CHOICE, BELIEF, AND THE ROLE OF EVIDENCE

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Will Barrett

Choices can be rational. So can beliefs. But what is the relationship between rational choice and rational belief? I will argue that rational choice imposes an evidentiary constraint on the beliefs that inform decision-making, and that Bayesian decision theory violates this constraint. We need a modified decision theory.

Our actions are more likely to be successful if the beliefs they are based on are true. A rational agent should want to reason in a way that leads to true belief. Talk of 'true belief', however, should not be taken literally here. Although we should not limit our talk of belief to degrees of belief, the processes of rational choice only require degrees of belief. But what constraints does choosing rationally impose on how we form our degrees of belief? I will argue against orthodox Bayesianism that evidence about probabilities bears directly on the rationality of degrees of belief, and that rational decision-makers should only form degrees of belief where there is positive evidence about probabilities. Bayesianism is flawed because it entails degrees of belief in situations devoid of evidence. Decision theory can be justified as a regulative ideal, but Bayesianism fails on this interpretation as well.
Rational Choice Theory

According to rational choice theory, an action is rational if it satisfies the following three optimality conditions: first, it is the most effective means of satisfying an agent’s desires, given her beliefs about relevant factual matters; second, her beliefs are sensitive to relevant information, and the processes of belief formation are not influenced by various biases, including wishful thinking; third, investment of resources in information acquisition is neither inadequate nor excessive, given the agent’s aims and prior beliefs. Rational choice theory aims to both explain how people do behave, and how they ought to behave. This dual role as explanatory and normative is not a problem: we use norms in explaining behaviour.¹

If we hope that rational choice theory will be followed, and if we hope that people will actually behave according to its precepts, then rational choice theory faces various problems. The theory tends to make simplifying assumptions that we know in general to be false. It assumes that both an agent’s set of beliefs and her set of desires are internally consistent; but sometimes agents make decisions about what to do on the basis of logically inconsistent beliefs and incoherent patterns of desire. It assumes that there is a single ‘best’ means to satisfy an agent’s desires; however, there may be several equally good and no better options, and a rational choice model cannot tell us which one the agent will choose. Another problem concerns a tension between the
three conditions. It is important to note that what counts as the ‘best’ action is to be understood as subjective, in that it depends on the agent’s beliefs. But an agent’s prior beliefs can influence where and how she seeks information, and how much information she considers adequate. (She may have basic beliefs that she will not let any evidence count against. She may have beliefs that she simply wants to be true.)

There is a close connection between rational choice theory and the view that rational agents aim to maximise subjective expected utility. On this view the epistemic input to the decision-making processes of rational agents consists of subjective probabilities—degrees of belief—and rational degrees of belief are distributed according to the rules of the probability calculus. But is that all there is to rational partial belief? For the theory to be a satisfactory account of rational behaviour, should it require that the distribution of an agent’s degrees of belief amongst various propositions be more than just consistent in the sense that it satisfies the axioms of the probability calculus? What weight should be given to evidence, or to facts about probabilities? Subjectivism, in its standard Bayesian version, does specify rules for belief change in the light of new evidence. Prior degrees of belief are modified by conditionalising on evidence, leading to posterior degrees of belief. Bayesians argue that the weight of evidence forces convergence of posterior probability over widely diverse prior probabilities, and that the probability calculus entails this result. Even
though subjectivists give a role to evidence in the formation of our degrees of belief, coherence is still the criterion of the rationality of partial belief.

Typically, actions are successful if the beliefs they are based on are true, and fail otherwise. Given this, rational decision-makers should want to reason in a way that leads to true beliefs. They also should want to reason in a way that brings their degrees of belief into accordance with the known probabilities. I am more likely to get what I want if my degrees of belief about outcomes are responsive to the relevant facts. In using the phrases “known probabilities” and “relevant facts” I do not intend to commit myself on the question of whether there are objective probabilities, nor do I need to. I only aim to establish that we can make sense of the idea that degrees of belief are related to facts about probability that go beyond the axioms of the probability calculus and Bayesian conditionalisation on evidence.

