

# **The normative decision theory in economics: A philosophy of science perspective. The case of the expected utility theory.**

The article published first online in July 2019 as: The normative decision theory in economics: a philosophy of science perspective. The case of the expected utility theory, *Journal of Economic Methodology*, DOI: 10.1080/1350178X.2019.1640891

Magdalena Małecka

*TINT – Centre for Philosophy of Social Science, University of Helsinki, Helsinki, Finland*

magdalena.malecka@helsinki.fi

ORCID: 0000-0001-5395-9256

Word count: 8392

**Funding information:** This work was supported by the Academy of Finland under grant no. 308682 and by Marie Skłodowska-Curie Fellowship EPISTEMEBEHAVIOUR.

**Biographical note:** In September 2018 I joined the Department of Philosophy at Stanford University as Marie Skłodowska-Curie Global Fellow. Before I was an Academy of Finland post-doctoral researcher at TINT – the Centre for Philosophy of Social Science, University of Helsinki. Until July 2018 I was also a Junior Core Fellow at the Institute of Advanced Study of the Central European University in Budapest. I am a recipient of research grants and prizes (granted by the European Commission, the Academy of Finland, Poland's National Science Centre and the Foundation for Polish Science). I publish on a variety of topics in the philosophy of the social sciences, economic analysis of law, and philosophy of economics.

**Acknowledgments:** I am grateful to many scholars and colleagues who have commented on different versions of this article. I would like to especially thank, in alphabetical order, Vincenzo Crupi, Marion Godman, Wade Hands, Tomi Kokkonen, Luis Mireles Flores, Alain Marciano, Robert Sugden, as well as audiences of: Philosophy of Science Seminar and TINT Brown Bag Seminar at the University of

Helsinki, The 4<sup>th</sup> International Conference Economics and Philosophy in Lyon, East European Network for Philosophy of Science in Bratislava, Workshop *Behavioral Political Economy* at Walter Eucken Institut in Freiburg, YSI Plenary Session: Piecing together a paradigm at Central European University in Budapest, ESHET Conference at Sorbonne in Paris.

## **The normative decision theory in economics: A philosophy of science perspective. The case of the expected utility theory.**

This article analyses how normative decision theory is understood by economists. The paradigmatic example of normative decision theory, discussed in the article, is the expected utility theory. It has been suggested that the status of the expected utility theory has been ambiguous since early in its history. The theory has been treated as descriptive, normative, or both. This observation is the starting point for the analysis presented here. The text discusses various ways in which economists and philosophers of economics have conceptualized the normative status of the expected utility theory, and it shows that none is satisfactory from the point of view of philosophy of science.

Keywords: philosophy of economics; philosophy of science; normative decision theory; the normative turn in economics; expected utility theory

### **Introduction**

In studies of individual decision making we have normative and descriptive theories. This conviction is widely accepted in economics, decision theory, the philosophy of economics, and the study of judgment and decision making (see e.g.: Bell & Raiffa 1988, Hausman & McPherson 2006, Baron 2004, Briggs 2014, Over 2004). It is generally believed that normative decision theory prescribes how people should behave and make choices, whereas descriptive decision theory explains how they actually behave. The development of behavioural economics has facilitated the acceptance of the distinction between normative and descriptive theory in the studies of economic decision making: the common view is that modern neoclassical economics consists mostly of normative theories or models of decision making, whereas behavioural economics is descriptive and aims to explain how agents in economic settings ‘really behave’ (see e.g.: Thaler 2000, Camerer & Loewenstein 2004, Angner 2012, Cartwright 2018, Wilkinson & Klaes 2012). This widely accepted view was also stated by Richard Thaler in his Nobel Prize Lecture in Economic Sciences, delivered in December 2017 when he presented his remarks on past developments in economics and its future prospects: “Economics needs two completely different types of theories: normative and

descriptive” (Thaler 2018: 1267). Normative theories, which Thaler equates with those of neoclassical economics, “are essential both in characterizing optimal choices and in serving as benchmarks on which to build descriptive theories (...). (W)hen trying to build models to understand how people actually behave, we need a new breed of descriptive theories designed specifically for that task” (Thaler 2018: 1267).

A paradigmatic example of such a normative theory in economics and decision theory is the expected utility theory<sup>1</sup> (henceforth, EUT). I show that neither economists, nor philosophers of economics, provide us with reasons for treating EUT as a normative theory that could be accepted from the point of view of philosophy of science. However, whenever someone is brave enough to write one more paper on EUT, unavoidably touching upon its affinities with rational choice and normativity, she risks being accused of boldness, as well as being misunderstood. The possible misunderstanding may stem from the fact that the notions of rationality and of normativity often invoked by economists or decision theorists when talking about a normative decision theory are also widely discussed in all branches of philosophy and, therefore, bring all sorts of meanings and associations to readers’ minds. Hence, it is important to clarify what my paper is not about. Here, my aim is not to discuss general questions of rationality, whether rationality is normative, how it is related to reasons, or what are the minimal conditions for rationality (see e.g. Kolodny 2005, Way 2009, Bromme 2008, Raz 2010, Steele 2010). I also do not intend to participate in the discussion on the normative/positive distinction, widely accepted by economists, where

---

<sup>1</sup> Expected utility theory was introduced to modern economic theorizing by John von Neumann and Oskar Morgenstern in 1944 in their seminal book *Theory of Games and Economic Behaviour*.

The theory states that when making decisions under conditions of risk a decision maker compares the expected utility of options (utility value of options multiplied by the probability of getting them) and opts for the one that has the highest expected utility. Von Neumann and Morgenstern provided the mathematical, axiomatic treatment of the thus understood maximization of the expected utility. Alternative axiomatizations of EUT were proposed by Marschak (1950) and Herstein and Milnor (1953). Savage (1954) developed the axiomatization of the subjective expected utility theory under conditions of uncertainty.

the normative, roughly speaking, means “ethical” (see e.g. Colander & Su 2015; Su 2012; Davis 2016; Mireles-Flores 2016). When one makes a distinction between a normative and a descriptive *theory*, as most economists interested in studying individual decision making continue to do (especially within behavioural economics), then one means something else by “normative”. My aim is to analyse what the normativity of decision theory, and in particular of EUT, is about, in the eyes of the proponents of the normative status of EUT. The picture that will emerge from this analysis will be a rather confusing mix of claims that obfuscates more than it clarifies. I shall show, however, that we do not need to ascribe a normative status to EUT in order to make sense of the normative concerns, or commitments, that economists and decision theorists used to share and still share when studying individual decision making. I focus on EUT because it is the theory that features in the microfoundations of neoclassical economics (it is a primary theory in game theory, finance and the theory of asymmetric information) and continues to be treated as a normative theory, or as a theory that is both descriptive and normative. Behavioural economists also subscribe to this view of EUT, which is not without consequences for their research agenda.

