# Verbs of Creation and Intensional Verbs

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## 1 General background: Temporally limited Existence of Referents

Most of the entities we talk about have a limited span of existence: They don't exist throughout eternity but come into being at some time and go out of it again at another. (According to many of us today it is something that is true in particular of ourselves, notwithstanding the fact that mankind has gone through the most astounding mental contortions for the sake of denying this.) Probably only certain abstract entities, such as the proposition that $2+2 = 4$, the property of being a material object, the second order property of being a universally true property, etc. are eternal in that they "exist" at all times. Let us call such entities *eternal*, and refer to the others as *non-eternal*.

From a logical and semantic point of view the limited existence of non-eternal entities is a well-known problem. It is one that we are very good at keeping at bay in practice, so when we make use of natural language in the way in which we normally do. But the problem is nevertheless so serious and pervasive that it requires the theorist's attention. In fact, the very circumstance that it doesn't seem to get us language users into more trouble than it does is something which requires an explanation.

In the context of natural language there are two salient aspects to this problem. First, a noun phrase which is meant to refer to a certain non-eternal object d will be able to do so only at times when d is available a possible referent. (And similarly d will belong to the quantification domain of a quantifying NP only when this NP is evaluated at the right times. Second, when d is involved as argument in a predication at a given time t, then this may have implications for d's existence (at t and/or at certain related times). This means that NPs occurring as part of a sentential utterance are subject to two kinds of constraints. First – assuming for simplicity that the NP is a referential one –, the referent must be a possible object of reference at the NP's evaluation time; second, the referent must satisfy all the existence requirements connected with predications in the sentences (as well as, in cases which involve anaphora, predications in earlier utterances of the discourse). Language users are adept at avoiding the difficulties which would result from violations of these constraints. In particular, interpreters exercise, whenever necessary, the principle of charity: Within the limits language sets they choose the evaluation times of NPs in such a way that the mentioned constraints are satisfied.

So far, the verbs and other predicates we have been considering had the property that their arguments could be assumed to exist at predication time. That is, if the verb (or other predicate) V is used in a sentence, and makes to the meaning of that sentence a contribution which we represent as the condition 'ev: $V(x_1, ..., x_n)$', and $\mathsf{ev}$, $\mathsf{a}_1, ..., \mathsf{a}_n$ verifies this condition in a given model M , then $\mathsf{a}_1, ..., \mathsf{a}_n$ exist in M at the time of $\mathsf{ev}$. Let us refer to such predicates as *temporally transparent*.

As long as we are dealing only with temporally transparent predicates, the problems connected with non-eternal arguments are comparatively straightforward. But further complications arise with temporally *opaque* predicates.

One just has to make sure that the phrases that are used to refer to the arguments of such predicates are evaluated at the time of predication (or at a time close enough to it to guarantee that the entities to which these phrases refer or over which they quantify do exist). It appears that in the normal course of events speakers make sure that the referential and quantificational phrases of their statements can be evaluated at times where non-existence doesn't cause trouble, and the recipients of those statements take the evaluation times of the referential and quantificational phrases occurring in them to be such that the non-existence problem won't arise for their interpretation.

For a semantic representation formalism capable of dealing with the temporal dimension of natural language meanings the fact that so many of the objects that we talk about in natural language are non-eternal poses certain problems (even in the comparatively simple cases where all predicates are temporally transparent.) How these problems can be solved depends on the kind of formalism we are dealing with. For instance, in formalisms in which temporal relations are represented solely with the help of temporal operators a solution would look quite different from the one that we will propose here.

The main problem which non-eternity poses for semantics can be summarised as follows. Any sentence (of most if not all natural languages) has a main verb with noun phrases or prepositional phrases which specify some or all of its arguments. (For simplicity we concentrate on the case where *all* arguments of the verb are realised by such phrases.) The predication expressed by the main verb of a sentence uttered at a time n is generally understood as being located somewhere in time, typically at a time which stands in a certain relation to n. (E.g. when the sentence is in the present tense, then the evaluation time of the verbal predication is usually n itself.) To determine the arguments that are involved in the verbal predication, the DPs or PPs occupying the argument slots of the verb must be evaluated in order to determine what they denote. The result of such an evaluation may depend on the time at which it is carried out. It is part of the grammar of the language to determine (or at least to constrain) the evaluation times for the different DPs that occur in a given sentence utterance. So in a semantic representation for the uttered sentence, in which this aspect (like any other semantically relevant aspect of the utterance) should be reflected, this like any other semantically relevant aspect of sentence grammar, the evaluation times for the different DPs in the sentence and the effects they have on evaluation should be made explicit.

In a version of DRT such as that of [Kamp/Reyle:1993] representations specify the predication times of verbs. But the predication times of non-verbal predicates (such as nouns, adjectives and prepositions) are not represented. In more recent work provision has been made for the representation of such non-verbal predications. (See Tonhauser, 2003) For instance the condition that x is a student can be represented in the form of the condition "s: student(x)". with the option of specifying the time at which x is claimed to be a student by adding one or more conditions which relate the state s to certain time discourse referents occurring in the DRS. To our knowledge no provisions have thus far been made for representing the evaluation times of DPs. In the case of complex DPs with a nominal lexical head the issue is, we believe, essentially the same as that of the temporal location of the predication involving their lexical head. But of course the issue arises in principle also for NPs which do not have such a complex structure, such as proper names, pronouns or simple demonstratives.

Just a couple of words about these last categories of non-complex DPs before we set them aside. We take it that the evaluation time of proper names presents no problems, and this for the following reason. A proper name serves to refer to its bearer. We assume, following Kripke, that a "proper" proper name can only become the name of its bearer by being attached to it as a kind of label. It is natural (even if it isn't absolutely necessary) to connect with this assumption the condition that naming is only possible when the bearer of the name is available as an object of reference and thus belongs to the universe of discourse at the time of the naming. If we assume this, then a proper name will make its entry into the language only at a time when its bearer is a member of the universe of discourse. Since we assume, for reasons which will be explained below, that once an object is part of the universe it remains a member of the universe at later times, the condition of referent availability will be fulfilled at any time when a proper name is available for use at all (i.e. at all times at which it is "part of the language"). Moreover, since a proper name always refers to the same entity (names refer "rigidly"; a name always refers to the bearer as whose "label it has been introduced), it is immaterial what we take to be the evaluation time of an occurrence of a proper name (so long, of course as we restrict ourselves to times since the one at which the name was first introduced).

Pronouns and demonstratives do not present any real difficulty either. When such expressions are used demonstratively - in the general sense of the term used by Kaplan, i.e. either as referring to an object indicated by a demonstrative act (or "demonstration") or through the application of some indexical interpretation rule (cf. the rule which says that the referent of "I" is the one who counts as the producer of the utterance) – then the intended evaluation time is clearly the utterance time and the referent is the demonstrated object, or the object determined by the indexical interpretation rule. (Apparently the only exceptions to the principle that demonstratives and indexicals are always evaluated at the utterance time are cases where an indexical like, say, "now" refers via some shift in perspective to some time in the past of n.) Anaphoric uses of pronouns and demonstratives do not present a problem either. In such cases the evaluation of the anaphoric antecedent is transferred to the anaphoric expression. In the DRT-based treatment of the problem which we will present below, this transfer takes the form one would expect: The evaluation time constraints associated with the antecedent discourse referent get transferred to the discourse referent which represents the anaphor.

For the remainder of this note we restrict our attention to complex DPs, which contain (at a minimum) a determiner and a nominal head (either of which may be phonologically empty). We assume that for such DPs the time of the predication expressed by the N part of the DP coincides with the evaluation time of the DP as a whole. Moreover, in the cases we will consider here the predication time of the N part will always coincide with that of the lexical head. (Cases where this is not so are NPs involving modifying adjectives like "former", as in "a former president".) Complex DPs can be divided into two groups, *referential* DPs, which pick out a single referent, and *quantificational* DPs, which quantify over some "domain" which is normally presupposed two contain two objects or more. (We are not concerned here with the theoretical foundation of this distinction.) For the time being we will focus on referential DPs. We will have a few things to say about quantificational DPs towards the end of this first general introduction to predication and evaluation times.

How are the evaluation times of the argument phrases of a verb related to the time of the verbal predication? This is a non-trivial question, which has been discussed in work of [Enc:1981], [Musan:1997], [Musan:1998] and [Tonhauser:2002]. Often the evaluation times of an argument phrase is the same as the time of the predication which involves the phrase as argument. But this isn't always so, as shown by the following example

(1) In 1973 my wife and I spent a wonderful week in Venice.

(1) can be used to describe either an event involving the speaker's first wife, to whom he was married at the time, but from whom he is now divorced; or as reporting an extra-marital escapade with the person to whom the speaker became married subsequently and to whom he is married now. On the first interpretation the evaluation time of the subject DP, and thus the predication time for the noun "wife", coincides with the predication time of the verb. On the second interpretation the evaluation time is the utterance time. As far as we know, the general principles which determine the possible predication times of non-verbal predicates, or for that matter, the possible evaluation times for argument phrases, are not yet fully understood. However, we will proceed on the assumption that we know what the available options are.

