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Temporal *Propositiones* and the Logic of Possibility in John Buridan

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Abstract

This paper examines the role of temporal considerations in John Buridan's logic by focusing on his conception of *propositiones* as the basic objects of logical theory. Unlike contemporary abstract propositions, Buridanian *propositiones* are concrete, spatio-temporal entities—mental, spoken, or written—which come into existence and cease to exist. This work argues that this ontological commitment has far-reaching semantic and metalogical consequences. First, it shows that if *propositiones* are temporal objects, truth must presuppose existence. Second, it argues that, under these constraints, validity can no longer be defined in terms of truth-preservation. Buridan is instead led to reconceive validity as the preservation of *significatio*. Finally, the paper demonstrates that these revisions compel a redefinition of possibility. Indeed, it can no longer be argued that sentence p is possible if it is true in a state w, since Buridan's ontological proposal allows for the existence of possible *propositiones* that are neither true nor will be true. Buridan therefore detaches possibility from truth and defines it in terms of satisfiable significate. This account rejects a temporal interpretation of modality and yields a systematic alternative to truth-based modal logic, illuminating Buridan's position within both medieval and contemporary debates on modality.

Keywords: Time; Buridan; *Propositio*; Possible; Master Argument; Truth

"Das Satzzeichen ist eine Tatsache."
Ludwig Wittgenstein, *Tractatus Logico Philosophicus*, 3.14.

1. Logic with Temporal Buildings Blocks

1.1 Introduction

"The nominalist tradition of the fourteenth century is closely related to theoretical developments concerning the relations between time, truth, and modality" (Normore 2013, 389). The ways in which these three notions were related varied from author to author and were shaped by logical, physical, metaphysical, and theological concerns. As a result, modal concepts were often analyzed in different contexts and for different purposes. As Alt observes, "John Buridan provided different analyses of modal concepts in various contexts of his writings" (Alt 2023, 237).[1]

In Buridan's case, two such contexts can be clearly distinguished: the logical context and the context of natural philosophy. Accordingly, the analysis of modal notions not only differs across authors, but also within the work of a single author and even within a single analytical framework. In Buridan's logical writings, the understanding of modality undergoes a significant transformation over the course of his intellectual development. As Johnston notes, "Buridan begins by supporting a temporal analysis of modal propositions, where modal expressions are reduced to combinations of temporal expressions, but in his later writings

[1] "John Buridan has provided different analyses of modal concepts in diverse contexts of his writings. As a logician, Buridan developed a theory of modal consequence and of modal syllogistics based on the semantics of ampliated sentences. It has been frequently argued that his framework approaches an understanding of modality as a form of generality tractable in the framework of possible worlds semantics (e.g., see Johnston 2021). As an interpreter of Aristotelian natural philosophy, Buridan used alternative descriptions of necessity and contingency the intended domain of which is the physical world. In the world around us, we observe some things coming about always, others for the most or for the minor part, and still others by chance, and philosophers traditionally tended to describe what comes about in those different ways by appeal to conceptions of necessity and contingency". (Alt 2023, 237)

on logic, he leans toward an analysis of modality based on the idea of what an agent can or cannot bring about" (Johnston 2024, 51).

In this paper, we focus exclusively on the logical context of Buridan's treatment of modality, and within that context, almost exclusively on the notion of possibility. Among the triad highlighted by Normore—time, truth, and modality—time will be the central object of our analysis. Modality and truth will be considered only insofar as they are related to time. Our main thesis is that, within Buridan's logical writings, time is operative in two fundamentally different ways: (a) as a factor grounding modal concepts, and (b) as a constituent element of logical language at the ontological level. These two roles, we argue, are incompatible, since they give rise to distinct and mutually inconsistent conceptions of possibility.

Buridan ultimately privileges the second option, according to which time enters logic as a component of its basic building blocks. This ontological commitment forces a reconceptualization of possibility. In particular, Buridan separates the concept of possibility from that of truth and abandons the traditional definition of the possible as "that which will be true." The motivation for this shift is not primarily philosophical or metaphysical, but logical. It stems from the decision to assign time a central role in the constitution of the fundamental objects of logic, that is, in the language of logic itself.

We shall argue that once time is taken into account at this foundational level, the basic notions of metalogic—truth, validity, and possibility—must be reformulated. A direct consequence of this reformulation is the rejection of what Becker (1952) and Knuuttila (1993) call the "statistical" or "temporal frequency" interpretation of modality, characteristic of ancient philosophy. Buridan's position is thus incompatible with any account that identifies the possible with what is, or will be, true. This conclusion aligns with Johnston's recent defense of a logical, rather than temporal, interpretation of Buridanian modality, and the present paper offers further reasons—both logical and temporal—to support that view. All of these reasons ultimately derive from Buridan's conception of propositiones as temporal objects.

1.2 Logic and Time

How important is time in the construction of a logical theory? The answer depends, unsurprisingly, on the historical context. In contemporary classical logic, the role of time is minimal or altogether

absent, with notable exceptions such as the work of Prior and Kamp. By contrast, in fourteenth-century logic, temporal considerations pervade virtually every component of logical theory, beginning with language itself.

In the nominalist tradition, and especially in Buridan's work, time plays a decisive role in shaping the very nature of logic—a role that has not yet received the attention it deserves. The connection between language and time can be articulated along three dimensions:

(a) time belongs to the ontological presuppositions that ground the concept of language, insofar as the components of language—terms, sentences, and arguments—are spatio-temporal objects;

(b) grounding propositions in time has semantic consequences for their semantic properties;[2]

(c) time is represented within propositions themselves, through the function of the copula "is," as developed in the theories of *amplificatio* and *restrictio*.[3]

In this paper, we focus primarily on (a), and to a lesser extent on (b), while setting aside (c). By accepting (a), time is introduced directly into logical language: if the building blocks of language are spatio-temporal objects, then logic itself is constructed out of temporal entities.

