Evolving Economics: Synthesis

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Abstract

This paper reviews the literature of behavioral-, experimental-, and neuro-economics research with the ultimatum and the dictator games.

> "One may wonder whether Adam Smith, were he working today, would not be a neuroeconomi[st]"
>
> Aldo Rustichini 2005

I would like to thank Paul Zak for his relentless support and great comments. All mistakes remaining in this paper are solely the mistakes of the author.

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Introduction

Some of the limitations of the *Homo economicus* model of classical economic theories are effectively illustrated by empirical findings from games, such as the Ultimatum Game (UG), Dictator Game (DG), Prisoners' Dilemma (PD), and Public Goods Games (PGG). In this paper, though the others games are sometimes mentioned, the focus is on UG and DG. In both the UG and DG, two people play with money that they are dividing between themselves in some manner. The purpose and the strategy of the two games are different. In the DG, player1 receives certain dollar amount, typically $10, and is told that there is another person in the same room—in most cases players have full anonymity from both other players and experimenters—whom he or she can decide to give some money to from the $10. There is no further exchange, player1 allocates some money (or no money) to player2 and the game is over. The UG goes a step further than the DG by incorporating social signals. Again, player1 receives $10 and is told to allocate as much as she wishes to player2. However, in the UG, player2 can reject the offer, thereby canceling all of player1's gains as well. Thus the strategy here, for player1, is to allocate "just enough" money to keep player2 happy.

Standard economic models assume that an agent, the Economic Man, is "rational" and "selfish" in his decision-making. A "rational agent" is well described by the Rational Choice Theory (RCT):

> [RCT] accounts for human behavior with two components: (1) preferences (desires, utility, or goals), which function as the motivating force behind human action and which are specific to each agent (their origins fall outside the scope of RCT); and (2) rational calculation and evaluation of the outcomes of possible behaviors, which lead the agent to enact the behavior that is expected to result in the achievement of what the agent

prefers (to maximize his utility, to best satisfy his desires, etc.)
(Christophe Heintz 2005)

A concise definition of selfishness is "choosing dominant outcomes independent of context" (Vernon L. Smith 2005). The Economic Man is expected to be self-regarding and keep all of the $10 in the DG. Thus, if such agents receive "$10 in manna from experimental heaven and [are] asked whether they would like to share some of it with a stranger" (Colin F. Camerer, Richard H. Thaler 1995), the Subgame Perfect Nash Equilibrium answer is "NO" in the case of DG, and in the case of UG, give the tiniest increment of amount possible to the stranger. The stranger would accept that something, however tiny, because something is better than nothing.

However, experiments with small manna, big manna, culturally diverse experiments—including indigenous people in tribes—face-to-face, blind, double-blind, and in general, experiments in any shape or form provide strong evidence that people don't behave according to the expected rationality axioms of self-regarding behavior. The questions then become "why not" and "what rule *do* people obey?" To answer these questions, this paper set out to review literature that spans over two hundred years, starting with Darwin and Adam Smith, ending with the most recent of concepts and experiments of 2006, and to synthesize the behavioral models and experimental results of others. Experimental interference and mistaken concepts played a key role in our developing understanding and is highlighted when necessary to advance my thought.

Experiments using the UG and DG help us gain more knowledge than simply a better understanding of how people play these games. Social infrastructure, business operations, and institutions evolve uniquely to fit the particular culture of each specific society. Economic exchanges frequently involve cooperation, reciprocity, and trust that enable decision makers to plan, reduce risk, diversify food and income sources, and plan for both the short and long term. "Most anthropologists would hardly be surprised by a finding that cultural ideas about sharing and cooperation prevent participants in economics experiments from acting in their narrowly defined self-interest" (Michael Chibnik 2005, pages 201-206).

This paper concludes that human economic activity is a function of the biological and cultural makeup of each individual. Both games are often used as parts of economic experiments in laboratory settings with US and other civilized Western university students as subjects. In the recent past, these games have been adapted to experiments in other cultures, such as a study in 15 small-scale societies (Joseph Patrick Henrich *et al.* 2005) and others (Michael Gurven 2004;Hessel Oosterbeek *et al.* 2004;Swee-Hoon Chuah *et al.* 2005;Laura Schechter 2006) around the world.

Overwhelming evidence suggests that humans behave similarly across most cultures in that they often show other-regarding behavior rather than a purely self-regarding one. Evidence strongly suggests that human decision-making is greatly influenced by the cultural norms found in each respective society. Interestingly, in nearly all cultures, there are some individuals who obey the rationality rule and leave nothing for player2. However, in nearly all cases, such acts are punished by rejection of player1. In Henrich et al.'s study, the Au and Gnau of Papua New Guinea rejected offers even above 50% of the stash. Rejecting such generous offers sounds weird but it may have a cultural foundation that is not obvious to the outsider. In some societies, like the Au and Gnau villages and throughout Melanesia, accepting gifts of any kind creates a strong obligation to reciprocate at some future time. Debts accumulate, and place the receiver in a "subordinate status… As a consequence, excessively large gifts, especially unsolicited ones, will frequently be refused" (Joseph Patrick Henrich *et al.* 2005, page 811).

There are several open questions and unresolved issues remain with using economic games for experiments to see true economic behavior in the artificial environment of the laboratory. This paper covers as many of them as was possible to discern from the hundreds of published experiments. This paper also provides some recommendations to improve the experimenting environment, based on repeated observations of similar issues in some experiments. The organization of the sections is as follows: after a brief introduction of why I found it important to research the literature and write this paper, I compare some of the assumptions of classical and behavioral economics. The following sections describe the development of behavioral economics, more or less chronologically, showing the pros and cons of each attempt, where such was available to discern from the literature. The paper concludes with my thoughts on some of the issues mentioned and a few recommended actions for future experiments.

Perspectives of a Student

It has not been too long ago that I took my first game theory class and I remember what it was like learning something I completely and instinctively disagreed with. Not only in game theory but also in micro economics, economists discuss "agents" as though they were puppets hanging on shoestrings. They have no feelings, no emotions, no friends or families, and they always spend all the money they earn. They spend their days speculating how they could work less and shirk more to optimize their well-being and follow specific mass-demand curves with their purchases of goods. I did not ever think they were talking about people I know or people like me but apparently they were. Economists also talk about the firm as an inanimate *thing* without its human parts whose decision-making is based on their individual personal and financial incentives. So when the firm decides to "maximize," it is the people within who make that decision. But how do they make a purely maximizing and "firm-regarding" decision if they themselves are a mix of self-regarding and other-regarding individuals? The review of the UG and DG literature probes into areas that hint at some of the possible answers and introduces the reader to this fascinating field with endless opportunities for future research.

Rational Thought vs. Adaptive Mechanisms

Gul and Pesendorfer suggest that evidence coming from neuroscience, the study of how the brain works, "cannot refute economic models because the latter make no assumptions and draw no conclusions about the physiology of the brain" (Faruk Gul, Wolfgang Pesendorfer 2005, page 2). In their opinion, thus, decision-making of an individual, though is conducted by the brain as part of a higher-order processing mechanism, is separate from the mechanisms of how that decision is derived.

Physiology is the study of *all* the biological functions of living organisms. Thus, if economics is the study of exchanges that living people make, then economics is the study of human physiology as it relates to those economic exchanges. The physiology of the brain cannot be disconnected from the functions of the brain any more than the economic exchanges of a person can be disconnected from thinking about those actions with the use of his or her brain. The human brain is the headquarters of human actions; take the brain away and what is left is a human in a vegetative state, incapable of making any economic decisions. With this introduction, let me visit the birth of the conflict in economic thought and why economists play games, such as the UG and the DG.

The Birth of Changes

The Discovery of Adaptive Decision-Making

There is a strong connection between what Charles Darwin and Adam Smith discuss in their books. While Darwin established an evolutionary hierarchy of living creatures, Smith recognized that people are often driven by their predisposition and intense passion that may mislead them in their decision-making. Alain Marciano, 2005, wrote that "the Descent of Man is interesting for it evidences a second but rarely noticed debt towards political economists. In effect, it includes references to Adam Smith's Theory of Moral Sentiments – a book that Darwin actually read – [which] stresses the importance of sympathy" (Alain Marciano, 2005, page 5).

