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# Betting Interpretation and the Problem of Interference[*]

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It has long been common to identify an agent's degrees of belief with her betting rates. Here is this *betting interpretation* (BI) in a nutshell: A bet on a proposition *A* with price *C* and a non-zero stake *S* (= the monetary prize to be won by the bettor if *A* is true) is said to be *fair* for an agent iff the latter is willing to take each side of the bet, to buy the bet as to sell it. Assuming that such a bet on *A* exists and that the *C*/*S* ratio is constant for different fair bets on *A*, this ratio is the agent's *betting rate* for *A*. The rate in question is taken to be the agent's degree of belief in *A* (his credence in *A*, or – to use yet another terminology – his subjective probability for *A*).

BI is an instance of operationalism. It makes degrees of belief observable and measurable. It also opens up for pragmatic arguments for various rationality constraints on beliefs such as standard probability axioms, conditionalization, reflection, etc. An agent whose degrees of belief violate these constraints will have betting rates that make her vulnerable to exploitation.

There is an actualist and a dispositionalist version of BI. On the former, degrees of belief are fixed by the agent's actual betting behavior, while on the latter, the more plausible one, they are fixed by the agent's dispositions to bet. It is the dispositionalist version that

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we shall focus on. Note that the identification of *degrees* of belief with betting rates does not force the dispositionalist to identify beliefs themselves with dispositions to bet. He can instead assume that an agent's betting dispositions supervene on her beliefs.

Although operationalism has fallen from grace in most other fields, it has shown amazing resilience regarding degrees of belief. The objections to operationalism in this area mostly concern cases in which agents are judged to have beliefs that they aren't disposed to manifest in behavior, or cases in which agents have reasons to bet that are unconnected with what they believe. Troublesome as these objections are, it is arguable that attitudes to bets still *could* represent the agents' degrees of belief; the objections only show that in this or that situation, they don't.

We propose to consider a more fundamental problem for BI: There is a sense in which degrees of belief *cannot* be interpreted as betting rates. The bets we are disposed to accept do not reflect our current unconditional degrees of belief in various propositions. Whether a bet on *A* would be accepted or not does not depend on the agent's degree of belief in *A* but rather on the degree of belief she would have if she were confronted with this bet proposal, or – more generally – the degree of belief she would have if she were in a position to bet on *A*. Assuming the conditionalization model for belief change, this means that whether the agent would be willing to bet depends on her current *conditional* beliefs concerning *A* on the supposition that she has an opportunity to make this bet. Furthermore, her disposition to bet also depends on the expected effects the act of betting would have on the truth of the proposition to be betted on. Both these phenomena imply that finding oneself in a betting situation might alter one's expectations in important ways. Consequently, the identification of (unconditional) degrees of belief with betting rates is a mistake. The reason is, to put it shortly, that we need to take into consideration potential interferences that bet opportunities and betting itself might create with regard to the proposition to be betted on. It is because of this *interference problem* that the agent's degree of belief in *A* cannot be interpreted as her betting rate for *A*. This suggestion will be developed in what follows.

The problem as such isn't new. Ramsey, for example, was right on to this idea when he wrote:

> … the proposal of a bet may inevitably alter [one's] state of opinion; just as we could not always measure electric intensity by actually introducing a charge and seeing what force it was subject to, because the introduction of the charge would change the distribution to be measured. (Ramsey 1931 [1926], p. 172)

We will show that this problem comes up in several different versions.

**Causal relations between bets and the propositions betted on**

Consider this case: I am fairly confident that I will fall asleep tonight. But were I to bet on this, I might lie awake all night, trying to get to sleep and failing. So, I am not confident that I would fall asleep tonight if I were to bet that I will. (See Hájek 2009.)

The problem can be of two sorts. First, trying to win the bet might be counter-productive. Trying to fall asleep makes it harder to do so. There are benefits that can be gained as side-products, but not when they are deliberately targeted. Second, it might be that it is thinking of the bet you have made rather than trying to make true the proposition betted on that is counter-productive. If you bet you will be happy next week, this can make you less happy in that period if you are going to worry that you might lose your bet or if you are going to regret for some reason that that you have made this bet. Of course, it doesn't have to work out in this way. Feeling pretty certain that you will be happy, the expectation of the gain from your bet might add to your happiness. Taking the bet might thus lead your beliefs in either direction, making it either more or less likely that the proposition you have betted on is true. However, the crucial point is that no matter in which direction you go, the bet can influence your probabilities for what you are betting on.

