set of partial functions from  $DM$  into the universe (with the empty function as a distinguished member), a function  $F$  that sends all non-logical constants except the discourse markers to a denotation of the appropriate type, and a world of evaluation  $w_0$  from  $\mathcal{K}$ . We require that for all states  $\sigma \in \Sigma : \sigma(w_0) = w_0$  if  $w_0 \in Dom(\sigma)$ . Furthermore we require that the non-logical constants used in the text have their intended meaning, i.e.  $F(WS) = WS, F(\sqsubseteq) = \sqsubseteq$  etc. (Note that we overload the symbols  $WS, \sqsubseteq, \dots$ )

Denotation domains of the types are defined recursively as follows:

DEFINITION 2. (Domains).

$$1. D(e) = A \cup S$$

$$2. D(t) = \{\langle \sigma, \tau \rangle \in \Sigma \times \Sigma \mid \sigma \subseteq \tau\}$$

$$3. D(\langle A, B \rangle) = D(B)^{D(A)^\Sigma}$$

Furthermore interpretation depends on a set  $G$  of assignment function that maps variables to functions from states to denotations of the appropriate type. The recursive interpretation function is defined as follows, where meaning assignment is always relative to a model (that is suppressed in the notation), a state  $\sigma$  and an assignment function  $g$ . We need a 2-place merge operation  $\otimes$  on states as auxiliary notion, where  $(\sigma \otimes \tau)(\mathbf{x}) = \sigma(\mathbf{x})$  if defined, else  $\tau(\mathbf{x})$  if defined, undefined else.  $\sigma \sqsubseteq_{\mathbf{x}_1, \dots, \mathbf{x}_i} \tau$  means that  $Domain(\sigma) \cup \{\mathbf{x}_1, \dots, \mathbf{x}_i\} = Domain(\tau)$ ,  $\{\mathbf{x}_1, \dots, \mathbf{x}_i\} \cap Domain(\sigma) = \emptyset$ , and  $\sigma \subseteq \tau$ .

DEFINITION 3. (Interpretation).

$$1. \text{If } v \text{ is a variable, } \|v\|_g^\sigma = g(v)(\sigma).$$

$$2. \text{If } \mathbf{x} \text{ is a discourse marker, } \|\mathbf{x}\|_g^\sigma = \sigma(\mathbf{x}).$$

$$3. \text{If } c \text{ is a constant, } \|c\|_g^\sigma = F(c).$$

$$4. \|\phi(\psi)\|_g^\sigma = \|\phi\|_g^\sigma(\lambda\tau\|\psi\|_g^\tau)$$

$$5. \|\lambda v_A \phi\|_g^\sigma = \{\langle \alpha, \|\phi\|_{g[v \rightarrow \alpha]}^\sigma \rangle \mid \alpha \in D(A)^\Sigma\}$$

$$6. \|\phi = \psi\|_g^\sigma = \{\langle \tau, \tau \rangle \in \Sigma \times \Sigma \mid \|\phi\|_g^{\tau \otimes \sigma} = \|\psi\|_g^{\tau \otimes \sigma}\}$$

$$7. \|\mathbf{x}_1 \cdots \mathbf{x}_n | \phi_1 \cdots \phi_m\|_g^\sigma = \\ \{ \langle \tau_1, \tau_2 \rangle \in \Sigma \times \Sigma \mid \exists \tau_3 (\tau_1 \sqsubseteq_{\mathbf{x}_1 \cdots \mathbf{x}_n} \tau_3 \wedge \tau_3 \|\phi_1\|_g^\sigma \circ \\ \cdots \circ \|\phi_m\|_g^\sigma \tau_2) \}$$

$$8. \|\neg\phi\|_g^\sigma = \{ \langle \tau, \tau \rangle \mid \nexists \tau_2 : \tau \|\phi\|_g^\sigma \tau_2 \}$$

As the reader may convince herself,  $\alpha\beta\eta$ -equivalences are meaning preserving under the usual restrictions. Furthermore, in the text we sometimes make tacit use of the conversion from

$$[\mathbf{x}_1 \cdots \mathbf{x}_n | \phi_1, \cdots, \phi_k, [\mathbf{x}_{n+1} \cdots \mathbf{x}_{n+l} | \psi_1, \cdots, \psi_m], \zeta_1, \cdots, \zeta_o]$$

to

$$[\mathbf{x}_1 \cdots \mathbf{x}_{n+l} | \phi_1, \cdots, \phi_k, \psi_1, \cdots, \psi_m, \zeta_1, \cdots, \zeta_o]$$

This transformation is also meaning preserving provided the discourse markers  $\mathbf{x}_{n+1} \cdots \mathbf{x}_{n+l}$  do not occur in any  $\phi_i$ .

A DRS  $\phi$  is *true* iff there is a state  $\sigma$  such that for any assignment function  $g : \emptyset \|\phi\|_g^\emptyset \sigma$ .

A final remark on the intended interpretation of the non-logical constants used in the text. While intuitively a predicate constant like WALK of type  $\langle e, \langle e, t \rangle \rangle$  is supposed to denote the relation between individuals  $x$  and situations  $s$  that holds exactly iff  $x$  walks in  $s$ , its denotation in the formal system sketched above is a 3-place function from a state and two individual concepts (i.e. functions from states to individuals) to an update. However, the relation between the intuitive and the formal denotation is a simple implicit type lift; for the example WALK this

means:  $\tau \parallel \text{WALK} \parallel_g^\sigma(a)(b)\tau'$  iff  $\tau = \tau'$  and the individual  $a(\tau \otimes \sigma)$  walks in the situation  $b(\tau \otimes \sigma)$ . The interpretation of the other predicate constants used in the text is derived from their intuitive extension in an analogous way.

