Postsemantic Peirceanism

Andrea Iacona, Samuele Iaquinto

Abstract: There are essentially two ways to develop the Peircean idea that future contingents are all false. One is to provide a quantificational semantics for 'will', as is usually done. The other is to define a quantificational postsemantics based on a linear semantics for 'will'. As we will suggest, the second option, although less conventional, is more plausible than the first in some crucial respects. The linear approach overcomes three major troubles that have been raised in connection with Peirceanism: the apparent scopelessness of 'will' with respect to negation, the failure of Future Excluded Middle, and the so-called zero credence problem.

Keywords: Future contingents, Peirceanism, Credence, Excluded middle, Negation.

1

Peirceanism as a view about future contingents was introduced by Prior in *Past, Present, and Future.* Prior describes the gist of this view as follows:

> 'It will be that p' is not true until it is in some sense *settled* that it will be the case, and 'It will be that not p' is not true until it is in some sense settled that not-p will be the case. If the matter is not thus settled, both these assertions, i.e. $F_n p$ and $F_n \neg p$, are simply false.[1]

For example, the following sentences are both false according to Peirceanism, for it is contingent whether it will rain tomorrow:

(1) It will rain tomorrow

(2) It will not rain tomorrow

The same goes for any other sentence about the future that does not express a determinate truth, in that it is true in some possible futures but false in other possible futures.[2]

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[1] Prior [14], p. 129.

[2] As explained in Prior [14], p. 132, the view is attributed to Peirce because he described the future as "the region of the necessary and the possible".

The claim that future contingents are true only if they are determinately true is notoriously controversial, and several authors—including ourselves—doubt its tenability.[3] According to a line of thought that goes back to Ockham, future contingents are true or false, although they are neither determinately true nor determinately false. Ockhamism differs from Peirceanism precisely in that it draws a principled distinction between truth and determinate truth: the former is defined as truth in the actual future, while the latter is defined as truth in all possible futures.[4] In this paper, however, we will not compare Peirceanism with other views, because we are mainly concerned with some of its implications.

Prior formulated Peirceanism in a rigorous way by providing a quantificational analysis of 'will' in the framework of branching time semantics. To illustrate his proposal, we will adopt a language $\mathcal{L}$ whose vocabulary is constituted by a set of sentence letters $p, q, r \ldots$, the propositional connectives $\neg, \vee$, and the metric tense operator F_n. The formulas of $\mathcal{L}$ are defined in the usual way: every sentence letter is a formula; if α is a formula, so are $\neg \alpha$ and $F_n \alpha$; if α and β are formulas, so is $\alpha \vee \beta$.

F_n is the operator employed by Prior in the original formulation of the view. As is well known, a non-metric counterpart F of F_n can also be defined. But for our purposes, F_n is preferable because it does not involve existential quantification over moments. This makes it better suited to show the key feature of Peirceanism, namely, that it requires universal quantification over possible futures. In what follows we will call *quantificational* an account characterized by the latter condition, and *linear* an account that instead makes reference to a single future. Any further issue concerning existential quantification over moments is orthogonal with respect to this distinction.

Let a branching time model be a triple $\langle M, \prec, V \rangle$, where M is a non-empty set of moments, $\prec$ is a strict partial order on M, and V is a valuation function that assigns 1 or 0 to every atomic formula of $\mathcal{L}$ for each moment-history pair m/h, that is, for each moment m and maximal linearly ordered set of moments h that includes m. In a model so defined, for every formula α that does not contain F_n, the truth of α at a moment-history pair m/h is defined truth-functionally on the basis of the values assigned by V to its constituents:

Definition 1

1 If α is atomic, then $[\alpha]_{m/h} = 1$ iff $V(\alpha)_{m/h} = 1$;

2 $[\neg \alpha]_{m/h} = 1$ iff $[\alpha]_{m/h} = 0$;

3 $[\alpha \vee \beta]_{m/h} = 1$ iff $[\alpha]_{m/h} = 1$ or $[\beta]_{m/h} = 1$.

The truth conditions of the formulas that contain F_n can be specified by adding the following clause to definition 1:

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[3]Iacona [3] and Iacona [5] raise some problems in connection with this claim.

[4]Ockhamism originates from Ockham [12], pp. 515-517. This view is elaborated and defended, among other works, in Øhrstrøm [13], Rosenkranz [15], Iacona [4], Wawer [20], Malpass and Wawer [10].

Definition 2

4 $[F_n\alpha]_{m/h} = 1$ iff, for every h' such that $m \in h'$, the moment m' that lies at n units after m is such that $[\alpha]_{m'/h'} = 1$.

