Verb Tenses, Temporal Adverbs, Episodic Verbs, and Ability Explicated in Transparent Intensional Logic

Logika: systémový rámec rozvoje oboru v ČR a koncepce logických propedeutik pro mezioborová studia (reg. č. CZ.1.07/2.2.00/28.0216, OPVK)

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Abstract

An important period of Transparent Intensional Logic started after Tichý's adoption of time-moments in the system. Tichý's analysis of verb tenses, temporal adverbs and temporal prepositions is a proposal rivalling the other proposal at the date of its publishing (1980). On the other hand, there is no known competitor to Tichý's logical analysis of episodic verbs and verb aspects (Tichý published his analysis also in 1980). Finally, we present the joint work of Tichý and Oddie on ability and freedom, i.e. analysis of some activity notions.

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Content

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I. Preliminaries

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I. Some basic concepts of TIL used for explication

- *extensions*: truth-values (o-objects, T, F), individuals (ι-objects), classes of objects (i.e. (oξ)-objects; for any type ξ), logical functions ($\neg$, $\wedge$, ..., $\forall$, ...), etc.
- *intensions* = function from possible worlds and time-moments:
  properties (i.e. (oξ)$_{\tau\omega}$-objects), *propositions* (i.e. o$_{\tau\omega}$-objects), etc.
- *constructions* (written by certain λ-terms) of intensions / non-intensions as *meanings* (logical analyses) expressed by linguistic expressions
- constructions construct intensions/extensions

- e.g. logical analysis (meaning) of the sentence "Peter is happy" is the propositional construction (=construction of a proposition)

$$\lambda w \lambda t\, [\mathbf{Happy}_{wt}\ \mathbf{Peter}]$$

II. Semantics of temporal discourse

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II. Semantics of temporal discourse: introduction of temporal parameter

- satisfaction of a *condition* (i.e. property/relation/proposition) such as *BE AT HOME* is performed in time, condition is a *temporal affair* (see the philosophical justification in The Transiency of Truth, Tichý 1980, *Theoria*)
- we need an addition of a *temporal parameter* to the modal one (already in 1978)

- various 'names' of *time-moments* or their classes, i.e. *intervals*, such as dates ("1/1/1977"/(oτ)), temporal (e.g. frequency) adverbs, etc., such as "yesterday" /((oτ)τ), "since", ...
- their analysis is in fact unproblematical (cf. Tichý 1980)

- key paper: The Logic of Temporal Discourse (1980, *Linguistic and Philosophy*)

II. Semantics of temporal discourse: logical structure of a common sentence

- Tichý argues that simple analysis *Tense(UnderlyingProposition)* is wrong

- he suggests rather structure:

Tense (FrequencyAdverb(UnderlyingProposition)), ReferenceTime)

- *cf.* "X was at least once drunk in 1977":

$\lambda w \lambda t$ [$\mathbf{Past}_t$ [$\mathbf{AtLeastOnce}_w \lambda w' \lambda t'$ [$\mathbf{BeDrunk}_{w't'}\mathbf{X}$]]] 1977]

- past *tense* – *WAS*
- *frequency adverb* – *AT LEAST ONCE*
- *reference time* – *1977*
- *underlying proposition* – *X IS DRUNK*

II. Semantics of temporal discourse: definition of a tense

- the sentence "In 1977, X was at least once drunk" is true if the proposition "X is drunk" was true within the time-interval 1/1/1977 - 31/12/1977 at least once
- in Tichý's explication, grammatical tense operates on what is the result of applying the function 'at least once' to the proposition 'X is drunk', and the reference time
- tenses are thus $(o\ (o(o\tau))\ (o\tau))_\tau$-objects
- definitions of all tenses (simple-past, present-perfect, ...,) in (Tichý 1980)
- e.g.:

$$[\mathbf{Past}_t\ l\ i] \Leftrightarrow_{df} [\mathbf{Sng}.\lambda o\ [\ [\exists.\lambda t'\ [\ [i\ t'] \wedge [t' < t]\ ] \wedge [o = [l\ \lambda t''\ [[i\ t''] \wedge [t'' < t]]\ ]]\ ]\ ]]$$

where i / $(o\tau)$; l / $(o(o\tau))$; $<$ $(>, \leq, \geq)$ / $(oo\tau)$; o / o; **Sng**/$(o(oo))$ ('singularizer');

II. Semantics of temporal discourse: definitions of tenses

- explications of selected tenses (most of them from Tichý 1980, definition of present tense is mine)

