ARNIM VON STECHOW

TEMPORALLY OPAQUE ARGUMENTS IN VERBS OF CREATION*

Summary

Verbs of creation (**create**, **make**, **paint**) are not transparent. The object created does not exist during the event time but only thereafter. We may call this type of opacity temporal opacity. I is to be distinguished from modal opacity, which is found in verbs like **owe** or **seek**. (Dowty, 1979) offers two analyses of creation verbs. One analysis predicts that no object of the sort created exists before the time of the creation. The other analysis says that the object exists throughout the act of creation. I investigate three theories: Theory I says that no object of the sort created and which is caused by the very act of creation exists before the creation. In this theory, verbs of creation must embed a property. Theory II can regard the indefinite object of a creation verb as a quantifier and gives it wide scope with respect to the verb. The theory has to make sure that the objects quantified over exist only after the event. While Theory I and II start from the assumption that the extension of all nouns depend on time, Theory III says that Individual Level predicates do not depend on time. This ontology will enable us to treat verbs of creation as first order relations. The theory will entail that **a picture** does not mean the same as **there is a picture**. The paper discusses various approaches to the problem: Krifka, Parsons, Landman, Kratzer and Zucchi.

* Earlier versions of this paper were presented at the Tysk Institutt of the University of Oslo on October 2 1992, at the Linguistics Department of the University of Texas in Austin on May 2 1993, at the Philosophy Department of the University of Milan on February 20tth 1997 and at the DFGS-meeting on February 26th 1997. I wish to thank Regine Eckardt, Graham Katz, Claudia Maienborn, Renate Musan, Roger Schwarzschild and Ede Zimmermann for helpful comments. My intellectual debts toward Alex Zepter will be evident from the text. Eva-Carin Gerö helped me to improve the English of an earlier version. Thanks to the comments of an anonymous referee.

Fra i crudi sassi tra Tevere ed Arno
da Christo prese l'ultimo sigillo
che le sue membra due anni portarno
Paradiso

1. OVERVIEW

I want to say what the meaning of verbs of creation and of coming into existence in general is. Examples are:

(1) a. John built a house.
b. it. Sta nascendo una stella "A star is getting born"

The most obvious property of these verbs is that the object created or coming into existence doesn't exist at the truth-interval of the VP. Therefore, a straightforward analysis in terms of predicate logic is not possible. For instance, we cannot represent (1a) as:

(2) ∃x[x is a house at t & John builds x at t]

(Dowty, 1979) is aware of the problem and proposes an analysis along the following lines:

(3) John builds CAUSE BECOME ∃x[x is a house & x exists]

If we make this precise using Dowty's own assumptions, the logical form (LF) entails that there is no house at all before the time of the building activity executed by John. I will spend some time to make this claim precise.

The first revision of Dowty will be to relativise the predicate "exists" to particular events. Roughly speaking, the LF of the sentence will be

(4) ∃e[building(e,John) & BECOMING(e, ∃x[x is a house & x is created by e)]

This is a Davidsonian analysis and can be read: "There is an event e, e is a building done by John and e is a becoming with the result that there is a house that is created by e".

We will have to make precise the notion of "x is created by e". It should be read as an adjectival passive and means something as "x exists as a result of the occurrence of e". The analysis is closely related to Dowty's, but the revision that we have to relativise the results of an event to the occurrence of the event itself is crucial.

The theory improves the original one but it cannot deal with a counter example due to Roger Schwarzschild (p.c):

(5) John will draw a dotted line

In order to deal with this sentence, I consider an alternative LF, which will be something like (6):

(6) Fut ∃x[dotted line after event-time(x) & [draw(John) CAUSE BECOME exist(x)]]

Representations of this kind seem to violate Abusch's **Upper Limit Constraint**, which says that nouns cannot be evaluated at a time later than the local evaluation time or the speech time. The violation of the constraint can be circumvented, if the scoping and the temporal restriction of scoped nominal is done in the lexicon, not in the syntax. This requires type raising for verbs of creation.

A third theory starts from a different ontological assumption: Individual Level nouns do not depend on time. This will enable us to analyse the sentence as:

(7) Fut ∃x[dotted line(x) & [draw(John) CAUSE BECOME exist(x)]]

This LF *cannot* be paraphrased as **There will be a dotted line that John will draw**. The paper compares different approaches and discusses many aberrations before reaching simplicity.

2. OPAQUE ARGUMENTS

An argument of a verb is referentially opaque, if it doesn't permit Existential Exportation. Classical cases are object opaque verbs. Neither of the following two arguments is valid.

(8) Socrates owes Pericles a horse.
∴ There is a horse that Pericles owes Socrates.

(9) Socrates owed Pericles a horse.
∴ There was a horse which Pericles owed Socrates.

The examples are shaped after John Buridan's 15th Sophisma, which will be commented in section **7**.

In this paper I would like to comment on a similar behaviour of verbs of creation and verbs of coming into existence. The following argument is invalid if we keep the reference time constant:

(10) John drew a circle.
∴ There was a circle that John drew.

On the other hand, the following argument is valid with respect to the same reference time:

(11) John pushed a cart.
∴ There was a cart that John pushed.

The following sentence adapted from (Bonomi, 1997) shows that opacity has nothing to do with (Vendler, 1967)'s accomplishment/activity distinction:

(12) Leo went to a French city where there was a concert of Baroque music.
∴ There was a French city where there was a concert of Baroque music to which Leo went.

And we must take care to not confuse the source of opacity, which may not be the verb but an intervening progressive operator. The following argument is not always valid:

(13) Leo was going to a French city where there was a concert of Baroque music.
∴ There was a French city where there was a concert of Baroque music to which Leo was going.

Leo wanted to go either to Besançon, Metz or Paris. He had reserved rooms in each of these towns, but he wanted to take the decision where to go only after the Mont-Blanc tunnel. Unfortunately, there was this fire in the tunnel. So he never reached the point of decision. This is the kind of story (Bonomi, 1997) tells us. If we accept that the premise is true under these conditions, we don't want the conclusion to be true.[1] The premise illustrates Bonomi's **Multiple-**

[1] (Hamm, 1999) disputes Bonomi's claim as to the invalidity of the argument. Perhaps the example is not very natural. The following argument, which is due to Angelika Kratzer (p.c.), is certainly not valid:

They were picking out a pumpkin.
∴There was a pumpkin that they were picking out.

Choice Problem, and the explanation is that the indefinite term has narrow scope with respect to the progressive operator, a modal operator in the style of (Dowty, 1979).

There is another difference between the opacity induced by the progressive and the opacity of a verb of creation. An object of a verb in the progressive can be denoted by a demonstrative term, but this is not possible for opaque objects or subjects that occur in the position of an "effected" object (the standard terminology in German grammar). I can say:

(14) Andrea is climbing that mountain over there (I am pointing to some top)

but I cannot point to a heap of amorphous sand with Andrea in front of it and say:

(15) Andrea is building this sandcastle here.[2]

The progressive cannot be responsible for this difference in behaviour.

The same point can be made with intransitive verbs:

(16) Eine Sonne entstand. "A sun came into existence"
∴ Es gab eine Sonne, die entstand. "There was a sun that came into existence"

This argument is not sound. The outcome of this discussion is that existential exportation is always blocked by verbs of creation, but it is not always blocked by accomplishments that are not verbs of creation. There must be a difference in the lexical semantics responsible for the difference in behaviour. Before developing theories, we will introduce some semantic terminology.

Yet, it is not so clear that the source of the opacity is the progressive here. If this were the case, the following argument should be a good one, which seems doubtful to me.

They picked out a pumpkin.
∴There was a pumpkin that they picked out.

Presumably, the verb "to pick out" is opaque in some sense as well.

[2] We can use a definite term when the heap has enough shape to guess that it will be a sandcastle. This is the problem of incomplete objects, to which we will return at the end of the article.

3. SEMANTIC NOTIONS

In this section I will introduce some semantic properties of nouns (homogeneity, existential impact) and verbs (opacity/transparency with respect to certain arguments). I am using a haecceitistic framework, i.e., individuals are possible things and may have different properties in different worlds and times. I will use the following types: s for worlds (better: world histories), i for times (in the sense of time intervals), e for individuals and t for truth-values. I assume an extensional typed λ-language in the style of (Gallin, 1975) or (Zimmermann, 1993) with variables ranging over worlds and the standard possible world semantics. Like (Cresswell, 1973) I am assuming that meanings can be partial functions.

As usual, I will assume that an individual may exist in a world at some time or not exist. For the time of coming into existence, the predicate **exist** may be undefined, i.e. ||**exist**|| is a partial function from W X T into D, the set of possible individuals. If we denote the speech time by the variable s*, we may represent the somewhat unnatural sentence (17a) as (17b):

(17) a. Goethe existed

b. $\exists t[t < s^* \ \&\ \mathbf{exist}(w)(t)(\mathbf{Goethe})]$

Exist means something like “lives” in a sense that is so general that it may apply also to inanimate things like stones. The sentence **Goethe doesn’t exist anymore** is therefore represented as:

(18) $\neg\mathbf{exist}(w)(s^*)(\mathbf{Goethe})$

One of the most important properties of nouns is that they express properties that are homogeneous in the following sense:

(19) [TH] A predicate of type <s,<i,et>> is **temporally homogeneous**

iff $\forall w \forall t \forall t' \forall x[P(w)(t)(x) = 1 \ \&\ t' \subseteq t \rightarrow P(w)(t')(x) = 1]$

Virtually all nouns are temporally homogeneous, most adjectives, verbs expressing states are, and the predicate **exist** is homogeneous as well. If something is a house at the interval t it is a house at any subinterval of t. Therefore, temporal homogeneity is often referred to as the **subinterval property** (cf. (Dowty, 1979), (Cresswell, 1979), (Krifka, 1989)) and many others.

Predicates of coming into existence are not temporally homogeneous: if something comes into existence at interval t, that thing doesn't come into existence at any proper subinterval of t in the sense that the thing does not exist at the beginning of the subinterval but it does at the end. We know from the literature, especially (Dowty, 1979) that it is an essential feature of accomplishments/achievements that they don't have the subinterval property.

How do we know whether a predicate is temporally homogeneous or not? This knowledge belongs to our lexical knowledge. In terms of model theory, we may think of appropriate axioms for each predicate. For instance, each standard model for English should satisfy the following axiom:

(20) TH(**house**): $\forall w \forall t \forall t' \forall x[\mathbf{house}(w)(t)(x) \ \& \ t' \subseteq t \rightarrow \mathbf{house}(w)(t')(x)]$

The axiom entails that we cannot represent sentence (21a) as (21b):

(21) a. Andrea built a house
b. $\exists t[t < s^* \ \& \ \exists x[\mathbf{house}(w)(t)(x) \ \& \ \mathbf{build}(w)(t)(x)(\mathbf{Andrea})]]$

TH(**house**) entails that x is a house from the first moment of the building on! In order to block the undesired entailment, we have to conclude that **build** cannot be a first order predicate.

Individuals have life times, which might be different in each possible world. We will simplify here and we will assume that an individual lives at the same time in each world where it exists. We will use the notation t(x) for the time of the individual x. If x is a horse in w, it is a horse in w throughout t(x). **Horse** denotes a permanent property or what has been called an **Individual Level** (IL) property.[3] **Stage Level** (SL) properties are true of an individual at one time and false at another time. **Tired** is such a property. SL-properties do not require the

[3] It is instructive to compare this analysis with that of (Kratzer, 1995). Consider the sentence **Brunellus was a horse**. In our semantics, it is formalised as:

$\exists t[t < s^* \ \& \ \mathbf{horse}(w)(t)(\mathbf{Brunellus})]$

Kratzer, however, would analyse the sentence as something like the following:

t(Brunellus) < s* & Brunellus is a horse in w.

t(Brunellus) is the time of Brunellus' existence. This can be read "Brunellus lives before s* and he is a horse in w". For Kratzer, IL predicates have no time (or "location") argument. They are predicates of individuals simpliciter. My approach crucially assumes that nouns have time arguments, otherwise the talk about temporal homogeneity would not make sense. Kratzer's analysis excludes that Brunellus is still alive at s*. The consequence has been criticised in Musan's dissertation ((Musan, 1997)).

introduction of a different ontological sort like stages. An SL predicate P is true of an individual x at time t iff the temporal stage of x at t has the property P.