Falling asleep is something we can't do on purpose (if we don't have sleeping pills). *Not* falling asleep, however, is something we *can* control, at least for a time. If you place a bet that you won't fall asleep tonight, you can do something to make it happen. While in the absence of the bet you are confident you will fall asleep tonight, your probability

decreases if you bet that you won't. This point generalizes: our probabilities for actions under our control can differ from our probabilities for these actions if we bet on them. This spells trouble for the betting interpretation.

Some proponents of BI have argued that we should bite the bullet and accept that we cannot have subjective probabilities for the choices we are about to make. Practical deliberation crowds out self-prediction (cf. Levi 1997, pp. IX and 81). Wolfgang Spohn presented this idea as follows:

> The agent's readiness to accept a bet on an act does not depend on the betting odds but only on his gain. If the gain is high enough to put this act on the top of his preference order of acts, he will accept it, and if not, not. (Spohn 1977, p. 115)

Explanation: On BI, the agent's subjective probability for a proposition *A* equals the price-stake ratio *C*/*S* in a fair bet on *A*. But now suppose that *A* describes an action that stands at the agent's disposal. If the agent bets on *A*, then, since *A* is something she can make true if she so chooses, she can count on a sure net gain $G = S - C$. We can represent the expected utility of the bet on *A* as eu(*A*) + *G*, where eu(*A*) stands for the expected utility of A in the absence of the bet. Now, assume for simplicity that there is just one action, *B*, that is an alternative to *A*. Suppose that eu(B) > eu(A). However, as long as eu(*B*) < eu(*A*) + *G*, the rational agent will accept the bet on *A*. But, and this is crucial, the size of $G = S - C$ is not fixed by the ratio *C*/*S*. When we vary *C* and *S* while keeping the ratio *C*/*S* constant, *G* can decrease so much that the bet on *A* loses its attraction. As Spohn puts it: "If the gain is high enough to put this act on the top of his preference order of acts, [the agent] will accept it, and if not, not". This sensitivity to the size of *G* conflicts with the assumption that *C*/*S* is constant for different fair bets on a given proposition. But then, in the absence of such a constant ratio, there is no well-defined betting rate for *A*, which means – on the betting interpretation – that the agent lacks a subjective probability for that proposition.

The argument above implicitly presupposes that the agent is *certain* she will perform the action if she bets on it. If there is some doubt on this account, the agent might still abstain from taking the bet even if the net gain *G* makes the sum eu(*A*) + *G* larger than eu(*B*). For

in the presence of such uncertainty she would not be assured of winning the bet in the first place.

However, a slightly modified argument goes through even in the absence of certainty (cf. Rabinowicz, 2002, p. 101). The net gain *G* could swing the balance so much to *A*'s advantage as to make it profitable for the agent to accept the bet, as long as she considers it sufficiently *likely* that she would perform *A* as a result. There is no need of certainty, if *G* is sufficiently large.

This argument, if correct, proves more than Spohn has intended, however (cf. Rabinowicz, 2002, pp. 101ff). At least in principle, it shows that for *all* of one's future actions, and not just for those that are subject to current deliberation, their subjective probabilities (*and* the subjective probabilities of events that these actions could influence) cannot be interpreted as betting rates. Betting on them might make them sufficiently likely for the bet to be profitable, if G is large enough. While friends of BI might be prepared to deny that the agent has subjective probabilities for the actions she currently deliberates upon, extending this claim to all future actions of the agent would go too far. Surely, we do have degrees of belief concerning things we will do in the future. To be able to allow for this, while still denying that we have degrees of belief for the actions about which we currently deliberate, friends of BI would need to make use of some pretty heavy idealizations, such as, say, positing that – insofar as future actions are concerned – the agent expects to forget her bets after having made them, before she is going to start to her future deliberation on how to act. Forgotten bets on future actions do not create interferences, since they are not going to influence the actions themselves. Clearly, however, the more counterfactual and outlandish idealization is required, the more problematic becomes the claim that BI gives an account of what degrees of belief *are*.

We'll come back to the issue of idealization in the penultimate section.

**Evidential relations between bets and the propositions they concern**

Another class of putative counterexamples to BI depends on the fact that betting, or finding oneself in a position to bet, might sometimes carry information bearing on the proposition on which the bet is made. This can happen in at least four different ways: The information might be carried by someone offering you a bet, by your acceptance of that bet, by your own bet offer, or by your bet offer being accepted.

(i) Examples of the first kind are easy to find. In general, an offer of a bet will change one's probability for the proposition to be betted on if one has grounds to suspect that the person who has made the offer has access to superior information.

