Rationality and Utility: Economics and Evolutionary Psychology

C. Monica Capra and Paul H. Rubin

Abstract Economics has always prided itself on having a unifying theoretical framework based on rational choice theory. However, data from controlled experiments, which often provide theory the best chance to work, refute many of the rationality assumptions that economists make. The evidence against rational choice, as traditionally defined, has forced economists to rethink their traditional models. However, despite the investment of many brilliant minds in the pursuit of better behavioral models of choice, behavioral economics has so far made little progress in providing an alternative paradigm that would be both parsimonious and accurate. In this chapter, we review the evidence against rational choice and the ways in which behavioral economists have responded. In addition, we put forward the idea that evolutionary psychology can give economics back its overriding paradigm. Evolutionary psychology can place structure on the utility function and provide content to rationality. By doing so, it can explain many of the behavioral anomalies that behavioral economists and psychologists have documented. If economists are willing to use the evolutionary psychology paradigm, then they can regain theoretical consistency of their discipline and have models that are better descriptors and predictors of behavior.

Keywords Economics · Rationality · Utility · Anomalies · Behavior · Experiments · Evolutionary psychology and economics

Introduction

In the last 30 years, experimental and behavioral economists have gathered vast amounts of data that suggest that human behavior systematically deviates from rational choice, narrowly defined as that prescribed by neoclassical economic

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choice theory. It is already possible to explain some of these deviations in terms of evolutionary psychology. In this article, we argue that economics would benefit from continuing to build bridges between economics and biological and psychological sciences. These bridges will enable us to establish Evolutionary Psychology as a unifying framework for explaining why such anomalies occur. In the first part of this chapter, we provide an overview of the arguments, and review evidence that have challenged the assumption of rationality in economics. We then discuss some of the ways in which economists have attempted to explain anomalous behaviors, and we present some of the challenges that these explanations face. In particular, current behavioral models do not derive from first principles. Many of current behavioral models are constructed with the purpose of fitting empirical observations. This means that there are likely to be as many models of behavior as there are behavioral anomalies. Many of the behavioral models fit data well, but mainly because they include many parameters that adjust to fit the data. In the third part of this chapter, we develop arguments for adopting evolutionary psychology as a workhorse for understanding behavior. In particular, evolutionary psychology can help us identify the nature of utility and choice. With respect to utility, we argue that it essentially represents the fitness evolutionary function. With respect to decision-making, we believe that the concept of ecological rationality – that is, the adaptation of decision processes to contex – is a promising step towards a theory of choice that is grounded on evolutionary principles. We believe that behavioral economics and economics in general would benefit from introducing a unifying paradigm that is alternative to rational choice and that is based on evolutionary psychology. We believe that this endeavor is both possible and that it would benefit not only economics, but also other sister disciplines.

1 The Rationality Critique

Critiques of the rationality postulate in economics trace back to the early 1900s when psychologists and some economists attacked the assumption that individual behavior was solely motivated by the urge to achieve maximum pleasure and minimum pain. To the early skeptics of rational choice, the reliance of economic theory on the hedonistic idea of utility maximization trivialized the fact that habit, instinct, evolution, and the environment influence choices. Thorstein Veblen (1909), for instance, believed that the hedonistic premise that all choice could be explained by the urge to achieve highest utility was too narrow to explain how people really behaved. Choice implied much more than pleasure and pain, it was a joint product of certain underlying psychological tendencies developed and given their shape and direction by the universe outside. "*[T]he facts of choice depend upon instincts interplaying with the great body of customs, current technology, and common-sense philosophy that have been handed down to them; above all by the kind of prowess held in most esteem*" (Veblen in Dickinson 1919).

Early twentieth century skeptics also acknowledged the notion that decisions involve costs. They argued that it is difficult, if not impossible, for a human being to always behave in a manner consistent with utility maximization. "*Decisions involve effort of attention, and this effort cannot be sustained beyond a few seconds at a time, nor repeated without limit*" (John Bates Clark 1918 p. 23). Indeed, Clark was referring to the contemporary idea that human rationality is a scarce resource, and as such, it is costly to always choose the optimum. Decisions imply costs of concentration, information acquisition, and analysis of available alternatives, thinking, deciding what to do, figuring out the best way to do it, and finally acting upon one's final decision. As Vernon Smith (1991) argues, many decisions that require complex calculations are too costly to follow compared to their value. Therefore, it makes sense to resort to habit or simple rules of thumb.

Despite the early criticisms, rational choice flourished and developed into a widely accepted postulate among economists. Most economists not only continued to regard instincts, habits, and decision costs as unimportant elements of choice, but they also stretched the assumption of perfect rationality to unrealistic extremes. Game theoretic models, for example, assume that super rational agents perfectly understand the model or game that the theorist is studying, probably with much difficulty. Here, an analyst might spend a year or two solving a difficult maximization problem and, then, automatically assume that the solution explains behavior of less persistent and less sophisticated game participants. Clearly, a problem with modeling economic behavior under such unrealistic assumptions is that the resulting predictions, although elegant, may have very little practical and empirical relevance.

