What Makes Rational Decision Making Under Uncertainty Possible? A Comment

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Abstract

Güth and Kliemt (2015) propose a flow chart that, on the one hand, is intended as a slightly idealized description of human (that is, boundedly rational) decision making under uncertainty. On the other hand, they argue that following the procedure outlined in the flow chart can help decision makers to better achieve their goals.

This raises a question. According to Güth and Kliemt, rational decision making is based on knowledge about the causal relations between actions and relevant consequences. Uncertainty is characterized by the absence of such knowledge. What, then, is the basis for rational decision making under uncertainty?

In this comment, I give a sketch of the background to this question, try to answer the question at least partially, and indicate how Güth and Kliemt's flow chart might be extended.

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1 Introduction

Güth and Kliemt (2015) discuss the possibilities for rational decision making in the case of insufficient knowledge or uncertainty (in contrast to risk). They focus on real human decision makers, that is, on bounded rationality. The key ingredient of their approach is a flow chart for scenario-based decision making that describes, in a slightly idealized way, how decisions under uncertainty are actually taken. But they also use this flow chart in order to advise decision makers: they claim that the flow chart describes a good way to make decision under uncertainty.

I agree completely with their general line of argument. Rational decision making rests on knowledge about the casual relations between possible actions and consequences that are relevant in the light of one's goals. Uncertainty is a case where such knowledge is lacking. In such a situation, technological advice might be welcome. Technological advice, in contrast to moral exhortations or similar forms of normative advice, tells people how to achieve their goals.

With their flow chart, Güth and Kliemt give very general technological advice for decision making under uncertainty. On this level, they cannot provide knowledge about the specific causal relations relevant to a decision maker. What, then, is the basis for their advice?

In this comment, I give a sketch of the background to this question, try to answer the question at least partially, and indicate how Güth and Kliemt's flow chart might be extended.

2 Decisions, Scenarios, and Causal Laws

The arguments of Güth and Kliemt (2015) are based on the twin assumptions that, first, there are, in fact, causal connections between actions and their consequences, and that, second, rational decision making is based on an explicit consideration of these causal connections. Let me spell out these assumptions more explicitly.

Rational decision making is always based on the consideration of different scenarios. For each of the available actions, one must consider at least one scenario where the respective action is chosen and specify the causal consequences of this choice. At the end, one compares the scenarios and decides in favor of the action that generates the most preferred consequences.

The consideration of hypothetical scenarios of which only one is realized is equivalent to the consideration of a set of conditionals connecting hypothetical choices with their causal consequences: "If I choose action A in the present situation, then consequence X obtains." Rational choice requires that these conditionals are believed to be true independently from whether action A is taken. Thus, unless events force the decision maker to revise his beliefs, a rational decision maker must claim that, even though he chose action B, the following counterfactual conditional is true: "If I had chosen action A in the relevant situation, then consequence X would have obtained."

The conditionals discussed above are true if and only if the decision situation is covered by an appropriate causal law: "In all situations of type S, if one chooses A, then X obtains." If the decision situation is actually of type S, the conditionals, whether indicative or counterfactual, follow. The fact that the conditionals relevant to decision making are based on laws makes learning possible. Relevant laws can be learned in one situation and applied for making decisions in other situations.

Of course, the laws can be very general, like the laws of physics. Deriving causal conditionals applying to a decision situation and specifying the causal consequences of one's actions can be a non-trivial task. Moreover, the relevant laws can be stochastic. In that case, the relevant conditionals may only spell out how the actions influence the probability of events. The concepts of causal law and causal conditionals can easily be generalized to take stochastic relations into account.

Rational decision making, then, presumes the existence of causal laws, whether they are deterministic or stochastic. Of course, the decision maker may not be aware of this fact. He may just have learned, for instance, that stones that are thrown fall in a certain way, without being able to spell out the physical laws behind these facts. Moreover, he may not be aware of the conjectural element in his beliefs. Nevertheless, whenever he considers different scenarios and derives the consequences of his actions, he relies on causal conjectures that are true or false depending on the relevant laws.