Bradley and Leitgeb (2006) argue that the examples in which the offer of a bet changes your credence aren't yet worrying for BI, as they do not concern credences that are relevant for behavior. The relevant credences are those you have *ex post*, after having been offered the bet. And your credence ex post does equal your betting rate: You are willing to bet at the rate that corresponds to your changed degree of belief. It is for this reason they move to a more elaborate case, "Forgery": Suppose a fair coin will be flipped. Whether it land heads or tails, you will be offered a bet on Heads. But you know that, if the coin will land heads heads, the bet will use fake money (both your banknotes and the bookie's will be secretly exchanged for fakes). Then the offer of the bet will not change your probability for Heads, but the latter will still diverge from your betting rate. Your probability for Heads will still be ½, but you won't be willing to bet on Heads at these odds.

A less fanciful example that makes the same point is a case in which a bookie offers to make a bet with you on a given proposition, but with the proviso that you must be prepared to take each side of the bet. Only after you have accepted his offer, he will disclose whether you are to buy or to sell the bet. The bookie's offer in such a case doesn't change your probability for the proposition on which the bet is to be made, but it still makes you suspect that the bookie knows more than you do. Therefore, you wouldn't be willing to accept the offer at odds that correspond to your probability.

We think, however, that the problem for BI already arises in the original simple examples in which the bet offer does change your probability. In those cases, your *ex ante* credence for the proposition you are asked to bet on cannot be interpreted as your betting rate for that proposition. This is troublesome enough. BI is meant to be general and therefore it should also apply to a person's degrees of belief ex ante. In fact, to the extent that exposure to bet offers is a method to elicit the agent's probabilities, it is the ex ante probabilities that are meant to be the object of elicitation.

(ii) The second case is when information is revealed by the very fact that you accept the bet. Consider the following example: Your degree of belief that you are not a gambler is high. But then you are offered a bet on this proposition and you do accept the bet, which reveals something about yourself that is of relevance to the truth of the proposition you have betted on. So, in considering whether to accept the bet or not, it seems you should take into consideration that accepting it would be revealing in this way.

(iii) The third case is similar to the second: The fact that you make a bet offer can reveal something about yourself that is of relevance to the truth of the proposition betted on. For example, offering a bet on a proposition that you are a risk-lover (risk-hater) can increase (decrease) your probability for that proposition.

(iv) The fourth case, in which the information is provided by your bet offer being accepted, is similar to the first case: That your offer is accepted might be evidence that your opponent knows something you don't.

In these four kinds of cases, making a bet or being confronted with an opportunity to bet would have evidentiary (but not causal) bearings on the proposition betted on. This evidentiary effect explains why the rate at which you are willing to bet does not correspond to your degree of belief in the proposition under consideration.

**Qualification: Causal versus evidential decision theory**

At this point, however, we need to stop and re-consider. Cases of type (ii) and (iii) in the section about evidentiary relations are problematic. Our suggestion that they exemplify the Interference Problem for BI is incompatible with causal decision theory (CDT). If an action has purely evidentiary bearings on the relevant states of nature, but no causal bearings, CDT tells us that we should calculate the expected utility of the action in terms of the unconditional probabilities of states, rather than in terms of their conditional probabilities given the action under consideration, as evidentiary decision theory (EDT) would have it. In other words, on CDT, purely evidentiary bearings of actions should be disregarded in decision making. Now, suppose that the action I deliberate upon consists in placing a bet, and assume that this act has mere evidentiary bearings on the proposition on which the bet is to be made, as in the example in which that proposition states that I am not a gambler. Placing a single bet would not in itself cause me to become a gambler, but it would provide some evidence concerning my gambling dispositions. In such a case, CDT recommends that I should place the bet if my *un*conditional probability for the proposition under consideration is high. However, we have suggested above that, in my decision, I should take into consideration that placing the bet would provide evidence against the proposition on which the bet is to be made. This kind of counter-example against BI is incompatible with CDT. The same applies to type (iii) cases.