### **A glimpse of history. Ambiguity of the normative status of EUT in economics.**

Even though the view that EUT is a normative theory is widely accepted today, some philosophers and historians of economics (Hands 2012, Herfeld 2018, Heukelom 2012, 2014, Starmer 2005) point out that in the past EUT was treated rather, and mainly, as a theory that was supposed to explain individual economic behaviour. They claim that the change in the understanding of the status of EUT began in the mid-1950s, and some of them call this change the normative turn (e.g. Hands 2012, Herfeld 2018). They suggest that treating EUT as a normative theory appeared only after the theory had been subjected to testing. Evidence from the experiments that falsified EUT did not lead to

the refutation of the theory.<sup>2</sup> Instead, it is claimed that EUT began to be treated mainly as a normative theory that sets a standard for what rational agents ought to do. The historical reconstruction of the developments in EUT that are claimed to initiate the normative turn usually starts in this context from the 1952 conference in Paris on decision making under risk. During the conference Maurice Allais presented his choice problem, later called the Allais paradox, that demonstrated the inconsistency of the actual choices made by conference participants with the predictions of EUT.<sup>3</sup>

Not all historians agree with the hypothesis of such a normative turn and emphasize that the discussion whether EUT is a normative or descriptive theory started before the Paris conference and accompanied the development of EUT almost from its very beginning (see e.g.: Moscati 2018, Mongin 2014/18). They seem to agree, however, that with time the normative understanding of EUT became more prominent. Interesting shifts in this discussion are pointed out as well. Paul Samuelson, Leonard Savage and Jacob Marschak endorsed EUT as a normative theory as for them the axioms of the theory were prerequisites for rational behaviour in conditions of risk and therefore were normatively compelling. Samuelson was at one time a fierce critic of EUT as a descriptive theory of decision making under risk but became convinced about

---

<sup>2</sup> See the review of this evidence in Schoemaker (1982). Compare with Harrison's (1994) criticism of these experimental works. However, it should be noticed here that already in the late 1940s there were experimental works that claimed to corroborate EUT (e.g. Mosteller & Noguee 1951).

<sup>3</sup> Conference participants overweighed outcomes (events) which they considered to be certain. In this way, they were making choices that are not in accordance with the predictions of EUT. Allais paradox was not a proper experiment though, but it remained rather a thought experiment until researchers in the mid-1960s started testing people's behaviour in experimental settings, inspired by Allais choice problem, as well as by so-called Ellsberg paradox (Ellsberg 1961) that targeted Savage's version of the utility theory (e.g. Becker & Brownson (1964), Fellner (1965), MacCrimmon (1965), for review see: Camerer & Weber (1992)).

the normative appeal of the independence axiom<sup>4</sup> and defended EUT as a normative theory already before Paris conference (see: Moscati 2016). Initially Savage endorsed EUT due to its simplicity, empirical validity and normative plausibility. When he published together with Friedman on the explanation of risky choices he understood EUT as a descriptive theory (Friedman & Savage 1948, 1952; see also: Hands 2012, Jallais & Pradier 2005). Yet, under the influence of his exchanges with Samuelson he put emphasis mainly on the normative defense of the theory: he argued for the sure-thing principle as having normative force because it can guide individuals in their decision making under uncertainty (see: Moscati 2016). William Baumol initially opposed EUT as a normative theory (Baumol 1951). Convinced by Samuelson and Marschak he accepted it on normative grounds: as having axioms which are ‘attributes of rationality’ (Moscati 2018, chapter 11).

The development of behavioural economics has further contributed to the normative understanding of EUT, particularly the works of Amos Tversky and Daniel Kahneman and of economists inspired by them. Kahneman and Tversky endorsed the idea that people systematically deviate from the norms of rationality, and thus from the predictions derived from EUT, as they treated EUT as a normative theory of rational choice. In the introduction to their seminal article on the prospect theory they mention, however, that EUT can be also interpreted descriptively, seemingly endorsing its dual status – as a normative and a descriptive theory (Kahneman & Tversky 1979). As Heukelom (2012) points out, they related their work to research on cognitive psychology, where the normative-descriptive framework had already been established.<sup>5</sup>

---

<sup>4</sup> The independence axiom was not present in von Neumann and Morgenstern’s formulation of EUT and was suggested, independently, by Samuelson (1947), Marschak (1950), and Nash (1950). This axiom sets a requirement of separability of preferences across disjoint events for decisions under risk. Savage’s (1954) sure thing principle is its mathematical equivalent for decisions under uncertainty (see Fishburn & Wakker 1995).

<sup>5</sup> See the section below, in which I refer to the discussion about the normative understanding of theory in studies of judgment and decision making in cognitive psychology.

There is a need for further historical studies to trace the origins of the normative understanding of EUT.<sup>6</sup> However, the discussion initiated by historians makes it clear that the status of EUT was at least ambiguous from very early on. EUT was treated by some as a normative theory, by some as a descriptive one, by yet others as both. In the next section I comment on the ways in which the participants in this early discussion and more recent philosophers and economists ascribe a normative status to EUT.

### **Various ways of ascribing a normative status to EUT: Reconstruction and analysis.**

EUT is normative and it is a theory of how people should behave, or make decisions.<sup>7</sup> But what does it mean? How is the normative status of this theory understood and how is it related to the claim that people should behave in a way that the theory stipulates? There is no one clear and unambiguous way in which the normative character of EUT in economics is argued for. This is also true in the philosophy of economics and in the field of decision theory. In contemporary discussions<sup>8</sup> the normative status of EUT (and

---

<sup>6</sup> The work of Catherine Herfeld on the Cowles Commission Research Reports from the years 1944-54 (2018) is an illuminating example of this type of historical analysis.

<sup>7</sup> See e.g. “[t]his article discusses expected utility theory as a normative theory—that is, a theory of how people should make decisions” (Briggs 2017: 1). According to Martin Peterson, normative theories of decision making, and EUT, “seek to yield prescriptions about what decision makers are rationally required – or ought – to do” (2009: 3).

<sup>8</sup> There is of course a vast number of studies, both theoretical and empirical, that refer to the distinction between normative and decision theory and treat EUT as a normative theory. In this section I focus on relatively prominent works – in economics, philosophy of economics, decision theory and philosophy of decision theory – in order to ensure, at least to some extent, that I reconstruct and analyse the widely accepted views.



often also of rational choice theory<sup>9</sup>, or models of neoclassical economics), is conceived of at least in the following ways: EUT is an axiomatic theory and its axioms have a function of a normative ideal<sup>10</sup>; EUT provides the formal conditions that choices and preferences ought to satisfy<sup>11</sup>; EUT is a model of an idealized decision maker<sup>12</sup>; EUT is the standard of evaluation of actions<sup>13</sup>. I argue that all these claims can be grouped into claims of two types. First, it is suggested that EUT can be understood as a philosophical theory of rationality. Second, it is claimed that EUT is a theory of rational choice that can have a normative use. Below I elaborate on what I understand by this, and I argue

---

<sup>9</sup> EUT is often treated as a rational choice theory, but I do not discuss in which sense this view is accurate. This would require meticulous work in clarifying which theories in economics qualify as theories of rational choice and why (such an attempt has been proposed in Herfeld (2013)).

<sup>10</sup> “[A] demonstration that human choices often violate the axioms of rationality does not necessarily imply any criticism of the axioms of rational choice as a normative ideal” (Thaler 1991: 138).

<sup>11</sup> “utility theory lays down formal conditions that choices and preferences ought to satisfy ... To define what rational preference and choice are is ipso facto to say how one ought rationally to prefer and choose” (Hausman & McPherson 2006: 49).

<sup>12</sup> “The modern theory of decision making under risk (...) was conceived as a normative model of an idealized decision maker, not as a description of the behavior of real people” (Tversky & Kahneman 1986: 251).

