The Junction of Modal and Tense Logic: William of Ockham and Arthur Prior

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Abstract

That Arthur Prior treasured and was inspired by William of Ockham on specific issues is fairly evident from his writings and the references contained therein. It is possible, however, that this inspiration was more fundamental and somewhat broader than Prior seemed to realise or acknowledge. Tense logic was invented through work done on modal logic and as a unification of metaphysical convictions about time and free will. This article investigates whether the bond between modal and tense logic was to some extent foreshadowed in Ockham.

Keywords: William of Ockham, Arthur N. Prior, modal logic, tense logic

1 Introduction

In the introduction to the Cambridge Companion to William of Ockham, Paul Vincent Spade wrote the following: "Beginning in the 1970s, English-speaking philosophers of a broadly "analytic" training

came to regard Ockham as a kindred spirit" (1999a, 4). Spade explains this by the common approach to applying "logical techniques and skills to a wide variety of philosophical problems". What is interesting is that Arthur Prior antedates this by approximately 20 years. Believing modern logic to have certain blind spots, Prior became convinced that these blanks could be filled by turning to medieval theologians and logicians, of which none was more important to him than Ockham.

Philotheus Boehner said the following in the preface to his book collecting some of William of Ockham's philosophical writings: "His language makes it impossible simply to *read* him ; he needs to be studied, or rather, … *ruminated*" (1955/1957, v). This is what Prior did. As far as we know, Prior only read a fraction of Ockham's writings, but what he read, he worked through several times. In 1945, Boehner published an edited Latin version of Ockham's *Tractatus de Praedestinatione*[1], which, among other things, contained part of Ockham's commentary on the important ninth book of Aristotle's *Perihermenias*. The latter was truly ruminated upon by Prior, who used it to make his own annotated translation — a work he referred to and expanded upon several times during his tense logical phase (Øhrstrøm and Jakobsen 2022, 33). In the article "The Syntax of Time-Distinction" (1958), which is a four-year-later publication of his very first public address on tense logic, Prior wrote that medieval logic "took tenses far more seriously than our own common logic does, and which already had such laws as our PF1" (2025, 89-90). PF1 refers to a calculus of pastness and futurity containing the axiom "What is the case will always have been the case" (2025, 79). A footnote is attached to PF1 in the first-mentioned quote, which refers to *Tractatus de Praedestinatione*, demonstrating that Ockham was at the heart of Prior's invention. Prior was a student of the history of logic, but his rumination

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[1] I apply the following abbreviations and editions:
Brev. Phys. — *Brevis summa libri Physicorum* (Davis 1989).
Expos. Phys. — *Expositio in libros Physicorum Aristotelis* (Boehner 1990).
Praedest. — *Tractatus de praedestinatione et de praescientia dei respectu futurorum contingentium* (Adams and Kretzmann 1983).
Qoudl. — *Quodlibeta septem* (Freddoso and Kelley 1991).
SL — *Summa Logicae*, Part I (Loux 1998), Part II (Freddoso and Schuurman 1998), Part III-1-3 (The Logic Museum), Part III-4 (Robinson 2025).
Ordinatio (Boehner 1990).
Expos Periherm. — *Expositio in librum Perihermenias Aristotelis* (Adams and Kretzmann 1983).
When Ockham's works are quoted, the translation is from the above mentioned editions, unless otherwise specified. When the original Latin is quoted in the footnotes, the translation is my own.

on Ockham was more constructively minded than antiquarian. Indeed, his historical interest was often motivated by locating discussions that contained the potential to develop logic in contemporary debates. That Prior did so with Ockham in relation to divine foreknowledge and future contingents is well known. This article, however, investigates a somewhat more general and subtle area of inspiration: Whether the junction of modal and tense logic to some extent was foreshadowed in Ockham's logic.

This will be done by first noticing a few important parallels between their approach to logic, metaphysics, and theology. The connection between Prior's work in modal and tense logic will then be treated, from where a deeper dive into the logic of Ockham will be possible. What this will demonstrate is that Prior's turn to medieval logic was not merely about being inspired by specific insights, but was likely also about being inspired by a broader approach where logic was connected with and could be directly applied to a range of issues like the metaphysics of time, human freedom, and divine omniscience.

2 Parallel Approaches to Logic, Metaphysics, and Theology

Before approaching the junction of modal and tense logic, a few relevant preliminary core convictions are worth noticing. Ockham and Prior had a similar approach to the application of logic. Moreover, logic could and should be applied to basically every subject. According to Ockham: "the logician … has to know the various general rules that are applicable to all bodies of knowledge, by which, together with the knowledge drawn from other domains, he can detect every false argument erring in form, regardless of the subject matter" (*SL* III-4.1). Many contrary opinions in theology, philosophy, and so forth may be due to ignorance of logic.. Instead of being guided by "what is expressly found in sacred Scripture and in the writings of learned logicians," they "teach or write extensively from what they have in their own head" (*SL* III-4.1). Knowing logic and how to apply it to various domains implies a close connection between logic and language, ontology[2], science,

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[2] The word "ontology" was introduced in academia in the early 17th century (Øhrstrøm and Uckelman 2022). What I imply here is that Ockham applied logic to what we, by today's standards, would call ontology. Thanks to David Jakobsen for pointing out that this needed clarification.

metaphysics, and theology. Prior would be in complete agreement and believed we should formalise as much of reality as possible. He believed that we must discuss language to solve metaphysical problems and, therefore, calls himself a "grammaticist" (2003, 11). He compares the logician to a lawyer because while the logician would be happy to provide someone like a physicist, theologian, or metaphysician with a logic that fits his beliefs about the subject, it would be an absolute demand that it should be consistent: "He must tell his client what the consequences of a given choice will be … and what alternatives are open to him" (1967, 59). Thus, logic for both Ockham and Prior strongly delimits feasible convictions within every area of knowledge.

