Sociologie Românească, Volumul II, Nr. 3, 2004

Irrationality and automaticity in human behavior from an evolutionary perspective

Detlef Fetchenhauer
University of Groningen

Teoreticienii alegerii raţionale argumentează că procesul decizional poate fi privit ca fiind raţional şi conştient. Pe de altă parte, cercetătorii care studiază euristica, bias-urile şi procesele automate evidenţiază iraţionalitatea umană. Articolul de faţă arată cum poate fi rezolvată această dispută de o altă paradigmă metateoretică ce a luat naştere în ultima decadă şi care a fost etichetată drept psihologie evoluţionistă. Teoria subliniază cogniţia şi comportamentul uman ca fiind rezultatele unei adaptări în curs de desfăşurare a oamenilor faţă de mediul lor natural şi social. În timp ce psihologii cognitivişti (sociali), pe perioada ultimei decade, au acordat mult timp demonstrării erorilor inerente cunoaşterii umane şi luării deciziilor, psihologia evoluţionistă, pe de altă parte, reliefează eficienţa cu care omul îşi foloseşte capacităţile cognitive pentru a se comporta într-un mod adaptativ. Prin urmare, articolul descrie elementele principale ale gândirii evoluţioniste şi discută felul în care teoria evoluţionistă poate ajuta la rezolvarea automatismului şi iraţionalităţii în ceea ce priveşte cogniţia şi comportamentul uman.

Introduction

On the one hand humans appear to be by far the most intelligent species that has ever been living on earth. We are able to communicate worldwide via the Internet, are able to fly to the moon and to heal sick patients by transplanting nearly all kinds of body parts. On the other hand humans are unable to resist the temptations of fat food, engage in apparently foolish competition for social status in their peer groups, commit homicides for seemingly trivial reasons and are influenced by a large number of factors that they cannot consciously control.

Within psychology and other social sciences these different aspects of human behavior have been at the focus of different theories for a very long time. For example, Freud (1977) and his scholars argued that humans are highly irrational and that they are the slave of their sexual desires (the eros) and their aggressive instincts (the thanatos). While Freud's ideas of psychoanalysis have been rejected by most (academic) psychologists since quite a long time, the notion that human behavior is

driven by strong and often unconscious motives has prevailed. For example in his theory of cognitive dissonance Festinger (1957) stated that humans have a strong desire for their cognitions and attitudes to be in logical harmony with each other and therefore try to rationalize their irrational behavior.

However, in the past decades, the emphasis on human irrationality has declined and many scholars in the social sciences have been influenced by so-called "rational choice" theories arguing that humans try to maximize the expected utility of their behavioral consequences in quite a rational way. This assumption lies at the core of neo-classical economics that has been the dominating paradigm within economics for a very long time (Becker, 1976). These economic ideas were adopted by a large number of sociologists (e.g. Coleman, 1990) and (often implicitly) by many psychologists (for an overview of psychological utility theories see Stephan, 1989).

In the last decades another influential meta-theoretical paradigm in the social sciences and especially within psychology has been the research program of cognitive psychology. Using the metaphor of the human mind as being comparable to a computer, cognitive scientists started to analyze the way humans process information, build estimates of certain parameters and come to judgements about certain issues. While one line of cognitive research mainly developed normative theories about human behavior (i.e. how a person should behave in a certain situation) another line of research tried to describe how people really behave when having to make judgements and decisions. This line of research argued that humans very often use so-called heuristics when making decisions. Such heuristics can be described as rules of thumb that work reasonably well in some situations but lead to severe deviations from normative theories of decision making in many other situations. This "heuristics and biases approach" to human decision making has been very much influenced by the work of Kahneman and Tversky (1973, 1982). In this line of research, normative theories very often served as a kind of benchmark indicating the degree of rationality in the decision making processes of the subjects that were investigated. Furthermore cognitive psychology has demonstrated that human behavior is influenced by a large number of stimuli that remain unconscious to the human mind (Bargh, 1997).

To summarize one can say that the question to which degree human behavior is rational and guided by a reflected consideration of different goals and alternatives is still open. On the one hand rational choice theorists argue that human decision making can be regarded as rational and conscious while on the other hand researchers studying heuristics, biases and automatic processes emphasize human irrationality.