<sup>13</sup> “Expected utility theory has dominated the analysis of decision making under risk. It has been generally accepted as a normative model of rational choice, and widely applied as a descriptive model of economic behaviour. Thus, it is assumed that all reasonable people would wish to obey the axioms of the theory” (Tversky & Kahneman 1979: 263); Francesco Guala argues that the ““(n)ormativists’ claim that their theories aim to describe the behaviour of an ideal rational agent, but not only because such an ‘ideal type’ is useful in order to understand the behaviour of real agents; rather, models of rational behaviour are significant for evaluative and prescriptive purposes” (2000: 67).

that neither of these reasons for ascribing a normative status to EUT can support the claim that EUT prescribes how people should behave – the claim proponents of the normative understanding of EUT often endorse.

### ***EUT as a philosophical theory of rationality***

When ascribing a normative status to EUT, it is claimed that 1) axioms of EUT set conditions under which choices or preferences can be treated as rational (Thaler 1991, Hausman & McPherson 2006), as well as 2) they serve as ideals and/or standards of evaluation (Thaler 1991, Tversky & Kahneman 1979, Guala 2000). In this subsection I analyse the first understanding of the axioms; in the following subsection I comment on the second.

In the case of EUT the axioms (completeness, transitivity, continuity, independence) are formal conditions that enable one to rank options by assigning numerical values to them.<sup>14</sup> It should be noted that, strictly speaking, the axioms of a theory cannot be *obeyed*, contrary to the formulations often used in the literature on economics or decision theory. These formulations, as wrong as they might be if one understands the role that axiomatization has in theories, only indicate that for many authors the axioms of EUT have two functions – they are used for the sake of axiomatization, but they also define the requirements that a behaviour/decision that we would like to treat as rational should satisfy.

Obviously, the axiomatic character of EUT does not make the theory *normative*. If we understood EUT as axiomatic *only*, then it would not differ from any other axiomatic theory to which a normative status is not assigned, as axiomatization and normativity are not necessarily connected. Indeed, as we have already seen above, it is often claimed that EUT axioms are in some way special and distinct. For instance, it is believed (see e.g. Hausman & McPherson 2006, Thaler 1991) that the axioms of EUT set conditions under which choices or preferences can be treated as rational. Also, most

---

<sup>14</sup> In their seminal work (1944), von Neumann and Morgenstern did not understand axioms as *normative* conditions with which individuals ought to comply. As noted in the historical section above, normative interpretations were proposed later.

decision theorists who endorsed EUT as a normative theory early on, as mentioned in the brief historical part, believed that its axioms are prerequisites for rational behaviour. In this sense, EUT provides a philosophical interpretation of rationality. EUT can be understood as a theory that explicates the concept of rationality, makes it precise, or provides definitional characteristics of it. In other words, it provides conditions under which we can treat someone's actions as rational. In this sense EUT is not only a theory of decision making, but also a philosophical theory of rationality. But does it mean that EUT, so understood, prescribes how we *ought to* behave, as it is so often claimed (see e.g. Peterson 2009, Brigg 2017 in footnote 12)? No: as a philosophical theory of rationality it only says what it means to be rational.<sup>15</sup>

### ***EUT as a theory of rational choice that can have a normative use***

Some proponents of the normative status of EUT believe that the axioms of EUT not only set conditions under which we can treat behaviour as rational, but also that they serve as a standard, an ideal of behaviour<sup>16</sup> (see e.g.: Thaler 1991, Tversky & Kahneman 1979, Kahneman & Tversky 1986). This could be understood in at least two ways.

---

<sup>15</sup> The vast literature in the philosophy of action addresses to a great extent exactly this question – what is rationality, what are the definitional features of rationality, is rationality normative and, if so, in what sense? The proponents of EUT seem to take a single stand on these topics – for them EUT explicates some intuitions about rationality. They also seem to presume that rationality is a normative concept and for this reason they may be inclined to treat EUT as a normative theory. However, they mostly do not take part in the philosophical discussion and they do not bring well-argued philosophical points to support their views. In the next section I will show how the commitment to a certain notion of rationality influenced developments in decision theory. I believe that we should account for this commitment in order to understand how EUT evolved. I do not think, however, that this should lead us to defend the idea of having a normative theory in economics.

<sup>16</sup> Sometimes it is also pointed out that EUT is a “model of an idealized decision maker” (Kahneman & Tversky 1986). The idealized character of the EUT should mean that it contains

First, it could mean that EUT is a theory of rational choice. If the rational choice is treated as an ideal, then it could be said that in order to behave rationally (according to the ideal) one ought to behave in a way that EUT stipulates. The ‘ought’ here means then a directive ‘ought’: that in order to achieve a certain goal, or ideal (behave rationally), one has to do something (behave in a way stipulated by the theory). However, if we understand this ‘ought’ as such a teleological directive, the adjective ‘normative’ is superfluous when speaking about EUT – many other theories could be normative in the same way. Any other theory of behaviour (that states e.g. what is adaptive, or altruistic behaviour) would be normative in this instrumental sense, as it could instruct us how to behave adaptively, or altruistically, if we wish to do so, or if we treat these goals (being adaptive, being altruistic) as ideals.

Morgenstern himself observed that a theory can be *used* in a normative way: “if the individual, for example, expresses the desire to behave ‘optimally’ in a specific situation or environment, the theory will tell him how he ought to behave” (Morgenstern 1972: 711). He further argued that only certain theories in the social sciences can have this normative use, as they must be “absolutely convincing”: “This ‘convincing’ means the intellectual (and practical) acceptance of the theory for its predictive worth (...). It is assumed, of course, that the theory in question is sufficiently specific to be able to guide behaviour. Few theories in the social sciences have reached this state” (Morgenstern 1972: 711). Morgenstern, however, analysed the normative *use* of a theory, and it did not lead him to claim that we have normative *theories* in economics. Furthermore, in the light of Morgenstern’s reflections on the conditions under which a theory in the social sciences could be used in a normative way, EUT does

---

idealizations – in particular, idealized assumptions that eliminate the factors that are incidental for explanation of certain phenomena (Nowak 1977, McMullin 1985, Mäki 2012). Similarly as in the case of the axiomatic character of EUT, its idealized character and normativity are not necessarily connected. In the case of EUT, idealizations, like axioms, seem to have a dual status: they are both simplifying assumptions and ideals.

not even seem to meet the criteria set by him, as its predictive power has been seriously questioned in the experimental works mentioned in section 1 above.<sup>17</sup>

There is moreover a slightly different claim about the features of EUT that is often made: that one should not only behave in the manner stipulated by EUT to be rational, but also that one *ought to be rational in this particular way* indicated by EUT. This is how we can interpret Kahneman and Tversky's remark that "reasonable people would wish to obey the axioms of the theory" (1979: 263). For instance, it is sometimes suggested that behaving in a way stipulated by EUT – displaying transitive preferences in particular – is beneficial for an agent. The most widely discussed arguments of this type, meant to demonstrate the 'reasonableness' of action in accordance with EUT, are the money-pump argument, or the Dutch book argument.<sup>18</sup> These arguments, however, state only why being rational in the sense presumed by EUT can have some value for an agent. EUT is then, again, claimed to be *used* to inform actions in a particular way – to achieve beneficial outcomes (and as such, it is not different from possible normative uses of other theories).

The view on EUT as a normative theory, however, persisted over time. Below I discuss the challenging questions of theory change that this view provokes.