Both were also strong believers in free will and formulated their views in such ways that a range of positions normally falling under that category[3] would be excluded. According to Ockham, "freedom is the power by which I can indifferently and contingently posit diverse things, in such a way that I am both able to cause and able not to cause the same effect when there is no difference anywhere else outside that power" (*Qoudl.* I, q. 16, a. 1). The point is, that for a rational soul to have genuine freedom it should not only be unconstrained by external things but must also be undetermined by its own cognition (Stump 1999, 193; Karger 1999, 205; Adams 1999, 245). Acts of willing are one of the rational souls capabilities, which Ockham formulates the following way: "the free agent can be acting and can stop acting, all the requisites being posited, and the necessary agent cannot" (*Brev. Phys.* VIII.1). Though Prior's treatments of free will are somewhat limited and sporadic, his conviction of it is stated very explicitly. It was intimately connected with an asymmetric view of time and a modal distinction between the past and future. The past is fully resolved, while the future is "something we can make for ourselves" (1999, 266) and, thus, must be open to a degree. On this metaphysical problem, Ockham and Prior have strong demands on what constitutes genuine free will.

Moving now to a theological issue,[4] most medieval theologians and philosophers understood God's eternity as timelessness, which played a crucial role in their conception of omniscience, including foreknowledge. Ockham's view of eternity and omniscience was different: "God Himself or the divine essence is one intuitive cognition both of itself and of everything else producible and not producible, that is so perfect and so

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[3] Like Thomas Aquinas', John Locke's, or the compatibilists' views.
[4] Of course, free will and omniscience are both metaphysical and theological issues.

clear that it is also an evident cognition of past, future, and present things" (*Ordinatio* I, d.38, q.u, quoted from Adams 1987b, 1078). Ockham was careful in explaining that we do not know exactly how God knows, but he did speak of God having knowledge of propositions (Freddoso 1998, 42). Because all propositions are tensed, God knows dissimilar propositions at different times. "God may eternally entertain the whole of world history; but if He does not know which states of affairs have which primitive properties, or how much of the sequence is (present tense) given in the ontology, He is cognitively deficient" (Adams 1987b, 1113). Prior could not agree more with this final point. If God's knowledge is "in some way right outside of time," i.e. tenseless, "its final effect is to restrict *what God knows* to those truths, if any, which are themselves timeless" (Prior 2003, 42). Knowledge is essentially tensed because reality is tensed, and to know what is happening *now* is different from knowing what happens on a correctly depicted date and time. Thus, while Ockham's and Prior's solutions to divine foreknowledge and future contingents differed, it is interesting to notice how similar their premises were in dealing with these problems.

Having established a certain common ground in their approach to logic, metaphysics, and theology, the connections between modality and tense in Prior will now be treated in order to investigate afterwards whether Ockham also foreshadowed Prior in this regard.

3 Prior's Work in Modal and Tense Logic

Prior sought to capture the logical structure of reality. Being convinced that this included the dynamic nature of our experience, modality and tense had to be integrated. Another strong conviction of his was human free will. A dynamic understanding of reality implies that the past is settled: nothing can be done to change it, and in that sense, events become necessary once they have happened. The future, on the contrary, is to some (even if only very small) extent open to different possibilities, where we are able to make genuine free choices. In *Some Free Thinking About Time*, Prior expresses this in the following way (1999, 266):

> In my own logic with tenses I would express it this way: We can lay it down as a law that whatever now is the case will always have been the case; but we can't interchange past and future here and lay it down that whatever now is the case has always been going to be the case - I don't think that's a logical law at all; for if something is

the work of a free agent, then it wasn't going to be the case until that agent decided that it was.

This quote reflects Prior's mature thinking, which he came to through many years of engaging with theological issues, originally being a determinist. Tense logic was invented through his grappling with the problem of divine foreknowledge. Its formal apparatus could model an open future — an indeterminate reality with a realm of possibilities.

Prior's first book-length treatment of tense logic, *Time and Modality*, begins by introducing the general subject as modal logic (1957, 1). Prior introduces the necessity operator *L* and possibility operator *M*, where *Lp* is logically equivalent to *NMNp* and *Mp* to *NLNp*.[5] Thus, if *Lp* then *p* and if *p* then *Mp*. In the next chapter, Prior introduces a "logic of tenses" stating: "I shall show, however, that this *is* a modal logic in the sense of Łukasiewicz, and even that it is structurally very similar to systems which we have no hesitation in classifying as modal" (1957, 8). Subsequent to mentioning medieval logic, Prior introduces his famous tense logical operators *P* for "It has been the case that" and *F* for "It will be the case that". After providing examples of these, he states: "in my view they apply also to the operators 'It could be that' and 'I think that'" (1957, 9). Indeed, Prior's contribution to both logics may be seen not in the creation of two separate systems, but in a demonstration of their necessary unity.