The aim of this paper is to show how this argument may be solved by another meta-theoretical paradigm that has emerged mainly within the last decade and that was labeled evolutionary psychology (for introductions see Buss, 1995, 1999; Gaulin & McBurney, 2001; Crawford & Krebs, 1998). This approach argues that human cognition and behavior is the result of an ongoing adaptation of humans to their natural and social environment. It holds that human beings cannot be described as general purpose and utility maximizing decision making machines because their cognitive capacities are highly specific (Cosmides & Tooby, 1994). On the other side, evolutionary psychology takes a rather different view on human's use of heuristics and inferential shortcuts than the heuristics and biases appproach. While cognitive (social) psychologists during the last decades spent much time demonstrating the error

proneness of human cognition and decision making, evolutionary psychology rather emphasizes the efficiency with which the human mind uses its specific cognitive capacities to behave in an adaptive way (Gigerenzer & Todd, 1999 ; Pinker, 1997).

In this paper the main elements of evolutionary thinking are described and it will be discussed how evolutionary theory may help to solve the puzzle of automaticity and irrationality in human cognition and behavior.

Central aspects of evolutionary thinking

Mutation and selection as the two core principles of evolution

The core idea of natural selection was outlined in Darwin's book *On the origin of species* first published in 1859. The starting point of his theory was the observation that all organisms are capable of overproducing offspring while the size of population of the different species tends to remain relatively stable over time. This stability in population size is mainly due to restrictions in the resources that are necessary for the survival of the individual organisms. From these assumptions it can be derived that organisms of a certain species compete about these limited resources (Crawford, 1998).

If all individuals of a certain species had the same attributes the question of who of these individuals survives would be a matter of chance. However, individuals differ on attributes that either lower or heighten their chance for survival. This may be due to natural variations of a certain attribute (e.g. tallness or body weight) or to some genetic mutations that occur via sexual reproduction. A crucial assumption of the theory of natural selection is the idea that at least some of these attributes are inherited meaning that they are passed from parents to their offspring.

From these assumptions it can be derived that attributes increasing the chances of survival and reproduction are more often passed to subsequent generations than those attributes that lower these chances. This principle holds true for both physical and behavioral attributes.

To summarize one can say that organisms differ in their physical and behavioral attributes. This is the principle of mutation and variation. Dependent on these attributes individuals differ in their chance to survive and thus in their ability to pass their genes on to the next generation. This is the principle of selection.

From the logic of this theory it can be derived that not those organisms do have the biggest chance of reproduction that do have the highest longevity but those that are able to produce the most offspring and are thus able to pass their genes to following generations. Suppose there would at this point of time exist a species whose individuals were able to live for 10,000 years but would produce no offspring. Despite the fact that the life expectancy of this species would be tremendously high it could be predicted exactly when this variant will go extinct (i.e. in 10,000 years). The fact that it is not longevity but number of offspring that is relevant for success in evolutionary terms is able to explain animal behaviors that would otherwise appear just to be mysterious.

Species that reproduce only once in their lifetime provide an impressive illustration of this fact. Eels for example hatch in the Saragossa sea near Mexico and are driven by the gulf stream either to the coasts of North America or Europe. They then live in rivers or lakes until they are approximately 9-11 years old. Then they start a very long journey back to the gulf of Mexico. It is estimated that only a minor

portion of all eels ever rich the gulf of Mexico. Those that succeed in doing so engage in sexual reproduction and die afterwards. The fact that eels sacrifice their own life for reproducing offspring is only understandable if one realizes that it is reproduction and not an organism's longevity that is the motor of evolution.

It is important to note that differences in reproductive success do not have to be very high to have a strong effect over an extended period of time. Suppose that in a given species there are two subtypes. Subtype 1 has a certain attribute while subtype 2 does not have this attribute. The total population of this species stays stable over time and consists of 200 individuals. Both subtypes cover 50% of the total population. Now suppose that the chance to pass its genes to the next generation is slightly higher for subtype 1 than for subtype 2. Say the total number of offspring in the next generation for subtype 1 is 101, while for subtype 2 it is only 99. In the third generation the ratio is 102 to 98, in the fourth generation it is 103 to 97. Given this example it would take only 100 generations to totally extinguish subtype 2 from the total population. In evolutionary terms however, 100 generations are a rather short period of time. Most biologists agree that the human species now exists for approximately 4 million years (Wrangham & Peterson, 1996). Given that humans reproduce themselves on average at an age of 30 years this means that the human species had roughly 130,000 generations time to develop its main attributes.