Nevertheless, the ideas that individuals may not always optimize and that decision-making is a costly endeavor reemerged in the economic literature. In the 1950s research by psychologists such as Duncan Luce (1959) and economists such as Herbert Simon (1955, 1957) provided alternative ways of describing human behavior that better mirrors the way people actually behave. Simon, in particular, put forward the idea of bounded rationality. His basic idea was that almost all human behavior has a large rational component, but only in terms of the broader everyday sense of rationality, not the economists' more specific sense of maximization (Simon 1959, 1978). Rationality in economics is reflected entirely in the choices realized, whereas, according to Simon, human rationality is reflected in the *process* that involves a decision. Procedural rationality is the hallmark of "satisficing". As William Baumol (1979) puts it, "*. . . a person who is in a situation of having to find a needle in a haystack will quickly realize that there is little to be gained by looking further once the first good, usable needle has been found*". Maximization requires a costly and careful process of comparison of all available alternatives. Satisficing involves comparing a candidate decision in terms of the acceptability of that decision. That is, the needle found in the haystack, even if it is not the best, may be usable enough to make one want to stop looking any further. Although Simon's ideas eventually earned him the Nobel Prize in Economics in 1978, many of his early contributions were all but ignored by mainstream economics.

Indeed, economists addressed some of these issues and attempted to salvage the model of rationality. For example, Armen Alchian (1950) followed by Milton Friedman (1953) argued that markets would select for maximizing behavior even if individuals did not seek or understand such behavior. In fact, in market interactions, all you need is a small percentage of agents who can exploit arbitrage opportunities to get rid of biased behaviors. This argument applied more to behavior of firms than of individuals. Garry Becker (1962) argued that many results of economics, such as the downward sloping demand curve, would follow even if individuals behaved irrationally. These arguments, especially those of Friedman, enabled economists to maintain the rationality assumption in the face of much contradictory evidence. Thus, although individuals may be irrational, they behave *as if* they were perfectly rational. A baseball player running to catch a ball does not really solve a system of differential equations to determine how fast to run, but he runs *as if* he did. The reluctance of early economists to abandon the rational framework is not surprising. Economists had been heavily influenced by physics, which aims at finding unified theories for understanding the physical world. Thus, economists differ from other social scientists in that we search for parsimonious models of economic choice that can be derived from first principles and that can be used to explain decisions in a wide variety of economic contexts. In other words, economists want a unified model of social behavior. This is in stark contrast to the way psychologists study choice; psychologists seem not particularly concerned with finding a unifying framework, but prefer to explain each phenomenon they face with a different theory.

In the 1970s through the early 1990s, the assumption of rationality was most strongly and successfully questioned through the important works of psychologists such as Amos Tversky and Daniel Kahneman.[1] Through a series of simple experimental tasks, these researchers were able to show large anomalies in judgment and decision-making including framing effects (which violates procedural and description invariance), the status quo bias and the endowment effect (which imply reference dependent utility and an asymmetry in how we treat gains and losses), and preference reversals (which challenges the stability of preferences) in both riskless choice and choice under risk. Faced with the overwhelming empirical evidence, economists could no longer ignore the evidence against rationality assumptions. In fact, there were some economists who became instrumental in emphasizing the importance of psychology in economics and finance. Richard Thaler (1985, 1981), in particular, pointed out that the models of saving and consumption that guide policy making do not test well against data.

Traditional models of inter-temporal choice rely on the assumption that people smooth consumption over their lifespan. However, consumption smoothing is rarely seen. Thaler showed that consumption is highly sensitive to income and that savings tend to increase when consumers are offered 401 K plans. This pattern of consumption and saving behaviors suggest that the marginal propensity to

[1]See Tversky and Kahneman (1974; 1991, and 1992) and Kahneman and Tversky (1979)

consume different types of wealth is not equal. In response to this and other evidence, Thaler proposed a model of mental accounts. The main premise of mental accounting is that people tend to label money for specific consumption or investment decisions. For example, people would use their salary moneys to buy food and other necessities, use gifts from parents or relatives to buy luxuries, but use bonuses to save. Richard Thaler (1999) suggested that people create mental accounts to facilitate comparisons between consumption goods, such as buying a computer or a new dress, and to exert self-control. That is, moneys labeled as "savings" (e.g., 401 K) are kept out of reach, but moneys labeled as "cash" can be used for consumption. When experiencing changes in income, for example, people correct their consumption accounts, but not necessarily their savings accounts, as they are usually "recorded" as different and independent from each other. Mental accounting, thus, violates the basic assumption that money is fungible, as investors behave as if its origin determined its use.

More recently, with the backing of a significant body of evidence that documented a systematic departure from the predictions of rational economic behavior[2] and the professional birth of a new generation of experimental economists, limitations on the rationality assumptions have become commonplace, as part of what is called "behavioral economics". For example, Kahneman shared the Nobel Prize in economics in 2002 (Tversky had died in 1996) and in 2004 Matthew Rabin, a scholar in behavioral economics, won the John Bates Clark medal, an important honor for young economists. Nowadays, virtually every issue of every important journal in economics has one or more articles reporting on non-rational behavior of some sort. Economics has now reached a point where non-rational behavior is, as common as, or possibly more common an assumption than rationality.