What Prior was most interested in can be characterised as metaphysical modality. This distinguishes him to some degree from a more broadly applied possible world semantics. The preface to *Time and Modality* expresses this "conviction that logic and general philosophy have more to bring to one another than is sometimes supposed" (1957, vii). Two sources of inspiration were often referenced and pivotal in Prior's work: The Polish logicians, especially Jan Łukasiewicz, who worked in modal logic, and the scolastics, especially Ockham, who took tense and modality for granted in logical exposition. Prior preferred the Polish notation to that of *Principia Mathematica* and thought this system would prevail. But it was by being led "to the sources" (1967, 16), i.e. to the scholastics, that he found a temporal view of propositions he could apply. Prior's turn from modal logic to tense logic was, for him, a way to apply logic directly to reality, enabling him to express fundamental

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[5] In modern symbolism, $\Box p \equiv \neg \Diamond \neg p$ and $\Diamond p \equiv \neg \Box \neg p$.

metaphysical beliefs in a formal language. With this move, tense logic ceased to be a mere application of modal logic, but became its most fundamental and intuitive interpretation. The temporal operators behave just like modal operators, grounding metaphysical modality in our common sense structure of time.

This can be described as reaching a unified metaphysical vision, since his ontology of time and position on modality are aligned. What we today often speak of as broad logical modality was, for Prior, more of a useful abstraction, but ultimately less interesting than understanding and applying logic to the real world. If, for example, I want to understand what possibilities I have, the flow of time provides the structure for answering this: Tomorrow I have different options, but yesterday is no longer open (thus necessary). While Prior chronologically moved from modal to tense logic, his mature view mainly expressed modality through a dynamic nature of reality where time metaphorically flows. Developing his thinking on these subjects through articles and books reveals a vast amount of references to medieval logicians, especially Ockham. The following from *Formal Logic* is especially illuminating, where he extends the notion of modality to tenses (1962: 216):

> Medieval logicians laid down a few rules on this subject; thus Ockham states that, with certain qualifications, what may now be said truly in the present tense may for ever afterwards be said truly in the past tense, and even God's absolute power will be unable to alter it.

Prior interprets, discusses, and develops Ockham's position both in relation to a two- and three-valued logic (1962, 240-250; 1967, 122-127). While these discussions are highly illuminating in regard to Prior's application of Ockham in relation to the problem of divine foreknowledge, this article seeks to understand whether Prior's integration of tense and modal logic was to some extent foreshadowed in Ockham. It is evident from Prior's many references that Ockham played an important role in Prior's invention of tense logic. But to attain a nuanced picture of the above research question, the remainder of this article will focus on the junction of modality and tense in Ockham in order to understand how it likely influenced Prior's mature thinking on the subject.

4 The Junction of Modality and Tense in Ockham

Ockham's *Summa Logicae*[6] presents tense as a very common grammatical feature that affects mental propositions (*SL* I.3). Mental language is what makes natural language (like English) possible and is associated with thinking and concepts. "The natural relation between concepts and their objects is the foundation of Ockham's semantics. He identifies it with the semantic property of (natural) "signification": roughly, meaning" (King 2005, 4). Because tense is an integral part of verbs, it makes a difference in meaning whether a proposition is expressed in the past, present, or future tense.

Being is, in Aristotelian fashion, a very fundamental concept that is common to everything. In Ockham's very reductive ontology, everything is either a substance or an accident. But though we predicate *per se* and *per accidens*, both substance and accident are *per se* being (*SL* I.38; I.45). These are interesting for understanding Ockham's application of the ten Aristotelian categories, which he calls: "… simple terms containing under them different words or intentions of the soul" (*SL* I.41). Ockham, as all Scholastic philosophers, applies terms in broader and stricter senses. Thus, substance can, in a broad sense, be applied to accidents, but not in the strict sense. The question is what this means for the category of time. Ockham argues that time is placed under the genus of quantity, but so *per accidens* and not *per se*: "'time' does not signify a thing existing in nature … 'time' as well as 'motion' connotes something which exists neither actually nor potentially" (*SL* I.46). Thus, an enduring object is in motion, and time cannot be something distinct from this motion. This is what makes time a passion or accident of substances. The category of time answers the question "when?"[7] with adverbs or like expressions. This is remarkably similar to Prior's following description (2003, 13):

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[6] Peter King calls it "a manifesto masquerading as a textbook" (2005, 1) because while it introduces itself as an aid for theology students to avoid logical mistakes, it in reality strongly promotes nominalism.

[7] When "conveys that [a thing] coexists with or has coexisted with or will coexist with such-and-such a time … the category of ´when´ is composed of such adverbs as ´yesterday´, ´today´, ´tomorrow´, ´on the previous day´, and so on for all the adverbs by which one can appropriately respond to the interrogative ´when´" (*Qoudl.* VII, q. 5).

I want to suggest that putting a verb into the past or future tense is exactly the same sort of thing as adding an adverb to the sentence. 'I *was* having my breakfast' is related to 'I am having my breakfast' in exactly the same way as 'I am *allegedly* having my breakfast' is related to it, and it is only an historical accident that we generally form the past tense by modifying the present tense, e.g. by changing 'am' to 'was', rather than by tacking on an adverb.

Prior continues to explain that in a completely rationalised language, past tense sentences could easily be formed by adding "It was the case that". "I was eating my breakfast" could be expressed as "It was the case that I am eating my breakfast". The same goes *mutatis mutandis* for future tense sentences. Thus, Prior would agree with Ockham that adverbs could be applied to express tense in a logic or rationalised language.