By the way, another seeming counterexample to BI in group (ii) is the well-known case of Sleeping Beauty. If a fair coin lands Heads, the Beauty will be awakened only once, while if it lands Tails, she will be awakened twice, with the memory of her first awakening erased. All causal links will thereby be removed between her actions on both occasions. Upon each awakening, she will be offered a bet on Heads. She knows all this. Now she wakes up and gets an offer of a bet on Heads. If she accepts the bet, this will increase her probability that she will accept another offer like this if she will be awakened again. These purely evidentiary bearings of her bet are bad: She will be awakened more than once only if the coin has actually landed Tails. If she for that reason abstains from betting, despite of the rate of the bet equaling her probability for Heads, her decision is in line with EDT, but not with CDT. For an analysis of Sleeping Beauty along these lines,

see Arntzenius (2002). Bradley and Leitgeb's (2006) argue that betting odds and credences come apart in the case of Sleeping Beauty. Bovens & Rabinowicz (2010) suggest that this argument implicitly presupposes EDT.

If we stand by CDT, we have to reject such counterexamples. But other counterexamples we have presented still stand. Thus, CDT does imply that the agent's willingness to bet on a proposition *A* should depend on (a) the evidentiary bearings on *A* of the *opportunity to bet*, i.e. the evidentiary bearings on *A* of the agent's being in a position to place a bet on *A* if she so chooses, and (b) the expected causal effects that betting on *A* could have on that proposition.

Very roughly, then, a hypothetical bet *b* on *A* at a certain rate is acceptable to an agent iff this rate does not exceed the agent's current degree of belief that *A would* be the case if she were to make bet *b*, *conditioned* on the supposition that she will have an opportunity to make the bet in question. I.e., if we let *P* stand for the agent's current probability assignment, *b* is acceptable to the agent if and only if *b*'s price-stake rate does not exceed $P$(bet *b* on *A* $\boxdot\!\!\rightarrow$ *A*/opportunity to bet on *A*). Only if none of the interfering factors (a) and (b) mentioned above is present, this degree of belief is reducible to the agent's current unconditional degree of belief in *A*. In the absence of factor (b), $P$(bet on *A* $\boxdot\!\!\rightarrow$ *A*/opportunity to bet on *A*) = $P$(*A*/opportunity for bet on *A*), and in the absence of factor (a) $P$(*A*/opportunity to bet on *A*) = $P$(*A*). Thus, it is only in the absence of both factors that BI does not encounter the interference difficulties we have raised.

Even this is an oversimplification. Even if an action of betting has purely evidentiary bearings on the proposition to be betted on and the opportunity to bet has no such bearings, the agent should still beware of fixing her betting rate in advance, in accordance with her current degree of belief in the proposition in question. Here's the reason why: When she starts to deliberate whether to accept the bet or not, she will often be able to gain introspective access to her psychological leanings – to her inclinations to decide one way rather than the other. Now, even on CDT, the information the agent will gain prior to her final decision is relevant to what she should decide. This means that the agent's ex

ante probabilities aren't reliable betting guides in case like this, since they can be expected to change during deliberation leading to a decision on whether to bet or not. In what follows, we shall disregard this complication.

**Other versions of the betting interpretation**

There are other versions of BI apart from the simple operationalism we have been focusing on. Of special interest is the view that while degrees of belief can be *measured* by betting rates, they are distinct from the latter. Even de Finetti himself wavered between the operationalist account and the measurement view. One of the advocates of the measurement view was Richard Jeffrey. But Jeffrey certainly recognized that there were cases in which betting rates didn't seem to measure degrees of belief well (Jeffrey 1956, p. 238-9). In fact, all the standard problematic cases for the operationalist view are trouble-cases for the measurement view as well: If a person dislikes betting, her degrees of belief cannot be identified with her betting rates, since she doesn't have any, but neither can they be measured by these non-existent betting rates. However, the consequences are less drastic for the measurement view: Instead of constituting an outright refutation, the apparent counterexamples only restrict the range over which betting rates provide a reliable measure. It is standard that a particular measurement method only works under limited conditions. Thermometers only work over a certain range, but this doesn't compromise their reliability for the temperatures within that range. (cf. Jeffrey, ibid.)

It is arguable that Frank Ramsey also adhered to the measurement view. Cf. the following quotation from Ramsey (1931 [1926]), p. 172:

> The old-established way of measuring a person's belief is to propose a bet, and see what are the lowest odds which he will accept. This method I regard as fundamentally sound; but it suffers from being insufficiently general, and from being necessarily inexact. It is inexact partly because of the diminishing marginal utility of money, partly because the person may have a special eagerness or reluctance to bet, because he either enjoys or dislikes excitement or for any other reason, e.g. to make a book. The difficulty is like that of separating two different co-operating forces.

The quoted passage continues with Ramsey pointing out the interference problem that confronts this method of measurement.

