INDEFINITE AND DEFINITE TENSE

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1. PLOT

Static semantics analyses indefinite terms as existential quantifiers (Frege/Russell). Definite terms are analysed as descriptive (Frege/Russell) or anaphoric (Heim). Heim/Kamp have succeeded to analyse indefinite terms as predications of new discourse markers. Heim’s dissertation analyses definite terms as anaphoric predications of old/familiar discourse markers. While the predicational analysis of for indefinites is entirely successful, not every use of the definite article can be reduced to the anaphoric on. It has been tried to eliminate the anaphoric use in favour of the descriptive one. My claim is that this is implausible as an overall strategy. Certain phenomena of definiteness should be analysed by the anaphoric theory of Heim’s dissertation. There are cases where the descriptive alternative is utterly tedious if manageable at all. I illustrate this view by considering the semantics of tenses.

My claim is that tenses have a double nature, they are ambiguous between definite (anaphoric) and indefinite terms (in the sense of new).

2. ANAPHORIC VS. DESCRIPTIVE DEFINITES

2.1. Descriptive definites cannot be reduced to anaphoric ones

Heim’s Dissertation:

Indefinite NPs introduce a new variable/discourse markers. Definite NPs are anaphoric to indefinite NPs.

(1) John₂ has a car₁. He likes the/this car₁.

\[
\begin{align*}
\text{car}(x₁) \land \text{John}(x₂) \land \text{car}(x₁) \land \text{likes}(x₂, x₁) \\
\text{new} \quad \text{new} \quad \text{old} \quad \text{old} \quad \text{old} \\
\text{ind} \quad \text{def} \quad \text{def} \quad \text{def}
\end{align*}
\]

On the text level the variables are existentially quantified.

Donkey sentences, negation and other cases of quantification require syncategorematic rules:

(2) Every farmer that has a donkey₁ likes the/this donkey₁.

Still: In a local context the/this donkey is anaphoric to a donkey.

Problems come with possessives:
(3)  \[\ \text{John}_1 \ \text{has} \ [\text{a car}]_2 , \text{He}_1 \ \text{likes} \ [\text{his} \ \text{car}]_2 ;\]
\[\begin{align*}
\text{John}(x_1) & \ \& \ \text{car}(x_2) \ \& \ [\text{car}(x_2) \ \& \ \text{has}(x_1, \ x_2)] \ \& \ \text{likes}(x_1, \ x_2) \\
\text{Ind} & \ \text{def} & \ \text{def} & \ \text{def} & \ \text{def}
\end{align*}\]

*his car* is anaphoric to a *car*, *his* is anaphoric to *John*. No problem.

*The/this* is the anaphoric definite article.

(4)  \[\ [\text{Every German}]_1 \ \text{likes} \ [\text{his} \ \text{car}]_1;\]
\[\begin{align*}
\text{Every German}_1 \ \text{likes} \ [\text{the car of him}]_1 ? \\
\not\ \forall x_1[\text{German}(x_1) \ \rightarrow \ [\text{car}(?) \ \& \ \text{has}(x_1,?)]]
\end{align*}\]

The sentence is good without antecedent. The car should be anaphoric to an old variable. But there isn’t any. (I am not considering the case that all Germans possess the same car.)

*The* cannot be analysed as the anaphoric article. The is the Frege/Russell description.

(5)  \[\ \forall x_1[\text{German}(x_1) \ \rightarrow \ \text{the unique } y[\text{car}(y) \ \& \ \text{has}(x_1,y)]]\]

(Heim 1983) analyses *Every nation cherishes its king*. She does not use the anaphoric semantics of her dissertation but the Frege/Russell semantics. See the appendix.

**Conclusion:** The descriptive use of the definite article cannot be reduced to the anaphoric use.

2.2. **Anaphoric use reducible to descriptive?**

Can the anaphoric use reduced to the descriptive one?

(6)  \[\ \text{John has a car. He likes the car.} \]
\[\text{John has a car. He likes the car [that he has]} \]

Assuming the Fregian meaning for the definite article, the \textbf{P} denotes the unique \( x \) that is a \( P \). Then \( P \) must be a unit set. But \textbf{car} has a multiple denotation. Therefore we have to find an appropriate restriction for \textbf{car} that makes it unique. So the explicit restriction of a definite article is virtually never complete.

Her is a donkey pronoun:

(7)  \[\ \text{Every German that has a} \ \text{dog}_1 \ \text{likes it}_1;\]
\[\begin{align*}
[\text{Every German that has a dog}]_x \ \text{likes it[the unique dog x has}] \ (\text{E-type})
\end{align*}\]

The E-type strategy replaces even personal pronouns by descriptions; works only for weak readings. Cf. (Heim 1990) for an analysis of donkey-anaphora via E-type and (Chierchia
1995) for the limitations of the E-type strategy.

On the other hand, most cases of anaphoric definites can be interpreted directly without recurring to invisible material. Ranking Simplicity higher than Occam’s Razor, OT gives us:

*Assume the anaphoric reading for the definite article if the analysis becomes simpler.*

3. **DEFINITE AND INDEFINITE TENSE**

3.1. *Covert [±def]-Marking*

Many languages have no overt [±def] – marking in the NP-domain.

With John is car. He likes car.

(9) U kazdogo nemca est’ mashyna. Kazhdyj nemec lubit [svoju mashynu].

\[
\begin{array}{ll}
\text{Ind} & \text{def} \\
\end{array}
\]

with every German is car. every German likes his car.

