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Talking about the future: unsettled truth and assertion

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2.1 INTRODUCTION: FUTURE CONTINGENTS IN BRANCHING TIME FRAMEWORKS

Future contingency is one of the oldest topics in philosophy, dating back to Aristotle, the Stoics and the Megarians.[1] It is tightly connected with several core problems in philosophy, and, in particular, with the topics of agency, free will, and moral responsibility.

As it arises in natural language semantics, the problem of future contigents may be seen as the problem of specifying the truth conditions for future tensed sentences in such a way that the resulting semantics remains compatible with the hypothesis of an indeterministic universe; that is to say, a universe such that not every event is *causally determined* by the ones that have occurred up to it (even if most are). Suppose that the events that have taken place up to this moment leave it open whether it will rain tomorrow in Paris. What, then, should be the truth-value that our semantics assigns (if any) to the sentence 'It will rain tomorrow' as uttered today in Paris? Different frameworks will provide differents answers, depending on whether they give preference to either of the following desiderata, or instead treat them on a par:

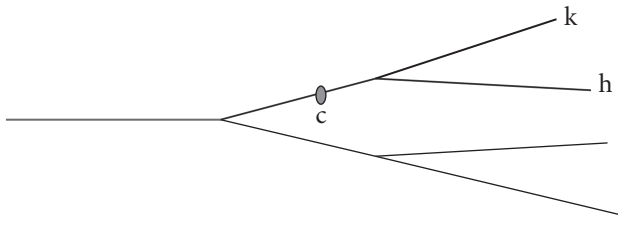
- *Lack of a pre-established truth-value*—Given that, at the time of the utterance, it is not yet settled whether it will rain or not, the sentence 'It will rain tomorrow' appears to lack a truth-value as of the time of the utterance.
- *Retrospective truth-evaluability*—Suppose that it rains indeed. Then, once the event has happened, we may retrospectively assign value True to the sentence 'It will rain tomorrow', as uttered yesterday. Similarly, if it does not rain, we may

[1] For an overview and a historically informed discussion, see e.g. Gaskin (1995); see also Annexe in Prior (1957).

assign it value False. Thus from an appropriate future standpoint, the sentence does not lack a truth-value.

Although most of the existing accounts of future-tensed sentences take the two desiderata to be incompatible, there are accounts, such as the one put forward by Nuel Belnap (e.g. Belnap and Green 1994; Belnap et al. 2001), or the one proposed by John MacFarlane (see e.g. MacFarlane 2003, forthcoming), that attempt to satisfy both desiderata.

In this section, we start by briefly presenting and comparing four accounts that all rely on *branching time* structures. The core idea of a 'branching time' is that the future is open, that is to say, that there is not just one, but many, perhaps even *infinitely* many possible ways in which the world may evolve from now on. This idea is modelled by means of tree-like structures: from any point on the tree, looking backward, there is a single, linear past, while, looking forward, the future is not linear but branching. On some branches, it rains on a certain day in Paris, on others, it does not; on some, Hollande gets reelected at the next presidential elections in France; on others, someone else gets elected; and so on. In a branching time framework, a 'moment' corresponds to a point on the tree, while a 'history' (or a 'chronicle') corresponds to a path on the tree. Representing the idea graphically, in th, 'c' denotes a moment while 'k' and 'h' denote histories.



Presented somewhat more formally, a branching time structure is a tense-logical structure (T, ≤, H, *Val*), where T is a set of moments of time, ≤ is a partial ordering relation on T, and H is a set of histories and is a subset of T's powerset (i.e. its members are *sets* of moments). Note that histories may overlap, as k and h do in the schema above, just as sets may have non-empty intersections. Note also that one and the same moment may belong to more than one history, just as one and the same element may be a member of more than one set (thus c, in the schema above, belongs to both k and h). Finally, *Val* is a valuation function that maps propositional constants to sets of moments.[2] Intuitively, a moment *m* will be belong to *Val*('p') iff the proposition denoted by 'p' holds, or is true, at *m*; thus if 'p' stands for the proposition that it rains in Paris, then a moment belongs to *Val*('p') iff *at that moment* it rains in Paris. It is also

[2] For the sake of simplicity, we are only considering a propositional language that does not contain quantifiers, so that the semantic structures do not contain any domains of individuals.

common to assume that the members of H are (all and only) maximally ordered *linear* subsets of T.

A branching time structure by itself does not yet deliver any particular analysis of future tensed statements. We will now present four accounts that all share an underlying branching time semantics, yet differ significantly in their approach to future contingency. Note that the four accounts that we will look at do not exhaust the landscape of possible accounts—even within the family of branching time accounts! Nevertheless, they arguably correspond to the four major traditions.[3] They are:[4]

(1) the Open Future approach;
(2) the Thin Red Line approach;
(3) the Supervaluationist approach;
(4) the Peircean approach.

The differences among these four accounts are often subtle, and a proper discussion of the details of these accounts, and of their respective advantages or distadvantages over one another, goes beyond the scope of a single paper. Presented in a nutshell, there are three choice-points at which, as we'll shortly see, these accounts depart from one another:

(a) whether the account posits (or recognizes) one or more than one notion of *truth*;
(b) what are the parameters on which sentence truth—or truths—depend(s);
(c) what is the semantic clause for the future tense.