Vernon Smith suggested that one of Adam Smith's works is based on non-cooperative self-interest and the other on other-regarding sympathy and that this conflict is carried forward (Vernon L. Smith 1998b). Undoubtedly, The Theory of Moral Sentiments discusses passions and how preferences are born at length:

> Neither is it those circumstances only, which create pain or sorrow, that call forth our fellow-feeling. Whatever is the passion which arises from any object in the person principally concerned, an analogous emotion springs up, at the thought of his situation, in the breast of every attentive spectator (Adam Smith 1892, page 5)

The above passage is often quoted in literature as the leading "passion" statement of Smith and in the same breath a disclaimer like "oh well, it is in the Moral Sentiments, after all." It is less often discussed that Smith refers to passion in his other book too, which is considered to be the more "rational" book:

> With regard to profusion, the principle which prompts to expence, is the passion for present enjoyment; which, though sometimes violent and very difficult to be restrained, is in general only momentary and occasional (Adam Smith 1909, pages 281-282).

In this passage, Smith clearly indicates that people sometimes spend more than they intend to; e.g. their emotions carry them away from making purely rational economic decisions. Though temporary, nonetheless general *irrationality* exists even for Smith. Perhaps, even more strikingly, Smith points to a phenomenon that is now an often-studied human behavior: humans seem to value more that which they already own than an identical item before they take possession of it (Daniel Kahneman 2003):

> To be deprived of that which we are possessed of, is a greater evil than to be disappointed of what we have only the expectation. Breach of property [rights]… are greater crimes than breach of contract, which only disappoints us of what we expected. (Adam Smith 1909, page 121)

The phenomenon thus described is the *endowment effect*. There is recent scientific evidence that different parts of the brain are responsible for the calculation of loss and gain, which provides possible explanation for Simth's simple laws of this otherwise very complex system; see (Jonathan D. Cohen, Kenneth I. Blum 2002;Paul W. Glimcher 2002;Samual M. McClure *et al.* 2004;Nava Ashraf *et al.* 2005;Scott A. Huettel *et al.* 2006) for additional detail of the endowment effect and loss aversion.

The Search for Rationality through UG and DG

In this part of the review, I examine literature discussing how rationality and emotions are connected in experimental games, such at the UG and DG. I also introduce the reader to my surprise discovery: non-human primates have been playing ultimatum and dictator games—albeit their researchers did not explicitly state such claim. While rationality is considered to be specific to the human primate in economic circles, some non-human primates are capable of grasping the meaning of economic exchanges as well as displaying emotions.

Classical economics stands by its assumptions of "rational thought" because being rational is considered to be a "higher" mental process than making decisions based on emotions and gut-feelings. Ironically,

> there is intriguing evidence that younger children behave more selfishly [rationally], but gradually behave more fair-mindedly [other-regarding] as they grow older, up to age 22 or so… An important exception is that about one third of autistic children and adults offer nothing in the UG (E. Hill, D. Sally 2004); …[they] behave, ironically, in accordance with the canonical model (Joseph Patrick Henrich *et al.* 2005, page 799).

Camerer and Thaler describe fairness as an example of a learnt manner, which is expected in social settings (Colin F. Camerer, Richard H. Thaler 1995) and Murnighan and Saxon found that the notion of fairness and sharing do not appear until past the third grade (J. Murnighan, Keith & Michael S. Saxon 1998). In their experiment, the group of player2 subjects who behaved most like pure income maximizers were kindergartners (J. Keith Murnighan, Michael Scott Saxon 1998). They suggest that the tendency to reject insulting low offers is learned, similarly to how manners are, but do not elaborate on how something that was not specifically experienced by the subjects in their past, could be used as experience for learning in other and unrelated areas. They found that boys took greater strategic advantage of asymmetric information than girls did. Like adults, children accepted smaller offers when they did not know how much was being divided.

“Consistent with this view is evidence from UG, DG, and PGG experiments among children and adults in the United States showing that preferences related to altruism, conditional cooperation, and equity are acquired slowly over the first two decades of life (second graders are pretty selfish)” (Joseph Patrick Henrich *et al.* 2005, page 813).

Classical economic theory follows a paradoxical path: a person is expected to make self-regarding decisions but research shows that as humans grow older, they change from self-regarding persons to become more other-regarding. Thus “rational” decision-making belongs to the young and the uninitiated and the emotionally challenged individuals, such as children and autistic children and adults. Hence, if we stick to the canonical model of human decision-making, we are treating the decision-making ability of children as the norm. In economics terminology, making a self-regarding decision implies that one maximizes one’s own utility regardless of other factors. Given two goods of equal utility, the one with the lower price or higher quantity at the same price would be chosen to be consumed. But this sort of “rationality” is easy to come by in the animal kingdom; offer your dog a choice between a big treat and an otherwise identical but little treat for the same trick of “roll over,” and your dog will decide rationally.

For finding non-human primate emotions and reasoning, let me turn to the experiments of several experts in that field. Brosnan, de Waal, and many others, tested for emotions and reasoning in non-human primates (Frans B. M. de Waal 1997;H Smith *et al.* 1998;Sarah F. Brosnan, Frans B. M. de Waal 2000;Sarah F. Brosnan, Frans B. M. de Waal 2002;Sarah F. Brosnan, Frans B. M. de Waal 2003;Sarah F. Brosnan, Frans B. M. de Waal 2004a;Sarah F. Brosnan, Frans B. M. de Waal 2004b;Sarah F. Brosnan, Frans B. M. de Waal 2004c). In their examination of Capuchin monkeys’ cooperation, Bosnan et al. formulated an experiment that reveals interesting similarity to humans playing the ultimatum and dictator games. They set up pairs of Capuchin monkeys in two cages separated by a small fence and trained them to trade work for food. Two see-through bowls were provided outside these cages. Sometimes they were filled with food for one Capuchin, sometimes for the other one, or for both. They attached weights to the levers so that *cooperative* pull was necessary; e.g., if the bowl for one Capuchin was empty but the bowl was filled for the other, the one with empty bowl had to help pull, else *neither* of them got any food—this is a similar composition to the UG. Not helping to pull is rejection. In particular, Brosnan and de Waal found that Capuchins were found to help pull more often in the cooperation trials if in the previous trial cooperation was achieved. In other words, experience with the playmate from previous social interactions helped in the decision-making if this Capuchin was worthy of a helping pull to give her food—the expectation of reciprocity appears strong in non-human primates. Further, 9 out of 10 trials were successful and resulted in food transfer and subsequent willingness to pull (Brosnan and de Waal, 2000, page 563). Thus the Capuchins appear to be reciprocating *tit-for-tat* style.

Brosnan and de Waal found the success rate of Capuchins' acceptance of having to give a helping hand to be 39% (Sarah F. Brosnan, Frans B. M. de Waal 2000), which is somewhat lower than the acceptance rate of humans in UG (apparently between 40%-70% in the literature, dependent upon the society), but the cooperation was definitely not zero. In the same experiment, Brosnan and de Waal found that Capuchins share their food in what they called "facilitated taking," in which when only one Capuchin received food from the cooperative pull, she moved close to the separating fence, let food pieces fall to the floor, and allowed the other Capuchin to reach over and take it through the fence. This I find similar to the dictator game, in which one person receives all the money (food in the case of the Capuchin) and may decide to share some with someone in the room (this means *giving* in DG and *allowing to take* in Capuchin experiments). Note, however, that in the case of the Capuchins, each participating female knew each other whereas the experiments with humans are usually blind and multi-gender.

Observing the literature on primate experiments and the contradiction of the two-faced human in Adam Smith's work, Vernon Smith suggested that people have both cooperative and non-cooperative skills and they use them according to the appropriate occasions (Vernon L. Smith 1998b). Humans use non-cooperative (self-regarding) methods when dealing in the impersonal markets, while they use the more cooperative (other-regarding) means when dealing with family, friends, and neighbors. It is interesting to note however, that while Vernon Smith appears intuitively completely correct, his suggestions implies a continuum between self-regarding and other-regarding behavior, which then begs the question for the location of a tipping point. Between the non-cooperative markets and the cooperative friends and family are layers of in-between-persons, such as "best friend," "good friend," "an acquaintance," "the teacher of my kid," etc. This point is further elaborated in my concluding thoughts section.

Having discussed alternate views of how human and non-human primates play economic games, I showed that the distinction between acting rationally (from economic sense) and acting other-regardingly is in a continuum. What is also true is that what might be rational in one situation might be utterly irrational in another, and vice versa. I also showed that purely rational behavior is frequently punished and thus often times, to be rational is to *balance* rather than maximize utility; a contradiction, and which implies that no unique solution may exist. In the next sections, I show that a rational actor may choose to pretend to be irrational in order to achieve a goal that is rational, complicating our deciphering what our experiment-subject actually really think when they make their decision.