Russian NPs are ambiguous with respect to [±def]. The construal is the same as in English. Since we find ambiguity in the nominal domain, we may find ambiguity in other domains as well.

3.2. *The [±def]-Ambiguity of Tense*

Slogan since (Partee 1973): Tenses are pronouns.

I prefer to say: tenses are definite or indefinite terms. Most occurrences of tenses are not simply pronominal, but they are relations between two times of which only one is intuitively a pronoun. The other one is the definite or the indefinite article.

(10) John left at eleven. He didn’t turn off the stove.

\[
= \text{John leaves at a time before now},_1 \text{ which is at 11. He doesn’t turn off the stove at that time before now},_1.
\]

The underlined indefinite term is the contribution of the first PAST, the underlined definite term is the contribution of the second PAST.

Idea for the LF:

(11) ₁, PAST now [John leave (t₁) [t₁ at 11]]. Not ₁, PAST now [I turn-off (t₁) [t₁ at 11]]

i stands for indefinite (- definite) and d stands for definite (+ definite).
The simple past is ambiguous between an indefinite and a definite tense, contra (McCoard 1978), who claims that the simple past is only definite. The English present perfect, pluperfect, future and future perfect are always indefinite, though they contain a definite centre. 

Similarly we have to assume a covert descriptive definite article for these languages as well.

(12) John left at 11. He had arrived yesterday.

John leaves at a time before now which is at 11. He arrives at [a time before that time before now which is on yesterday].

The information [a time before now] is introduced by the first PAST. The information [a time before [that time before now]] is introduced by the pluperfect in the second sentence. The pluperfect is an indefinite tense that contains an anaphoric tense, i.e. a definite one. Every perfect is indefinite (“passé indéfini”).

(13) 1₁ PAST now [John leaves (t₁) [t₁ at 11]]. ₁₄ PAST now [ 2₁ PAST t₁, ₂d on yesterday [John arrives(t₂)]]

The underlined information will actually be a presupposition and therefore redundant/erasable (“transparent” as Schlenker would call it).

3.2.1. Excursus

The reduction of the anaphoric use to the descriptive one is even more tedious than before (an no one has tried that).

(14) John left at eleven. He didn’t turn off the stove.

John leaves at a time before now which is at 11. He doesn’t turn off the stove at the unique time before now [which is at 11 (of a particular day)].

(15) John called at 6. Mary had left.

John calls at [a time before now] which is at 6. Mary leaves at [a time before [the unique time before now which is at 6]].

Uniqueness is easily established because the first tense is localized by a positional adverb.

(16) Donald called Daisy. He was feeling ill.

---

¹ The German present perfect may always replace the German simple past and may therefore be definite.
Donald calls Mary at a time before now. He is feeling ill at that time before now.
≠ Donald calls Mary at a time before now. He is feeling ill at the unique time before now [at which he calls Mary].

Too weak. Donald had called Daisy many times. We have to restrict the semantic PAST by some contextually given property C: \( t \text{ PAST } \text{now} \& \ C(t) \).

(17) Donald called Daisy. He was feeling ill.

Donald calls Mary at a time before now which is in P. He is feeling ill at the unique time before now which is in P [and at which he calls Daisy]

If P is appropriately small we can guarantee uniqueness.

Again we can eliminate anaphoric definite tenses in favour of descriptive tenses with context-dependency and covert material. The anaphoric semantics gets the interpretation right without pragmatics.

End of excursus

4. A FRAMEWORK FOR TEMPORAL ANAPHORA

The semantic of tenses involve cross-sentential anaphora and presupposition. There might even be donkey constellations.\(^2\) Dynamic frameworks have been designed for the analysis of such phenomena. We therefore assume a dynamic framework in the style of (Heim 1982).

The main idea is that tenses are two place predicates of times. Tenses can be indefinite; then they introduce a new variable/discourse marker. Or they are definite. Then they pick up an old dm and are in fact purely presuppositional. The system presented in the following can presumably be easily translated into DRT. Cf. the chapter about tense in (Kamp and Reyle 1993). Here I will only be concerned with the simple past and pluperfect. The Engl. present perfect poses special problems. See, e.g. (Pancheva 2004) and my recent talk “7 perfect puzzles.”; cf. my web site.

4.1. Syntax

We have variables (discourse markers) for individuals (type e), for times (type i) and for events (type v),…Each variable is either definite (\textit{def} or \textit{d}) or indefinite (\textit{ind} or \textit{i}).

(18) \textit{Variables/discourse markers:}

\(^2\) \textit{If a farmer has a donkey, he often beats it.} Interpret \textit{often} not only as a quantifier over individuals but over times as well.
will be represented by a bundle \([n, \sigma, F]\), where \(n\) is a number, \(\sigma\) a type symbol, \(F\) is def or ind.

The type indices will mostly be left away. The context will make clear what the type of a variable is. \(Traces\) (created by adjunction) are always definite, i.e. \(t_n\) stands for \([n, \text{def}]\). Similarly, \(\text{he}_n, \text{she}_n\) stand for \([n, \text{def}]\).

