DELIBERATION *DOES* CROWD OUT PREDICTION

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Wlodek Rabinowicz (2002) has challenged the thesis that deliberation as to what one is to do and prediction as to what one will do cannot be jointly undertaken coherently. He maintains that even if it were true, it would not have the kind of relevance for theories of rational choice and game theory that some of its proponents claim it has. He also claims that the proponents have not made a compelling case for the thesis. I disagree. I will devote my tribute to Wlodek on his 60th birthday to an effort to respond to his cogently presented essay. In doing so, I carry on a tradition of long standing where Wlodek and I maintain our friendship by challenging each other's work.

At the outset, I would like to take exception to his formulation of the thesis that deliberation crowds out prediction. Rabinowicz rightly notes that the thesis can be parsed into a weak thesis and a strong one. But the weak one he formulates is not weak enough. Indeed, it is false.

Here are Rabinowicz's two theses:

> *Weak Thesis*: In a situation of choice, an agent does not assign extreme probabilities, one or zero, to options among which his choice is being made.
>
> *Strong Thesis*: In a situation of choice, an agent does not assign any probabilities at all to options among which his choice is being made.(Rabinowicz, 2002, 92.)

As I suggested, the weak thesis is false. But the counterinstances to it are trivial. When account is taken of such trivialities, the weak thesis is not weak enough.

Prediction whether of choices or anything else can be understood to express full belief in the truth of some claim about the future or a judgment as to how probable some conjecture about the future is to be true. These are two quite distinct kinds of prediction. When predictions express full belief, they

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are either true or false. When they express judgments of probability, they are neither true nor false. To be sure, full beliefs may be taken to assign probability one to the actions they predict. But they are judgments of absolute certainty. When extralogical propositions are taken to be absolutely certain, their negations are ruled out as serious possibilities. Some propositions are assigned probability one without being judged absolutely certain. Thus, when an infinite sequence of tosses of a fair coin is said to converge in relative frequency to 0.5 with probability 1, the certainty is not absolute certainty. The logical possibility that the sequence diverges from 0.5 is not ruled out as a serious possibility. The credal probability judgment in this case, lacks a truth value. Rabinowicz's formulation of the weak thesis overlooks the distinction between absolute and "almost" certainty.

In the case where prediction of choice is concerned, the predictions focus on hypotheses as to which of the options available to the decision maker to choose. Attend to the case where the decision maker fully believes that he or she will implement exactly one of a given set of alternative options belonging to set *A*. The decision maker X's state of full belief entails that exactly one element of a set U_{K} of hypotheses each of which asserts that a specific option in *A* is implemented from those available to X. Consider then the power set $2^{U_{\mathrm{k}}}$ of U_{K}. Any prediction of X's choice is representable by an element |h| of $2^{U_{\mathrm{k}}}$ or a sentence *h* asserting that the true element of U_{K} belongs to |h|.

If X is deliberating among the options expressed by hypotheses in U_{K} relative to state of full belief K, X can predict for sure that exactly one option from the given set will be chosen. That is to say, X fully believes u_{k} asserting that exactly one element of U_{K} is true. Because full beliefs carry probability 1, X assigns probability 1 to the hypothesis u_{k} expressing this prediction. In this trivial respect, Rabinowicz's weak thesis is false. Deliberation allows for prediction of choice in the sense of full belief that u_{k}.

When this quibble is taken care of, the weak thesis I favor precludes prediction in the sense of full belief in the truth of any hypothesis *h* where |h| belongs to $2^{U_{\mathrm{k}}}$ except for u_{k} as long as X is deliberating among the options in *A*. Since X's state of full belief is X's standard for serious possibility, the weak thesis I favor is equivalent to the following:

> *Weak Thesis according to Levi*: In a situation of choice among the alternatives in *A*, X should judge every element of U_K to be a serious possibility.

Assuming that Rabinowicz's weak thesis prohibits assigning extreme credal probabilities of 0 and 1 to elements of U_K, Rabinowicz's weak thesis entails the one I propose but not conversely. On the weak thesis I am suggesting, elements of U_K can carry 0 probability while remaining serious possibilities. Rabinowicz's version rules out assignments of 0 probability regardless of whether 0 probability means incompatible with the evidence (state of full belief) or does not.