So much for the relation between predication times and the evaluation times for DPs. So far none of this has had anything to do with the non-eternity of individuals. (Note that the ambiguity we observed in (1) had nothing to do with who was alive when. In the scenario we considered the sentence is ambiguous also on the assumption that both the first and the second wife were alive at the time of the week in Venice as well as at the utterance time.) However, for the problem of non-eternity the question of predication and evaluation times is nonetheless important, since the constraints imposed by DP evaluation and by (verbal) predication must both be satisfied at evaluation time.

Within the setting of our formalism the existence constraints connected with non-eternity manifest themselves in the first instance at the level of the model-theoretic evaluation of the DRS. This is to be expected, since the temporally limited existence of an object is a feature of particular individuals in particular models. Before we can say anything more, however, we must agree on how temporal existence limits are encoded in our models. Exactly what form this encoding should take is an old bone of contention. The choice we make is to some extended reflection of our own ontological preferences: We assume (i) that our formalism includes a special predicate EXISTS whose extension in a model M varies with time and consists at each time t of M of the entities existing at t. In addition we assume (ii) that entities remain possible objects of reference and quantification once they have come into existence; that is, they retain this status of possible referents even after their "real" existence has come to an end. This second idea is captured formally through the assumption that the universe $\mathbf{U}_{M,t}$ of a model $\mathbf{M}$ for our DRS formalism is a function of time, but one which can only grow - new objects may become part of the universe, while the old ones remain (in a fashion "surviving after death"). Formally:

if t $\prec$ t', then $\mathbf{U}_{M,t} \subseteq \mathbf{U}_{M,t'}$.

However, the assumption of a steadily growing universe implies that not everything in $\mathbf{U}_{M,t}$ will count as existing at t. Thus we will typically have that the extension of EXISTS in M at t is a proper subset of $\mathbf{U}_{M,t}$.

We can now make the restriction on permissible embeddings explicit by indexing the discourse referents for which they are defined according to the following principle:

> Discourse referents representing non-eternal entities are indexed with sets of discourse referents representing times. The index set of a discourse referent x consists of all those temporal discourse referents which represent times of predications which involve x

as argument, together with the evaluation time of the DP which introduced x (assuming x is introduced in this way).

How are these indices to be assigned? We will not spell out the procedure in full formal detail, but be content with an informal description. First, there is the question how we determine the predication time constraints on the arguments $x_i$ of a predication ev: $V(x_1,..,x_n)$. The general procedure we propose is that the temporal index corresponding to this predication is the term "dur(ev)" (where "dur" is a function which assigns to each eventuality the temporal interval it covers, or during which it lasts). (In examples we will often simplify this by choosing, in case the predication condition has the form " s: $V(x_1,..,x_n)$" and there is an accompanying temporal locating condition "t $\subseteq$ s", t as temporal predication index on the argument discourse referents $x_i$ instead of the term "dur(s)".)

The second question concerns the set of temporal indices that is to be associated with a given occurrence of a discourse referent x in a given DRS K. We begin by considering only discourse referents that are introduced by definite and indefinite DPs. The temporal indices on such discourse referent occurrences x have two sources: (i) the times of the predications in which x occurs as argument; (ii) the evaluation time of the DP which introduces x (as representation of its "referent"). As we saw in connection with (1), the evaluation time of an argument DP isn't fully determined by the predication time of the predicate to which the DP is an argument, and it isn't yet completely clear what the various options fofor the choice of DP-evaluation times are, but we assume for the remainder of this note that some way of determining DP evaluation times is in place.

Here just one example of what this comes to in practice. Suppose that the verbal predication condition in the representation of (1) has the form "e:spend(x+i,w,v)" (where "x+i" stands for the mereological sum of the referent introduced by *my wife* and that introduced by *I*, w for the week in question and v for Venice). On the interpretation according to which *my wife* refers to the speaker's current wife x will have the temporal index {dur(e),n}. On the interpretation according to which the subject DP refers to the speaker's wife at the time of e it will simply be {dur(e)}. Note that x also occurs in predications stemming from the nominal part of the DP itself - in the present case this is just the predication "s:wife(x,i)". Since the time of the predication involving the lexical head of the DP is assumed to be identical with the evaluation time of the DP, this predication will yield no further contributions to the temporal index of x. However, with more complex DPs – in which for instance the head noun is accompanied by a relative clause – predications from the N part of the DP may give rise to additional elements of the temporal index.

Let $x_{\{t_1,\ldots,t_n\}}$ be a temporally indexed discourse referent. What is the constraint which the index imposes on permissible embeddings for the DRS in which this indexed discourse referent occurs? Now that we have introduced, with the temporal variability of $\mathbf{U}_{M,t}$ on the one hand and the predicate EXISTS on the other, two notions of ”existence”, this question has become correspondingly more complex. First, we assume the following principle, which we consider uncontroversal given the model-theoretic assumptions that have already been made:

> No predication can involve an entity which isn't a possible object of reference at the time of the predication.

In other words, a predication at a time t in a model M can involve an entity d (as "predicable") only if $d \in \mathbf{U}_{M,t}$. Given the way in which the index set is constructed this means that the evaluation of a DRS K containing the indexed discourse referent $x_{\{t_1,\ldots,t_n\}}$ is subject to the following constraint:

> An embedding function f whose domain includes $x_{\{t_1,..,t_n\}}$ is admissible in the course of the evaluation of K only if: for all instants $\mathsf{t}$ of $\mathsf{M}$ such that for at least one i $\mathsf{t} \in f(t_i)$, $f(x) \in \mathbf{U}_{M,t}$.

With the temporal variation of the universes $\mathbf{U}_{M,t}$ on the one hand and the predicate EXISTS on the other we have introduced two kinds of ”existence” into our models. This adds a further dimension to the question what constraints the temporal indices of discourse referents impose on embedding functions. Often predications do not only impose the logical requirement that the identity of their arguments is somehow secured, but also that their arguments "genuinely" exist. An example is the verb *kiss*, as in *Mary kisses John.* Here as elsewhere *kiss* imposes this condition on both its arguments: if the kissing was at t, then both John and Mary must be in the extension of EXISTS at t. However, not all predicates impose this additional existence requirement on all their arguments. *remember* for instance, as in *John remembers Mary*, imposes the requirement only on its first argument. WE find similar differences among adjectives.The adjective *awake* does impose the existence constraint on its one non-referential argument, whereas *famous* does not. Thus, whether this constraint applies to a particular argument of a particular predicate varies from case to case and therefore needs to be part of the lexical specification of individual predicates. (We suspect that there must be general principles to determine where this existence constraint applies and where it doesn't. But we do not know precisely what they are have no clear idea how they might be stated. So we leave this as a matter for further investigation.)

One thing, however, does seem quite clear. The constraint functions much like a selection restriction on the given predicate argument. In fact, we propose that it be given as part of the selectional restrictions in the lexical entries for words which have the semantic status of predicates. In any case, whether we treat it as a selectional restriction or not, the constraint has a presuppositional character. In particular, under normal conditions a statement like *Bill didn't kiss Mary* would be understood as implying that both Bill and Mary existed at the time to which the statement pertains. The implication can be cancelled, as in *Bill didn't kiss Mary on that occasion for the simple reason that she/they both had been dead for several years.* But some context has to be supplied in order to make cancellation effective.

If we assume that real existence constraints are treated as selectional restrictions (or, more generally, as presuppositions carried by the predicates in question), then it isn't necessary to impose additional constraints reflecting them on the admissibility of embedding functions. The general process of presupposition justification, which leads from the preliminary representation to the final representation, will have the effect that in the final representation all predications will be accompanied of EXISTS predications. These will have the effect of restricting verifying embedding in the required way.

In the next section we will see that the constraint relating to the universes $\mathbf{U}_{M,t}$ and that relating to EXISTS are both relevant to the analysis of creation verbs.

The temporal indexing of quantifying DPs raises special problems. To see this let us first consider an example involving adverbial quantification.

(2) Im 19-ten Jahrhundert war ein Parlamentsmitglied immer männlichen Geschlechts.