(19) \textbf{Predicates} (Ns and Vs)

0-place N, \textbf{Sigurd} type e, \textit{yesterday} type i, \textbf{6 o’clock} type i

1-place N, type (e): \textit{Sigurd, man, woman, jaguar, boar,…},

2-place N, type (e,e): \textit{mother, father, brother,…},

intransitive V, type (e,v): \textit{sleep, arrive}

transitive V (e,e,v): \textit{eat, see, know, carry,…},

temporal P (i,i): \textit{ON, AT}

(20) \textbf{Deictic Tenses}

0-place, type i: \textit{PRES*}

1-place, type (i): \textit{PAST*}

(21) \textbf{Relative Tenses}

2-place, type (i,i): \textit{PAST}

\textit{FUT}

(22) \textbf{Aspects} type (i, v)

\textit{PF, IPF,…}

In addition the language has operators, which are introduced in turn.

The \textit{syntax rules} for the LF fragment are these:

(23) 1. \textit{Atomic formulas}

If \(R\) is an \(n\)-place predicate and \(x_1, \ldots, x_n\) are variables, then \(R(x_1, \ldots, x_n)\) is a sentence.

2. Every atomic formula is a sentence.

3. \textit{Molecular formulas}

If \(S_1\) and \(S_2\) are sentences, \([S_1 S_2]\) is a sentence (or text).

4. If \(OP\) is an operator and \(S\) is a sentence, \([OP S]\) is a sentence.

The syntax generates an enormous amount of un-interpretable sentences, but the rules of construal for LF generate interpretable structure and therefore act as a filter.

1. Assign every (non-pronominal, non-quantified) NP a variable a reference index.
   a. Definite DPs get a definite variable (discourse marker)
   b. Indefinite NPs get an indefinite variable.
      \[(Indexing)\]
   c. Unmarked XPs either get a def or an ind variable.

2. Quantified DPs have the form \([\text{quant}(i) \text{ NP}]\) where \(i\) is a number without feature.
   They get no additional reference index.

3. Adjoin every non-pronominal DP to S leaving behind a co-indexed trace.
   Quantified DPs are adjoined to their own S.
      \[(LF\text{-movement})\]

4. Adjuncts are co-indexed with their heads. The index of the adjunct is definite.
   \[(Adjunct rule)\]

5. Negation, adverbs of quantification are treated by syncategorematic rules.

Syntactic derivation 1:

(25) John left at eleven

\[
\text{DS: } [_{vP} \text{John leave (}[_{\text{AspP}} \text{PF([}_\text{T} \text{PAST}*_{1i} [at eleven]_{1d})])_{2i}])] \text{ Indexing, Adjunct Rule}
\]
\[
\Rightarrow \text{LF\text{-movement}}
\]
\[
[_{\text{AspP}} \text{PF([}_\text{T} \text{PAST}*_{1i} [at eleven]_{1d})])_{2i} [_{vP} \text{John}_{3i} \text{ leave (}t_{22})]]
\]
\[
\Rightarrow \text{LF\text{-movement}}
\]
\[
[_{\text{AspP}} \text{PF([}_\text{T} \text{PAST}*_{1i} [at eleven]_{1d})])_{2i} [_{vP} \text{John}_{3i} [_{vP} \text{t}_{3i} \text{ leave (}t_{2i})]]
\]
\[
\approx [_{TP} \text{PAST}*_{1i} [at eleven]_{1d}] [_{\text{AspP}} [_{\text{AspP}} \text{PF(}t_{1i})]_{2i} [_{vP} \text{John}_{3i} [_{vP} \text{t}_{3i} \text{ leave (}t_{2i})]]
\]
\[
\approx t_1 < n \& t_1 = 11h \& \tau(e_2) \subset t_1 \& x_3 = \text{John} \& \text{leave}(x_3,e_2)
\]

\(\approx\) gives the corresponding formula in predicate logic. On the text level, the free variables will be existentially closed via the truth definition, exactly as in DRT. Indefinite terms are what the Amsterdam school calls dynamic existential quantifiers. Note that the LF exhibits the standard Tense/Aspect-architecture.

Syntactic derivation 2:

(26) Mary had left.
DS: Mary leave(PF(have(PAST*_{1d})_{t_5}))
⇒ LF-movement
PF(have(PAST*_{1d})_{t_5}) [Mary leave(t_5)]
⇒ LF-movement
have(PAST*_{1d})_{t_5} [PF(t_6)_{t_5} [Mary leave(t_5)]]
⇒ LF-movement
PAST*_{1d} [have(t_1)_{t_5} [PF(t_6)_{t_5} [Mary leave(t_5)]]]
⇒ LF-movement
LF: PAST*_{1d} [have(t_1)_{t_5} [PF(t_6)_{t_5} [Mary leave(t_5)]]] = PAST*_{1d} [PAST(t_1)_{t_5} [PF(t_6)_{t_5} [Mary leave(t_5)]]]q

(have is translated as (relative) PAST)

≈ t_1 < n & t_6 < t_1 & τ(e_5) ⊂ t_6 & x_4 = Mary & leave(x_4,e_5)

This LF is anaphoric to the former one.

4.2. Semantics

The interpretation is based on a model

M = <A, <T, <, ≤, ⊂, ⊆, o, ∩,...>, <E, τ>, <D, l>, ..., n, F>

with A a set of individuals, T a set of time intervals with the usual relations, E a set of events with the projection function τ that assigns each event its running time, D a set of temporal degress with l a function that assigns each time its length, n a distinguished time, the now. Possibly we need more structure.