The strong thesis I favor is substantially the same as the one Rabinowicz favors. I reformulate it within the framework I have just sketched:

> *Strong Thesis according to Levi*: In a situation of choice among alternatives in *A*, no sentence expressing a member of 2^{U_k} except U_K and $\varnothing$ should be assigned a credal probability and the exceptions should be assigned the probabilities 1 and 0 respectively. In particular, no sentence expressing an element of U_K should be assigned a probability. More generally, the set of permissible probability distributions over U_K according to X's state of credal probability judgment should be empty.

Wolfgang Spohn (1977) and I (Levi, 1997) have both advocated something like the strong thesis just formulated. I say "something like" because Spohn is unhappy with dealing with full belief as a standard for serious possibility and might want to formulate the issue somewhat differently than I have done. In any case, I owe debts of gratitude to both Spohn and to Teddy Seidenfeld for having pushed me to conclude that assigning credal or belief probabilities to options in a decision problem ought to be disallowed. Rabinowicz seeks to formulate the shared view of Spohn and myself as follows:

> Now Spohn's and Levi's arguments for the strong thesis are meant to show that, *on pain of contradiction or incoherence*,

> *the agent cannot have betting rates for the actions that stand at his disposal*. (Rabinowicz, 2002, 98.)

Again, Rabinowicz does not quite capture the view that I and, I think, Spohn endorse. Neither Spohn nor I preclude agents from having betting rates for their options "on pain of contradiction or incoherence" unless some additional assumptions are adopted.

Spohn argues, and I concur, that assigning unconditional probabilities to options in a decision problem plays no useful role in deliberation. We offer slightly different arguments for this claim; but neither of us maintain that one cannot assign credal probabilities (whether determinate or indeterminate) to one's options or that one cannot have betting rates for one's one's options and be coherent. What I, at any rate, contend is that one should not assign fair betting rates to one's options that at the same time represent one's credal probabilities for hypotheses as to which of one's options will be implemented. Agent X could assign credal probabilities to hypotheses about what X will do while deliberating as to what X should do. But such credal probabilities are a useless epiphenomenon as far as deliberation is concerned.

Moreover, I (but not Spohn) contend that in inquiry, even when concerned with theoretical matters, standards for evaluating changes in point of view are practical. Changes in point of view are to be justified by showing that they are optimal or, more generally admissible, as options among the available options and relative to the goals of the inquiry. The function of probability judgment in theoretical inquiry is the same as in practical deliberation.[1]

But even on the assumption that credal probabilities are used to compute expected values of options and, hence, to determine fair betting rates, the argument I offer does not show that the decision maker's assigning unconditional probabilities to hypotheses concerning what the decision maker will do is incoherent *unless one wants the standards of rationally coherent probability judgments to serve in the evaluation of expected value in contexts of choice where the principles of choice will sometimes be applicable non vacuously*. I do want to focus on probability judgment on the assumption that

[1] I have defended this view throughout all of my career beginning with Levi, 1967 and including Levi, 2004.

principles of choice can be applied non vacuously to the determination of which of the available options are admissible and which are not. But my argument does not show that rejecting this assumption is incoherent or inconsistent.

I show that a rational decision maker assigning probabilities to hypotheses concerning the option he is about to choose must assign full belief to the prediction that the decision maker will choose rationally (i.e., choose an admissible option among those judged to be available) on pain of incoherence or contradiction. Only admissible options are seriously possible according to the decision maker. From this, according to the weak thesis, the admissible options and the feasible or available options must coincide. Hence, criteria for rational choice must be vacuously applicable in *all* contexts of choice.

If this vacuous applicability thesis is rejected, the admissible and the available cannot coincide in all contexts of choice. Hence, the criteria for rational probability judgment should prohibit a rational decision maker from assigning unconditional credal probabilities to hypotheses concerning which available option will be chosen *on pain of inconsistency with the vacuous applicability thesis*.