Ockham begins his account of predication with present tense non-modal propositions. In this way, the fundamental propositions are about actually existing individuals. These simple propositions are his starting point from where the more complex (past and future tense and modal) propositions can be understood. Supposition describes what is required for the truth of a proposition. In a present tense non-modal proposition like "Socrates is a man", the truth is determined by whether the subject "Socrates" and predicate "man" supposit for the same thing (*SL* II.2). These, whether particular or universal, are thus easy to determine the truth value of. When dealing with past and future tense propositions, things become more complicated as it involves certain ambiguities. It is not clear whether the subject in a past tense proposition supposits for a thing which is or was so and so (*SL* II.7). "Ockham's general strategy is to formulate the truth conditions for a past-tense proposition in terms of the past truth of some present-tense proposition" (Freddoso 1998, 29). Thus, "X was Y" is true if "X is Y" was true at a certain time. The same holds for future tense propositions. This also implies that the truth condition of past and future tense propositions is only indirectly formulated by supposition. Fixing the meaning of different terms is something Ockham discusses at length.[8] What is clear from the account is that present tense propositions are fundamental for understanding the truth conditions of both past and future tense propositions.

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[8] Cf. *SL* II.7; Freddoso 1998, 28-43.

It is also clear that the truth value of propositions are not static, but we must be careful in expressing and affirming them: "Similarly, 'A boy will be an old man' is true, and yet 'A boy is an old man' will never be true. Rather, 'This is an old man' will be true, referring to that person who is now a boy" (*SL* II.7). This underlines the difference between propositions that are present tense and past or future tense. The difference lies in the supposition that must be qualified in a certain manner. It also raises a problem: How does something supposit when the term concerns the past tense, future tense, or some modality? How does something supposit when the thing in question, Socrates for example, is non-existent? Ockham tries to solve this by applying personal supposition.[9] Personal supposition is about the concept of signification: the objects signified. "Universally, personal supposition occurs when a term supposits for the thing it signifies, whether that thing be an entity outside the soul, a spoken word, an intention of the soul, a written word, or any other thing imaginable" (*SL* I.64). Ockham believes a term can supposit for things that were, will be, or even can be. This is a natural way to signify objects. But this can only be done when we carefully apply verbs in past tense, future tense, or modally (*SL* I.72):

> The Point is that where the proposition concerns the past, the assertion is that the proposition in which that predicate (under its proper form) is predicated of that for which the subject supposits (or of the pronoun referring to that thing) was once true. If the proposition concerns the future the assertion is that the relevant proposition will be true. If the proposition concerns the possible the assertion is that the relevant proposition is possible, and similarly in the case of propositions that are necessary, impossible, per se, per accidens and so on for the other modalities.[10]

In such propositions, the terms supposit personally for (non-existing) things that were, will be, or could be their supposita. Thus, for Ockham, there is a major difference between expressing something by a present tense verb and by other tenses and modalities. If in "Socrates was wise" Socrates supposits for an existing thing, the proposition would be false. While Ockham would hold that a term in a proposition should supposit

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[9] For simple and material supposition, cf. *SL* I.64.

[10] For Ockham, modality contains four modes: necessary, impossible, contingent, and possible (*SL* II.1).

for a thing that actually is, he believes an exception to this rule is predicates[11] (*SL* I.72). This solution will likely strike the reader as problematic.[12] But for the purpose of this article, the important part is seeing the clear connection between Ockham's tense and modal logic.

5 From Tense to Modality

It is also worth noting that Ockham begins with past and future tense propositions, which he characterises as non-modal, and afterwards deals with modal propositions.[13] Ockham defines necessity the following way: "a proposition is called necessary not because it is always true, but because it is true if it exists and cannot be false" (*SL* II.9). This definition implies that the necessary proposition cannot be false, just as a past tense proposition is defined as something that cannot ever be made false — not as something that forever remains true. That someone exists can become false when the person ceases to exist, but it could never become false that the person existed. Thus, tense, in a way, is more fundamental than modality since it is used to explain it. The difference between the contingent and possible is that the possible may also be necessary. Since possibility is defined as "not impossible", the proposition "Aquinas is the pope" is not logically impossible even if he no longer exists. Interestingly, Ockham likes to formulate present tense propositions affirmatively, whereas past and future tense propositions are often formulated negatively (cf. *SL* II.19-20).

When dealing with conversion (*SL* II.21-29), the same pattern emerges: Ockham begins with present tense non-modal propositions, moves onto past and future tense non-modal propositions, and ends by discussing modality containing tensed elements. Applying our former example, "Socrates is a man," it is straightforward to convert this into, for example, "a man is Socrates". But when the proposition is past- or future-tense, the common term is equivocal in the third mode[14]; that is, linguistically

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[11] Ockham exemplifies this with the difference between "I promise you a horse" and "A horse is promised to you". The former is valid, since it is not specified what present or future horse it might be. The latter is strictly speaking invalid as the term "horse" is the subject and, thus, has a determinate signification.

[12] For a discussion of a possible solution to these puzzles, cf. Freddoso (1998, 40-43).

[13] Ockham's definition of modal propositions is very broad, including "true," "written," "believed," and so forth (cf. Freddoso 1998, 43).

[14] In Aristotle's *De Sophisticis Elenchis*, three modes of equivocation are distinguished. The third mode is about words that have simple meanings when they are taken

ambiguous. The reason is that it is no longer clear whether the subject supposits for something that *is* such-and-such or *was* or *will be* such-and-such. Socrates either supposits for something that is or was a man. According to Ockham, we should begin by distinguishing which of the senses we are implying; i.e. whether the subject in a past-tense proposition supposits for something which is or was such-and-such (*SL* II.22). In the former case, the proposition must be converted into a present-tense proposition. He converts "No white thing was a man" into "nothing which was a man is white," whereas "no man was white" would be incorrect. In the latter case, the proposition should be converted into a past-tense proposition. In that case, "No white thing was a man" can be converted into "no man was white," because the subject now applies to that which was a man. "For it is impossible that some man was white and yet that nothing which was white was a man" (*SL* II.22). The same goes for future tense propositions.