3 Uncertainty

There is, of course, no way to ensure that one's relevant beliefs are true, or true with a known probability. In this sense, there is always uncertainty (also called radical or Knightian uncertainty). However, Güth and Kliemt (2015) consider this to be an unavoidable "residual uncertainty". They assume that, for practical purposes, science can lead to knowledge that decision makers can rationally rely on, more or less as if it were certain knowledge.

Relative to this kind of knowledge, we can make the usual distinction between decision making under certainty, under risk, and under uncertainty. Specifically, decision making under uncertainty is the case where the decision maker's knowledge about the causal consequences of the actions taken into consideration, or even about the set of possible actions, is incomplete.

Of course, what is not known may just be assumed. Subjective expected utility theory (a.k.a. Bayesianism) requires decision makers to supply subjective probabilities where objective probabilities are missing or do not exist so that the probabilities of the relevant consequences conditional on each possible action are specified. Güth and Kliemt warn against transforming, by mere assumption, a situation of uncertainty, where relevant scientific knowledge is lacking, into a situation of risk, where knowledge is more or less complete—a warning reminiscent of the title (not the content) of Karl Popper's (1957) critical paper on Bayesianism: "Probability magic or knowledge out of ignorance". However, the focus of Güth and Kliemt is not on a systematic criticism of Bayesianism (for this, cf., e.g., Albert, 2003) but on an alternative approach. Following their line of thought, I subsequently ignore Bayesian decision making.

4 Sound Advice for Decision Making under Uncertainty

Technological advice tells decision makers how to achieve their goals, or whether it is possible to achieve their goals, that is, it gives them the information they need in cases where they lack this information or are unable to organize the information they have in a suitable way. Since decision makers usually know a lot, advice just bridges gaps in their knowledge (where knowledge includes knowledge about logical relations).

Technological advice may fall into three categories, then. First of all, it can be information about singular facts, as when somebody inquires after the way to the main station. Second, advice may just point out overlooked logical consequences of information the decision maker already has. Third, advice can be information about causal relations. Let us call advice sound if and only if it consists of true statements.

Uncertainty results from gaps in one's knowledge. If the relevant knowledge is complete, there may be risk but not uncertainty. Güth and Kliemt give technological advice for all situations of uncertainty, that is, situations where the relevant knowledge is incomplete. This advice addresses neither specific decision makers nor specific situations. By definition, such advice cannot bridge gaps in a decision maker's knowledge about the specific decision situation. How, then, is sound advice of this kind possible? What is its basis?

Güth and Kliemt (2015) provide a flow chart that describes, in a slightly idealized and very general way, how decision makers deal with decision making under uncertainty. They also advise decision makers to proceed according to this flow chart. In order for this to be sound technological advice, they must claim that there is some advantage for decision makers if they follow this advice. Such a claim is missing in the paper, so let me supply it:

> On average over all situations of decision making under uncertainty that may occur in their lives, if decision makers follow the procedure outlined in the flow chart, then their probability of achieving their goals is, on average, higher than if they instead followed any other known procedure. (C)

Some claim like C, it seems to me, must be connected with the advice to proceed according to the flow chart. C is a law-like causal hypothesis: it says that following the flow chart has an effect on a decision maker's probability of success. This law-like hypothesis may even be testable, and, indeed, Güth and Kliemt refer the reader to relevant experimental tests.

Let us assume, then, that C is true and, therefore, a causal law. The puzzle is how to explain this law. Such an explanation would point out other causal laws from which C follows. In other words, we would like to find some causal laws that could explain the flow chart's superiority relative to other procedures.

As in the parallel case of general methodological advice in science, it is something of a riddle which kinds of causal laws could support such a claim. Here are the candidates: laws that govern the decision maker's own cognitive mechanisms (laws of cognition); laws that govern the interaction with others who are involved in the decision procedure (laws of social interaction); laws that govern other features of the decision situation (further laws); and laws that govern the interaction between any two or all three of these areas. The puzzle is to come up with some plausible candidates.

5 The Critical Method

In order to simplify a bit, let us exclude the possibilities of experimentation and social interactions. Thus, our decision maker is alone with whatever information he has. He has no direct information about how he might proceed with his decision problem. Then, there is an intervention: the decision maker gets the flow chart with all necessary explanations. Let us assume that, in an empirical investigation of many cases, this intervention turns out to improve the average quality of decision making according to the decision makers' own standards in comparison with a control group where the intervention is absent. How could we explain such an observation?