An analogy with spatial predication is helpful here. The following example is due to David Lewis (it was said at some conference):

(22) Look at this pipe. It's square in the ground but it is round in the first floor.

The pronoun **it** refers to the entire pipe, a long thing, but the predicates **square** and **round** are true of different spatial parts of the pipe. How could that be? The answer is obvious if we look at the meaning of the second sentence. A reasonable paraphrase is this:

(23) $\exists$x[x is a spatial part of the pipe & x is in the first floor & x is round]

Now, look at the relation **round in the first floor,** which is obtained by abstracting away the pipe.

(24) **round in the first floor**:= $\lambda y \exists x$[x is a spatial part of y & y is in the first floor & y is round]

The analogy with time is obvious, the ground and the first floor play the role of times. They localise spatial parts of large spatial objects, they do not localise the entire objects. Still the relation **round in the first floor** is about entire individuals.[4]

Before I go on I want to mention another property of the predicate **house**, which may be called **Existential Impact** (EI): If something is a house at time t, it exists at t. We can formulate this as another axiom that every standard model for English has to satisfy:

(25) EI(**house**): $\forall w \forall t \forall x[\mathbf{house}(w)(t)(x) \rightarrow \mathbf{exist}(w)(t)(x)]$

Let us turn to transparency/opacity now. Montague's method to analyse opaque verbs is to embed

[4] (Musan, 1997) distinguishes between stages and individuals in the ontology. While I don't dispute that this can be done, I think that the ontology becomes unnecessarily complicated. We can always avoid the talk about stages. Consider the sentence

Brunellus is tired

Musan would say that **tired** is true of certain Brunellus stages, say b_1 and b_2 and false of others, say b_3 and b_4. I say that **tired** is true of Brunellus at $t(b_1)$ and $t(b_2)$ but false of Brunellus at $t(b_3)$ and $t(b_4)$. Clearly the two approaches

NP-intensions (cf. (Montague, 1974, p. 265)). Since we are interested in temporal opacity and not in modal opacity, a definition of temporal transparency amounts to this:

(26) **Transparency for quantifier embedding predicates**

Let P be a predicate of type $<s, <i,<\alpha,<e,t>>>>$, $\alpha = <s,<i,<et,t>>>$

P is **transparent** iff the following condition is fulfilled:

$\forall w\forall t\forall Q_\alpha\forall x[P_{wt}(Q)(x) = 1 \leftrightarrow Q_{wt}(\lambda w\lambda t\lambda y.P_{wt}(\lambda w\lambda t\lambda R.R(y))(x)) = 1]$, where R is of type $<e,t>$.

If P is not temporally transparent it is **opaque**.

For instance, **Socrates sees a horse** is represented as (27a). Since there is a sense in which **see** is temporally transparent, the formula is logically equivalent with (27b).[5]

(27) a. $\mathbf{see}_{wt}(\lambda w\lambda t.\mathbf{a}_{wt}\ \mathbf{horse})(\mathbf{Socrates})$.[6]

b. $\mathbf{a}_{wt}\ \mathbf{horse}(\lambda w\lambda t\lambda x.\mathbf{see}_{wt}(\lambda w\lambda t\lambda R.R(x))(\mathbf{Socrates}))$

$= \exists x[\mathbf{horse}_{wt}(x)\ \&\ \mathbf{see}_{wt}(\lambda w\lambda t\lambda RR(x))(\mathbf{Socrates})]$

We have to assume a transparency postulate for each transparent verb, of course. Following (Zimmermann, 1993), I will not embed intensions of generalised quantifiers at the object position. I will rather assume that opaque verbs embed intensions of one-place predicates. We are therefore forced to formulate a second definition covering this case as well.

(28) **Temporal transparency for predicate embedding predicates**

Let P be a predicate of type $<s, <i,<\beta,et>>>$, $\beta = <s,<i,<e,t>>>$

P is **temporally transparent** iff the following condition is fulfilled:

$\forall w\forall t\forall R_\beta\forall x[P_{wt}(Q)(x) = 1 \leftrightarrow \exists y[R_{wt}(y) = 1\ \&\ P_{wt}(\lambda w\lambda t\lambda z[y = z])(x) = 1]]$

Temporally opacity is defined as before. This is Zimmermanns (1993) definition of transparency, and it amounts in fact to Montague's notion of object-extensionality. Suppose now we have a

---

come to the same in terms of truth-conditions. In a previous version of this paper, I have said more about Musan's approach, but limits of space prevent me from doing this here.

[5] The meaning of the indefinite article is standard: $\|\ \mathbf{a}\ \|(w)(t)(P)(Q) = 1$ iff $\exists x[P_{wt}(x)\ \&\ Q_{wt}(x)]$.

[6] The meaning of this verb **see** is this: $\|\ \mathbf{see}\ \|(w)(t)(Q)(x) = 1$ iff $Q(w)(t)(\lambda w\lambda t\lambda y.x$ sees y in w at t$) = 1$, where the λ-operator is used metalinguistically.

verb **see** that embeds a property of type β at the object position. Suppose further that (**a**) **horse** has the type β and that **sees** is transparent. Using the definition, the sentence **Socrates sees a horse** would then have the following logical form:

(29) $\mathbf{see}_{wt}(\lambda w\lambda t.\mathbf{horse}_{wt})(\mathbf{Socrates})$

$= \exists x[\mathbf{horse}_{wt}\ \&\ \mathbf{see}_{wt}(\lambda w\lambda t\lambda y[y = x])(\mathbf{Socrates})]$[7] (by temporal transparency)

By the meaning rule given in footnote 7, the first expression is true in w at t iff there is an x such that x is a horse in w at t and Socrates sees x in w at t. The second expression is true in w at t iff there is an x such that x is a horse in w at t and there is a y such that y = x and Socrates sees y in w at t. Thus, both expressions mean the same.

4. Dowty on Verbs of Creation

The best known account of verbs of creation is due to (Dowty, 1979), p. 91. I believe that the solution is on the right track but does not work as it stands and the task of Theory I will be to overcome the difficulties while keeping the spirit of the enterprise. There is a second proposal of Dowty's which runs into difficulties of a different sort. The second proposal will be taken up in section 12 as Theory III. Dowty considers the sentence (30a) and proposes the analysis (30b).

(30) a. John painted a picture.

b. [John paints] CAUSE [BECOME [a picture exists]]

The unwanted prediction is that this LF is true at an interval t if no picture exist at the beginning of t. Clearly this is not what Dowty intends. One would think that this can easily be repaired, but we will see that major revisions seem needed. Let us make Dowty's LF precise, using his own semantics. Adapted to our extensional framework, his meaning of BECOME is the following one:

(31) BECOME is a symbol of type $<s,<i,<\pi,t>>>$, where π is $<s,<i,t>>$.

[7] The meaning of this verb **see** is this one: $\|\ \mathbf{see}\ \|(w)(t)(P)(x) = 1$ iff $\exists y[P(t)(y) = 1\ \&$ x sees y in w at t].

||BECOME||(w)(t)(p) = 1 iff (1) there is an i containing BEG(t) such that p(w)(i) = 0; (2) there is a j containing END(t) such that p(w)(j) = 1; (3) p is undefined for any proper subinterval of t.

BEG(t) is the initial point of t and END(t) is the end point of t. I am using a partial interpretation, for the BECOME-operator could be defined for points only if the logic were total. The idea is that at the becoming-interval, it may be unclear whether something is already a picture or not. Say that it is not a picture until the last moment of the becoming.

Dowty's meaning for CAUSE is rather complicated. It is a sort of counterfactual dependency in the sense of (Lewis, 1973). For our purposes, the following simplification will do, but you should consider this as a crude substitute for the original definition.[8]

(32) CAUSE is symbol of type $<s,<i,<\pi,\pi t>>>$, $\pi = <s,<i,t>>$

$||$ CAUSE $||(w)(t)(q)(p) = 1$ iff $p(w)(t) = q(w)(t) = 1$ & $\exists w'[p(w')(t) = q(w')(t) = 1$ & $\forall w''[p(w'')(t) = 1$ & $q(w'')(t) = 0 \rightarrow w'$ is more similar to w than $w'']]$

The essential point of the rule is the factivity of the CAUSE-relation: if p CAUSE q in the world w at time t, then p and q are both true in w at the interval t. The precise version of Dowty's (30b) is therefore this:

(33) $\exists t[t < s^* \ \& \ \text{CAUSE}_{wt}(\psi)(\varphi)]$,

where

$\varphi = \lambda w \lambda t.\mathbf{paint}_{wt}(\mathbf{John})$

$\psi = \lambda w \lambda t.\text{BECOME}_{wt}(\lambda w \lambda t.\exists x[\mathbf{picture}_{wt}(x) \ \& \ \mathbf{exist}_{wt}(x)])$

Suppose, (33) is true at the speech time s*. Then there is an interval t before s* which satisfies φ and ψ in the actual world w. The meaning of BECOME entails that the proposition $||\lambda t \lambda w \exists x[\mathbf{picture}_{wt}(x) \ \& \ \mathbf{exist}_{wt}(x)]||$ is false in w at BEG(t). In other words, John can paint a picture at t only if there is no picture at all at the beginning of t.

---

8 (Dowty, 1979: 108). The above definition is in reality **causal dependency**. We say then that **p is a causal factor for q in w at t** iff there are propositions $p_1, p_2, \ldots, p_n$ which are locally connected by causal dependency in w at t_i, where t_i is a subinterval of t for each of these. We finally define **p CAUSE q in w at t** iff p is a causal factor of q in w at t and there is no "better" causal factor than p in terms of similarity.

As we would expect, scoping doesn't help. If we scope out the indefinite term, we obtain a plain contradiction:

(34) a picture$_x$[[John paints] CAUSE [BECOME [x exists]]]
$\exists t[t < s^* \,\&\, \exists x[\mathbf{picture}_{wt}(x) \,\&\, \mathrm{CAUSE}_{wt}(\psi)(\lambda w\lambda t.\mathrm{BECOME}_{wt}(\lambda w\lambda t.\mathbf{exist}_{wt}(x)))]]$

If t is the interval of the painting, then there is a picture x which exists during t, because the predicate **picture** belongs to the predicates with existential impact. Hence x exists at BEG(t). Even if **picture** did not satisfy the EI-axiom, it clearly is temporal homogeneous. Therefore John would paint something that is a picture from the beginning on.

One could object that the criticism is not valid because quantification is contextually restricted. **A picture** doesn't mean that there is some picture in the entire world but that there is some contextually relevant picture. (Fintel, 1994) expresses this kind of restriction by means of a property C variable whose value is specified by the context, which may be thought as the variable assignment g. We are tempted then to replace the ψ in (33) by the following expression ψ':

(35) $\psi' = \lambda w\lambda t.\mathrm{BECOME}_{wt}(\lambda w\lambda t.\exists x[\mathbf{picture}_{wt}(x) \,\&\, C_{wt}(x) \,\&\, \mathbf{exist}_{wt}(x)])$

This means that no picture with property C exists at the beginning of the painting interval, but some picture with property C exists at the end of the painting interval. If we say that the context specifies the value of a free variable, we should be able to say in principle what this value could be. Here, it is the property of being created by the painting event itself. Since this is always so, there is no room for variation and the C is therefore not determined by the context but by the meaning of the verb. So this analysis is essentially incomplete.

