The Primacy of Tense: A.N. Prior Now and Then
Applicant: Peter Øhrstrøm

Brief summary: Arthur Norman Prior (1914-69) developed tense logic – in particular, he articulated the 'internal' (or A-series) and the 'external' (or B-series) views of time, showing how both could be treated formally. Most metaphysicians think there is a 'real' difference between these two views – that only one describes the real nature of time. Prior too thought there is a difference, and argued that the internal view is the 'right' one – that the correct view takes 'the present' as metaphysically privileged - and that all aspects of time could be studied from this perspective. The debate here remains heated, and today many metaphysicians support the external view, arguing that the present is not fundamentally different from other instants of time. The philosophical ramifications of this internal/external distinction need to be fully explored and our project is to explain, first, the extent to which it drove Prior's work, and, second, what other uses the distinction might have, for Prior gave us tools whose full force he himself was not always aware of.

An important question that has not been given the attention it deserves is whether the internal and external views are in fact different. It is difficult to make progress about the metaphysics because the positions are not usually articulated precisely enough. But one of the great advantages of Arthur Prior's approach is that he uses a language of modern formal logic which allows the precise articulation of both views – and this makes it possible to assess whether the claims are genuinely different, and if different, to identify what makes them so. By blending historical research with current research on Prior's work, we hope to demonstrate the importance of what Prior did, and to gain a deeper understanding of time in general and of the internal/external distinction in particular..

We will map Prior's work (see 25; 53), looking for places where he endeavours to explain just what he takes the difference to be, and will explore, extend and integrate a range of technical tools, developed since Prior's death, which critically articulate his internal or tensed view of time, and extend it in directions not considered by Prior.

1.   The backdrop to the project
Arthur Norman Prior was born on 4 December 1914 in Masterton, New Zealand. He studied philosophy in the 1930s and was a significant (and often provocative) voice in theological debates until well into the 1940s. He became a lecturer in philosophy at Canterbury University College in Christchurch in 1946, and full professor in 1949. He left New Zealand permanently in 1959, first

taking a chair in philosophy at Manchester University, England, and then becoming a fellow of Balliol College, Oxford, in 1965. Prior died on 6 October 1969 in Trondheim, Norway (20; 49; 51).

1.1 The study of Prior's Nachlass and the development of Prior studies

Prior wrote a lot and many of his papers have still not been published. Most of Prior's Nachlass is now kept at the Bodleian Library in Oxford, but there are papers elsewhere. A Virtual Lab for Prior Studies (VL), a joint cooperation between Aalborg University (AAU) and The Royal School of Library and Information Science, University of Copenhagen (KU), has been established (54) and this is giving rise to a flourishing international community of Prior researchers. With permission from the Bodleian Library, the Prior collection has been photographed, and there are now more than 6000 digital photos in the VL. In addition to the material kept at the Bodleian, other texts and letters from Prior have been located and are being added to the VL. The Nachlass (53) is edited based on the work carried out in the VL. This model should be further developed in the project (see 43).

The Nachlass has already yielded important insights. For example, David Jakobsen defended his PhD thesis on Prior's contribution to metaphysics, at Aalborg University in April, 2013, based heavily on evidence from Prior's unpublished papers. Jakobsen (27) showed that a number of newly discovered texts lead to a far better understanding of Prior's metaphysical ideas. A second example is the recent work on Prior's somewhat neglected work on the temporal indexical 'now' (8). Drawing on the archived correspondence between Hans Kamp and Arthur Prior, and combining this with technical results from contemporary hybrid logic, it established that Prior had indeed correctly isolated the basic logic of 'now'.

1.2 The significance of A.N. Prior's ideas in contemporary thought

Prior's thinking (particularly his insistence on taking an internal perspective on time) has also had significant influence in areas beyond metaphysical philosophy. Perhaps the most spectacular example comes from computer science. In the 1970s, Amir Pnueli (1941-2009) realised that Prior's temporal logic was the framework needed for reasoning about the dynamic behaviour of software and hardware (49:344-45; 50). These ideas are now a standard methodology in computer science - indeed, in 1996 Pnueli received the Turing award (the Nobel Prize of Computer Science) for his application of temporal logic to computation.

