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CHAPTER 5: TENSE AND ASPECT

5.1 The Semantics and Logic of Temporal Reference

(5.3) Peter owns a car. He bought it from Fred.
(5.4)

x y z u v
Peter(x)
car(y)
x owns y
z=x
u=y
Fred(v)
z bought u from v

PROBLEMS: The representation above fails...

- to account for how satisfaction of the predicate *z bought u from y* is determined by the extension of the verb *buy from*.
- to make explicit that *owns* and *bought* pertain to different times.

Some questions that are raised:

→ How do we model the temporal structure of the world?
→ How can we capture the temporal information contained in a tensed discourse?

☞ We must ask ourselves: What should a DRS look like?

→ it should contain info about the extensions of predicates at more than one time
→ but this is quite complicated; K&R do not claim an unequivocal solution

GOALS OF THIS CHAPTER:

- to reflect on how such information can be made explicit
- to define the DRSs which contain this information
- to develop a construction algorithm that produces those DRSs.

5.1.1 Tense Logics

GOAL: survey of some earlier proposals for the treatment of temporal reference and tense

- The most familiar time structure: 〈 T,< 〉 , where T is the set of temporal instants {t1, t2, …} and < is an earlier-later relation between them (a total ordering of T). The zero duration indivisible instants make up intervals of some duration.

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- This is a *Priorean tense logic* (Arthur Prior 1967)
  - a function which assigns to each *t* a corresponding model M_t
  - predicate logic + tense operators (P, F) (1-place sentence connectives)
    Roughly: **P** = "It was the case that ϕ" **F** = "It will be the case that ϕ"

    Formally:
    Pϕ is true in M at t iff [∃ t': t' < t]ϕ is true in M at t'
    Fϕ is true in M at t iff [∃ t': t < t']ϕ is true at M at t'

  - in TPL, (5.3) could be represented as

    $$\exists x \exists y (x = Peter \wedge car(y) \wedge own(x,y) \wedge \exists z (z = Fred \wedge \mathbf{P}\, buy(x,y,z)))$$

  - validity of formulas depends on logical properties of the structure of time (must be a dense linear ordering - for every t1<t2 there is a t3 in between) Pϕ⟶PPϕ
  - conceptually important:
    "*once the temporal dimension of natural language is taken into account, questions of "logical validity" can no longer be clearly separated from certain metaphysical questions which concern the nature of time*" (490).

5.1.2 Inadequacies of TPL and Similar Systems

TPL cannot express a sentence like (5.13):

(5.13) Bill **has been watching** little Alice ever since Mary left.

- We need a more powerful system: tense logic with binary operators **S**, **U** (can further define P & F)

  Roughly: **S**(ϕ, ψ) = "It has been the case that ϕ since it was the case that ψ"
  U(ϕ, ψ) = "It will be the case that ϕ until it will be the case that ψ"

  Formally:

S(A,B) is true in M at t iff [∃ t' : t' < t ∧ A is true in M at t][At'': t' < t'' < t]B is true in M at t''

U(A, B) is true in M at t iff [∃ t' : t < t' ∧ A is true in M at t][At'': t < t'' < t']B is true in M at t''

- So how do we do here?
  → This can express a much larger range of the temporal properties in natural language.
  → But in terms of expressing actual *natural* representations of language, the advantages aren't great.

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"When it comes to providing natural representations of tensed sentences from languages such as English, however, the system with **S** and **U** is no more satisfactory than the one with **P** and **F**. In fact, its ability to provide truth conditionally correct representations for a much wider variety of temporal relations that are expressible in English has, from a linguistic point of view, been none to the good. It has encouraged the tendency to ignore how devious these representations are and so has stood in the way of our seeing more clearly what the particular mechanisms are which natural languages exploit in order to convey the quite complex temporal information that it is within their power to express."