For example, I might claim that probability is a relation between evidence and conclusion, where that relation reflects known frequencies. Probability statements are constitutive of a body of knowledge. Rational degrees of belief conform to what is probable given the body of knowledge, and that is in turn determined by the empirical evidence that we in fact possess. What it is rational for me to believe to a high degree is what the empirical evidence supports. An agent’s degrees of belief should be both consistent, and revisable in light of new empirical evidence. The rationality of
degrees of belief is a matter of conforming to known probabilities, not merely happening to coincide with the evidence. Alternatively, I might have a propensity theory of chance, and claim that knowledge of propensities makes having a particular partial belief reasonable. Evidence of propensities is provided by chance trials, although propensities, like other dispositional properties, can exist without being displayed. In this sense objective chance provides a measure of reasonable partial belief in a suitably situated agent. I might claim that probabilities are frequencies, on the basis of which we can make correct predictions. Estimates of probabilities that correspond to these frequencies function as the epistemic input to the practical reasoning of rational decision-makers.

The theory that monadic probability statements express a speaker’s degree of belief in the outcome of an event is compatible with the view that there is more to the rationality of partial belief than internal consistency, and that probability statements can be more than purely subjective.

Another problem for rational choice theory is that beliefs also need to be more than just sensitive to the available evidence. A belief needs to be the ‘best’ belief in light of the available evidence, and needs to be caused by the evidence, in an appropriate way. The agent needs to have taken care to look for evidence. But even with these modifications a problem remains. What if a choice of action must be made, in a
situation where the evidence does not uniquely determine the correct belief, or even fails to give support to any particular belief? Rational choice theory goes from an assumption of rationality to a unique behavioural prediction, and fails to the extent that even on that assumption sometimes a unique behavioural prediction is not possible.

However, that is not in itself a reason to give up the view that the individual conditions rational choice theory lays down capture our concept of rational action. It may be unjustified to call an agent irrational simply because her behaviour cannot be uniquely predicted according to the model generated by rational choice theory. But we do have a concept of irrationality, and typically apply it to violations of those conditions. Failing to choose an action that will help to realise my all-things-considered best judgement; letting my desires determine my beliefs about what action to choose, or ignoring evidence that needs to be taken into account if I am to achieve my aims; collecting too much or too little information, or otherwise irrelevant information, given my desires: apart from very unusual circumstances, these count as ways of being irrational.

There is both more and less to rationality than rational choice theory recognises, but it does identify central aspects of rational behaviour. It is perhaps best taken as a set of regulative ideals, presenting optimality conditions for rational decision making. But
this requires that the theory be modified. Unmodified, it imposes normative requirements: I fail to be rational if, for example, my beliefs are not consistent. Understood as a regulative ideal it does not have the same normative force, but suggests that the beliefs of a fully rational agent would be consistent. On this interpretation, the force of the conditions of rational choice theory is not a unique prediction of the behaviour of a rational agent but, appropriately modified, to state the conditions that the actions of a suitably situated ideally rational agent would satisfy.

**Degrees of Belief**

The view that probability statements express degrees of belief is often expressed in terms of bets: my degree of belief in a proposition is a matter of the lowest odds I am willing to accept for a bet on that proposition. So if I accept a bet at 4 to 1 on some proposition, then my belief in that proposition has a strength of at least 0.2.

The theory needs to be qualified in various ways. Actual willingness to bet is often presented as a criterion of degree of belief. It seems plausible, however, for someone to consider a bet at certain odds reasonable, without being disposed to accept that bet. A connection between belief and disposition to accept a bet can be made by introducing subjective utilities, and measuring the value of choices between bets in terms of these. But the subjective utility of a bet depends on an agent’s situation,
attitudes and values. In order to avoid problems raised by the fact that money has diminishing marginal utility (the value of an extra $100 might depend on how much money someone already has), by the fact that people differ in their attitudes to risk, by an agent’s wish that some things be true and others not, and by the effect of stake size on acceptable odds, a method is required which eliminates these factors. One proposed solution is that the bettor’s opponent decides the size of the stake and the direction of the bet after the odds are set. The claim is that all that is left to dispose an agent to settle on some odds in preference to others is degree of belief, and thus the odds accepted are a fair measure of that degree of belief. The truthmaker of an ascription of partial belief is a possible state of affairs: I have a certain degree of belief if I would have accepted a bet at such-and-such odds in appropriate circumstances.