The analysis of 'will' conveyed by definition 2 is quantificational in that it involves universal quantification over the histories passing through m, which represent the futures that are possible at m. In other words, clause 4 says that $F_n\alpha$ is true at m/h if and only if α holds n units after m in each history h' containing m. As Prior himself observes, this analysis crucially differs from an account where clause 4 is formulated as follows:

Definition 3

4 $[F_n\alpha]_{m/h} = 1$ iff the moment m' that lies at n units after m along h is such that $[\alpha]_{m'/h} = 1$.

The analysis of 'will' conveyed by definition 3 is linear rather than quantificational, in that the condition of α holding n units after m only concerns a single history, namely, h itself.[5]

2

After Prior, Peirceanism has been widely discussed, and at least three major problems have been raised in connection with it. The first concerns negation. Intuitively, (2) and the following sentence have the same truth conditions:

(3) It is not the case that it will rain tomorrow

More generally, there seems to be no discriminable difference in truth conditions between two sentences that are formalised respectively as $F_n\neg\alpha$ and $\neg F_n\alpha$. This offers some linguistic evidence in favour of the equivalence between $F_n\neg\alpha$ and $\neg F_n\alpha$. In Cariani and Santorio's words, 'will' is scopeless with respect to negation.[6] However, definition 2 does not account for this fact, as it yields different truth-conditions for $F_n\neg\alpha$ and $\neg F_n\alpha$:

$[F_n\neg\alpha]_{m/h} = 1$ iff, for every h' such that $m \in h'$, the moment m' that lies at n units after m along h' is such that $[\alpha]_{m'/h'} = 0$.

$[\neg F_n\alpha]_{m/h} = 1$ iff it is not the case that, for every h' such that $m \in h'$, the moment m' that lies at n units after m along h' is such that $[\alpha]_{m'/h'} = 1$.

Note that definition 3, on the contrary, is able to account for the scopelessness of 'will', as it entails that the truth-conditions of $F_n\neg\alpha$ and $\neg F_n\alpha$ are exactly the same.

The second problem concerns Future Excluded Middle, the principle instantiated by the following sentence:

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[5] Although Prior calls definition 3 "Ockhamist", we will reserve this label for the view outlined above, according to which future contingents are true or false without being determinately true or determinately false.

[6] Cariani and Santorio [2].

(4) Either it will rain tomorrow or it will not rain tomorrow

The intuitions in favour of the validity of this principle are quite strong. As Thomason has it,

> [i]t will or it won't has the force of tautology. It is invariably true to say things such as either it will rain tomorrow or it won't.[7]

However, Peirceanism does not preserve Future Excluded Middle. Since the disjuncts of (4) are both false, the same goes for (4) itself. In fact from definitions 1 and 2 we get that $F_n\alpha \vee F_n\neg\alpha$ is false whenever $F_n\alpha$ and $F_n\neg\alpha$ represent future contingents. Note that this second problem is a direct consequence of the first. Peircean semantics validates Excluded Middle, so the disjunction $F_n\alpha \vee \neg F_n\alpha$ is true at every moment-history pair. But $F_n\alpha \vee F_n\neg\alpha$ is not derivable from this disjunction precisely because $F_n\neg\alpha$ is not equivalent to $\neg F_n\alpha$.

A third problem for Peirceanism is the so-called zero credence problem. Consider an agent who is going to throw a coin, while knowing that the coin is fair. Consider the following sentence:

(5) This coin will land tails

What is the degree of credence that the agent should assign to (5)? It is quite natural to expect that a rational agent obeys some principle relating credences with beliefs about objective chances, such as Lewis's Principal Principle. For any formula α and moment m, call X the proposition that the objective chance of α at m is x. Call E the proposition, compatible with X, expressing the total evidence of the agent up to m. The Principal Principle says that the degree of credence in α at m conditional on the conjunction of X and E equals x. Thus, the credibility at m of (5), conditional on the proposition that the objective chance of tails is 0.5 and the total evidence available to the agent up to m, equals 0.5. This conclusion, however, seems at odds with the Peircean persuasion that all future contingents are false. On the assumption that one ought to ascribe zero credence to the sentences that one evaluates as false, the agent should ascribe zero credence to (5).[8]

The three problems just presented are indeed serious, and we will not discuss any specific attempt to defend definition 2 from them. Our aim is rather to show that there is an alternative version of Peirceanism which is not affected by these problems. This by itself does not make the alternative version better than other theories which do *not* share the idea that future contingents are all false. However, we think it will be of some interest to whoever finds that idea at least initially appealing.

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[7]Thomason [17], p. 267.

[8]The zero credence problem is discussed in Cariani and Santorio [2], Cariani [1], pp. 61-63, and Todd [18], Ch. 6.