In the representation format for adverbial quantifications - as expressed by frequency adverbs like *always/immer, often/oft, rarely/selten* and so on - that was proposed in [Kamp/Reyle:1993] and which is discussed at greater length in [Rey/Ro/Kamp:2000] a sentence such as (2) is assigned the DRS in (3):

(3)
$$\begin{array}{|c|}\hline \mathrm{t}_{adv}\ \mathrm{t}\ \mathrm{s}^{qua} \\ \\ \mathrm{t} \prec \mathrm{n} \\ \text{das 19- Jahrh.}(\mathrm{t}_{adv}) \\ \mathrm{dur}(\mathrm{s}^{qua}) = \mathrm{t} \subseteq \mathrm{t}_{adv} \subseteq \mathrm{dur}(s^{qua}) \\ \mathrm{s}^{qua}: \begin{array}{|c|}\hline \mathrm{t}^q\ \mathrm{s}^q\ \mathrm{x} \\ \\ \mathrm{t}^q \subseteq \mathrm{s}^{qua} \\ \mathrm{C}(\mathrm{t}^q) \\ \mathrm{t}^q \subseteq \mathrm{s}^q \\ \mathrm{s}^q\text{: Parlmgl(x)} \\ \hline \end{array} \left\langle \begin{array}{c} \forall \\ \mathrm{t}^q \end{array} \right\rangle \begin{array}{|c|}\hline \mathrm{t}^{ns}\ \mathrm{s}^{ns} \\ \\ \mathrm{t}^{ns} = \mathrm{t}^q \\ \mathrm{t}^{ns} \subseteq \mathrm{s}^{ns} \\ \mathrm{s}^{ns}\text{: männl.Geschl(x)} \\ \hline \end{array} \\ \hline \end{array}$$

The temporal indexations for the quantified discourse referent x are shown in (4).

(4)
$$\begin{array}{|c|}\hline \mathrm{t}_{adv}\ \mathrm{t}\ \mathrm{s}^{qua} \\ \\ \mathrm{t} \prec \mathrm{n} \\ \text{das 19- Jahrh.}(\mathrm{t}_{adv}) \\ \mathrm{dur}(\mathrm{s}^{qua}) = \mathrm{t} \subseteq \mathrm{t}_{adv} \subseteq \mathrm{dur}(s^{qua}) \\ \mathrm{s}^{qua}: \begin{array}{|c|}\hline \mathrm{t}^q\ \mathrm{s}^q\ \mathrm{x}_{\{t^q\}} \\ \\ \mathrm{t}^q \subseteq \mathrm{s}^{qua} \\ \mathrm{C}(\mathrm{t}^q) \\ \mathrm{t}^q \subseteq \mathrm{s}^q \\ \mathrm{s}^q\text{: Parlmgl(x)} \\ \hline \end{array} \left\langle \begin{array}{c} \forall \\ \mathrm{t}^q \end{array} \right\rangle \begin{array}{|c|}\hline \mathrm{t}^{ns}\ \mathrm{s}^{ns} \\ \\ \mathrm{t}^{ns} = \mathrm{t}^q \\ \mathrm{t}^{ns} \subseteq \mathrm{s}^{ns} \\ \mathrm{s}^{ns}\text{: männl.Geschl}(\mathrm{x}_{\{t^q,t^{ns}\}}) \\ \hline \end{array} \\ \hline \end{array}$$

(N. B. The predicate C is required in order to restrict the values of the quanified variable to times of the right " granularity", i.e.to determine whether the quantification ranges over days,over weeks,over years, or over periods of some other size. Usually what C is intended must be reconstructed from context, and often it is something that the interpreter can only guess, or that will remain underspecified in the interpretation he assigns. For the purposes of this note C is unimportant and from now on we will ignore it.)

The discourse referent x is quantificationally bound, and evaluation of the quantification will involve, as values for it, arbitrary elements of the domain of quantification. But what does this domain consist of in the present instance? Intuitively it seems clear that it includes all those who were Members of Parliament at some time during the 19-th century. So it consists of individuals whose lives need not have overlapped. What we want by way of temporal existence constraint on x should therefore take the form of a constraint which is dependent on the particular values which are assigned to x in the process of evaluating the duplex condition which represents the quantification. We achieve this by including in the temporal index of x the quantified temporal discourse referent $t^q$. This will have the effect that the embedding functions f which verify the restrictor of the quantification must assign x a value which is a member of $\mathbf{U}_{M,f(t^q)}$. Our general procedure for assigning temporal indices requires adding also the term "dur($s^{ns}$)" (or, in our simplified procedure, the discourse referent $t^{ns}$) to the index of x. Note, however, that this last index cannot be a constraint on embeddings f which verify the restrictor of the duplex condition, since it is defined only for discourse referents occurring in the nuclear scope. Therefore this last index should be added only to the occurrence of x within the nuclear scope, but not to its accurrences in the restrictor. As a consequence we see in this example an instance of a more general feature of temporal indexing: the index set for a given discourse referent may grow as one considers occurrences of it in more deeply embedded positions within a given DRS. In particular, we get for the occurrences of x in the restrictor of the duplex condition of (3) as temporal index the singleton set $\{t^q\}$ and as index for the occurrence of x in the nuclear scope the set $\{t^q,t^{ns}\}$. (In the present case, of course, the constraint imposed by the presence of the additional element $t^{ns}$ in this second index set is of no real significance, since the condition "$t^{ns} = t^q$" entails that the constraint imposed by $t^{ns}$ is the very same as that imposed by $t^{ns}$.)

It should be noted that the temporal dimension of quantification which [Kamp/Reyle:1993] and [Rey/Ro/Kamp:2000] discuss only in connection with adverbial quantification, plays a role in the context of nominal quantification too. Note that the following sentence expresses the same proposition as (2):

(5) Im 19-ten Jahrhundert war jedes Parlamentsmitglied männlichen Geschlechts.

(In the 19-th Century every member of Parliament was of the male sex.)

A DRS for this sentence that is constructed according to the principles of [Kamp/Reyle:1993] looks as follows:

(6)

$$
\begin{array}{|c|}
\hline
\mathrm{t}_{adv}\ \mathrm{t} \\
\\
\mathrm{t} \prec \mathrm{n} \\
\text{das 19- Jahrh.}(\mathrm{t}_{adv}) \\
\mathrm{t} \subseteq \mathrm{t}_{adv} \\
\begin{array}{|c|}\hline \mathrm{x} \\ \\ \text{Parlmgl(x)} \\ \hline\end{array}
\;\; \left\langle \begin{array}{c} \forall \\ \mathrm{x} \end{array} \right\rangle \;\;
\begin{array}{|c|}\hline \mathrm{t}^{n^s}\ \mathrm{s}^{ns} \\ \\ \mathrm{t}^{n}s \subseteq \mathrm{t} \\ \mathrm{t}^{ns} \subseteq \mathrm{s}^{ns} \\ \mathrm{s}^{ns}\text{: männl.Geschl(x)} \\ \hline\end{array} \\
\hline
\end{array}
$$

This representation fails to account for the temporal dimension of the predications involving “Parlamentsmitglied”. It is clear that the predication times of these predications must be included, just as in the representation of (2), within the period denoted by the adverb *im 19-en Jahrhundert*. In addition the time of the predication in the nuclear scope should now be related to the predication time of the restrictor. We assume for simplicity that these times are identified. Leaving aside the exact statement of the principles which establish this dependency, we get as representation of (5) the following DRS:

(7)

$$
\begin{array}{|c|}
\hline
\mathrm{t}_{adv}\ \mathrm{t} \\
\\
\mathrm{t} \prec \mathrm{n} \\
\text{das 19- Jahrh.}(\mathrm{t}_{adv}) \\
\mathrm{t} \subseteq \mathrm{t}_{adv} \\
\begin{array}{|c|}\hline \mathrm{t}^{pr}\ \mathrm{s}^{pr}\ \mathrm{x} \\ \\ \mathrm{t}^{pr} \subseteq \mathrm{t}_{adv} \\ \mathrm{t}^{pr} \subseteq \mathrm{s}^{pr} \\ \mathrm{s}^{pr}\text{: Parlmgl(x)} \\ \hline\end{array}
\;\; \left\langle \begin{array}{c} \forall \\ \mathrm{x} \end{array} \right\rangle \;\;
\begin{array}{|c|}\hline \mathrm{t}^{ns}\ \mathrm{s}^{ns} \\ \\ \mathrm{t}^{ns} = \mathrm{t}^{pr} \\ \mathrm{t}^{ns} \subseteq \mathrm{t} \\ \mathrm{t}^{ns} \subseteq \mathrm{s}^{ns} \\ \mathrm{s}^{ns}\text{: männl.Geschl(x)} \\ \hline\end{array} \\
\hline
\end{array}
$$

Again, the temporal index set increases as we move from restrictor to nuclear scope. The occurrences within the restrictor have the temporal index $\{t^{pr}\}$. The occurrence of x in the nuclear scope has an index consisting of two elements and looks like this: $x_{\{t^{pr},t^{n^s}\}}$ With these constraints on x the evaluation of (7) comes to the same thing as evaluation of (6).