### **Can a normative theory of decision making be refuted, modified, falsified?**

The broad acceptance of the normative understanding of EUT at a certain moment in the developments in economics and decision theory provokes questions about why it

---

<sup>17</sup> This understanding of EUT – as the theory that can be used by individuals to guide their actions – was present in decision theory very early on. It is how Savage (1954) tried to defend and articulate the normative force of his subjective expected utility theory, as well as what Ellsberg (1961) challenged – he argued that people, in conditions of ambiguity, don't upon reflection decide to use EUT as a guidance for their decision making. See Zappia 2018 for a review of this discussion and of recent experimental attempts to study whether people wish to adopt EUT to make decisions, or to reason.

<sup>18</sup> See e.g. Davidson, McKinsey & Suppes (1955), Rabinowicz (2000), Levi (2002) on the money pump and Vineberg (2016) on the Dutch book argument.

was introduced and what triggered its acceptance. Hands (2012) mentions one possible hypothesis: treating EUT as a normative decision theory may have been a “defensive methodological move”. The growing experimental evidence demonstrated that EUT did not provide accurate explanations and predictions of how people make decisions. The normative understanding of EUT could have offered a way of “saving” the theory – not necessarily as an explanatory theory, but as a theory that serves as a normative benchmark. This hypothesis is, to some extent, supported by the analysis of the success of behavioural economics initiated by Tversky and Kahneman. For instance, Floris Heukelom argues that the success of Kahneman and Tversky in entering mainstream economics was related to their reinterpretation of EUT as a normative theory (Heukelom 2012: 817).

However, is such a “defensive move” at all justifiable? Should a scientific community accept it as a legitimate form of theoretical development? Does the theory function only as a normative benchmark after it is “defended”, or does it have a dual status and need to be treated as an explanatory theory as well? Questions of this kind, that the claim about the normative status of EUT must provoke, have not been extensively discussed by philosophers of economics nor by philosophers of science. From this perspective, Francesco Guala’s paper entitled *The logic of normative falsification: Rationality and experiments in decision theory* (2000) is worth noting. Guala attempts to show, among other things, that normative decision theory can have its own methodologically justifiable role. He claims that EUT has been refined and reformulated in a process of what he calls “normative falsification”. If one claims that there is a normative decision theory in economics, then one should be able to clarify whether such a normative theory is a subject to scientific methods of theory appraisal, modification and rejection. Guala is, to my knowledge, the only author who seriously engages with the methodological challenge of accepting the normative status of EUT.<sup>19</sup>

---

<sup>19</sup> Recently, Zappia (2016) and Mongin (2014/18) have subscribed to Guala’s proposal of how to make sense of the presence of a normative theory in decision theory and economics and how to apply notions of empirical testing, or falsification of it. It should be noted that Guala’s work is not the only one that intends to bring insights from the philosophy of science in order to account for the developments in decision theory and for modifications of EUT. However, neither of the

Therefore, he asks whether and in what sense a normative decision theory can be, and was, falsified. Below, I argue that he demonstrates that the commitment to the notion of rationality was an important factor in the development of EUT and its modifications. However, it is rather controversial to interpret this commitment as leading to decision theorists ‘inventing’ a special type of falsification, namely the falsification of normative theory.

Guala reconstructs the discussion that took place in decision theory and economics after Allais challenged the field in 1952. Guala’s aim is to disentangle the normative and empirical considerations about how to respond to the tests of EUT. His analysis is inspired by Lakatos’s philosophy of science. He suggests that the developments in economically-oriented decision theory can be interpreted as following the “methodology of normative appraisal”. Guala argues that the versions of EUT proposed in response to the Allais paradox were reformulated in order to account for the counterexamples – choices that were not in accordance with EUT. These versions were modified in the light of a minimal notion of rationality that decision theorists shared. The minimal notion of rationality was actually explicitly stated by Allais himself, who discussed the consequences of his challenge for EUT with other decision theorists.<sup>20</sup>

For Allais the simple shift from a descriptive to a normative interpretation of EUT deprived the theory of its scientific character (Guala 2000: 67), as it led to disregarding the experimental evidence and to claiming that all choices that are not

---

existing proposals (e.g. Fishburn & Wakker’s (1995) and Mongin’s (1988)) attempts to take into account the methodological consequences of treating EUT as a normative theory (see Guala 2000: 60-61).

<sup>20</sup> Guala points out that the Allais paradox could be interpreted at least in two ways: it is evidence that shows it is impossible to measure classical utilities by means of von Neumann and Morgenstern’s method; it also shows that subjects’ preferences can be inconsistent with EUT axioms. The paradox was mainly interpreted in the latter way by the tradition (Guala 2000: 66). See also Mongin (2014/18) on different interpretations of the paradox and his proposal of treating the paradox as “the normative argument”, emphasizing, like Guala, the importance of normative considerations in the discussion initiated by Allais.

consistent with EUT are irrational and therefore cannot be treated as evidence falsifying the theory. Decision theorists' responses appear to have been more nuanced, however. Guala argues that to a great extent the discussion concerned the question: Which experimental counterexamples indeed falsified EUT? In this context the "methodology of normative appraisal" was proposed, after Allais suggested that in order to assess choices made in experimental contexts as rational or not, one should be able to provide a notion (a theory) of rationality, independent from EUT itself, in the light of which the assessment of evidence is made (Guala 2000: 67-70). Allais proposed a minimal notion of rationality that was supposed to serve such a role: rationality as consistency<sup>21</sup> and as satisfaction of first order stochastic dominance. Hence, EUT could have been treated as a theory that is a formalization of this notion of rationality. To be more precise, its three axioms (completeness, transitivity and monotonicity) explicated this notion, whereas the axiom of independence was redundant with respect to it.

In addition, Guala claims that EUT was tested by coming up with what he calls 'normative falsifiers'. Normative falsifiers were formulated in the light of the notion of rationality (Allais's minimal notion of rationality) shared by decision theorists who were concerned about modifying EUT that was challenged by evidence that contradicted the predictions derived from EUT. According to Guala, these versions and modifications of EUT – such as Machina's generalized expected utility theory (1982, 1983), or Quiggin's theory of anticipated utility (1982) – that were in accordance with this notion of rationality, as well as with the empirical evidence, were kept after the tests and treated as theories of rational choice (normative theories).<sup>22</sup> For instance, the

---

<sup>21</sup> According to Allais "a man will be deemed to act rationally: (1) if he pursues ends that are mutually consistent (i.e. not contradictory); (2) if he employs means that are appropriate for these ends" (Guala 2000: 71, after Allais 1979 [1953]: 78)

<sup>22</sup> Guala is well aware of other developments in decision theory, for instance those that weakened the transitivity axioms (e.g. Loomes & Sugden 1982; Fishburn 1982), accounting for the evidence about preference reversal. For him these theories, like e.g. regret theory, were not accepted as normative (rational) though, but only as descriptive theories: they didn't satisfy



generalization of EUT proposed by Mark Machina (1982;1983) spotted the independence axiom as the weak axiom of EUT and removed it. The rest of the axioms were left in this generalized version of EUT as they were not impacted by the conditions for the rationality principle proposed by Allais.