Nominalist logicians, and Buridan in particular, provide a clear illustration of how temporal considerations affect logic at its most fundamental level, including its core metalogical notions. The aim of this paper is to show how a modal notion such as possibility is reshaped under these conditions. The issue at stake is not merely the development of modal logic within a temporal framework, but the way in which the basic metalogical concepts of Buridan's logic—*propositio*, truth, and validity—are themselves defined in light of time.

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[2] For example, language is time sensitive, in the sense that the truth value of a proposition may change according to the moment at which it is considered (for example 'Socrates is sitting' may be true or may be false according to the moment at which it is considered). See section 1.4.

[3] Readers interested in this point may refer to Moody (1956) or Dahlquist (2018) as introductory texts; for more technical considerations, see Normore (1976).

We shall argue that, for Buridan, a conception of possibility grounded in truth cannot coexist, without paradox, with the validity of certain modal principles, such as the inference from $\Box(A \rightarrow B)$ to $(\Diamond A \rightarrow \Diamond B)$, once the foundational objects of logic are conceived as temporal. As a result, a truth-based account of possibility is displaced by an epistemic conception grounded in *significatio*. Crucially, this shift is motivated by logical rather than philosophical considerations: it follows from the internal consistency of Buridan's logical framework once time is treated as a fundamental concept. Depending on the ontological conception of proposition one adopts, different notions of the possible emerge. The Buridanian alternative, we suggest, is logically, philosophically, and semantically significant.

1.3 Logic, Language, and proposition

It is often said that "a logic consists of a formal or informal language together with a deductive system and/or a model-theoretic semantics" (Shapiro and Kissel 2024). While a logical theory may lack either a deductive system or a semantic treatment, language is indispensable. Language matters to logicians because it is composed of propositions, and propositions are the vehicles through which content is expressed.

> We communicate by exchanging propositions, encoding them in linguistic expressions and making those expressions public. In this way, new information is introduced, beliefs are revised, and bodies of knowledge are transmitted. As Russell, Murray, and Tillman emphasize, propositions constitute much of our intellectual inheritance, including our laws and collective identities
>
> (Russell, Murray, and Tillman 2023, 1).

Since reasoning consists in drawing conclusions from propositions, propositions are indispensable to logic. The question of what a proposition is in a given logical framework—how the notion of proposition is understood or defined—is therefore fundamental. As Epstein puts it, "the basic object of study of logic is a proposition" (Epstein 1990, 3). Because of its foundational status, the conception of proposition adopted by a logical theory interacts with other central metalogical notions, such as truth, validity, and possibility. We turn now to this interaction.

1.4. An Ontological Distinction: Propositio vs Proposition

At the outset, the question arises: what is a proposition? Answers to this question have varied throughout the history of logic, and the issue is far from trivial. In what follows, we distinguish between the contemporary and the medieval uses of the term. To avoid confusion, we use "proposition" to refer to the contemporary notion, and *propositio* (plural: *propositiones*) to refer to the medieval conception.

In its contemporary sense, a proposition is typically understood as an abstract object, often with a distinctly Platonic character. In his revised and expanded *Introduction to Mathematical Logic*, Alonzo Church writes:

> "Any concept of a truth-value, provided that being a truth-value is contained in the concept, and whether or not it is the sense of some actually available sentence in a particular language under consideration, we shall call a proposition, translating thus Frege's Gedanke. Therefore, a proposition, as we use the term, is an abstract object of the same general category as a class, a number, or a function"
>
> (Church 1956, 26). 4

By contrast, medieval logicians understood a *propositio* as a linguistic object. As Cesalli notes, "a *propositio*—that is, a proposition in the medieval sense of the word—is a type of sentence, that is, a linguistic expression singled out by its truth-evaluable character" (Cesalli 2016, 245).

This difference marks a deep ontological divide. Whereas propositions are abstract objects, *propositiones* are spatio-temporal particulars. In contemporary terms, they correspond most closely to sentence-tokens.[5] As Orayen explains, sentence-tokens are concrete entities located at specific spatio-temporal coordinates, whether as spoken sounds or written inscriptions (Orayen 1989, 19).

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[4] Church later adds that "It has not the psychological character of William of Ockham's *propositio* mentalis or of the traditional judgment" (1956, 26), but here Church is wrong, since for the nominalist logicians of the fourteenth century (as Ockham was) propositions are not (not even mental propositions) psychological objects (at least in the Fregean sense of the term).

[5] The idea of considering medieval *propositiones* as tokens is established in many important works on medieval logic. Among these, we can highlight Spade (2002), Klima (2004-2009), and Dutilh Novaes (2005).

To this we must add mental *propositiones*, which medieval authors also regarded as spatio-temporal particulars. As Klima emphasizes, mental *propositiones* are "naturally representing individualized qualities of thinking substances" (Klima 2004, 98). Spoken, written, and mental *propositiones* all come into existence and cease to exist like other objects in the world. From Ockham onward, it was commonly accepted that the domain of entities is not fixed, and *propositiones* form part of this changing ontology.[6]

Buridan's ontology thus includes not only the objects of a given universe of discourse, but also the linguistic items used to describe that universe. As a result, his logical semantics is token-based: it assigns semantic properties to individual *propositiones*, understood as concrete entities.

1.5. Propositio: Semantics Properties

Because *propositiones* are temporal objects, they possess semantic properties that differ in important ways from those of abstract propositions.

First, a *propositio* can be true or false only if it exists. If a *propositio* does not exist at a given time, it cannot bear a truth-value at that time. As Hughes formulates the point, "for a proposition to be true at time *t*, it must first meet the requirement that it exists during *t*, and then it can be true at *t*" (Hughes 1982, 6).

Second, since the objects of logical language include linguistic items themselves, semantic evaluation must take into account not only how things are in the world, but also how the items of the language under evaluation are. As Klima observes,

> "given Buridan's nominalist, token-based conception of language and logic, in assigning semantic values to the items of these

[6] For those who find this idea only linked to the Middle Ages, it is worth remembering what Russell said in this regard in 1919, when he spoke of propositions:
"According to the theory of propositions suggested in the previous section, it would be a mistake to regard truth and falsehood as relations of the " ideal" to the " real." Propositions are facts in exactly the same sense in which their objectives are facts. The relation of a proposition to its objective is not a relation of something imagined to something actual: it is a relation between two equally solid and equally actual facts." (Russell 1919, 37.)

