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DEBATE

UNCERTAINTY AVERSION: A DISCUSSION OF CRITICAL ISSUES IN HEALTH ECONOMICS

PETER P. WAKKER*
Department of Medical Decision Making, LUMC, Leiden, Netherlands

Models deviating from classical expected utility are extensively studied in the modern decision literature, with a close interplay between mostly economists and psychologists. Risk and uncertainty attitudes are no longer modeled solely on the basis of sensitivity towards outcomes (utility), as they were in the classical model; a new dimension has been added: sensitivity towards chance and uncertainty, which is modeled on the basis of non-additive probabilities. Decisions are derived in a rank-dependent manner. An extensive study of this new dimension of risk attitude was started during the last decade, when the theoretical foundations by Quiggin [1] and Schmeidler [2] were combined with the empirical realism of prospect theory [3] leading to cumulative prospect theory [4].

An intriguing concept of the modern theories is uncertainty aversion. Its precise definition, as well as its empirical status, remain controversial. For economic applications, a universal uncertainty aversion seems to be most convincing [5] but laboratory studies suggest more complex patterns [6]. Uncertainty aversion means, roughly, that people are more pessimistic/risk-averse (thus preferring egalitarian society) as probabilities are more ambiguous. Andersson and Lyttkens [7] (henceforth A&L) provided intriguing new evidence on this controversial issue.

I am happy to see that the new ideas about uncertainty attitudes are being taken up in the health domain, an obviously important domain of application. Here lies one contribution of A&L. A role for rank-dependence in explaining Rawls' criterion has been outlined before (see Ebert [8] and its title). However, linking Rawls' criterion to uncertainty aversion is interesting and original; this is a second contribution of A&L. It should be noted here that the veil of ignorance is a thought experiment serving to properly elicit value systems. Rawls' proposal is primarily directed towards normative justice. It is, therefore, not a question of empirical correctness whether or not the veil of ignorance concerns known or unknown probabilities. It is a question of convenience at the discretion of the experimenter. In this sense, Rawls' rule is not an empirical prediction that can be refuted (see A&L, p. 374). Nevertheless, an empirical test and an original linking to uncertainty aversion are useful contributions.

Oliver [9] gave a clear and accessible account of basic concepts such as comonotonicity and (the three-colour version of) the Ellsberg paradox in the context of health economics. I agree with Oliver that the test of comonotonic independence in Fennema and Wakker [10] is primarily a test of whether non-additive probabilities are empirically effective, and not of whether the non-additivity should support uncertainty aversion, uncertainty seeking or otherwise. Still, as is properly explained in the answer by A&L, if non-additive probabilities are not effective, as suggested by Fennema and Wakker [10], then one can indirectly conclude that they do not generate uncertainty aversion after all. Let me hasten to mention that many other studies provide evidence in favour of non-additive probabilities (Wu and Gonzalez [11] and the many references therein). The

* Correspondence to: Department of Medical Decision Making, University of Leiden—LUMC (AZL No. 43), PO Box 9600, Leiden 2300 cc, Netherlands.

precise empirical status of uncertainty aversion is still controversial today.

The most well-known version of the Ellsberg paradox is the two-colour one. A *known* urn contains 50 white and 50 black balls; an *unknown* urn contains 100 black and white balls in an unknown proportion. A ball is drawn at random from each. For either urn, if people can gamble on the colour of their choice (receiving $100 if their chosen colour shows up), then they are usually indifferent. They do, however, prefer to gamble on either colour from the known than from the unknown urn. People are accordingly willing to pay more for the former than for the latter gamble. This, within-person, finding has commonly been interpreted as uncertainty aversion.

Fox and Tversky [12] shed new light on the Ellsberg paradox. According to them, if people receive full information on the composition of one urn but not of the other, then because of this contrast they may become averse to the unknown urn, the contrast enhancing the subjects' perceived incompetence. This need not be the result of ambiguity aversion but may merely be a contrast effect. Fox and Tversky, therefore, investigated willingness to pay for the two-colour Ellsberg paradox in a between-subject design, where each subject saw only one of the two urns. As natural as this between-subject test seems to be in retrospect, it is remarkable that such a test had not been conducted before. On average, no significant difference was found between the amounts that the subjects were willing to pay for the two urns. Note that Fox and Tversky's hypothesis can only be tested in the two-colour Ellsberg example. This is because in the three-colour example described by Oliver, the contrast effect is also always present in the between-subject design and, hence, cannot be excluded as a confounding factor.