Before we conclude this preamble on existence in time and temporal indexing as a device for capturing the constraints which a semantic representation imposes on the evaluation times for the discourse referents it contains, there is one point that deserves ot be drawn attention to. We stipulated that the temporal index on an occurrence of a disourse referent x in the universe of a sub-DRS K' of a DRS K, and of an occurrence in an atomic condition of K', includes the predication times of all the predications in K which contain x and are accessible in K from K'. It might be thought that there must be at least one exception to this principle, viz predications involving the predicate EXISTS. One function of EXISTS – and arguably the most inportant one – is that it makes it possible to say at some time t of a thing (at which that thing either exists or has previously existed) that there were certain times t' in the past of t at which the thing did not exist. Such statements involve predicational conditions of the form

(8) $\quad s\colon \neg \boxed{\begin{array}{c} s' \\ s'\colon \text{EXISTS}(x) \end{array}}$

Our indexing procedure entails that the occurrence within this DRS will bear the index t. Can this be right? As it happens, the index t' on x is harmless. It requires that any embedding f that arises in the evaluation of the DRS of 8 must assign to x an object d in $U_{dur(f(s))}$. Clearly this is impossible in the situation envisaged, in which dur(f(s)) is before the time when d came into existence. But since the point of the condition is that there are no f's of the kind described, the impossibility of an f with the given property is in keeping with what we want.

Did we just luck out? So far EXISTS is of all the predicates of our representation language the only one which doesn't presuppose existence in the sense of belonging to the universe at predication time. Its positive occurrences *entail* membership of this universe. And so long as its use in non-existence claims takes the form of (8), everything will work out fine, because of the rules for evaluating the complex DRS-condition beginning with ¬. But can we be sure that our representation language won't be in need of other predicates which do not presuppose "weak existence" (i.e. that which consists in belonging to the predication time universe)? In that case our indexing procedure might get us into trouble. For instance, were non-existence made into an atomic predicate, then the requirement of belonging to the universe of the time of a predication involving this predicate would apply to any embedding that would verify this *non*-existence claim (and not just embeddings that verify positive existence claims, which is, as we just saw, the situation in connection with predications of the form (8).

At this point we cannot see the need for atomic predicates which neither carry a weak existence presupposition nor entail weak existence. Should such predicates be introduced, then it would be necessary to modify the indexing procedure in such a way that the unwanted effect to which these last three paragraphs have drawn attention is prevented.

# 2 Verbs of Creation.

So much by way of background to the more specific problems which this note is intended to address. The first of these problems is connected with verbs of creation. It is this. The themes of creation verbs do not exist at the time when the event described by the verb occurs; it is only as a result of this event that the theme acquires its existence. Thus in (5.a) the cake referred to by the direct object DP existed only after the time of the baking event (or at least after the time when the process began). Likewise, in (5.b), where there is no explicit reference to some particular cake, the object instantiating the discourse referent contributed by the object DP must, as product of the baking process, have begun its existence only as the result of the baking and thus its existence will go back to the beginning of that process at hte very earliest.

(9) a. Gereon baked this cake./Gereon backte diesen Kuchen.

b. Gereon baked a cake./Gereon backte einen Kuchen.

Another way to put this is to say that for all the interpreter of (9) knows, the direct object of the creation verb *bake* may not have existence during the event itself but is guarantedd to have it only during the result state of that event. In fact, the procedure for temporal indexation described in connection with (3) can be applied essentially without change to the representation (10) of (9.b) (and of sentences involving *bake* and other creation verbs generally).

(10)
$$\boxed{\begin{array}{c}
\mathrm{t\ \ ec\ \ e'\ \ e\ s}^{res}\ \ \mathrm{g\ \ t}_n\ \ \mathrm{s}_n\ \ \mathrm{y} \\[6pt]
\mathrm{t} \prec \mathrm{n\ \ ec} \subseteq \mathrm{t\ \ Gereon(g)\ \ e} \supset\!\subset \mathrm{t}_n\ \ \mathrm{t}_n \subseteq \mathrm{s}_n\ \mathrm{t}\ \ \mathrm{s}_n\mathrm{:\ kuchen(y)} \\
\mathrm{ec:\ e'\ CAUSE}_{backen}\ \mathrm{e} \\
\mathrm{g = Agent(e')} \\
\mathrm{res(s}^{res}\mathrm{,e)} \\
\mathrm{e} \supset\!\subset \mathrm{s}^{res} \\
\mathrm{s}^{res}\mathrm{:\ EXISTS(y)}
\end{array}}$$

In this DRS we have assumed that the evaluation time $t_n$ of the object DP *einen Kuchen* immediately follows the process e. (For the reasons discussed the evaluation time of the DP cannot be assumed to be the same as that of the eventuality described by the creation verb *backen*.) With this choice of the evaluation time we can be sure that temporal indexation according to the procedure outlined in the last section will impose the intuitively correct conditions on embeddings.

Informally put, the representation in (10) says that there was an action e' by g which led to a baking process e which resulted in the existence of a cake y. We will say more about this representation below when we give the lexical entry for *backen*.

Applying the indexation procedure to the discourse referent y of (10) gives us as temporal index the set $\{\mathrm{dur}(s^{res})\}$ In (11) the temporal index has been added. (Since in this case all occurrences of y bear the same index, we have kept the notation lean by adding the index only to the occurrence of y in the DRS universe.)

(11)
$$\boxed{\begin{array}{c} \mathrm{t}\ \ \mathrm{ec}\ \ \mathrm{e'}\ \ \mathrm{e}\ \ \mathrm{s}^{res}\ \mathrm{g}\ \ \mathrm{t}_n\ \ \mathrm{s}_n\ \ \mathrm{y}_{dur(s^{res})} \\[6pt] \mathrm{t} \prec \mathrm{n}\ \ \mathrm{ec} \subseteq \mathrm{t}\ \ \ \mathrm{Gereon(g)}\ \ \mathrm{e} \supset\!\subset \mathrm{t}_n\ \ \ \mathrm{t}_n \subseteq \mathrm{s}_n\ \ \ \mathrm{s}_n\mathrm{: kuchen(y)} \\ \mathrm{ec{:}\ e'\ CAUSE}_{backen}\ \mathrm{e} \\ \mathrm{g = Agent(e')} \\ \mathrm{res(s^{res},e)}\ \ \mathrm{e} \supset\!\subset \mathrm{s}^{res} \\ \mathrm{s}^{res}\mathrm{: EXISTS(y)} \end{array}}$$

The lexical entry for*backen* which leads to the representation in (10) is given in (12)

(12)

| | backen | DP: nom; subj | DP: akk; dir. obj. |
|---|---|---|---|
| | ec | x | y |
| SR | event | capable of int.(x) | physical obj(y) |

Sem Rep
$$\boxed{\begin{array}{c} \mathrm{e'\ e} \\[6pt] \mathrm{ec{:}\ e'\ CAUSE}_{backen}\ \mathrm{e} \\ \mathrm{x = Agent(e')} \\ \mathrm{e{:}\ BEC(}\lambda \mathrm{s.} \boxed{\begin{array}{c} \\ \mathrm{s{:}EXISTS(y)} \end{array}} ) \\ \mathrm{backen(e)} \end{array}}$$

Insertion of the semantic representation of (12) into the representation of (9.b) does not lead to (6) directly, but involves an application of the veridicality principle connected with BEC, according to which an event e of the type given leads to an abutting result state $s^{res}$ of the type specified by the formula of the $\lambda$-abstract that is the argument of BEC.

In addition, verbs of creation carry the lexical implication that the theme does not exist until after the start of the process which the verb describes. For *backen* the axiom is as in (13):

(13)
$$\boxed{\begin{array}{c} \mathrm{e} \\[6pt] \mathrm{e{:}\ BEC(}\lambda \mathrm{s.} \boxed{\begin{array}{c} \\ \mathrm{s{:}P(y)} \end{array}} ) \end{array}} \Rightarrow \neg \boxed{\begin{array}{c} \mathrm{s} \\[6pt] \boxed{\mathrm{beg(e)} \subseteq \mathrm{s}} \vee \boxed{\mathrm{s} \prec \mathrm{beg(e)}} \\ \mathrm{s{:}\ EXISTS(y)} \end{array}}$$

(N.B: probably (13) should not have the form of an implication. It seems more likely that the right ahnd side of the implication should be regarded as a presupposition for the left hand side.)

In this respect creation verbs differ from change-of-state verbs like *reinigen/clean* or *heilen*. The latter presuppose that the theme existed before the beginning of the event complex they describe. (This is part of their pre-state presupposition, since the pre-state presuppositions of such verbs always involve the theme.)

Given that this is the only general difference between the two classes of verbs, one wouldn't expect the difference to be manifest in the interpretation of many sentencwes in which these verbs occur. One type of sentence where the difference does not make itself felt are sentences in which the verb is in the (simple) past tense. The reason is that from the perspective of the utterance time the theme qualifies as a regular object of reference irrespective of whether it came about as a result of the event described or whether it already existed beforehand. Much the same applies to sentences in which the verb is in the simple future tense. There is one context, however, in which the difference between creation verbs and change-of-state verbs does become tangible at the level of sentence representation and the associated truth conditions; and it is this which has led certain linguists to see creation verbs as involving a kind of intensionality, which is not present in the case of change-of-state verbs. The difference is especially clearly visible when the verb (of either class) occurs within the simple present (in German) or in the present progressive (in English). Thus (14.b) carries an existence implication, whereas (14.a) does not:

(14) a. Gereon is baking a cake./ Gereon backt einen Kuchen

b. Gereon is cleaning a shirt./Gereon reinigt ein Hemd.