> languages, he has to take into account not only how things other than items of a language are, but also how things that are items of the language under evaluation are"
>
> (Klima 2009, 205).

One striking consequence of this is that the sentence "No proposition is negative" (*Nulla propositio est negativa*) may be true *of* a state of affairs, while failing to be true *in* that very state of affairs.

Third, once propositions are no longer treated as types but as tokens, and once self-reference is admitted, equiform sentences can differ in their logical properties.[7] Self-reference arises naturally in a token-based framework, since *propositiones* can refer to themselves or to the class to which they belong. As Read notes, this kind of self-reference is indirect but philosophically significant (Read 2001, 193)

By abandoning the assumption that propositions are types and allowing for self-reference, Buridan transforms the semantic landscape of logic. These changes are not accidental; they follow directly from the ontological definition of *propositio*. We conclude with the following characterization:

> **Propositio.** A *propositio* is a sentence that is uttered—thought, spoken, or written—at a specific time *t*, and is used in such a way that it is either true or false, but not both. *Propositiones* come into existence and cease to exist like other objects in the world. Once a *propositio* exists, it is legitimate to speak about it as one more entity among others.[8]

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[7] The sentence in box R contains forty-seven letters.

Box R

⇓

The sentence in box R contains forty-seven letters.

As we can see, these sentences contain no indexical words, nor anything similar. Just having the means to create self-reference in the language allows for equiform sentences to have different properties of logic.

[8] For discussions on this type of semantics, see Epstein (2006), Chapter XXII.

2. Metalogic and Temporal Building Blocks

2.1. Truth

What was established in the previous section is well captured by the first part of the following remark:

> Buridan rejects any abstract notion of 'proposition' to serve as truth bearer and fundamental constituent of semantic analysis, and replaces it with a theory of logic and language designed to apply to the individual inscription.
>
> (King 1988, 5; emphasis added)

What remains to be examined is the second component of this claim, namely, the distinctive features of a logic constructed out of temporal building blocks and the ways in which it diverges from contemporary logical frameworks. In metalogical terms, this amounts to asking how core notions such as truth, implication, and possibility are affected once propositiones are taken to be temporal objects. Given the aims of this paper and limitations of space, we will focus primarily on possibility, while treating truth and validity more schematically and providing references for further discussion.

Buridan's account of truth presupposes several necessary conditions for a propositio to be true. For present purposes, these can be summarized as follows:

(i) **Existence**: a propositio must exist in order to be true. We label this requirement **(T-EXIST)**;[9]

(ii) **Causation**: there must be something in virtue of which a true propositio is true. We label this requirement **(T-CAUSE)**;[10]

[9] Section 1.4.

[10] A propositio is true if and only if there are causes for it to be true: "I understand by "the causes of truth" of a proposition whichever of them is enough for the proposition to be true." (Buridan 2010, 65). Archambault paraphrases Buridan's definition: "A cause of truth of a present-tense assertoric proposition φ at time t is a state of affairs present at t making the proposition true, provided φ exists." (2017, 27). Thus φ must have some cause to be true; if φ lacks a cause of truth, φ is not true.

(iii) **Consistency**: if a propositio φ is true, then its negation (¬φ) cannot be deduced from it, either alone or in conjunction with another true propositio ψ. We label this requirement **(T-CONS)**;[11]

These three conditions are jointly necessary for truth. Among them, (T-EXIST) is the most distinctive, since it follows directly from the temporal conception of *propositiones*. Condition (T-CAUSE) anchors truth in facts, in line with broadly classical assumptions, while (T-CONS) expresses a minimal requirement of consistency that any body of true sentences must satisfy.

It is precisely (T-EXIST) that creates tension with what is now known as Schema T, usually formulated as T⟨*A*⟩ ↔ *A*. Medieval logicians were familiar with this principle through Aristotle's formulations, but also through William of Sherwood's more explicit and deflationary account.[12]

> There are six modes—true, false, possible, impossible, contingent, necessary. However, since the first two do not distinguish a modal proposition from an assertoric statement, they are omitted; for it is the same thing to say 'Socrates is running' and 'it is true that Socrates is running'.
>
> (Sherwood 1960, 40–41)[13]

In contemporary notation, this principle is expressed as T⟨*A*⟩ ↔ *A*, often understood as licensing unrestricted substitution between a sentence and its truth ascription. This property—commonly called *transparency*—"allows, for any well-formed formula *A*, the claim T⟨*A*⟩ to

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[11] "This is a principle to which Buridan appeals several times in later sophisms. It is easily derived from two simpler ones: that a true proposition cannot entail a false one, and that if a conjunction is false then at least one of this is false." (Hughes 1982, 114)

[12] For Aristotle's formulation, see Met 1051b1–5 and Cat 14b14–22.

[13] "Truth and falsity are ascribed primarily to propositions. The proposition to which they are ascribed may be either explicitly given or described. Suppose first that it is explicitly given; then it is evident that *'It is true that Caesar was murdered' means no more than that Caesar was murdered, and 'It is false that Caesar was murdered' means no more than Caesar was not murdered...*" (Ramsey 1990 (1927), 38–9). As can be seen from the quote, Ramsey only mentions T<*A*> → *A*.

be substituted for A or vice versa, in all extensional contexts without change in validity" (Cobreros et al. 2013).

For Buridan, however, the difficulty with Schema T arises from the nature of the *propositio* itself. Once logic is built out of temporal building blocks, the biconditional T⟨*A*⟩ ↔ *A* cannot be accepted without restriction. Buridan illustrates this point in the second sophism of Chapter 8 of the *Sophismata*:

> Second sophism: No proposition is negative; therefore, some proposition is negative.
>
> (Buridan 2001, 956)[14]

Buridan argues that this inference is invalid, since the conclusion is simply the contradictory of the premise, in violation of (T-CONS). Yet if the premise is true—that is, if *T⟨No proposition is negative⟩* holds—then, by (T-EXIST), the *propositio* "No proposition is negative" exists. But if it exists, then at least one negative *propositio* exists, namely that very sentence, which makes the conclusion true. The inference thus appears both valid and invalid, yielding a paradox.