It seems to me that there is only one possible answer. Systematic success is based on relevant information-information about the decision situation and the causal relations holding in this situation. Such information is not contained in the flow chart. Therefore, the intervention must help decision makers to make better use of relevant information they already have. First of all, this requires that there are some laws of cognition which could explain why the intervention was helpful. Second, however, it requires that uncertainty can be reduced in some ways that, without the intervention, were not obvious to the decision maker.

The effect of the flow chart must be similar to the effect of a map. If I give a map of the environment to a wanderer who has lost his way, two requirements must be fulfilled for the map being helpful. Obviously, the wanderer must have the cognitive faculties and general knowledge necessary for reading the map. But this is not sufficient. He must also be able to connect his knowledge about his immediate environment and about his possibilities of moving through the landscape with the information contained in the map. Depending on the information the wanderer has, the map may help him to determine the way home or at least to avoid some of the wrong ways. Eliminating some of the wrong ways can easily increase the probability of taking the right way.

I have no complete theory of how this may work. I just want to make a well-known point that might deserve emphasis and that does not occur explicitly in the exposition of Güth and Kliemt (2015) (cf. Miller, 2006, 119-124).

Many problems of decision making cannot be solved by derivation from known laws even if knowledge of the relevant laws is complete. Given that the set of available actions is large, it is not at all trivial to find an action that leads to specific consequences in a given situation.In other words, a theory does not lead automatically to a technology.

A general method for finding a technology that achieves a given aim is the critical method. One considers a scenario where some action is chosen (a solution proposal) and searches for obstacles in the decision situation that might prevent the achievement of one's goals (criticism of the proposal). If one discovers an obstacle in one's internal simulation of the scenario, the action is discarded and some other action is considered. This is a search process that ends if a proposal survives criticism. As Güth and Kliemt emphasize, in such a search process goals may also be criticized (or aspiration levels may be adjusted).

The critical method may be the only practical method even if knowledge of the relevant laws is complete. However, it also works with incomplete knowledge. If criticism can at least eliminate some proposals that do not work, the critical method may increase the probability that a solution (a proposal that actually works) will be adopted.

A general theory of rational decision making need not emphasize the differences between complete and incomplete knowledge. In problems that are complex enough, even complete knowledge is consistent with uncertainty because decision makers are not logically omniscient. In all complex problems, the critical method is the only practical method for decision making. Success of the critical method requires that decision makers have enough relevant knowledge in order to recognize at least some non-solutions to their decision problems and are not generally biased against correct solutions. In fact, some of the relevant knowledge may be knowledge about cognitive biases.

The critical method can be viewed as a search process that closely fits the flow chart of Güth and Kliemt. At least in practical decision making (but maybe also in pure science), this search process also involves choices of intermediate goals and the adaptation of aspiration levels. Looking at the flow chart as a description of the critical method, however, reveals that an extension might be in order.

If I understand the flow chart correctly, revisions of the mental model, scenarios and aspiration level are only triggered by the failure to find an action with satisfactory consequences. This is, of course, a feedback loop that is part of the critical method. However, there are further ways to criticize one's assumptions. One of the dangers in decision making is that decision makers derive seemingly satisfactory solutions based on mental models containing overly optimistic assumptions. Decision makers may systematically profit by a critical attitude towards their mental models, that is, by checking the current model for typical biases and modeling mistakes. For instance, as in Kahneman's nice example of curriculum development (Kahneman, 2011, 245-254), an expert may profit from forcing himself to take the outside view in group decision making in order to make use of his expertise.

The critical method, or critical rationality, has of course been emphasized in philosophy of science by Karl Popper and his followers for a long time. In a sense, science provides the paradigmatic case of rational decision making under uncertainty. It is therefore not surprising that ideas from the philosophy of science can become relevant in economic theory (for a discussion and references to the literature, see Albert 2009, 2011). Modern cognitive psychology also seems to discover critical thinking as an important ingredient of rationality (see, e.g., Stanovitch and Stanovitch, 2010). This literature might contain further interesting hints on how to extend the flow chart.

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