F interprets the predicates by assigning them appropriate extensions. We assume the following semantic domains:

(27) Semantic domains

a. n-place nouns: ϕ(D^n) time dependence ignored
b. n-place verbs: ϕ(D^n × E)
c. n-place tenses/aspects: ϕ(T^n) n = 1,2

The following constants get the same denotation in every model:

(28) Deictic tenses

F(PRES*) = n
F(PAST*) = \{t | t < n\}
F(has) = \{t | n is the endpoint of t\}

(has is used for the English/Skandinavian present perfect; see my Bochum talk.)
Relational tenses

\[ F(\text{PAST}) = \{<t, t'> | t < t'\} = F(\text{have}) \]
\[ F(\text{FUT}) = \{<t, t'> | t > t'\} = F(\text{will}) \]

(30) \[ F(\text{ON}) = \subseteq \]
\[ F(\text{AT}) = = \]
\[ F(\text{today}) = \text{the day that contains } n \]

Heim’s semantics is dynamic, i.e. sentences have a context change potential (CCP). In the dissertation, contexts are thought as files, each consisting of a set of file cards. Files are satisfied by assignments. Today it is standard to identify contexts \( c \) directly with sets of assignments, cf. e.g. (Heim 1983). An assignment will be a function from the variables used in a text to individuals. If \( f \) is an assignment, \( \text{dom}(f) \) is the domain of \( f \), i.e. the variables for which \( f \) is defined. A context \( c \) is a set of assignments with the same domain, i.e. \( \text{dom}(c) \) is identical with \( \text{dom}(f) \) for any \( f \in c \). For the definition of CCPs we need the notion of expansion (increment, enlargement) of an assignment:

(31) Let \( f \) and \( g \) be assignments and let \( i \) be a variable. \( g \) is an \( i \)-expansion of \( f \), \( f[i]g \), if there is an \( a \in E \) with \( g = f \cup \{<i,a>\} \). In analogy we define \( f[i_1,\ldots,i_n]g \).

If \( i \in \text{dom}(f) \), the expansion is not proper. The default case is that an expansion is proper, i.e. \( i \notin \text{dom}(f) \).

The CCPs of the language are defined along the syntactic rules. Since the CCP is a function that changes any context into a new context, we define for each sentence \( p \) a (partial) function \( \llbracket p \rrbracket \) from contexts to contexts. We follow Heim’s notation and write \( c + p \) for \( \llbracket p \rrbracket (c) \).

The most important principle of Heim’s theory governing the interpretation of variables is the

(32) \textit{Old/New-condition}

If NP\( _i \) is indefinite, then \( c + \text{NP} \) is only defined if \( i \notin \text{dom}(c) \). If NP\( _i \) is definite, \( c + \text{NP} \) is only defined, if \( i \in \text{dom}(c) \).

Now we give the recursive definition of the CCPs.

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\[ \text{Let } f \text{ and } g \text{ be assignments and let } i \text{ be a variable. } g \text{ is an } i\text{-expansion of } f, f[i]g, \text{ if there is an } a \in E \text{ with } g = f \cup \{<i,a>\}. \text{ In analogy we define } f[i_1,\ldots,i_n]g. \]

\[ \text{If } i \in \text{dom}(f), \text{ the expansion is not proper. The default case is that an expansion is proper, i.e. } i \notin \text{dom}(f). \]

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\[ \text{Now we give the recursive definition of the CCPs.} \]
(33)  

**Context change potential of atomic formulas**  

(A)  

Atomic formulas  

Let c be a context.

a. Let p be an n-place VP or indefinite NP containing the variables i_1,...,i_n.

\[ c + p = \{ g | (\exists f \in c) f[i_1,...,i_n]g \& <g(i_1),...,g(i_n)> \in F(p) \} \]

b. Let p be a definite NP (or XP in general). Then c + p is only defined if c entails p.  

4 The variables in a VP are always definite because they are traces or pronouns. Therefore the expansion will always be vacuous, i.e. c + p will be a subset of c in this case.

c entails p if c + p = c. This is the case if every f in c satisfies p, but for our purposes it is sufficient. It follows that definite XPs are purely presuppositional:

(34)  

An expression p presupposes an expression q iff q follows from every admissible context for p.

In the limiting case, an expression presupposes itself, i.e., it must have been said already.

(35)  

**Context change potentials of molecular formulas**  

(M)  

Let c be a context and let T be a molecular formula of shape [ p q ]. Then c + T is only defined if c + p and (c + p) + q are defined. If defined, c + T = (c + p) + q.

This is the semantics for dynamic and.

(36)  

**Truth**  

A context c is true if it is not empty. c is false if it is empty. A sentence or text p is true with respect to the context c if c+p is true. p is false with respect to c if c+p is false. p has no truth value with respect to c if c + p is undefined.

(37)  

**Positionals Adverbs**  

c + i ON yesterday = \{ f \in c | f(i) \subseteq yesterday \}

c + i at 6 = \{ f \in c | f(i) = 6 \}

4 Heim’s dissertation doesn’t have this rule. But it is said at several places that we need it.

5 The definition doesn’t cover all cases of entailment. For a more general definition of entailment, see Beaver, D. I. (2001). Presupposition and Assertion in Dynamic Semantics, Stanford, California, CSLI Publications and FoLLI.
(38) Aspects
\[ c + [\text{PF}(i)] = \{ f | (\exists g \in c) g[e]f \land \tau(f(e)) \subseteq f(i) \} \]
\[ c + [\text{IPF}(i)] = \{ f | (\exists g \in c) g[e]f \land \tau(f(e)) \supseteq f(i) \} \]

4.3. Analysis of examples

(39) John left at 11 A.M.