Ockham then moves on to modality, starting with *de necessario* propositions: "If the antecedent is necessary, the consequent is necessary" (*SL* II.24). Again, he provides several examples of conversion gone wrong like the following: "A being which creates[15] is necessarily God; therefore God is necessarily a being which creates" and "Only what is necessary is necessarily true; therefore everything true is necessarily necessary". The same rules about conversion that Ockham discusses in relation to necessary propositions apply to possible (*de possibili*) propositions.[16] The following passage expresses the junction between modality and tense (*SL* II.25):

> when the subject of a *de possibili* proposition is a common term or includes a common term, then the proposition must be distinguished. For the subject can supposit either for that which is actually such-and-such or for that which is possibly such-and-such. This rule should be understood as analogous to what was said above about past-tense and future-tense propositions.

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alone, but which can have more than one meaning in combination (as in propositions) with other words (van der Lecq 2008, 367).

[15] In medieval philosophy, "create" most often, if not always, implies "ex nihilo".

[16] Note that possible is defined as "not impossible" and, thus, contains both the necessary and contingent. The contingent (*de contingenti*) is, thus, defined as propositions that are neither necessary nor impossible (*SL* II.27).

The last sentence neatly captures something crucial for our present purpose: Ockham's logic — his rules — concerning tense and modality are keenly integrated to the point where he always discusses and develops the latter whenever he treats the former.

This is just one example of a picture that begins to emerge. Under disjunctive propositions, Ockham moves from future tense[17] to necessary and possible propositions (*SL* II.33). His treatment of categorical syllogisms begins with "syllogisms composed entirely of non-modal and present tense propositions; secondly, about the others"[18] (*SL* III-1.3). After a thorough discussion of these, Ockham turns to syllogisms containing past and future tense propositions (*SL* III-1.17-19) before entering a long exposition modality that takes up the remainder of Part III-1. In the part on fallacies, Ockham moves from present tense to past and future tense and, then, to modality when explaining equivocation (*SL* III-4.4), amphibology (*SL* III-4.5-6), figure of speech (*SL* III-4.10), accident (*SL* III-4.11), and affirming the consequent (*SL* III-4.12). In summary, logic must begin with present tense non-modal propositions. This implies that all our knowledge has a connection to the present moment without implying a presentist ontology in Prior's sense. It is also noteworthy that Ockham finds it instinctive to deal with past and future tense before dealing with necessity, impossibility, possibility, and contingency. While his relationship between tense and modal logic is difficult to decipher, it certainly is natural for him to move from the former to the latter. There was a proper series of arrangement as demonstrated in the following quote: "every universal is predicated of many either in a *de inesse* present tense proposition or in a past, present, or future proposition or in a modal proposition" (*SL* I.33).[19] Indeed, temporal statements seem to define modality at many points since Ockham is more interested in the kind of modality that has to do with reality (the created order) than broad logical modality.

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[17] In relation to divine foreknowledge, the following quote is important: "For, in fact, a future-tense proposition is either true or false, though not in a deterministic way" (*SL* II.33).

[18] "syllogismis ex omnibus de inesse et de praesenti, secundo de aliis". When discussing Aristotle's sea-battle, Ockham moves from tense to modality as well (*Expos. Periherm.* 9.1122).

[19] "A complete Ockhamistic semantics would, of course, need rules to deal with propositions which are both modal and past-tense or future-tense" (Fredosse 1998, 74).

6 A Couple of Tense Logical Rules

Ampliation[20] (*ampliatio*) was the standard medieval way to widening a domain of discourse from what *is* to include what *was*, *will*, or *could be*. In this way, a term can supposit for a broader range of things than presently existing entities. Ampliation was, however, not used by Ockham (probably deliberately) since it contained certain ambiguities (cf. Priest and Read 1981) as the ones treated above. It is a division of personal supposition that allows Ockham to handle assertions about non-existent or merely possible entities,[21] which his nominalism required. Thus, he was able to explain the truth-conditions for statements about entities that lay outside substances and qualities without positing abstract entities such as "time" or "universal possibilities". Primary signification is used by Ockham in a strict and wide sense (Adams 1987a, 325; Panaccio 1999, 56; Freddoso 1998, 4). The former signifies actually existing objects when the proposition is uttered, while the latter includes past, future, or merely possible objects. Thus, "all humans" can signify all presently existing human beings or include all past and future, or even possible, humans. We are able to have propositions about past, future, or possible individuals since both the subject and predicate term can supposit for non-presently existing individuals.