Consider a situation where X has options **a** and **b** and strictly prefers the former to the latter. Suppose X assigns credal probabilities to the two options *and* uses the probability judgments to determine fair betting rates for bets on whether **a** or **b** will be chosen. We can envisage an offer to X of a bet where X wins S utiles if **a** is chosen and 0 utiles if **b** is chosen. How much should X be willing to pay for the bet?

X faces a choice between **a** and **b**. Suppose for the sake of the argument that X is offered a bet on **a** with stake S and price P on a take it or leave it basis, X now has four options. X can combine a choice of **a** or **b** with acceptance or refusal of the bet at a given price. The set of options reaches the order of the continuum when bets at all prices between 0 and 1 are on offer. Clearly X will prefer choosing **a** and accepting the bet for any price no greater than S over refusing that bet and choosing **a** (choosing **b**). He will also prefer accepting the bet for any price greater than S and choosing **a** to accepting the bet at that price and choosing **b**. So, *given that X is facing a choice between* **a** and **b**, X's fair price for the bet on choosing **a** is S and the fair betting rate is 1. This fair betting rate is equated with the probability that X will choose **a** according to the supposition that the fair betting rate is equivalent to X's credal probability. Notice that the fair price is exactly S and not S diminished by some infinitesimal amount. Hence, X's probability should be absolute certainty so that X is committed to full belief that **a** will be chosen.[2] *If* the weak thesis is endorsed, this entails that the *only* option available to X from the pair (**a**, **b**) is **a** itself. I do not claim that it is incoherent or inconsistent for X to regard himself as having one option (in common parlance, as having no choice). But the set of admissible and the set of available options coincide. Principles of rational choice are vacuously applicable if credal probabilities used to determine expected values are assigned to hypotheses about options currently being evaluated as objects of choice.

This conclusion generalizes to cases where we begin with a set *A* of available options where two or more are optimal or are, more generally, admissible. Let *A* = {**a,b,c**} and let **a** and **b** be equipreferred and **c** be strictly dispreferred to **a** and to **b**. Let X be offered a bet where X wins S utiles if either **a** or **b** is chosen and wins nothing if **c** is chosen. Once more X should be prepared to pay up to S utilities for the gamble; for X wins S-P utiles if X chooses one of the admissible options and loses P utiles if X chooses **c**. So an optimal choice for X is to choose one of the admissible options **a** or **b** together with accepting the bet for P utiles. X will always come out ahead on the assumption that **a** and **b** are preferred to **c**. If X equates fair betting rates with degrees of credal probability, X comes out absolutely certain that X will choose **a** or **b**. The weak principle takes over and entails that the only available options are **a** and **b**. Admissibility and availability once more coincide.

I take for granted that principles of rational choice are designed at a minimum to sometimes reduce a set of feasible or available options to a proper subset of admissible ones. If the criteria of choice *always* render the admissible options

[2] In the two places where I offer my argument (Levi, 1997, ch.2 and ch.4), I did not explicitly mention that the conclusion was conditional on the supposition that credal probability and betting rate coincide. But it has always been my intention to think of the argument as conditional on this supposition. I cannot fault Wlodek for failing to appreciate this point.

coextensive with the available options, there is no contradiction or incoherence. But the principles of rational choice are only vacuously applicable. To prohibit this unfortunate result, I endorse both the weak and the strong thesis.[3]

Rabinowicz contends that my argument is spurious. He writes:

> Surely, if the agent has any doubts as to whether he will perform A if he takes the bet, and if the cost of the bet is positive, then he may well be wary of taking the bet on A if the most he can gain is nothing at all… Thus being prepared to do a combination of the actions, and being prepared to do one part of this combination, does not imply that one is prepared to do the other part, considered on its own. (108).

According to the scenario under consideration, the decision maker has a given roster of options. The offer of a bet is made with the understanding that accepting (or refusing) the bet is a new pair of options to be combined with some member of the roster. The number of options is doubled for each price.