- *simple past* (préteritum – minulý čas):

$$[\mathbf{Past}_t\ l\ i] \Leftrightarrow_{df} [\mathbf{Sng}.\lambda o\ [\ [\exists.\lambda t'\ [\ [i\ t'] \wedge [t' < t]\ ] \wedge [o = [l\ \lambda t''\ [[i\ t''] \wedge [t'' < t]]\ ]]\ ]\ ]]$$

- *present perfect* (perfektum – předpřítomný čas):

$$[\mathbf{Pf}_t\ l\ i] \Leftrightarrow_{df} [\mathbf{Sng}.\lambda o\ [\ [\exists.\lambda t'\ [\ \lambda t''\ [[t' < t''] \wedge [t'' \leq t]] \subset i\ ]]$$
$$\wedge [o = [l\ \lambda t'''\ [[i\ t'''] \wedge [t''' \leq t]]\ ]]\ ]\ ]]$$

- *present time* (prézens – přítomný čas):

$$[\mathbf{Pr}_t\ l\ i] \Leftrightarrow_{df} [\mathbf{Sng}.\lambda o\ [\ [\exists.\lambda t'\ [[i\ t'] \wedge [t' = t]]]\ \wedge [o = [l\ \lambda t''\ [[i\ t''] \wedge [t'' = t]]\ ]]]]$$

II. Semantics of temporal discourse: definitions of tenses (cont.)

- *future* (futurum – budoucí čas):

$$[\mathrm{F}_t\, l\, i] \Leftrightarrow_{df} [\mathbf{Sng}.\lambda o\, [\, [\exists.\lambda t'\, [[i\, t'] \wedge [t' > t]]] \wedge [o = [l\, \lambda t''\, [[i\, t''] \wedge [t'' > t]]\,]]\,]]$$

- *future perfect* (perfektní futurum – budoucí dokonavý čas):

$$[\mathrm{Ff}_t\, l\, i] \Leftrightarrow_{df} [\mathbf{Sng}.\lambda o\, [\, [\exists.\lambda t'\, [\, \lambda t''\, [[t' > t''] \wedge [t'' \geq t]] \subset i\,]]$$

- other grammatical tenses are explicated as *nested tenses*
- nested tenses; X was once drunk when Y was happy – "when Y was happy" is a description indicating the reference interval; i.e. no special complication

III. Semantics of temporal discourse: selected temporal adverbs

- explications of selected temporal adverbs (some of them taken from Tichý 1980):

$$[\mathrm{Throughout}_w\, p] \Leftrightarrow^{(o(o\tau))} \lambda i\, [i \subset p_w]$$

$$[\mathrm{Once}_w\, p] \Leftrightarrow^{(o(o\tau))} \lambda i\, [\exists.\lambda t\, [\, [i\ t] \wedge p_{wt}]]$$

$$[\mathrm{Never}_w\, p] \Leftrightarrow^{(o(o\tau))} \lambda i\, [\neg\, [\exists.\lambda t\, [\, [i\ t] \wedge p_{wt}]]]$$

$$[\mathrm{ExactlyOnce}_w\, p] \Leftrightarrow^{(o(o\tau))} \lambda i\, [\exists.\lambda t\, [\, [i\ t] \wedge p_{wt} \wedge [\forall.\lambda t'\, [p_{wt'} \rightarrow [t' = t]]]\,]]$$

$$[\mathrm{Twice}_w\, p] \Leftrightarrow^{(o(o\tau))} \lambda i\, [\exists.\lambda t\, [\exists.\lambda t'\, [\, [i\ t] \wedge [i\ t'] \wedge p_{wt} \wedge p_{wt'} \wedge [\neg\, [t = t']]\,]]]$$

$$[\mathrm{ExactlyTwice}_w\, p] \Leftrightarrow^{(o(o\tau))} \lambda i\, [\exists.\lambda t\, [\exists.\lambda t'\, [\, [i\ t] \wedge [i\ t'] \wedge p_{wt} \wedge p_{wt'} \wedge [\neg\, [t = t']] \wedge [\forall.\lambda t''\, [p_{wt''} \rightarrow [[t'' = t'] \vee [t'' = t]]]]\,]]]$$

II. Semantics of temporal discourse: semantic structure vs. surface form

- some complications, i.e. one cannot mechanically follow the syntax of sentence

- frequency adverb is often missing: "In 1977, X was drunk" = *tacitly: once*
- indicator of reference time is often missing: "X was once drunk", "Caesar crossed Rubicon" = *tacitly: during his life-time* (both suggestions by Tichý 1980)