Thus both variants of the first solution are unsatisfying and, in the formal part of the book, Dowty does not take up his initial proposal. He advocates a formalisation without the BECOME-operator and with the object in a transparent position. In other words, the idea is that verbs of creation are temporally opaque is not pursued by him. On page 223, he writes: "To be sure, there is a transitive accomplisment verb **make**, but this means "cause to exist"(**John made a sandcastle**, **John made a statement**)". And on page 366 we find the meaning rule for **make**:

(36) **make**, TV, $\lambda \boldsymbol{P} \lambda x \boldsymbol{P}\{{}^\wedge y \exists P[P(x)\ \mathrm{CAUSE}\ \mathbf{exist'}(y)]\}$

P is a variable for quantifier intensions of a rather complicated type. As can be seen from the formula, ***P*** has wide scope with respect to the intensional functor CAUSE. If we simplify the type of the variable, the translation into our extensional language yields the following formula:

(37) $\lambda w\lambda t\lambda \boldsymbol{P}\lambda x\boldsymbol{P}(\lambda y\exists P.\mathrm{CAUSE}_{wt}(\lambda t\lambda w.\mathbf{exist}_{wt}(y))(\lambda w\lambda t.P_{wt}(x)))$

Since the formalisation contains no BECOME-functor, we may hope to get rid of our problem, because it was this functor that yielded the contradiction. Here is an analysis of one of Dowty's sentences in a tenseless version. (38a) is Dowty's and (38b) is our formula:

(38) a. **Andrea make a sandcastle**

b. $\exists y[\mathbf{sandcastle'}(y)\ \&\ \exists P[P(\mathbf{Andrea'})\ \mathrm{CAUSE}\ \mathbf{exist'}(y)]]$

c. $\exists y[\mathbf{sandcastle}_{wt}(y)\ \&\ \exists P.\mathrm{CAUSE}_{wt}(\lambda w\lambda t.\mathbf{exist}_{wt}(y))(\lambda w\lambda t.P_{wt}(\mathbf{Andrea}))]$

(38b) is true at interval t in w iff a sandcastle x exists in w throughout t, and Andrea has a property in w at t which causes x to exist in w at t. The quantifier expressed by **a sandcastle** is in a purely transparent position. Due to TH(**sandcastle**), the sandcastle is a sandcastle already at the moment in which Andrea starts to make it. Due to EI(**sandcastle**), the sandcastle exists from the first moment of Andrea's activity. Clearly, this is not compatible with the meaning of a verb of creation. So this way is not viable either.

5. THEORY I: RESULTS ARE RELATIVISED TO PARTICULAR EVENTS

The solution I want to work out first is this. The tenseless version of *John paints a picture* is true at interval t iff there is an event e which is a painting, and a picture comes into existence as the result of that particular e. In other words, the result of a particular becoming-event is relativised to the event itself. This avoids the difficulties of Dowty's first proposal, because we can have an event e whose running time is t and at the beginning of t there is no picture which is a result of e but at the end of e there is a picture which is the result of e.

Before making the semantics precise, I write down the tenseless version of Dowty's sentence (30a). It is this:

(39) $\exists e[\mathbf{painting}_{we}(\mathbf{John})\ \&\ \mathrm{BECOMING}_{we}(\lambda w\lambda t.\exists x[\mathbf{picture}_{wt}(x)\ \&\ \mathbf{created\text{-}by}_{wt}(e)(x))]$

An inspection of the formula shows that the original problem is – at least partially – solved. The proposition embedded under the BECOME-operator contains a variable bound from outside. Thus the conclusion that there was no picture at all before the occurrence of the becoming e is avoided. Note that x is created by e at END(t(e)) but x is not created by e at BEG(t(e)).

The formula presupposes a Davidsonian approach, of course. In other words, the expression $\mathbf{painting}_{we}(\mathbf{John})$ has to be read as "e is a painting in w and e is executed by John".

BECOMING is the adaptation of Dowty's BECOME-operator to events (cf. (Stechow, 1996)). I denote the logical type of events by ev.

(40) BECOMING is a symbol of type $<s,<ev,<\pi,t>>>$, $\pi = <s,<i,t>>$

$\|$ BECOMING $\|(w)(e)(p)$ is defined only, if $p(w)(t)$ is undefined for any proper subinterval t of t(e). When defined, $\|$ BECOMING $\|(w)(e)(p) = 1$ iff

a. there is an i containing BEG(t(e)) such that $p(w)(i) = 0$;

b. there is a j containing END(t(e)) such that $p(w)(j) = 1$.

Everything is exactly as before. The only difference is that we speak about events instead of times.

And here is the semantics for the predicate **created-by**.

(41) **created-by** is of type $<s,<i,<ev,et>>>$. $\|$ **created-by** $\|(w)(t)(e)(x) = 1$ iff $\lambda w\lambda t.O_w(e)$ causes $\| \lambda w\lambda t.\mathbf{exist}_{wt}(x) \|$ in w at t, for any world w, time t, event e and individual x.

O is a metalinguistic predicate which is true of an event e in a world w at time t iff e occurs in w. It is crucial that the predicate O does not depend on time. If the proposition $\lambda w\lambda t.O_w(e)$ is true in a world w at some time, it is true at any time in w. But the proposition "$\lambda w\lambda t.O_w(e)$ causes $\| \lambda w\lambda t.\mathbf{exist}_{wt}(x) \|$ in w at t" depends on time, because "causes" is a predicate that depends on time. The idea is, of course, that the occurrence of e causes the truth of that proposition at the last moment of e. The predicate "causes" has to be understood in the sense made precise above (cf. the semantics for CAUSE). The reader may convince herself that (39) is a reasonable representation of Dowty's sentence. Thus the original approach is rescued.

While I think that this analysis rescues Dowty's proposal, it is not immune against the principled objections against decomposition. For instance, John's painting a picture may unintentionally cause a red spot on his trousers. The semantics would entail that

(42) John painted a red spot

were true. Intuitively, the sentence is not true under this condition. This is, of course, Georgia

Green's classical criticism of lexical decomposition. I am grateful to G. Fanselow for reminding me of this.

A comment on the formula (39) is appropriate. (Zepter, 2000) believes that the trick of my analysis is that I reverse the scope of CAUSE and BECOME, given that **created-by** contains BECOME in its definition. This, however, is not the idea of the analysis. I think that in an event approach the higher CAUSE-operator is dispensable in most cases since CAUSE expresses the idea that the event has an agent. Here, the agent information is contained in the "manner"-component **painting**, which describes the kind of the action. It might be that we need the higher CAUSE-operator as well. In that case (39) should be replaced by a more complicated decomposition:

(43) $\lambda w'\exists e[\mathbf{painting}_{w'e}(\mathbf{John})]$ CAUSE_{wt} $\lambda w'\exists e[\text{BECOMING}_{w'e}(\lambda w\lambda t.\exists x[\mathbf{picture}_{w't}(x)$ & $\mathbf{created\text{-}by}_{w't}(e)(x))]]]$

Thus, I don't reverse the scope of CAUSE and BECOME, but I introduce a further scope operator under CAUSE. Formulas of this kind are more complicated than those considered in the paper. I therefore return to the simpler kind, when I am using an event approach.

6. The logical Type of Verbs of Creation

In this section I want to investigate the logical type of verbs of creation. I will argue that these verbs behave similar as modally opaque verbs such as **owe** or **seek**, which have been studied in (Zimmermann, 1993). If we want a unique type for the object, the best thing to say is that these verbs take one-place properties *in intenso* as objects. If we want to say that the verbs interpret the intensions of generalised quantifiers, we have to restrict the verb to positive – and weak – quantifiers. Otherwise we obtain wrong results. This behaviour is the same Zimmerman has observed for his object opaque verbs. Therefore, the techniques developed by him should carry over to the analysis of temporally opaque verbs. The verbal entries given in this section belong to Theory I, and this theory will be given up in favour of Theory II, but the considerations justifying the logical types will carry over.

Let us ask what the lexical entries of a verb like **paint** could be. It is possible to define the meaning of the transitive verb **paint** by abstracting away the object and the subject in the formula. We have three possible types for the verb:

(44) **A verb of creation**

a. $\mathbf{paint}^e$ is a symbol of type <s,<ev,<e,et>>>.

$\mathbf{paint}^e := \lambda w\lambda e\lambda y\lambda x[\mathbf{painting}_{we}(x)\ \&\ \text{BECOMING}_{we}(\lambda w\lambda t.\mathbf{created\text{-}by}_{wt}(e)(y))]$

b. $\mathbf{paint}^P$ is a symbol of type <s,<ev,<P,et>>>, P = <s,<i,et>>.

$\mathbf{paint}^P := \lambda w\lambda e\lambda P\lambda x[\mathbf{painting}_{we}(x)\ \&\ \text{BECOMING}_{we}(\lambda w\lambda t.\exists x[P_{wt}(x)\ \&\ \mathbf{created\text{-}by}_{wt}(e)(x)])]$

c. $\mathbf{paint}^Q$ is a symbol of type <s,<ev,<Q,et>>>, Q = <s,<i,<et,t>>>.

$\mathbf{paint}^Q := \lambda w\lambda e\lambda Q\lambda x[\mathbf{painting}_{we}(x)\ \&\ \text{BECOMING}_{we}(\lambda w\lambda t.Q_{wt}(\mathbf{created\text{-}by}_{wt}(e)(x)))]$

$\mathbf{paint}^e$ is the verb which takes an individual as an argument. For instance we could analyse the sentence (45a) as (45b)

(45) a. Messer Leonardo dipinse Mona Lisa.

b. $\exists e[e < s^*\ \&\ \mathbf{paint}^e{}_{we}(\mathbf{Mona})(\mathbf{Leo})]$

The verb $\mathbf{paint}^e$ is temporally opaque with respect to the object. Therefore, the picture Mona Lisa did not exist at the painting interval. But if we allow the verb $\mathbf{paint}^Q$, then we do not need the simple type. This verb embeds a quantifier intension and we may consider Mona Lisa as such a thing:

(46) $\lambda Q\lambda x[\mathbf{painting}_{we}(x)$

$\&\ \text{BECOMING}_{we}(\lambda w\lambda t.Q_{wt}(\lambda w\lambda t\lambda x.\mathbf{created\text{-}by}_{wt}(e)(x)))](\lambda w\lambda t.\lambda P.P_{wt}(\mathbf{Mona}))$

$= \lambda x[\mathbf{painting}_{we}(x)\ \&\ \text{BECOMING}_{we}(\lambda w\lambda t.\mathbf{created\text{-}by}_{wt}(e)(\mathbf{Mona}))]$

So far, we are left with three logical types for verbs of creation. Do we need all of them? In the next section I will argue that opaque objects are not of the quantifier type.

7. NEGATIVE TERMS IN OPAQUE POSITION

In this section I remind you of Zimmermann's (1993) analysis of opaque objects. I will repeat just one argument of Zimmermann's against the quantifier type of objects: If object-opaque verbs did embed quantifiers, we would obtain the wrong reading for negative quantifiers in object position. Zimmermann considers "modal object-opacity" only, but the argument applies to temporally opaque arguments as well as we will see.

Suppose we analysed the sentence

(47) Jones seeks no unicorn.

along the lines indicated in (Montague, 1970) with a negative existential quantifier in the opaque object position. Assuming a rather plausible meaning rule for **seek**, the sentence would then mean something like the following: in every world where Jones finds what he is searching in the actual world there is no unicorn that he finds. Since the sentence doesn't mean this and there is no obvious way to avoid this reading, we follow Zimmermann in concluding that Montague's analysis cannot be correct.

The same point can be made with John Buridan's Sophisma 15, a classical example of an object-opaque verb. Plato claims the following.

(48) Socrates Periclei equum debet. "Socrates owes Pericles a horse"

There are three horses in the world: Brunellus, Morellus and Favellus. The sophist refutes Plato by the observation that Socrates doesn't owe Pericles Brunellus, that he doesn't owe him Morellus, and that he doesn't owe him Favellus. Therefore, the sentence is compatible with (49a)

(49) a. Socrates Periclei nullum equum debet "Socrates owes Pericles no horse"
b. There is a horse that Pericles owes to Socrates.

though (48) doesn't necessarily entail (49a) contrary to what the sophist pretends. And (48) certainly doesn't entail (49b).

Owe is an object-opaque verb. Suppose that **nullum equum** were a quantifier at object position and "x owes y Q" did mean something like this: In every world where x fulfils his actual obligations toward y, Q applies to the property λz[x gives z to y]. Then (49a) would mean that whenever Socrates fulfils his obligations toward Pericles, there is no horse that he gives to Pericles. This meaning is so absurd that not even Buridan's sophist was able to figure it out. I think that again the conclusion must be that **nullum equum** cannot be interpreted as a negative quantifier here.

So what is the proper analysis of these data? Recall that the standard account of object opacity is due to (Quine, 1960) and (Montague, 1970): the object is interpreted *in situ* and the verb is a predicate that depends on the intension of the object. While Montague assumed that the object is of the quantifier type, (Zimmermann, 1993) assumes that these verbs embed one-place properties, i.e., entities of type <s,<i,et>>. In Zimmermann's paper, the meaning of (48) can therefore be represented as

(50) $\mathbf{owe}_{ws*}$(**horse**)(**Pericles**)(**Socrates**).