LF: \[ [[\text{TP PAST}^*_{11} [\text{PP t}_1 \text{ at } 11h]] [\text{VP PF}(t_1)_{2i} [\text{vP John leave (t}_2)]]] \]
\[ c + \text{LF} = \{ f | (\exists g \in c) g[1,2]f \land f(1) < n \land f(1) = 11h \land \tau(f(2)) \subseteq f(1) \land \text{John leaves(f(2)))} \] = \[ c_4 \]

Proof:
\[ c + \text{PAST}^*_{11} = \{ f | (\exists g \in c) g[1]f \land f(1) < n \} = c_1 \]
\[ c_1 + t_1 \text{ at } 11h \text{ t}_1 = \{ f \in c_1 | f(1) = 11h \} = \{ f | (\exists g \in c) g[1]f \land f(1) < n \land f(1) = 11h \} = c_2 \]
\[ c_2 + \text{PF}(t_1)_{2i} = \{ f | (\exists g \in c_2) g[2]f \land \tau(f(2)) \subseteq f(1) \} \]
\[ = \{ f | (\exists g \in c) g[1]f \land f(1) < n \land f(1) = 11h \land \tau(f(2)) \subseteq f(1) \} \]
\[ = \{ f | (\exists g \in c) g[1,2]f \land f(1) < n \land f(1) = 11h \land \tau(f(2)) \subseteq f(1) \} = c_3 \]
\[ c_3 + \text{John leave (t}_2) = c_4 \]

(40) \[ c_4 + \text{He had arrived yesterday} \]
\[ c_5 + \text{PAST}^*_{1} [\text{PAST}(t)_4,\text{ind} [\text{t}_4 \text{ ON yesterday}]] [\text{PF}(t_4)_{5,\text{ind} [\text{John arrive(t}_5)]]] \]
\[ = \{ f | (\exists g \in c) g[1,2,4,5]f \land f(1) < n \land f(1) = 11h \land \tau(f(2)) \subseteq f(1) \land \text{John leaves(f(2))} \land f(4) < f(1) \land f(4) \text{ on yest} \land \tau(f(5)) \subseteq f(4) \land \text{John arrive(f(5))} \} \]
\[ (\exists t_1) (\exists e_2) (\exists t_4) (\exists e_5)[t_1 < n \land t_1 = 11h \land \tau(e_2) \subseteq t_1 \land \text{leaves(John,e_2)} \land t_4 < t_1 \land t_4 \subseteq \text{yesterd} \land \tau(e_5) \subseteq t_4 \land \text{arrive(John,e_5)}] \]

4.4. Pragmatics: Temporal Progression

(41) John left at 11. He was ill.

= He was ill at 11.

(42) a. John left at 11. He didn’t turn of the stove.
John didn’t turn off the stove at 11
b. John left at 11. He turned off the stove.
    ≠ John turned off the stove at 11
    = John turned off the stove after 11.

(Kamp and Rohrer 1983): Perfectives push the reference time forward, imperfectives don’t. The reason is obvious: It is difficult to perform two achievements/accomplishments at the same time, but there is no problem having many properties (states) at the same time. In principle, the reference time could be backwards shifted, but this we express by the pluperfect.

The forward shift is formalized by inserting a covert relative future.

The minimal pair in (42) is explained by the fact that the negation not is a stativizer. Wait a moment to see that.

(43)  John left at 11. He turned off the stove.

\[
\begin{align*}
    c + [[TP \ PAST^{*}_{1i} [PP t_1 at 11h]] & [ASP PF(t_1)_{2i} [vP John leave (t_2)]] \\
    [[TP \ PAST^{*}_{1d} [ASP PF(t_1)_{3i} [vP John \ turn\_off (t_3)]]] \\
    (\exists t_1, e_1, e_3) \ t_1 < n & \ t_1 = 11 & \tau(e_2) \subseteq t_1 & \text{leave}(j, e_2) & \tau(e_3) \subseteq t_1 & \text{turn}(j, e_3)
\end{align*}
\]

The leaving and the turning off have to be at the same time, a pragmatic impossibility!

Repair strategy: Covert future:

(44)  c + [[TP \ PAST^{*}_{1i} [PP t_1 at 11h]] [ASP PF(t_1)_{2i} [vP John leave (t_2)]]

\[
\begin{align*}
    [[TP \ PAST^{*}_{1d} FUT(t_1)_{3i} [ASP PF(t_3)_{4i} [vP John \ turn\_off (t_4)]]] \\
\end{align*}
\]

Pragmatics!

‘John left at 11 and he turned off the stove after 11’

Now consider negation:

(45)  Negation (Heim/Kamp)

\[
    c + \text{not } p = \{f \in c | \neg(\exists g \supset f) \ g \in c + p\}
\]

Why is this a stativizer? Because it changes a temporal property that doesn’t have the subinterval property into a property that has it.

(46)  John left at 11. He didn’t turn off the stove.
There is not conflict this time.

5. **DO WE NEED A DYNAMIC FRAMEWORK FOR TEMPORAL ANAPHORA?**

A static framework would have to represent the arguments of tenses by free variables that are existentially bound on the text level. We still would need the [+def]-distinction to make sure that indefinite variables are new, definite ones are old. We would have to make sure syntactically that indefinite variables in the scope of a negation or other operator are not used later in the text. Furthermore, we would need a fourth kind of free variables that represent deictic words. These are not bound at the text level. These restrictions on co-indexing will be very difficult to formulate. Therefore OT-theory says that the dynamic framework is the better framework for the analysis of temporality.