Guala's analysis of 'normative falsification' described in the paragraphs above is inspired by the following fragment from Lakatos: "(i)f we insist that a formal theory should be the formalisation of some informal theory, then a formal theory may be said to be 'refuted' if one of its theorems is negated by the corresponding theorem of the informal theory" (Lakatos 1976 [1963–64]: 36). It should be noted here that Guala refers to the work of Lakatos on the philosophy of mathematics. Lakatos believed that the development of mathematics should not be viewed as a series of deductions. Against the logicians' and formalists' views on the philosophy of mathematics, he claimed that mathematics is a 'quasi-empirical' science (Lakatos 1976 [1963–64]: 24). According to him, formal mathematical theories are generated in order to make informal theories precise. The formal theories can be refuted by confrontation with counterexamples formulated in the light of informal theories that are meant to be made precise by the formal ones. Guala comments that Lakatos's ideas "seem to fit very well the case we are concerned with. Suppose in fact we had a rough idea of what a rational choice is. Formal models may indeed be seen as (fallible) attempts to turn our intuitions into a precise, rigorous formulation. In this sense, informal notions of rationality may play a regulative role in assessing formal models. The latter – unless we are certain of a perfect overlapping – must be corrigible in the light of some counterexample" (Guala 2000: 70).

However, there are two problems with Guala's interpretation of Lakatos. First, Lakatos claims that quasi-empirical tests may take place in mathematics when formal theories are proposed. In this context he mentions the relationship between two types of theories – a formal and an informal one. In order to use this analogy to speak about a possible refutation of EUT (a formal theory), when confronted with falsifiers inferred from an informal theory, one should be able to indicate an informal *theory* and not only a *notion* of rationality (the minimal notion of rationality proposed by Allais). Lakatos

---

Allais's criteria for rationality. Compare also Starmer 2000 on other developments in non-EUT descriptive theories.

does not speak about confronting a formal theory with someone's notions or intuitions, but with a theory that has not yet been formalized. Even if such an informal theory existed, we would still have a reason to ask why the formal theory that is a precise version of an informal theory is treated as the normative theory. Second, it remains questionable whether the Lakatosian 'quasi-empirical' tests and Guala's 'normative' tests are analogous. Lakatos used the notion of falsifiers in the context of mathematics because he attempted to show that development of formal theories there can be understood as resembling the procedures in empirical sciences, in other words that mathematics is fallible and in a way similar to an empirical science.<sup>23</sup> Guala suggests instead that there is a unique 'methodology of normative appraisal' embraced by decision theorists and which made EUT a special kind of theory. He shows that decision theorists accounted for empirical evidence (in this respect the theory was tested empirically), but also took into account the minimal notion of rationality (in this sense it was 'tested normatively') when revising EUT. However, the latter move is only an assessment of a theory in the light of a normative notion one is committed to – there is nothing empirical, not even quasi-empirical about it. It seems that we should be reminded about an almost trivial, but still important point here – falsification is a procedure of assessing theories, or hypotheses, by confronting them with empirical data. Therefore, obviously, the idea of 'normative falsification' suggested by Guala is an oxymoron (falsification by very definition can only be an empirical procedure). It is questionable whether assessing and modifying theories (in this case EUT) in the light of notions of rationality that researchers endorsed could be called falsification.

We could treat the notions 'normative falsification' and 'methodology of normative appraisal' as denoting the whole set of research practices that decision theorists were engaged in (including being driven by commitment to a notion of rationality) when they were modifying EUT. However, this terminology can give an impression that there was indeed a special *kind* of falsification that they proposed. The reference to Lakatos's philosophy of mathematics made by Guala suggests that he hints at such a possibility. However, we can very well avoid introducing controversial terms, such as 'normative falsification' in order to make sense of the developments of EUT.

---

<sup>23</sup> It remains an open question to what extent he succeeded. See e.g. Steiner 1983, Corfield 1997 for a discussion of Lakatos's view on the quasi-empirical, fallible, character of mathematics.

Guala shows that informal notions of rationality were among the tacit heuristics that led to the development of the generalized versions of EUT (Guala 2000: 74-80). He provides a compelling reconstruction of the way in which decision theory evolved. His methodological reconstruction of the development of decision theory illustrates the role that considerations of rationality had in the project of advancing theories of individual decision making. Normative intuitions, or commitments can guide researchers – in a way suggested by Guala – towards the formulation of an explanatory, positive theory.<sup>24</sup> From this perspective, it remains unclear, however, why the theories that are proposed as a result of research processes influenced by value commitments (like the commitment to a notion of rationality) should be treated as normative theories. The discussion on values in science can provide us with illuminating insights on why we should not hold such a view.

Philosophers of science show that values, understood here as normative commitments of a moral, social or political character, interfere with what evidence is available and whether or not it is regarded as reliable (Douglas 2000), or relevant (Longino 1990); that values enter research via background assumptions adopted by researchers in order to make sense of data (Longino 1990) and the concepts they choose to employ (Dupre 2007); and values also influence the ways in which scientific claims are justified (Intemann 2001). At the same time these philosophers argue that science remains explanatory, even if it is unavoidably value laden (see e.g. Anderson 2004). Hence, it is never suggested by them that normative commitments, which can be present at each stage of the scientific process, lead to the formulation of normative theories – e.g. theories that state how one ought to behave. On the contrary, the main stake of the discussion on values in science is precisely to show that the presence of values in scientific research does not lead to coming up with theories that prescribe norms of any kind, because such a conclusion would mean that values can lead researchers to give up a scientific project.

---

<sup>24</sup> See also similar remarks made by Chris Starmer, who has pointed out that “although economists have been prepared to relax the independence axiom in pursuit of better descriptive models, there has been an apparent reluctance to give up other normatively appealing principles such as transitivity or monotonicity” (Starmer 2005:281).

Thus the discussion on values in science offers us a very illuminative way of making sense of the developments in the decision theory that Guala reconstructed. The experimental tests of EUT posed a challenge to the theory. Decision theorists started treating this evidence seriously and tried to reformulate or modify the theory (its axiomatization). They did this by accounting for evidence and commitments to the notion of rationality that they endorsed and which they found ‘normatively compelling’. In this sense a normative commitment played an important role in assessing evidence and deciding which experimental results count as counterexamples to EUT, as well as in eliminating some axioms and proposing new axiomatizations and modified versions of EUT. It should not mean, however, that all this led to the formulation of normative theories. It was indeed the case that some decision theorists interpreted EUT (and its versions) as a normative theory, but in doing this they were in fact engaged in a philosophical task of reflecting on what behaviour should be treated as rational, or in a pragmatic task of advising which behaviours can be beneficial for agents.

### **The research biases stemming from ascribing normative status to decision theory**

Ascribing normative status to decision theory, in particular to EUT, is not only controversial, but it is also unnecessary from the point of view of philosophy of science. It can, moreover, lead to serious research biases.

As mentioned above, the distinction between normative and descriptive theory has also been present in cognitive psychology, in studies on judgment and decision making. In the study of the psychology of judgment and decision making, an advanced discussion has recently developed on whether the acceptance of the normative understanding of a theory can be defended if we scrutinize the research practices to which it leads. In a well-researched article, Shira Elqayam and Jonathan Evans (2011) analyse normativism, as they call the approach to studying reasoning and decision making based on the claim that “thinking reflects a normative system, against which [thinking] should be measured and judged” (p. 233), and that people ought to conform to a normative standard prescribed by a theory. The way in which they criticize the normative understanding of decision and reasoning theories in cognitive psychology can illuminate the analysis of normative decision theory in economics.