For the purposes, the following approximation to the meaning of **owe** is good enough:

(51) **owe** is of type <s,<i,<π,eet>>>, where π is of type <s,<i,et>>.

$\|$ **owe** $\|(w)(t)(P)(y)(x) = 1$ iff $\forall w'[w' \in \mathrm{Deon}_{wt}(x) \rightarrow (\exists z(P(z)(w')(t) = 1\ \&\ \exists t'\exists z[t' \geq t\ \&$ $P_{w't'}(z) = 1$ & x in gives z to y in w' at t'])]

$w' \in \mathrm{Deon}_{wt}(x)$ is short for "w' is a deontic alternative for x in w at t". This is a solution of Buridan's insolubile. Suppose namely that the three horses mentioned live in every world, and there are no other horses in any world. Then the formula (50) is true in the actual world if Socrates gives Pericles either Brunellus or Morellus or Favellus in every world where he fulfils his actual obligations. In fact, it doesn't matter, which of these he gives to Pericles, because the universal quantifier over the deontic alternatives has wide scope with respect to the existential quantifier.

But what can we do with the negation facts observed above? In order to obtain the correct meaning for sentence (49), we have to analyse the nominal **nullum equum** as a negative polarity item (NPI) which is licensed by an abstract negation. In other words, the sentence is analysed as if it were the following one:

(52) Socrates non debet Periclei ullum equum "Socrates doesn't owe Pericles any horse"

The LF of this is the negation of the formula (50), and the kind reader may check for herself, that this is the intuitively correct meaning. There is wide evidence that this somewhat abstract treatment of negation is exactly correct, (cf. (Stechow and Geuder, 1997)). Here is one Italian example illustrating the point:

(53) Tu non mi devi niente[9]

---

[9] To my mind the example shows that the LF worked out for sentential negation in (Zanuttini, 1991) cannot be correct. There **niente** is analysed as $\neg\exists x$[thing(x) & ....]. This information is scoped to the position of **non** at LF, which has no semantic content. If we have several negative terms as in **Non ho detto niente a nessuno**, both terms

≠ It is not so that there is nothing that you have to give me

= It is not so that there is something that you have to give me

Of course, this makes the syntax more abstract, but the necessity to apply such a method is known among German grammarians since (Bech, 1955/57). Bech has given many examples that the negation contained in a negative quantifier cannot always be evaluated together with the indefinite term where it is located. He speaks of **cohesion** ("Kohäsion"). The proper LF for Buridan's example must therefore be something like this:

(54) NEG Sortes Periclei nullum [+NPI] equum debet.

Nullum equum is an NPI and means the same as **ullum equum** ("some horse"). Within the tradition of Montague Grammar, the problem arising with negation is stated clearly in (Jacobs, 1980), though Jacobs is afraid to say that Germ. **kein Pferd** "no horse" means the same as **ein Pferd** "a horse".[10] To conclude: the negation facts support Zimmermann's claim that the object opaque verbs should not embed quantifier intensions in general.

Exactly the same considerations apply to temporally opaque verbs. We cannot analyse the sentence

(55) Andrea painted no picture.

with the quantifier **no picture** as an object of the object-opaque verb **paint**^{Q}. That would give us the meaning Andrea did a painting that had the result that no picture was created by that event, but at the beginning of the event there had been a picture that was created by the very same event. The problem disappears with the new analysis.

8. The Upper Limit Constraint

Our semantics for nouns worked with explicit time arguments, which may be represented by variables. If the variables remain free, their value is determined by a contextually given variable assignment. Such an approach generates too many readings if we allow nouns to be evaluated at

are scoped to that position and only the highest negation remains. The other negations are deleted syntactically. While this works for object transparent verbs, we obtain the wrong readings for object-opaque verbs.

[10] To my knowledge, this has been claimed for the first time in a working paper containing (Stechow, 1993).

any time. I will argue that these cases are restricted by some version of Abusch's Upper Limit Constraint for temporal reference ((Abusch, 1997)). To be sure, Abusch speaks of the reference of tenses and she assumes that tenses are definite terms with direct reference. This is not my concern here and I don't want to commit myself to a definite semantics for tenses in this paper. The principle I want to assume is this:

(56) **The Upper Limit Constraint** **[ULC]**

No time variable may "refer" to some time that is later than the speech time or the local evaluation time (or a salient context time).

The formulation of the principle is somewhat vague. I will assume that the local evaluation time is determined by some tense operators, which are considered to be existential quantifiers. In subordinate clauses, the local evaluation time is abstracted away, it is Abusch's "subjective now". The temporal "reference" of the said time variable is thought as an existential quantifier as well, which means "a time not later than the local evaluation time". Instead of making this precise, consider the example that motivated Enç's indexical theory of the temporal reference of nouns ((Enç, 1981)):

(57) a. All fugitives are in jail.

b. $\exists t[t = s^* \ \& \ \forall x[\mathbf{fugitive}_{wt'}(x) \rightarrow \mathbf{in\ jail}_{wt}(x)]]$

The local evaluation time introduced by the present is s*. The variable t' is free. The intended interpretation of the ULC requires that the expression $\mathbf{fugitive}_{wt'}(x)$ has to be replaced by the expression $\exists t'[t' \neg> s^* \ \& \ \mathbf{fugitive}_{wt'}(x)]$. Pragmatic reasoning tells us that the statement can in fact be narrowed down to $\exists t'[t' < s^* \ \& \ \mathbf{fugitive}_{wt'}(x)]$, for the people in jail cannot be fugitives at the same time. The ULC excludes that we speak about future fugitives, and this is correct.

It is always possible to have access to the local evaluation time of a sentence. If we say:

(58) The fugitives were good prisoners.

we evaluate **fugitives** with respect to the speech time s*..

The ULC is not applicable to nouns which restrict a demonstrative article like **this**, when we are using the word in a strict *hic et nunc* sense, i.e., we do not use it in an anaphoric sense or in a presentational sense ("There is this crazy professor."). The strictly demonstrative use requires temporal transparency for the restriction. It follows from these assumptions that the following sentences are odd:

(59) a. ?Hier ensteht dieser Stern. (pointing at a gas cloud)
Here comes-into-existence this star
b. ?Gereon is baking this cake. (pointing at flour, eggs, sugar, butter and lemon)
c. ?Hier wächst dieser Baum (pointing at a tiny plant)
"Here is growing this tree"

These sentences have a progressive interpretation and they are asserted of the speech time. Therefore, **dieser Stern** should refer to a particular star existing at the speech time contrary to the assumption that the star doesn't exist yet at the speech time.

But non-demonstrative definite terms are fine in an opaque position:

(60) a. In Berlin entsteht das größte Linguistikzentrum.
In Berlin comes-into-existence the biggest linguistics centre.
b. Hier entsteht für Sie das Bodensee-Einkaufszentrum.
Here comes-into-existence the Lake-of-Constance-shopping centre

The ULC seems to entail that "the biggest linguistics centre" and "the Lake-of-Constance-shopping centre" refer to object fulfilling the restriction in the past, which is not intended. The solution is that these terms are not referential at all. The objects created have the properties only after the time of the creation.

We now give an analysis of the said contrast. The German verb **entsteht** can be defined as:

(61) $\mathbf{entsteht}^{P} := \lambda w \lambda e \lambda P.\text{BECOMING}_{we}(\lambda w \lambda t.\exists x[P_{wt}(x) \ \& \ \mathbf{created\text{-}by}_{wt}(e)(x)])$

Das größte Linguistikzentrum is abbreviated as **the LL**, and it has the following meaning:

(62) **the LL** is of type <s,<i,et>>. || **the LL** ||(w)(t)(x) = 1 if x is the largest linguistics centre in w at .

There is as systematic procedure for obtaining this property from the nominal **the LL**. We have to form the property of being an x which is identical to the largest linguistic centre in w at t. I am not concerned with this problem here (cf. (Partee, 1987) and (Zimmermann, 1993)).

The analysis of (60a) is then:

(63) $\exists e[\mathbf{in}_{ws*}(\mathbf{Berlin})(e)\ \&\ \mathbf{entsteht}^{P}{}_{we}(\mathbf{the\ LL})]$

The reader may convince herself that this is the correct meaning. The linguistic centre is there only after the end of the event. Contrast this with the odd use of the demonstrative. I am using a German example because in German, the use of the demonstrative article is much more restricted than in English.

(64) ?Hier entsteht dieses größte Linguistikzentrum (pointing to a construction at work)

The sentence is out of the blue, the hearer has not the slightest idea what the speaker is talking about. A formalisation is this[11]:

(65) $\exists e[t(e) = s^*\ \&\ \mathbf{here}_{wt}(e)\ \&\ \mathbf{entsteht}^{e}{}_{we}(\mathrm{Dthat}(\mathbf{the\ LL}))]$

Dthat is supposed to be an approximation to Kaplan's operator, which identifies the evaluation index with the utterance index ((Kaplan, 1978)). I have not introduced the notion of character, which is necessary for a proper definition. The following definition gives an approximation:

(66) Dthat is a symbol of type <<s,<i,et>>,e>. $\|$ Dthat $\|(P)$ is defined only if there is a unique object x such that $P(x)(w^*)(s^*) = 1$, where w* is the actual world and s* is the speech time. If defined, $\|$ Dthat $\|(P)$ is the said object.

$\mathbf{Entsteht}^{e}{}_{we}$ is the individual embedding version of **entsteht**, which has to be defined as $\lambda w\lambda e\lambda y.\mathrm{BECOMING}_{we}(\lambda w\lambda t.\mathbf{created\text{-}by}_{wt}(e)(y))$. If we look at the formula, we easily see the reason for the failure of reference: The meaning of the verb $\mathbf{entsteht}^{e}$ requires that the subject is created by the event. The meaning of the demonstrative article **Dthat** requires that the subject is a linguistic centre at the time of the event, i.e., s*. Hence the linguistic centre must exist at s*, a contradiction to what we have said just before.

The time variable in the restriction of a definite description may refer to a time earlier than the local evaluation time by the ULC. This accounts for the contrast.

There is, of course, not the slightest problem to analyse indefinite subjects of verbs of coming into existence. Here are just two more examples.

[11] If the speech time s* is conceived as a point, the formalisation should involve the progressive operator. This would not affect the argument made here.

(67) a. Tief im Inneren des kollabierenden Gebiets *beginnt* nun ein Stern *sich* aus den Gasmassen *zu formen*.
"Deep in the interior of the collapsing area a star *begins to form itself*."
b. Dabei *entsteht* eine staubfreie Zone, die Opazitätslücke, durch die Licht hindurchdringen kann.
"At this occasion, a zone free of dust *comes into existence*, the opacity gap, through which the light can pass."

Universal terms linked to a temporally opaque position must be quantified in and require the e-type verb. The following example exhibits such a case:

(68) Jeder Stern ist einmal entstanden.
"Every star came into existence at some time".

The semantics of the verb **enstehen** requires that the stars talked about are not yet stars when they come into being. The ULC states that each star existed before the local evaluation time or the speech time. It should be obvious that the sentence can meet these requirements. A good LF is the following:

(69) $\forall x[\exists t(t \neg> s^* \ \& \ \mathbf{star}_{wt}(x)) \rightarrow \exists e[e < s^* \ \& \ \mathbf{entsteht}^{e}{}_{we}(x)]]$

So the sentence speaks about present or past stars, but not of future ones. This seems exactly right. And the ULC entails the unacceptability of the following sentence:

(70) ?Jeder Stern wird entstehen. "Every star will come into existence"

There is no way to get this right out of the blue. If we hear that sentence we immediately think of a partitive interpretation, i.e., we quantify over a set of stars already introduced somehow.

The ULC is a pragmatic principle and presumably an oversimplification in the form it stands. If future objects have been introduced in previous discourse, we can refer to them. Claudia Maienborn gives me the example:

(71) Die Sonnenfinsternis hat den Optikern ein Riesengeschäft beschert.
The eclipse has to the opticians a gigantic deal provided

This sentence was written before the eclipse. It would seem then that a future object is responsible for a big deal at present. We have to be careful, however. This cannot be literally so, or we would have to believe in backward causation. Following (Lewis, 1986), we reject the existence of such a thing. If so, the subject in (71) undergoes a reinterpretation and means something like “the expectation of the eclipse that will happen at time so and so”. This complex noun is interpreted according to the ULC.

