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I defend a simple argument for why considerations of epistemic probability should lead us away from Open Future views according to which claims about the future are never true.

1. Introduction

The Open Future (OF) view holds, among other things, that no temporally contingent proposition affirming what will be the case is true. A temporally contingent proposition is one that is not entailed by the present and past states of the world, and defenders of OF views take future indeterministic events or future libertarian-free choices as paradigmatic examples. I shall call a temporally contingent proposition affirming what will be the case a "future contingent proposition." There are two variants of the OF view, corresponding to two accounts of the truth value of future contingent propositions: the older No Truth Value (NTV) view, perhaps held by Aristotle, on which future contingent propositions lack truth value, and what might be called an Error Theory (ET) on which future contingent propositions are simply false, recently defended by Rhoda, Boyd and Belt[1] (hereinafter referred to as RBB). NTV requires a denial of bivalence: future contingent propositions are neither true nor false. ET, on the other hand, requires a denial of the principle that ~will(*s*) ⇒ will(~*s*), where the double arrow is entailment: it is not the case that I will eat dinner tomorrow (that is a temporally contingent claim), but likewise it is not the case that I will tomorrow fail to eat dinner.

Open Theism (OT) holds that God does not know any future contingent propositions. OF conjoined with the existence of God entails OT, assuming that only true propositions can be known. On the other hand, the conjunction of OT with the proposition that God knows all true propositions entails OF's claims about future contingent propositions not being true. Since it would appear to lessen the departure from traditional theism if the defender of OT were able to affirm that God knows all true propositions, a defender of OT has good reason to try to defend OF, or at least its claim about future contingent propositions not being true. Likewise, if we

[1]Alan R. Rhoda, Gregory A. Boyd and Thomas G. Belt, "Open Theism, Omniscience, and the Nature of the Future," *Faith and Philosophy* 23 (2006), pp. 432–459.

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affirm that God knows all true propositions, then a denial of OT entails a denial of OF.

But OF is very unlikely to be true. My argument is simple in form, but after giving it, I shall consider objections. In the following I will work with a consistent system of epistemic probabilities. I shall write T(p) for the claim that p is true and FC(p) for the claim that p is a future contingent proposition. I shall work within System T of modal logic (which is weaker than S4 or S5). I need three crucial but very plausible axioms about truth and probability, where K is our current background information:

(1) $p \Rightarrow \mathrm{T}(p)$

(2) if $p\&K \Rightarrow q$, then $\mathrm{P}(p \mid K) \leq \mathrm{P}(q \mid K)$

(3) $\mathrm{P}({\sim}p \mid K) = 1 - \mathrm{P}(p \mid K)$.

These indeed seem highly plausible. If (2) gives one any pause, it suffices to note that it follows quickly from the pair of axioms that (i) if $p \Rightarrow q$, then $\mathrm{P}(p \mid K) \leq \mathrm{P}(q \mid K)$, and (ii) $\mathrm{P}(p\&K \mid K) = \mathrm{P}(p \mid K)$.

At the same time, there is at least one adherent of OF who denies (1): Keith DeRose,[2] who accepts a variant of NTV according to which for a future contingent p it is the case that p or ${\sim}p$, but it is not the case that Tp or T${\sim}p$. In other words, DeRose affirms excluded middle but denies bivalence. However, I take (1) to be extremely plausible—plausible enough not to need argument. It would go beyond the scope of this paper to argue for (1). I will, nonetheless, make one note about DeRose's version of OF. There is a way in which DeRose's version of OF is weaker than other versions of OF, because DeRose's version of OF is actually compatible with God's knowing future contingents. The reason for that is that compatibly with this version of OF one can deny the principle that $x\mathrm{K}p \Rightarrow \mathrm{T}p$ (where $x\mathrm{K}p$ means that x knows p) and replace it with the principle that $x\mathrm{K}p \Rightarrow p$. And once one does that, one can actually hold that God knows future contingents: thus, God may know that I will mow the lawn tomorrow, and that he knows it entails that I will do it, but it does not entail that it is *true* that I will do it. So even if one can get out of my argument by denying (1), still the present argument may at least work against those versions of OF that force one to adopt OT.

I also need one more assumption for my argument. This assumption is not an axiom, and the OF advocate will want to reject it, but the assumption nonetheless is true and common-sensical, and I will sketch an argument for its truth:

(4) There is a proposition p such that $\mathrm{P}(p \;\&\; \mathrm{FC}(p) \mid K) > 0.99$.