Prior's ideas are also highly relevant to the study of natural language. Contemporary semantic theory draws heavily on the work of Richard Montague (who made use of Prior's temporal logic in his classic work) and Hans Kamp (who took a course in tense logic taught by Prior at UCLA in the late 1960s). Thus Prior's ideas are built into the DNA of much contemporary semantic research. And there are many Priorean themes here that deserve a deeper exploration, such as his views on

tense, temporal reference, intervals, and events, and his prescient later work on indexicality. Recent work at RUC has addressed some of these (6; 7).

2. The focus of the project

Prior's work has had a lasting influence in logic itself. Critics of Prior's tense logic, and of the 'presentism' which goes with it, point out that there are things his logic cannot say. Prior himself suggested ways of expanding it. Late in his life Prior developed his tense logic into what he called 'egocentric logic'; nowadays it is usually called 'hybrid logic'. During the late 1980s and early 1990s hybrid logic established itself as an important logical discipline. One reason for this was the ease and generality with which inference systems could be devised in hybrid logic. Three project members played a prominent role in this work: see (12; 13; 14; 15). Indeed, Braüner (18) devotes a book to this topic. The modern edge of Prior's egocentric logic is the hybrid logic being done in Denmark. The key to hybrid tense logic is that terms which in the external perspective are terms in a tenseless metalanguage (which is used to explain a tensed object language) are incorporated into the tensed object language itself. Prior held the view that if the terms were actually represented by 'propositional' letters (rather than individual variables), they enabled his tense logic to provide a powerful account of the internal perspective on times – and indeed, on other domains – a perspective which can do all the work that an external perspective can. Prior and his PhD student Robert Bull started the long process of exploring the consequences of this idea, a process continued in (2; 11; 24; 33). There seems to be a consensus that this expanded logic is at least as powerful as the standard logic used by advocates of the external perspective. But this needs to be made more precise: in what sense and to what extent are these perspectives formally equivalent? Secondly, what implications do such formal equivalences have for metaphysics? And finally, how do Prior's own writings illuminate the first two questions? These things – hybrid logic and Priorian scholarship – have never been systematically brought together before.

We want to use the insights from hybrid logic and the insights from a historical survey of Prior's own views on metaphysics and theology, to see what kind of difference (if any) there is between the internal and external perspectives. The reason this has not previously been done is because, typically, logicians have not appreciated the metaphysics, and the metaphysicians have been largely ignorant of the logic. Prior himself was *both* a logician and a philosopher, and in Prior's work the one always informs the other. This means our own investigations require sensitivity about the links between the logic and Prior's wider thought, and an appreciation of the way the modern tools can be used in conjunction with a close historical study of Prior's own writings, both published and unpublished. It is the combination of all of this which makes our project unique.

In what follows we list a number of specific themes crucial to Prior's work, which bear on the relation between the internal and the external perspective. Each of these themes will be investigated by looking both at the history of Prior's thought and at the logics he developed, and a key part of our work will be to integrate the insights of both aspects, and to develop them in novel directions. We have tried to make this project self-contained and specific enough to be achievable in the period of the grant, but we would like to stress that there will be many spinoffs for future researchers to develop and explore.

2.1 Specific questions we plan to tackle:

- *The concept of time.* Since St. Augustine's celebrated remarks it has been the common view that time cannot be defined. But it can certainly be discussed, and indeed it has been intensively debated in philosophy. One famous debate of particular relevance to the project concerns the relationship between what McTaggart termed the A-series (internal) and the B-series (external) views of time. Prior favoured an A-series account of time. Indeed, he argued that time should be seen as *constructed* from tense logic (47). Others (e.g. D.H. Mellor; 29; 30) have favoured a B-series account of time. We will investigate the various positions and arguments regarding the internal/external distinction and use the tools of contemporary hybrid logic to map the various positions more precisely. We shall also discuss the idea of branching time (another key Priorean theme) and its relations to ideas on time in physics and other sciences (1; 21; 32; 34; 44; 46;), again using contemporary logical tools when appropriate.