On the other hand, I will not dispute that there are cases in which the time variable of a noun takes up a contextually given time. I am not dealing with this case in this article. “Context times” are what (Fabricius-Hansen, 1986) calls “Kozeit”. Their proper handling requires a serious discourse representation, e.g. the framework by (Kamp and Reyle, 1993). Furthermore, the precise conditions restricting reference to context times deserve a special study. I refer the reader to (Musan, 1998).

9. COPULAS AND THE EXISTENTIAL

In this section I want to defend the claim that copulative verbs and the German existential **es gibt** “there is” embed properties as objects. Hence we need the logical type assumed for creation verbs anyway.

In Musan’s dissertation (i.e. (Musan, 1997)) it has been observed that the temporal arguments of nouns in predicative position do not freely refer. Consider the following contrast:

(72) a. In 1964, I met my wife.

b. In 1964, I met Franzis. She was my wife.

The first sentence is true. Franzis is my actual wife. Our formulation of the ULC doesn’t exclude this interpretation. I married my wife in 1968. So the second sentence in (72b) is false. How could that be? Musan takes this as evidence that copulative predicates are about temporal stages of individuals, a different sort of objects. Then the simultaneity of “she” and “my wife” follows, because if a temporal stage of Franzis is a stage of my wife, it must be a stage located at the same time. Since I defend the view that nouns are sets of “big” individuals, I have to derive Musan’s observation in a different way. I will show that it follows directly from the semantics of the copulative verbs. Like verbs of creation, the copulas embed properties *in intenso*, i.e., the time argument of the noun is not projected at all but lexically “controlled”. Hence no extra stipulation is necessary.

The copulative verbs of German are **sein** "be", **werden** "become", **bleiben** "remain". We start with the most simple, viz. "be".

(73) $BE := \lambda w \lambda t \lambda P \lambda x.P_{wt}(x)$

This is the identity function. The analysis of

(74) Ede is a professor.

is:

(75) $\exists t[t = s^* \;\&\; BE_{wt}(\mathbf{professor})(\mathbf{Ede})]$
$= \exists t[t = s^* \;\&\; \mathbf{professor}_{wt}(\mathbf{Ede})]$

The time arguments of the predicate are not even projected so the ULC has nothing to what it could apply and we don't have to worry about the temporal reference of the noun.BE is by definition transparent.[12]

Let us turn to **werden** "become" next. The first point that is worth noticing is that this copula is not a verb of coming into existence. The definition of its meaning does not involve the notion **created-by**. The verb is adequately analysed be means of Dowty's temporal BECOME-operator. The only thing that has to be adapted is the logical type. The proper analysis is the following one:

(76) $BECOME^P$ is a symbol of type <s,<i,<P,<e,t>>>>, P = <s,<i,<e,t>>>.
$BECOME^P := \lambda w \lambda t \lambda P \lambda x.BECOME_{wt}(\lambda w \lambda t.P_{wt}(x))$

We symbolise **Caroline wurde Professorin** "Caroline became a professor" as (77).

(77) $\exists t[t < s^* \;\&\; BECOME^P{}_{wt}(\mathbf{professor})(\mathbf{Caroline})]$

$= \exists t[t < s^* \;\&\; BECOME_{wt}(\lambda w \lambda t.\mathbf{professor}_{wt}(\mathbf{Caroline}))]$

---

[12] Here is a proof. Let P be any predicate of type <s,<i,et>>, let w, t, x by any world, time and individual respectively. Then the following equivalences hold:
$BE_{wt}(P)(x) \leftrightarrow P_{wt}(x)$ (definition of BE) $\leftrightarrow \exists y[P_{wt}(y) \;\&\; x = y\,]$ (logical reasons)
$\leftrightarrow \exists y[P_{wt}(y) \;\&\; \lambda w \lambda t \lambda z[z = y](x)]$ (by logic) $\leftrightarrow \exists y[P_{wt}(y) \;\&\; BE_{wt}(\lambda w \lambda t \lambda z[z = y])(x)]$ (definition of BE)
q,e,d,

Professor is a stage-level predicate. If it is defined for each interval, the sentence must be an achievement.

Note by the way that $BECOME^p$ is temporally opaque with respect to the object while BE is temporally transparent as we have seen in footnote 12.

Next, consider the meaning of **bleiben** "remain". The following analysis is due to Manfred Bierwisch (but I am not able to identify the reference):

(78) $REMAIN := \lambda w \lambda t \lambda P \lambda x. \neg BECOME_{wt}(\lambda w \lambda t. \neg P_{wt}(x))$

This meaning might be too weak because the transparency of the object doesn't follow. Perhaps the existence the object has to be presupposed, but I will on elaborate on that here. Again the definition entails strict simultaneity of the reference time and the time of the predication. Here is a relevant example:

(79) a. Brandt blieb Bundeskanzler.

b. $\exists t[t < s^* \ \& \ REMAIN_{wt}(\mathbf{chancellor})(\mathbf{Brandt})]$

$= \exists t[t < s^* \ \& \ \neg BECOME_{wt}(\neg \mathbf{chancellor}(\mathbf{Brandt}))]$

This completes the analysis of the copulative verbs. They fit well into our picture, because they have the same logical type as the temporally opaque verbs, so we need this type anyway. And they derive Musans's observation about the temporal reference of the predicate without stipulations.[13] There is no need to recur to an ontology that distinguishes temporal stages of individuals from individuals.

Finally, consider the German existential **geben**, which has an impersonal subject and an accusative object, which is the logical subject.

(80) a. Es gibt einen Gott. "There is a god"

b. Es gibt keinen Gott. "There is no god"

This verb embeds a property as well and says that it has an existing instance at the local evaluation time.

(81) **The existential *es gibt***

$\mathbf{exist}^P := \lambda w\lambda t\lambda P\exists x[\mathbf{exist}_{wt}(x)\ \&\ P_{wt}(x)]$

(80b) has a analysis with Bech's "cohesive negation", i.e., the verb is negated and the indefinite is the semantic subject:

(82) $\neg\mathbf{exist}^P{}_{wt}(\mathbf{god})$
$= \neg\exists x[\mathbf{exist}_{wt}(x)\ \&\ \mathbf{god}_{wt}(x)]$

I assume that certain instances of the English **there**-construction, which is syntactically rather different from the German construction, are formalised by means of this predicate. Thus, the sentence **There is a horse that Socrates sees** does *not* have the LF b):

(83a) but rather b):

(83b):

(83) a. $\exists t[t = s^*\ \&\ \exists x[\mathbf{horse}_{wt}(x)\ \&\ \mathbf{see}_{wt}(x)(\mathbf{Socrates})]]$
b. $\exists t[t = s^*\ \&\ \mathbf{exist}^P{}_{wt}(\lambda w\lambda t\lambda x[\mathbf{horse}_{wt}(x)\ \&\ \mathbf{see}_{wt}(x)(\mathbf{Socrates})])]$

Due to the existential impact of the predicate **horse** both expressions express the same proposition. But there will be a difference when we turn to theories in which the predicate **horse** has not time argument. These will be discussed in section 12.

10. OBJECTIONS TO THEORY I

Half a year after the completion of this article (June 1999), I got an e-mail from Roger Schwarzschild (December 6th) with objections and suggestions. His reaction triggered another theory that I had considered a long time ago but that I had rejected because I thought it was incompatible with the usual assumptions on LF. The situation may have changed in the meantime. Therefore I will revive the approach. Here is the relevant part of the mail:

[13] Ede Zimmermann informs me that an analysis of copulative verbs with this logical type has been proposed by (Partee, 1992) and Friederike Moltmann in her criticism of (Zimmermann, 1993).

Suppose I say

(D) Between 9 and 9:01, Arnim drew a dotted line on his notepad.

Supposing that 9-9:01 is the interval during which the becoming is evaluated, we predict that there was no proper subinterval of that interval during which a dotted line caused by Arnim's drawing came into existence. But there was. Already in the first few seconds, there was a dotted line caused by the drawing event. ...Suppose we diagnose the problem as a problem of scope of an existential and we use functions to avoid running into the ULC. These functions will just be the generalized quantifier meaning of a name, and I will write them as capital letters. So to begin with notice that if Leonardo painted a picture and that picture was the Mona Lisa, then the following is true:

PAST [Leonardo paint] CAUSE [BECOME [MONA(picture)]

MONA(picture) will be true at a world-time just in case Mona is in the denotation of "picture" at that world time. Given the transparency of "picture" it follows that Mona exists at that world time. So now, if [BECOME [MONA(picture)] is true at world w, time interval I, then, MONA(picture) is false at the first moment of I, hence the picture did not exist (at least not as a picture) at that moment. And MONA(picture) is true at the last moment of I, hence the picture, Mona existed then. Now we can existentially generalize on MONA, with a variable N over name meanings (in type ett):

PAST (there is N) [Leonardo paint] [CAUSE [BECOME[N(picture)]

We do not have to worry about some N which names one of Giotto's frescoes in the Arena chapel, because Leonardo's painting didn't cause that to exist. And the line-drawing problem goes away. Consider the dotted line that Arnim drew, about which (D) is speaking. Let's call that line Dotty. The following is true:

(E) [Between 9 and 9:01, Arnim draw [CAUSE [BECOME[DOTTY(line)]]]]

All this entails is that at 9, Dotty didn't exist (as a line) and at 9:01 she did, and Arnim's drawing caused that!

I am not entirely sure that my analysis cannot treat this particular example. Using the decomposition in terms of CAUSE and BECOME, an analysis of sentence D is this:

(84) $\exists e[t(e) = [9.00, 9.01]$ & $\text{drawing}_e(\text{Arnim})$ CAUSE BEC_e(a dotted line is created by e)]

There exist many dotted lines before the end of the interval [9.00, 9.01] that are parts of the whole dotted line. My original idea was that these were not created by the event e but by subevents e’ of e. Suppose d is created by e and d’ is a proper part of d. Then it is not true that d’ would not exist if e did not exist. Therefore d’ is not created by e. Ede Zimmermann thinks that this argument holds good only for initial segments d’ of d, not for final ones. I am not sure of this either. In a counterfactual world there might be a drawing that starts later than the actual one and generates just the final part d’ of d. I admit, however, that the point is hard to show due to the vagueness of the counterfactual semantics of “is created by e”. The alternative suggested by Schwarzschild avoids all these uncertainties.

Returning to the alternative proposal hinted at by Schwarzschild, it seems to me that the type lifting of the logical subject of the object term is not necessary. We obtain the same effect by scoping the existential quantifier ∃x alone. In other words, the representation of the sentence (E) could be something like this:

(85) PAST ∃x[Between 9 and 9:01, Arnim draw [CAUSE [BECOME [dotted line(x)]]

Due to the existential impact of **dotted line**, x exists only after the act of creation. A fortiori, x is not a dotted line before the end of the creation. A part of it exists before and is a dotted line.

This approach seems simpler than the one elaborated in the paper because we don’t need the tedious predicate **created-by** in the decomposition. A problem with the formalisation is that it doesn’t treat the verb draw as a verb of creation but rather as a verb of transformation. For instance, the sentence

(86) John wrote a book.

would be predicted to be true if John added some stuff to a an existing article and thereby transformed it into a book. We could try to avoid this unwanted consequence by predicating **exist** of the object. In other word’s we replace (85) by the following analysis:

(87) PAST ∃x[Between 9 and 9:01, Arnim draw [CAUSE [BECOME [dotted line(x) & exist(x)]]

But this wouldn’t help because x could exist at the beginning of the event but not as a dotted line. This would make the conjunction false. If x were a dotted line at the end of the event, the conjunction would be true, but the sentence would describe a transformation, not a creation.

(Zepter, 2000) presents an argument in this style against my analysis. She considers the sentence **Max built a house**, which has the following LF in the theory developed so far:

(88) $\exists e[e < s^* \;\&\; \mathbf{building}_{we}(Max) \;\&\; BECOMING_{we}(\lambda w\lambda t\exists x[\mathbf{house}_{wt}(x) \;\&\; \lambda w\lambda t O_{wt}(e)\; CAUSE_{wt}\; \lambda w\lambda t.\mathbf{exist}_{wt}(x)])]$

The objection of Alex Zepter is the following.