To give you a hint at what these choices signify, in the case of (a), one may want to draw a distinction between *plain* truth, which is truth with respect to a history, and *settled* truth, which is truth regardless of which history turns out to be the actual history, and is, in this sense, history-independent.[5] Thus the proposition that it rains tomorrow

[3] In their survey article on future contingents in the *Stanford Encyclopaedia of Philosophy*, Øhrstrøm and Hasle (2011) identify and discuss seven accounts: in addition to the four discussed here, they consider the three-valued logical account (put forward by Jan Lukasiewicz in the 1920s), the Lewisian or Leibnizian account, and the relativist account. Of those three, I have left aside the first one because of its serious problems (e.g. it predicts that 'It will rain or it will not rain' is as indeterminate as 'It will rain' alone is. I have left out the second one as relatively marginal, while, as for the relativist account, the main reason why I am leaving it out is that its main proponent, John MacFarlane, has changed his views significantly in the course of time, from (2003) via (2008) to his forthcoming monograph, where only the earliest proposal is set within the branching time framework. Thus, in the absence of a firm view, I find it somewhat difficult to discuss 'the' relativist account.

[4] In Øhrstrøm and Hasle (2011) terminology, (1) would qualify as the 'Ochamist' approach; for (2) their preferred label is 'True Futurism' (which they explicitly identify with the Thin Red Line approach). Let me also note that if one starts taking into consideration further metaphysical issues, concerning, for instance, the ontological status of time (e.g. whether time exists, whether time is real, whether past and future objects exist at the present time, etc.), the landscape becomes much more complicated; a helpful up-to-date discussion may be found in Correia and Rosenkranz (2011).

[5] The distinction between plain truth and settled truth was anticipated long ago by the medieval philosopher William of Ockham.

in Paris is plain-true relative to a history on which it rains, and plain-false relative to a history on which it does not. Precisely because it is not yet settled whether it will rain, the same proposition is not settled-true (nor is it settled-false, for that matter). On the other hand, the proposition that the sun will rise tomorrow would, for example, qualify as settled-true with respect to a moment, if the state of the universe at that moment already causally determines that the sun will rise tomorrow. Something like this distinction may be found in the first three approaches. Furthermore, approaches (2) (Thin Red Line) and (3) (Supervaluationism), in addition to the level of truth with which semantics operates, posit yet a further level of truth-evaluation, as we shall shortly see in greater detail.

As for the question raised in (b), it may be illustrated by the way in which the first two approaches (Open Future versus Thin Red Line) differ. For the Open Future approach, the truth-value of a sentence depends, in a non-eliminable way, on the *history* parameter, along with the *moment* parameter, while for the Thin Red Line approach, it depends only on the *moment* parameter, since the *history* parameter is determined by the model of interpretation. That is to say, the latter approach holds that at any given moment, there is a unique *actual* history, the 'true future', metaphorically drawn as a 'thin red line': among the many possible ways the world *might* go on, some unique one is distinguished as the way that the world *will* go on.

As for the choice-point (c), the best way to see what it amounts to is by spelling out the four approaches' semantic clauses for future tense—a task to which I now turn. In presenting the four accounts, I will assume a tense-logical propositional language, in which 'F' and 'P' are unary sentential operators read respectively as 'once it will be the case that' and 'once it was the case that'.[6] Let us also use the box operator $\Box$, *alias* the necessity operator, read as 'it is settled that'.

2.1.1 THE OPEN FUTURE ACCOUNT

Let S be a tense-logical structure $(T, \leq, H, \mathit{Val})$. The semantic value of a given expression E, written, as customary, $[\![E]\!]$, is defined recursively as follows. Let 'p' be a propositional constant, 'A' and 'B' arbitrary sentences, and let $m \in T$ and $h \in H$. Then:

$$[\![p]\!]^S_{m,h} = 1 \text{ iff } m \in \mathit{Val}(\text{'p'})$$
$$[\![A \wedge B]\!]^S_{m,h} = 1 \text{ iff } [\![A]\!]^S_{m,h} = [\![B]\!]^S_{m,h} = 1$$
$$[\![\sim A]\!]^S_{m,h} = 1 \text{ iff } [\![A]\!]^S_{m,h} \neq 1$$
$$[\![FA]\!]^S_{m,h} = 1 \text{ iff for some } m^\circ \in h \text{ such that } m < m^\circ, [\![A]\!]^S_{m^\circ,h} = 1$$

[6] Their duals G ('it will always be the case that') and H ('it has always been the case that') can be defined in the usual way, as in the case of any modal dual operators. (Note though that in the fourth, Peircean approach, the definition of the duals is going to be somewhat more complicated.)

$$[\![PA]\!]^{S}_{m,h} = 1 \text{ iff for some } m^{\circ} \in h \text{ such that } m^{\circ} < m, [\![A]\!]^{S}_{m^{\circ},h} = 1$$
$$[\![\Box A]\!]^{S}_{m,h} = 1 \text{ iff for every } h^{\circ} \text{ such that } m \in h^{\circ}, [\![A]\!]^{S}_{m,h^{\circ}} = 1$$

2.1.2 THE THIN RED LINE ACCOUNT

There is more than one way of cashing out semantically the idea of a 'true future', or a Thin Red Line. I shall opt for one that distinguishes between structures and models, and relies on the idea that while the recursive definition of semantic clauses goes exactly the way it goes in the Open Future account, the evaluation of a sentence for its *truth-value* must be done with respect to a model—which is a structure with some unique history singled out. So let S be, as before, a tense-logical structure (T, $\leq$, H, *Val*), and let 'p' be a propositional constant, 'A' and 'B' arbitrary sentences, and let $m \in T$ and $h \in H$. A model M is then just a pair (S, $\underline{h}$), where $\underline{h} \in H$. The semantic clauses are exactly as before—albeit relativized to models rather than structures, even though this change does not affect any specific clause:

$$[\![p]\!]^{M}_{m,h} = 1 \text{ iff } m \in \mathit{Val}(\text{'p'})$$
$$[\![A \wedge B]\!]^{M}_{m,h} = 1 \text{ iff } [\![A]\!]^{M}_{m,h} = [\![B]\!]^{M}_{m,h} = 1$$
$$[\![\sim A]\!]^{M}_{m,h} = 1 \text{ iff } [\![A]\!]^{M}_{m,h} \neq 1$$
$$[\![FA]\!]^{M}_{m,h} = 1 \text{ iff for some } m^{\circ} \in h \text{ such that } m < m^{\circ}, [\![A]\!]^{S}_{m^{\circ},h} = 1$$
$$[\![PA]\!]^{M}_{m,h} = 1 \text{ iff for some } m^{\circ} \in h \text{ such that } m^{\circ} < m, [\![A]\!]^{S}_{m^{\circ},h} = 1$$
$$[\![\Box A]\!]^{M}_{m,h} = 1 \text{ iff for every } h^{\circ} \text{ such that } m \in h^{\circ}, [\![A]\!]^{S}_{m,h^{\circ}} = 1$$