This scenario has no room for doubts as to whether A will be implemented when the bet on A is taken. The proposition that the bet is taken and A is implemented is by hypothesis optional for the decision maker. Optionality presupposes efficaciousness (Schick 1979, Levi, 1986, 1991 ch.2.). The agent should fully believe that if the agent chooses implementing A while accepting the bet, the choice will be implemented. Rabinowicz worries about a situation where this efficaciousness assumption fails so that accepting the bet and

[3] Rabinowicz alleges that if this argument is correct, it proves more than I claim. Suppose X has two options **a** and **b** and they are equipreferred. Rabinowicz alleges that in that case as well, X should be absolutely certain that **a** and also that **b**. But that would be absurd.

I agree that it would be absurd. No matter whether the two options are equipreferred or one is strictly preferred to the other, it is incoherent to assign credal probability 1 to two hypotheses that relative to the agent's state of full belief are exclusive. No rational agent would be prepared to pay a price P = S for gambles both on **a** and **b**. This is so whether **a** or **b** holds. The maximum price X should be prepared to pay for bets on hypotheses as to whether X will choose **a** or choose **b** is not determined by the information that **a** and **b** are equipreferred although it is determined when one is strictly prepared to the other. What is clear in both cases is that the fair betting rate on the hypothesis that either **a** or **b** will hold is 1.

implementing A is not an option. That is not a scenario I am considering and it is not relevant to a discussion of the strong thesis.

What does Rabinowicz mean by accepting the bet on A (my **a**) "on its own"? My thesis (the strong thesis) prohibits assigning credal probabilities to propositions expressing the performance of actions which *in the context of deliberating as to what to do* count as options under the decision maker's control. In that context, the decision maker judges that he or she has the options of choosing **a** and choosing **b**. This is the context in which the number of options are doubled by offering a bet on **a** is also on offer. However, the bet on **a** does not appear to be "on its own" in Rabinowicz's sense.

Hence, if a bet as to what X will do is on offer and "is on its own", this should mean that it is considered in a context where X is *not* deliberating as to what to do. X may not have control over whether he or she will do **a** or do **b**. X may in that setting be uncertain as to whether X will do **a** or do **b** and assign (determinate or indeterminate) credal probabilities to hypotheses as to what X will do. In that context, I readily agree that X may assign probabilities to hypotheses as to what X will do. But that is irrelevant to the issue under examination.

My argument is aimed at supporting the view that an agent cannot *deliberate* as to what to do as if what he or she does is subject to his or her control and at the same time *predict* what he or she will do. Far from refuting my argument, Rabinowicz seems to support it.

Rabinowicz anticipates this *riposte* and responds as follows:

> Now it seems that the fair betting rate for A can only be determined by considering what bet on A he is willing to take, period. The bet on A he is willing to take in *combination with* A is irrelevant for the specification of his betting rate for A. (Rabinowicz, 2002, 109)

Rabinowicz seems to think that there is such a thing as a unique betting rate for A independent of the context in which bets are offered. I disagree. Surely the information available to X is relevant to determining a fair betting rate for X. Change the information and the bet on A X is willing to take may change as well. What then is the bet X is willing to take on A period?

In a context where X has the option of choosing between **a** and **b**, *the* betting rate for doing **a** period is revealed by identifying the highest price X would be willing to pay for a bet on **a** at a fixed S and highest price while deliberating as to whether to choose **a** or **b** if such a price exits. There may sometimes be a betting rate in that context although even that is not clear. But if there is, I am arguing, the betting rate does not reveal a degree of belief in the sense of a degree of probability that **a** will be done.

In a context where X does not have the option of choosing between **a** and **b** but predicts that he will do one or the other, the betting rate is also revealed by offering a bet on **a** on a take it or leave it basis and ascertaining the fair price. But the agent is certain that he or she is confronted with a situation where exactly one of the acts will be done. And he may have a preference among acts just as in the case where X has control over which of the acts will be implemented. But in this case X lacks such control. That is to say, X does have the option of accepting or refusing an offer of a bet on **a**. But he does not have the option of implementing **a** or of implementing **b**. X has only two options: to accept or refuse the bet. X may also have preferences as to whether **a** or **b** occur. But if X avoids wishful thinking, X's evaluation of the bet will depend on X's fair betting rate for gambles on the hypothesis that **a** will be implemented. The preference for **a** over **b** is irrelevant.