Here is one way to argue for (4). Let p be that claim that it will be the case that I do not win the jackpot in the next drawing of the California

[2]Keith DeRose, comment on "Modality and Open Future," comment posted February 26, 2009 1:51 a.m. at http://prosblogion.ektopos.com/archives/2009/02/modality-and-op.html.

State Lottery. Now, I am very unlikely to play, not even being in California, and second, even if I play, I am extremely unlikely to win the jackpot. Thus, we may conservatively suppose,

(5) $P(p \mid K) > 0.999999$.

Moreover, our current background knowledge K entails that p is a future contingent proposition, since p plainly depends on my free choice whether to play the California State Lottery, and if so, then on what numbers to choose, as well as on what numbers are picked as winning numbers. All of this is contingent. Granted the rules of the California State Lottery could change in such a way as to specify that necessarily Alexander Pruss does not win, but such a change would also depend on contingencies. Thus, we can be extremely close to certain that FC(p), so that we can say:

(6) $P(\mathrm{FC}(p) \mid K) > 0.999$.

Putting (5) and (6) together, we easily get $P(p \,\&\, \mathrm{FC}(p) \mid K) > 0.99$. I think we are quite confident of this claim. And (4) immediately follows.

Given (1)–(4), the argument against OF is a mere technicality. Let p be as in (4). Now, OF entails that no future contingent proposition is true. Therefore, OF $\Rightarrow$ ~(FC(p) & Tp). Thus:

(7) $P(\mathrm{OF} \mid K) \leq P({\sim}(\mathrm{FC}(p) \,\&\, \mathrm{T}p) \mid K) = 1 - P(\mathrm{FC}(p) \,\&\, \mathrm{T}p \mid K)$,

where the inequality follows from (2) and the equality follows from (3). It follows from (1) that

(8) $(\mathrm{FC}(p) \,\&\, p) \Rightarrow (\mathrm{FC}(p) \,\&\, \mathrm{T}p)$

(this step uses the theorem that if $a \Rightarrow b$, then $c\&a \Rightarrow c\&b$, which can be easily proved[3] to hold in System T). Therefore, by (2), we have

(9) $P(\mathrm{FC}(p) \,\&\, p \mid K) \leq P(\mathrm{FC}(p) \,\&\, \mathrm{T}p \mid K)$.

It follows from (7) and (9) that:

(10) $P(\mathrm{OF} \mid K) \leq 1 - P(\mathrm{FC}(p) \,\&\, p \mid K)$,

Applying (4), we conclude that

(11) $P(\mathrm{OF} \mid K) \leq 1 - P(\mathrm{FC}(p) \,\&\, p \mid K) < 0.01$.

Thus, the epistemic probability of OF given our current knowledge is less than 0.01. A proposition whose epistemic probability given our current knowledge is less than 0.01 should be rejected, unless there is some non-epistemic justification. Hence, the Open Future view should be rejected.

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[3]It is a tautology that $(a \supset b) \supset (c\&a \supset c\&b)$. Therefore, by the Necessitation Axiom (which says that if r is a theorem, then so is Lr, where L is the necessity operator), it is a theorem that $\mathrm{L}[(a \supset b) \supset (c\&a \supset c\&b)]$. Then by the Distribution Axiom (which says that $\mathrm{L}(r \supset s) \supset (\mathrm{L}r \supset \mathrm{L}s)$) and *modus ponens*, it is a theorem that $\mathrm{L}(a \supset b) \supset \mathrm{L}(c\&a \supset c\&b)$. Now, suppose we have $a \Rightarrow b$. Then, by definition of entailment, $\mathrm{L}(a \supset b)$. Using the theorem we just proved, that $\mathrm{L}(a \supset b) \supset \mathrm{L}(c\&a \supset c\&b)$, and *modus ponens*, we conclude that $\mathrm{L}(a\&c \supset b\&c)$ or, equivalently, that $c\&a \Rightarrow c\&b$.

2. *Objections*

i. Intuitionistic logic. Axiom (3), applied twice, implies that $P(\sim\sim p \mid K) = P(p \mid K)$. This may well be too close to the axiom of Double Negation (DN), $\sim\sim p \Leftrightarrow p$, for intuitionistic logicians to be comfortable with (3).