Degrees of belief are not necessarily rational degrees of belief, so further moves are required to make this a theory of rational belief. The Dutch Book argument often appears at this point. Your set of beliefs is irrational if you are willing to accept a series of bets that guarantee that you will lose, whatever happens. For example, if you bet $2 for a return of $1 on each of the horses in a two-horse race, then no matter which one wins, you lose $1. Bayesians typically argue that a set of degrees of belief that satisfies the axioms of the probability calculus is not susceptible to a Dutch Book, and that rational degrees of belief can be numerically represented in a way that obeys
the rules of the probability calculus. In contrast, violations of these rules lead agents to form incoherent valuations of the expected outcomes of bets, making them susceptible to Dutch Books.

We need the concept of partial belief, because full belief about probabilities does not capture an agent’s tendency to act. I may believe that the chance of heads on the toss of a fair coin is 0.5, and not take any action that relates to that belief. If, however, I will accept odds of evens and higher that the outcome of that coin being tossed is heads, then I have a partial belief of 0.5 that heads will result from the toss. The notion of betting odds does capture my tendency to act as if a particular event will occur, by representing my confidence in that occurrence, or in the truth of a proposition that that event will occur.

We have seen that the rationality of preferences between bets is connected with the rationality of belief, and that the constraints on the former are closely related to those on the latter. Insight into the rationality of preferences between bets bears directly on questions about the rationality of a person’s degrees of belief.
Belief, Truth and Confidence

I have assumed a behavioural conception of partial belief. Having a particular degree of belief disposes an agent to accept certain odds. Dispositions to betting behaviour are a matter of an agent’s degrees of belief in propositions about outcomes. The expected value of a bet depends on the relationship between the range of possible outcomes, the probabilities of each, and the odds given. My degree of belief is measured by the amount I am willing to lose if I am wrong against the return if I am right. Accepting odds expresses degree of belief, not categorical belief.

My degrees of belief are crucial to the odds I am willing to accept, if I am to achieve my aims. An epistemic approach to probability seems to be appropriate in such cases. Consider someone who says “I believe I will win” when a probability of 1 cannot be sustained. In cases like this, the evidence condition of rational choice theory is satisfied by information that is relevant to degrees of belief. Being right about the probabilities is important if I am to get what I want, and this consideration takes us beyond internal consistency. But clearly an account of partial belief and its relation to action is needed, and it is this that an epistemic theory of probability can provide. The requirement that I optimise evidence relevant to the satisfaction of my aims in order to act rationally concerns degrees of belief, not categorical belief.
Maybe we should stop talking of categorical belief altogether, and only talk about degrees of belief. Believing a proposition entails holding it to be true. If you hold something to be true, you are very confident in its truth. You are less confident about the truth of other propositions. Why not say that belief is just a matter of confidence, something that always admits of degrees? We could still talk of degrees of belief, because that is all there is to belief.

This won’t do, because categorical belief is a distinct epistemic state. Imagine your degree of belief that the Labor Party will win the next Australian federal election is well above 0.5. The minimum odds you will accept on that outcome are say 3 to 1 on. Even if I know this, I can quite reasonably ask if you actually believe Labor will win. Rejection of the distinction between degrees of belief and categorical belief also has to deal with the fact that we employ categorical beliefs as premises for further reasoning. Assuming a proposition involves provisionally holding it to be true, putting yourself in a position of belief. In such situations it does not make sense to ask your degree of belief.