Rabinowicz's talk of accepting the gamble "on its own" seems to conform to the second context. In that context, however, X is not deliberating as to what to do. There is no deliberation to crowd out prediction. The first context is the one where X is deliberating concerning what to do. In that context, I have been arguing prediction is not in place.

If in the first context the agent has a fair betting rate for **a** being implemented and for **b** being implemented, the evaluation of the bet depends on the option with which it is combined. To repeat what I have reported before, a bet on the hypothesis that the agent will choose an admissible option should be acceptable at any price no greater than the stake. And if the fair betting rate is then equated with the probability that the agent will choose an admissible option, the agent should be absolutely certain that he or she will choose an admissible option.

According to the weak thesis (as I construe it), it follows that the set of admissible and the set of available options coincide. And such a result is death to any non trivial account of rational choice.

This argument does not prohibit, given the weak thesis, the decision maker from assigning credal probabilities to hypotheses as to which of his or her options will be implemented. It does insist, however, that if they are assigned, the probabilities cannot be used to determine the expected values of options in decision problems. The probabilities cannot be expectation determining.

I have insisted that credal, belief or subjective probability judgments have a useful function in deliberation and inquiry when they are used to evaluate expected values (and, in effect, to determine fair betting rates). Stripping such probabilities of this function is to render them useless. Spohn has also insisted that credal and belief probability judgments that are not used for determining expectations have no useful role to play in deliberation. Spohn had the insight to use this point to argue against assigning probabilities to hypotheses about what will be chosen.[4]

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[4]I am not suggesting that "degree of belief" must be interpreted so that its function is to calculate expected value. There are conceptions of degree of belief (and disbelief) that do not function that way. My favorite is based on the formalism pioneered by G.L.S. Shackle (1949, 1961) which is useful in stating a principle of inductive expansion according to which X should expand X's state of full belief only if X's degree of belief is high enough. A closely analogous conception is L.J. Cohen's Baconian probability. Formally similar notions of degree of belief have been formulated by Spohn (1988) and Gärdenfors and Makinson (1993). I think that my account of Shackle-type degrees of belief in terms of boldness dependent, deductively cogent inductive expansion rules identifies an important function for assessments of such degrees of belief to serve. Spohn, Gärdenfors and Makinson think they can identify a different role for such degrees of belief and resist my construal. No matter how this dispute sorts out, Spohn and I agree that probability is not a useful measure of degree of belief but is important when interpreted as partial belief when it is used to evaluate expectations.

Rabinowicz quite legitimately asks whether the tension between deliberation and prediction that is under discussion has any serious ramifications. I claim it has. Indeed, the ramifications are legion – many more than Rabinowicz actually considers.

One of the trademarks of R.C. Jeffrey's approach to representing probability and utility is a resolute refusal to recognize a distinction between acts, states and consequences. He complained about wrong headed ontologies that distinguished between three kinds of entities here when propositions alone would do. In point of fact, however, Savage's trichotomy distinguished between three kinds of propositions. Act and consequence propositions are not assigned unconditional probabilities. State propositions are assigned unconditional probabilities. Consequence propositions are assigned unconditional utilities. State propositions are not. Act propositions are assigned unconditional utilities equal expected utilities conditional on the acts. *Pace* Jeffrey, Savage's distinction was not an ontological distinction but a restriction on the domains of probability and utility judgment in the context of a given decision problem. The same proposition might be an act proposition in one context and a state proposition in another.

Jeffrey began with a single sigma algebra of propositions and assigned unconditional probabilities and utilities without restriction to all propositions (except for the inconsistent proposition that carries no utility). If deliberation crowds out prediction, this approach automatically becomes unacceptable as"logic of decision".