Reciprocity – The Nice Guys

Adam Smith's sentences about emotional decision-making have been increasing in importance over the years. However, in the classical theories the environment and human behavior were simplified and reduced to minimal interactions between imaginary agents that traded goods. *Ceteris paribus* was evoked to become the most commonly used phrase. The transition started with Dawkins, Axelrod, and Güth in the mid to late 70's.

Richard Dawkins titled chapter 12 of his book "Nice Guys Finish First," (Richard Dawkins 1976, 1999 edition) which was his translation of the turn of events brought to light by Robert Axelrod in three competitions for a Prisoners Dilemma (PD) game solution (Robert Axelrod, William D. Hamilton 1981;Robert Axelrod, Douglas Dion 1988). The winner in the first two competitions would be the "computer character" solution with the most points earned. The PD game is simple; two computer characters receive two cards: "cooperate" and "defect." Four combinations exist: either both cooperate, both defect, or one cooperates and the other defects with an asymmetrical payoff structure. Dawkins discusses this game from an evolutionary perspective. He started his chapter by quoting American biologist Garrett Hardin saying "nice guys finish last" to emphasize what may have been called "selfish genery," that is befit to be a member of the classical economics theory of self-regarding rational actors. In Darwinian sense, “a nice guy is an individual that assists other members of its species, at its own expense, to pass their genes on to the next generation. Nice guys, then, seem bound to decrease in numbers: niceness dies a Darwinian death” (Dawkins, page 10). The classical economic theory’s self-regarding maximizing individuals thus suit the Darwinian evolutionary image well. But in Axelrod’s competition, the “nice guy” did finish first.

Dawkins brings up an example for what this “nice guy” could mean in positive evolutionary terms (in contrast of the “Darwinian death” as mentioned earlier), which conceptualizes what is to have become the ultimatum game. He introduces *Grudgers*, a group within a type of bird, that helped each other in an altruistic way, but

> refused to help—bore a grudge against—individuals that had previously refused to help them. Grudgers came to dominate the population because they passed on more genes to future generations than either Suckers (who helped others indiscriminately, and were exploited) or Cheats (who tried to exploit everybody and ended up doing each other down). The story of Grudgers illustrates an important general principle, which Robert Trivers called ‘reciprocal altruism’ (Dawkins, page 202).

Reciprocal altruism is often discussed in economics but has been assumed to only be advantageous within kin groups; hence it was troubling to think that people acted altruistically in UG with non-kin. However, the *Grudgers* tell us a different story about altruism; they tell us that the *Grudgers* ended up dominating the population. What this means is that behaving altruistically, in appropriate moderation, can change the population from cheaters and defeaters into cooperators in a few generations. This leads us to important conclusions. Camerer et al. (Colin F. Camerer, Ernst Fehr 2006) and Fehr et al. (Ernst Fehr *et al.* 2000a) introduce us to their concepts that are akin to this population domination by the “nice guys.” These concepts suggest that individuals with sharing motive can turn individuals with non-sharing motive into sharing types. The tools are the proper identifications and use of "strategic complements" and "strategic substitutes," albeit with one caveat: in Camerer et al., the transformation is strategic and temporary, whereas in the *Grudgers*, it becomes genetic and permanent, pending genetic mutations on the long run. At this point little can be said about possible methods of changing an entire population generation toward becoming more sharing types, particularly if we use our abilities to put on a new face as the environment necessitates it. Changing to become other-regarding, in the case of strategic complementarity, is not only temporary but also a "fake." This should present a serious problem in our understanding of human behavior because we cannot know for sure when the subjects play genuine and when opportunistic or fake.

Axelrod did not get this deep into the analysis of human nature; instead, he decided to find if the "nice guy" population was a stable one. Axelrod and Dion added a third competition, which they did not advertise, but its details are discussed by Dawkins in his 1999 edition updates (Richard Dawkins 1976;Robert Axelrod, Douglas Dion 1988). In it, they ran all 63 computer programs from the second competition in *evolutionary iterations*, in which the winners of the first generation were the offspring that then continued into the second generation, and so forth. The winner was the one that was able to maintain an Evolutionary Stable Strategy (ESS). In 1,000 generations, Tit-for-Tat still won; however, Dawkins put a cautionary note on the ESS of this system. Had the 63 competing strategies not been nearly 50-50 split between "nice" and "nasty" guys, the end result might have been different. If the majority of the 63 were made up of the "nasty" guys that always defected, Tit-for-Tat would not have become the winner once the evolutionary clock was ticking; Darwinian evolution is, after all, a numbers game rather than a game of individual utility. A large share of strong reciprocators in the population can be part of an evolutionarily stable situation (Robert. Boyd *et al.* 2003;R. Sethi, E. Somanathan 2003;Samuel Bowles, Herbert Gintis 2006).

Both the Ultimatum and Dictator Games are games of cooperation or defection with added tricks and options that appeal to the individual's sense of utility. It is important to note that each individual playing these games in the experimental laboratories represents his or her personal attitude toward these games but the evaluation of the experimenters is on the *aggregate* level, representing the society as a whole. Looking at it from this perspective, the evolutionary connection is obvious. Some of the questions I would like to ask are as follows: What are the modifiable elements that change the behavior of the people? What provides ESS: sharing or selfishness? What are the underlying biological functions that drive us toward or away from an ESS? Can we modify these biological functions to modify the ESS?

As we have seen, decision-making neither happens in a vacuum nor can we say that decision-making by one person is sufficient for analysis. To see what is "left out" of decision-making in classical economics, it is helpful to look at what it takes to program economic decision-making into computers that mimic human decision-making in a risky environment. When Axelrod set up the model for the evolution of human cooperation, he listed several requirements for the simulation steps, of which two are described here: (1) *specification of an environment* in which the PD can be operated, and (2) specification of the genetics, including the way in which information on the emulated chromosome is translated into a strategy for the simulated individual (Robert Axelrod 1981). Axelrod wanted to develop a PD game that was based on survival mechanisms, not unlike that of

Dawkins' theories on the gene (Richard Dawkins 1976). This ignited the imagination of many.

Axelrod wrote:

> Before about 1960, accounts of the evolutionary process largely dismissed cooperative phenomena as not requiring special attention. This position followed from a misreading of theory that assigned most adaptation to selection at the level of populations or whole species. As a result of such misreading, cooperation was always considered adaptive… The original individualistic emphasis of Darwin's theory is more valid (Axelrod, 1981, page 1390).

Axelrod also showed that increasing the number of players increases the difficulty of maintaining cooperation, and that having one player defect after a number of cooperating periods increases the likelihood of the population reaching a certain threshold at which defection dominates.

The Games Are Born

The UG was introduced in 1963, (L. E. Fouraker, S. Siegel 1963), and first used as part of an economic experiment by Güth *et al.* to "analyse in detail certain aspects of bargaining behavior" (Werner Güth *et al.* 1982, page 368). Güth and his team described that by game theory, the UG is considered to be a game of one person on each end; each person is playing a game alone. But this assessment is incorrect. Güth continued to say that "all that player *i* has to do is to make a choice which is good for himself" (*ibid*, page 368), and the same for player *j.* However, if player *i* chooses his best maximizing solution and passes little or nothing to player *j*, in the UG player *j* has veto rights. If *j* is unsatisfied with the share of the pie, he can reject the deal, thereby cancelling the deal for player *i* as well; they both end up empty handed. Thus this is really not a game where the two players are playing independent from one another.

Güth ran three experiments to test his theory. He designed an easy and a complex way to play the game and found that the players gave more money to the stranger than would have been optimal. Even more surprisingly, the receiving players used their veto rights even when some money was given to them. In the third experiment, players played both roles, the role of the sender and the receiver. Güth compared the amount of what each player would maximally have offered as player 1 and what they would minimally have accepted as player 2. The inconsistency, Güth thought, was attributed to the players' knowledge that they will play both roles. "Knowing to be player1 in one game and player2 in another game, might have caused some subjects to care for a fair bargaining result" (380). Note the use of the term "fair," pointing out that human emotion are, indeed, used in economic exchanges.

Mistaken Concepts

With Axelrod and Güth's publications showing that something other than rational choice was driving economic decision-making in the laboratory, many experiments commenced; some with mistaken concepts that gave confused results or were based on unsound theoretical principles. Binmore et al. set out to test the rationality of the players in one-shot UG. They designed the experiment such that each person played both player1 and player2 roles against the same individual (K. Binmore *et al.* 1985). What they found was identical to what Güth et al found in 1982. Binmore's team believed that their results implied that the game was played more "rationally" than expected and warned about the validity of the results of the one-shot games. However, what they played were really not one-shot games but sequentially repeated games with learning effects. Neelin et al., in repeating Binmore's experiment with three-shot games, found that the results of the two-shot games did not hold in three-shot games, showing that it might be too soon to jump into conclusion about any-shot games (Janet Neelin *et al.* 1988).

