

# Specification of Tenses in Tichý's Transparent Intensional Logic and Prior's Temporal Logic

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In his paper 'The Logic of Temporal Discourse', Pavel Tichý (1980) pointed out that contemporary systems of logic were unable to sufficiently formalise temporal discourse. He therefore suggested temporal specification in Transparent Intensional Logic (TIL), a system of logic that he developed. Discussing contemporary systems of logic, Tichý also took into account the system of Arthur N. Prior, who is considered a founding father of modern temporal logic, and his criticism was also addressed to Prior. Tichý only focused, however, on Prior's early systems of temporal logic. Patrick Blackburn (2006) recently raised awareness that Prior also developed systems of hybrid logic in his latest periods (see e.g. Prior 2003a; Prior 2003b). From the point of view of temporal specification, this system is particularly interesting as the system has greater expressive power than Prior's early systems of temporal logic. Hence it could also deal with the problematic specifications of tenses that Pavel Tichý pointed out (see Blackburn and Jørgensen 2016). The aim of my talk is to demonstrate that the temporal propositions that Tichý introduced as problematic could be formalised in Prior's hybrid logic. I will also compare formalisations in TIL and hybrid logic and Tichý's and Prior's views that influenced their systems of logic.

The challenging features of temporal discourse that Tichý pointed out are, for instance, the difference between Past Simple and Present Perfect. Let us imagine we have a friend in common whose name is Nick. Nick was happy on Christmas Eve in 2021 and has been happy ever since. We could say:

1. Nick was happy on Christmas Eve in 2021.

and

2. Nick has been happy since Christmas Eve in 2021.

Tichý proposed a formalisation of these two propositions as:

1.  $\lambda w \lambda t P_t [\mathbf{Onc}_w \lambda w \lambda t H_{wt} X] \lambda t. t = T^0$ <sup>1</sup>

respectively

2.  $\lambda w \lambda t P_f [\mathbf{Thr}_w \lambda w \lambda t H_{wt} X] \lambda t. \mathbf{Aft} t = T^0$ <sup>2</sup>

Although Prior did not discuss the difference between Past Simple and Present Perfect in his system of hybrid logic, these propositions could also be formalised in it, namely, as:

1.  $P(a \wedge p)$ <sup>3</sup>

and

2.  $P(a \wedge p) \wedge \forall b [TaFb \rightarrow (b \wedge p)]$ <sup>4</sup>

Although Prior's formalisation is by no means as detailed as Tichý's, it is able to grasp the basic difference between these two tenses. There are, however, more challenging temporal specifications that could be compared.

## References:

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- Prior A. N. (2003a). Tense Logic and the Logic of Earlier and Later. In Prior A. N., *Papers on Time and Tense*. Hasle, P., Øhrstrøm, P., Braüner, T., & Copeland, J. (eds.), Oxford University Press, 117-138.

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<sup>1</sup> *Gloss.* In any possible world  $w$  and time  $t$  ( $\lambda w \lambda t$ ) it was the case ( $P_t$ ) once ( $\mathbf{Onc}_w$ ) that in any possible world  $w$  and time  $t$  Nick ( $X$ ) is happy in this possible world and in this time ( $H_{wt}$ ) which is Christmas Eve in 2021 ( $\lambda t. t = T^0$ ).

<sup>2</sup> *Gloss.* In any possible world  $w$  and time  $t$  ( $\lambda w \lambda t$ ) it has been the case ( $P_f$ ) that throughout ( $\mathbf{Thr}_w$ ) in any possible world  $w$  and time  $t$  Nick ( $X$ ) is happy in this possible world and in this time ( $H_{wt}$ ) which is any time after Christmas Eve in 2021 ( $\lambda t. \mathbf{Aft} t = T^0$ ).

<sup>3</sup> *Gloss.* It has been the case ( $P$ ) on Christmas Eve in 2021 ( $a$ ) that Nick is happy ( $p$ ).

<sup>4</sup> *Gloss.* It has been the case ( $P$ ) on Christmas Eve in 2021 ( $a$ ) that Nick is happy ( $p$ ) and for every instant 'b', if the instant 'b' is later than Christmas Eve in 2021 ( $TaFb$ ), it is the case at 'b' that Nick is happy at the instant ( $b \wedge p$ ).

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- Tichý, P. (1980). The logic of temporal discourse. *Linguistics and Philosophy*, 343-369.