2 In Search for an Explanation

Throughout the debate regarding the inconsistency between theoretical predictions and behavioral observations, there has been little success in unifying the mounting evidence against perfect rationality into a consistent theory. There have been some attempts to meet the challenge. Kahneman and Tversky, for example, did propose "prospect theory" and "cumulative prospect theory" as a unifying set of hypotheses to explain anomalies in individual choice experiments. The main pillars of these are that individuals evaluate outcomes based on a reference point, and that people value gains differently from losses. In particular, the theory predicts loss aversion, which refers to the idea that losses feel worse (almost twice as bad) than equivalent gains feel good. A typical value function proposed by prospect theory treats gains and losses differently with respect to a reference point. It is concave over gains and is convex over losses, depicting diminishing sensitivity in both domains. This means

[2]See Conlisk (1996) for an extensive review of departures from rational predictions in games

that, with respect to a reference point, people are risk averse when they face uncertain positive outcomes, but risk seeking when they face uncertain negative outcomes. A gravely ill patient facing a choice between certain death versus a very small chance of a recovery through experimental therapy is likely to choose the later. In addition, to introducing a reference-point based value function, Tversky and Kahneman suggested that value drops faster in the loss domain than it rises in the gain domain. This later concept is called "loss aversion".

That losses feel much worse than equivalent gains feel good is not much of a surprise to anyone who has both lost and found money on the streets, or who has had papers accepted and rejected in a journal. Richard Thaler (1980) used Tversky and Kahnman's ideas to explain that endowments (such as owning a house) set an individual's reference point so that selling (e.g., selling the house) moves the individual in the direction of a loss and buying in the direction of a gain. So, the individual would "irrationally" ask more for an item she owes than she is willing to pay for it; this phenomenon was later named "the endowment effect". In addition, there is recent evidence that such a model can predict choices when the outcomes are non-monetary and negative, and when in "real-life" large stake games. Gregory Berns et al. (2007), for example, used painful electric shocks to induce negative non-monetary outcomes in a choice under risk task. They observed that the pattern of choices of the majority of the subjects could be explained by cumulative prospect theory. In a recent field study of the behavior of contestants in the popular TV show "Deal or No-Deal"[3] Thierry Post et al. (2008) find that contestants' decisions can be largely explained by a reference-dependent type of model, such as cumulative prospect theory. However, despite their descriptive appeal, these behavioral models do not derive from first principles, but rather represent methods of organizing observations. What these explanations lack is an account for why non-rational choice exists in the first place. What is the origin of observed "anomalous" behavior in individual choice tasks? What first principles can support reference points and loss aversion? These are questions that cumulative prospect theory does not address.

In games, the lack of a unifying paradigm for explaining anomalous behavior is even more evident. Traditional game theory assumes perfect rationality, rational expectations, and common knowledge of rationality. Not surprisingly, because of the stringent rationality assumptions, traditional game theory performs very poorly as a descriptive theory of choice. Persistent and systematic deviations from the rational prediction have been documented by innumerable experiments with different incentives, frames, and subject pools (see Conlisk 1996 and Camerer 2003). In general, it is not surprising that such disconnect between game theoretic predictions and behavior exists. Game theory is a branch of mathematics. As such, it is more

[3] *Deal or No Deal* is a game show broadcasted in the U.S. on NBC. It consists of a contestant selecting one briefcase of 26, each containing a cash value from $.01 to $1,000,000. Over the course of the game, the contestant eliminates the other cases in the game, periodically being presented with a "deal" from The Banker to take a cash amount to quit the game. Should the contestant refuse every deal, they win the value of the case selected at the start

concerned with the internal consistency of its theorems than with their practical relevance. It makes normative statements about how perfectly rational players would behave, but makes no statement about how real people would behave. Thus, it is not a descriptive theory of choice.

Perhaps because of its simplicity and applicability, the Ultimatum Game (Guth et al. 1982) represents a notorious example of what is wrong with game theoretic predictions. In an ultimatum game, a player makes an offer to another player of how to split an amount of money, say $10. The responder has the option to accept or reject the offer. If the offer is accepted, each gets the amount that the first player determined. If the offer is rejected, both players get nothing. The Nash equilibrium predicted by traditional game theory indicates that the first player will offer the minimum possible amount, and the second will accept it. However, this game has been played in innumerable countries including the Israel, Japan, US, and Yugoslavia (Roth et al. 1991) with different subject pools (see for example Harbaugh et al. 2000) and with both relatively small and relatively large stakes (Cameron 1999). Yet, the Nash equilibrium is virtually never observed.[4] In general, low offers tend to be rejected and first players, perhaps anticipating a rejection, tend to offer between 40% and 50% of the endowment (Camerer 2003).