Fox and Tversky's finding seems to place the Ellsberg paradox in an entirely new light. It seems to cast doubt on uncertainty aversion and thus jeopardize one of the most commonly accepted phenomena in the decision field. Chow and Sarin [13] repeated Fox and Tversky's experiment in a careful setup, controlling for every possible confounding variable. Their paper confirms the contrast effect found by Fox and Tversky but also finds evidence of uncertainty aversion. The truth thus seems to be somewhere in the middle. Uncertainty aversion is a factor but is less strong than was believed some years ago.

I agree with Oliver's point that, *ceteris paribus*, a within-subject design is the most natural choice. This is, however, not a universal rule. Between-subject designs have been used in studies of individual choice theories and sometimes are even crucial for avoiding special distortions, as was also the motivation for A&L. Besides Fox and Tversky [12], another study is Cubitt *et al*. [14], who provided a detailed explanation.

I agree with Oliver that acceptance of a null hypothesis of equality, as in the results of A&L, is not strong evidence. It is not clear whether a big effect of uncertainty aversion could have been expected for these stimuli, even if this phenomenon can be pronounced in general and even if other phenomena do have significant effects for these stimuli. Simulations with some known quantitative models could provide further clarity; hence, this is a topic for future research.

Oliver correctly suggested that subjects facing unknown probabilities may resort to a 50-50 heuristic. This explanation also applies to the finding of Fox and Tversky [12]. It does not refute the claim of absence of uncertainty aversion but, as pointed out in the answer of A&L, instead supports it and provides further insight into this claim. A detailed empirical study of the 50-50 heuristic is provided by Fischhoff and Bruine de Bruin [15].

I hope that there will be general agreement that Oliver's valuable questions have highlighted some central issues, advancing the understanding of us all. His comments in addition to A&L's paper are useful and all are undertaken with clarity, precision and understanding. Decision under uncertainty will benefit from these findings from the health domain and vice versa. I am happy to see this mutual fertilization between different fields taking place.

REFERENCES

1. Quiggin, J. Risk perception and risk aversion among Australian farmers. *Australian Journal of Agricultural Economics* 1981; **25**: 160–169.
2. Schmeidler, D. Subjective probability and expected utility without additivity. *Econometrica* 1989; **57**: 571–587.
3. Kahneman, D. and Tversky, A. Prospect theory: an analysis of decision under risk. *Econometrica* 1979; **47**: 263–291.

4. Tversky, A. and Kahneman, D. Advances in prospect theory: cumulative representation of uncertainty. *Journal of Risk and Uncertainty* 1992; **5**: 297–323.
5. Epstein, L.G. A definition of uncertainty aversion. *Review of Economic Studies* 1999; **66**: 579–608.
6. Tversky, A. and Fox, C.R. Weighing risk and uncertainty. *Psychological Review* 1995; **102**: 269–283.
7. Andersson, F. and Lyttkens, C.H. Preferences for equity in health behind a veil of ignorance. *Health Economics* 1999; **8**: 369–378.
8. Ebert, U. Rawls and Bentham reconciled. *Theory and Decision* 1988; **24**: 215–223.
9. Oliver, A. Uncertainty aversion: a reply to the paper by Andersson and Lyttkens. *Health Economics* 2000; **9:** 261–263.
10. Fennema, H. and Wakker, P.P. A test of rank-dependent utility in the context of ambiguity. *Journal of Risk and Uncertainty* 1996; **13**: 19–35.
11. Wu, G. and Gonzalez, R. Nonlinear decision weights in choice under uncertainty. *Management Science* 1999; **45**: 74–85.
12. Fox, C.R. and Tversky, A. Ambiguity aversion and comparative ignorance. *Quarterly Journal of Economics* 1995; **110**: 585–603.
13. Chow, C.C. and Sarin, R.K. Choices under uncertainty: known, unknown, and unknowable. University of California, Los Angeles: Anderson Graduate School of Management, 1998.
14. Cubitt, R.P., Starmer, C. and Sugden, R. The selection of preferences through imitation and the common ratio effect: an experimental investigation. *The Economic Journal* 1998; **108:** 1362–1380.
15. Fischhoff, B. and Bruine de Bruin, W. Fifty-fifty = 50%? *Journal of Behavioral Decision Making* 1999; **12**: 149–163.