Ockham believed our soul to correctly detect the presentness of reality: "Intuitive cognition is such that we just know when what appears before us is really present and when it is not" (Stump 1999, 188). If a thing is right before us, our intellect immediately judges the thing to exist. "Abstractive cognition, on the other hand, is that knowledge by which it cannot be evidently known whether a contingent fact exists or does not exist" (*Ordinatio* Prologue q. I, N sqq, quoted from Boehner 1990, 23). There is a very real difference between perceiving and remembering or imagining. Ockham also distinguishes between inferences that hold as of now (*ut nunc*) and simply (*simpliciter*). An example of the former is the following: "All animals run, consequently Socrates runs"[22] (*SL* III-3.1). The reason it holds "as of now" is that it is not possible for the consequent

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[20] Cf. Spade 1998, 414; Klima 1999, 140; King 2005, 24.
[21] In Paul Vincent Spade's words, Ockham "seems ontologically committed" to past, future, or merely possible entities: "The Razor is thus powerless for actually *denying* the existence of certain kinds of entities; all it does is prevent our positively affirming their existence" (1999b, 101-102).
[22] "omne animal currit, igitur Sortes currit".

to be false and the antecedent true "now," i.e. while Socrates is alive. However, when Socrates is no longer, the antecedent could be true and the consequence false. If at no time a true antecedent and false consequence is possible, then the inference would hold *simpliciter* (Boehner 1952, 55; Adams 1987a, 478-479; Normore 1999, 44; Strobino and Thom 2016, 366). This constitutes another junction between tense and modal logic — one which Prior was keenly aware of and inspired by (1957, 1).

There is a clear relationship between modality and tense, since the possible will change over time. The way things are now is the way things are, and in that sense, they can be characterised as necessary. Some things are possible now, but other things may be possible at different times. In some logical statements, the antecedent may be necessary now because it is about the past or present. But the consequent may be about the future, which is presently contingent but still true. An example of this is the second coming of Christ, the truth of which Ockham was fully convinced. In the simply valid consequences, it would never — neither past, present, nor future — be possible for an antecedent to be true and the consequent false. A true proposition about the past or present expresses a necessity in the strongest sense. "But there is a distinction between the immutability of what now makes a sentence true and the immutable truth of that sentence" (Normore 1999, 45). "Christ was incarnate" is a basic and necessary proposition that can never again become false. But if the same proposition was expressed at the time of Socrates, it would have been false. Likewise, the proposition "Christ's will return" will at some future time be false. These propositions are necessarily true "ut nunc," but not "simpliciter". In this way, modality is described by Ockham in a thoroughly tensed manner.

The past, for Ockham, is necessary, but what is past changes with time. This implies that what is necessary also changes with time. As time moves along, a range of new necessities come to be while a range of former possibilities vanishes. What is possible today may not be possible tomorrow. Calvin Normore notices that this implies that the S5 modal system cannot be attributed to Ockham as the possible is not necessarily possible (1999, 50). In my understanding, the reason is that Ockham's modality is often expressed from the premise of a temporal reality. He is not mainly concerned with broad logical modality — where the only necessity would be God — but with the modality of reality. Since reality is tensed, modality is best explicated from that outset. Though Prior started in modal logic before elucidating tense logic, he ended in a very

similar position, where tense logic became the most intuitive and metaphysically fundamental interpretation of modal logic.

7 What, then, is Time?

While Ockham explicitly says that his commentaries on *Physics* merely presents Aristotle's opinions, he believed that the right interpretations thereof approximated truth[23] while he also corrects Aristotle on certain points: "The upshot is that we get Ockham's genuine view of what unaided reason would conclude however much he may have been willing to revise those conclusions in the light of Catholic orthodoxy"[24] (Goddu 1999, 144). According to Ockham, "motion is not a distinct and definable entity in itself" but simply signifies the non-simultaneous past, present, and future aspects of things (*Brev. Phys.* III.1). When we commonly speak of the existence of motion and time, this implies the truth of both propositions about the past and future. But though we may be able to signify "time" as a sort of totality, this does not imply that it is *per se*[25] one thing (*Brev. Phys.* IV.5). Time is not an actual unity in reality, but a measurement by the heavenly movement that can be carried out by the soul. Similar to motion and place and fitting with Ockham's parsimonious ontology, time should be understood as a connotative term. The motions of the heavens are privileged, being most uniform: "time in the strict sense is the most uniform, most regular, and swiftest motion of all. In a larger and more improper sense, time is any motion by means of which we measure other motions" (Goddu 1999, 160; cf. Adams 1987b, 886). "Now"[26] is an adverb that, just like any syncategorematic[27] term, does not signify some actual thing but can only co-signify.

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[23] "Truly, although this man [Aristotle], aided by God, has discovered many great things, he has, nevertheless, due to human impediment, mingled a few mistakes with the truth" (*Expos. Phys.* Prologue) — "Sane, licet vir iste multa et magna divinitus adiutus invenerit, nonnullos tamen impeditus humanitus errores immiscuit veritati".

[24] There are, however, exceptions to this (e.g. *Brev. Phys.* VIII.1).

[25] Note that Ockham speaks of *per se* predication in four ways (*Brev. Phys.* V.1).

[26] A now, a point, an instant, and so forth are "not indivisible things really distinct from other things" (*Brev. Phys.* VI.1), and continuity can be explained without indivisibles. "He [Aristotle] says that 'now' can be taken for an individual (point of time) and it can be taken for a short duration of time surrounding the present" (*SL* II.19).