Some experiments that claimed to *test* rational decision-making placed the experiment itself on the basis of the thenceforth assumed agent-rationality, and set out to look for the very thing it assumed. A classic example of this is Rubistein's UG experiment in 1982 (Ariel Rubistein 1982). This experiment he called an "ultimatum-type" game between two players. In the first step, player1 proposes and if player2 accepts, the game is over. If player2 does not accept, player2 may make an offer and the game goes on for *several rounds*, until player2 accepts. The assumption is that "both parties 'behave rationally' and that all the axioms of expected utility theory are met." Another critical assumption is that all players have complete information about the preferences of the others. But in lab experiments (as in real markets), subjects don't know whom they play against and so preferences of the other players are not known. Further, the game he set up was a sequential *centipede* game with full knowledge at each nod of the opponent's step. Thaler critiqued by writing

> that Rubinstein (1982) … is only theorizing about what will happen in a bargaining situation if both parties behave rationally… First, allocators should make offers approaching zero. Second, recipients should accept all positive offers. The data are inconsistent with both … When a Recipient declines a positive offer, he signals that his utility function has non-monetary arguments (Richard H. Thaler 1988) (197).

Gneezy et al., 2003, had a very similar experiment to Rubistein, 1982. They experimented with what they called a "reverse ultimatum game" (Uri Gneezy et al.

2003). They hypothesized that the addition of a deadline would shift the subgame perfect equilibrium prediction from one extreme to the other in terms of which bargainer is predicted to gain all but a fraction of the available wealth. In their game, if player2 rejected the offer, *player1 was allowed to make another offer*. If player1 chose to end the game instead, both players received 0 tokens. They called the game a "reverse" ultimatum game because it was player1 doing the bargaining until player2 accepted. However, similarly to Rubinstein's mistaken concepts in 1982, Gneezy et al. also applied a centipede game, in which update was actual rather than Bayesian; each player received specific answer rather than a risky social cue.

Hoffman and Spitzer, while testing the Coase Theorem in two- and three-person bargains, ended up drawing a conclusion for one-shot games, like UG and DG (Elizabeth Hoffman, Matthew L. Spitzer 1982). Their results suggested that while parties engaged in repeated negotiations may split profits equally, in single-shot negotiations they are more likely to choose "individually rational" divisions. Their experiment did not allow freedom of decision of each individual; had complex rules, and there was this ever-present arbitrator to implement some decision.

Harrison suggested that the reason why player2's reject offers is that the opportunity cost of 'misbehavior' in these experiments is small and thus the anomalies may not be anomalies at all but reflect a "theoretically consistent behavior under conditions where misbehavior is virtually costless"(Glenn W. Harrison 1992, page 1426). However, so long as the stakes are small for both gain and loss, if the players find any kind of behavior costless, then I would think that the reverse is also true: there cannot be any benefits to being upset about not receiving enough share of the pie. The showing of “feeling insulted” by rejecting the offer, however small it may be, should become too costly to bother with; it would be cheaper to just “accept”!

Dickinson suggested that bargainers take advantage of information asymmetries (David L. Dickinson 2000). He hypothesized that as the size of the pie gets arbitrarily large, player2 will be less likely to reject a smaller offer since the monetary penalty for doing so grows increasingly large. He set up an experiment to test information asymmetry in action and the kindness theory. He did so by changing the size of the available stash and by telling only player1what player2 did in the previous round. Player1s were informed on “a piece of paper what [player2] was offered, what the pie size was, and they were also told whether or not [player2] accepted or rejected the offer” (David L. Dickinson 2000). In my view, in this experiment player1’s offer was not a response for the changing size of the pie but for the previous response of player2; Dickinson removed ambiguity and placed a known probability distribution in its place.

Eckel and Grossman recruited two groups of players: volunteer subjects in the usual way and pseudo-volunteer subjects (class-time students), all participating in a DG experiment with a *charity* as the recipient (Catherine C. Eckel, Philip J. Grossman 2000). Although the experiment was meant to test for social signal differences between volunteers and pseudo-volunteers in the typical economic exchange scenario using DG, the unintended interference was provided by a charity and by the pseudo-volunteers’ knowledge that they are sitting in their classroom in front of their professors’ chosen charity; the risk here was represented by the students’ fear of their grades being affected by their decision. Hence because there is no risk or ambiguity involved in offering a donation to a charity, no applicable social signal was exchanged, only personal preference, and because the professor's image was hovering in the pseudo-volunteers mind when making their decisions, they showed skewed preference toward "sharing". Eckel and Grossman thus found that volunteer subjects were significantly more likely to offer zero to the charity than pseudo-volunteers and that almost 29% of the pseudo-volunteer gave *everything* to the charity, while only 5% of the true volunteers did.

Even as late as 2005, we still find erroneous experiments and complete misunderstandings about human nature and human behavior in economic games. For example, Bradsley noted that people don't seem to make anonymous donations to strangers and decided to set up an experiment to test whether dictator games truly measure social preferences or if they measure something else (Nicholas Bardsley 2005). He hypothesized that if giving money was equivalent to taking it away, then the game reflected true social preference. His DG had two parts: treatment 1 (giving phase) and treatment 2 (taking phase). He measured the difference between what players offered to give and what players took. Players could take whatever they wanted, *including the show-up fee* earned by the opposing players. Hence, what Bradsley actually tested was not social preference but the level of endowment-effects in the particular subject-pool of his lab. Endowment-effect is the result of people valuing more what they already own than what they just have the opportunity to gain—something that was referred to by Adam Smith as well in his Moral Sentiments. Sanfey et al. showed in 2003 using functional Magnetic resonance Imaging (fMRI) that *giving* and *taking* uses different parts of the brain (A. G. Sanfey *et al.* 2003). Giving is an altruistic act while taking is a punishing act. Different circuitry is used in the brain to evaluate the two different actions.

As a result, the two cannot be described as different manifestations of the same action. Thus showing them as equal does not represent social preference in any way.

My final “miss-experiment” example is Rustichini, who suggests that

> the task of an economist is to establish useful predictions on which human behavior will follow given certain incentives, preferences, and feasibility constraints. This set of parameter, that is available to the economist analyzing the situation, defines the input, and the behavior is the output (Aldo Rustichini 2005, page 203).

I believe that Rustichini is missing the most important element in his definition of the variables and the output. Where is the giant human processing machine, the brain? Rustichini suggests that inputs are given by external conditions (incentives and constraints) and internal ones (preferences) that combined provide the variables for processing, of which the *output* becomes the human *behavior*. Put differently, if Rustichini’s comments were true, similarly to any factory machinery or computer used as processors, so long as the inputs are the same, one would predictably always get the same output. This suggests that the *processor* does not add additional input variables.

However, each person has a very unique processor sitting atop his or her neck and each of these processors provides additional inputs into the model based on a mixture of physiological constraints. In fact, this is precisely what laboratory experiments with economic games are trying to capture. The researchers provide the same instructions and the same money to each participant—thus the controllable external variables are the same. Not only do experimenters want to see the end result (the outcome) of how much money is exchanging hands, but the behavioral constraints as well by analyzing blood hormonal levels or imaging the brain at the time of decision-making or adding peptides to analyze how modified behavior of the individual (in terms of neural mechanisms) affects how much money is exchanging hands; behavior modifies the output. If the brain did not add addition inputs, what would the point be for adding peptides to modify the outcome? Yet adding peptides does modify the outcome! See a great study about nasally administering Oxitocin (a peptide) into human subjects and what that does to their behavior in terms of modifying the output they offer (Michael Kosfeld *et al.* 2005).

Great Experiments

There have been some truly ingenious experiments too as well as there were lots of oppositions to the games and experimenting techniques. Vernon Smith suggested that "subjects experience the choices of others and then choose based on what they have learned to accept" (Vernon L. Smith 1998b, page 110). Smith argued that the experimental procedures themselves constitute an unintended treatment that contaminates the interpretation of the results. He further suggested that

> the idea that one should randomize effects that are not controlled comes from biology, where you randomize treatments among plots of land to prevent differences in soil quality from being attributed accidentally to the treatments. But human subjects are not plots of land, and the method of assignment may not have a neutral effect on behavior… results call into question the interpretation of data from the large literature in bilateral bargaining that is characterized by a first-mover, or other asymmetric advantage, randomly assigned… the question is whether inducing fair behavior is the appropriate way to frame the test of a bargaining theory that assumes self-interested agents whose interests conflict, as with management and labor. Now, if one were to replicate all the asymmetric bargaining experiments, assigning privileged rights only to those who earned them, and still observe fair outcomes, then this would call into question the relevance of the theory" (Vernon L. Smith 1998a, pages 112-113).