But I do not think many defenders of OF will want to follow intuitionistic logicians. After all, denying DN destroys the validity of *reductio ad absurdum* arguments, which surely we do not want to do. One might try to deny (3) in the special case of future contingent propositions and their negations, but that is objectionably *ad hoc*. And if DN is not secure in the case of propositions about the future, this precedent would allow one to always escape from any *reductio* argument by saying that that argument provided yet another case of an exception to DN.

ii. Epistemic probabilities. On what grounds could I assign probabilities, or at least probability bounds, to future contingent propositions, such as are required by (4)?

Obviously, there is much inductive evidence for the unlikelihood of any particular person winning a particular drawing of the lottery. Suppose that p was a proposition affirming that at t, I do not win the jackpot in the California State Lottery drawing. Assuming we assign a high probability to the time t existing, we would assign this a high prior probability, regardless of whether t is in the past, present or future. And, in the case where t is in the near future and K is our present background knowledge, the probability remains high. Similarly we have much inductive and intuitive evidence for p being a future contingent proposition—in fact, while p will not be entailed by K, the claim that p is a future contingent proposition may well be entailed by K.

Any case of a proposition whose status as a future contingent proposition is entailed by our present background knowledge but where the proposition is strongly inductively confirmed will do for (4).

If we are not able to assign high probabilities to future contingent propositions, then our decision making about the future is in trouble. And my argument does not even require spectacularly high probabilities. It seems quite likely that under most circumstances, we wouldn't spend our money on a plane ticket unless the probability that the plane would successfully arrive at the destination is at least 0.75. But plugging this value into my main argument, and assuming that K contains the fact that whether we safely and successfully make the trip is temporally contingent, will give us the claim that $P(\mathrm{OF} \mid K) \leq 0.25$. And the defender of OF won't like that, either.

iii. The Error Theory and (4). The Error Theorist is committed to denying (4). For according to the Error Theory, if p is a future contingent proposition, then p is false. Hence, if we are close to certain of the Error Theory, we will be close to certain that p is false, and thus $P(p \mid K)$ will be close to zero rather than close to 1 as (4) would require.

At the same time, RBB in their development of ET appear to feel quite free to make claims about probabilities of future contingent propositions, and do not seem to think that these probabilities are all close to zero. Their account appears to be grounded in the notion of "causal force." Thus, the probability of a future event seems to be proportional to the amount of causal force that the present state of the world has for producing that event. If the causal force of the present state is sufficient to determine the event to happen, the probability is 1, and if the causal force of the present state is sufficient to determine the event not to happen, the probability is zero, but in-between causal forces give in-between probabilities.

It appears, then, that RBB are committed to (4), since there should be plenty of propositions p whose status as future contingent propositions is entailed by K but where there is very high causal force in favor of p. If so, then my argument succeeds.

But in fact that is probably not the right way to read the relation between RBB and my argument. For my argument concerns *epistemic probabilities*, while the causal force story surely goes along not with epistemic but objective probabilities. Thus, the current objection to my argument becomes this: While there is a high objective probability of p, the epistemic probability of p is not high.

To push this objection through, it would be necessary for RBB to deny Lewis's Principal Principle that epistemic probabilities should match objective probabilities when the objective probabilities are known. But even if one does not wish to affirm the Principal Principle in every case, it would be a very uncomfortable thing in this case to say that it is objectively very likely that I will fail to win the California State Lottery, but that the epistemic probability of the very same claim is zero, since I know that p is false on ET.

Moreover, since prudence dictates that I should make my decisions on the basis of the very high probability of my failing to win the California State Lottery, prudential decisions would have to be based on the objective rather than epistemic probabilities. This is an uncomfortable position. After all, in cases where the objective probabilities are unknown, the epistemic ones are *surely* what I should go by. So the resulting view of deliberation would have to be a hybrid one on which I use objective probabilities in some cases and epistemic ones in others, and I make no attempt to make the epistemic ones match the objective ones. This is not plausible.

iv. Two senses of "will." ET can accommodate ordinary language by saying that there is a weaker sense of "will" which does not require for the truth of "S will happen" that the causal force of present events render S inevitable. All that is required is a high degree of force, and the exact degree required depends on the conversational context. In any case, the degree required is such as to ensure at least a one-half objective probability (understanding objective probabilities as correlated with causal force, as in the discussion of objection iii). In that case, $P(p \mid K)$ need not be close to zero, as it would be on the stronger sense of "will."