Notoriously the events (or processes) described by sentences with telic verbs in the progressive need not "culminate in the telos" - both the cleaning process described in (14b) and the baking process described in (14a) could be interrupted shortly after the utterance has taken place (and well before the intended process has reached its completion). (The fact that English verbs in the progressive and German verbs in any tense can be used to describe such incomplete events is part of the complex that is known in the literature as the “Imperfective Paradox”.) But whether completed or not, the process described in (14b) entails that there is an object that can be described as the shirt which Gereon is now in the process of cleaning. In contrast (14a) does not entail that there exists an object that could be described as the cake that Gereon is baking.

Observations such as this one have also led to the hypothesis that the direct object of a creation verb is (often) incorporated, and hence subject to the Definiteness Effect: When the verb is used in this way, its direct object must be an indefinite DP (or “weak NP”). And the contribution of the DP is essentially that of a predicate (the predicate given by its descriptive content). We could make this explicit by postulating an alternative lexical entry for such verbs.

(15)

| | backen | DP: nom; subj | DP: akk; dir. obj.; indef. |
|---|---|---|---|
| | ec | x | P |
| SR | event | capable of int.(x) | physical obj. property (P) |

Sem Rep

$$\boxed{\begin{array}{c} e'\ e \\ \\ ec\text{: } e'\ \mathrm{CAUSE}_{backen}\ e \\ x = \mathrm{Agent}(e') \\ e\text{: BEC}(\lambda s. \boxed{\begin{array}{c} y \\ \\ s\text{:}P(y) \end{array}}\ ) \end{array}}$$

The semantic representation of this entry does justice to the intuition that a particular theme need not be given from the outset when the verb is used. In “telic” (or “perfective”) uses of the verb, where the described event does reach its culmination, there is an entailment to a particular theme. But in its progressive uses, where the event may be an “initial segment”, there is no such entailment.

To be more precise, for the representation of a sentence like (9.a) it is immaterial whether we use entry (12) or entry ( 15). Using (12) we get (directly) the representation in (10). Use of (15) leads in the first instance the representation in (16)

(16)
$$\boxed{\begin{array}{c} \text{t} \quad \text{ec} \quad \text{e'} \quad \text{e} \quad \text{g} \\[6pt] \text{t} \prec \text{n}\ \ \text{ec} \subseteq \text{t} \ \ \text{Gereon(g)} \\ \text{ec: e' CAUSE}_{backen}\ \text{e} \\ \text{g} = \text{Agent(e')} \\ \text{e: BEC}(\lambda \text{s}.\boxed{\begin{array}{c} \text{y} \\[4pt] \text{s:kuchen(y)} \end{array}}\ ) \end{array}}$$

Using the veridicality principle for BEC we can augment (16) to the DRS (17).

(17)
$$\boxed{\begin{array}{c} \text{t} \quad \text{ec} \quad \text{e'} \quad \text{e} \quad \text{g} \quad \text{s}^{res} \quad \text{y} \\[6pt] \text{t} \prec \text{n}\ \ \text{ec} \subseteq \text{t} \ \ \text{Gereon(g)} \\ \text{ec: e' CAUSE}_{backen}\ \text{e} \\ \text{g} = \text{Agent(e')} \\ \text{e: BEC}(\lambda \text{s}.\boxed{\begin{array}{c} \text{y} \\[4pt] \text{s:kuchen(y)} \end{array}}\ ) \\ \text{s}^{res}\text{: kuchen(y)} \\ \text{res(s}^{res}\text{,e)} \\ \text{e} \supset\!\subset \text{s}^{res} \end{array}}$$

This last representation is not strictly identical with (16), but the two are logically equivalent (in the strong sense of determining the same information states). In particular, the predication $\text{s}^{res}$: EXISTS(y) for a states $\text{s}^{res}$ abutting e in (10) follows from the material in (17) if we assume that a predication of the form “kuchen(y)” entails “EXISTS(y)” at the same time.

The representation of (14.a) should not entail the existence of a cake y. So here, it would seem, we ought to make use of entry (15). This gives us the DRS in (18).

$$
(18)\quad
\begin{array}{|c|}
\hline
t \;\; s^{prog} \;\; g \\[4pt]
n \subseteq t \;\; ec \subseteq t \;\; \text{Gereon}(g) \\
s^{prog}\text{:PROG}(\lambda ec.
\begin{array}{|c|}
\hline
e' \;\; e \\[4pt]
ec\text{: } e' \;\text{CAUSE}_{backen}\; e \\
g = \text{Agent}(e') \\
e\text{: BEC}(\lambda s.
\begin{array}{|c|}
\hline
y \\[4pt]
s\text{:kuchen}(y) \\
\hline
\end{array}
) \\
\hline
\end{array}
) \\
\hline
\end{array}
$$

This DRS does not entail that there was a cake. But is it really true that we must use (15) in order to prevent the unwanted existence implication? What would have happened if we had used entry (12) instead? The resulting DRS is given in (19).

$$
(19)\quad
\begin{array}{|c|}
\hline
t \;\; s^{prog} \;\; g \;\; g \;\; t_n \;\; s_n \;\; y \\[4pt]
e \supset\!\subset t_n \;\; t_n \subseteq s_n \;\; s_n\text{: kuchen}(y) \\
n \subseteq t \;\; ec \subseteq t \;\; \text{Gereon}(g) \\
e \supset\!\subset t_n \;\; t_n \subseteq s_n \;\; s_n\text{: kuchen}(y) \\
s^{prog}\text{:PROG}(\lambda ec.
\begin{array}{|c|}
\hline
e' \;\; e \\[4pt]
ec\text{: } e' \;\text{CAUSE}_{backen}\; e \\
g = \text{Agent}(e') \\
e\text{: BEC}(\lambda s.
\begin{array}{|c|}
\hline
\\[4pt]
s\text{:EXISTS}(y) \\
\hline
\end{array}
) \\
\hline
\end{array}
) \\
\hline
\end{array}
$$

It is clear that this DRS does carry an existence commitment concerning y, and so cannot be what we want. But why, one may ask, is the discourse referent y declared where it is, viz. as a member of the universe of the main DRS? If we had declared y within the scope of PROG, then there would haved been no existence implication. The answer to this question rests on two points. The first is one which has been implicit in all the sentence DRSs which have been shown so far. It is a general assumption of the construction algorithm with the help of which DRSs are constructed that each DP which occupies an argument position of a verb which is marked with a "normal" place holder in the lexical entry (such as the y in the entry (12)) introduces a discourse referent which gets inserted into the given argument position and gets "bound" according to the specifications provided by the DP. With complex DPs this specification is provided by the determiner. The binding specifications conveyed by the indefinite article *a* are a notoriously difficult part of the theory of reference and quantification in natural language, but they do not matter here. All that matters here is that for any type of DP binding takes place "outside" the verbal predication, i.e. in a position which contains the verbal predicationwithin its scope.

The second point concerns the scope of the operator PROG. From what has just been said it follows that the binding of y is outside the verbal predication in the form in which it is contributed by the verb's lexical entry. But this doesn't by itself entail that the binding should also be outside the scope of an operator that takes the lexical predication as argument. That it nevertheless is outside the scope of the operator in this case follows from a separate principle which concerns aspectual operators such as PROG, RES or BEC. This principle says that such operators always apply *directly* to the verbal predication. (More precisely, application of such an operator always involves $\lambda$ abstraction over the eventuality variable ev of a condition of the form "ev:K", and here ev is either a constituent introduced by the semantic component of the lexical entry (such as e in our example) or else the eventuality discourse referent which has been introduced by some other application of an aspectual operator. (An example of the latter situation are perfects of progressives in English, as in *she has been writing a letter.*)

Given these two assumptions, about the binding of discourse-referent-introducing DPs and about the scope of aspectual operators, the use of entry (12) gives the wrong representation for (14a). It is important in this connection to realise clearly that it is the operater PROG in (18) which blocks the unwanted existence entailment. The veridical operator BEC, which also appears in the verbal predication of (18),"lets the ebtailment through",just as we saw in our discussion of (18).

These observations lead naturally to general hypotheses about the nature of intensional argument positions of verbs and about the mechanisms which account for non-extensional interpretations. The first is that reinterpretation of an argument phrase as predicate contributor is in principle always an option, but that in most cases it will not lead to a tangible difference in interpretation. For this assumption to be tenable it should of course be possible to demonstrate that the option leads to an extensional interpretation in *all* cases where speakers of the language judge that the only interpretations are extensional. The tenability of our explanation depends therefore in particular on our getting the right result in one of the four cases on which this discussion focussed, viz. (14b). This sentence, we saw, is just as extensional as (9b). But how do we account for the fact that in this case, where the verb is the change-of-state verb *reinigen*, we do not get the intensional reading which (18) gives for the analogous sentence with the verb *backen*?