Several explanations have been put forward to explain data of this game and other similar games; these include inequality aversion (Fehr and Schmidt 1999) and fairness preferences (Rabin 1993). These models have generated a large amount of studies that look at the effects of social preferences, such as envy and generosity on strategic decisions. However, just like prospect theory, these explanations are a way to organize behavioral data and do not derive from a unifying paradigm. Perhaps in an attempt to find a framework for understanding the role of social emotions on strategic choice, researchers have ventured into the area of neuroscience. Their initial motivation was to accumulate process data that would help us in understanding the mechanisms by which choices are made. With respect to the ultimatum game, brain imaging studies reveal that rejections are motivated by adverse physiologic reactions (visceral disgust) to low offers (Sanfey 2004). In other words, people seem to reject low offers in the Ultimatum game because low offers make them feel bad, and they need to take an action (rejection) to feel better, possibly to maintain homeostasis.[5] The idea that emotions play a role in rejecting offers in the Ultimatum Game has been further supported other behavioral experiments. For example, in a clever study, Dan Houser and Erte Xiao (2005) gave recipients a chance to vent their anger and pain from low offers. More specifically, they allowed recipients to write nasty messages to the first players before making a decision. Interestingly, the venting option significantly reduced rejection rates.

[4]High acceptance rates of low offers have been observed in underdeveloped, isolated communities and among very small children. Anthropologists argue that these choices reflect culture (see Camerer 2003 for a review of experiments done in small societies)

[5]According to (Damasio 1994), emotions are cognitive representations of body states that are part of a homeostatic mechanism by which the internal milieu is monitored and controlled, and by which this internal milieu influences behavior of the whole organism

The behavioral and neurobiological studies mentioned above, and others studies suggest that people's decisions are not uniquely motivated by a deliberate rational process; rather these are also influenced by emotions and instinct. This idea has gathered further support from mood studies (Capra 2004 and Capra et al. 2009) and hormonal studies (see Zak and Fakhar 2006). C. Monica Capra, for example, showed that subjects' decisions in games are affected by induced positive or negative affective states. Her results replicate observations in the psychological literature that show a long-lasting effect of background emotions or mood on helping behavior. In particular, C. Monica Capra found that positive mood tended to enhance generosity as measured by the amount a player offered in a Dictator game.[6] Similarly, Paul Zak and Alham Fakhar (2006) found that spraying oxytocin (the hormone responsible for regulating pro-social behavior) in subjects' noses make them more generous and trusting. Recent animal studies (Donaldson and Young 2008) also support the view that hormones are responsible for much of our pro-social behavior.

The challenge that these studies and other pose to social preferences is that they question their stability. As some authors have shown (Cherry et al. 2002), it is possible to generate both generous and spiteful behavior in the lab just by changing the decision environment, helping the subjects generate specific hormones, or helping them get into a specific mood. However, in general, it should not surprise us to see anomalous behavior in games. After all, in the lab, games cannot be defined as "*rule-governed strategic interactions*" (Gardner 1995). Laboratory games are rule governed *social* interactions; as such, unless the players have some psychiatric pathology, decisions ought to be affected by social emotions. The issue, then, is that we do not have a framework that can help us integrate emotions with strategic decision-making.

3 Evolutionary Psychology

Evolutionary psychology can contribute to our understanding of the origins and nature of utility and choice. The most basic economic paradigm of choice assumes that decision makers maximize an objective function subject to constraints. Evolutionary psychology can explain both the nature of the maximization (i.e., the decision making process) and also the nature of the objective function or utility function. In the next section, we discuss decision-making and utility from the point of view of evolutionary psychology. We argue that an evolutionary paradigm can explain the anomalies in decision making that have been widely documented by many behavioral and experimental economists.

[6]In a dictator game, one subject is given the task to split a given amount of money with another anonymous subject. The participant who receives the offer has no power to either accept or refuse the offer (as is the case in the ultimatum game)

Decision-Making

Consider first decision making. Generally speaking, economists assume that agents consider all possible alternatives, and choose the best available alternative. The satisficing literature mentioned above was the first body of analysis to criticize this assumption. Experimental evidence shows that individuals do not consider all possible set of options due to cognitive and motivational limitations. For example, Gad Saad and J. Edward Russo (1996) have demonstrated that individuals often use stopping decisions to arrive to a final choice. Although, satisficing implicitly recognized that human decisions such as choice under risk and decisions in games result from a physiological process, and is therefore subject to limitations in computational capacities and will, satisficing did not provide a unifying explanation for the origin and nature of such limitations.