The counter-examples considered in this paper can be treated as problems for measurement: Introducing bet opportunities sometimes creates an interference with what we want to measure. So does betting itself. One might conclude that this just shows yet another limitation of the betting approach viewed as a measurement procedure. However, this move considerably weakens the measurement view. The situation is not like the one in the thermometer analogy. There is no specific range of propositions for which the betting interpretation provides a reliable method. While some interference-based objections to this interpretation focus on particular classes of propositions (about future actions, about the agent's dispositions to bet, etc.), other such objections, like the one having to do with the evidentiary bearings of betting opportunities, apply – at least in principle – to *any* proposition.

A possible response to this problem might appeal to recent general discussions about dispositions. As has been pointed out by several authors, dispositions may well be subject to various interferences that falsify the simple stimulus-manifestation conditionals that they standardly are defined by. (For good up-to-date discussions, see Contessa 2012 and Fara & Choi 2012.) Thus, under some circumstances, the dispositions can be *masked* (as when a fragile object is carefully wrapped, so that it wouldn't break if it were dropped), or they might be overridden by *antidotes* (as when a poisonous food wouldn't kill if ingested provided we have taken an appropriate antidote), or they might be *finkish*, which means that the condition for an object losing (or acquiring) a disposition is the same as that disposition's stimulus condition. Here is an example of a fink, due to Martin (1994), who first introduced this idea: A wire is disposed to conduct electricity when touched by a conductor, but it is part of a circuit with a circuit-breaker that would open if a conductor were to touch the wire, which would hinder the wire from conducting electricity.

Now, an adherent of BI might conceivably argue that the dispositional interpretation of probabilities as betting rates an agent would be willing to accept if she got an opportunity is perfectly in order, but that the relevant dispositions are finkish: Their stimulus conditions, i.e. betting opportunities, would introduce new information and thereby cause

the agent to lose these dispositions. In other words, betting opportunities have evidentiary bearings that interfere with the agent's dispositions to bet. A betting disposition exists as long as its stimulus condition is not actualized. That it does exist under those circumstances can be shown by a thought experiment: If the betting opportunity *didn't* have any evidentiary bearings, then the agent would accept the relevant bet if offered. On this proposal, the evidentiary bearings of the betting opportunity in certain cases *mask* the disposition rather than make it disappear. This happens in the earlier mentioned example in which a bookie offers to make a bet with you on a given proposition, but only on condition that you would be willing to take each side of the bet. Only after you have accepted his offer, he will disclose which side you will have to take. The bookie's offer in such a case doesn't change your probability for the proposition in question, and thus, on BI, you still have the same disposition to bet. But the evidentiary bearings of the offer are such that you wouldn't be willing to accept it at the odds that correspond to your probability.

We are not sure what to say in response to this kind of proposal. It certainly is attractive, but there is something strange in dispositions that are supposed to be finkish or masked in such a pervasive and systematic way. It is one thing to accept finks and masks in rare cases, as exceptions, as in the example of a wire which is disposed to conduct electricity but would not do so because of the presence of a circuit-breaker. But if the interfering effect of the stimulus conditions on the purported dispositions is supposed to be a rule rather than an exception, then the very existence of such dispositions might be questioned. And even if we were to accept their existence, the whole point of identifying degrees of belief with behavioral dispositions – the underlying operationalist strategy – is undermined if these dispositions are so pervasively and systematically interfered with.

Some friends of BI respond to criticisms by taking a position that decision theory is not supposed to be about actual people anyway. Problems with betting rates as representations of degrees of belief that arise for actual people need not be equally serious when we consider agents viewed as *theoretical constructs*. In reply, the first thing to be noted is that this response leaves open the question why the degrees of belief of

such theoretically constructed agents need to be defined, measured or otherwise elicited by betting behaviour. After all, the reason for introducing bets was to gain access to degrees of belief through observable phenomena. But theoretically constructed agents aren't observable anyway.

Talk of theoretical constructs, however, could also be used to justify various counterfactual or subjunctive moves as solutions to our problem. One such suggestion (due to Sebastian Enqvist) is that my degrees of belief at a given time *t* are given by the bets that my *hypothetical* alter ego would be willing to make at *t*, not about events in her hypothetical world, but about the *actual* world. This alter ego is exactly like me up to and including time *t*. The relevant bets, in other words, are those that we ourselves would be willing to accept about the actual world, if we could take a time-out from reality. This allows us to avoid the problem that a bet on a proposition sometimes causally influences the proposition in question and that this influence needs to be taken into consideration by the bettor. Bets made in another world have no causal influence on what happens in the actual world.