Elqayam and Evans argue that the claim that people should behave in a way in which a theory stipulates is problematic and unnecessary for researching judgment and

decision-making processes. They point out that normativism faces a problem when we can indicate several theoretical frameworks in the light of which the empirical evidence can be interpreted through normative lenses. They write, for example, about the famous Wason selection task<sup>25</sup>: “Wason’s normative departure point was logicist: the material conditional of the propositional calculus, according to which a conditional statement if p, then q is true whenever q is true or p is false. When measured against alternative normative systems, such as (...) Bayesian probability or information theory (...), or default logics (...), the prevalent choices can be argued to be rational” (Elqayam & Evans 2011:238).

Thus, they ask: if we can indicate several ‘normative systems’ in the light of which a particular decision can be judged (as being rational, or not), how are we going to choose between them? Elqayam and Evans claim that what makes one account standard and ‘normative’ and another ‘alternative’ is hard to determine, at least on the basis of the theoretical means and standards of argumentation available in cognitive psychology. This observation is very important, as it shows that the authors have identified the philosophical dimension of the research work done in cognitive psychology. Cognitive psychologists in fact engage in philosophical activity when they claim that certain theories (e.g. those based on classical logic) are normative and others (e.g. mental model approaches) are not. However, as psychological research doesn’t equip them with proper philosophical tools to make their point, they mostly either stipulate that certain theories have a normative character, or, if they try to provide arguments for this claim, they end up in circular reasonings or in committing a naturalistic fallacy (Elqayam & Evans 2011: 236, 239). Hence, the authors propose refraining from any attempt to specify which theories are normative, and instead treating e.g. the classical logic,

---

<sup>25</sup> A series of experiment initiated by Peter Wason demonstrating people’s inability to reason according to the rules of classical logic, especially showing the fallacy of affirming the consequent, as well as failures in applying *modus tollens*. For review of the early research, see Evans & Over 2004.

default logic, or the Bayesian theory as *formal*, not normative theories. They understand formal theories, along Chomskyan lines, as competence theories.<sup>26</sup>

According to the authors, if we eliminate the normative understanding of decision theory from the research on judgment and decision making, then we can also avoid the research biases to which it leads. They mention three types of biases: prior rules bias, interpretation bias, and clear norm bias. Prior rules bias rests on a presumption that people have built-in normative systems, which leads to the exclusion of learning as part of people's rationality. Interpretation bias means that responses are presented in terms of normative correctness, which results in assuming that normative status equals processing. Clear norm bias means that researchers are looking for unambiguous norms, which excludes multiple-norm paradigms from inquiry (Elqayam & Evans 2011: 242).

The normative understanding of EUT leads to a research bias similar to the interpretation bias, namely only seeking explanations for those behaviours that are treated as deviations from the 'norms of rationality' that are claimed to be implied by EUT. Ylikoski and Kuorikoski (2016) point out that such a bias is present in behavioural economics and its focus on "the ways in which behaviour diverges from the rational baseline" (Ylikoski & Kuorikoski 2016: 219).<sup>27</sup> Ylikoski and Kuorikoski argue that this leads to asymmetry or inequality in explanations. According to them, these ideas stem from the fact that rational and self-interested behaviour is assigned the status of a natural order. Building upon Stephen Toulmin's (1961) notion of the ideal order – presupposed in the sciences and determining which phenomena require explanation and which are treated as obvious and in no need of explanation – they argue that in the social sciences (including economics) the idea that people behave rationally and in a

---

<sup>26</sup> For Chomsky (1965), competence is a structural description of abstract knowledge that is not contrasted with 'incompetence', but with 'performance' (Elqayam & Evans 2011: 239).

<sup>27</sup> They are not of course the only scholars who notice this. Most notably, researchers working with Gerd Gigerenzer have developed a similar criticism of the behavioural economics initiated by Kahneman and Tversky. Ylikoski and Kuorikoski, however, bring insights from the philosophy of science in order to account for the possible bias stemming from researching deviations from the norm of rational behaviour, often allegedly implied by EUT.

self-regarding way is, similarly, treated as evident, intuitively appealing, and thus as not requiring explanation. According to Ylikoski and Kuorikoski, this impedes the study of the possible mechanisms of choice, which can be the same for the behaviours treated in the light of a normative theory as rational and irrational. They emphasize that this hypothesis should not be excluded from research by accepting “normative a priori conceptions of rationality”, as they call them.

Moreover, these a priori conceptions have been strengthened in economics and decision theory by the fact that formal theories that explicate a certain notion of rationality, like EUT, are treated as normative. The normative understanding of EUT further facilitates the research bias that leads to studying mainly deviations from the norm of rationality, especially in behavioural economics. The most important textbooks on behavioural economics state that standard (neoclassical) economic models are questioned as descriptive ones but are kept as the normative benchmark (see e.g. Cartwright 2014, Wilkinson & Klaes 2017, Just 2013, Angner 2012).

At the same time it is often pointed out that behavioural models provide descriptions of what people do (how they behave) and not why they behave in a particular way. This observation is followed by a critical argument: behavioural economics does not focus on tracing the psychological decision processes that cause economic behaviour (see e.g. Berg & Gigerenzer 2010). Behavioural economics has been also criticized for being a collection of *ad hoc* observations of behaviours for which neoclassical economic models cannot account. Hence, behavioural economics is supposed to tell us only when the standard economic model explains well (and when not) and how to change the neoclassical models to get a better fit with experimental data. This leads to the danger of overfitting (see e.g. Binmore & Shaked 2010). I believe that we could think about this already established criticism of behavioural economics<sup>28</sup> as pointing out research biases stemming from the belief that EUT and neoclassical models are normative and, as such, benchmarks – both for decision making as well as for researching economic decision making. *Ad hoc* explanations, overfitting, lack of identification of the mechanism of decision processes, are all related to the attempt to explain the ‘deviations’ from the standard model treated as the normative one. Once we

---

<sup>28</sup> See also Cartwright 2014, chapter 1; Wilkinson & Klaes 2017, chapter 11 for concise summaries of this criticism.

agree with such an interpretation of this criticism, we also notice that the normative view on EUT (or neoclassical models) is the main methodological problem of behavioural economics. Therefore, the often-mentioned remedies for the perceived deficiencies of behavioural economics (conducting more experiments and/or bringing new theoretical insights from other disciplines) cannot improve the project of behavioural economics as long as its very research perspective remains flawed.

## **Conclusion**

The normative status of EUT is widely accepted in economics. Even most adherents of behavioural economics who attempt to propose more descriptively adequate theories of economic behaviour for the most part do not question the characterization of EUT as a normative theory. I have attempted to show why, although it is widely accepted, the normative understanding of EUT is difficult to defend. I have argued that neither understanding EUT as a philosophical theory of rationality, nor as a theory of rational choice that can have normative use, can justify treating EUT as a theory that says how people ought to behave. I have also claimed that, even if the notion of rationality played a role in the development of the various versions of EUT, it is not a reason for treating EUT as a normative theory, in particular from the philosophy of science point of view. Finally, I discussed the research biases to which the normative understanding of EUT leads.

Allow me to speculate a bit on what would happen if we abandoned the normative view of EUT. It could result in treating EUT as an explanatory and formal theory. As such, the theory has already been demonstrated to predict inaccurately many times over, at least in some choice contexts. This could then further lead to developing alternative (e.g. formal) theories of decision making, which would then be subject to tests as well. The axiomatization proposed by von Neumann and Morgenstern was introduced as a set of conditions under which the principle of maximization holds. Maximizing behaviour was treated by von Neumann and Morgenstern as rational behaviour. This is not the only way of understanding rationality, however. Different notions of rationality could then, as heuristics, drive the search for alternative theories of choice and decision making. Alternatively, we could set aside the rationality principle altogether and search for mechanisms of choice, irrespective of their possible assessment in the light of any notion of rationality. Maintaining the normative understanding of EUT is difficult to



defend, leads to research biases, and precludes other, potentially promising, ways of explaining economic behaviour and choices.