6. **OPEN ENDS**

I haven’t treated intensional contexts and attitudes. (Grønn and von Stechow 2010), among others, have argued that the centre of the highest tense in a complement is neither anaphoric nor deictic, it is abstracted away: $\emptyset$-tense. To express this, the framework must be enriched. See appendix 2. Another point is event anaphora: There is nothing in the architecture that prevents the event variable of an aspect operator to be anaphoric to the variable introduced by a previous aspect operator. (Grønn 2003) has used that to explain certain uses of the Russian imperfective. In haven’t compared this proposal with other dynamic accounts in the literature, e.g. (Bary 2009). The comparison might highlight one interesting difference: starting with (Groenendijk and Stokhof 1991), many accounts of dynamic semantics analyse the CCP of a sentence simply as a relation between two (total assignments); cf. e.g. (Muskens 1996). This makes it impossible to give a semantic definition of what is an old/new variable. Heim’s approach reconstructs the CCP of a sentence as a relation between sets of assignments. This makes a semantic definition of old/new possible. My guess is that this difference in fundamental concepts creates indexing problems for these other approaches, problems that have worried (Haug 2010).

7. **CONCLUSION**

The semantics of tenses crucially relies on Heim’s semantics for the [+ definite]-distinction. There are two meanings for definiteness: the anaphoric one and the descriptive one.
Simplicity tells us which is used.

8. **APPENDIX 1: DESCRIPTIVE NPs (POSSESIVES)**

(47) Universal quantification (Kamp/Heim)

Any DP of form [**every** NP] has an indefinite referential index.

Adjoin **every** to its sentence and leave no trace.

\[ c + \text{every} \left[ [\text{DP-} \ p]_{a,1} \right] q = \{ f \in c \mid (\forall g \supset f) \ g \in (c + p) \rightarrow (\exists h \supset g) \ h \in (c + p_l) + q \} \]

(48) **Descriptions** (Frege/Russell)

\( \text{the}(i) \) is an operator

\( c + \text{the}(i) \ [p \ q] \) is only defined iff

a) \( i \notin \text{dom}(c) \quad \) (i is new)

b) \( (\forall f \in c) (\exists g) \ f[i]g & g \in c+p \) \quad (existence)

c) \( (\forall f \in c) \#\{ g \mid f[i]g & g \in c+p \} \leq 1 \) \quad (uniqueness)

If defined, \( c + \text{the}(i) \ [p \ q] = \)

\( \{ f \in c \mid \{ x \mid \exists g \supset f: g(i) = x & g \in (c + p) \} \subseteq \{ x \mid \exists g \supset f: g(i) = x & g \in (c + p) + q \} \} \)

(49) [Every German]_1 likes [his\_3 car]. \quad \text{Tense ignored}

DS: every German\_1 likes [NP he\_1 HAS the(2) car]

\( \Rightarrow \) LF-movement

every German\_1 [t\_1 likes [NP he\_1 HAS the(2) car]]

\( \Rightarrow \) Q-movement

every [German\_1 [t\_1 likes [NP he\_1 HAS the(2) car]]]

=> Vergaud-movement

every [German\_1 [t\_1 likes [NP the(2) car [NP he\_1 HAS t\_2]]]]

\( \Rightarrow \) LF-movement

LF: every [German\_1 [NP the(2) car [NP he\_1 HAS t\_2] [t\_1 likes t\_2]]

(\( \forall x\_1 \)[German(x\_1) \rightarrow likes(x\_1, \text{the unique } x\_2, \text{car}(x\_2) & \text{has}(x\_1, x\_2))]}

The binding index of a quantifier counts as the index of the DP, when LF-movement applies. Vergaud-movement is another method to generate restrictions. The DP is an argument of the attribute. Then it is adjoined to the attribute leaving a trace. The category of the moved DP is projected. For a more comprehensive analysis of bound pronouns in possessives, see (Sæbø 2009).

9. **APPENDIX 2: ZERO TENSE**

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Under attitudes, the referential time is abstracted away. This is called $\emptyset$-tense; see (von Stechow 1995), (Kratzer 1998) among others. Attitudes require a modal framework. In this extensional treatment is cannot treat them appropriately, but I can show how $\emptyset$-tense is treated. It is enough to say that believe makes accessible different times at different evaluation times.

Scenario: On Monday morning at had an appointment with Dag for 10 A.M. I overslept and woke up at 9:30. When I reached the breakfast lounge (frokostsal), it was closed. So I looked at my watch an realized that it was 10:10 A.M. Ten minutes before I had believed that it was 8 A.M.

In this scenario the following sentence is true:

(50) At 10 AM Arnim believes it is 8 AM

I will first show that an analysis that interprets the present in the complement clause doesn’t work.