More recently, evolutionary and cognitive psychologists (Cosmides and Tooby 1994) and (Gigerenzer and Goldstein 1996) have analyzed the decision making process from the perspective of evolutionary psychology. The thrust of this analysis is that the mind is not a general purpose computer ruled by the laws of pure logic. Rather, there are specialized modules in the brain aimed at solving particular problems that are evolutionarily relevant. The idea is that the brain, a physiological system, evolved from natural as well as sexual selection to solve problems that we faced in our evolutionary past. In addition, as all existing organic systems, our brains and their resulting decision strategies adapt to the environment. Thus, a new concept of decision making called "ecological rationality" replaces both satisfying and maximizing. Through the lens of evolutionary psychology, then, it is not surprising that choices in experimental setups seem irrational from a pure maximizing perspective. In experiments, seemingly irrational behavior may be explained in terms of evolved mechanisms. For example, in a series of studies (Peters 2007) showed that people do not naturally process probability information the way economists assume. Indeed, the ability to comprehend and transform probability numbers requires specialized training. Interestingly, over 50% of the subjects in his experiments (all college students, who are usually smart) were unable to fully comprehend relatively simple probability numbers. It is possible that the percentage may be much smaller among the general population, which is rather seldom targeted as a population of interest for these kinds of studies.[7] However, by providing probability information in terms of relative frequencies, it is possible to improve performance on judgment tasks, and reduce biases in decision making (Gigerenzer 2002). Pharmaceutical companies are well aware of the unnecessary anxiety that providing information in percentages can generate, so they opt for providing frequencies information. For example, "9 in 10 people did not experience any adverse effects" is preferred means of communicating that 90% of the people did not experience any adverse effects.

[7]See Joseph Henrich et al. (2009) for an interesting critique of the over-representation of Western and educated subjects in behavioral studies

In a recent paper Eileen Chou et al. (2009) found that the ability of subjects to make strategic decisions in a simple two-person guessing game depended on the way the game was presented. A two-person guessing game consists of two people guessing a number in a given range (e.g. 0 to 100); whoever guesses closer to a fraction, say 2/3, of the average wins a fixed prize. In this game, it is a dominant strategy to always guess a lower number as one is compensated for guessing below the average. Higher numbers are dominated by lower ones. When the game was presented in a familiar context – that is, with a description of what average means, and a graphical explanation of who wins the prize – subjects chose the dominant strategies. When the game was presented in an abstract context, utilizing language such as "if your number x is less than the average", very few subjects (mostly smart Caltech students) seemed to grasp the game. The gist of these studies is that our brain has neither evolved to understand mathematical constructions such as percentages, nor to decode abstract information.[8] As Paul Rubin argues, humans may simply not be good innate abstract thinkers (Rubin 2002). Related to this issue is the study of Leda Cosmides and John Tooby (1992). These authors investigated whether the evolved architecture of the human brain included specialization of reasoning for detecting cheaters in social contracts. Through a series of experiments they showed that participants, who do very poorly in identifying logical rules such as if P then Q, are remarkably accurate in identifying cheating in social exchanges such as "*if you help me, I help you*". Clearly, there is evolutionary advantage for identifying cheaters, which requires the ability to make logical inferences; however, that ability is constrained by the context in which it is called into action. More generally, the brain does better in dealing with other humans than with logical abstractions. This may be because the main force driving evolution of human intelligence was competitive pressure from other humans, not pressure from "nature".

The existence of loss aversion and other anomalies documented by Tversky and Kahneman can also be explained through the evolutionary lens (see McDermott et al 2008). For example, consider the exchange experiment of Jack Knetsch (1989), who endowed subjects with mugs and asked to exchange them for candy bars. He found that very few subjects (only 11%) exchanged their mugs. When a different group was endowed with candy bars and asked to exchange for mugs, again very few (10%) exchanged their candy bars for mugs. This seemingly irrational tendency of subjects in the experiment to value an item more when they own it, and therefore ask more for it than she is willing to pay for it, generating a gap between the willingness to accept (WTA) and the willingness to pay (WTP) for an item, was first conceptualized by (Thaler 1980). Interestingly, recent experimental studies with non-human primates suggest that anomalies in decision-making may have an evolutionary origin. Sarah Brosnan et al. (2007), for example, found

[8]Eileen Chou et al. (2009) interviewed subjects after the experiment and found that many of the subjects simply did not understand the structure of the simple game when the instructions utilized abstract language. This is remarkable, as their subjects were very intelligent Caltech students. Furthermore, subjects' understanding of the task was not responsive to the financial remuneration associated with performing well in the game

that chimpanzees favored items they just received more than items that could be acquired through exchange. They also found that this effect was stronger for food than for other objects, perhaps because of the historically greater risks associated with exchanging food versus keeping it. These results are relevant because they suggest a preference for the status quo among species other than humans. So, not only do humans favor the status quo, but chimpanzees are also inclined to forgo a likely gain in favor of what is safe and known. There were no standardized goods in the evolutionary environment, so exchange would have been subject to greater risks than is true today. Similarly, experimental economists have also replicated violations of expected utility theory in animal experiments. Like humans, Rats violate the independence axiom, suggesting that rats distort probabilities in ways possibly similar to the way humans distort them (see McDonald et al. 1991).