The solution of this puzzle is connected with the prestate presuppositions which distinguish genuine change-of-state verbs from creation verbs. The lexical entry of each change-of-state verb includes a prestate presuppositon to the effect that the theme exists before the described event and is, at the time when this event begins, in a state which is the opposite of the result state. The operator PROG leaves this prestate presupposition untouched as it applies directly to the relevant part of the non-presuppositonal component of the semantic representation. (In the case of (14b) this is the condition "e:BEC.." from the lexical entry of *reinigen*.) Moreover, there is the question what happens when the P-option for the interpretation of the theme argument is exercised for a change-of-state verb. We assume that this is a special case of a more general principle which governs the use of this option for lexical entries that are more complex than the (comparatively simple) entry for a creation verb like *backen*: The bearer y of the predicate P gets "narrowly bound" in each scopally maximal position in which P occurs, while occurrences of P in all positions from which some maximal occurrence of P is accessible (in the sense of DRT's accessibility hierarchy!) will "inherit" their argument discourse referent from that maximal position. In the case of a change-of-state verb, where the prestate presupposition is accessible form positions within the non-presuppositional part but not vice versa, this means that y gets introduced into a DRS in the presupposition and that this occurrence "binds into" the non-presuppositional part. For (14b) the result is that in (20)

(20)
$$\begin{array}{|c|}\hline \text{t} \\ \text{n} \subseteq \text{t} \\ \langle\ \{ \begin{array}{|c|}\hline \text{s}^{pr}\ \text{t}^{pr}\ \text{y} \\ \text{hemd(y)} \\ spr\text{: } \neg\ \text{REIN(y,z)} \\ \hline \end{array} \}, \begin{array}{|c|}\hline \text{s}^{prog} \\ \text{s}^{prog}\text{:PROG}(\lambda \text{ec.} \begin{array}{|c|}\hline \text{e' e } \mathbf{z} \\ \text{ec: e' CAUSE}_{reinigen}\ \text{e} \\ \text{g} = \text{Agent(e')} \\ \text{e: BEC}(\lambda \text{s.} \begin{array}{|c|}\hline \\ \text{s:REIN(y, } z\text{)} \\ \hline \end{array}) \\ \hline \end{array}) \\ \hline \end{array}\ \rangle \\ \hline \end{array}$$

The just mentioned principle – concerning the effects of applying the P-option for interpreting an argument DP in cases like the one discussed here – needs to be worked out more carefully. In fact, what is really needed is a principle which transforms the “y-entry” for a given verb into its “P-entry”. This involves the replacement of all “logically first” occurrences of y in the semantic representation of the “y-entry” - i.e those from which no other occurrences of y within the representation are accessible - by the following DRS

(21)
$$\begin{array}{|c|}\hline \text{t s y} \\ \text{t} \subseteq \text{s}\ \ \text{R(t,t')} \\ \text{s: P(y)} \\ \hline \end{array}$$

whereas all occurrences of y which are not logically first are kept as is. Here, by “replacing y by the DRS 21 we mean the following: the occurrences of y in the semantic representation of the “y-entry” are all occurrences in argument positions, i.e. in conditions of the form ev: Q($x_1$, , y, ..,$x_n$). “Replacing y by (21)” means that the DRS K containing this predicational condition is merged with (21). The condition “ R(t,t')” in (21) is a dummy for a variety of different termporal relations R between t and some time discourse referent t' from K. (We shy away at this point from saying more precisely how R and t' are determined in each case.)

By way of example, 22a gives the “y-entry” for *renigen* and 22b the result of its “P-transformation”.

(22) a.

| | reinigen | DP: nom; subj | DP: akk; dir. obj. | PP: von DP: dat |
|---|---|---|---|---|
| | ec | x | y | z |
| SR | event | capable of int.(x) | physical obj(y) | stuff(z) |

Sem Rep

$$\left\langle \left\{ \boxed{\begin{array}{c} t^{pr} \quad s^{pr} \\ \\ s^{pr}\text{: } \neg\ \text{REIN(y,z)} \end{array}} \right\} \boxed{\begin{array}{c} \text{e' e} \\ \\ \text{ec: e' CAUSE}_{reinigen}\text{ e} \\ \text{x} = \text{Agent(e')} \\ \text{e: BEC}(\lambda\text{s. } \boxed{\begin{array}{c} \\ \text{s:REIN(y,z)} \end{array}}\ ) \\ t^{pr} \supset\!\subset \text{ec} \quad \text{end}(s^{pr}) \leq \text{end(ec)} \end{array}} \right\rangle$$

b.

| | reinigen | DP: nom; subj | DP: akk; dir. obj. | PP: von DP: dat |
|---|---|---|---|---|
| | ec | x | P | z |
| SR | event | capable of int.(x) | phys. obj prop(P) | stuff(z) |

Sem Rep

$$\left\langle \left\{ \boxed{\begin{array}{c} t^{pr} \quad s^{pr} \quad \text{t} \quad \text{s} \quad \text{y} \\ \\ \text{s:P(y)} \quad \text{t} \subseteq \text{s} \quad \text{t} = t^{pr} \\ s^{pr}\text{: } \neg\ \text{REIN(y,z)} \end{array}} \right\} \boxed{\begin{array}{c} \text{e' e} \\ \\ \text{ec: e' CAUSE}_{reinigen}\text{ e} \\ \text{x} = \text{Agent(e')} \\ \text{e: BEC}(\lambda\text{s. } \boxed{\begin{array}{c} \\ \text{s:REIN(y,z)} \end{array}}\ ) \\ t^{pr} \supset\!\subset \text{ec} \quad \text{end}(s^{pr}) \leq \text{end(ec)} \end{array}} \right\rangle$$

It should be clear that in the end it won't make a difference to the representation of (14.b) whether we make use of entry 22a or entry 22b. Even if we use 22b, the binding of the discourse referent y in the prestate presupposition will remain outside the application of PROG.

We have argued that for verbs of creation the DP-as-property option must be available, since without it there would be no way of blocking the existence entailment from sentences in which the verb occurs in the progressive. We should note, however, that this argument rests in part on the principle that when an argument position of a lexical predicate is marked in its entry as a position for an ‘ ordinarry” discourse referent, the construction of the semantic representation for a sentence involving this predicate will give the discourse referent contributed by the argument phrase which occupies this argument position in the sentence wide scope with respect to certain operators (such as PROG) which operate on lexical predications in the “direct” way described above. If this assumption is dropped, then operators like PROG would in principle be able to capture the discourse referent introduced by the argument DP, and an ‘ intensional” effect would be produced of exactly the same kind as that which we obtain with the help of P-entries in the account we have given.

As a matter of fact, this alternative should, we think, be taken very seriously. Among other things it might prove to have the following advantage: As it is the syntactic realisation on P-arguments according to which such arguments can be realised only in the form of indefinite DPs is a mere stipulation. If we modify our assumptions in the way just considered, however, it may be possible to account for this fact. The reason why it is only indefinites which allow for an “intensional” interpretation might now be explained in terms of the special conditions which govern the binding of the discourse referents introduced by indefinite DPs: They and only they make their discourse referents available for the special narrow scope binding which, we have argued, is part of the non-extensional interpretation of the progressive uses of creation verbs. Exactly what form this explanation should take is a matter on which we do not want to speculate, but it is likely to involve (i) something like the “free variable” account of indefinites that is one of the distinctive features of Dynamic Semantics in its various forms, and (ii) something about the capacity of operators like PROG to provide a binding environment for such “free” variables.

For the time being we will continue our exploration of intensional verbs on the assumption that construction of semantic representations proceeds according to the principles we have adopted. But the alternative just indicated should be kept in mind as a possibility throughout, and we will return to it explicitly later on.

## 3 Other Intensional Verbs

In the light of what has been said about the intensionality of creation verbs it is of interest to compare them with "truly intensional" verbs such as *suchen* (seek), *sich wünschen* (wish for), *schulden* (owe), *ähnlich sehen* (look like, resemble) or *fehlen* (be lacking) and others. All sentences in (11) can be true in situations where there is no object of the kind described by the DP of which the predication expressed by the verb is true.

(23) a. Fritz suchte einen Lektor für seine Buchmanuskripte (bis er zuletzt die Suche aufgab).
Fritz was looking for someone to correct his manuscripts (until he finally abandoned the search)

b. Stella wünschte sich ein neues Kleid
Stella wanted a new dress.

c. Fritz sah einem Ochsen erstaunlich ähnlich.
Fritz looked surprisingly like an ox.

d. Marcus schuldete Marius ein Pferd.
(Marcus owed Marius a horse.)

e. Es fehlte (uns) noch ein vierter Spieler.
We were missing a fourth player.