Let me end this article with a brief reference to Tversky's early work. In 1975 he remarked that "(t)he axioms of utility theory can be regarded as maxims of rational choice only in conjunction with an intended interpretation, and the criteria for the selection of an interpretation are not part of utility theory" (Tversky 1975: 172).

Tversky makes a very important point here. Interpreting EUT in a normative way is not a scientific task, it is a philosophical endeavour that can be done, for instance, in the light of our practical concerns about how to act. In the discussion about EUT these separate concerns, philosophical, practical and scientific, often get conflated. The notion of a normative decision theory is a manifestation of this confusion. Theories can have normative interpretations. Science, however, does not know normative theories.

## Bibliography

- Allais, M. (1953). Le comportement de l'homme rationnel devant le risque: critique des postulats et axiomes de l'école américaine, *Econometrica*. 21 (4), 503-546.
- Anderson, E. (2004). Uses of value judgments in feminist social science: A case study of research on divorce. *Hypatia* 19 (1):1-24
- Angner, E. (2012). A course in behavioral economics. Palgrave Macmillan.
- Arrow, K. J. (1951). Alternative approaches to the theory of choice in risk-taking situations. *Econometrica: Journal of the Econometric Society*, 404-437.
- Baron, J. (2004). Normative models of judgment and decision making, [in:] Koehler D.J. & Harvey N. (eds.), *Blackwell Handbook of Judgment and Decision Making*, 19-36.
- Baumol, W. J. (1951). The Neumann-Morgenstern Utility Index--An Ordinalist View. *Journal of Political Economy*, 59(1), 61-66.
- Becker, S. W., & Brownson, F. O. (1964). What price ambiguity? Or the role of ambiguity in decision-making. *Journal of Political Economy*, 72(1), 62-73.
- Bell, D. E., & Raiffa, H. (1988). Marginal value and intrinsic risk aversion. [in:] Bell, D.E., Raiffa, H. & Tversky, A. (eds.), *Decision making: Descriptive, normative, and prescriptive interactions*, Cambridge University Press, 384-397.
- Berg, N., & Gigerenzer, G. (2010). As-if behavioral economics: Neoclassical economics in disguise? *History of economic ideas*, 133-165.
- Binmore, K., & Shaked, A. (2010). Experimental economics: Where next? *Journal of Economic Behavior & Organization*, 73(1), 87-100.
- Briggs, R. A. Normative theories of rational choice: expected utility, *The Stanford Encyclopedia of Philosophy* (Spring 2017 Edition), Edward N. Zalta (ed.), URL = <https://plato.stanford.edu/archives/spr2017/entries/rationality-normative-utility/>
- Bromme, J. (2008). Is rationality normative? *Disputatio* 11, 151-71.

- Camerer, C.F. & Loewenstein, G. (2004). Behavioural economics: past, present, future, [in:] Camerer C.F., Loewenstein G. & Rabin M., *Advances in behavioural economics*, Russell Sage Foundation, 3-51.
- Camerer, C., & Weber, M. (1992). Recent developments in modeling preferences: Uncertainty and ambiguity. *Journal of Risk and Uncertainty*, 5(4), 325-370.
- Cartwright E. (2014). Behavioral economics. 3<sup>rd</sup> edition. Routledge
- Chomsky, N. (1965). Aspects of the theory of syntax. Cambridge MA: MIT Press.
- Colander, D., & Su, H. C. (2015). Making sense of economists' positive-normative distinction. *Journal of Economic Methodology*, 22(2), 157-170.
- Corfield, D. (1997). Assaying Lakatos's philosophy of mathematics. *Studies in History and Philosophy of Science Part A*, 28(1), 99-121.
- Davidson, D., McKinsey, J. C. C., & Suppes, P. (1955). Outlines of a formal theory of value. *Philosophy of Science* 22, 140–160.
- Davis, J. B. (2016). Economists' Odd Stand on the Positive–Normative Distinction. [in:] *The Oxford Handbook of Professional Economic Ethics*, Oxford University Press
- Douglas, H. (2000). Inductive risk and values in science. *Philosophy of science*, 67(4), 559-579.
- Dupré, J. (2007). Fact and value. [in:] *Value-Free Science: Ideals and Illusions?* Kincaid, H., Dupré, J., & Wylie, A. (eds.). Oxford University Press.
- Ellsberg, D. (1961). Risk, ambiguity, and the Savage axioms. *The Quarterly Journal of Economics*, 643-669.
- Elqayam, S., & Evans, J. S. B. (2011). Subtracting “ought” from “is”: Descriptivism versus normativism in the study of human thinking. *Behavioral and Brain Sciences*, 34(5), 233-248.
- Evans, J. S. B. T., & Over, D. E. (2004). Oxford cognitive science series. If. New York, NY, US: Oxford University Press.
- Fellner, W. (1965). Probability and profit: A study of economic behavior along Bayesian lines. Homewood, Ill.: Irwin.
- Fishburn, P. C. (1982). Nontransitive measurable utility. *Journal of Mathematical Psychology*, 26(1), 31-67.
- Fishburn, P., & Wakker, P. (1995). The invention of the independence condition for preferences. *Management Science*, 41(7), 1130-1144.

- Friedman, M., & Savage, L. J. (1948). The utility analysis of choices involving risk. *Journal of Political Economy*. 56(4), 279-304.
- Friedman, M., & Savage, L. J. (1952). The expected-utility hypothesis and the measurability of utility. *Journal of Political Economy*. 60(6), 463-474.
- Guala, F. (2000). The logic of normative falsification: rationality and experiments in decision theory. *Journal of Economic Methodology* 7 (1), 59-93.
- Hands, W. (2012). Normative rational choice theory: past, present, and future. *VOPROSY ECONOMIKI* 10.
- Harrison, G. W. (1994). Expected utility theory and the experimentalists. [in:] *Experimental economics*, Physica-Verlag HD, 43-73.
- Hausman, D. & McPherson, M. (2006). Economic analysis, moral philosophy and public policy. Cambridge University Press
- Herfeld, C. (2013). PhD thesis summary: The many faces of rational choice theory. *Erasmus Journal for Philosophy and Economics*. 6 (2), 117-121
- Herfeld, C. (2018). From theories of human behavior to rules of rational choice: Tracing a normative turn at the Cowles Commission. *Journal of History of Political Economy*. 50 (1), 1-48.
- Herstein, I. N., & Milnor, J. (1953). An axiomatic approach to measurable utility. *Econometrica, Journal of the Econometric Society*, 291-297.
- Heukelom, F. (2012). Three explanations for the Kahneman-Tversky Programme of the 1970s. *The European Journal of the History of Economic Thought*, 19(5), 797-828.
- Heukelom, F. (2014). Behavioral economics: A history. Cambridge University Press.
- Intemann, K. (2001). Science and values: Are value judgments always irrelevant to the justification of scientific claims? *Philosophy of science*, 68(S3), S506-S518.
- Jallais, S. & Pradier, P-Ch. 2005. The Allais Paradox and its immediate consequences for expected utility theory. [in:] *The Experiment in the History of Economics*, Fontaine P. & Leonard, R.J. (eds.), New York: Routledge, 25–49.
- Just, D. (2013). Introduction to behavioral economics. Willey.
- Kahneman, D., & Tversky, A. (1979). Prospect theory: An analysis of decision under risk. *Econometrica: Journal of the Econometric Society*, 263-291.
- Kolodny, N. (2005). Why be rational? *Mind* 114, 509-563.
- Lakatos, I. 1976 [1963–64]. Mathematics, science and epistemology. Cambridge University Press