Schotter et al. designed the experiment to test what Smith asked for: mimic a "true" market under survival pressures and see if agents still defy the theory (Andrew

Schotter *et al.* 1996). His team introduced property rights in two-stage-survival ultimatum and dictator games, in which proposers were competing with each other in offering higher amounts to the same one responder. Whoever was able to have his offer accepted, entered stage two as "property right owner." As property owners, the money they kept for themselves in the second game (second stage) was higher; "demand behavior changes substantially as we move from the one-stage to the two-stage experiments" and player2s rejected less often the smaller amounts offered in the second stage (Schotter et al., 1996, page 44). However, offers were still significantly higher than zero and considered to be fair by player2, thereby showing that, indeed, the relevance of the theory is called into question.

When faced with market-like conditions, such as anonymous interactions, people behave like self-interested, outcome-oriented actors. They use informal heuristics and socially acquired rules and norms to choose among risky alternatives. The *Homo economicus* model assumes that people react to the absolute level of payoffs, whereas in fact they tend to privilege the status quo and are sensitive to changes from it (Herbert Gintis 2000). By contrast, Bolton et al. suggests that dictators determine how much they will give on the basis of the total money available for the entire experimental session, rather than on the basis of what is available per game (Gary E. Bolton *et al.* 1998).

To address the first-mover-advantage question, Weber et al. set up an experiment to see if first movers would demand different dollar amount from when the same players moved second (Roberto A Weber *et al.* 2004). They found that minimal acceptable offers of the responders became lower when they knew that they were going to move second, and were higher when they knew that they were first-movers. They suggested that the timing result points to an interpretation on fairness that is incomplete. If only distaste for unfairness drives the response of player2, their minimum acceptable offer amount should not change based on the knowledge of who moves first. Within the fairness framework, the answer they suggest is that a low offer appears to be fairer when a person is player1 and moves first than when that same player is player2 and moves second. But this answer suggests that fairness means "fair exercise of advantage" (Weber, page 40).

Kahneman et al. wanted to get a better understanding of how consumers react to the model of profit-seeking firms by considering the newly discovered preferences that people have for being treated fairly (Daniel Kahneman *et al.* 1986). They concluded that firms have an incentive "to act in a manner that is perceived as fair if the individuals with whom they deal are willing to resist unfair transactions and punish unfair firms at some cost to themselves." From the UG and DG experiment results to that date, they assessed that firms might face the danger of rejection by consumers who choose to use their punishing power against business practices they did not find fair. They set up an experiment in which two individuals played the DG. The dictator was called "fair," if he offered half of the play-money or "unfair" if he took more than half. A third individual then had to choose with whom she would split a certain dollar amount. Would she split a larger amount with an unfair player or a smaller amount with a fair player? The majority of the third players chose to split the smaller stash in order to share with the fair player, albeit at a cost to themselves.

Aumann suggested that even though we now know that people reject in UG because they are insulted, the models still consider this insult exogenous (Robert J. Aumann 1986b). He recalled Axelrod et al.'s experiment with the PD game and how it is usually “a crazy type, that wins out – takes over the game, so to speak… there is only one crazy type, who always plays tit-for-tat, no matter what the other player does; and it turns out that the rational type must imitate the crazy type, he must also play tit-for-tat.” Of course, Axelrod’s team already had a theory why crazy types win, as discussed earlier; see Axelrod (Robert Axelrod, William D. Hamilton 1981;Robert Axelrod 1981;Robert Axelrod, Douglas Dion 1988). New theories have since emerged providing different theories about who these “crazy types” are and why they win. Fehr and Tyran (Ernst Fehr, Jean-Robert Tyran 2005), and Camerer and Fehr (Colin F. Camerer, Ernst Fehr 2006) suggest that under “strategic complementarity,” (easily explained as “I do as you do”) a “small amount of individual irrationality may lead to large deviations from aggregate predictions of rational models, whereas [under strategic substitutability,] a minority of rational agents may suffice to generate aggregate outcomes consistent with the predictions of rational models” (easily explained as “if you go right I go left”). Strong reciprocators reward and punish at cost to themselves.

The process of why Aumann’s “crazy types” win is detailed by Camerer and Fehr as follows: what happens if a strong reciprocator faces a self-regarding player and both players know each other’s preferences? [Note: there is a bit of a problem here with “knowing” the other person’s preferences but I will let it go at this time for the sake of making Camerer’s and Fehr’s point]. In a simultaneous game, the existence of the selfregarding player will induce the reciprocator to behave noncooperatively as well. If the exchange is structured sequentially, however, with the selfregarding player stepping first, an exchange will take place because the selfregarding player knows that the reciprocating player will only send his good in response to a reasonable offer (Colin F.Camerer, Ernst Fehr 2006, page 47).

I would like to return to my note about knowing the preferences of others above in Camerer's and Fehr's explanation. Obviously they placed the framework of the "old" *Homo economicus* model as grounds for explaining a phenomenon that otherwise has no known answer for the time being—unless you strongly believe that telepathy exists for anyone under any circumstance. Assume for a moment that you, the reader of this article, and I are suddenly find ourselves engaged in playing a game of DG or UG. Would I, under any circumstances, know your preferences without actually knowing you? Would you know mine? Certainly, I may postulate that given that you are reading my article, you and I share at least one thing in common: we both know what this article is about. This may allow us to form beliefs about one another's expectation but those are just *beliefs* and *not* actual knowledge of preferences.

The mere belief that there are reciprocators may generate incentives to cooperate among self-regarding players. However, when competition is introduced, offers and rejection rates converge to very low levels. Although strong reciprocal players still would prefer to punish unfair behavior, the competition undermines this effort; the "buyer" will just shop elsewhere and will reject all offers but the lowest one. Ironically, rational agents mimicking the behavior of other-regarding agents can be construed as an economically and strategically rational and self-regarding action that is consistent with the classical economic models, because in UG, reciprocators punish openly self-regarding behavior. To maximize, a rational player must *pretend* to also be a reciprocator to prevent punishment and induce reward—hence Aumann's crazy-type-acting but otherwise rational players evolve.

Selten, noting that people were not consistent in their decision-making suggested that population fitness maximization must be the force behind this as he explained preferences in terms of evolution (Reinhard Selten 1989). "Cultural traits like values, ambitions, and lifestyles influence economic behavior and thereby economic conditions (see on this subject (Paul J. Zak, Stephen Knack 2001)). Economic conditions exert selective pressure on the cultural traits" (Selten, page 90). "Mechanisms of cultural evolution are shaped by biological evolution and competitive processes involve learning and imitation" (Selten 1989, page 101). Thus Selten also noticed the mimicking behavior necessary for successful societies.

Aumann questioned why the "insult" player2 feels when player1 offers too little money in the UG is treated external to the game if the insult "arose from the situation." He suggested to come up with a new game theoretical way to describe this endogenous behavior (Robert J. Aumann 1986a). One such endogenous model was formulated in 2003 by Bowles and Gintis, in which they used variables such as reciprocity, shame, unconditional altruism and punishment, and it was played out in a Public Goods Game (PGG) (Samuel Bowles, Herbert Gintis 2003). A PGG is somewhat different from UG and DG in that players are asked to contribute a share form their play-money into a common pool, which then grows in value by some multiplier before it gets to be divided amongst all the members—including in the distribution those who did not contribute.

Thaler tested if rationality would take over if the players had a chance to think about the game and also if raising the stakes did any good to save the *Homo economicus* model, but neither result supported the rationality theory (Richard H. Thaler 1988). He also found no evidence of any learning effects, similar to Bell and team (David Bell *et al.* 1988). Learning effects form expectation and adaptation in brain cells. For example, drug addiction is a form of learning effect, called "incentive learning," where if the neurons' expectation of upcoming drug is not met, withdrawal follows. During "withdrawal, rats with previous experience of heroin in withdrawal initiated drug-seeking with a shorter latency, and showed more completed cycles of drug-seeking compared to either saline controls or control groups without experience" (D. M. Hutcheson *et al.* 2001, page 944). Thus learning effects modify behavior and in many lab experiments with humans, such learning effects may be substantial.