Imagine a scenario, where Max' house already exists, but the municipal authorities decided to pull down the house. Max, who is a fighter and has craft skills, does some building and a new entrance with a flight of steps. The municipal authorities are so impressed that they withdraw from the destruction. In this scenario, Stechow's logical representation would be true, because (a) there was a 'building event' and this event caused – at the end of the occurrence of the event – that the house exists rather than being destroyed by bulldozers. Thus, the conjunction embedded under BECOME true at the end of the event. (b), the event didn't cause the existence of the house at the beginning of the event ...., therefore the second conjunct under BECOME is false, hence the entire conjunction is false at the beginning of the event. Putting (a) and (b) together, we have a falsehood of the entire proposition at the beginning of the event but truth at the end. Ergo, the BECOME operator is satisfied. But obviously, Max didn't build a house, and the house only *still* exists. Thus, according to our intuitions, 'Max built a house' should be false.
To highlight the point: even if this is subtle, it is not enough that Stechow's formula *allows* the non-existence of the created object at the beginning of the event, it should *demand* this non-existence.

I think this criticism is well taken. To overcome the difficulty, Zepter proposes the following LF for the sentence **Max painted a picture**[14]:

(89) $\exists f \exists t[t < s^* \;\&\; \lambda_w \lambda_t[\mathbf{paint}_{wt}(\mathbf{Max})]$
$\text{CAUSE}_{wt}\; \lambda_w \lambda_t[\text{BECOME}_{wt}(\lambda_{w'} \lambda_{t'}.\mathbf{exist}_{w't'}(f(\mathbf{picture}_{w',t'})))]]$

f is a choice function of type <et,e>. I don't think that this can be entirely correct. The reason is that I do not see how the proposition $||\lambda w'\lambda t'.\mathbf{exist}_{w't'}(f(\mathbf{picture}_{w',t'}))||^g$ can be false at an interval I that contains BEG(t), if there is a picture at I. One of the defining criteria for choice functions is the following logical truth:

(90) If f is a choice function of type <et,e>, then P(f(P)) = 1 for any non-empty P of type et.

In ordinary language, the principle may be stated as: "Some P is a P". Now, consider the proposition $||\lambda w'\lambda t'.\mathbf{exist}_{w't'}(f(\mathbf{picture}_{w',t'}))||^g$ in the word w and the said interval I. It follows that $||f(\mathbf{picture}_{w,I})||^g$ is a picture in w at I if $||\mathbf{picture}_{w,I}||^g$ is not empty. Since $||\mathbf{picture}||$ is a property

[14] Actually, this is not exactly the original formula given by Zepter. Her LF is this:
$\exists f \exists t[t < s^* \;\&\; [\text{PAINT}_{wt}(\text{MAX})]\; \text{CAUSE}_{wt}\; [\text{BECOME}_{wt}(\lambda w'\lambda t'.f(\text{PICTURE}_{w',t'}).\text{EXIST}_{w't'})]]$
Since CAUSE_{wt} is a relation between propositions, I have bound the world-time variables of PAINT_{wt} and BECOME_{wt}, respectively. Presumably, Zepter regards here CAUSE as a syncategorematic symbol in the style of Dowty's (1979) original definition.

with existential impact, $||f(\mathbf{picture}_{w,I})||$ exists in w at I and the proposition $||\lambda w'\lambda t'.\mathbf{exist}_{w't'}(f(\mathbf{picture}_{w',t'})))||^g$ is true in w at I. But the BECOME-operator requires the proposition to be false at I. Zepter is aware of the problem and tries to overcome it by allowing that a choice function doesn't pick out any entity at all. I don't think that this is the correct move. (Winter, 1997) and (Stechow, 2000) introduce conventions that guarantee the falsehood of P(f(P)) iff P is empty. If P is not empty, then the statement that some P is P is true. Allowing a non-choice for non-empty predicates runs against the very concept of choice. Since $||\lambda w'\lambda t'.\mathbf{exist}_{w't'}(f(\mathbf{picture}_{w',t'})))||^g$ can only be true for an empty set $||\mathbf{picture}_{w,I}||^g$, we are back to the original problem: the sentence entails that there is no picture at the beginning of the event. Thus, I reject Zepter's revision as it stands. In the next section we will see, however, that the analysis is *almost* correct.

11. THEORY II: LEXICAL SCOPING

The source of the difficulties with Zepter's revision lies in the type of choice function she uses. A choice function f of type <et,e> gives different values for different extensions of a predicate. On the other hand, there is only one object created and it comes to life at the end of the event only. At that point we must choose it from the predicate, not earlier. In order to achieve this, we introduce the following terminology[15]:

(91) Let f be a function of type <<s,<i,et>>,e>. **f is a choice for the world w and the time t** – $ch_{wt}(f)$ – iff P(w)(t)(f(P)), for any P in the domain of f.

We now replace Zepter's (89) by the following formula:

(92) $\exists t[t < s^* \ \& \ \exists I[t >< I \ \& \ \exists f[ch_{wI}(f) \ \&$
$\lambda_w\lambda_t[\mathbf{paint}_{wt}(\mathbf{Max})] \text{ CAUSE}_{wt} \ \lambda_w\lambda_t[\text{BECOME}_{wt}(\lambda_w\lambda_t.\mathbf{exist}_{wt}(f(\mathbf{picture})))]]]]$

>< stands for the abutting relation. This expression is very similar to Zepter's, and it is equivalent to the following expression, which clearly shows that the choice is done at the end of the event:

[15] Cf. (Heim, 1994)

(93) $\exists t[t < s^* \;\&\; \exists I[t >< I \;\&\; \exists x[\mathbf{picture}_{wI}(x) \;\&$

$\lambda_w\lambda_t[\mathbf{paint}_{wt}(\mathbf{Max})]\ \mathrm{CAUSE}_{wt}\ \lambda_w\lambda_t[\mathrm{BECOME}_{wt}(\lambda_w\lambda_t.\mathbf{exist}_{wt}(x))]]]]$

Both formulas can serve as the base for a lexical representation of verbs of creation. Here are the revised entries for the verb **paint**. Under the revised analysis, it is not necessary to work with events anymore. Hence we can stick closely to Dowty's original decomposition.

(94) **A verb of creation** (revised)

a. $\mathbf{paint}^e$ is a symbol of type <s,<i,<e,et>>>.

$\mathbf{paint}^e := \lambda w\lambda t\lambda y\lambda x[\mathbf{paint}_{wt}(x)]\ \mathrm{CAUSE}_{wt}\ \lambda_w\lambda_t[\mathrm{BECOME}_{wt}(\lambda_w\lambda_t.\mathbf{exist}_{wt}(y))]]$

b. $\mathbf{paint}^P$ is as symbol of type <s,<i,<P,et>>>, P = <s,<i,et>>.

$\mathbf{paint}^P := \lambda w\lambda t\lambda P\lambda x\exists I[t >< I \;\&\; \exists f[ch_{wI}(f) \;\&$

$\lambda_w\lambda_t[\mathbf{paint}_{wt}(x)]\ \mathrm{CAUSE}_{wt}\ \lambda_w\lambda_t[\mathrm{BECOME}_{wt}(\lambda_w\lambda_t.\mathbf{exist}_{wt}(f(P)))]]]$

Alternatively:

$\mathbf{paint}^P := \lambda w\lambda t\lambda P\lambda x\exists I[t >< I \;\&\; \exists y[P_{wI}(y) \;\&$

$\lambda_w\lambda_t[\mathbf{paint}_{wt}(x)]\ \mathrm{CAUSE}_{wt}\ \lambda_w\lambda_t[\mathrm{BECOME}_{wt}(\lambda_w\lambda_t.\mathbf{exist}_{wt}(y))]]]$

At first sight it looks as if the new LFs run into the ULC because the alternative formulation of the semantics of $\mathbf{paint}^P$ gives wide scope to the existential quantifier in object position and evaluates the noun at a time later than the local evaluation time.

(95) a. Max will paint a picture.

b. $\exists t[t > s^* \;\&\; \exists I[t >< I \;\&\; \exists y[\mathbf{picture}_{wI}(y) \;\&$

$\lambda_w\lambda_t[\mathbf{paint}_{wt}(\mathbf{Max})]\ \mathrm{CAUSE}_{wt}\ \lambda_w\lambda_t[\mathrm{BECOME}_{wt}(\lambda_w\lambda_t.\mathbf{exist}_{wt}(y))]]]]$

Although the interval I has a common border with t, it is later than t. Therefore, (95b) violates the ULC. Note incidentally that we appear to have done exactly the same that we declared to be impossible when we discussed Dowty's theory: we have out-scoped the quantifier from the object position (cf. the discussion in section 4). But (95b) isn't the LF of (95a)! The sentence rather has the LF

(96) $\exists t[t > s^* \;\&\; \mathbf{paint}^P{}_{wt}(\mathbf{picture})(\mathbf{Max})]$

This expression doesn't violate the ULC, because the temporal argument of **picture** is not even projected. To put the point differently: the argument **picture** has no temporal reference at all and cannot violate the ULC.

Which of the two analyses offered in Dowty's original decomposition.

(94b) is to be preferred, the one done by means of an intensional choice function or the one done by quantifying in? If both define the same predicate — what I have assumed — both are equally good.

Note that the theory developed here is not compatible with the claim defended in (Stechow, 1996) that decomposition should not be done exclusively in the logical language but also in the syntax. In that case one of the two expressions that *define* $\mathbf{paint}^{P}$ would be part of the actual LF.

We have seen already that the second alternative in Dowty's original decomposition.

(94b) violates the ULC. If we take the first alternative, i.e. the expression involving a choice function, the restriction of the choice function — $ch_{wI}(f)$ — would violate the ULC. The motivation for decomposing accomplishments in the syntax was the representation of the so-called restitutive reading arising with **again**. These readings are hard to get for verbs of creation. The question is whether the sentence **Leonardo painted a picture again** has a reading meaning that Leonardo painted a picture, and the very same picture had existed before. This reading would require one of the following two LFs:

(97) $\exists t[t < s^* \;\&\; \exists I[t >< I \;\&\; \exists y[\mathbf{picture}_{wI}(y) \;\&$

$$\lambda_w\lambda_t[\mathbf{paint}_{wt}(\mathbf{Max})] \text{ CAUSE}_{wt}\ \lambda_w\lambda_t[\text{BECOME}_{wt}(\lambda_w\lambda_t.\mathbf{again}_{wt}(\lambda_w\lambda_t.\mathbf{exist}_{wt}(y)))]]]]$$ [16]

I find it hard to argue that exactly the same picture had existed before. One could equally argue that a different picture with exactly the same features had existed before. If this is so, then we need no restitutive reading for **again** modifying verbs of creation. Another possibility to have decomposition is to give up the ULC and to replace it by some other principle governing the use of temporal reference of nouns.

Be that as it may. The lexically governed scope approach can meet the objections against Theory I, it seems to me. Note however, that the theory is not very elegant. We express the information that the picture created exists only after the interval of creation twice: the information is contained in the BECOME-part and in the abutting interval I. This looks

[16] I am assuming the following meaning for **again**: $\|\,\mathbf{again}\,\|(w)(t)(p) = 1$ iff $p = 1$; the presupposition is: $\exists t' < t$: $p(w)(t') = 1$.

stipulative and suggests that error is lurking somewhere.

12. THEORY III: IL-NOUNS DO NOT DEPEND ON TIME

The theories considered so far started from the assumption that all nouns have a temporal argument. We will arrive at a rather different analyse of verbs of creation if we assume that the objects of creation verbs do not have a time argument but only a world argument. To be sure, nouns that are SL-predicates (e.g. **professor**) continue to have a time argument. But the object of a verb of creation is typically an IL-predicate and need not have a time argument.