In any case, categorical belief cannot be successfully translated into something that always comes in degrees. If believing a proposition is a matter of certainty, you have a degree of belief of 1. But then, on a subjectivist analysis, you would be willing to
bet whatever you can on each of your beliefs. Assuming you are offered the same
odds, you would not prefer a bet on any of the propositions you believe, even a
tautology, to any other. A more permissive approach would be to count you as
believing a proposition if your degree of belief meets some suitably high threshold.
This approach avoids the problems raised above, but leaves you a victim of the lottery
paradox. In a lottery you are highly confident is fair, and which has 1,000,000 tickets,
your degree of belief in each proposition ‘this ticket will win’ is very small. Well
below the threshold. However, your degree of belief in the proposition that not all the
tickets will lose is very high, in fact well over the threshold. So you have an
inconsistent set of beliefs. Categorical belief is not just the same as or reducible to
degrees of belief.

Believing is integral to the process of practical decision-making. From a decision-
theoretic point of view you have a belief if the following conditions are satisfied.
First, you choose the action that would be most likely to satisfy your aims given the
justification of your belief. Second, you understand that the action you choose will
have the outcome you want if your belief is justified. You act on the basis that your
belief is justified. Unless we accept that belief entails being certain, which I have
argued leads to irrational choices, we have to take the claim as one about degree of
belief. And according to the analysis of belief as holding to be true, that degree would
have to be extremely high. You would have to be willing to accept very short odds on
a bet. Decision theory is intended to guide our choices in situations of uncertainty, and
the input of our beliefs would be unhelpful to say the least if belief entailed certainty
or something close to it. Even though we should not limit our talk of belief to degrees
of belief, the processes of rational decision-making only require degrees of belief.

**Interlude: Evidence and Coherence**

There is clearly more to the rationality of degrees of belief than coherent betting odds.

Consider the following states of affairs:

1. A coin has been tossed 100 times, resulting in 40 heads, 60 tails.
2. The same coin has now been tossed 1000 times, resulting in 400 heads, 600 tails.

Knowing this, what should my attitude be to the following propositions?

(A) The chance of heads resulting from the coin being tossed is 0.4.

(B) The result of the next toss of the coin will be heads.

It seems reasonable that my confidence in A should be greater in Case 2 than in Case
1. My degree of belief in B should remain the same. In Case 1 I form a partial belief
of 0.4 that the result of the next toss will be heads: the minimum betting odds I will
accept on the proposition that the result of the next toss will be heads (6/4) measure
that degree of belief. There is no apparent reason to modify that in response to the situation in Case 2.8

In the circumstances of Case 2 I have more evidence for the hypothesis that the coin is biased in such a way that the expected long-term ratio of tails to heads is 6 to 4. I am thus justified in being more confident that the chance of the next toss resulting in heads is 0.4, even though in both situations the minimum betting odds I will accept on the proposition that the result of the next toss will be heads is 6 to 4. How can we accommodate the idea that I should be more confident of the outcome in Case 2? If I were to bet on the basis of the available evidence in both of the situations described, it would be reasonable to bet at the same odds; but intuitively I should be more willing to bet in the second situation.

Perhaps a formula could be devised that enabled degrees of belief in propositions about the results of future events to be revised according to my confidence in propositions about chances. A formula like this would have no place in situations like the one given here. How could an adjustment in the odds I would accept on the likelihood of heads on the next toss be justified?

Evidence about the coin’s behaviour justifies confidence not just about outcomes, but also about the value of bets. I have greater justification for accepting a bet on heads at
6 to 4 or above if I am aware of the 600/400 distribution. The lowest betting odds I will accept measure my degree of belief. I thus have greater justification for having the degree of belief that is measured by the lowest odds I will accept. Evidence about probabilities bears directly on the rationality of my degrees of belief, not just by way of their coherence.

**Betting, Bayesianism and Indifference**

Returning to rational choice theory, what are the appropriate epistemic constraints on our attitude towards propositions? This question can be expressed in terms of subjective decision theory: what are the requirements of a method for deciding what degree of belief we should give to propositions?