The question of whether *fairness* drives the unexpected human behavior in UG was asked by many. *Fairness* is defined as sacrificing self-gains "to change the distribution of material outcomes among others, sometimes rewarding those who act prosocially and punishing those who do not" (Joseph Patrick Henrich *et al.* 2005, page 797). Forsythe et al. tested if the fairness hypothesis can explain the result of Güth's experiment (Robert Forsythe *et al.* 1994a;Robert Forsythe *et al.* 1994b). They hypothesized that if the results of the UG and the DG are the same, fairness is the explanation. However, they did not find this to be the case and concluded that fairness must only be one factor that determines the money offered by player1 in UG. Nowak *et al*. developed an evolutionary approach to the UG (M. A. Nowak *et al.* 2000). They suggested that fairness will evolve if player1 can obtain some information on what deals player2 has accepted in the past, similarly to the hypothesis of Dickinson (David L. Dickinson 2000). They believed that the evolution of fairness, similarly to the evolution of cooperation, is linked to *reputation* and is driven by a mechanism that is similar to genetic evolutionary forces. Like Dawkins' *Grudgers,* future generations of individuals leave their offspring in proportion to their "total payoff," which in this case is "success rate," and each new generation only deals with those who have been accepted by player2s in previous encounters. This process can readily lead to the evolution of fairness.

Saad and Gill (Gad Saad, Tripat Gill 2001) and Eckel and Grossman (Catherine C. Eckel, Philip J. Grossman 1996) found that female allocators were more concerned about fairness when making offers than males, while males made more generous offers when pitted against a female than a male. White females made equal offers independently of the sex of the recipient. They suggested an evolutionary explanation to fairness, similarly to Saad and Gill: "male allocators are altruistic towards female recipients and competitive with male recipients is construed as a manifestation of social rules, which evolve from the male predisposition to use resources for attracting mates" (Saad and Gill, 2001, page 171).

Takahashi observed that there was a negative correlation between interpersonal trust and social stress-induced cortisol elevation in player2's in UG under stress, indicating that subjects with high levels of interpersonal trust showed reduced social stress (Taiki Takahashi 2005). "Collectively, interpersonal trust might possibly enhance social cooperation via better social memory due to lowered acute social stress actions during a face-to-face social interaction, which would result in high levels of an economic growth" (Taiki Takahashi 2005, page 4). Boles and Messick found that if actual dollar bills were laid in front of player2s, the offers were accepted more frequently (T. M. Boles, D. M. Messick 1990).

Henrich and team found in their experiments in 15 small-scale societies that there were distinct group-differences in notions of fairness (Joseph Patrick Henrich *et al.* 2005). They also found that the level of market integration of a society influences differences in notions of fairness and punishment. While among university subjects it is generally thought that UG offers are fairly consistent with expected income-maximizing strategies, Henrich et al.'s results suggest that this is not the case in several of the societies they studied (page 803). They found that few or none of the subjects in these small-scale societies offered zero in UG, whereas the modal offer among university students is typically zero (page 805). They further wrote that "cultural evolution and its products have undoubtedly influenced the human genotype… The relationship between culture-gene coevolutionary theory and the preferences, beliefs, and constraints approach is straightforward, although rarely illuminated" (Henrich, page 812).

By contrast, Haselhuhn and Mellers found that the *impression* of fairness is sufficient to induce acceptance and cooperation (Michael P. Haselhuhn, Barbara A. Mellers 2005). DG, by its nature, removes incentives for strategic behavior. The assumption is that if players still act fairly in DGs, they must have a taste for fairness, which was introduced earlier as sacrificing self-gains in order to change the distribution of material outcomes among others to benefit those who act prosocially and punish those who do not. Haselhuhn and Mellers modified the UG and DG such that player1s were also asked to imagine the pleasure they would feel with each possible payoff—payments were paid according to the actual games and not based on the imagined possible payoffs. They were told to rank-order their preferences over all possible offers, and to draw inferences about the emotions player2 might feel. Their statistics shows that 25% of player1s thought they did not derive pleasure from fairness, 65% some pleasure, and 10% significant pleasure (Haselhuhn, page 28). They also found that preference-orders differed from pleasure-orders. Most player1s made fair offers in the UG, but cooperation appeared to be strategic rather than emotional. However, there were 10% of player1s who derived greater pleasure from fair payoffs than from larger payoffs (Haselhuhn, page 29). In the DG, 55% of dictators derived no pleasure from fairness, and 15% felt significant pleasure from fairness. Those dictators who received pleasure from fairness, tended to make fair offers even when they had no strategic reason to do so.

Kagel et al. also set up an UG experiment to test if the *impression* of fairness is enough. In their experiment, only player1 knew that the chips (used as currency) that player1 kept were worth 30 cents but whatever was passed on to player2 was worth only 10 cents each to player2. Here an equal division of money would require an asymmetric split of 75 percent of the chips to player2 and 25% to player1 (John H. Kagel *et al.* 1996). However, what they found was that if only player1s knew the value asymmetry of the chips, they typically offered 50% of the number of chips, seeming fair in the process to player2s but being self-regarding in actuality.

Camerer and Thaler suggest that when playing the UG, player1s act fair-minded because they fear having their offers rejected. There seems to be

> an asymmetric attitude toward fairness in which relative comparison matters a lot when I feel unfairly treated, but matters very little when I feel fairly treated…. People are punishing unfairness, not rejecting inequality… In the ultimatum game, the Responder [player2] is primarily reacting to the manners of the first player, [which] incorporates etiquette into economics (Camerer, Thahler, page 214-216).

I think that a better explanation is in order for what this fear of rejection means in UGs, than the analysis that Camerer and Thaler provided. I do not hear the behavioral view coming through loud enough in their explanation, particularly when it appears that they are explaining the behavior of the players by the behavior itself. Let me elaborate what I mean. They suggest that player1 acts fair-minded because she fears rejection and that comparison matters a lot when she feels unfairly treated, but matters very little when she feels fairly treated. But the argument forgets that no player ever knows what the other player knows with respect to the *intent* of the other player. Thus comparisons of what a player might do are based on beliefs—unless a player is explicitly given information by the experimenter about the other player, as was the case in Dickinson's experiment, in which he explicitly told one player what the other player did in the previous games (David L. Dickinson 2000). Thus the fear of rejection based on this ambiguity should itself be the point of examination rather than the explanation.

Blythe et al. set up an interesting experiment that shows just how such social cues may enter into comprehension without the players' knowledge (Philip W. Blythe *et al.* 1999). Their goal was the opposite of what one may expect; they wanted to see if complex social cues can tell the story about the *intentions* of the individuals while playing certain games. The games were played by volunteers on the computer with imaginary little creatures. On screen two bugs: one blue and the other red. Each player played 6 types of games: red bug *plays* with blue bug, red bug *courts* blue bug, blue bug acts *being courted*, blue bug *courts* red bug and red acts *courted*, red bug *pursues* blue bug who is trying to *evade*, the same with bug color change, and lastly the two bugs are *fighting*. In each of these games, the human volunteer controlling the specific bug is given a list of “to do’s” but otherwise “acts out” the feeling according to his or her best interpretation of what “courting” or “fighting” means. For example, to court, the bug “owner” volunteer was told to move the bug to court the other bug by interacting with it in any way that he might find it interesting, exciting, or enticing. The owner of the courted bug was instructed to move the bug to show interest or disinterest, and to elicit further displays in any way desired (Blythe *et al.* 1999, page 266).

Since the bugs were computer images, their movements could easily be digitized and recorded on a time-series model 3D graph. Blythe *et al.* averaged the motion images of the many trials and displayed the aggregate image of the six motion types. Next they invited new volunteers who were not familiar with the game and replayed in front of them only the time-correct motion graphs (no bugs were seen). The job of the volunteers was to identify which type of the six the particular bug-aggregate-motions they were looking at. The uninitiated were able to predict the motion-intents of the bug on the screen with about 50% accuracy, based on the graphs alone—random guessing is expected to be correct 18% of the time, so 50% is well above randomness. When Blyth’s team removed one of the two bugs and showed, again, to uninitiated players, but this time the bug-aggregate-motions of only one of the two bugs, the recognition of the motion was reduced to approximately 30% but still above guessing levels.

What this experiment clearly demonstrates is that social cues “in the air” can continuously reaffirm or modify a person’s belief in the type of environment. In the laboratory, there is plenty of opportunity for receiving such social cues. One of them, I already mentioned, is that the volunteers come from the same institution. Another is that as they come for the experiments, they line up to provide their student identifications;

sometimes the line is long and there is ample opportunity to look and feel who is in the crowd. Although once the UG or DG starts in the lab, the volunteers do not know specifically whom they play against or with, they certainly know the "average makeup" of the people in the room. They might be able to, thus, estimate if they are in an environment where acting according to the rules of strategic complementarity or strategic substitutability would offer the highest payoff.