- Tichý's semantics of temporal discourse was criticized for its analysing sentence with and without frequency adverbs and indicators of reference time by the same manner
- such criticism can be easily rejected by defining:

$$Tense^{FreqAdv,RefTime}\ (UnderlyingProposition)$$
$$=_{df} Tense\ (FrequencyAdverb(UnderlyingProposition)),\ ReferenceTime)$$

II. Semantics of temporal discourse: resultativness

- a deeper complication: *resultativness* (details explained in Tichý 1980): on natural understanding, the sentence

  "Since 1977, X has borrowed a hundred dollars from Y"

  is meant in the sense that X still owes money to Y (not: once); 'that X still owes money to Y' is a *trail-proposition* which is a result of X's borrowing the money from Y; resultativness as a special (tacit) frequency adverb

III. Semantics of episodic verbs

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III. Semantics of episodic verbs: attributive and episodic verbs

- *attributive verbs*: "is red", ... (= how things are)
- *episodic verbs:* "run", "kill", ... (= what agents do; note the 'time consumption')

- the topic covers also: tense aspects (perfective, imperfective), the progressive; explication of events and episodes

- key paper: Semantics of Episodic Verbs (Tichý 1980, *Theoretical Linguistics*)
- Tichý's masterpiece in semantics
- a very complex topic; a number of auxiliary concepts defined (explicated)

III. Semantics of episodic verbs: events, episodes

- consider a collision of two billiard balls as an event
- before the collision happens, the balls were gradually approaching each other; so a number of propositions about their positions, velocity, etc. – *describing propositions* (describing how things are; this is not Tichý's term) - had to be true before the collision

- *event* = a proposition which is a conjunction of certain propositions which include certain interrelated describing propositions

- *episode* = a certain series of certain events (an $(oo_{\tau\omega})$-object)
  examples: singing an Internationale, heckling, WW2, coronation of Elisabeth II

III. Semantics of episodic verbs: does, do

- heckling - an episode consisting in a certain behaviour by an agent
- "X heckles" is not analyzed as a common S-P sentence (that S is or has P)
- the sentence is about X and actual heckling episodes; X and the class of episodes are related by the relation *DOES* (an $(o\ \iota\ (o(oo_{\tau\omega})))_{\tau\omega}$ -object)
- tacit 'does' is visible on pronominalization – "X heckles and Y does it too"

- 'do' as a plural counterpart of 'does'; 'do' is tacit in "X and Y heckle"

III. Semantics of episodic verbs: labour / upshot episode

- examples: killing Y / pleasing Y
- *labour episode LE*: setting a time bomb / writing a nice letter
- time break - a postman delivers bomb / letter from X to Y
- *upshot episode UP*: cessation of Y's life / spasm of Y's pleasure
- (both LE, UP not to be confused with *running time* of an episode)
- (without UP, such an activity is only X's attempt to kill / please Y)

- *achievement verbs*: kill, please; LE≠UP (LE and UP can overlap)
- *performance verbs*: dance a Mazurka, laugh; LE=UP (do not confuse with often related impact on other things - X's laughing can, but as a by-product, please Y)
- *activity verbs*: walk, push a cart; any segment of LE is a LE of that activity
- *task verbs*: sing an Internationale; any segment of its LE is not a LE of that activity

III. Semantics of episodic verbs: perfective/imperfective aspect

- *imperfective* - action-behaviour is not finished-completed
- *perfective* - complicated in the case of achievements verbs (*c.f.* killing - the end of upshot episode;)
- aspectual ambiguity: "Yesterday, X brushed his teeth" (perfective?)
- aspect inbuilt to the meaning: "Yesterday, X killed Y" (no imperfective reading)
- transitive verbs ("kill") are of type $((o(oo_{\tau\omega})(oo_{\tau\omega})) \iota)$ (not: $(o\ \iota\ \iota)_{\tau\omega}$)
- "X killed Y (within) yesterday."