The method proposed by Bayesian decision theory, when applied to the analysis of degrees of belief as betting behaviour, entails that we have degrees of belief in all decision situations. I am indifferent between two propositions if and only if I am willing to accept the same odds on both; in other words when I do not prefer a bet on one of the propositions where the same odds are offered on both. If I do prefer one bet to another at the same odds, I have a higher degree of belief in one of the propositions. I either prefer one bet to the other, or value them equally. It follows that I have a degree of belief in each proposition, no matter what. Assuming that the bets I
will accept in suitable circumstances measure my degrees of belief, and that I am either indifferent between bets or prefer one to another, I will always be able to provide the epistemic input necessary for rational decision-making. Rational decision-making requires that I should always prefer one bet to another, or be indifferent between them. So, if I don’t have a higher degree of belief for one proposition over another, I will have equal degrees of belief.

Now consider the following. I don’t have any information relevant to which horse will win in a two-horse race. I should therefore be willing to accept the same bet on the propositions ‘Neddy will win’ and ‘Dobbin will win’. But given that I don’t know anything relevant to the outcome of the race, it is unreasonable to require that I give specific values to propositions about the outcome. I might think it rational to accept a bet at higher odds than evens on either horse, if I believe the person offering the odds has no greater information than I do. But if my opponent does offer favourable odds, and is as ignorant as I am, that only shows my opponent’s foolishness. It does not establish that either of us should have formed degrees of belief of 0.5. In such a situation it seems quite rational for me to remain undecided as to the outcome. Further to this, in conditions of ignorance it is rational to abstain from action unless the expected utility of not acting is less than any alternative amongst the range of possible actions. Don’t act under ignorance unless the worst possible predictable outcome is the one that results from not acting. It may be responded that calculating expected
utility requires subjective probabilities. In the imagined scenario, however, it is clear that a possible outcome of betting at evens is the loss of the amount of one’s stake, and that is a worse outcome than that resulting from not betting.

This argument advocates employing a minimax loss strategy under situations of ignorance, and rejects the notion of rational indifference. Interestingly, a minimax argument has also been used to defend indifference. There are circumstances, so the argument goes, in which it is rational to allocate betting odds equally over the alternative outcomes. No other distribution of odds has the potential outcome of an equal or lower possible loss. I am not convinced that the proposed allocation of odds involves indifference. A minimax loss argument is doing the work here, and it is concluded that it is rational in certain cases to accept equal odds. The better may in fact value some possible outcome more than another. That is not the same as being indifferent between odds, where the outcomes are being valued equally.

The foregoing criticism of indifference has a practical correlate. In situations of ignorance you should refrain from choosing between bets that are actually on offer, unless you have separate grounds for believing that the outcome of not choosing will definitely be worse than any other predictable outcome. But then you do have information relevant to your choice. Sometimes choices are necessary under genuine
ignorance, but typically a rational agent will not place a bet if no information relevant to the outcome is available.

Bayesianism requires that degrees of belief be represented as numbers, in order to determine whether they are rational, that is whether they obey the rules of the probability calculus. Interpreted subjectively, even allowing rational degrees of belief that do not have a unique value, this requirement is often unachievable. But that mightn’t be such a bad thing. Even though you cannot always meet the standard Bayesianism imposes, perhaps that standard functions as a regulative ideal, violations of which open your epistemic states to legitimate criticism, and not as a rule for the conduct of inquiry such that if you violate it you are properly classified as irrational. It lays down the conditions for the solution of problems about what degree of belief to give to propositions, and holds that fully rational agents would have solutions to all such problems. But a regulative ideal that requires even fully rational agents to form degrees of belief in circumstances where there is no relevant evidence cannot be justified.

Mark Kaplan has developed a version of epistemic decision theory, ‘Modest Probabilism’, that he argues is not subject to many of the problems facing Bayesianism.\textsuperscript{10} The principles Kaplan proposes do not have the consequence that we always have solutions to decision problems, in the sense that we always give values to
propositions; he allows rational indecision. He distinguishes indecision and indifference in the following way:

Both when you are indifferent between A and B and when you are undecided between A and B you can be said not to prefer either state of affairs to the other. Nonetheless, indifference and indecision are distinct. When you are indifferent between A and B, your failure to prefer one to the other is born of a determination that they are equally preferable. When you are undecided, your failure to prefer one to the other is born of no such determination.’11

Although Modest Probabilism holds that rational degrees of belief satisfy the axioms of the probability calculus, it does not entail degrees of belief in situations devoid of evidence, even for fully rational agents.