I start with a discussion of (Krifka, 1989). Krifka analyses verbs of creation by means of the thematic relation **Incremental Theme** (I-Theme). The idea is that the I-Theme of an event is successively created by the event. Krifka would represent (98a) as something like (98b):

(98) a. Andrea will build a house

b. $\exists t \exists e[t > s^* \ \& \ t(e) = t \ \& \ \mathbf{building}_w(e) \ \& \ \mathrm{Agent}_{ew}(\mathbf{Andrea}) \ \& \ \exists x(\mathbf{house}_w(x) \ \& \ \text{I-Theme}_{we}(x))]$

Krifka's formal language has no world parameter. I have added it in order to be conform with the previous discussion. For our purposes it suffices to define the relation I-Theme as follows:

(99) $\text{I-Theme} := \lambda w \lambda e \lambda x.\mathrm{BECOMING}_{we}(\lambda w \lambda t.\mathbf{exist}_{wt}(x))$.[17]

In Krifka's theory the predicate **house** cannot depend on time because then the analysis would run immediately into the ULC. The house would exist in w throughout t(e), and we would derive a contradiction since the relation I-Theme requires that the house exists only after the event.

Doesn't the representation (98b) imply that the predicate **build** is transparent? No. This would be the case if it did represent the sentence (100) with an interpretation that keeps the

[17] x is an I-Theme of e iff there is a bijection f, such that for any part e' of e: f(e') is a part of x & f(e') does exist at BEG(t(e')), but f(e') exists at END(t(e)).

A more accurate analysis of the notion I-Theme must involve the relation CAUSE, because the present formulation establishes no close connection between the event e and the object created. So, a better definition could be

$\text{I-Theme} := \lambda w \lambda e \lambda x.[\lambda w'[O_{w'}(e)] \ \mathrm{CAUSE}_w \ \lambda w' \exists e'[\mathrm{BECOMING}_{w'e'}(\lambda w' \lambda t.\mathbf{exist}_{w't}(x))]]$.

reference time constant for the main verb and the subordinate verb.

(100) There will be a house that Andrea will build.

This, however is not the case. From section 9 we know that (100) has the truth conditions that are not equivalent with (98b), namely the following ones:

(101) $\exists t[t > s^* \ \& \ \exists x[\mathbf{house}_w(x) \ \& \ \mathbf{exist}_{wt}(x) \ \&$
$\exists e[t(e) = t \ \& \ \mathbf{building}_w(e) \ \& \ \text{Agent}_{ew}(\mathbf{Andrea}) \ \& \ \text{I-Theme}_{we}(x)]]]$

Theories with IL-predicates without a time argument require a different notion of transparency. Suppose transitive verbs embed quantifiers at the object position.

(102) **Temporal Object-Transparency of transitive predicates**

Let P be a predicate of type $<s,<ev,<\gamma, et>>>$, $\gamma = <s,<<e,t>,t>>$.

P is object-transparent iff

$\forall w \forall t \forall e \forall Q_\gamma \forall x[P_{we}(Q)(x) = 1 \leftrightarrow Q_w(\lambda y[\mathbf{exist}_{wt}(y) \ \& \ P_{ew}(\lambda w \lambda R.R(y))])(x)]$

We can now define the surface predicate $\mathbf{build}^Q$ as

(103) $\mathbf{build}^Q := \lambda w \lambda e \lambda Q \lambda x[\mathbf{building}_w(e) \ \& \ \text{Agent}_{ew}(x) \ \& \ Q_w(\lambda y.\text{ITheme}_{we}(y))]$,

Q a variable of type $<s,<et,t>>$.

and obtain

(104) $\exists t \exists e[t > s^* \ \& \ t(e) = t \ \& \ \mathbf{build}^Q{}_{ew}(\mathbf{a\ house})(\mathbf{Andrea})]$

as LF for (98a). This expression is not equivalent with (101). Hence $\mathbf{build}^Q$ is an object-opaque verb. On the other hand, the verb $\mathbf{see}^Q$ is object-transparent. Therefore the sentence **Socrates sees a horse** has the LF by the transparency postulate:

(105a), which is equivalent with by the transparency postulate:

(105b) by the transparency postulate:

(105) a. $\exists t \exists e[t = s^* \ \& \ t(e) = t \ \& \ \mathbf{see}^Q{}_{we}(\mathbf{a\ horse})(\mathbf{Socrates})]$

b. $\exists t \exists e[t = s^* \ \& \ t(e) = t \ \& \ \exists x[\text{horse}_w(x) \ \& \ \mathbf{exist}_{wt}(x) \ \& \ \mathbf{see}^Q{}_{we}(\lambda w \lambda R.R(x)))(\mathbf{Socrates})]]$

There is a first order verb **see** which allows us to simplify the last conjunct of by the transparency postulate:

(105b) as $\mathbf{see}_{we}(x)(\mathbf{Socrates})$.

To resume Krifka's account: verbs of creation looks extensional, but a closer inspection shows that it is not *entirely* extensional. There is subtle difference in meaning between the two sentences:

(106) a. Andrea built a house

b. There was a house that Andrea built.

Keeping the reference time constant, the second sentence is nonsense in some reading, whereas the first is entirely ok.

There is a proposal in the literature that denies the difference, namely (Parsons, 1990). Parsons would analyse sentence a) as:

(107a) as:

(107) $\exists I \exists t[I < s^* \ \& \ t \in I \ \& \ \exists x[\mathbf{house}(x) \ \& \ \exists e[\mathbf{building}(e) \ \& \ \text{Agent}_e(\mathbf{Andrea}) \ \& \ \text{Theme}_e(x) \ \& \ \text{Cul}(e,t)]]]$

Parsons rejects possible worlds, but he accepts incomplete objects. A heap of material is a house if we start transforming it into one. A point is a circle if it is a part of a circle that we are drawing. Events may be partial as well. Thus a crossing of the street is a crossing of the street, even if the crosser dies after the first step. Such events hold only, but they do not culminate (= **Cul**).

(Landman, 1992) has given arguments against this approach, notably against Parsons' analysis of the Progressive via the predicate **Hold**. I don't want to go into this here. Let me mention at this occasion only that I haven't the slightest idea how Bonomi's multiple-choice problem, which was mentioned in section 2, can be dealt within that approach. Parsons' theory of incomplete objects seems mainly motivated by verbs of creation. If we accept Parsons' ontology, these verbs pose no problem at all. Let me make it clear that I am not against incomplete objects. A segment may be an incomplete circle but it is not a circle. It is a part of a projected circle.

While (Landman, 1992) rejects Parsons' theory of the progressive, he accepts his analysis of creation verbs. His LFs look exactly like Krifka's with the difference that Landman uses the relation **Theme** instead of **I-Theme**. Landman claims that verbs of creation are extensional. The reason is that he accepts the following argument given in (Parsons, 1990): if creation verbs were intensional with respect to the object position, we should expect (108a) to behave like (108b). The latter has a reading that does not entail the existence of a unicorn. Similarly, (108a) should have a reading that doesn't entail the existence of a house. While (108a) may be true, (108b) may not, since there are no unicorns.

(108) a. Andrea built a house. It is in Grissoney.

b. Andrea looked for a unicorn. It is over there.

My reaction should be obvious. The meaning of **build** entails the existence of the house built after the building interval, but the house does not exist during the building interval. The verb **look for** in (108b) doesn't entail the existence of a unicorn at all. This is a different type of opacity, namely modal opacity as opposed to temporal opacity. You may call verbs of the first kind extensional if you like. But then you have to distinguish several kinds of extensionality. And note by the way that the following text is odd if keep the reference time constant.

(109) Andrea built a house. It was in Gressoney.

Is Landman's analysis a good representation for verbs of creation? That depends on your interpretation of the relation **Theme**. To begin with, I am not the only one to find this notion rather obscure; cf. (Dowty, 1989, Dowty, 1991). Furthermore, exactly the same relation is used by Landman for the representation of accomplishments that do not create their objects, for instance in **John is crossing the street**, the street is the Theme of the crossing. This suggests that being the Theme of an event implies existence at the time of the event. Let us call this principle the Theme Principle:

(110) **The *Theme* Principle**

$\forall w \forall e \forall x[\mathrm{Theme}_w(e)(x) \rightarrow \mathbf{exist}_w(t(e))(x)]$

If Landman accepted the Theme Principle, sentence (106a) would be true if the house built by Andrea did exist throughout the building interval. So Landman must be a follower of Parsons her, or his analysis is not adequate. Since Landman uses the relation **Theme** as a semantic primitive it is hard to say whether his account has this undesirable consequence. In any case it should be made more explicit in this respect. We will return to the issue when we will discuss Zucchi's theory.

Before doing that let us shortly comment on Kratzer's (1994) theory of creation verbs.

Her lexical entry for **build** is this:

(111) $\lambda w \lambda x \lambda e[\mathbf{building}_w(e) \;\&\; \mathbf{exists}_w(x)(f_{target}(e))]$

f_{target} is a function that assigns the target state to every event. It is not entirely clear to me what *the* target state of an event should be, but it certainly is a state or time that starts after the event. So the entry makes sure that the object exists after the end of the event, but it is not required that the object doesn't exist before the event, nor does the entry express the idea that the object is created by the event. Thus the entry is not very informative but it might be a good first approximation to the meaning of the verb.

It should be clear from the preceding discussion that Kratzer can represent verbs of creation without the risk to run into inconsistencies or to violate the ULC. As an example consider what would be her representation of (106a)

(112) $\exists t \exists e[t < s^* \;\&\; t(e) = t \;\&\; \exists x[\mathbf{house}_w(x) \;\&\; \mathbf{building}_w(e) \;\&\; \mathbf{exist}_w(x)(f_{target}(e))]]$

This formula is *not* equivalent with:

(113) $\exists t \exists e[t < s^* \;\&\; t(e) = t \;\&\; \exists x[\mathbf{house}_w(x) \;\&\; \mathbf{exist}_{wt}(x) \;\&\; \mathbf{building}_w(e) \;\&\; \mathbf{exist}_w(x)(f_{target}(e))]]$

It follows that the type-lifted version $\mathbf{build}^Q$ of **build** is not object-transparent. So this is a tenable account as far as the temporal behaviour of objects created is concerned.[18]

(Zucchi, 1999) believes that Landman's approach implies the existence of the created object throughout the event time. Though he doesn't put it that way, he obvious thinks that Landman has to accept the Theme Principle. Zucchi defends the view that creation verbs are intensional with respect to the object precisely in the sense that the object created exists after the event time. His analysis of (106a) is this:

(114) $\exists e \exists I \exists t[I < s^* \;\&\; t \in I \;\&\; \mathbf{building}(e) \;\&\; \mathrm{Agent}(e,\mathbf{Andrea}) \;\&\; \mathrm{Theme'}(e,{}^\wedge\lambda P \exists x[\mathbf{house}(x) \;\&\; P(x)] \;\&\; \mathrm{Cul}(e,t)]$

Cul stands for Parsons' "culminates" and **Theme'** is a relation between an event and an intension of a generalised quantifier. There is a first order Theme-relation as well, which is defined in the

[18] In (Stechow, 1996) I have argued that this type of lexical analysis cannot capture the restitutive reading arising in sentence like **Angelika caught the cat again**.

style of (Montague, 1973) by a type lowering operation:

(115) $\text{Theme}^* := \lambda e\lambda x.\text{Theme}'(e,{}^\wedge\lambda XX(x))$

In order to make sure that sentence (108a) entails the existence of a house, Zucchi introduces a meaning postulate that warrants the extensionality of the object:

(116) **The *Building* Principle** (Zucchi, 1999, p. 189)

$$\forall e\forall t\forall x\forall Q[[\mathbf{building}(e) \,\&\, \text{Agent}(e,x) \,\&\, \text{Cul}(e,t)] \rightarrow [\text{Theme}'(e,Q) \leftrightarrow {}^\vee Q\lambda y(\text{Theme}_*(e,y))]]$$

The principle has the consequence that the expression (114) is equivalent with the following formula:

(117) $\exists e\exists I\exists t[I < s^* \,\&\, t \in I \,\&\, \mathbf{building}(e) \,\&\, \text{Agent}(e, \mathbf{Andrea}) \,\&\, \exists x[\mathbf{house} \,\&\, \text{Theme}^*(e,x)] \,\&\, \text{Cul}(e,t)]$

There is considerable uncertainty as to the question when the house to be built actually exists. Let us translate the two last expressions into an extensional language to see the problem:

(118) $\exists e\exists I\exists t[I < s^* \,\&\, t \in I \,\&\, \mathbf{building}_w(e) \,\&\, \text{Agent}_w(e)(\mathbf{Andrea}) \,\&\, \text{Theme}'_w(e)(\lambda w\lambda P\exists y[\mathbf{house}_w(y) \,\&\, P_w(y)]) \,\&\, \text{Cul}_{wt}(e)]$

$\leftrightarrow$ (by the Building Principle)

$\exists e\exists I\exists t[I < s^* \,\&\, t \in I \,\&\, \mathbf{building}_w(e) \,\&\, \text{Agent}_w(e)(\mathbf{Andrea}) \,\&\, \exists x[\mathbf{house}_w(x) \,\&\, \text{Theme}^*_w(e)(x)] \,\&\, \text{Cul}_{wt}(e)]$

Theme* is the same relation as Landman's **Theme**. Obviously, Zucchi cannot accept the *Theme* Principle because that principle entails that the house did exist throughout the building interval. Could we revise the Theme Principle to the extent that the Theme of a culminating event exists only after the culmination point? Let us try:

(119) **A *Theme* Principle for culminating events?**

$$\forall w\forall e\forall x[\text{Theme}_w(e)(x) \,\&\, e \text{ culminates} \rightarrow \exists I[e >< I \,\&\, \mathbf{exist}_{wI}(x)]]$$

Leaving aside the problem that this principle is not sufficient because it doesn't guaranty that x doesn't exist at t(e), this semantics would prevent the Theme-relation from being used in ordinary accomplishments or achievements like **crossing the street**, **opening the door** or **pushing the cart**.