While this counterfactual construction does take care of the interference phenomena related to the expected causal effects of bets, it still fails to attend to interferences generated by the evidential bearings of the opportunities to bet. But the most basic problem seems to be that the more idealized, hypothetical or counterfactual we go, the less it makes sense to look to bets for an interpretation of degrees of belief. What these cases at best show is that if we twist and turn enough, we might possibly construct hypothetical betting rates that would correspond to the agent's actual degrees of belief. *But it is our independent understanding of these degrees of belief that guides the hypothetical constructions.* Therefore, the former are not really illuminated by the latter.

**What does this tell us?**

It is not only the identification of the agent's degrees of belief proposition with her betting rates that is undermined by the cases we discuss. The very notion of a *betting rate* is put into question. As we remember, the betting rate for a proposition *A* is supposed to be the price-stake ratio common to all fair bets on *A*, where a bet is fair if and only if the

agent is willing to take each of its sides. However, if a bookie's offer to sell a bet on *A* could decrease the agent's probability for *A*, while a bookie's offer to buy a bet on *A* could increase that probability, fair bets on *A* might not be available: There might be no ratio at which the agent would be willing both to buy and to sell the bet on *A*. On the other hand, if *A* is a proposition about some event that stands under agent's control (such as her current or future action), then there would be too many fair bets on *A*: As long as both the net gain *S* - *C* and the price *C* are sufficiently large, the agent might be willing to both buy and sell bets with different *C*/*S* ratios. (If she buys this bet, it will be to her advantage to make *A* true if the net gain is sufficiently large, while if she sells it, she will profit by making *A* false if the price of the bet is sufficiently large.) Thus, no such ratio would be common to all fair bets on *A*. For both these reasons, the notion of a betting rate is problematic.

As we have seen, the interference problem creates difficulties not only for the view that identifies degrees of belief with dispositions to bet but also for other versions of BI: for the measurement view and for various counterfactual constructions. Can we do better?

An idea that seems right but would require much work to be properly developed is that beliefs should be given a *functional* interpretation: they are definable in terms of their double role of truth-trackers and guides of behaviour. On this view, beliefs are internal states of the agent that come in degrees and have propositional content. Their function is to adjust the agent's behaviour to the state of the world in such a way as to make the agent flourish, in some sense that would need to be spelled out. (This spelling out can be done in terms of desire satisfaction or in some more objective, Aristotelian way, by taking its point of departure from an appropriate theory of human nature. It could also be done on the evolutionary lines, in terms of the number of offspring.) This function accounts for their double role: On the input side, they track truth, which gives them a direction of fit different from desires, and their degrees are informed by the goal of truth approximation. (If we think of beliefs as coming in degrees, it is natural to expect that the truth-tracking aspect of beliefs should be accounted for in terms of some appropriate *accuracy* measure, such as the Brier score. See Joyce (1998), for a proposal along these

lines.) On the output side, they guide the agent's behaviour and not least her betting behaviour: In one sense, all acting under uncertainty can be seen as betting. This means that there does exist, after all, a conceptual connection between degrees of belief and dispositions to bet. But the existence of such a conceptual connection does not imply any simple equation of the kind: the degree of belief in *A* = the betting rate for *A*. In the first place, the problem with this equation is that it wholly ignores the role of beliefs as truth-trackers. In the second place, the agent's betting dispositions with regard to *A* might well be determined by the degree to which the agent believes some other, more complex proposition – a proposition related to *A* but different from it (such as that *A* would be true if the agent made a bet on it). In addition, this complex belief, whose degree is relevant to the agent's disposition to bet, might well itself be conditioned on some suppositions – thus, in particular, it might be conditioned on the supposition that the agent will have an opportunity to bet on *A*.

Even this picture is extremely simplified. On the input side, the role of beliefs is not always to track truth and thereby enable one to act in an efficient way. At least sometimes, their presence is more directly tied to flourishing, as in the case of wishful thinking and ex post rationalization. And on the output side, the role of beliefs is not just to guide actions. They influence behaviour in other ways as well. Consider for example a person who is about to do a driving test: His confidence calms him down and makes him drive well, whereas a low confidence in one's driving skills would have the opposite effect. Furthermore, beliefs often affect other aspects of our functioning, apart from behaviour. Not least, they influence our emotions. Likewise, one's beliefs also guide various psychological processes, such as inferences, desire formation, etc.

All this shows that the functionalist approach of beliefs might turn out to be very complicated. But this is just to be expected. Correct theories about complicated creatures like us are not likely to be simple.

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