Crucially, though, in addition to these clauses, on which the Thin Red Line account agrees with the Open Future account, it further posits a definition of sentence truth that no longer depends on a history parameter:[7]

$$\text{A is true at M, with M} = (S, \underline{h}), \text{ with respect to m, iff}_{def} [\![A]\!]^{M}_{m,\underline{h}} = 1$$

2.1.3 THE SUPERVALUATIONIST ACCOUNT

The Supervaluationist account, put forward in Thomason (1970), may also be seen as one that agrees with the Open Future account—and, for that matter, with the Thin

[7] A different and perhaps better known way of cashing out the idea of a Thin Red Line is to enrich the structures themselves, with a (many-to-one) function TRL that maps moments to histories, and then define sentence truth as follows:

$$\text{A is true in S, with respect to m, iff}_{def} [[A]]^{S}_{m,TRL(m)} = 1$$

The reason I have opted for the structure-model distinction is that the move is well-known from modal logics, where it is customary to think of a model as a pair consisting of a structure and a 'designated' world, which represents the actual world (see Kripke 1963).

Red Line account as well—on the basic semantic clauses, but diverges when it comes to the definition of sentence truth. Like the Thin Red Line account, it introduces a notion of truth that is different from the mere assignment of semantic value 1; unlike it, it does not posit any privileged history, but instead quantifies over all of the (still open) histories. Since the semantic clauses are as for the account in (1), there is no need to repeat them. The two extra-semantic clauses, which jointly define sentence truth and sentence falsehood, are as follows:

A is true in S, with respect to m, iff for every h such that $m \in h$, $[\![A]\!]^S_{m,h} = 1$

A is false in S, with respect to m, iff for every h such that $m \in h$, $[\![A]\!]^S_{m,h} \neq 1$

It takes little to see that a sentence that gets assigned value 1 on some but not all of the histories (to which the moment of evaluation belongs) is neither true nor false; it is thus customary to talk of the supervaluationist approach as allowing for 'truth-value gaps'.[8]

2.1.4 THE PEIRCEAN ACCOUNT

Let again S be a tense-logical structure (T, $\leq$, H, *Val*), 'p' a propositional constant, 'A' and 'B' arbitrary sentences, m ? T and h ? H. Then:

$$[\![p]\!]^S_{m,h} = 1 \text{ iff } m \in Val(\text{'p'})$$

$$[\![A \wedge B]\!]^S_{m,h} = 1 \text{ iff } [\![A]\!]^S_{m,h} = [\![B]\!]^S_{m,h} = 1$$

$$[\![\sim A]\!]^S_{m,h} = 1 \text{ iff } [\![A]\!]^S_{m,h} \neq 1$$

$$[\![FA]\!]^S_{m,h} = 1 \text{ iff for every } h^\circ \text{ such that } m \in h^\circ \text{ there is } m^\circ \in h^\circ \text{ such that } m < m^\circ \text{ and } [\![A]\!]^S_{m^\circ,h^\circ} = 1$$

$$[\![PA]\!]^S_{m,h} = 1 \text{ iff for every } h^\circ \text{ such that } m \in h^\circ \text{ there is } m^\circ \in h^\circ \text{ such that } m^\circ < m \text{ and } [\![A]\!]^S_{m^\circ,h^\circ} = 1$$

$$[\![\Box A]\!]^S_{m,h} = 1 \text{ iff for every } h^\circ \text{ such that } m \in h^\circ, [\![A]\!]^S_{m,h^\circ} = 1$$

Among the four accounts that we are considering, the Peircean account distinguishes itself from the other accounts by providing a different clause for the future tense operator F, since it builds, into the definition itself, a universal quantification over

[8] Supervaluationism has been a very infuential approach in theories of vagueness. It should not be confused with three-valued logical approaches, with which it shares the idea that some sentences are neither true nor false. According to supervaluationism, such sentences *lack* a truth-value, while according to three-valued logic, they don't lack a truth-value, but they have neither value True nor value False but a third value, 'Indeterminate'. Correspondingly, the semantic clauses for truth-functional sentential operators, such as negation or disjunction, are defined in terms not of those three truth-values.

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all of the (still open) histories.[9] This is tantamount to viewing the future 'tense' operator as a special sort of *modal* necessity operator, which is why the account is also referred to, in the linguistic literature, as the Modal Account of 'will'. While its source of inspiration ultimately comes from the writings of the philosopher Charles Peirce, the proposal was first laid out in Prior (1967). Note, furthermore, that though I have kept, for the sake of convenient comparison, the history parameter subscript h for ⟦ ⟧ (i.e. the semantic value function), in the Peircean account, semantic values actually do not depend on the history parameter: in the case of atomic propositions, the range of the valuation function *Val* are simply sets of moments (rather than, say, moment-history pairs), while in the definitions of sentential operators F, P, and □, there is a universal quantification over the histories in the definiens that does not depend on the value of h in the definiendum.