Analysis of the matrix-version of the it-sentence

( 51) It is 8 AM.

\[ \text{PRES}_{1}^{*} t_1 \ at \ 8 \]

\[ \lambda \mathcal{C} \{ f \mid (\exists g \in \mathcal{C}) \ g[1]f \ & \ f(t_1) = n \ & \ f(t_1) = 8 \} \]

Consider 3 models

M1 = (\(<8,9,10>\), 8)
M2 = (\(<8,9,10>\), 9)
M3 = (\(<8,9,10>\), 10)

The times are ordered, the time apart is the speech time, the now.

\[ \mathcal{C}_0 = \{ \emptyset \} \]
\[ \mathcal{C}_0 +_{M1} \lambda \mathcal{C} \{ f \mid (2g \in \mathcal{C}) \ g[1]f \ & \ f(t_1) = n \ & \ f(t_1) = 8 \} = \{ <1 \rightarrow 8> \} \quad \text{true!} \]
\[ \mathcal{C}_0 +_{M2} \lambda \mathcal{C} \{ f \mid (2g \in \mathcal{C}) \ g[1]f \ & \ f(t_1) = n \ & \ f(t_1) = 8 \} = \emptyset \quad \text{false!} \]
\[ \mathcal{C}_0 +_{M3} \lambda \mathcal{C} \{ f \mid (2g \in \mathcal{C}) \ g[1]f \ & \ f(t_1) = n \ & \ f(t_1) = 8 \} = \emptyset \]

LF for (50):

(52) \text{PRES}_{11}^{*} t_1 = 10 \ Arnim \ believes(t_1) \ [\text{PRES}_{21}^{*} t_2 = 8] \]

Ignoring the meaning of Arnim believe(t_1), the matrix tense changes the $c_0$ to [ $<1 \rightarrow 10>$] = $c_1$. The dynamic meaning of Arnim believes(t_1) could be:

(53) \ $c_1 + \text{Arnim believes}(t_1) \ p = \{ f \in c_1 \mid \text{Dox}_{\text{Arnim}}(f,t_1) + p = \text{same}\}$
Cf. (Heim 1992). What is Dox_{Arnim}(f,t_1)? It is a subset of c_2. It cannot the empty subset because the belief of Arnim at 10 is consistent. Therefore Dox_{Arnim}(1 \rightarrow 10, t_1) = \{ <1 \rightarrow 10> \}.

The CCP of the embedded sentence is \( \lambda c \{ f \mid (2g \in c1) g[2]f \& f(t_2) = n \& f(t_1) = 8 \} \)

Therefore:

\[ \{ <1 \rightarrow 10> \} + \text{PRES}^*_{i1} t_1 \text{ at} \]

\[ = \lambda c \{ f \mid (2g \in c1) g[2]f \& f(t_2) = n \& f(t_1) = 8 \}(<1 \rightarrow 10>) = \emptyset! \]

So the sentence (50) should be false \( c_i \). Then reason is that that the content of Arnim’s belief amounts to a contradiction, viz. that 10 AM = 8 AM. Intuitively, the belief is rational (and we happen to have it at many times).

Therefore the embedded clause cannot have the same meaning/CCP as its unembedded version. It has to express a property, a set of times, those times at which the subject might be according do his belief. This point has been made in (Lewis 1979) and (von Stechow 1982).

We enrich M3 with accessible times for Arnim, i.e. doxastic temporal alternatives. M4:

\(<8,9,10> , 10 >

\begin{align*}
\text{Arnim believes}(8) &= \{9,10\} \\
\text{Arnim believes}(9) &= \{9\} \\
\text{Arnim believes}(10) &= \{8\}
\end{align*}

(We should ad a function F that interprets the predicates; this is meant by the bold face expressions.)

I.e., at 8 Arnim believes it is 9 or 10

At 9 Arnim believes it is 9

At 10 Arnim believes it is 8

In order to have access to this information, we have to treat \textbf{Arnim believes} as an operator, i.e. a verbal quantifier. The verbal quantifier \textbf{arnim believes(j)}_{(k)} has a temporal argument j and a binding index (k), where k is a new temporal variable. The LF for (50) is derived as follows:

( 54) \quad \text{DS} \quad (\text{Arnim believes(PRES}^*_{i1} t_1 \text{ at 10}))_{(2)} \text{ is 8}
\(\Rightarrow\) LF-movement

\(\text{Arnim believes}(\text{PRES}^*_{t_1} \text{ at } 10)_{(2)} t_2 \text{ is } 8\)

\(\Rightarrow\) LF-movement

LF \hspace{1em} \text{PRES}^*_{t_1} t_1 \text{ at } 10 \hspace{0.5em} \text{Arnim believes}(t_1)_{(2)} t_2 \text{ is } 8

In other words, when the verbal quantifier is moved out of its argument position, it leaves a trace co-indexed with its binding index.

(55) \hspace{1em} \text{Arnim believe as verbal quantifier}

\[c + \text{Arnim believes}(j)_{(k)} p\] is only defined if \(k\) is new w.r.t. \(c\). If defined,

\[c + \text{Arnim believes}(j)_{(k)} p = \{f \in c \mid \text{Dox}_a(j, f)_{(k)} + p = \text{same}\}\]

with \(\text{Dox}_a(j, f)_{(k)} = \{g \mid f[k]g \& g(k) \in \text{Arnim believes}(f(j))\}\)

For our model we have:

\(\text{Dox}_a(1, f)_{(2)} = \{g \mid f[2]g \& g(2) = 8\}\)

\(C_0 = \{\emptyset\} + \text{PRES}^*_{t_1} = \{<1 \rightarrow 10h>\} = c_1\)

\(C_1 + t_1 \text{ at } 10 = \text{same} = c_2\)

\(C_2 + \text{Arnim believes}(t_1)_{(2)} t_2 \text{ is } 8\)

\(= \{f \in c_2 \mid \text{Dox}_a(f, t_1)_{(2)} + t_2 \text{ is } 8h = \text{SAME}\}\)