- *Hybrid logic.* An important part of this project will be to examine in detail the ways in which hybrid logic can articulate Prior's conception of the dependence of time on tense. One motivation for this extension is the need to incorporate features of everyday human language. For Prior, the operators of tense logic captured the essence of human temporal talk. In many respects Prior got things right: his insight that tense logic captured the situated nature of everyday tensed talk remains fundamental, and his work on the temporal logic of the indexical 'now' was skilled and insightful. But Prior's own tense logic requires further extension to provide an account of many features of temporal discourse in natural language (8; 9). Some of these features, such as those found in hybrid logic (3; 17; 19), provide interesting solutions to standard problems in natural language semantics, but their potential has never been systematically explored. We will examine the work in the semantics of tense and aspect since Prior's death, with particular attention to its role as an articulation of the internal view of time.

- *Temporal logic and metaphysics.* As noted above, Prior's tense logic needs to be supplemented in the direction of hybrid logic, so an important part of the project will be to concentrate on the question of whether and how this enriched tense logic affects the question of a metaphysical

difference. For although Prior <u>used</u> this kind of language he preferred not to endorse the entities that this enriched language appears to refer to. But there are indications in his philosophical writings about what he might have said about the metaphysics of time, and we want to see how they can illuminate our understanding of the internal/external divide, and how it relates to the current debate on the metaphysics of time (16; 35; 36; 42).

- *Time, determinism and existence.* One of Prior's most important motivations for creating a logical language of time was his wish to deal with the apparent conflict between the doctrines of divine foreknowledge and human freedom (cf. 39; 45; 52). Prior was also extremely interested in the notion of existence and the relations between time and existence; he was one of the first researchers to appreciate the importance of a famous principle called the Barcan formula. He questioned its acceptability in tense logic and developed his Q-system to explore the underlying issues. In the project we intend to study how Prior's ideas on such theological and existential problems might link with questions in the metaphysics of time (22; 23; 31; 48).

- *Ethics and deontic logic*. During the 1940s Prior was deeply interested in the study of ethics. In 1949 he published the book, *Logic and the Basis of Ethics* (37). He later wanted to combine ethics with models of reasoning, and became interested in deontic logic, the logic of obligation and permissibility. The correspondence between Prior, von Wright and others who contributed to the early development of deontic logic has never been studied in detail before. The project will investigate to what extent moral reasoning, when formalised in the manner considered by Prior, with the addition of more recent logical tools (cf. 4; 5; 10), can be of help in addressing the question that underlies the project: to what extent does the internal (A-series) approach to temporal reasoning spill over to the deontic domain?

3. Project organisation

The project requires two kinds of expertise: the historical and philosophical study of Prior's works and the use of hybrid logic in developing his tense logic. The project will be organized around these two aspects. The historical/philosophical study will be directed by Øhrstrøm using the resources of the VL developed jointly by AAU and KU; an important goal of the project is to continue developing the Prior VL. This requires the expertise in the Digital Humanities (43) provided by Per Hasle and his associates. The study of the logical extensions of Prior's work will be directed by Blackburn at RUC. This group is built around philosophers and logicians associated with the Danish CADILLAC network (55) and the Modality and Modalities workshop (56). The project will thus create a genuine national network: the five Danish universities (AAU, AU, KU, RUC, SDU) and the Technical University of Denmark (DTU) are represented. – Internationally, we will co-operate with the researchers in the VL – in particular with the researchers in New Zealand (57).

Group I includes: Peter Øhrstrøm (chairman); Per Hasle; Thomas Ploug; Anne Gerdes; Lars Bo Gundersen; Volkmar Engerer; Henriette Roued-Cunliffe; David Jakobsen; Jørgen Albretsen.

Group II includes: Patrick Blackburn (chairman); Klaus Frovin Jørgensen; Torben Braüner; Thomas Bolander; Jens Christian Krarup Bjerring; Julie Lundbak Kofod.