Causal decision theory allegedly conflicts with Savage's expected utility theory and Jeffrey's decision theory due to different recommendations prescribed for decision problems where it is alleged (falsely in my judgment) that causal and probabilistic independence come apart. The best known problem is the infamous Newcomb problem. Newcomb's problem (in this respect it is quite typical). In the Newcomb problem, the demon is alleged to be a good predictor of the decision maker's choices in the sense that the conditional probability of the decision maker choosing one (two) boxes conditional on the predictor predicting that he will do so is near one. To obtain a recommendation for the decision maker according to standard expected utility theory that deviates from causal decision theory, one needs to derive the conditional probability of the predictor predicting one (two) boxes conditional on the predictor doing so accordingly. To do this, it is necessary to invoke *unconditional* probabilities for the predictors' predictions. The calculus of probabilities entails the unconditional probabilities for the options of the decision maker. If deliberation crowds out prediction, these predicaments are not proper decision problems and do not constitute contexts where causal decision theory conflicts with its rivals. Some authors vociferously deny that causal decision theory conflicts with the dictum that deliberation crowds out prediction. Such authors must then explain how causal decision theory sometimes makes different recommendations from those derived from Savage's approach. If the recommendations according to Savage and causal decision theory are the same for all contexts of choice, why all the fuss?

My contention is that *both* Jeffrey's theory (often misnamed "evidential decision theory) *and* causal decision theory insofar as they conflict with one another are called into question by the thesis that deliberation crowds out prediction. The versions of expected utility theory that survive are those that evaluate options in terms of the conditional probabilities of consequences given the option implemented. Savage's approach is a special case of this where acts are representable as functions of states to consequences and where states are probabilistically independent of acts. According to such theories, no unconditional probabilities for acts are or need be specified. Even though expected utilities of acts calculated according to such approaches are the same as they would be in Jeffrey's so called evidential decision theory, unconditional probabilities for acts are not provided. It is this difference that constitutes the basis of Jeffrey's claim to have simplified ontology by refusing to discriminate between acts, states and consequences.

The thesis that deliberation crowds out prediction is incompatible with both Jeffrey's and causal decision theory. Rabinowicz thinks that the thesis is alleged to threaten evidential decision theory and responds, in effect, that it threatens Jeffrey's version but not an account where probabilities of consequences given acts are available. (Rabinowicz, 2002, 95). In other words, Rabinowicz is suggesting that expected utility as characterized by Fishburn or by Savage is acceptable even if one endorses the thesis. That is true. But the thesis is important because it shows that some of the rivals advocated by philosophers are unacceptable.

Decision problems are sometimes presented in a sequential form where decisions made at an initial stage or node may yield either a result depending on the state of nature (horse lottery) or a roulette lottery, an opportunity for further choice or an ultimate payoff. The first kind of result is a “chance node”, the second is a choice node and the third is a terminal node. A strategy is taken to be a specification of a choice at each choice node which determines a “path” to a lottery whose payoffs are rewards at terminal nodes. It is often assumed that such an “extensive form” decision problem is equivalent to a normal form decision problem where each strategy in the extensive form is an option for the decision maker.

As I explained in Levi, 1991, the equivalence of extensive and normal form is ruled out by the thesis that deliberation crowds out prediction. This is a very important claim if true. Peter Hammond, 1976, 1977, 1988 has elegantly argued that a formalization of this thesis mandates conformity with the classical conditions for choice consistency and, hence, with the requirement that rational agents should have a complete ordering of their options in the context of deliberation. Such a view conflicts with the views of those who, like myself, think that conflicts in value and indeterminacy in probability judgment warrant rational agents violating the demands of such ordinalism. The claim that deliberation crowds out prediction thus supports the rejection of ordinalism by rejecting the equivalence of extensive and normal form.

The existence of common priors and of common knowledge (or, common full belief) of rationality play a central role in Robert Aumann’s effort to show that rational expected utility maximers participating in non cooperative games should achieve a correlated equilibrium (Aumann, 1987). Rabinowicz seems to agree that the thesis that deliberation crowds out prediction precludes the existence of such common priors and common knowledge. This matters greatly if one seeks to take correlated equilibrium seriously. Rabinowicz does not comment on correlated equilibrium but he seems to think that game theory can do without common priors and common knowledge of rationality. Perhaps so, but it is important to ascertain whether it can. And part of the urgency to do so derives from the circumstance that deliberation crowds out prediction.

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