The idea of evolution in different scientific disciplines

In the last two decades a new sub-discipline of psychology emerged that calls itself "evolutionary psychology" (Buss, 1995, 1999; Gaulin & McBurney, 2001; Crawford & Krebs, 1998). This discipline tries to apply the main arguments of Darwin's theory to the human mind and human behavior. In the remainder of this paper the main ideas of evolutionary psychology will be explained and it will be discussed how they can be used to explain irrationality and automaticity in human behavior. However, it is worthwhile to note that evolutionary ideas have also been used in a vast number of other scientific disciplines.

For example Edelman (1992) demonstrated that the human immune system uses a system of variation and selection structurally similar to the one described above. When confronted with a new virus the human immune system produces a large number of different anti-viruses that mostly are totally unable to fight the virus. However, when a certain anti-virus turns out to be successful it is produced at a large rate.

In 1898 Thorndike invented the so called "law of effect" stating that a certain behavior is repeated if it turns out to be successful (i.e. is positively rewarded) but is avoided if it leads to negative consequences. This "law of effect" can be perceived as a core element of learning theories that have been developed by behaviorists like Watson (1924) and Skinner (1981). Kolk (2000) argued that this law of effect is not only applicable to overt behavior but also to a large number of behavioral alternatives that are considered as potential options throughout human decision processes. However many of these possible alternatives never find their way into real behavior because they are considered as misleading and maladaptive.

Evolutionary ideas have also been influential in economics and have even led to a distinct sub-discipline that calls itself explicitly "Evolutionary Economics" (Witt 1993). However, because this issues are explained in detail in a parallel paper by Jeroen van

den Bergh they will not be dealt with in the present paper.

The danger of natural fallacies in evolitionary explanations

It is important to note that evolutionary theory – like every other good scientific theory – is totally silent about the moral judgement of the phenomena it describes (Gaulin & McBurney, 2001). To say a certain behavior is natural does not imply to say it is morally good. Evolutionary theories simply hold that to fully understand many phenomena an evolutionary analysis of the reasons for their existence is inevitable.

If for example Wilson and Daly (1988) argue that men are more aggressive than women because throughout their evolutionary history men had to face a stronger intra-sexual competition than women this does by no way imply a moral judgement of male aggressiveness, but that the higher rates of aggressiveness of males in comparison to females cannot be understood if its evolutionary background is neglected. A similar argument is used by Thornhill and Palmer (1999) in their analysis of males' tendency to rape women under certain conditions.

A related misunderstanding is to say that human behavior cannot be changed because it is determined by biology. Contrary to early versions of ethological instinct theories (Lorenz, 1965) modern evolutionary theories do not hold that behavior is independent of environmental conditions. Quite to the contrary it has been emphasized that behavior is always the result of an interaction between behavioral dispositions and conditions of the very situational circumstances under which a behavior in question occurs (Buss, 1999).

This argument can also be explained using the example of male aggressiveness. As Daly, Wilson and Vasdev (in press) have shown homicide rates seem to be influenced by the level of social inequality. With data for both the USA and Canada they could show that homicide rates are the highest in areas in which differences in income are the greatest (using the so called Gini-Index as an indicator for income inequality). This seems rather plausible from an evolutionary point of view because having a very low status it is adaptive to engage in extremely risky behaviors (like killing other people) to gain social status. If this argument by Daly *et al*. holds societies that want to lower their homicide rates should try to limit the degree of social inequality. Another measure might be to offer other status gaining opportunities for those with a low social status (like education or vocational opportunities).

Proximate vs. ultimate causes of behavior

In evolutionary analyses of certain physiological or behavioral adaptations it is important to distinguish between proximate and ultimate causes of behavior (Crawford, 1998 ; Gaulin & McBurney, 2001). When proximate causes of behavior are investigated the focus is on the linkage between certain physiological and psychological attributes of an organism on the one hand and its behavior on the other hand. When ultimate causes are investigated the focus is on the reproductive advantages that the existence of the proximate causes imply for a certain organism.