According to Buridan, the source of the difficulty lies in a misinterpretation of Schema T.[15] The error consists in ignoring the temporal character of *propositiones*. If one recognizes that truth presupposes existence, then one may legitimately infer *A* from *T⟨A⟩*, since truth entails existence by (T-EXIST). The converse inference, however—from *A* to T⟨*A*⟩—is illegitimate, since it disregards the existential requirement.[16] Schema T must therefore be restricted.
Buridan makes this explicit:

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[14] *Secundum sophisma: Sequitur «nulla propositio est negativa; igitur quaedam propositio est negativa»*. As in the English translation of the first sophism, Klima (2001) uses the term "proposition," so for the sake of argument I will use "proposition" here, but I am talking about what we call "*propositio*" (Section 1.4.).

[15] "And I respond to the first argument by saying that that rule, thus stated, is not true properly speaking [*de virtute sermonis*], namely, [the rule] that any proposition entails that it is true;" (Buridan 2001, 957)

[16] "indeed, this is not valid: ''A man is; therefore, 'A man is' is true,'' for a man could exist even if no proposition existed, and also because it is possible that things could be as the proposition 'A man is' signifies or would signify if it were propounded, whereas they would not be as '''A man is' is true'' would signify. For this would be the case if there were a man, but no proposition existed." (Buridan 2001, 957)

> But you will ask: "How should that rule of Aristotle's be understood?" I reply that it should be understood as involving the existence of the proposition, so that every conjunction consisting of some proposition and another stating that it exists entails that it is true.
>
> (Buridan 2001, 957)

The upshot is that Schema T holds only under existential quantification.[17] The restriction is not ad hoc, but follows directly from the temporal ontology of *propositiones*. It is also metalogical in nature, since it concerns the concept of truth itself and its dependence on the existence of the truth-bearer.

2.2. Validity

The classical notion of logical validity is commonly associated with the idea of truth-preservation: if the premises of an inference are true, then the conclusion must also be true. We refer to this requirement as the **truth-preserving principle (TPP)**. Once *propositiones* are understood as temporal objects, however, (TPP) comes under pressure.

Buridan illustrates the problem in the first sophism of Chapter 8 of the *Sophismata*:

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[17] Buridan —to avoid the paradox— adds an existential quantifier on the proposition tokens, which joins A with a conjunction, and forms the antecedent of the conditional; in symbols:

(T-IN)* $\exists\,(A) \wedge A \;\Rightarrow\; \text{True}(A)$.
We can add, derived from the previous one, the rule:
(T-OUT)* $\text{True}(A) \;\Rightarrow\; \exists\,(A) \wedge A$

After modifying the rule, the paradox does not happen, since for 'No proposition is negative' to be true, it needs to exist (T-EXIST), *and* what A says happens must happen. When 'No proposition is negative' exists (it is uttered) it ceases to be true (since there exists at least one negative sentence, namely itself). Thus, the conjunction ['$\exists$(*No proposition is negative*) $\wedge$ *No proposition is negative*'] is false (since if the left side is true, the right side is false and *vice versa*); for this reason, we cannot infer 'True(No proposition is negative)'. Therefore, by applying the clause of existence; i.e. accepting that a proposition must first exist, in order to then be true, we avoid the paradox.

> First sophism: Every proposition is affirmative; therefore, no proposition is negative.
>
> (Buridan 2001, 952)[18]

According to Buridan, the premise may be true while the conclusion is false. The sentence "No proposition is negative" is a *propositio*, and thus, by (T-EXIST), it must exist in order to be true. But if it exists, it falsifies itself. As Prior famously observes, the sentence cannot be true, since its existence guarantees the existence of at least one negative *propositio*—namely, itself (Prior 1969, 481). The conclusion is therefore always false.

By contrast, the premise "Every proposition is affirmative" can be true under certain conditions—for example, if only affirmative sentences exist.[19] An inference whose premises can be true while its conclusion is false fails to satisfy (TPP) and would therefore be invalid by contemporary standards.

Buridan, however, insists that the inference is valid. He supports this claim by appealing to three independent considerations:

(A) the locus of contraries;[20]
(B) the possibility of reconstructing the argument as a first-figure syllogism;[21]

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[18] *Primum sophisma: Sequitur «omnis propositio est affirmativa; ergo nulla propositio est negativa».*

[19] ""Every proposition is affirmative" would be true if God annihilated all negatives, and then the consequent would not be true, for it would not be. (Buridan 2001, 953.) The atheist reader can imagine a scenario, a blackboard on which only affirmative sentences are written.

[20] "This [that is, PS] is proved first by the locus from contraries. For just as Every man is ill; therefore, no man is healthy is valid because it is impossible for the same [person] to be both ill and healthy, so is the above, because it is impossible for the same proposition to be both affirmative and negative". (Buridan 2001, 952)

[21] "Again, an enthymeme is valid if by the addition of a necessary proposition it can be completed into a formally valid syllogism for it is by such additions that we usually prove our enthymemes. For example, we say that this is a valid consequence: A donkey flies; therefore, a donkey has wings, for this is necessary: Everything fling has wings, and if we add this as the major, then we get a valid syllogism in the third mode of the first figure. So, also in connection with the sophism, this is true: No

(C) the rule of contraposition;[22]

The appeal to the locus of contraries requires (little more than) accepting standard equivalences between quantifiers.[23] The syllogistic reconstruction is decisive, since syllogisms of the first figure were taken to exemplify formal validity (Read 2012, 908), and the first sophism can be transformed into *Celarent*. Finally, compliance with contraposition was regarded by medieval logicians as a necessary condition for valid consequence.[24]

From these considerations, Buridan concludes that (TPP) is not a necessary condition for validity. The divergence from contemporary logic is again traced to the ontological status of propositiones. Because "No proposition is negative" is self-falsifying whenever it exists, validity cannot be grounded in truth-preservation. Instead, Buridan relocates validity at the level of *significatio*.