Other experiments with non-human primates and other animals also shed light into the evolutionary origins of inter-temporal discounting. In the 1960s Richard Herrnstein designed clever experiments that were later used to measure time discounting in humans and other less sophisticated animals. In his pigeon experiments, for example, Herrnstein (1961) presented the animals with two buttons, each of which led to varying rates of food reward. He observed that pigeons tended to peck (i.e., allocate time and effort) the button that yielded the greater food reward more often than the other button; however, they did so at a rate that was similar to the rate of reward, and in inverse proportion to their delays. This phenomenon is called the matching law. With respect to time discounting, the matching law suggests that the attractiveness of a reward increases exponentially, the closer one gets to its due date. That is, our psychological reward system is designed to assign high value to imminent rewards as compared to future ones. Thus, when we are asked to choose between say A: $100 in 25 days or B: $120 in 28 days, we clearly choose B. However, when we are asked to choose between C: $100 now or D: $120 in 3 days, our preferences reverse. This pattern of choices implies that our decisions are dynamic or time inconsistent and suggests that we are doomed to fail to comply with future plans. Indeed, dynamic inconsistent choices imply that we do not have self-control.

Richard Thaler's idea of mental accounting, which was explained earlier, may be an adaptive response to our inability to exert self-control. Having a mental account for savings only versus one for consumption only, may be a way to implement an internal commitment devise to stop us from consuming too much. Similarly, social emotions such as guilt and compassion may have evolved to pre-commit us to behave in a way contrary to our initial impulses and short-term self-interest in social contexts. Frank (1988), for example, suggests that the anger one feels when one is offered a low amount in the Ultimatum game commits us to reject the offer. This behavior is not selfish-rational in the short-run, but it may help us obtain higher benefits in the long-run, as building a reputation for getting angry at low offers would guarantee higher offers in the future. But, a more fundamental question is: why did we evolve to have no self-control? Larry Samuelson and Jeroen Swinkels (2006) explain that our lack of self-control is a consequence of our tendency to derive utility from intermediate actions rather than the evolutionary

outcome. For example, we derive utility from sex, not from maximizing reproduction. The utility from sex may tempt us to engage in sexual activities even when it is irrational to do so (e.g., unprotected sex with a prostitute). Samuelson and Swinkels suggest that this is a result of us having an imperfect prior understanding of the *causal and statistical* structure of the world. For example, we do not know exactly what the changes are of reproduction when we meet a potential sexual partner. Indeed, many beautiful and young females are infertile, and there is no obvious way to infer that information.

Because our brains are not general-purpose machines, they make decisions that are situational rational. In recent papers, Gerd Gigerenzer and his collaborators (Gigerenzer et al. 2002), in particular, demonstrated that the decision mechanisms actually used by the human brain are often more efficient than more complex formal mechanisms. For example, the Recognition Heuristic exemplifies a cognitive adaptation where knowing less results in more accurate inferences than knowing more. A person using this heuristic would compare the relative frequency of two categories; if she recognizes one category, but not the other, she would conclude that the recognized category has a higher frequency. Thus, the individual exploits patterns of information in the environment to make inferences in a "fast and frugal" way. In their experiments, Daniel Goldstein and Gerd Gigerenzer, asked German and US students to guess the populations of German and American cities. Each group scored slightly higher on the foreign cities despite only recognizing a fraction of them. The experiment also demonstrated that having more information and knowing more is not necessarily better, as it may complicate the decision rule or heuristics employed in making an estimate. Their experiments demonstrated that, under some circumstances, less-is-better. Simple heuristics have been shown to be more accurate than complex procedures (Gigerenzer et al. 2008). The general idea of this way of looking at choice is that rationality must be interpreted in terms of the specific decision process one utilizes in a given environment, or the specific matching between the decision process and the environment in which it is utilized.

Finally, our evolutionary past may have also had an influence in determining our beliefs about social welfare. This idea has been put forward by Paul Rubin (2003) and called "Folk economics". The principles of folk economics include zero sum thinking about various aspects of the economy, such as trade. Under folk economics, the act of buying from other nations, communities, or tribes is seen as a loss. People, then, are not willing to support trade agreements that increase purchases from others. Folk economics also includes the belief in labor theory of value, and lack of understanding of incentives. All these principles can be shown to derive from the evolutionary environment. The idea is that during much of our evolutionary past, humans evolved in an environment which was essentially zero-sum. In such environment, there was little room for exchange, or any exchange implied a loss. There was little room for investment in human capital, and there was virtually no technological change. In teaching economics and in advocating

policies, economists would do well to consider these evolutionary based arguments. Indeed, folk economics tells us that political economists face a difficult challenge in trying to get people to understand the mutual advantages derived from exchange, specialization, and incentives.

The Utility Function

Related to our understanding and modeling of rationality is the nature of the "utility function". Economists assume that people maximize a utility function, which has certain mathematical properties. However, economists have given themselves an out – the nature of this function (beyond the mathematical properties) is never specified. "Rationality" is then defined in terms of maximizing this function. Rationality is defined as certain properties of behavior which would result from consistent maximization of a function subject to (budget) constraints. For example, in most cases, a reduction in price will lead to an increase in consumption. (There may be exceptions, e.g., Veblen effects and Giffen goods, but the theory allows one to identify these exceptions as well). The experimental evidence discussed above consists of violations of some of the predictions of the theory of maximizing utility subject to constraints. Except for internal consistency requirements, however, utility functions are quite flexible and can be made to explain pretty much any preference. Such an approach is scientifically controversial, however, as the theory generates unfalsifiable hypotheses. Killing children, for example, would not violate any of the rationality assumptions. A preference for dead children can indeed be added to the utility functions. Similarly, elderly ladies who fill their houses with cats may be behaving consistently with respect to some utility function. But, common sense would suggest that there is a problem with this approach.