2.2 EVALUATING FUTURE CONTINGENTS FOR TRUTH: HOW THE FOUR APPROACHES DIFFER

Now that we have the four accounts laid down in greater detail, we can compare them in terms of the choices they make regarding (a) (i.e. one versus two or more notions of truth), (b) (i.e. on which parameters truth depends), and (c) (i.e. the semantic clause for future tense), as well as in terms of how they account for the two desiderata laid down at the outset (i.e. lack of pre-established truth-value and retrospective truth-evaluability).

The first issue is whether the semantic notion of truth, defined recursively through the semantic clauses (and written as the semantic value '1') is sufficient to play the role of sentence truth, or whether one must introduce some further notion of sentence truth, and then posit 'bridging principles' that will connect the two.[10] This issue opposes Open Future and Peircean approaches, on the one hand, to the Thin Red Line and Supervaluationist approaches, on the other. Both of the latter posit an extra-semantic principle, which tells us when a sentence is true with respect to a moment: in the Thin Red Line account, the sentence is true when it is true *with respect to some privileged history*, the 'one and true' future; and, in the Supervaluationist account, when it is true with respect to *every* history that, at that moment, remains open. No such further truth definition is to be found in either Open Future or Peircean accounts.

Now, there is yet another way of tackling the question of how many notions of truths one recognizes. Earlier in Section 2.1, I pointed out the distinction between 'plain'

[9] For the sake of uniformity, we have such a universal quantification over histories in the definition of the past operator, P, as well. However, due to the nature of the branching time framework, this quantification will be, as it were, vacuous: for if there is such a moment on one history, then there is one on all histories.

[10] This is a more general issue; indeed, one that occupies a central place in the recent debate opposing 'relativist' accounts to contextualist and invariantist accounts regarding, for instance, the semantics of predicates of personal taste and other evaluative terms. See Stojanovic (2012) for discussion.

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truth, which depends on a history, and 'settled' truth, which does not. Belnap himself emphasizes the distinction in those very terms when he writes: 'We sharply distinguish settled truth, which is not history-dependent, from plain truth, which is' (Belnap et al. 2001: 235). It may thus be said that even the Open Future account makes room for more than one notion of truth. However, this distinction, although explicitly acknowledged, has no bearing on the semantics of future-tensed claims, nor does it affect the analysis of their use in ordinary language.

Turning to the second choice-point, viz. the question of what are the parameters on which truth depends, we made the comparison simpler by moulding the four approaches upon the same skeleton of branching time structures. Thus, for the four approaches, the semantic, recursive notion of truth (viz. the recursive assignment of semantic value '1') requires relativization to a history parameter. However, as already noted, in Peircean semantics, this dependence is, as it were, vacuous. The histories, or branches, are primarily put to work in the definition of the future tense operator, but we can give the same definition without making the assignment of semantic value dependent on histories, and this without any loss:

$$[\![\mathrm{FA}]\!]^{S}_{m} = 1 \text{ iff for every } h^{\circ} \text{ such that } m \in h^{\circ} \text{ there is } m^{\circ} \in h^{\circ} \text{ such that } m < m^{\circ} \text{ and } [\![\mathrm{A}]\!]^{S}_{m^{\circ}} = 1$$

Now, does this choice-point make it possible also to distinguish among the other three accounts, all of which acknowledge non-eliminable history-dependence in the recursive *semantic* clauses? The answer is related to the previous choice-point: while the semantic notion of truth, represented with value '1', depends on the same parameters in all three accounts, for the Thin Red Line and Supervaluationist accounts, truth *tout court* is not relative to a history. That is to say, when we ask whether some sentence, as used on a specific occasion, is true, we don't need to add '. . . with respect to such-and-such history'. For the Thin Red Line account, this would be superfluous because truth is, by definition, truth with respect to the one and only actual history (or future); for the Supervaluationist account, because truth is truth with respect to every possible history (or future).

The third choice-point sets apart once again the Peircean account from the rest. On this account, the future tense involves a universal quantification over the possible ways the world might go; thus, in this respect, it behaves like the modal operator of necessity. As a consequence, the Peircean account makes the future tense 'will' synonymous with what, according to the other accounts, would come out as a modal-temporal complex expression 'it is settled that . . . will . . .'. We will return later to this feature of the Peircean account, as it constitutes one of its most serious shortcomings.[11]

[11] As noted earlier, the Peircean account is similar, both strucurally and in spirit, to the so-called modal accounts of 'will', which have been fairly influential in the linguistic literature on future tense. For an overview as well as powerful criticisms of such modal accounts, see Kissine (2008a).

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This comparison among the four accounts in terms of how they understand the notion(s) of truth, what role they give to history-dependence, and what semantic clause they give to the future tense, does not aim at discarding any particular account, but only at making it possible to better understand the ways in which these accounts differ from one another. Let us now see how they differ in terms of the predictions that they make regarding the two desiderata with which we started, reproduced below for convenience:

- *Lack of pre-established truth-value*—Given that, at the time of the utterance, it is not yet settled whether it will rain or not, the sentence 'It will rain tomorrow' appears to lack a truth-value as of the time of the utterance.
- *Retrospective truth-evaluability*—Suppose that it rains indeed. Then, once the event has happened, we may retrospectively assign value True to the sentence 'It will rain tomorrow', as uttered yesterday. Similarly, if it does not rain, we may assign it value False. Thus from an appropriate future standpoint, the sentence does not lack a truth-value.