For medieval logicians, to signify is "to establish an understanding of a thing."[25] Hence an utterance signifies that thing whose understanding it establishes:

> Against these replies I argue as follows: first, "to signify" is described as "to establish an understanding of the thing"

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affirmative is a negative, and if this is made the major in this enthymeme, then we shall get a valid syllogism, in the second mode of the first figure". (Buridan 2001, 952)

[22] "Again, the opposite of the consequent entails the opposite of the antecedent; therefore, the consequence is valid. For this rule is common to every valid consequence. P.3.1: But the antecedent [suggested in P.3] is obvious: for Some proposition is negative; therefore, not every proposition is affirmative is obviously valid". (Buridan 2001, 952)

[23] $\forall x(Px \rightarrow Ax) \equiv \exists x(Px \wedge \neg Ax)$. If we understand "P" as "proposition" and "A" as affirmative, we have Buridan's idea presented in a logically precise manner. We must assume that "non-affirmative" is equivalent to "negative." (See Uckleman 2012, 489; Dahlquist 2023, 114)

[24] In every good consequence, the contradictory of the antecedent must follow from the contradictory of the consequent, and every proposition formed as a consequence is a good consequence if the contradictory of the antecedent of the said consequence follows from the contradictory of the consequent of the said con sequence. (Buridan 2015, 76)

[25] "To signify x =df. to establish an understanding of x". (Spade 2002, 63)

(Buridan 2001, 828)

An inference is therefore valid if and only if it is impossible for things to be as the premises signify without also being as the conclusion signifies. As Klima summarizes, "Buridan reformulates the requirement for the validity of a consequence in terms of the correspondence-conditions of the propositions it involves" (Klima 2016, 320–321).

2.3. Some Characteristics of Buridan's Approach

Buridan's framework exhibits several distinctive logical features. Some were already noted by Prior in his discussion of the first sophism, while others reflect more general traits of medieval logic. Taken together, they clarify the structure of Buridan's metalogic.[26]

A central feature is that each sentence under consideration is a propositio, and distinct propositiones of the same type may differ in truth-value. This allows each propositio to function as evidence for itself, contributing to the determination of its own semantic content and modeling the inferential context in which it appears.

A further noteworthy feature is that propositiones can ascribe syntactic properties to themselves, such as being affirmative or negative, without collapsing the distinction between object language and metalanguage. As Prior observes, this is less problematic than semantic self-ascription:

> We could say … that the characterization of a proposition as "negative," unlike its characterization as "true," is a syntactical rather than a semantic matter, and that there is nothing against a language containing its own syntax, though there may be plenty against its containing its own semantics.
>
> (Prior 1969, 481)27

These features are not accidental, but follow directly from the temporal and token-based conception of *propositiones*. They set the stage for the analysis of possibility in the following section.

[26] See Dahlquist 2023, 105-106.

[27] See also, Uckelman 2012, 495.

3. Possibility

3.1 Primum Sophisma

We now arrive at the central part of this paper. In what follows, we examine how the concept of possibility relates to *propositiones*. Our point of departure is the first sophism (*Sequitur*: *omnis propositio est affirmativa; ergo nulla propositio est negativa*), which exhibits two fundamental features:

a) The first sophism is a **valid inference** (for the reasons given in §2.2).

b) The first sophism has a **premise that can be true**, namely *Every proposition is affirmative*, and a **conclusion that cannot be true**, namely *No proposition is negative*.

For the sake of clarity, we introduce part of the standard formal language of alethic modal logic. As usual, "□" stands for *necessary* and "◊" for *possible*. "⊃" represents the material conditional, and "¬" classical negation.[28] On this basis, the First Sophism—understood in light of the two features just mentioned—can be formalized as follows:

$$\Box(A \supset B) \supset (\Diamond A \supset \neg \Diamond B)$$

The antecedent $\Box(A \supset B)$ captures feature (a), that is, the implication is valid and therefore necessary. The consequent expresses feature (b): the antecedent is possible, whereas the consequent is impossible, since *No proposition is negative* cannot be true.

[28] In medieval logic, modal operators (necessary, possible, contingent) are interdefinable via negation, a thesis found in Aristotle's *De interpretatione* (See Lemmon and Scott 1977, 1). More relevant are the ideas concerning which sentence components are affected by modalities; the distinction between *dictio* and *de re* can be considered a fully developed medieval theory on the matter, but it also originates with Aristotle and Abelard's readings of *Sophistic elenchi* 4, 166a23-30. Buridan discusses the conversions between these two concepts (See Knuuttila 1993). It is often argued that his framework provides an understanding of modality as a kind of generality that can be examined within the context of possible worlds semantics (see Johnston 2021; Prior 1969).

Buridan is fully aware that this result poses a serious difficulty. It is a difficulty because Buridan does not want to accept $\Box(A \supset B) \supset (\Diamond A \supset \neg\Diamond B)$ as a true conditional (or, equivalently for him, as a valid inference, since he does not distinguish sharply between the two notions). The reason is that such a result conflicts with one of the core Aristotelian modal principles, and indeed, "the whole logic of compound modal propositions was in fact based on the Aristotelian principles for propositional modal logic" (Knuuttila 2008, 554).[29] We return to this issue in §3.3.

3.2 Time and Conditionals

As Broadie rightly observes, "the medieval vision that a proposition has a time-span and also, in the case of inscription, a spatial location, plays a role right at the heart of medieval logic in discussions about the nature of valid inference" (2002, 20–21). Time is therefore an essential element for an accurate account of Buridanian conditionals.[30]

In his *Tractatus de Consequentiis*, Buridan offers a series of progressively refined definitions of logical consequence. He begins with what we may call the intuitive conception of consequence, that is, truth-preservation:

> Hence, many say that of two propositions one is antecedent to the other if it is impossible for the one to be true without the other being true, and one is consequent to the other if it is impossible for the one not to be true when the other is true, so that every proposition is antecedent to every other proposition for which it is impossible for it to be true without the other being true.
>
> (Buridan 2015, 67)

As is well known, Buridan—unlike some other medieval logicians—does not draw a strict distinction between logical consequence and conditionals. His notion of implication is therefore close to what we would now call a strict conditional, with the crucial addition of temporal considerations. In order to accommodate these temporal aspects, Buridan

[29] Specifically, $\Box(A \supset B) \supset (\Box A \supset \Box B)$ and $\Box(A \supset B) \supset (\Diamond A \supset \Diamond B)$; See section 4.2

[30] See Dahlquist 2021, section 1 and section 2.

must adapt the definition of consequence so that it applies to *propositiones* rather than to abstract propositions—and this is precisely what he does.