(492-3)

Sidebar: We could imagine other enrichments to get the same expressive capacity. We could add "nominals" i.e. sentences that are true at only one time and give them names like t,t',t'' and ↓t and @t operators. (Blackburn 2000)

t' is true in M at t with assignment h iff t = h(t')

↓t'ϕ is true in M at t with assignment h iff ϕ is true in M at t with g[t']h & g(t') = t

@t'ϕ is true in M at t with assignment h iff ϕ is true in M at t' with h

We can define H, G, and with them S, and U in terms of F, P:

Hϕ := ~P~ϕ

Gϕ := ~F~ϕ

S(ϕ, ψ) := ↓t P(ϕ ^ G(Ft -> ψ)

U(ϕ, ψ) := ↓t F(ϕ ^ H(Pt -> ψ)

n.b. we could go this route with all quantification if we wanted to:

Bill kicked Henrik ⇝ @b<kick>h
Bill only kicked Henrik ⇝ @b[kick]h

RECAP: Drawbacks of TPL and S,U Logic:

1. No unrestricted iterability and nesting of tense operators in natural language.

***It was the case that it was the case that Sue was sick.**

Henrik said Sue was sick.
Sue's being sick could be prior to or while Henrik said that she was sick

|----------Sick(s)----------| Say(h, Sick(s)) Speech-Time

or

|----------Sick(s)----------| Speech-Time
Say(h, Sick(s))

→ This option suggests that embedded tenses to not involve (simple) stacking.

not

*Say(h, Sick(s)) |----------Sick(s)----------| Speech-Time

Henrik said that Sue is sick

Sue's being sick overlaps with speech time and Henrik's saying that she's sick.

|----------Sick(s)----------|
Say(h, Sick(s)) Speech-Time

not

* |----------Sick(s)---|
Say(h, Sick(s)) Speech-Time

Unavailability of the last options shows that we can't re-set the tense operators in each clause relative to speech time either.

2. Indexicality of natural language tenses - must be interpreted with reference to the utterance context, irrespective of how deeply they are embedded:

(5.28) It was predicted that the Messiah will/would come.

3. Temporal anaphora (on both inter and intrasentenial plane)-- tenses anaphorically interact with the contexts in which they appear, incomparable to the tense operators of TPL and similar systems which are supposed to represent them

4. Natural language tenses cooperate with other devices/elements to express complex temporal relationship:

- explicitly quantifying over times or referring to points of time using phrases, e.g. *there will be a time, there was a time, on Sunday,*
- adverbs, e.g. *then, subsequently*

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☞**QUESTION**: Could TPL be adapted to capture this? Yes and No.

→ On the one hand, we could just adjust the semantics of the tense logic operators.

→ On the other, they cannot make explicit reference to times. This could perhaps be remedied by using TPLs to represent tenses that don't occur with temporal NPs

- But this would create an artificial split between tenses that interact with these temporal NPs, and those that don't.
- This, and changing the tense operators enough so that they can account for the anaphora aspect would lead us too far from the "original spirit of these logics."

5.1.3 Instants, Intervals, Events and States

- Truth, as it pertains to language in the way we use it, relates sentences to temporal **intervals**. Utterance time is also an interval.

- TPL and S,U-logic assign truth values to atomic sentences at **instants** of time

→ This is not worrisome if we treat instants as intervals of a special kind - interdefinable relation

BUT, problematic: instant-based models takes extensions of a predicate as a primitive relation between individuals and indivisible instants of time. This is too strong for predicates like *write, asleep, run.*

c.f. models of causality that analyse causality as a relationship between events that depends on what happens in other worlds.

This is not a conclusive argument but casts serious doubt on viability of instant-based semantics of natural language

5.1.3.1 Events

Davidson (1967): sentences are descriptions of events.

(5.30)Fred buttered a toast in the bathroom at midnight.

(5.31) $\exists e \exists x \exists p \exists t$ *(buttering(e,Fred,x) & toast(x) & bathroom(p) & midnight(t) & in(e,p) & at(e,t))*

Similarly, in DRS notation:

(5.32) Mary wrote the letter on Sunday.
(5.33)

e x y t
Mary(x)
the letter(y)
Sunday(t)
write(e,x,y)
Time(e,t)

PUSHBACK: indeterminacy of event concept, difficult to pinpoint their properties (Quine "no entity without identity")

K&R: natural language semantics is different from philosophy, pretheoretical indeterminacy is ok

What do we need for an Event-based semantics?