- Levi, I. (2002). Money pumps and diachronic books. *Philosophy of Science* 69, 235–247.
- Longino, H. E. (1990). Science as social knowledge: Values and objectivity in scientific inquiry. Princeton University Press.
- Loomes, G., & Sugden, R. (1982). Regret theory: An alternative theory of rational choice under uncertainty. *The Economic Journal*, 92(368), 805-824.
- MacCrimmon, K. R. (1965). An experimental study of the decision making behavior of business executives. University of California, Los Angeles.
- Machina, M. J. (1982). Expected utility analysis without the independence axiom. *Econometrica: Journal of the Econometric Society*, 277-323.
- Machina, M. (1983). Generalized expected utility analysis and the nature of observed violations of the independence axiom. *Foundations of Utility and Risk Theory with Applications*, 263-93.
- Mäki, U. (2012). The truth of false idealizations in modeling, [in:] *Models, Simulations and Representations*, Humphreys P. & Imbert C. (eds). Routledge, 216-233.
- Marschak, J. (1950). Rational behavior, uncertain prospects, and measurable utility. *Econometrica: Journal of the Econometric Society*, 111-141.
- McMullin, E. (1985). Galilean idealization. *Studies in History and Philosophy of Science Part A*, 16(3), 247-273.
- Mireles-Flores L. (2016), Economic science for use (doctoral dissertation). Erasmus University Rotterdam
- Mongin, P. (1988). Problèmes de Duhem en Théorie de l'Utilité Espérée. *Fundamenta Scientiae* 9, 299–327.
- Mongin, P. (2014/18). Le paradoxe d'Allais: Comment lui rendre sa signification perdue? *Revue économique*, 743-779. [English version from 2018 available at [https://papers.ssrn.com/sol3/papers.cfm?abstract\\_id=3214506](https://papers.ssrn.com/sol3/papers.cfm?abstract_id=3214506)]
- Morgenstern, O. (1972). Descriptive, predictive and normative theory. *Kyklos*, 25(4), 699-714.
- Moscati, I. (2016). Retrospectives—how economists came to accept expected utility theory: The case of Samuelson and Savage. *Journal of Economic Perspectives* 30 (2), 219–36.
- Moscati, I. (2018). Measuring utility. From the marginal revolution to behavioral economics. Oxford University Press
- Mosteller, F., & Noguee, P. (1951). An experimental measurement of utility. *Journal of Political Economy*, 59(5), 371-404.

- Nash Jr, J. F. (1950). The bargaining problem. *Econometrica: Journal of the Econometric Society*, 155-162.
- Von Neumann, J., & Morgenstern, O. (1944). *Theory of games and economic behavior*. Princeton University Press
- Nowak L. (1977). *Wstęp do idealizacyjnej teorii nauki*, Warszawa PWN
- Over, D. 2004. Rationality and the Normative/Descriptive Distinction. [in:] Koehler, D., Harvey N., *Blackwell Handbook of Judgment and Decision Making*, Blackwell Publishing, 3-18.
- Peterson, M. (2009). *An introduction to decision theory*, Cambridge: Cambridge University Press.
- Quiggin, J. (1982). A theory of anticipated utility. *Journal of Economic Behavior & Organization*, 3(4), 323-343.
- Rabinowicz, W. 2000. Money pump with foresight. [in:] *Imperceptible harms and benefits*. Dordrecht: Springer, 123-154
- Raz J. (2010). Reason, Reasons and Rationality, [in:] Russ Shafer-Landau (ed.), *Oxford Studies in Metaethics, Volume 5*. Oxford University Press.
- Samuelson, P. (1947). *Foundations of economic analysis*. Harvard University Press.
- Savage, L. J. (1954). *The foundations of statistics*. New York: Dover Press.
- Schoemaker, P. (1982). The expected utility model: Its variants, purposes, evidence and limitations. *Journal of Economic Literature*. 20(2), 529-63.
- Sent, E. M. (2004). Behavioral economics: How psychology made its (limited) way back into economics. *History of Political Economy* 36(4), 735-760.
- Starmer, C. (2000). Developments in non-expected utility theory: The hunt for a descriptive theory of choice under risk. *Journal of Economic Literature* 38 (2), 332-382.
- Starmer, C. (2005). Normative notions in descriptive dialogues. *Journal of Economic Methodology*, 12(2), 277-289.
- Steele, K. (2010). What are the minimal requirements of rational choice?: Arguments from the sequential-decision setting. *Theory and Decision* 68, 463–487.
- Steiner, M. (1983). The philosophy of mathematics of Imre Lakatos. *The Journal of Philosophy*, 80(9), 502-521.
- Su, H. C. (2012). Beyond the positive–normative dichotomy: Some remarks on Colander’s Lost Art of Economics. *Journal of Economic Methodology*, 19(4), 375-390.
- Thaler, R. H. (1991). *Quasi Rational Economics*, New York: Russell Sage Foundation.

- Thaler, R. H. (2000). From homo economicus to homo sapiens. *The Journal of Economic Perspectives*, 14(1), 133-141.
- Thaler, R. H. (2018). From cashews to nudges: The evolution of behavioral economics. *American Economic Review*, 108(6), 1265-87.
- Toulmin, S. (1961). *Foresight and understanding*. London: Hutchinson.
- Tversky, A. (1975). A Critique of Expected Utility Theory: Descriptive and Normative Considerations. *Erkenntnis* (9) 2, 163-173.
- Tversky, A., & Kahneman, D. (1986). Rational choice and the framing of decisions. *Journal of Business*, S251-S278.
- Vineberg, S. (2016). Dutch Book Arguments, *The Stanford Encyclopedia of Philosophy* (Spring 2016 Edition), Edward N. Zalta (ed.), URL = <https://plato.stanford.edu/archives/spr2016/entries/dutch-book/>.
- Way J. (2009). Two accounts of normativity of rationality. *Journal of Ethics & Social Philosophy* 1, 1-9.
- Wilkinson N., & Klaes M. (2012). *An introduction to behavioral economics*. Palgrave Macmillan.
- Wylie, A., & Nelson, L. H. (2007). Coming to Terms with the Value (s) of Science: Insights from Feminist Science Scholarship [in:] Kincaid, H. Dupre J. & Wylie A. (eds.), *Value-Free Science? Ideals and Illusions*. Oxford University Press, USA. pp. 58-86 (2007).
- Ylikoski, P., & Kuorikoski, J. (2016). Self-Interest, Norms, and Explanation [in:] Risjord, M. (ed.). *Normativity and Naturalism in the Philosophy of the Social Sciences*. Routledge, 212 -229.
- Zappia, C. (2016). Daniel Ellsberg and the validation of normative propositions. *Economia. History, Methodology, Philosophy*, (6-1), 57-79.
- Zappia, C. (2018). Rationality under uncertainty: Classic and current criticisms of the Bayesian viewpoint. *The European Journal of the History of Economic Thought*, 1-33.