$\lambda w \lambda t\ [\mathbf{Past}_t\ [\mathbf{Within}_w \lambda w' \lambda t'\ [\mathbf{Does}_{w't'}\ \mathbf{X}\ [\mathbf{Perfective}_w\ [\mathbf{Kill}\ \mathbf{Y}]_w\ ]]]\ \mathbf{Yesterday}_t]$

- simple-minded formalizations of action sentences are inadequate: they cannot capture all that is relevant for detection of full-blooded arguments involving tenses and episodic verbs

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III. Semantics of episodic verbs: progressive

- *progressive*: a property of propositions (progressive is thus a modal notion)
- to illustrate complexity of episodicity-related concepts, the definition of progressive (definitions of **Segm** and **Due** are of similar complexity):

$$[\mathbf{Progressive}_{wt}\ p] \Leftrightarrow [\exists\lambda t'\ [\exists\lambda t''\ [\ [t' \leq t < t'']\ \wedge\ [\exists\lambda c\ [\ [\mathbf{Segm}\ c\ t]_{wt}$$
$$\wedge\ [\exists\lambda w'\ [\mathbf{Due}_{w't}\ [\lambda w\lambda t\ [t' \leq t < t'']\ \rightarrow\ p_{wt}\ ]]]\ c]]\ ]]\ ]]]$$

- (the puzzle of X's going to the church: X is suddenly killed by lightning thus it seems that X went to the liquor store which is front of the church; X's intentions to go to the church are not part of the observable behaviour)

IV. Ability, freedom, responsibility

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IV. Ability, freedom, responsibility

- (Oddie, Tichý 1983): Ability and Freedom (*American Phil. Quaterly*), popular version of:
- key paper (Oddie, Tichý 1982): Logic of Ability, Freedom and Responsibility (*Studia Logica*)

- a number of interrelated concepts defined (explicated)

- description of a world involves also connections between events (e.g., causality)
- branching of worlds; *feasible* worlds ('futures') have the same past-and-present as the actual world
- some propositions are *feasible*, i.e. true in one of feasible worlds
- some feasible propositions are *inevitable*, i.e. true in all feasible worlds

IV. Ability, freedom, responsibility (strategy, "can" of opportunity)

- agent makes choices between feasible futures (selecting some of feasible worlds), which means that not any possible world can be chosen as the future
- X's raising his arm in one minute; *can* X succeed?
- it depends; if X is jailed (in the past-and-present) in the strait jacket, he cannot
- but somebody can help him; *cooperation* between agents

- *strategies* of an agent to *A* (to do something / to become being such and such)
- strict strategies / provisional strategies (insufficient to achieve the task without other support)
- *opportunities* of an agent
- *X* can *A* provided *P* = *"can" of opportunity*
- (some prima facia laws are invalid, e.g.: X can *F*., Thus: Inevitably, X can *F*.)

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IV. Ability, freedom, responsibility ("can" of ability)

- *ability sense of "can"* is stronger than the "can" of opportunity
- opening a combination lock; strategy: to dial the right combination of number; if *X* does not know the right number (or X does not intend to use it) he can't open the lock
- "can" of ability involves the disposition (and intention) of workable strategy

- then, it is defined that *X* is *free*
- then, it is defined that *X* is *responsible* for something

IV. Ability, freedom, responsibility (sample - logic)

- the concept Cn (i.e.can) defined (introduced), i.e. the object "Cn" is identified
- then, several new theorems follows; each of them is based on properties of "Cn"

Categorical ability can now be defined in terms of provisional ability the way categorical opportunity was defined in terms of provisional opportunity. *X can A* $(\mathbf{Cn}/(o\iota\sigma)_{\tau\omega})$ **if there is an etiologically complete *P* such that *X* can *A* provided *P*:**

7.18 $\vdash \mathbf{Cn}_{wt}xa \leftrightarrow_t (\exists p).[\mathbf{Ecom}_{wt}p]$ &. $\mathbf{Can}_{wt}xap$.

We have:

7.19 $\vdash \mathbf{Cn}_{wt}xa, \mathbf{Ints}_{wt}xa \rightarrow a_{wt}x$ (by 7.11).

Thus if an agent steadfastly intends something he can do then he will do it.

7.20 $\vdash \mathbf{Ints}_{wt}xa, a_{wt}x \rightarrow \mathbf{Cn}_{wt}xa$ (by 7.9 and 4.7).

By 7.20, an agent can do whatever he intentionally does in fact.

7.21 $\vdash \mathbf{Cn}_{wt}xa \rightarrow \mathbf{Fss}_{wt}0\lambda w\lambda t.a_{wt}x$ &. $\mathbf{Ints}_{wt}xa$ (by 7.10).

By 7.21 it is strongly feasible for an agent to do what he can do.

7.22 $\vdash \mathbf{Cn}_{wt}xa \rightarrow \mathbf{Op}_{wt}xa$ (by 7.7).

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