Reciprocity can be based on experience from the past by having repeated interaction but they can "also be based on the knowledge that the members of the interacting group are 'alike'" (Ernst Fehr, Bettina Rockenbach 2004). In an experiment by Gachter and Thoni, subjects were ranked with respect to their contribution in a one-shot PG game and then sorted into groups of individuals with similar ranks (S. Gachter, C. Thoni 2005). Cooperation in the "alike" groups of like-minded people was found to be significantly higher than in random group composition—supporting significantly that lab environment, which is made up of individuals that are members of an "alike" group, might provide economic choices that reflect the norms of that "in group."

Hoffman et al. conducted several interesting experiments testing fairness. In their 1996 experiment, using DG, they tested the theory that framing might have a lot to do with the appearance of fairness in the game (Elizabeth Hoffman *et al.* 1996). In most experiments until this one, the experiments were conducted under observation, rather than blindly from everyone, including the experimenters. This experiment was conducted double-blind and they requested that the dictators place their offer to the recipient into an envelope, place the envelope in a box, from which the experimenters took them, counted the money and passed them on to the recipients. They found that "there was a pronounced tendency for those leaving no money to seal their envelope, and for those leaving positive amounts of money to not seal their envelopes." They concluded that "other-regarding behavior is not a universal but varies with context depending upon opportunity costs" (Hoffman, 1996, 654). With respect to framing, they suggested that subjects bring their ongoing experience of the world with them into the laboratory, and the instructional language used can associate a subject's decision with past experience. For example, "suggesting that the task is to 'divide' the $10 may imply that the objective is to *share* the money with someone, who, though anonymous, is socially relatively near to the decision-maker" (Hoffman, 1996, page 655). Bolton et al. agrees with Hoffman et al., suggesting that in comparing their data with that of previous studies, they also find differences in the results of the games based on the differences in written directions (Gary E. Bolton *et al.* 1998;Elizabeth Hoffman *et al.* 1999).

Carpenter et al. showed that stakes don't affect offers in the UG and allocations in the DG (Jeffrey Carpenter *et al.* 2005). They had players fill out a personality scale called the *Mach* scale (first developed by R. Christie, F. Geis in 1970), which consists of 20 statements drawn from Machiavelli's *The Prince* to which subjects agree or disagree. Those who tend to agree with the statements are the high *Machs* and the others the low *Machs*. They included the *Mach* scale to control for "variations in predispositions toward engaging in manipulative behaviors." In previous work, H.-D. Meyer, 1992, found evidence suggesting that high *Machs* will accept low offers, and A. Gunnthorsdottir *et al.* 2002, found that high *Machs* reciprocated less. Burks et al. found that high *Machs* were also less trusting (S. Burks *et al.* 2003). Carpenter and team were looking to find the endowment effects to asses whether the players were risk averse or risk lovers: they found that their subjects were mildly risk-loving.

They further found several interesting facts: in the UG neither stakes nor most individual characteristics have statistically significant effects; the exceptions are race and the number of siblings; non-white participants offered 15% more money than white participants; each additional sibling was associated with a 2% reduction in the amount of money offered; allocations were significantly affected by family income while playing the DG; the affect of allocations were three times larger in DG than in the UG and this affect was negative; one standard deviation increase in family income reduced a dictator's offer by 9%; the endowment effect was statistically significant; one standard deviation increase in one's sensitivity to being endowed with a hypothetical lottery ticket was associated with a 10% reduction in one's money offer to the second player (Jeffrey Carpenter *et al.* 2005, pages 390-397).

Bornstein and Yaniv conducted two experiments: ultimatum game played by two-person and three-person groups; they showed that three-person groups are more competitive and aggressive than individuals are (Gary Bornstein, Ilan Yaniv 1998).

Strong reciprocity has been observed in sequential social dilemma experiments, in interactions with completely anonymous strangers (Ernst Fehr *et al.* 1993;J. Berg *et al.* 1995;Ernst Fehr, Simon Gachter 2000;Ernst Fehr *et al.* 2000b), across many different cultures (Joseph Patrick Henrich *et al.* 2001) and under stake sizes of up to three months income (L. A. Cameron 1999). Strong reciprocity contributes to moderate levels of cooperation in sequential dilemma settings (Ernst Fehr, Bettina Rockenbach 2004). If, however, effective punishment opportunities are available, high levels of cooperation are achieved because cooperative group members can discipline selfish subjects (T. Yamagishi 1986;Ernst Fehr, Simon Gachter 2000).

Xiao and Houser have come up with an interesting analysis (Erte Xiao, Daniel Houser 2005). As there is substantial debate over why humans use costly punishment, they tested experimentally if constraints on *emotion expression* would increase, decrease, or keep the same, the use of costly punishment. They found that rejection of unfair offers was significantly less frequent when player2s could convey their feelings to player1s concurrently with their decisions. Their data supports the view that punishment might be used to express the negative emotions players feel when they are treated unfairly. Xiao and Houser extended their research by suggesting that human demand for emotion expression may have "significant behavioral consequences in social environments, including families, courts, companies, and markets."

Sanfey et al. noted that the magnitude of activation was significantly greater for unfair offers from human partners than from computer partners (A. G. Sanfey *et al.* 2003). The areas that showed greater activation for unfair "compared with fair offers from human partners were bilateral anterior insula, dorsolateral prefrontal cortex (DLPFC), and anterior cingulate cortex (ACC)" (Sanfey et al., page 1756). They also found the magnitude of activation to be significantly greater in both sides of the insula for unfair offers from human partners than to both unfair offers from computer partners and low control offers. They suggest that these activations were not solely a function of the amount of money offered but rather they were sensitive to the context, the perceived unfair treatment from another human. Regions of "bilateral anterior insula demonstrated sensitivity to the degree of unfairness of an offer, exhibiting significantly greater activation for a \$9:\$1 offer than an \$8:\$2 offer from a human partner" (Sanfey et al., page 1756).

Sanfey et al.'s findings are in conflict with the results of Rilling et al., (James K. Rilling *et al.* 2004) who used fMRI for experimenting with UG and PD games, using human and computer partners (James K. Rilling *et al.* 2004). In Rilling's team's experiments of UG, the scanned participants were always in the role of player2. Unfair offers by humans were rejected at a significantly higher rate than the same offers by computers, as was also found by Sanfey et al. in 2003 (A. G. Sanfey *et al.* 2003). However, Rilling et al. found that while playing with computer partners, they got different results for playing UG or PD. While playing the UG, computer partners did not activate the same regions in the brain as did playing with real people. In other words, the scanned participants' brain actively distinguished between playing with a computer or a live person. Each participant in the scanner knew the identity of the other player, even when the other player was a computer—there was no deception. In spite of knowing that the scanned partner was playing against a computer, when playing the PD game, playing with computer partners elicited the same brain activation in the scanned player2 than when playing with a real human partner.

Put differently, in PD game, the brain is not able to distinguish between playing against a computer or a person, even when all facts are clearly stated to the scanned participant. Several areas, including right dorsolateral prefrontal cortex and right parietal lobe were activated in both cases. Event-related plots for both of these regions of interests (ROIs) reveal an increase in activation in response to the partner's face (could be computer "face" in case of a computerized partner) that remain elevated until the game outcome is revealed, at which time there is a secondary increase—in other words, when image is seen, there is an expectation until the offer is revealed. Rilling et al. found that there was a notable discrepancy between the UG and the PD games in the ability of computer partners to elicit activation in areas also activated by human partners. They suggest that this difference may relate to the varying "responsiveness" of the two computer strategies. In the UG game, the computer did not respond to participant choices; it simply made the participant an offer. But in the PD game, the computer responded to a choice by the participant and gave the impression that the computer's decision was contingent on the human participant's choice.

Mutual cooperation and the punishment of defectors activate reward related neural circuits, suggesting that evolution has endowed humans with mechanisms to render altruistic behavior psychologically and physiologically rewarding (Ernst Fehr, Bettina Rockenbach 2004).