[27] "The distinction between syncategorematic and categorematic terms corresponds roughly to that in contemporary logic between logical and non-logical constants, respectively" (Adams 1987a, 317). Words like "no," "every," "some," "only," "not,"

In relation to the Aristotelian definition of time as "the measure of motion according to before and after," Ockham stresses the importance of understanding time as the measured — not that by which we measure (*Brev. Phys.* IV.6). It can, however, be applied to measuring in the sense that the counting of before and after in the first motion and motion being uniform, other durations can be measured (Adams 1987b, 876). By coexisting with the change of the heavenly body, we, broadly speaking, sense and perceive time. We can know how long it takes for something to move, to be changed, to exists, or to come to rest, but this is not to imply that time literally measures something. Ockham sought to avoid having successive things be part of ontology: "His own positive position rejects time as an important piece of ontological furniture and concentrates on its epistemological significance as a cosmic clock relative to which duration can be measured" (Adams 1987b, 854-855). Due to its successive nature, time is not a whole — one thing — separated from permanent things.[28]

Ockham can be characterized as a reductionist about time; time somehow exists, but is not ontologically basic.[29] As Cecilia Trifogli puts it (2022, 11), "time is reducible to the basic things," which are particular substances and qualities. There are no successive things, such as time and change, in addition to the things that have all of their parts simultaneously. A ship can have all its boards at the same time, while a sea voyage has its parts successively. At any given time of the sea-voyage, most of these parts would be non-existent and "what is non-existent is not a part of something"[30] (*Expos. Phys.* III.2). Thus, "past and future are not parts of time as thing but are parts of the nominal definition of time, that is, of the linguistic formula that expresses what the term 'time' means" (Trifogli 2022, 20). We make philosophical mistakes when we reify our common way of speaking about time, thereby thinking of time as a real, distinct thing. Thus, Ockham's reductionism is quite different from Prior's realism.

"or," and so forth do not have a determinate signification, but must be used along with other words, thereby forming propositions.

[28] Or, as Ockham puts it, "'when' is not a relation distinct from absolute things" (*Qoudl.* VII, q. 5).

[29] The ontological inferences from Ockham's treatment of tensed and modal propositions are difficult to sort out, and the evidence from his own texts is variegated; cf. Adams (1987a, 400-416; 1987b, 898-899) for a nuanced discussion.

[30] "illud quod non est non est pars alicuius rei" (Latin quoted from Trifogli 2022, 15 n 11).

Prior is very explicit in believing time to be a fundamental part of reality: "So far, then, as I have anything that you could call a philosophical creed, its first article is this: I believe in the reality of the distinction between past, present, and future" (1999, 265). This entailed the present being connected with existence to the point where they become one and the same. The now is what actually *is*: "the present simply *is* the real considered in relation to two particular species of unreality, namely the past and the future" (Prior 2008, 129). Because of this, the propositions "this chair exists" and "this chair exists now" are equivalent, since the addition of "now" to the latter is redundant.[31]

But, according to Ockham, the present instant — the now — is not a real, distinct thing (*res*). Were it always the same now, all times would be simultaneous. All existing things would exist at the same instant, which is absurd. But if the now is always changing, all the instants would be corrupted successively, and this corruption would require a cause. As Marilyn McCord Adams has demonstrated, Ockham has a whole arsenal of arguments against the possibility of there being an infinite amount of instants in any period of time, of which none are simultaneous (1987b, 862-873). In the end, the reification of time and instants would be superfluous and, thus, does not survive his razor principle. What "time exists" means is the following: "Something is in continuous and uniform motion at the fastest speed, and the soul recognising the before and after of this motion can measure the duration of other things thereby" (*Expos. Phys.* IV.9 quoted from Adams 1987b, 888). The heavenly sphere — the first motion — is the most proper way to signify time. Every finite duration, everything save God, can be measured by it.

8 The Necessary and Contingent in Relation to the Past and the Future

As should be clear by now, all propositions are tensed, and "all knowledge is in regard to a proposition or propositions"[32] (*Expos. Phys.* Prologue). At least one verb and one noun are parts of a proposition. And since verbs consignify time, the notion of time must be brought into logic. The same proposition can be true now and false later, because substances are able to change. If something changes, like Socrates standing after

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[31] For an exposition of Prior's presentism, cf. Steiner (2024).
[32] "omnis scientia est respectu complexi vel complexorum".

having been sitting, the proposition regarding his pose would change in truth value. This description of change in relation to substances is very similar, if not identical, to Prior's substance language. A proposition, for Ockham, is not true or false because of some inherent quality (*SL* I.43). It is true because it correctly describes the state of affairs of a substance. When the truth value of a proposition changes, there must occur some change in reality which can happen through locomotion or when a thing (*res*) is generated or corrupted (Adams 1987a, 155; cf. 479; 1987b, 1107-1108). Correct propositions are correct descriptions of substances.

In Prior's time, things were different since correct propositions were expressed in a four-dimensional space-time language. N. L. Wilson began constructing a logically meticulous "substance-language," with which Prior "could hardly sympathise more heartily" (1976, 78). It is substances or individuals that change or endure, and to adequately capture this reality, we need to take tenses seriously. Our propositions must encapsulate the dynamic nature of the world.

For both Ockham and Prior, if a proposition is true about some present state of affairs, then it will from now on always be true about the past. "For if the proposition 'this thing is'—some thing or other having been indicated—is true now, then 'this thing was' will be true forever after, nor can God in His absolute power bring it about that this proposition be false"[33] (*Praedest.* q. I, A; cf. *SL* III-3.32; *Qoudl.* II, q. 5). In this sense, the past will be necessary. This is the case when "propositions are about the present as regards both their wording and their subject matter (*secundum vocem et secundum rem*)" (*Praedest.* Asm., M). Ockham speaks of two senses of the necessary (*Brev. Phys.* Prologue, ch. 2):

> In one sense, as meaning that which cannot not-be, and such necessity is not required for science, because nothing is necessary in that sense except God alone. In the second sense, "necessary" means that which cannot be false, although it can be non-existent; and thus some proposition is necessary, as is any known proposition; and not even God can make it false.