In order to formulate this alternative version we will rely on a distinction that has been employed by several authors in the debate on future contingents, the distinction between semantics proper and postsemantics: one question is how a technical notion of truth can be defined to convey an adequate formal analysis of 'will', another question is how our pretheoretical understanding of truth can be explained in terms of such a notion.[9]

In order to illustrate this distinction, suppose that one adopts definition 3. Then one has different ways of explaining our pretheoretical understanding of truth in terms of the defined notion of truth at a moment-history pair. What is it for a future contingent to be true in the context in which it is uttered? On the assumption that truth at a context can be identified with truth at a moment, this question can be answered in different ways.[10] If one adopts supervaluationism, as suggested by Thomason, one will identify truth simpliciter with truth in all possible futures, and falsity simpliciter with falsity in all possible futures:

Definition 4

(a) α is true at m iff $[\alpha]_{m/h} = 1$ for every h such that $m \in h$;

(b) α is false at m iff $[\alpha]_{m/h} = 0$ for every h such that $m \in h$;

(c) α is neither true nor false otherwise.[11]

If one adopts Ockhamism, instead, one will identify truth simpliciter with truth in the actual history, that is, being true at m amounts to being true at m in the actual history:

Definition 5

(a) α is true at m iff $[\alpha]_{m/h} = 1$ and h is the actual history;

(b) α is false at m iff $[\alpha]_{m/h} = 0$ and h is the actual history.[12]

Supervaluationism and Ockhamism may be regarded as different accounts of truth simpliciter which are based on the very same notion of truth at a moment-history pair: the former is quantificational, the latter is linear. In other words, if one starts with a linear semantics, one can either define a quantificational postsemantics or a linear postsemantics.[13]

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[9]The terminology adopted here goes back to MacFarlane [9], pp. 329-330, but the distinction can be traced back to seminal works in formal semantics such as Tarski [16] and Kaplan [7].

[10]Although for the sake of simplicity it is convenient to treat contexts as moments, nothing prevents one from enriching the notion of context with additional parameters.

[11]Thomason [17] suggests this definition.

[12]This is the analysis of truth simpliciter suggested in Iacona [4].

[13]The analysis of 'will' provided by Cariani and Santorio [2] is linear in this sense. Of course one could also start with a quantificational semantics, but in that case one would not get the same kind of differences at the postsemantic level.

Given the distinction between semantics proper and postsemantics, there are two ways to phrase Peirceanism. One—the usual way—is *Semantic Peirceanism*, the view formulated by Prior and expressed by definition 2. The other is what we call *Postsemantic Peirceanism*, which relies on definition 3 and goes as follows:

Definition 6

(a) α is true at m iff $[\alpha]_{m/h} = 1$ for every h such that $m \in h$;

(b) α is false at m otherwise.

Postsemantic Peirceanism is an account of truth simpliciter that differs both from supervaluationism and from Ockhamism. It differs from supervaluationism in that it does not allow truth-value gaps: every sentence turns out to be true or false, just as in Ockhamism. However, it differs from Ockhamism in that it is quantificational rather than linear: clause (a) of definition 6 is identical to clause (a) of definition 4.[14]

Note that Postsemantic Peirceanism preserves the core idea of Peirceanism—that future contingents are all false—because clause (a) of definition 6 is not satisfied whenever α is a future contingent. Note also that Prior's words as quoted above, setting aside interpretive questions on Prior's original understanding of the view, do not settle the question whether Peirceanism should be formulated in terms of semantics proper rather than postsemantics.

Of course, one might still contend that Semantic Peirceanism is the only genuinely Peircean view, as it primarily concerns the meaning of 'will', hence that the view proposed here is spurious in some important sense. But even so, it would still be the case that this view, no matter how one wants to call it, shares with genuine Peirceanism the idea that future contingents are all false.

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Now we will show that Postsemantic Peirceanism is not affected by the three problems discussed above. First, negation is treated as scopeless, as is plausible to expect, in that $F_n\neg\alpha$ and $\neg F_n\alpha$ turn out to be equivalent. Remember that definition 3 entails that the truth-conditions of $F_n\neg\alpha$ and $\neg F_n\alpha$ are identical. It is thus no surprise that, by definition 6, $F_n\neg\alpha$ and $\neg F_n\alpha$ are true at m at the very same conditions, that is, if and only if, for every h such that $m \in h$, the moment m' that lies at n units after m along h is such that $[\alpha]_{m'/h} = 0$.