The Open Future account attempts to give justice to *both* desiderata, along the following lines. The reason why an utterance of a future contingent appears to lack truth-value is that, in evaluating the sentence for its truth-value, while it is (normally) unproblematic to select a *moment* with respect to which to evaluate it, we cannot similarly select a unique *history* at which to evaluate it. In other words, the utterance lacks a truth-value to the same extent to which an utterance of '*x* is a mammal' lacks one; as soon as we supply a value for variable *x*, the utterance is either true (if the object supplied as a value for *x* is indeed a mammal) or false (if it is not); similarly, as soon as we supply a value for the history parameter, the utterance of 'It will rain tomorrow' will also get a truth-value. In the Open Future account, there are thus no genuine truth-value gaps: the failure of assigning any determinate truth-value to the utterance is, rather, due to our incapacity to supply any determinate history value. However, when we reevaluate the same sentence from a future stance, as, say, after the relevant event has happened, even though we are still unable to supply any such determinate history value, the fact that all the remaining open histories converge on the truth-value that they assign to the sentence is what allows us to endow the utterance, retrospectively, with a truth-value, and thereby satisfy the retrospective truth-evaluability desideratum.

Turning to the Thin Red Line account, it is generally believed that it can only do justice to the second desideratum, but not to the first. For if, at the time of utterance, there is already only one 'true future', then the utterance must already have a truth-value (namely, it is true if it rains on the next day on that future, false if it does not). The Thin Red Line account only satisfies a weaker desideratum, on which the utterance is not truth-evaluable in the *epistemological* sense: since no one is able to *know* what the actual future is (or to know, speaking metaphorically, which branch is marked with

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a thin red line), no one can know the utterance's truth-value. It remains, though, that the account squares badly with the very idea of *metaphysical* indeterminism, as has been repeatedly pointed out (cf. Thomason 1970; Belnap and Green 1994; MacFarlane 2003).[12]

Just as it is common to object to the Thin Red Line account that it favours the truth-evaluability desideratum to the detriment of the lack-of-truth-value desideratum, so it is to object to the Supervaluationist account that it does the opposite. For, Supervaluationism predicts indeed that the sentence, evaluated at the time of its utterance, is neither true nor false, but truth-value deprived, and says nothing about the sentence acquiring any truth-value at a later time. Now one might wonder whether this is a fair objection. Is it not enough, one might ask, to evaluate the same sentence at a later time, when the histories at which it did not rain are no longer live options, in order to turn the sentence from truth-valueless to true? Although this might actually work for the example we have been working with so far, where the time of the event is anchored to the day after the utterance by means of the indexical 'tomorrow',[13] so that the proposition that is being evaluated for truth is an *eternal* rather than *temporal* proposition, the suggested move will not work across the board. To see this, let us look at a different example. Consider the sentence: 'There will be life on Mars'. Assuming that the current state of the universe leaves it open whether there will ever be life on Mars, our first desideratum is that as of now, no definite truth-value may be assigned to an utterance of that sentence. Yet if in, say, ten million years, there gets to be life on Mars, then, once life on Mars has been brought about, our second desideratum is that we should be able to reevaluate that very same utterance, from the future standpoint, as true. Now, let t_0 stand for the present (i.e. year 2012) and let t_{10M} stand for some moment that lies ten million years ahead. One might have thought, following the move that I have outlined on behalf of Supervalutionism, that the statement 'There will be life on Mars', as evaluated at t_0, is neither true nor false, but is true as evaluated at t_{10M} (after there has been life on Mars). However, this will not work, because the sentence under consideration expressed a *temporal* proposition, and because the future tense operator F, on the analysis that has precisely motivated the tense-logical treatment of tense and is inherent to branching time frameworks, *shifts* the time of evaluation. That is to say, evaluated at t_{10M}, the statement is true iff 'There is life on Mars' is true at some time *that lies in the future of* t_{10M}. Yet, it may well be the case that by then, there will

[12] In fairness to the Thin Red Line view, it should be noted that an alternative interpretation is possible, one that purports to give justice to the lack-of-truth-value desideratum (cf. e.g. Borghini and Torrengo 2012). The idea, as I understand it, is that even though there is, at the time of utterance, a unique actual future, not all the facts that constitute this future need be determined yet. Thus if the fact that it rains on the next day only gets determined after the time of utterance, then, at that time, the utterance does not yet have a truth-value.

[13] Temporal indexicals such as 'now', 'today', and 'tomorrow' require the so-called mechanism of double-indexing, which, for the sake of simplicity, we have omitted from the four semantic frameworks presented here. For discussion and details, see Kamp (1971) and Kaplan (1989).

have been life on Mars, but there no longer is nor will ever again be. In such a case, the statement will come out *false* when evaluated at t_{10M}, contrary to our desiderata.[14]

Finally, the Peircean account seems to fare fairly badly with respect to both desiderata. For one, it predicts that the sentence 'It will rain tomorrow', evaluated at the time of its utterance, does not lack a truth-value, but is outright false—and this even if, at the end, it does rain, so long as it was possible that it would not rain. As for retrospective evaluability, the fact that it did rain does not turn the sentence from false to true. (Similarly, the move of evaluating the sentence at a later time, as when the branches on which it did not rain are no longer open, will not work for the same reasons as in the case of Supervaluationism.)

2.3 ASSERTING FUTURE CONTINGENTS

Let us take stock. Among the four accounts that we have considered, the Peircean account appears to be the least plausible, or, if your prefer, the least capable of accounting for the desiderata that we take to be intuitively plausible. This is because the account does not distinguish between plain and settled future, and, worse, because it makes the bare future tense synonymous with a tense-modal compound such as 'it is settled that . . . will . . . '. However, it is arguably a fact about the meaning of 'will' that it is *not* synonymous with any such necessity-expressing modal constructions.[15]

This leaves us with the other three accounts as the remaining competitors. It is not my goal here to try to adjudicate this competition; I only wish to underscore certain motivations for favouring the Open Future account, rather than offer any conclusive arguments in favour of that account against the other two.