He immediately notes, however, that the initial formulation is defective:

> But the description is defective or incomplete, since the following is a valid consequence: 'Every man runs; therefore, some man runs'; since it is possible that the first proposition is true and that the second is not true, because it does not exist at all.
>
> (Buridan 2015, 67; emphasis ours)

Buridan therefore revises the definition so as to include the time at which each *propositio* is formed:

> So, some say the given definition should be supplemented like this: the one proposition is antecedent to the other proposition if it is impossible that it be true the other not being true when they are formed together.
>
> (Buridan 2015, 67; emphasis ours)

What emerges here is a distinctive conception of logic—embraced by some philosophers and rejected by others. As Archambault aptly remarks:

> With Prior and Kripke and against Quine and Tarski, the propositional edifice upon which Buridan builds his account of consequence retains modality and tense.
>
> (Archambault 2016, 7–8)

In Buridan's framework, time occupies a place within the very building blocks of logic, namely *propositiones*. This temporal dimension permeates all other components of logical theory, including conditionals. Consequently, it makes little sense to ask which part of implication is "logical" and which part is "temporal" within Buridan's system. Implication is both logical and temporal—or, more precisely: if it is logical, it is temporal; and if it is temporal, it is logical.

3.3 The Master Argument

From the foregoing, it follows that the problem raised by the first sophism concerns time, modality, and conditionals. These same notions

were famously addressed by the Stoics through the Master Argument, which "can be regarded as an attempt to clarify the conceptual relations between time and modality" (Øhrstrøm 1995, 15). Conditionals belong to this triad, especially in Diodorus' framework, where they are closely tied to his modal theory.[31]

Buridan's discussion of the first sophism appears strikingly relevant to the issues raised by the Master Argument. One might even suspect that Buridan was directly responding to Diodorus, were it not for the fact that we know he had no access to the Stoic debates on conditionals and modality. Nevertheless, it is philosophically illuminating to imagine Buridan as a participant in this discussion, given how closely his treatment of the first sophism in the *Sophismata* aligns with the questions posed by the Master Argument. Moreover, Buridan's temporally grounded logic leads him to a different assessment of which premises of the trilemma should be accepted.

The Master Argument has come down to us through Epictetus' report. According to Mates' (1961, 38) reconstruction, Diodorus held the following three propositions:

(P1) Every proposition true about the past is necessary.
(P2) An impossible proposition does not follow from the possible.
(P3) There is a proposition which is possible, but which neither is nor will be true.

The Master Argument has been reconstructed in various ways, always on the basis of fragmentary and indirect evidence concerning Diodorus' views. Notable reconstructions have been offered by Mates, Prior, Hintikka, Øhrstrøm, and Gaskin. We follow here Arthur Prior's formulation:

[31] "The present study offers a more faithful characterization of the view of Diodorus in regard to conditionals and shows how that view is closely connected with his rather unusual views on necessity and possibility" (Mates 1961, 4). Later on: Little is known of the philosophy of Diodorus save two important definitions (and examples illustrating these): (1) a proposition is possible if and only if it either is true or will be true; (2) a conditional proposition is true if and only if it neither is nor was possible for the antecedent to be true and the consequent false. It is known that he constructed the famous "Master" argument (σκνρςενων) to justify his definition of "possible". (Mates 1961, 6)

(P1′) $Pq \supset \Box Pq$
(P2′) $(\Box(p \supset q) \wedge \Diamond p) \supset \Diamond q$
(P3′) $(\exists r)\ (\Diamond r \wedge \neg r \wedge \neg Fr)$

In this reconstruction, "propositions" are not understood in the modern sense, but rather on the assumption "that the same proposition may be true at one time and false at another" (Prior 1955, 205).

There is some disagreement concerning the correct formal representation of Diodorean implication. It is sometimes interpreted as a strict conditional, defined as:

$$p \rightarrow q \quad \stackrel{def}{=} def \quad \Box(p \supset q)$$

Øhrstrøm and Hasle (1995), by contrast, propose the symbol "⇒", defined as:

$$p \Rightarrow q \stackrel{\text{def}}{=} def\ \forall t(\mathrm{T}(t,p) \supset T(t,q))$$

Here, "T" is a truth predicate, "t" ranges over times, and "p" denotes a proposition. On this interpretation, Diodorean propositions are treated as functions of time, mapping moments to truth-values. The application of proposition p at time t is expressed as $\mathrm{T}(t, p)$.

There is, however, broad agreement concerning Diodorus' definition of possibility: something is possible if it is true or will be true at some time. This can be formalized as:

$$\Diamond p \quad \stackrel{\text{def}}{=} def \quad Fp$$

According to Epictetus, Diodorus maintained that the three propositions of the Master Argument cannot all be true. The argument therefore forms a trilemma. Diodorus himself accepted (P1) and (P2), and on that basis rejected (P3). Other Stoics proposed different resolutions. Chrysippus retained (P1) and (P3), rejecting (P2). Cleanthes, by contrast, accepted (P2) and (P3) and rejected (P1).[32]

[32] These seem to be the sort of starting points from which the Master Argument is posed. The following three propositions mutually conflict: 'Every past truth is necessary'; 'Something impossible does not follow from something possible'; and 'There is something possible which neither is nor will be true'. Diodorus saw this

This last position has received remarkably little attention in the secondary literature. Virtually no sustained discussion exists concerning Cleanthes' solution or the method by which he intended to implement it. One noteworthy feature of our analysis is that Buridan, like Cleanthes (though for different reasons), accepts (P3). In the following sections, we examine how and why Buridan arrives at this position.