But if p is the claim that I will fail to win the next California State Lottery, then we want to be able to say that $0 < P(p \mid K) < 1$, with $P(p \mid K)$ closer to 1 than to 0. On the strong reading of "will," according to ET advocates, I get $P(p \mid K)=0$, since all future contingent propositions have to be false then. But on the weak reading of "will," p says merely that the present state of things tends causally very strongly against my winning. But that the present state of things tends causally very strongly against my winning is not merely highly probable, but *certain*—I know *for sure* that I am unlikely to win. Thus, on this understanding of p, $P(p \mid K)=1$. But that's wrong, too. There *is* a tiny chance that I will both play and win. So neither reading works.

v. Assertibility. In light of the response to objection iv, one might supplement OF with a non-realist account of ordinary uses of "will."[4] This account would be parallel to conditional probability accounts of conditionals, like that of Edgington,[5] which focus on assertibility conditions and do not provide truth conditions. On Edgington's view, $a \to b$ is assertible provided $P(b \mid a\&K)$ is high (for an appropriate K). But it is not the case that there are probabilistic truth-conditions for $a \to b$. It is not, for instance, the case that $a \to b$ is true if and only if $P(b \mid a\&K)$ exceeds some value p_0.[6] One way to get out of my argument on an assertibility analysis of "will," will then be to deny (1) when p is a future contingent proposition, not for the DeRose reason discussed above, but for an irrealist reason.

However, a standard worry about theories that dispense with truth conditions and focus on assertibility is what to do with logical connections between sentences that lack truth conditions. Thus, the emotivist (emotivism is an assertibility theory according to which "*A* is wrong" is assertible if and only if one has a strong moral feeling against *A*) has a hard time explaining plausible conditionals such as "If all abortions are wrong, then all late abortions are wrong." Similarly, an assertibility theorist about conditionals may have difficulties about nested conditionals, disjunctions of conditionals, and so on.

Now, in the case of conditionals, some of these difficulties will not be as pressing, simply because in ordinary language we are loath to embed conditionals in larger conditionals, and we ordinarily rarely combine a sentence involving a conditional truth-functionally with another sentence except by way of conjunction.

However, we are quite willing to embed future-tensed claims, including ones expressing future contingent propositions, in larger sentences. Thus, we are willing to say things like: "If this method didn't work yesterday, it won't work tomorrow," "If George does not pay her back tomor-

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[4]It could be that this is in fact what RBB claim.

[5]Dorothy Edgington, "On Conditionals," *Mind* 104 (1995), pp. 235–329.

[6]Such truth-conditions would fail in ways precisely parallel to the way in which it will not do to analyze "I will fail to win the California State Lottery" as an assertion that there is a high objective probability that I fail to win the California State Lottery. For on such an analysis, it would be *certain* that I will fail to win the California State Lottery, and likewise it would be certain that were I to play the lottery, I would lose, because it is certain that $P(\text{lose} \mid \text{play}\&K)$ exceeds just about any reasonable p_0, whereas we do not want to say that either the "will" claim or the conditional claim is certain.

row, then next week he will be a marked man" and "Either he will show up for the exam or I will give him an F." If a sentence does not express a proposition, it is quite mysterious how one can combine it logically with other sentences.[7]

Moreover, what is the assertibility theorist about "will" to do with cases where the speaker does not know whether a given claim is about the past, present or future? For instance, you know that a friend on another continent is having an operation today. You say: "Today, my friend is having an operation," but do not know whether the operation is past, present or future. Surely we do not want to say that this is a disjunction of three claims, two of which have truth conditions, while the third does not: "Today my friend had an operation or right now my friend is having an operation or my friend will have an operation today."

Conclusions

Many Open Future theories have a difficulty with properly handling probabilistic claims about the future. In general, semantic views that hold that a class of propositions lacks truth value are going to make it difficult to assign probabilities to these propositions (think of the challenges for an emotivist to make sense of "Probably this operation is morally required"), while semantic views that hold a class of propositions to be false are going to make it problematic to assign any probabilities other than zero to propositions in that class. This general fact means, for instance, that anti-Molinists who deny that subjunctive conditionals of freedom have truth value had better not turn around and assign probabilities to these conditionals.[8]

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[7]It's worth noting parenthetically that problems with logical combination may also affect ET. Thus, if we take it that a necessary falsehood entails every proposition, an incompatibilist Error Theorist will have to say: "That George will freely commit a theft entails that George will be morally perfect." For the antecedent, according to ET combined with incompatibilism, is necessarily false.

[8]I am grateful to two anonymous referees as well as to Thomas Flint for a careful reading of this paper and a number of suggestions, many of which I have followed. I am also grateful to a number of commenters on prosblogion.ektopos.com.