The first motivation is a version of Ockham's Razor, and applies equally well against the Thin Red Line account as against the Supervaluationist account. Both of these accounts, as we have seen, crucially involve certain extra-semantic principles, which seek to define sentence truth in a way that presupposes the semantic notion of truth (i.e. the notion of truth, or semantic value, deployed in the recursive truth-conditional semantic clauses) and that leads to recognizing two distinct notions of truth. On mere

[14] MacFarlane (forthcoming) presents the supervaluationist account in such a way that 'we get correct predictions about *Retrospective truth judgments*'. Crucially, MacFarlane's supervaluationist avoids this problem by temporally anchoring the statement via a hidden indexical: what 'There will be life on Mars' expresses, as uttered at t_0, would not be the *temporal* proposition that there will be life on Mars, but the *eternal* proposition that, as of t_0, there would be life on Mars.

[15] One might argue that the auxiliary 'will' in English is a modal auxiliary, and that it is wrong to classify it together with tense morphemes. Even if one could plausibly argue, on morphosyntactic grounds, that 'will' is a modal auxiliary, it still remains a fact that it would be expressing a different kind of modality, not the necessity with which the Peircean account endows its truth clause. What is more, this sort of morphosyntactic argument would have no bearing whatsoever if we rephrased the problem of future contingents in a language (such as, e.g., any of the Romance languages) that expresses the future using regular tense morphemes in suffix position.

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metatheoretic grounds, it is preferable not to multiply notions (in this case, of truth) beyond the ones that are required for the theory to make accurate predictions. To my knowledge, no argument has ever been offered that would show the Open Future account to be unable to make the appropriate predictions as a result of not introducing any such further layers of truth.

Besides such metatheoretical considerations, the main motivation for preferring the Open Future account over the Supervaluationist account is, as already mentioned, that the latter seems unable to account for retrospective truth-evaluability.[16] As for the main motivation for preferring the Open Future account over the Thin Red Line account, recall that the idea of a unique 'true future' was seen as being at odds with the idea of an indeterministic universe, and that the account fell short of accounting for our first desideratum, viz. that, as of the time of utterance, it was impossible (not just *epistemically* but also *metaphysically*) to assign any determinate truth-value to the utterance.

I would now like to turn to a new set of considerations, concerned with the relationship between the *semantics* of the future tense and the use of future tensed sentences in *assertion*. It makes sense to bring these considerations into the discussion because there is something of a tension between the semantics built upon the branching time framework and the way we talk about the future. The problem is well put in the following passages:

> Crudely put, 'the assertion problem,' as we call it, arises because given indeterminism, it would seem as if future-tensed statements 'have no truth value.' . . . The reason that this is a problem is that it seems to make sense to assert a predictive statement even in the face of indeterminism. Since, however, such a statement 'has no truth value,' how can it make sense to do so?
>
> (Belnap et al., 2001: 141)

> On the branching picture, it seems, there is no such thing as *the* future. But we make claims about the future all the time. For example, I said ten days ago that it would be sunny today. It is sunny, so, it seems, my assertion was accurate. But how *could* it be accurate if, as the branching picture has it, there were both rainy and cloudy branches ahead of me when I made it?
>
> (MacFarlane, forthcoming: 192)

The challenge that these considerations are adding to the stack of our desiderata for an account of future contingents is that it be able to extend into an account of the conditions under which a rational speaker does, may, or should, *assert* something about the future.

It is widely acknowledged, at least in the philosophical literature, that merely by uttering a declarative sentence the speaker need not yet be *asserting* something. In other words, not all utterances of declarative sentences are *ipso facto* assertions.

[16] As also noted, supervaluationism comes with the assumption that there can be truth-value *gaps*, which are sometimes deemed to be problematic; however, I don't really want to put much weight on this issue.

However, what further conditions such an utterance, or its speaker, must fulfil in order for it to be an assertion is a controversial issue. What is more, even once we have answered this question, a further issue arises as to when the assertion is rationally *warranted*, that is, as to whether the speaker who is asserting something *should* indeed be asserting it. As applied to future contingents, there are, then, two distinct questions:

- *The descriptive question*—What conditions must an utterance of a declarative future tensed sentence fulfil in order to count as an assertion?
- *The normative question*—What conditions must an assertion of a future tensed sentence fulfil in order to be rationally warranted?

Note that the 'Assertion Problem', as raised by Belnap and Green and by MacFarlane, does not sharply distinguish between the two questions. In this chapter, my main interest will be in the normative question. But before I turn to it, let me briefly try to explain why future contingents raise a problem with respect to the descriptive question as well. One's answer to the question of what assertion is may entail that only utterances that are truth-evaluable, that is that have a truth-value, are apt to be assertions. Indeed, consider the sentence 'Susa Baloga is six feet tall', but assume that the name 'Susa Baloga' does not refer to anyone. Given that the name fails to refer, the utterance is (arguably) devoid of truth-value, and indeed, it seems that for that very reason it would not make any sense to *assert* that Susa Baloga is six feet tall. Now, if one's theory of assertion says that only utterances that are either true or false may qualify as assertions, then this theory paired with, for instance, Supervaluationism, will entail that no future contingents are *assertable*—not just *rationally* or *justifiably* assertable, but assertable *tout court*; only settled truths (or, for that matter, settled falsehoods) would be assertable.

Another theory of assertion for which future contingents raise a problem is the one that holds that only what is knowable is assertable. To be sure, there can be statements such that, as of the time of the assertion, nobody actually knows whether they are true or false. But the idea is that, as of the time of utterance, it was *possible* to know this. For instance, we may suppose that Gödel first asserted that arithmetics is incomplete before he went on to prove it and thereby came to know it (and was the first one to know it). Nevertheless, as of the time of the assertion, whether arithmetics is incomplete was already know*able*. Now, if knowability is a condition on assertability, then future contingents would again turn out to be unassertable, if we pair this assumption with either Supervaluationism, or with the Open Future account, or even with the Thin Red Line Approach.