Ockham, along with medieval logicians in general, contrasted absolute necessity (*necessitas absoluta / simpliciter necessarium*) with necessity *per accidens*, which was related to propositions concerning past

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[33] "God is deprived of this alone, to make undone what has been done" (*Qoudl.* VII, q. 5).

events (Adams 1987a, 481). Nothing, not even God Almighty, could presently or in the future make it false that Moses received the Ten Commandments. It is not broadly logically impossible that he did not. Indeed, a range of different situations could have occurred. But *now* it could never be otherwise, making it necessary *per accidens*. However, a proposition may be verbally (*vocaliter*) about the present or past without having a necessary proposition about the past. And if this is the case, the proposition is contingent since it might depend on a future truth (*Praedest.* q. I, C; Asm., M; *Expos. Periherm.* 9.222).[34] Though it is logically possible that something past had been otherwise, if a truth proposition is merely about the past, it is in reality necessary and beyond change.

Future events are, on the contrary, genuinely contingent. Ockham calls them "propositions formally about the future" (*Praedest.* Asm., N), implying that they are not settled yet. Ockham famously holds that propositions about the future can be true without thereby becoming necessary. Such a proposition is "*contingently* true, since it *can* be false" (*Praedest.* Asm., P), which makes divine foreknowledge possible. Ockham almost seems to quote Prior in one of the objections he answers: "everything that God knows will be, necessarily will be, and *A* is something that God knows will be; therefore necessarily *A* will be" (*Praedest.* q. II, a. IV, part 5). For Ockham, the mistake is imposing necessity through foreknowledge, which expresses a sense of division. This means that a mistake is made by mixing up modality *de dicto* and *de re*. The former applies to the necessity of God's foreknowledge, which cannot be mistaken. The latter applies to the thing itself — the event — which is genuinely contingent. In effect, God's foreknowledge is necessary *de dicto* while future events are contingent *de re*.

Ockham's logic of tense and modality is connected with theology. Nothing is eternal save God, which meant that everything else — everything created and contingent — must have temporality essentially. Thus, he rejected the *aevum*[35] defended by Thomas Aquinas and Duns Scotus (Boehner 1990, xliv). Everything created is ultimately contingent (can be annihilated) and temporal (its duration can be measured by time). Ockham also holds that "all impossibilities are from God"[36] (*Qoudl.* III, q. 3) since impossibilities are understood by terms, and all terms are from

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[34] In relation to this distinction, Alvin Plantinga has suggested a terminology of *hard* and *soft* facts about the past (1998, 271).
[35] A created eternity that is often associated with the life of the angels.
[36] "omnia impossibilia sunt a Deo".

God. Because of this even a proposition like "A human being is a rational animal" is contingent since the proposition would be false if no human being existed: "no merely nonmodal and merely present-tense affirmative proposition … is necessary; rather it is absolutely contingent" (*Qoudl.* V, q. 15). The conditional proposition "If a human being exists, a rational animal exists," however, is necessary. The necessity involved here is conditional as both the antecedent and consequent are contingent, whereas absolute necessity is about things that are necessary without qualification (*Qoudl.* VI, q. 2). Again, it is interesting that tense has a certain primacy in logic for Ockham over modality.

In relation to the possibility of foreknowledge, Prior reaches a different conclusion than Ockham. If the truth or falsity of a future state of affairs can be known with certainty, it is, as Prior puts it, "now-unpreventable" meaning "beyond anyone's power to prevent" (2003, 45). This challenges the kind of freedom Prior wants to preserve in his junction between modality and tense. If something can be known with certainty now about a future state of affairs, it can only be because it attains on all future branches. Otherwise, the following holds: "If the matter is not thus settled, both these assertions, i.e. *FnP* and *FnNp*[37], are simply false" (1967, 129). Prior sought to preserve free will by contrasting the openness of the future with the necessity of the past. Ockham maintained the consistency between divine foreknowledge and future contingency by arguing that the past is only necessary if a proposition is about the past both "*secundum vocem et secundum rem*". For our present purpose, the interesting point to notice is that both are examples of the junction between modal and tense logic, and in that sense, Prior's junction was foreshadowed in Ockham.

Two additional nuances deserve mentioning, of which the first is obvious: A formal apparatus was available to Prior in which his junction could be presented. There is a scholarly debate as to what degree formal logic should be used to interpret and present the logicians of scholasticism. I suspect that Ockham would have made full use of such a system. Second, though this article has presented many examples of how Ockham always treated tense and modality together, reading through these many examples reveals that he rarely deals with propositions that are both. In that sense, Prior's junction is more integrated and unified.

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[37] Meaning "It will be the case in *n* time units that *p*" and "It will be the case in *n* time units that not-*p*".

Conclusion

While Ockham and Prior had different views on the ontology of time and the possibility of foreknowledge, a range of similarities in their logic of tenses have been noted. Many of these similarities are to be found in the relationship between modality and tense. The article does not suggest that Prior, in fact, attained all these points from Ockham. It is quite evident that Prior's invention of tense logic had a range of different sources of inspiration, not the least contemporary Polish logicians. What is interesting is that much of what he took from his contemporaries, like Wilson's substance-language, he could as easily have found in Ockham. While Ockham was important for Prior, there was a potential for him to be even more important had Prior engaged with him sooner. Ockham's logical exposition constantly treats time and modality together, and in that sense, the junction of modal and tense logic, pivotal in Prior's invention, was foreshadowed in Ockham.

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