The two groups will work closely together. We shall ensure a high degree of synergy between the sub-projects. Regular joint seminars will be held, and joint publications strongly encouraged.

3.1 Postdoctoral research (David Jakobsen):

In his Postdoctoral project David Jakobsen will study Prior's contributions to metaphysics, developing the ideas suggested in his PhD dissertation (27). This work will be based on Prior's publications and on a study of Prior's extensive correspondence. The Postdoctoral project will include at least the following three themes:

i) An analysis of Prior's notion of a 'system'. Prior referred to various kinds of 'systems'. In all cases he wanted to find the formal structures of the thoughts in question, and to present them in terms of consistent systems. This also seems to hold for his studies of ancient and medieval ideas. Analysing his notion of a 'system' may give rise to an account of Prior's method and general approach to metaphysics, including the role of logic.

ii) An investigation of Prior's ideas on time and existence. This includes a further study of Prior's presentism which, as suggested in (26), does not seem to be correctly represented in most of the current literature. This theme should also include a continuation of the analysis in (28) regarding Prior's work with a tensed ontology, which he considered to be "the untidiest and most obscure part of tense-logic" (39:172). Finally, the theme should include a systematic discussion of Prior's Q-system according to which the language used in logic and scientific discourse grows, in the sense that more and more becomes statable.

iii) A study of Prior's attempts at constructing a logical framework which can be used in the various discussions of determinism versus indeterminism and in discussions of the semantics of future contingents. This should also include an analysis of the topics in the current tradition based on Prior's work on determinism/indeterminism, future contingency, ethics, and human freedom.

3.2 Doctoral research (Julie Lundbak Kofod):

In her PhD study Julie Lundbak Kofod will focus on logical issues relating to temporal logic, hybrid logic and natural language semantics. Her research will be built around the following two related themes:

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i) Drawing on the Nachlass she will trace the development of Prior's egocentric logic (40), its relationship to contemporary hybrid logic, and the ways in which it can be applied to both temporal and non-temporal domains, for example, in ethics and deontic logic.

ii) She will also investigate the application of such extended systems to problems in natural language semantics. Issues of particular interest include developing hybrid logics capable of dealing with temporal intervals and events, so that well-studied phenomena of temporal discourse such as temporal anaphora and aspect can be modelled. These systems should also integrate Prior-style approaches to natural language indexicals, both temporal and non-temporal.

4. Publication plan

Based on the work in the project we will produce a book which will integrate our findings. The book will provide a historical survey of Prior's work, and critically engage contemporary discussion of the internal/external distinction amounts. We intend to continue our co-operation with the journal *Synthese* (cf. special issues on Prior's philosophy and logic of time in 2006, 2012, and 2015). We anticipate editing a further special issue of *Synthese*.

Prior's Nachlass will be published as annotated texts on the site for Prior Studies (53). Finally, Peter Øhrstrøm, Per Hasle and David Jakobsen will publish a new edition of Prior's most important book, *Past, Present and Future* (1967) at Oxford University Press (58). In this new edition the notation will be changed from Prior's Polish to modern notation, and it will contain introduction, editor's notes and appendices (as it was done in 2003 with Prior's *Paper on Time and Tense*; cf. 41).

3.2 Time plan

The research will take place over the full period of the project (August 1, 2016- July 31, 2019). During this period the following six workshops will be organized in collaboration with the Modality and Modalities workshop series:

Nov. 2016 & May 2017: Workshops on time and modality in Prior's logic and philosophy.

Nov. 2017 & May 2018: Workshops on branching time models developed by Prior and others.

Nov. 2018: A workshop on time and tense: A-series and B-series approaches.

May 2019: A workshop on the origins of hybrid logic, 'now' and other temporal indexicals.

At these workshops, preliminary versions of the papers prepared in the project will be presented and discussed in order to improve the quality of the papers before they are submitted to relevant journals. The workshops will be open and organized as international events with internationally recognized keynote speakers.