Now, I see it as a desideratum for any theory of assertion that addresses the descriptive question that people *do* assert contigent truths about the future. I do not purport to give any argument to this effect, other than appeal to our intuitive concept of assertion, which clearly allows for assertions of future contingents. Consider a pilot who says 'We will be landing shortly'. This is a future contingent, and what is more, the

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pilot is aware that it is always possible that, say, due to some technical problems, the landing may be delayed, or even that the aircraft might never get to the point of landing. Nevertheless, I take it that she or he not only utters, or says, but indeed *asserts* that they will be landing shortly.

Let us now turn to the normative question. There is a vast literature on the question of what the *norms* of assertion are. The main three competing proposals hold that the norm of assertion is, respectively, *truth*, *knowledge*, or *belief*. Rendered in the imperative form, here are the three norms:

(**T**) Assert F only if F is true.[17]
(**K**) Assert F only if you know that F.
(**B**) Assert F only if you believe that F.

What I would now like to do is show that, paired with Supervaluationism, both (**T**) and (**K**) give us undesirable results, and then argue that (**B**) on its own is too weak to serve as a norm. It takes little to see that given the supervaluationist account of future tense, (**T**) predicts that one should never assert a future contingent. Thus, for instance, it is enough that there be a very tiny chance that it won't rain tomorrow for a speaker to have to abstain from asserting 'It will rain tomorrow', even if the weather forecast announces rain and the speaker has no reason to doubt that it will rain. The only case in which a future-oriented assertion could be warrantedly made is one in which the truth of the claim is *settled*. In other words, although the supervaluationist semantics of future tense is different from that of the modal-temporal compound 'It is settled that . . . will . . .', the account, if paired with (**T**) as a norm of assertion, predicts that the assertability conditions of those two coincide, and thus collapses into the Peircean view when it comes to assertion.

Note that taking knowledge rather than truth to be the norm of assertion will be of little help, given that truth is a necessary condition for knowledge. And if no future contingent is knowable, then none is assertable!

Now, would it help to retreat to a weaker norm such as (**B**)? Suppose again that the weather forecast announces rain, indicating 95 per cent chance of rain. Now consider a speaker aware of the forecast who for no good reason (other than maybe wishful thinking) believes that it will not rain. Her friend, ignorant of the forecast, asks her what the weather will be like. She asserts, 'Clear skies, no rain'. Even in case that, out of sheer luck, the future turns out to be the improbable one in which it did not rain, I take it that it is far from clear that the speaker was rationally warranted in asserting that it would not rain, given that there was a 95 per cent chance that it would rain, and

[17] Truth as the norm of assertion is explicitly stated in Grice's maxim of *quality:* 'Try to make your contribution one that is true' (Grice 1989: 27). However, both belief and knowledge also appear to be involved in Grice's maxim of quality, as he goes on to state two 'more specific' maxims: '1. Don't say what you *believe* to be false; 2. Don't say that for which you lack adequate *evidence*' (Grice 1989: 27, emphasis added).

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that it was extremely likely that the claim asserted by the speaker would turn out to be false. In other words, although the speaker did assert a future contingent statement, and although her statement was eventually proved to be true, its truth was a matter of luck, and the speaker had *no rational grounds* for asserting what she asserted.

To be sure, the above considerations do not discard Supervaluationism *qua* a semantic account. Rather, what I did was show that the account does not mesh well with any of the competing proposals that address the normative question raised by the Assertion problem.

Turning to the Thin Red Line account, it is widely held that one of its main advantages is, precisely, that it avoids the Assertion problem. Whether or not this is indeed correct, for the sake of simplicity, let me grant that it is so, and turn to the Open Future account. Recall that on this account, there are no genuine truth-value gaps: a future-tense claim is either true or false, *tertium non datur*; the lack of determinate truth-value is, rather, due to the impossibility of assigning a value to some parameters (viz., the history parameter) at which the sentence is to be evaluated for a truth-value. In other words, on the Open Future view, to assert a sentence of the form 'It will be the case that P' amounts to asserting *of* a moment and *of* a history that P obtains at some later moment on that history. But, while there is a single moment that the speaker's assertion can be plausibly taken to be about, there is a plurality of open histories none of which is distinguishable as *the* future, so that an assertion of a future tensed sentence should not be that different from an assertion of, for example, the sentence 'It arrived' in which the speaker does not refer to anything at all with the pronoun 'it'! The Assertion problem, as it arises for the Open Future account, is to explain how, on a semantic level, a future tensed sentence behaves like a sentence that contains a free pronoun, while behaving very differently at the level of assertion: asserting a future tensed sentence is typically felicitous even in the absence of a unique future (supplied as a value for the history parameter), while asserting a sentence with a pronoun appears to require that there be something the pronoun refers to.

A straightforward move would be to say that one is warranted in asserting a future tensed sentence whenever the choice of history 'does not matter', that is, whenever selecting one history rather than another as a value for the history parameter does not result in any difference. But this would be tantamount to saying that a statement about the future is warrantedly assertable whenever its truth-value is settled, thereby making this view, too, collapse at the level of warranted assertability conditions into a Peircean view! Not only would this be an unwelcome consequence, but also one that Belnap (1994) explicitly wish to avoid:

> We shall argue that it makes sense to assert A when A's truth value is not settled at the moment of use; the idea is that assertion is an act that has consequences for the speaker no matter how things turn out. (Belnap 1994, in Belnap et al. 2001: 171)

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Belnap and Green go on to develop their idea in terms of a pair of *normative* notions, those of *vindication* versus *impugnment*. Rather than present it in detail, let me quote one of the passages that captures their proposal and solution to the assertion problem:

> . . . vindication and impugnment come in many forms depending in part upon the subject matter and the conversation or situation in which the assertion is proferred. For example, sometimes vindication or impugnment involves owing some form of credit or discredit to the assertor, and sometimes not. Rather than addressing these issues, however, it is more to our purpose to ask *when* a person's assertion is vindicated or impugned. One idea is this.
>
> > [A person]'s assertion of *A* at a moment, m, is vindicated or impugned on a history, h, *as of the moment of assertion* (provided *A* is assignment-closed), according as S, m, f, m/h $\models A$ or S, m, f, m/h $\not\models A$.[18]
>
> We are now in a position to see that on the present account of assertion, it makes sense to talk of asserting '*Will:* (the coin lands heads)' exactly because assertion constitutes a way of closing the history parameter—not indeed semantically (the semantics of the asserted sentence is unchanged), but pragmatically, by the very act of assertion.' (Belnap et al. 2001: 174)

To the extent that Belnap and Green are accounting here for why it 'makes sense' to assert a future contingent, they may be seen as addressing the descriptive question, that is, explaining how there can *be* assertions whose contents are contingent truths about the future. But to the extent that the emphasis is on the normative notions of vindication and impugnment, they seem to be addressing the normative question as well. My main difficulty with their proposal is that it is not explicit enough when it comes to explaining how exactly vindication and impugnment regulate warranted assertability. In other words, if we wanted to formulate the view in terms of an imperative the way we did with (**T**), (**K**), and (**B**), what would such an imperative look like? Here are some straightforward options:

(**V**) Assert F only if your assertion of F is/will be vindicated.
(**KV**) Assert F only if you know that your assertion of F is/will be vindicated.
(**BV**) Assert F only if you believe that your assertion of F is/will be vindicated.

I submit that none of these options is satisfactory, and that they run into pretty much the same sort of obstacle that (**T**), (**K**), and (**B**) ran into. To see this, let us first consider the present tensed version of the three options. The condition that F should be asserted only if the assertion *is* vindicated boils down, in virtue of the very definition of 'vindicated', to the condition that F should be asserted only if it is true on the history on which it is vindicated. Since there is no independent assignment of a value to

[18] I have slightly modified the notation, so as to keep it in line with the one used in Sect. 1: thus 'S' stands for a (branching time) structure and 'f' for an assignment of values to variables. Note also that Belnap and Green don't use a stand-alone history parameter, but a moment-history pair, noted 'm/h'.

the history parameter, F should be asserted simpliciter only if the choice of a history does not matter; and this, in turn, implies that F should be asserted only if it is true on all of the histories that remain open, hence only if its truth is settled. Once again, then, even though the Open Future account offers a different *semantics* for the future tense than the Peircean account, it appears to collapse into the latter when it comes to *(warranted) assertability* conditions. And once more, note that requiring a speaker's knowledge that her assertion is vindicated, rather than merely that the assertion be vindicated, is of no help, for it entails equally well that only settled truths may be warrantedly asserted. On the other hand, bringing the norm down to the speaker's mere *belief* that her assertion is vindicated is doubly unsatisfactory. For one, recall the wishful thinker who says 'It won't rain' despite the weather forecast that predicts 95 per cent rain; if she happens to believe, for no good reason, that it would definitely not rain, she would be warranted in making this assertion—a result that would leave many of us unhappy! For another, recall the pilot who says 'We will be landing shortly'. If she is aware that the truth of the statement is not yet settled and that there is a possibility, however tiny, that they may not be landing shortly, then she will *not* believe that her assertion *is* vindicated. In turn, she will be required by (**BV**) to abstain from making any such assertion—again, a result that only a few might welcome!

Turning now to the future tensed versions of (**V**), (**KV**), and (**BV**), let me first point out that there may be something of a tension between the definition that Belnap and Green provide, according to which an assertion is vindicated *as of the moment of assertion*, and the futurity of 'will be vindicated'. Nevertheless, one might think that with future contingents, vindication only 'comes after', and this idea may be cashed out not so much through the idea that the assertion gets vindicated at a later moment, but through the idea that the future restricts the choice of histories on which the assertion is seen as vindicated or impugned—*as already of the moment when it was made*.

This being clarified, the future tensed version of (**V**) is easily seen to be a non-starter, as it commands the speaker to act depending on a contingent future fact; it is as unhelpful as telling someone 'Bring an umbrella only if it will rain' in a context in which it may rain or it may not. In other words, the future tensed version of (**V**) yields the prediction that future contingents simply should not be asserted; a prediction that perhaps some find plausible, but that runs against our desideratum that there are future contingents that are warrantedly assertable.

How about the future tensed version of (**KV**) and (**BV**)? Since the future tense now lies in the scope of the epistemic and the doxastic operator, which are in the present tense, we have eschewed the previous problem: the commands are perfectly felicitous. However, (**KV**) now amounts to requiring that the speaker should know that the asserted claim will be true; a requirement that can only be satisfied in the case of settled truths, thus making the view collapse once more into a Peircean view. As for (**BV**), the future tensed version is an improvement over the present tensed version, for it allows the pilot to assert 'We will be landing shortly'. However, it still suffers from the

problem that all other norms formulated in terms of mere belief suffer from, namely, that the requirement appears to be too weak to prevent those assertions that are not supported by any evidence or reasons from being included amongst perfectly warranted assertions.

The discussion from this final section appears to leave us with an overall negative observation; namely, that our best semantic theories of future tense do not mesh well at all with what are considered by many philosophers (at least in the analytic tradition) to be our best theories of assertion! To be sure, both future contingency and assertion and its norms are, in and by themselves, complex matters, and bringing the two together was inevitably going to add further complexity. I tried to show that the puzzle that arises from applying our standard model of assertion to statements of future contingents did not have an easy way out. On a more positive note, I did not show, or even *suggest*, that there was no way out. What this leaves us with, then, is an array of issues that open up exciting prospects for future research.

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