The moral of this seems to be that the theme relation has to be defined differently for each aspectual class, a move that would make it virtually empty. To resume the discussion of Zucchi: I cannot see that the theory achieves any progress with respect to Landman. It seems to me that a fair interpretation of the *Building* Principle makes the theory equivalent with Landman's.

What is the outcome of this section? It seems to me that Krifka's and Kratzer's theory can be refined in a way that they can deal with verbs of creation. Landman and Zucchi have to be enriched by Krifka's notion of **I-Theme** to be acceptable, to my mind. The theories have to be supplemented by analyses of the copulative verbs that do justice to Musan's observations. For instance, the copula **BE** must be something like:

(120) $\text{BE} := \lambda w \lambda t \lambda P \lambda x[\mathbf{exist}_{wt}(x) \ \&\ P_w(x)]$

I leave it to the reader to adapt the other copulas to the theory. I have to add the nothing forces us to adopt the Davidsonian approach as far as theories of the third kind are considered. The creation verb **build** can be defined in purely temporal and modal terms:

(121) $\mathbf{build} := \lambda w \lambda t \lambda y \lambda x[\lambda_{w'}\lambda_{t'}.\text{BUILD}_{w't'}(x)\ \text{CAUSE}_{wt}\ \lambda_{w'}\lambda_{t'}.\text{BECOME}_{w't'}(\lambda w' \lambda t' \mathbf{exist}_{w't'}(y))]$

Apart from the BECOME-operator this seems to be the analysis of Dowty's verb of creation **make**, which I rejected in section 4 (cf. meaning rule (36)). Well, it is not exactly the same, because Dowty's nouns have implicit time arguments and therefore the definition does not work in that theory. Thus, small ontological differences have big consequences for the syntax. Note that this analysis is again compatible with the conclusion reached in (Stechow, 1996) and (Rapp and Stechow, 2000) that decomposition should be done sometimes in the syntax.

13. Conclusion

The first two theories start from the assumption that every noun has a time argument. I have argued that temporally opaque objects must be properties in those theories. The conclusion gains support from Zimmermann's (1993) analysis of object-opaque verbs and copulative verbs, which both require properties as objects.

The first theory embeds an existential quantifier under BECOME and reaches the specificity of the object created by relativising the property to the generating event. Counterexamples by Schwarzschild and Zepter let me abandon the approach.

The second theory gives the indefinite object wide scope with respect to BECOME and has the information that the object exists under BECOME. This is done by the usual method of quantifying in or by means of an intensional choice function. Both methods generate an LF that seem to violate the ULC because the scoped object can exist only after the local evaluation time. The violation is circumvented by performing the operation in the lexicon, not in the syntax. The approach is somewhat clumsy because we are forced to double the information that the object exists only after the event time: the information is contained both in BECOME and in the restriction of the scoped object.

The third theory starts from a different ontological assumption. IL-nouns do not depend on time but only on the world parameter. I discuss several proposals made in the literature that treat creation verbs in such an ontology. Of these, Krifka's theory– followed by Kratzer's – seems to be the most successful. I have argued that Landman's and Zucchi's theory should take over Krifka's notion of I-Theme.

I have expressed my worries against a neo-Davidsonian way of theorizing, especially against the relation **Theme**. In fact, verbs of creation do not require an event approach at all. The second ontology for IL-predicate allows us to analyse verbs of creation as plain first order relations involving the intensional operators CAUSE and BECOME. Verbs like **build**, **compose**, **paint** etc. can be analysed more or less like Dowty's verb of creation **make**, whose definition we had to reject under the first ontological assumption. On the other hand, theory III is of course compatible with the usual assumption that non-stative verbs have an event argument.

Thus we have re-established logical simplicity, but we have lost uniformity. SL-predicates and IL-predicates cannot have the same logical type if theories of the third kind are true. These findings support the claims made in (Kratzer, 1995). For the time being, some version of Theory III seems the most attractive one, but many details remain to be worked out (e.g. the demonstrative article **this**), and thereby the picture might change. And one point is crucial for Theory III. Suppose Leo is painting a picture, and he will finish it. Then the (rough) LF (122a) is true, but (122b) is not!

(122) a, $\exists$x[picture(x) & Leo is painting x].

b. ≠ There is a picture that Leo is painting.

If you are a friend of the traditional logical paraphrase of existential quantifiers and you believe that the two statements should mean the same, you cannot accept Theory III. You should rather be a follower of Theory II then.

14. REFERENCES

Abusch, D. 1997. Sequence of Tense and Temporal de re. *Linguistics and Philosophy* 20(1):1-50.

Bech, Gunnar. 1955/57. *Studien über das deutsche verbum infinitum*. København: Det Kongelige Danske Akademie av Videnskaberne.

Bonomi, Andrea. 1997. The Progressive and the Structure of Events. *Journal of Semantics* 14:173-205.

Cresswell, M. 1979. Interval Semantics for some Event Expressions. In *Semantics from Different Points of View*, eds. Rainer Bäuerle, Urs Egli and Arnim von Stechow. Berlin: Springer.

Cresswell, M.J. 1973. *Logic and Languages*. London: Methuen.

Dowty, David. 1979. *Word Meaning and Montague Grammar*: Synthese Language Library. Dordrecht: Reidel.

Dowty, David. 1989. On the Semantic Content of the Notion of 'Thematic Role'. In *Properties, Types, and Meanings*, eds. Gennaro Chierchia, Barbara Partee and Raymond Turner, 69-129. Dordrecht: Kluwer.

Dowty, David. 1991. Thematic Proto-Roles and Argument Selection. *Language* 67:547-619.

Enç, Mürvet. 1981. Tense without Scope: An Analysis of Nouns as Indexicals.

Fabricius-Hansen, Cathrine. 1986. *Tempus fugit*. Düsseldorf: Schwann.

Fintel, Kai von. 1994. Restrictions on Quantifier Domains, University of Massachusetts, Amherst: Ph.D. Dissertation.

Gallin, D. 1975. *Intensional and Higher-Order Modal Logic*. Amsterdam: North-Holland.

Hamm, Fritz. 1999. Modelltheoretische Untersuchungen zur Semantik von Nominalisierungen, Seminar für Sprachwissenschaft, Universität Tübingen.

Heim, Irene. 1994. Questions: MIT, Lecture notes.

Jacobs, J. 1980. Lexical decomposition in Montague Grammar. *TL* 7:121-136.

Kamp, Hans , and Reyle, Uwe. 1993. *From Discourse to Logic*. Dordrecht/London/Boston: Kluwer Academic Publisher.

Kaplan, David. 1978. DTHAT. In *Pragmatics*, ed. P. Cole, 221 -243. New York: Academic Press.

Kratzer, Angelika. 1994. The Event Argument and the Semantics of Voice: UMass, Amherst.

Kratzer, Angelika. 1995. Stage-Level and Individual-Level Predicates. In *The Generic Book*, eds. G.N. Carlson and F.J. Pelletier. Chicago: University of Chicago Press.

Krifka, Manfred. 1989. *Nominalreferenz und Zeitkonstitution*: Studien zur Theoretischen Linguistik. München: Wilhelm Fink.

Landman, Fred. 1992. The Progressive. *Natural Language Semantics* 1:1-32.

Lewis, D. 1973. Causation. *The Journal of Philosophy* 70:556-567.

Lewis, David. 1986. Counterfactual Dependence and Time's Arrow. In *Philosophical Papers*, 32-51. New York/Oxford: Oxford University Press.

Montague, R. 1970. Universal Grammar. *Theoria* 36:373-398.

Montague, R. 1974. *Formal Philosophy. Selected Papers of Richard Montague.* New Haven/London: Yale University Press.

Montague, Richard. 1973. The Proper Treatment of Quantification in English. In *Approaches to Natural Language. Procedings of the 1970 Stanford Workshop on Grammar and Semantics.*, ed. J. Hintikka, 221-241. Dordrecht: Reidel.

Musan, Renate. 1997. *On the Temporal Interpretation of Noun Phrases*: Outstanding Dissertations in Linguistics. New York & London: Garland.

Musan, Renate. 1998. Temporal Interpretation and Information-Status of Noun Phrases. 22:621-661.

Parsons, Terence. 1990. *Events in the Semantics of English. A Study in Subatomic Semantics*. Cambridge MA: MIT Press.

Partee, B. 1987. Noun Phrase Interpretation and Type-Shifting Principles. In *Studies in Discourse Representation Theory and the the Theory of Generalized Quantifiers*, ed. Groenendijk et.al., 115-143. Dordrecht: Foris.

Partee, Barbara. 1992. Syntactic Categories and Semantic Types. In *Computational Linguistics and Formal Semantics*, eds. M. Rosner and R. Johnson, 97 - 126. Cambridge: Cambridge University Press.

Quine, Williard van Orman. 1960. *Word and Object*: Studies in Communication. New York/London: The Technology Press of The Massachusetts Institute of Technology/John Wiley & Sons.

Rapp, Irene, and Stechow, Arnim von. 2000. Fast "almost" and the Visibility Parameter for Functional Adverbs. *Journal of Semantics* 16:149-204.

Stechow, Arnim von. 1993. Die Aufgaben der Syntax. In *Syntax - Ein internationales Handbuch zeitgenössischer Forschung*, eds. Joachim Jacobs, Wolfgang Sternefeld, Arnim von Stechow and Theo Venneman, 1-88. Berlin/ New York: de Gruyter.

Stechow, Arnim von. 1996. The Different Readings of *Wieder* "Again": A Structural Account. *Journal of Semantics* 13:87-138.

Stechow, Arnim von, and Geuder, Wilhelm. 1997. Sind manche Sprachen präziser als andere? Über morphologische Kategorien und ihre Interpretation: Vortrag gehalten im Studium Generale der Universität Tübingen.

Stechow, Arnim von. 2000. Some Remarks on Choice Functions and LF-Movement. In *Reference and Anaphoric Relations*, eds. Klaus von Heusinger and Urs Egli, 193-228. Dordrecht/Boston/London: Kluwer.

Vendler, Z. 1967. *Linguistics in Philosophy*. Ithaca: Cornell University Press.

Winter, Yoad. 1997. Choice Functions and the Scopal Semantics of Indefinites. *Linguistics and Philosophy* 20:399-467.

Zanuttini, Raffaela. 1991. Syntactic Properties of Sentential Negation: A Comparative Study of Romance Languages, University of Pennsylvania.

Zepter, Alex. 2000. Verbs of Creation: CAUSE BECOME or BECOME CAUSE? On Arnim von Stechow (1999): Temporally Opaque Arguments. Rutgers University: Unpublished Term Paper.

Zimmermann, Th.E. 1993. On the proper treatment of opacity in certain verbs. *Natural Language Semantics* 1:149-179.

Zucchi, Sandro. 1999. Incomplete Events, Intensionality and Imperfective Aspect. *Natural Language Semantics* 7:179-215.