Economists take the preference or utility function as given and more or less arbitrary. In fact, the utility function of humans is essentially the fitness evolutionary function – that is, we get utility, or pleasure, from activities and consumption that would have caused our predecessors to successfully survive and reproduce. If we think about utility functions in these terms, then there are some implications, which can make the structure of the utility function more precise. For example, Paul Rubin and Chris Paul (1979) have explained the different risk preferences between young men and older men in evolutionary terms and utilizing life-history theory – this theory postulated that behaviors may be best understood in terms of effects of natural selection on the reproductive characteristics over the life cycle. In this context, young males who have no mates will not breed and leave any genes for the future unless they acquire sufficient resources to obtain a mate. Thus, a gamble that pays off will enable the individual to breed. A gamble that loses (perhaps resulting in death) will leave the person's genes no worse off than if the gamble had been refused. In this case, it pays to take bad gambles. On the other hand, once

someone has offspring, then it pays to become risk averse and avoid even fair gambles – particularly in a Malthusian world where survival is at risk. Similarly, since successful males can have virtually unlimited numbers of offspring and successful females have much more limited fertility, we would expect males to be more risk seeking than females.[9] Experimental data[10] on gender differences in lottery choice tasks clearly show that women are more risk averse than men (for a comprehensive review of laboratory gender differences see Croson and Gneezy 2009). In addition to higher risk aversion, recent experiments show that women, even highly successful Harvard MBA females, are less likely than men to enter profitable tournaments (Niederle and Vesterlund 2007; Gneezy et al. 2003). These results suggest a higher competitive preference among males than females. Indeed, as explained above, the source of these intriguing results may lie in evolutionary forces that have shaped sex differences in risk-taking preferences. Other authors such as Gad Saad and Tripat Gill (2001) show that, in the context of the Ultimatum game, it is possible and fruitful to use evolutionary psychology as a framework to understand gender differences.

An important assumption that traditional economic theory makes about utility is that it is derived from the outcome of choice and is independent from the process of choice. Experimental evidence, however, hints to the possibility that utility is also derived from process. Consider the winner's curse (Kagel and Levin 1986; Lind and Plott 1991), which arises when subjects systematically overbid for an item whose value is uncertain and, therefore, lose money. Evidence suggests that, although most people are risk averse, as evidenced by their preference for safe bets, in an auction-type mechanism like the common value auction they act as if they were risk seeking. Interestingly, overbidding has also been documented in Private Value Auctions (Friedman 1992), which would imply risk aversion (Cox et al. 1988). So, why do people overbid in auctions? The answer seems to lie in the competitive nature of the auction mechanism. Winning the auction seems to be more important than making a profit. If we see utility as derived from the activities that caused us to survive and reproduce, signaling fitness by trying to out-bid others (be a winner or avoid being a loser) has value (Rubin 2003). Other "anomalous behaviors" such as competitive altruism, over-consumption, and conspicuous consumption may also be a result of sexual selection. The individual who is most altruistic among his peers can signal fitness – an unobservable characteristic valuable to the members of the opposite sex – by showing that he cannot only care for himself, but he also has the power and fitness to care for others. Similarly, over consumption and conspicuous consumption exist because they are signals for fitness (De Fraga 2009).

[9]See also Netzer (2009) for an evolutionary perspective on risk and time preferences

[10]We emphasize experimental data here because in the real world, many behavioral differences between men and women may be influenced by variables that are difficult to control for. The laboratory environment provides researchers with the ability to control the environment and more effectively isolate the variables of interest

4 Discussion

Economics has always prided itself on having a unifying theoretical framework based on rational choice theory. However, recently such a framework has come under scientific scrutiny. Data from controlled experiments, which usually provide theory the best chance to work, refute many of the rationality assumptions that economists make. If people do not behave rationally, then the theory of maximization subject to constraints loses its predictive power. The mounting evidence against rational choice as traditionally defined has forced economists to rethink their traditional models. However, despite the investment of many brilliant minds in the pursuit of better behavioral models of choice, behavioral economics has so far made at best very modest progress in providing an alternative paradigm that would be both parsimonious and accurate.

We believe that the discipline is lacking an adequate framework for thinking about thinking. We, humans, are part of a natural world ruled by physical and biological laws. Utility, which represents one of the most basic concepts in economics, can easily be conceived as representing fitness. Decision-making is the result of an interaction of our brains, a physiological system, and the decision environment. Adaptation is the main characteristic of all beings, humans included. Thus, the concept of ecological rationality may be more consistent with the natural world than rational choice. In this context, we can conceive two possible futures for our discipline. One would have evolutionary psychology at its heart, the other would not.