Second, Future Excluded Middle is validated. Take an arbitrary m. For any h such that $m \in h$, definition 3 entails that either $[F_n\alpha]_{m/h} = 1$ or $[F_n\neg\alpha]_{m/h} = 1$, for either α holds at n units after m or it doesn't. It follows that $[F_n\alpha \vee F_n\neg\alpha]_{m/h} = 1$. Therefore, $F_n\alpha \vee F_n\neg\alpha$ is true at m. In this respect, Postsemantic Peirceanism is similar to supervaluationism, for it treats Future Excluded Middle as a disjunction whose value

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[14]As far as we know, Markosian [11] made a proposal along these lines in discussing a solution to the Truthmaker Problem for Presentism. However, he neither discusses Peirceanism nor presents his proposal as a way to vindicate the idea that all future contingents are false.

does not depend truth-functionally on the values of its disjuncts: even if $F_n\alpha$ and $F_n\neg\alpha$ are both false at m, $F_n\alpha \vee F_n\neg\alpha$ is true at m. As long as one is willing to grant that the intuitive plausibility of Future Excluded Middle is worth the price of truth-functionality, this is a positive result. In fact, Postsemantic Peirceanism may be regarded as more elegant than Semantic Peirceanism in the same sense in which supervaluationism is often regarded as more elegant than Łukasievicz's three-valued logic: it validates Future Excluded Middle without implying that one of its disjuncts is true.[15]

Of course, as this analogy suggests, Postsemantic Peirceanism also shares with supervaluationism some well known problems which have been widely discussed in the literature—failure of truth-functionality, retrospective assessments, knowledge ascriptions—and there is no reason to expect that it fares better than supervaluationism with respect to *those* problems.[16] The key difference, as explained above, is that Postsemantic Peiceanism does not allow truth-value gaps. Whether this is a desirable feature is obviously an open question, for one might wonder whether having bivalence without truth-functionality is better than simply not having it.

Let us now consider the zero credence problem. As it turns out from the example of the coin presented in 1, this problem arises from the conflict between two principles. One, the Principal Principle, requires credences to be related with beliefs about objective chance. The other requires one to ascribe zero credence to the sentences that one evaluates as false. In order to spell out the second principle, we will follow Cariani's formulation of the problem. Cariani defines the *world-profile* of a sentence A in context c as the set of worlds that are open possibilities in c and where A is true. Then he calls *Emptiness* the following assumption:

> If a sentence A, as uttered in context c, has an empty world-profile, then it is rationally permissible to ascribe to its content a very low credence (zero or near-zero).[17]

In the case of the coin, Cariani argues, the world profile of (5) must be empty if Peirceanism holds, for (5) turns out to be false at every world. Therefore, given Emptiness, it is rationally permissible to assign zero to (5). His point thus seems to be the following: if you accept Emptiness, which is a plausible assumption, and you endorse Peirceanism, then you are bound to go against the Principal Principle.

Cariani's point is well taken, given that his discussion focuses on Semantic Peirceanism: as long as definition 2 is adopted, the world-profile of a future contingent is always empty. However, the same does *not* hold for Postsemantic Peirceanism, a view which he does not consider. If definition 3 is adopted, it turns out that $F_n\alpha$ is true at m in some histories and false at m in other histories. So, when one quantifies over the histories that go through m, one does not always get falsity. Here m replaces c as used by Cariani because, in postsemantics as we understand it, truth at a context is identified with truth

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[15]Lukasiewicz [8].

[16]Such problems have been discussed in MacFarlane [9], Todd and Rabern [19], Iacona [5], among other works.

[17]Cariani [1], p. 63.

at a moment. So the world-profile of $F_n\alpha$ is not empty at m. This means that Postsemantic Peirceanism can consistently retain both Emptiness and the Principal Principle: the zero credence problem does not arise.

One way to substantiate this route is to rely on the distinction between truth and credibility suggested by Iacona and Iaquinto.[18] In their framework, credibility, as distinct from truth, can be coherently defined as a gradable epistemic property that depends on the amount and likelihood of the histories in which a sentence holds. Given a distribution of objective chance over the histories passing through m, the credibility value of α at m, indicated as $C(\alpha)_m$, is the sum of chance values of the histories in which α holds. This definition entails that, if the set of histories where α is true at m is empty, then $C(\alpha)_m = 0$, just as required by Emptiness. It also follows that $C(\alpha)_m$ is directly proportional to the objective chance of α at m. This is nothing but the relation between credibility and objective chance implied by the Principal Principle. Insofar as credibility is so defined, the Postsemantic Peircean can consistently maintain that (5) has credibility 0.5, in accordance with the Principal Principle, in spite of the fact that (5) is false, because being false does not mean—unlike in Semantic Peirceanism—having an empty world-profile.

The conclusion of this paper may now be summarised as follows. If one thinks that future contingents are all false, because one believes that no principled distinction can be drawn between truth and determinate truth, then one is not forced to endorse Semantic Peirceanism and face the three problems mentioned above. Postsemantic Peirceanism is comparatively better in that respect.

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