4. Buridan's Concept of the Possible

4.1 The Possibly-True and the Possible

One of the central implications of taking *propositiones* as the building blocks of logic is that the existence of a *propositio* is a prerequisite for its truth. *Propositiones* are treated as objects. This immediately raises a fundamental question: when can we say that something is possible, and what kinds of things can be classified as possible?

In modal logic, the term *possible* may apply either to objects or to sentences, depending on the context in which modality is deployed. This distinction was already clearly recognized in the Middle Ages, most notably in the contrast between *modalities de re* and *modalities de dicto*.

From a nominalist perspective, the distinction concerns the kinds of objects to which modality applies, since a *propositio* itself is an object.

At the same time, we must ask what criteria Buridan employs to determine what counts as possible. In antiquity,

> Modal terms refer to the one and only world of ours and classify the types of things and events on the basis of their actuality. This

conflict and exploited the convincingness of the first two to establish the conclusion that 'Nothing which neither is nor will be true is possible'. Now some will retain the pair 'There is something possible which neither is nor will be true' and 'Something impossible does not follow from something possible, but deny that 'Every past truth is necessary'. This seems to have been the line taken by Cleanthes and his circle and was in general endorsed by Antipater. Whereas others will retain the other pair, that 'There is something which neither is nor will be true', and that 'Every past truth is necessary', but hold that something impossible does follow from something possible. To retain all three is impossible because of their mutual conflict. So if someone asks me, 'Which of them do you retain?' I shall answer 'I don't know; but my information is that Diodorus retained the first pair I mentioned, the circles of Panthoides (I think) and Cleanthes the second pair, and Chrysippus and his circle the third pair.' e (Epictetus *Dissertationes* 2.19, 1-10).

> paradigm suggests that actualization is the general criterion of the genuineness of possibilities, but the deterministic implications of this view compelled Aristotle to seek ways of speaking about unrealized singular possibilities. Diodorus Chronus (fl. 300 BCE) was a determinist who found no problem in this way of thinking.
>
> (Knuuttila 2020, §1)

For Diodorus, actualization is the decisive criterion of possibility—and actualization is, of course, a temporal notion. Buridan initially appears to accept a temporal criterion when analyzing modalities, but later moves toward a conception of modality grounded in logical principles rather than temporal realization. This thesis has recently been defended by Johnston (2024), and we endorse it on the basis of our own analysis, developed independently of his work.

> Buridan starts off endorsing a temporal analysis of modal propositions, where modal expressions are reduced to combinations of temporal expressions, but in his later writings on logic he settles on an analysis of modality grounded in the idea of what an agent can or cannot bring about.
>
> (Johnston 2024, 51–52)

Our arguments rely primarily on Chapter 8 of the *Sophismata*, a logical work from Buridan's mature period, composed after his earlier treatises in which modality and time are developed jointly. The First Sophism provides the most illuminating example. Buridan asks us to imagine a situation in which only affirmative *propositiones* exist, because God has annihilated all negative *propositiones*. In such a scenario, *Every proposition is affirmative* can be true. This, however, seems to imply *No proposition is negative*.

The crucial point is that, while the first *propositio* can be actualized, the second cannot. When we are dealing with *propositiones*, the sentence *Nulla propositio est negativa* is itself an object that either exists or does not exist. If it comes into existence, it can be assigned a truth value—but precisely because it is self-contradictory, it loses its truth at the very moment it is actualized. Hence, *Nulla propositio est negativa* cannot be actualized without ceasing to be true.

Truth and actualization, therefore, are incompatible once propositions are treated as objects—that is, once we are dealing not with propositions, but with *propositiones*.

Buridan then introduces a distinction that drew the attention of both Prior and Hughes: although *No proposition is negative* is not *possibly true*, it is nevertheless *possible*, insofar as it describes a possible state of affairs.[33] This captures Buridan's own conception of possibility:

> Thus, an affirmative assertoric present-tense proposition is said to be possible if things can be altogether as it signifies them to be, and necessary if things must be altogether as it signifies them to be.
>
> (Buridan 2015, 64)

Here, modality shifts from the temporal to the epistemic domain. A world is epistemically possible if, given a world w_1, another world w_2 is one that cannot be known *a priori* not to be the actual world (Soames 2022, 36).[34] We return to this point below. For now, it is enough to note that, in the context of the Master Argument, Buridan explicitly allows for the existence of a *propositio* that is possible but neither true nor ever will be true—precisely the case asserted by (P3):

$$(\exists r)\ (\Diamond r \wedge \neg r \wedge \neg Fr)^*$$

*where r = *nulla propositio est negativa*.

4.2 An impossible proposition does not follow from the possible?

If we accept the foregoing analysis together with the account of validity presented in §2.2, then the First Sophism presents—according to Buridan—a case of valid implication (*bona consequentia*), whose antecedent is possible (*omnis propositio est affirmativa*), but whose

[33] ""No proposition is negative" cannot be true, since to be true it must be there, and if it is there, there is at least one negative proposition, namely itself. On the other hand, though not " possibly true ", it is " possible ", in the sense of describing a possible state of affairs, since God might have annihilated all negative propositions, including that one. (Prior 1969, 205)

[34] Of course, "Nothing we have said up to now rules this out. Nothing we know in advance excludes the (epistemic) possibility that what would be possible if one world- state were to be actual may differ from what would be possible if another world- state were actual". (Soames 2022, 41)

consequent (*nulla propositio est negativa*) cannot come into existence without losing its truth.

$$(\Box(p \supset q) \wedge \Diamond p) \supset \neg\Diamond q$$

where p = *omnis propositio est affirmativa* and q = *nulla propositio est negativa*.

Does this mean that Buridan rejects (P2)? According to Epictetus, Chrysippus was the only logician to take this route. Did Buridan follow him? Answering this question requires a significant shift in our understanding of Buridanian modality, and it lies at the heart of this paper.