- **discourse referents that represent times** in DRSs, and "real" times in the models onto which those discourse referents can be mapped.
- no categorical distinction betw. instants (atomic) and intervals (non-atomic, cf. Linkian models)
- events are ontologically irreducible entities (not definable in terms of other categories, e.g. times - there are proposals in the lit, see 5.6)

5.1.3.2 States

PROBLEM: What is a state?

(5.34) (i.) The play delighted Mary.
(ii.) Fred was angry.
(iii) Alan was ill.
(iv) Susan was a pediatrician.

→ division between event- and state- describing sentences is gradual

Intuition:

- events - involve some change (some condition obtains when the event begins, is terminated by the event and gets replaced by another "opposite" condition)
  - i.e. abrogation of a condition
- states - do not involve change (if a state obtains over some interval *i*, a condition remains in force for the duration of *i*)

- i.e. continuation of a condition

☞ "condition" is conceptual
→ we can conceptualize the same bit of reality as event- or state- like (only sometimes reflected in grammatical form)

(5.35) Mary wrote/was writing a letter.

"A theory that would correctly distinguish between state- and event-sentences on the strength of, among other things, their rhetorical role, would have to incorporate a fully developed account of rhetoric and discourse structure."

Emmon Bach 1981: **eventualities** - an overarching category that includes events & states

ONTOLOGICAL Q: How do events and states differ from each other?
→ problem for the model-theoretical component of the theory.

LINGUISTIC Q: How do we tell apart event-describing and state-describing sentences?
→ directly relevant to how DRS's are built for tensed discourse
→ basis for sections 5.2-5.5

5.2 DRS-Construction for Tensed Sentences

5.2.1 DRS-Construction for Single Sentences in the Past Tense

notational decisions:
~~write (e,x,y)~~ → e: [write(x,y)]
~~time (e,t)~~ → e ⊆ t (*e is temporally included within t*)
n → discourse referent of the utterance time, "now"

syntax:
2 new features:
TENSE -past, pres, fut,
STAT - +/-

DRS-construction operations:
1. Introduce a new discourse referent for the described eventuality *s*/*e*
2. Record the temporal relation between this discourse referent and *n* (*n* is assumed to be part of the context DRS even before the processing of its first sentence has started)
3. Introduce a discourse referent *t* ("location time")
4. Record the temporal relation between *t* and *n*
5. If there's a temporal adverb β, introduce condition β(*t*) to record the constraint
6. Introduce a DRS-condition e:[*detensed sentence*] specifying the type of the eventuality

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(5.32) Mary wrote the letter on Sunday.

n e x y t
on Sunday(t)
e⊆t
t<n
Mary(x)
the letter(y)
e:[x write y]

5.2.2 Temporal Anaphora. DRS-Construction for Sequences of Sentences

The interpretation of **non-initial past tense sentences** requires a special processing rule which links the described eventuality to some suitable element of the **antecedent** discourse
→ anaphoric dimension of the natural language tenses (Reichenbach 1947)

- From this, we get the concept of *reference point* - typically given by the context
- Meaning of the tenses of the verb involve two temporal relations:
  (i) between reference time and speech time, and
  (ii) between described eventuality and reference time

K&R argue for a quasi-Reichenbachian analysis:

- A reference point is made explicit in the DRS via a condition
  Rpt:= α
  where α is some discourse referent representing a time or an event and is already present in the DRS

PRINCIPLE: when a sentence whose interpretation required the choice of an Rpt has been fully processed, the equation expressing this choice is eliminated from the resulting DRS

Furthermore,
- Discourse initial sentences don't need a Rpt
- Events always follow their reference point, states always include it.