The results of the past recent years' experiences provide support for the hypothesis that neural representations of emotional states guide human decision-making. Sanfey found that the anterior insula scales *monotonically* to the degree of unfairness felt by the participant, reflecting the emotional response to the offer (A. G. Sanfey *et al.* 2003). Unfair offers were also associated with increased activity in the anterior cingulate cortex. Areas of anterior insula—maybe representing the emotional urge of resisting unfairness— and the dorsolateral prefrontal cortex (DLPFC)—maybe representing the cognitive part for earning money—represent areas for decision-making in UG. Other recent neuroeconomic studies that scan subjects' brains while they are making decisions in interactive economic experiments also provide interesting results on the neural foundations of strong reciprocity (K. McCabe *et al.* 2001;J. K. Rilling *et al.* 2002;A. G. Sanfey *et al.* 2003;R. Adolphs 2003;D. J-F. DeQuervain *et al.* 2004). These studies support the hypothesis that neural representations of emotional states guide human decision-making and that subjects derive specific rewards from mutual cooperation and the punishment of norm violators.

Synthesis

This paper was meant to be an in-depth review of literature relating to Ultimatum and Dictator Games, but it also serves as a synthesis of the many thoughts, mistakes, and great experiments, to see what we have learned over the years and where we may still have gaps that need to be filled with experiments.

My first observation is that happily, the transformation from the "old" economic theory of *Homo economicus* to a feeling and caring human is definitely in progress, though often still amid mongrel hypotheses and incomprehensible setups. But mishaps in good faith are healthy and useful because they teach us much about what we should not be doing the next time. This takes me back to the search for rationality. First, to the work of Rustichini, as an example of the confusion that standing on the framework of rationality theories may cause in trying to analyze behavioral phenomenon that does not support that framework: it is of outmost importance to understand that behavior is not the output because, for example, these pages that I typed are not my "behavior" but my output; they are the *result* of my behavior, and my *behavior* is the thinking part; I am thinking very hard about what my next word should be in this sentence. Chances are my next word will reflect my mood and general well-being. As a result, some of sentences might be of higher quality than others. My behavior is also *input*, the output of which is measurable by a variety of variables, some qualitative (do you like what I wrote?) and others quantitative (the number of words I wrote).

The reader should recall a statement I quoted earlier from Vernon Smith, which implied that each person has both self-regarding and other-regarding decision-making abilities and chooses to use each according to the requirements of the moment. I noted there that his suggestion implies a continuum between self-regarding and other-regarding behavior and asked for the location of a tipping point. There are two specific issues of further research come to mind here. The first one is the obvious: find the tipping point. The second is a bit more complex. I introduced the reader to several articles that talked about subjects giving the *impression* of fairness or *pretending* to be reciprocators to gain cooperation in circumstances where otherwise cooperation would fail. If this is true, then, perhaps, Vernon Smith is wrong. Perhaps we do not have an other-regarding "side;" we merely use whatever skills we have to achieve our individual goals—thereby making us self-regarding in the strongest sense, even with our family members and closest of friends. What is also true is that what might be rational in one situation might be utterly irrational in another, and vice versa. Purely rational behavior is frequently punished in UG thus often times, to be rational, is to *balance* rather than maximize utility; a contradiction, and which also implies that no unique solution may exist.

The work by John H. Kagel *et al.* (1996) and Michael P. Haselhuhn and Barbara A. Mellers (2005), in which they showed that the *impression* of fairness is enough to achieve full cooperation, implies that not only are humans irrational in their decision-making, but that they are gullible to meaningless or misdirected expressions of others. This, of course, brings us to two issues: the first one is that many of our well-intended economic experiments are misunderstood because economists assume that people behave according to genuine obligations rather than fake ones. As a result, I do not see how we can consider “trust signals” or “social signals” as true signals and much work needs to be done to redesign experiments to use fMRI as validating tool. With the second point I return to Vernon Smith’s comments that we have an other-regarding side. In fact, I think we must possess an other-regarding side if we are gullible enough to accept *any* signal from *anyone* as honest and real, knowing that we are mimicking the behavior of others to elicit a desired outcome. In this view, risk is in the gullibility of the beholder in thinking that others *behave differently* from him. This contradiction will require some work to resolve.

I read the stories of Brosnan and de Waal about their work with their Capuchins with great fascination. With the significant distinction that in the case of the Capuchins, each participating female knows each other, whereas the experiments with humans are usually blind and multi-gender, the results of the experiments were extremely similar. I find this very enlightening because it speaks volumes about the meaning of rationality.

I would like to return here to my earlier note about knowing the preferences of others in Camerer’s and Fehr’s explanation of Aumann’s question, because the assumptions that Camerer and Fehr bring up as part of their explanation is the main theoretical framework of classical game theory. Classical game theory obviously cannot be applied to behavioral games, because the assumptions are different. Classical game theory has arguments like: assume full information and all preferences are known by all players; player2 updates his Bayesian information set and reassesses his possibilities… Clearly nobody ever thinks this way, not the indigenous peoples of the 15 small-scale societies and not the university students who volunteer for experiments in the United States or anywhere else. If we want to make a statement about research in a new scientific field or subfield, the tools we use must change for our experiments. This means that we must accept that there is no such as full knowledge of someone else's preferences—in fact, there is considerable debate about whether the same person can order his or her own preferences consistently and knowingly, let alone someone else's. Because classical game theory assumes fully rational decision-making by all participants all the time with expected utility axiomatic requirements met, it cannot be used to describe human behavior because it does not appear to have those attributes.

The above argument can be extended to Camerer's and Thaler's analysis that they provided on human behavior in UG. They are explaining the behavior of the players by the behavior itself. They suggested that player1 acted fair-minded because she feared rejection and that comparison mattered a lot when she felt unfairly treated, but very little when she felt fairly treated. Their argument forgot that once we move outside of the framework of classical game theory, no player ever knows what the other players' intentions are. In real life, comparisons are based on beliefs. The fear of rejection also relies on beliefs, which is based on past experiences with others and cultural norms. There are also plenty of cues in the environment, as we could see from Blyth et al. about how motion reveals intention.

My next observation is based on the statement of Camerer and Thaler (1995) about manna given from Heaven. I think they are right in that money given for the purpose of play is not equivalent to how players would use money from their own wallets. The reason for this lies in the endowment effect, as discussed above through several experiments. Manna given for the play is technically just the *chance* at earning some money in the near future rather than using the hard-earned cash of each participant. I suspect that the results of economic games in which volunteer players would have to play with their own previously earned moneys would produce very different outcomes from what we get today. Perhaps, an experiment in which the players are first able to earn their play moneys by some game of brain-teasers or other competitive tasks, pay the money they earned in hard cash, let them go home for a day or two, and *then* let them come back to play UG and DG; I think our results might be very different. An even easier way to test this would perhaps be to offer the players some money to take home and return the next day to play the games. In that one day, the money changes from manna from Heaven to earned income—even without any games for true "ownership rights." I wonder how many of the subjects, thus endowed, would actually return for a day of gambling away what they have already warmed in their pockets for a day—or perhaps spent already.

Hsu *et al.* 2005 presents a phenomenon that happens when evaluating risk and ambiguity with risk (Ming Hsu *et al.* 2005). What they discuss may easily be converted to UG as well as the Trust Game, which I have so far not mentioned. The Trust Game (TG) is the reverse of the UG. The first player receives some play money and offers some amount (or zero) from that to player2. Whatever money was offered triples as it gets to player2. Player2 then faces the decision of how much—if any—to send back to player 1. Most players do send some money back; a few don't. In most experiments, in both the UG and the TG, the eye is on the first player in the belief that the amount of money sent to the second player represents a social signal.

Not only do we now understand that this might not be a genuine social or other signal of any kind, but based on Hsu et al., we also know that the second player represents both a risk as well as an ambiguity. How do we separate risk from ambiguity in the second player so as to account for whatever social signal we believe existed in the first player's decision-making? This is not a simple question to answer but we may give it a start by adding control player2s who return with a known probability distribution and watch how much money player1 now sends. If player1 is consistent and sends the same amount of money to both control and real player2, no matter what, it is possible that there is no ambiguity in palyer2, only risk—in which case cultural norms have done their job well and the signal might just really be a social signal of trust. If there is a consistent difference, we might be able to separate ambiguity from risk. However, if the changes are inconsistent, we might face random-walk social signals.

Concluding Thoughts

Evolution is happening on the level of the whole society through individual contribution of all of its members. Some of the questions I found important to be answered are as follows: What are the modifiable elements that change the behavior of the people? What provides ESS: sharing or selfishness or in what combination of the two—given the earlier discussion of the tipping point at which the continuum from selfishness tips over to become sharing? What are the underlying biological functions that drive us toward or away from an ESS and can we change these biological functions?

A most befitting closing statement is chosen from Rustichini: “One may wonder whether Adam Smith, were he working today, would not be a neuroeconomi[st]” (Aldo Rustichini 2005). I believe he would be.

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