To see why, we must recall that (P2) is closely connected with what is now known in modal logic as Axiom K, whose roots go back to Aristotle:

> If, for example, one should indicate the premises by A and the conclusion by B, it not only follows that if A is necessary, B is necessary, but also that if A is possible, B is possible.
>
> (Prior Analytics I.15, 34a 13–16)

This principle was equally well known to medieval logicians (Knuuttila 1993, 168):

> The whole logic of compound modal propositions was in fact based on the Aristotelian principles for propositional modal logic as well:
>
> (1) $\Box(A \supset B) \supset (\Box A \supset \Box B)$
>
> (2) $\Box(A \supset B) \supset (\Diamond A \supset \Diamond B)$

From a contemporary perspective, this principle appears almost beyond dispute. As the Kneales remark in their discussion of the Master Argument:

> To the modern reader only one statement in this argument is unexceptionable. This is the second proposition, a recognized thesis of modal logic, which was already known to Aristotle.
>
> (Kneale and Kneale 1961, 119)

Buridan, an exceptionally careful logician, is unlikely to have rejected (P2). The challenge, then, is to reconcile the truth of (P2) with both the validity of the First Sophism and the impossibility of actualizing the truth of *Nulla propositio est negativa*.

4.3 A New Conception of Possibility

Buridan addresses this difficulty by appealing to his conception of validity, according to which truth-preservation is neither a necessary nor a sufficient condition for valid inference:

> The second conclusion is that the antecedent of a valid consequence can be true while its consequent cannot be true. And this is clear in the present case: for 'Every proposition is affirmative' can be true and 'No proposition is negative' cannot be true, and yet the second follows from the first. And the same would hold in many other cases, for example, 'Every syllable is several letters; therefore, no syllable is a single letter'.
>
> (Buridan 2001, 954)35

From the perspective developed in §1.3, this result follows directly from treating sentences as temporal objects. The criterion of validity shifts from truth to *significatio*.[36] Accordingly, (P2) can be preserved even if the consequent of a valid inference is false.

> Therefore, some give a different definition, saying that one proposition is antecedent to another if it is impossible for things to be altogether as it signifies unless they are altogether as the other signifies when they are proposed together.
>
> (Buridan 2015, 67)

This reinterpretation of validity prepares the ground for a corresponding redefinition of possibility. In order to preserve (P2), Buridan must abandon the idea that possibility is defined in terms of truth or future truth. Hence:

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[35] In the phrase "Every syllable is several letters," every syllable in the words contains more than one letter. This suggests that no syllable consists of a single letter. However, the statement "no syllable is a single letter" itself contains the letter "a," which is indeed a single letter. The example is more effective in Latin than in English, but it is still understandable in both languages.

[36] A shift that Read has referred to as the "preservation of verification", Spade calls "firmness" and which Klima calls "correspondence".

> And thus it is clear that a proposition is not said to be possible because it can be true, nor impossible because it cannot be true but it is said to be possible because things can be as it signifies, taking these words in the proper sense according to the determination in chapter 2, and impossible because things cannot be so, etc.
>
> (Buridan 2001 954-955)

4.4 Signifies and Epistemic Possibilities

Buridan's definition of possibility turns on the notion of *significatio*. Fortunately, this notion is relatively straightforward in medieval semantics:

To signify x = to establish an understanding of x.

As Spade puts it, "a thing means what it makes us think" (Spade 2002, 63).

Possibilities, then, are epistemic: they concern what can coherently be understood as the case.[37] In this respect, Buridan's account anticipates modern epistemic theories of modality, such as those discussed by DeRose (1991) and inspired by Hacking.

No proposition is negative is logically possible, because it describes a coherent state of affairs, even though it can never be actualized. This illustrates how treating *propositiones* as temporal objects reshapes the metatheory of modality.

If for a moment we adopt (in a somewhat rough way, just as a sort of philosophical experiment) the medieval definition of *significatio* and equate it with the concept of information, the outcome aligns with what Barwise has presented. In this context, the reader can substitute the term "information" with "signification."

> The set of possible states at a given point in the inquiry depends on the information concerning the issues currently available. The impossible states are those incompatible with the currently available information; the others are possible.
>
> (Barwise 1997, 498)

Once again, let's say that the whole process that brought us here began with the acceptance that propositions are temporal objects.

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[37] It would probably be more accurate to call them epistemic/semantic conceptions of modality, but that would also be more cumbersome. I will use only the term "epistemic" for the sake of clarity.

4.5 Buridan versus the Statistical or Temporal-Frequency Interpretation of Modality

Reconsidering the Master Argument, Buridan's mature position becomes clear. By accepting (P2) and redefining possibility in semantic rather than temporal terms, he abandons the statistical or temporal-frequency interpretation of modality. Possibility is no longer a matter of what is or will be actualized, but of what can be signified.

Buridan initial understanding of modalities is clearly illustrated in his "*Questions Longe Super Librum Perihermeneias*"

> (...) that which is and will always be true and which cannot be false, although it was false before, is called 'impossible', which neither is nor can be true, although it could have been true. And that which is called 'possible' is called 'possible' because it is or could be true in the future.
>
> (p. 56, 21-25)

In contrast, when we focus on logical texts, semantic interpretation emerges:

> Thus, an affirmative assertive proposition in the present tense is said to be possible if things can be completely as it means, and necessary if things must be completely as it means. And if it is in the past tense, then it is possible if it was possible for things to have been completely as it means. And similarly for others.
>
> (Buridan 2015, 64)

Buridan's logical writings thus reflect a decisive shift away from temporal actualization toward epistemic modality. Our analysis supports Johnston's (2024) thesis, while adding a crucial point: Buridan's abandonment of temporal modality is driven by logical–ontological considerations rooted in his conception of *propositiones* as temporal objects.

The final lesson is stark: one cannot simultaneously define modalities through time and define propositions as temporal objects. Once *propositiones* become the building blocks of logic, possibility must be epistemic.

Dedication

To Diego Andrés Letzen and Ricardo Bergel, for all these years of friendship. To Aarón Saal, because every time I write a paper, I imagine what he would say, as a critical reader.

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