(23.a) doesn't entail that there was a particular individual for whom he was looking. He had a general idea of what he was looking for but that idea was not tied to some given person. Similarly, Stella need not have had any particular dress in mind. She just wanted something different to wear. (23.c) – (23.e) are cases with a somewhat different complexion. Here the "opacity" of the relevant DP cannot be accounted for in terms of the mental state of the subject. In (23.c) it is something like the "prototype of an ox" that is involved in what the sentence says. In (23.d) it is the circumstance that the basic conception underlying that of debts, trade contracts and the like is that what the debt (or the delivery to which the contract commits one of the parties) consists in is a quantity of some kind - so much or so many of some given category. And in (23.e) it is the closely related concept of a quantity of some kind not being where it ought to be. (*Brauchen* is much like *fehlen* in this regard.)

Before we proceed further, a bit of terminology. In philosophical logic and the philosophy of language the phenomenon illustrated in (11) has been a topic of intense concern for centuries. (For instance, the discussion of the opacity of the verb *owe* goes back to the Middle Ages.) Philosophers have developed a number of tests for "opacity". An important one of these is the test of "quantifier exportation": Non-opaque occurrences of indefinite DPs "permit quantifier exportation", non-opaque ones do not. What is meant by this can be illustrated as follows. In (24.a) and (24.b) we have represented two putative inferences:

(24) a. Fritz feuerte einen Lektor
Es gab einen Lektor, der von Fritz gefeuert wurde.
Fritz fired a reader. There was a reader whom Fritz fired.

b. Fritz suchte einen Lektor
Es gab einen Lektor, der von Fritz gesucht wurde.
Fritz was looking for a reader.
There was a reader whom Fritz was looking for.

In both (24.a) and (24.b) the second sentence is said to result from the first through (existential) quantifier exportation. The difference between (24.a) and (24.b is that in the former the second sentence is entailed by the first, whereas in the latter it is not. This difference is expressed by saying that the first sentence of (24.a) permits quantifier exportation, while the first sentence of (24.b) does not. The terminology is also applied to the verbs involved: *feuern* permits quantifier exportation with respect to its direct object, *suchen* doesn't.

The connection with the terminology we have been using so far in this note should be clear: The verbs which permit quantifier exportation are those for which special properties quarantee that the DP-as-property interpretation of an indefinite DP (in direct object position) leads to the same interpretation as the DP-as-discourse-referent-introducer interpretation. (As we have seen, the verbs of creation occupy a kind of intermediate position. One might say these "permit quantifier exportation under certain conditions".)

The verbs mentioned in (23) can be divided into three different categories:

(i) suchen, sich wünschen;
(ii) ähnlich sehen;
(iii) schulden, fehlen, brauchen

The DP-as-property interpretation of verbs of category (ii) involves some notion of stereotype, or prototype. We have (or are supposed to have) some conception of what an ox looks like, and on the basis of that have (or are supposed to have) some idea of what it is for something else, e.g. a person, to resemble this prototype. (This of course within the limits of what that something else really is - when a bull is said to look like an ox, this presumably will involve a resemblance that is important respects closer than it is in the case of Fritz.) To say more about this type of intentional verb we would need to provide a proper foundation for the role of prototypes in lexical semantics. This is a subject of great importance - some semanticists seem to hold the view that all word meanings (or at least the meanings of all "non-functional", or "content" words) are based on prototypes. However, a truly satisfactory formal theory of prototype-based word meanings is, to our knowledge, still outstanding. This is a matter which we cannot take up at this point.

Verbs of category (iii) can be analysed, we claim, as consisting of a denial of the predication expressed by the verb, together with some claim concerning the conditions under which the predication would be true. Consider for instance the following variant of sentence (23.e))

(25) Es fehlte der Gruppe ein vierter Spieler.

This means that there wasn't a fourth player in the given group. (It follows from the semantics of *vierter* that the group must have consisted of three players as it was.) However, the sentence seems to be saying more than just that the group consisted of only three players. It also implies that there *ought* to have been a fourth player, or that there was a need for one, in some appropriate sense of "ought" or "need". Exactly what this sense is may vary from case to case. (It also varies from verb to verb. Thus *schulden* typically involves some kind of moral or contractual obligation, something that isn't entailed by *fehlen* even if it isn't incompatible with what this verb implies.) In the entry in (14) we have formally represented this additional component of its meaning with the help of a modal operator O. (26) gives an entry for one of the possible argument frames for *fehlen*, viz the one exemplified in (25), in which the subject denotes that which is said to be missing and the dative DP denotes that which the first is said to be missing from. The entry contains a second element of underspecification in the relational predicate R, which stands for the relation between what is missing (y) and the thing that it is missing from (z). In example (25) this is the relation of y being present as part of the group z, but this is only one of wide range of possibilities. We leave the question of determining what this range is and how particular elements of this range are selected by context as a problem for further research.

(26)

| | fehlen | DP: nom; subj | DP: dat |
|---|---|---|---|
| | s | y | z |
| SR | state(s) | — | — |

SemRep

| |
|---|
| s: $\neg$ R(z,y)<br>O( R(z,y) ) |

**Interlude on modal operators**

In philosophical logic and in the semantics of formal and natural languages it is a long-standing tradition to make use of *modal operators*. The use is sometimes excessive and the tendency towards it is based in large part on the fact that modal logic is one of the oldest and best established extensions of classical prediate logic. In logic and semantics there is a penchant for using tools that one feels one understands and knows how to handle.

Modal logic is almost as old as the discipline of formal logic itself. Already in Arsitotle one finds attempts in this direction, and these were further elaborated by the members of the Stoa. However, the development of modal logic in the form in which it is used today had to wait until formal logic had been given the foundation which it got only towards the end of the 19-th century. And even then it wasn't until a good deal later that the crucial breakthrough occurred which made modal logic into the powerful and flexible tool that it is now. This breakthrough was due to the American philosopher and logician Saul Kripke (who at the time of his discovery was only 16 years old). The discovery can be described as that of a way of "relativising" the notion of necessary truth as "truth in all possible worlds". This "definition" of the concept of necessary truth had been formulated. But in this simple and rigid form there isn't much that one can do with it. Kripke (as well as a number of other people at about the same time, who however did not demonstrate the usefulness of the idea in the persuasive way in which he was able to) realised that there were modal notions (among them certain types of necessity) which could be analysed as involving truth in other sets of possible worlds (i.e. other than the set of all worlds). In particular, he recognised the possibilities of allowing the set of possible worlds in which the formula A had to be true in order that the formula OA is true in a given possible world w (where O is the modal operator in question) to vary with w. This idea leads to the assumption that the semantics of a modal operator O is given by a relation $R_O$ between worlds:

(27) OA is true in w iff A is true in all worlds w' such that w $R_O$ w'.

Operators O whose semantics is given by this clause are often referred to as "necessity operators". We need not stop at necessity operators, however, and insist that all modal operators should have a semantics of the form (27). In fact, the "dual" to any necessity operator O is a corresponding "possibility operator" P with the semantics that PA is true in w iff there is some world w' such that w $R_O$ w' and A is true in w'. Yet other schemes for defining the semantics of modal operators have been considered in the literature. However, the schemata for necessity and possibility operators are the most common.

To give some idea of the formalisation possibilities that are made available by a modal logic with these options for defining the semantics of modal operators we will briefly discuss some of the more familiar examples:

1. Epistemic necessity. This is "necessity" from the perspective of what is known (by a certain person at a given time). In other words, if K is the epsitemic necessity operator, then KA is true in w (at t) iff A is true at all worlds that are "epistemic alternatives" to w (at t). But what does it mean for a world w' to be an epistemic alernative of w (at t, for the person a in question)? The standard answer to this question: w'is an epistemic alternative of w iff w' verifies everything that is known by a in w (at t) . With this stipulation we get that KA is true in w at t iff A is entailed by all that a knows at t. Thus KA can be paraphrased as "A is among the things that a knows at t". This example illustrates one unsatisfactory feature of modal logic as a tool for the analysis of non-extensional concepts: The truth claue for formulas of the form KA isn't wrong, but it tells us precious little unless we have some independent way of determining which worlds are epistemic alternatives to w (for a at t). If we characterise this relation in the way we just did, what results is an "analysis" of "a knows at t that A" that could not be faulted on truthconditional grounds, but which is circular and thus unilluminating.

The classical possible world analyses of " attitudinal modalities"– knowledge, belief, hope,.. – all have this feature: you put in what you want, so you get back what you want, but without being any the wiser.