\(\text{Dox}_a(1 \rightarrow 10h, t_1)_{(2)} = \{g \mid <1 \rightarrow 10h>[2]g \& g(2) \in \text{Arnim believe}(<1 \rightarrow 10h)(1))\}\n
\(= \{<1 \rightarrow 10h, 2 \rightarrow 8h>\}\)

\([t_2 \text{ is } 8h]] = \lambda c\{f \in c \mid f(t_2) = 8h\}\)

\(\text{Dox}_a(1 \rightarrow 10h, t_1)_{(2)} + t_2 \text{ is } 8h\)

\(= \lambda c\{f \in c \mid f(t_2) = 8h\}(\{<1 \rightarrow 10h, 2 \rightarrow 8h>\}) = \text{same!}\)

Consider now the following sentence in the same model:

(56) \hspace{1em} \text{At } 8, \hspace{0.5em} \text{Arnim believed it was } 8 \text{ or } 9

\(\text{PAST}^*_{t_1} t_1 \text{ at } 8 \hspace{0.5em} \text{Arnim believes}(t_1)_{(2)} [t_2 \text{ is } 8 \text{ or } t_2 \text{ is } 9]\)

\(C_0 + \text{PAST}^*_{t_1} = \{<1 \rightarrow 9>, <1 \rightarrow 8>\} = c_1\)

\(C_1 + t_1 \text{ at } 8 = \{<1 \rightarrow 8>\} = c_2\)

\(C_2 + \text{Arnim believe}(t_1)_{(2)} [t_2 \text{ is } 8 \text{ or } t_2 \text{ is } 9]\)

\(= \{f \in c_2 \mid \text{Dox}_a(f, t_1)_{(2)} + t_2 \text{ is } 8h \text{ or } t_2 \text{ is } 9h = \text{same}\}\)

\(\text{Dox}_a(<1 \rightarrow 8>, t_1)_{(2)} = \{<1 \rightarrow 8h, 2 \rightarrow 8h>, <1 \rightarrow 8h, 2 \rightarrow 9h>\}\)

\([t_2 \text{ is } 8 \text{ or } t_2 \text{ is } 9]] = \lambda c\{f \in c \mid f(2) = 8h \text{ or } f(2) = 9h\}\)

So \(\text{Dox}_a(<1 \rightarrow 8>, t_1)_{(2)} + t_2 \text{ is } 8 \text{ or } t_2 \text{ is } 9 = \text{same}\)

So we have a semantics for temporal de se.
Why does the approach work? A careful inspection shows the difference between the two accounts. The first attempt had a deictic tense in the complement of Arnim believe. This creates a contradiction. The matrix sentence tells us that PRES denotes 10h and the embedded clause wants it to have that the same PRES denotes 8h.

The de se approach doesn’t have any deictic tense in the embedded clause. Instead of PRES or PAST we simply find the temporal variable \( t_2 \) which is bound by the operator Arnim believes\((t_1)\). At first sight one is puzzled that the approach can correctly express what is going on here. It looks as if the embedded clause where a proposition whereas it should be a temporal property. But in our approach to dynamic semantics, sentences are open propositions. And each open proposition expresses a relation. We have to make sure that the temporal variable quantified over by the verbal quantifier is a new one. If the embedded tense were anaphoric we could not bind it by the verbal quantifier. Note that the verbal quantifier is purely eliminative, i.e. it reduces the assignments in the context. Therefore the variable is only locally new (internally dynamic). It cannot be taken up by a later sentence. So no problem of the kind discussed by Dag Haug can arise.

10. **APPENDIX 3: EVENT ANAPHORA**

(Grønn 2003) defends the view that the Russian Imperfective is ambiguous. Its core meaning is that the event time includes the reference time, but it can also mean the same as the Perfective, viz that the event time is included in the reference time. The same happens when an Imperfective speaks about a previous event.

(57) Factual use of Imperfective

Ja chital\(^i\) vojnu i mir.
I read-\(ip\) war and piece.
I have read “War and Peace”.

(58) Anaphoric use of Imperfective (Tchechov)

V ètoj porternoj ja napisal\(^i\) pervoe ljubovnoe pis’mo Vere. Piscal\(^i\) krandashom.
In this tavern I wrote\(^i\) the first letter of love to Vera. I wrote\(^i\) with pencil.
In this tavern I wrote my first letter of love to Vera. I wrote it with a pencil.

(57) has an Extended Now analysis, i.e., what is called Experiential Perfect. Here the reference time is a large time span, which cannot be in the event time. So the inclusion relation is inversed.

We obtain the event anaphora reading in (58) if we assume that both the past and the
imperfective in the second sentence are definite:

\[(59) \quad \text{PAST}_{1i} \text{PF}_{2d} \ldots \text{napisal(t}_2\ldots \text{PAST}_{1d} \text{IP}_{2d} \ldots \text{pisal(t}_2\ldots\text{)}\]

\[\left(\exists t_1 < n\right)\left(\exists e_2\right) e_2 \subseteq t_1 \land \ldots \text{wrote(e}_2\ldots \text{)} \land t_1 \subseteq n \land e_2 \subseteq t_1 \land (e_2) \]

\[\uparrow\]

anaph. Imperfective

The anaphoric IP has a perfective meaning, here. In Grønn’s account, the information pisal (write) in the second sentence is actually presupposed, too. I am not treating this here.

Literature