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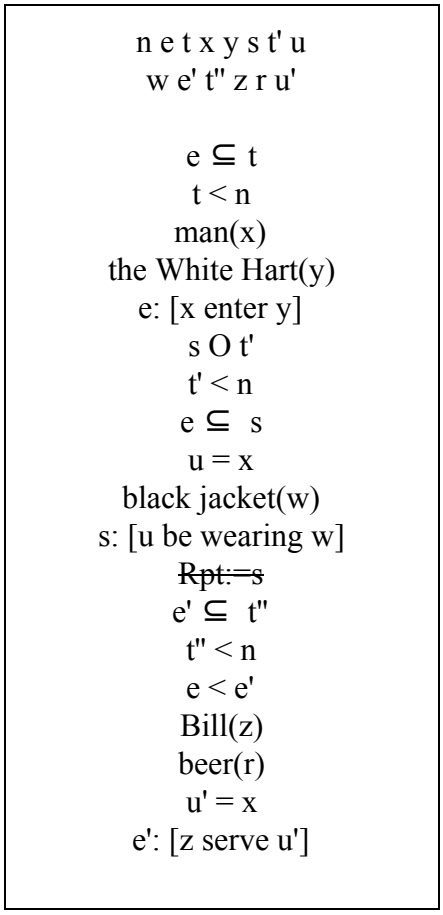
(5.54) A man entered the White Hart. He was wearing a black jacket. Bill served him a beer.

(5.60)



If a subsequent sentence in the discourse is *Some of it ran down his chin,* this would be an **elaboration** (one of a small number of rhetorical relations)

→ a simultaneous event, instead of a **narrative continuation** - successive events.
→ Another relation is **backgrounding** (usually event-state-sentence pairs).

At time of writing: None of the theories of discourse relations are formally detailed enough to be incorporated into DRT. We could imagine revisiting this issue? How would discourse relations be built in real time?

5.2.3 The Future Tense and the Present Tense 534

Desired time structure in the model: Branching vs. linear

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K&R choose a linear structure

Consider sentences like:

(i) John hid before Mary saw him
(ii) Mary saw him after John hid

- "Token reflexiveness" - principal distinction between present tense and the two others → present tense is governed by the interpretation principle:

  (5.74) The eventuality (a state) described by a present tense sentence must properly include the utterance time *n*.

  Events are not used in the (simple) present tense.

EXCEPTIONS to this analysis:

(i) Time-table use of present

Mary leaves on Sunday

(ii) Generic present

Mary leaves on Sundays

(iii) Reportive speech (in sports)

He shoots! He scores!

(iv) Historical present

So me and some friends **head** downtown and our friend **calls** us up and **tells** us to get to some taco place and pick him up before the cops **find** him with a bunch of sharpies and spray paint. I **want** nothing to do with this nonsense, so I just **stay** put and **drink** my coffee...

Sidebar: Could we use the historical present to ask any new processing questions?

(1) Can we use historical present contexts to push people away from (i) time-table readings or (ii) generic readings? Will they garden path in any detectable way?

So Sue **heads** down to LA thinking that it'd be a nice relaxing time, but when she **gets** here she **finds** out that no, we **have** a whole pile of plans lined up. The first night we **go** to this local bar and … So Sue **leaves** (?on Sunday).

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(2) If we can get them to garden path can we probe other issues of semantic interest? Is (i) a generic or an event defined over space instead of time?

(i) The path narrows as you approach the summit.

(3) Can we probe the nature of the morphosyntactic predictions made by the parser?

So here we **were/are** moving a bunch of new cabinets. And Bill all of the sudden **realized/realizes** that he left a bunch of his favorite Hummels in the one of them and **started/starts** freaking out looking for the key. We **looked/look** around for a half hour and **couldn't/can't** find them. We eventually **found/find** they key, but it looked pretty rusty. Fortunately, the key to the cabinets **worked/works/work** and we **were/are** able to rescue Bill's Hummels.

(4) There might be encoding/decoding time issues with the historical present Can you use it in an email? (I think no)

5.2.4 DRS-Construction Rules for Temporal Reference I

For non-initial sentences, conditions are added according to these rules:

1. Rpt := o ("overlap")
    a. o is the most recent *e* if the preceding discourse has an event-sent. in past/future tense
    b. o is the location time of the most recent past/future tense state-sentence
    c. otherwise: new arbitrary time, add a new discourse referent
2. o < e, in case STAT= -
3. o ⊆ s, in case STAT=+.