**Deontic modalities**

One of the oldest applications of modal logic outside the realm of the modalities in the original sense of the word (i.e. necessity and possibility) is to dontic notions such as obligation and permission. Using Ob for "it is obligatory that" and Pe for "it is permissible that"the semantics for formulas of the forms Ob A and Pe A is given by the clauses

(28) Ob A is true in w iff A is true in all worlds w'such that w $R_{Ob}$ w'

(29) Pe A is true in w iff A is true in some world w'such that w $R_{Ob}$ w'

Here $R_{Ob}$ is the relation which holds between w and w' if w' is a world which is "morally sound from the perspective of w", i.e. a world in which all the propositions that are obligatory in w are true: something which ought to be done is something that holds in every world in which everything is done which ought to be done, and analogously for things which it is permitted to do. Again it may look like this couldn't be false for the unexciting reason that nothing of is being said about the operators that could conceivably have made it false. But in fact, in the present case matters are even worse. It was pointed out in the early days that the clauses in 3 have the effect that once an impermissible act has been committed anything goes. A classic example is hit-and-run. If a driver has run down a pedestrian - something which he shouldn't have done - the worlds w' in which he has done this all fail to stand in the relation $R_{Ob}$ to the world in which the accident has occurred. In other words, there are no worlds w' in which (i) the accident has occurred and which (ii) stand in the relation $R_{Ob}$ to w. Thus, according to the clauses in 3 everything is obligatory in w and nothing permitted. Those who have sinned once are sheep irredeemably lost, to which a theory of morals based on these clauses will provide no further guidance. (As a matter of fact, things are even worse. Sin is not only irredeemable but also collective: as soon as one wrong has been committed by one member, the entire flock is lost.)

What is needed instead, it has been argued, is a concept of deontic soundness that is graded and conditional: It is an essential part of our moral intuition that even for a world in which some thing has happened that has deprived it of its moral immaculateness and that cannot be undone, there are some alternatives that are better than others (although of course all of them are less than perfect). And it is not quite so implausible that among these alternative worlds there are some which are at least as sound as any of the others. What is to be done in w after the driver has knocked down the pedestrian is reflected by what is the case in those "soundest possible" worlds; and in these worlds the driver will stay, not run.

This modification is especially important in connection with conditionalised moral precepts, such as 3

(30) If one is involved in an accident in which another party is hurt, one is obliged to abandon the victim.

Such conditionals should be true in a given world w in which no accident has taken place (yet), and their truth has something to do with the difference between those worlds in which the driver involved in the accident runs and those in which he stays. All these worlds are like w in that they contain the accident; and it is the soundest worlds among them which determine what ought to be done, once (regrettably) the accident has occurred: in all those maximally sound worlds that ar liek w in having the accident the driver doesn't abandon the victim. It was argued in connection with these considerations that conditionals like 3 should be analysed as involving a single binary operator of "conditionalised obligation". For the development of modal logic this has been important insofar as it brought the concept of more-than-1-place modal operators into the picture, with a vast increase in semantic options and potential expressive power. For our present concerns, however, operators of more than one place do not appear to be directly relevant.

**Temporal operators.**

One application of modal logic which should be regarded as a subject in its own right is "Tense Logic". Of the original tense logics, which go back to te late fifties and ealry sixties, the one that is still most widely known and used is a system due to Prior (see e.g. [Prior,1968]). It has two primitive operators of the possibility type. The usual symbols for these are: P, for "past", and F for "future". In the modal semantics for this and other, more elaborate tense logics the "possible worlds" are moments of time, and the relations between times in terms of which P and F are defined are the relations of earlier and later between times. More precisely, there is really only one relation in this case – that which holds between t and t' iff t is before t' – which is used in the semantic clauses for both P and F:

(31) P A is true at t iff A is true at some time t' such that t' < t.

(32) F A is true at t iff A is true at some time t' such that t' > t.

Thus PA can be paraphrased roughly as "It was the case that A" and FA as "It will be the case that A".

Tense logic differs from the other applications of modal logic in that here we have a fairly well developed notion of what the "set of possible worlds" and the relevant relations between them are like: Even if we may not quite know what the range of properties is that we should ascribe to temporal order, this is an issue where we feel we have much more solid ground under our feet than in the case of epistemic or deontic alternatives. For this reason tense logic provides a comparatively easy entry to modal logic as a general formalism for the treatment of non-extensional operators: The semantics of temporal logic has an immediate intuitive appeal, and (partiall related this) work on tense logic has yielded a wealth of non-trivial (and in some instances remarkably sophisticated) formal results whose content and importance are nonetheless easily understood. However, the very fact that the semantics of tense logic is so much more accessible to intuition is arguably connected with an aspect of the relation between time and meaning, which makes tense logic unsuitable as part of a formalism for the semantic representation of natural language expressions. As argued at length in other places (see e.g. [Kamp & Reyle,1993]), natural language is rife with expressions like "yesterday morning", "Saturday, June 5-th, at eleven sharp", "the 19-th Century" and so on whose behaviour must be considered to be that of referring to times if there is such a thing as reference at all. Treating those expressions as operators issimply perverse; and because their contributions to the temporal aspects of sentence meanings are so intimately intertwined with the contrivutions made by other devices, and in particular the tenses, treating the tenses as tense operators proves to be artificial too (as well as formally awkward). Thus, contrary to the original intuition, in which the tenses of the verb were seen as the model for the operators of tense logic (hence its name), tense logic has turned out to be of limited value in the context of natural language semantics. – reflected to make the operator notation a viable representation framework for the temporal aspects of natural language semantics.

In fact, in the decades since its invention, tense logic has come to be recognised as useful within disciplines that are situated in a quite different part of the scientific landscape: at first in Verification Theory (the discipline concened with methods for proving the correctness of complex programmes) and then, more recently, in chip desig (there as a formalism which provides the foundation for "model checking", a semi-experimental method for testing the edaquacy of chip circuits).

The shift of modal logic away from applications to natural language semantics and the philosophy of language towards Computer Science is something which we can observe not only in relation to tense logic but to modal logic generally. Perhaps the most active branch of mdal logic today is Dynamic Logic in the sense of Pratt (see [Pratt, 19??]), in which modal operators are used to represent the results of actions: Such logics will have means to denote action types, and for any action denoting expression A, there will be two "modal" operators, [A] and $<A>$, which tell us what must or may happen to a given situation if an action of type A is performed in it. Thus, if B is a formula describing a certain type of situation, then [A] B is true in a given situation or world iff B is true in any situation which results from the given one if an action of type A is performed in that initial situation. Dynamic Logic originated within the context of Computer Science, where the "action types" are given by computer programmes. Thus, Dynamic Logics of this original sort are equipped with operators [A] and $<A>$, where A is any programme from an underlying programming language. But in more recent years, such formalisms have become increasingly popular also in the systematic formal study of action generally (see [Van Benthem, The Logic of Action, 199?]).

This little story about modal logic goes well beyond what is strictly needed within the present context. The original motive for telling it was merely our encounter with the "non-extensional" operator PROG, withb its property that the satisfaction of a condition of the form "PROG($\lambda$e.C(e))" in a world w may depend on the extension of $\lambda$e.C(e) in other worlds besides w. Exactly what the relevant alternatives for such an operator are has been a subject of much debate. See in particular [Landman, 19??]. Note that with our intensional models we have provided a framework for the representation of intensional notions which has an almost unlimited potential. All that may be needed in addition in order to to express modal or intensional notions which aren't expressible as things stand, may be additional relations between worlds.

### 3.1 More on other Intensional Verbs

The special "opacity effect" of *fehlen* arises when we transform the DP-as-discourse-referent-introducer interpretation which (14) assumes for the subject DP into one assuming a DP-as-property interpretation for the subject. We then get for the DRS K which is denied in the first part of he semantic representation of (26) and asserted under the modal operator O in the second part:

| y |
|---|
| N(y)<br>R(x,y) |

where N is the descriptive content of the DP.

Further questions to be addressed in this connection at some later point:

1. Entries for other argument frames of *fehlen*.
2. More on R and O.
3. Entries for *schulden*, *brauchen*.
4. What other verbs belong to this group and what are their lexical entries?

With the verbs of the first group, opacity can be explained in terms of a mental attitude on the part of the verb's subject. Thus for *suchen* opacity arises from the fact that the one who is looking has a "non-identifying" representation of what she is looking for. A proper representation of this and many other lexical and supralexical semantic representations in which mental attitudes play a constitutive part requires a formalism for the representation of content-bearing mental states. We will use for this purpose the proposal outlined in Kamp (2003). As a first taste of this (33) gives that entry we propose for (one argument frame of) *suchen* in which the direct object DP is given a DP-as-property interpretation.

(33)

| | suchen | DP: nom; subj | DP: acc |
|---|---|---|---|
| | e | x | P |
| SR | event | capable of consciousness(x) | — |

SemRep

$$
\begin{array}{|c|}
\hline
\mathrm{s}_{att} \\
\\
\mathrm{e{:}act(x)} \\
\mathrm{s}_{att}\mathrm{{:}Att(x,lb{:}}\ \langle \left\{ \begin{array}{|c|}
\hline
\mathrm{s\ y} \\
\\
\mathrm{P(y)} \\
\mathrm{res(s,e)} \\
\mathrm{s{:}R(i,y)} \\
\hline
\end{array} \right\} \rangle) \\
\mathrm{ATTEMPT(e,x,lb)} \\
\mathrm{beg}(\mathrm{s}_{att}) \prec \mathrm{beg(e)} \\
\mathrm{end}(\mathrm{s}_{att}) \not\prec \mathrm{end(e)} \\
\hline
\end{array}
$$

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