Evolutionary psychology can give economics back its overriding paradigm. One important feature of evolutionary psychology is that it can both place structure on the utility function and also provide content to rationality. By doing so, it can explain many of the behavioral anomalies that behavioral economists and psychologists have documented. If economists are willing to use the evolutionary psychology paradigm, then they can regain theoretical consistency of their discipline and have models that are better descriptors and predictors of behavior. Such an adoption would not be much of a departure.

The closeness of the theoretical structures can easily be seen in the context of evolutionary game theory, which was invented by biologists (Smith and Price 1973) and was developed jointly by biologists and economists. Even earlier, the link between Darwin and Malthus is well known. For example, it seems that Hayek understood quite well the relationship between economics and evolution (Rubin and Gick 2004). There is already a literature using evolutionary theory to discuss economic issues, often in the context of the evolution of utility functions (Rubin and Paul 1979; Frank 1988; Rogers 1994; Robson 2001; Somanathan and Rubin 2004; Witt 2008; Samuelson and Swinkels 2006).[11] In addition to the authors mentioned here, there are several other evolutionary-minded economists whose work, we believe, could be the foundation of evolutionary-based economic models.

[11]See also Arthur J. Robson's website for many other publications in this vein

For example, economists such as Geoffrey M. Hodgson and Thorbjørn Knudsen have written countless papers at the nexus of evolutionary theory and economics. Other influential economists who have incorporated evolutionary theory within their work include Larry Samuelson, Avner Ben-Ner, Louis Putterman, and Ted Bergstrom. It would be possible to build on this literature and extend the evolutionary analysis of economic behavior.

The theory of evolution is quite consistent with economic theory (Hirshleifer 1985). In economics, the maximand is utility; in evolution, fitness. But as indicated above, utility functions are essentially functions relating fitness and welfare. That is, we get satisfaction or utility from consumption of goods and services that would have caused our ancestors to improve their chances of survival and reproduction (Gigerenzer et al. 2002; Gigerenzer et al. 2001; Payne and Bettman 2001; Rubin 2002, 2003; Thaler 1985; Thaler 1992; Thaler and Benartzi 2004).[12] With respect to decision-making, there are recent successful attempts to explain anomalies using an evolutionary perspective (Haselton and Nettle 2006). In addition, the introduction of brain scanning technology into the economist's toolbox would improve our understanding of the mechanisms whereby people make choices. For example, there is evidence that valuation of a future reward is processed in lateral prefrontal and parietal areas of the brain, which suggests that evaluating the future engages the executive, more sophisticated, and more energy demanding systems in our brain (McClure et al. 2004). Present consumption, in contrast, tends to be processed in limbic-related structures. This suggests that the ability to form expectations from future rewards was possibly developed latter in our evolutionary past, and is developed later in life through a process of cognitive and personality development, and socialization.

What would happen if we do not adapt evolutionary psychology into economics? We believe that there is a good chance that economics will become a largely "atheoretical" discipline. Although economists will use powerful mathematical tools to analyze behavior, the basic paradigm will still be a set of ad hoc models, derived from observation but not from an overriding theory. For example, as mentioned above, cumulative prospect theory, which has been an important development in economics – possibly an important propellant to a Nobel Prize – is nonetheless a way of classifying observations, but has no deep theoretical foundations. The models of social preferences also fall prey to this problem. Economists recognize that humans can be altruistic, but there is no theoretical explanation for this behavior. Economists have explained altruism in terms of the "warm glow" or social emotions such as compassion that individuals obtain from altruistic behavior, but there is no deep theory of why people should feel positive emotions from sacrificing self-interest for others. Even with respect to modeling decision processes and learning, we have come up with a bouquet of models that fit the data well, but we still do not have a unified basis. The last two models trace decision process at the

[12]The literature also provides explicit discussions of the link between utility and fitness in the context of modern marketing (see Saad 2007; Miller 2009)

introspective level, and describe experimental data in one-shot games rather well. The gist of these models is that they assume that the decision-maker is rational, but that she believes others are not. However, there is a weakness in these models. These models ignore the ability of people to adjust their decision strategies to the environment. Indeed, it is possible to generate environments where people behave as if they were bounded rational, but others that are strategically identical where people behave perfectly rational and believe others are rational too (Cox and James 2010).

Unlike many other social scientists, economists have not been hostile to evolutionary reasoning. We have cited many articles that have appeared in important journals using evolutionary methods, and our citations are by no means comprehensive. Nonetheless, overall, it appears that this mode of thinking has had less of an effect on economics, and particularly on behavioral economics, than might be justified. We think there is much room for improvement, and we hope that economists will agree with us. In addition to providing a unified method for understanding behavior, there are other advantages from utilizing evolutionary psychology as our workhorse paradigm. For example, it may be possible to explain the degree to which culture influences innate behaviors. Economic theory can offer hypotheses that can be tested in experimental environments across different cultures. This may have already occurred, as anthropologists have started using economic models to understand culture (Henrich et al. 2001). We believe that collaboration between economists and evolutionary psychologists is fruitful in more than one way. It can build on the already existing collaboration between neuroscientists and economists, and it can serve to enrich all disciplines.

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