Modest Probabilism suggests a different regulative ideal. According to the standards imposed by this ideal, your ‘states of opinion’ are open to legitimate criticism. In cases where violations are due to your limited cognitive capacities or logical acumen, or where you simply do not know how to avoid violations, or where the proposition is of no interest to you, you are not properly subject to criticism. You cannot be blamed for something that is beyond your capacity. But you should acknowledge that if an opinion does violate the standards proposed by Modest Probabilism it is open to legitimate criticism. Your opinions are not as justified as they might be, in that they do not meet the ideal.
Although Kaplan does not explicitly put it this way, I think that his ‘regulative ideal’
response to the claim that Bayesianism is too demanding essentially consists of a
rejection of indifference. It is rational to adopt only those opinions you have good
reason to adopt. Even ideally, according to this more modest version of probabilism
you ought only to be indifferent in your degree of belief between two propositions if
you have ruled out any assignment of values that does not place the same value on
each; you have given proper weight to the evidence. The basis for having equal
degrees of belief is not the formal requirement that you give values to all propositions.
Rather, you give them equal degrees of belief because the evidence supports that
distribution.

Bayesians do have an account of evidence, at least to the extent that the theory gives
rules for assigning degrees of belief given new evidence, but even this process starts
with assigning prior values to hypotheses. In the end for Bayesians what counts is the
internal consistency of an agent’s belief set. As I argued earlier, for a theory to be a
satisfactory account of rational behaviour, it really should require that an agent’s
beliefs be more than just internally consistent. Although Modest Probabilism only
gives a consistency constraint on rational belief, it does not claim to say all there is to
say about the rationality of belief. It acknowledges that evidence can be independently
important in belief formation, at least to the extent of saying that the assignment of
degrees of belief should always depend on the availability of relevant evidence.

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1 A great deal has been written about rational choice theory. My summary has been influenced by the
work of Jon Elster. See Elster, Jon, *Ulysses and the Sirens: Studies in Rationality and Irrationality*
(Cambridge U. P., 1979); Elster, Jon, *Sour Grapes: Studies in the Subversion of Rationality*

2 For a theory along these lines, see Kyburg, Henry E., Jr., *Probability and Inductive Logic* (London: Macmillan, 1970), Ch. 7.

propensity theory.

4 Ernest Adams takes this approach. See Adams, Ernest W., ‘Consistency and Decision: Variations on
Ramseyan Themes’ in *Causation in Decision, Belief Change, and Statistics* (Proceedings of the Irvine
(Dordrecht; Boston: Kluwer, 1988), pp. 49-69, at pp. 53-58; Adams, Ernest W., *A Primer of

5 This method was first developed by Frank Ramsey in the 1920s. See Ramsey, F. P., ‘Truth and
Probability’ in *Studies in Subjective Probability*, Henry E. Kyburg, Jr. and Howard E. Smokler (eds.),


7 A bet is said to be fair if the expected value is zero, favourable if it is positive, and unfavourable if it is
negative. If I believe that the probability of a coin landing heads is half, then a bet at evens is fair, at
2 to 1 is favourable, and at 1 to 2 is unfavourable. In a fair bet on that outcome, the ratio of my stake to
the sum of both stakes (for a bet of $1 at evens, 1/2) equals the probability of the coin landing heads.

8 If the coin had been tossed 10 times only, resulting in a 6-4 distribution, I would be foolish to accept
odds of 6/4. I’m assuming that a 60-40 distribution is sufficient ground for thinking that the coin may
be biased.

9 O’Neill, Len, Indifference and Induction’ in *Natural Kinds, Laws of Nature and Scientific


11 Kaplan, *Decision Theory as Philosophy*, p. 5.
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