This argument does hold for both physiological processes and for behavioral patterns of human beings. Consider for example the tendency of men to prefer young and healthy women as mating partners while women prefer men with a high social status that are slightly older than they themselves (Buss & Schmitt, 1993).

A proximate explanation for this preference pattern could be seen in the fact that young women are perceived to be more beautiful by men. On the other hand older men might be perceived to be more reasonable and mature than young men by women. However, as this example reveals, such proximate explanations appear very often to be post hoc and not very convincing. On the contrary, to derive an ultimate explanation for these phenomena one has to investigate which adaptive advantages these mating preferences had during the course of evolution. Such an analysis does lead to the following explanation (Buss, 1999): Men could only pass their genes on to following generations if their mating partners were fertile and reproductive. The reproductive value of a women (i.e. the number of children she is able to bear in the future) heavily declines with increasing age. Therefore men with a preference for young women had more children than men who preferred elder women (especially if they preferred postmenopausal women). Therefore a preference for young women led to more offspring and thus spread such a preference throughout the total population. A complementary explanation holds for the fact that women prefer men with a high social status. For women it was very important throughout their evolutionary history that the father of their children was able (and willing) to use resources to feed and protect them and their children. The chance of getting these resources were the better the higher the social status of their mating partner. Thus, females with a preference for high ranking males had more surviving children than women without such a preference (Buss, 1999).

This example clarifies the importance of ultimate explanations if one wants to understand the causes of human behavior. However, contrary to evolutionary biology, such ultimate explanations have rarely been in the focus of mainstream (humane) psychology (Buunk & Schaufeli, 1999). Therefore psychologists have just noticed that people try to have a positive social identity, avoid cognitive inconsistencies or strive for a high level of status and self esteem without explaining why humans should have such motives (Buunk & Dijkstra, 1999; Kenrick & Simpson, 1997).

The past explains the present

The logic of natural selection implies that organisms adapt to their environments only with a high degree of delay. Evolutionary theory assumes that human adaptations and behavior have been shaped in the Pleistocene. Since then the environment for humans was rather stable. During this time home sapiens developed its physiological and psychological properties. This means that human beings are adapted to the kind of environmental conditions that prevailed in the Pleistocene (the so called Environment of Evolutionary Adaptedness = EEA) (Tooby & Cosmides, 1992). In many aspects this implies that humans are not perfectly adjusted to the kind of environments they face today. One example are human preferences for fat and sweet dishes (i.e. dishes with a high load of calories). Such preferences were extremely adaptive in the EEA because food was scarce. In this situations a preference for food with many calories increased the chance of survival (and reproduction). However, the same preferences sometimes cause severe health problems in today's Western industrialized societies. People in these countries tend to eat too much fat and sugar (a problem that only very rarely occurred in the EEA). Thus humans and other species are not necessarily perfectly adjusted to their environments especially if these environments change rapidly (Crawford, 1998).

Furthermore it is important to note that at no point of time any species is perfectly

adapted to its environment. The fact that a certain species has solved a given problem of survival and reproduction in a certain way only proves that this solution has been (at least slightly) more adaptive than other solutions to the same problem. However, at a given point of time any adaptation is only one possible solution to a given problem. This is not to say that no other or better solutions would also be conceivable.

Can evolutionary theories be tested empirically ?

It is often complained that evolutionary explanations of human behavior cannot be falsified by empirical data (e.g. Hogan, 1995 ; Gould & Lewontin, 1979). It is argued that many hypotheses investigated in evolutionary psychology are mere post hoc explanations of data that were already well known for a long time. This fact is perceived to be in contradiction to principles of main stream psychology where the normal research procedure prescribes to have first a theory and then to test this theory by empirical data (e.g. an experiment). For example the fact that men are more aggressive than women was well known before evolutionary psychologists tried to explain this phenomenon. Furthermore it is argued that "evolutionists use consistency with data as the sole criterion and consider their work done when they concoct a plausible story" (Gould & Lewontin, 1979, 587-588). This criticism would surely be justified if evolutionary psychologists only reinterpreted well known phenomena without considering alternative explanations for these findings.

However, as Ellis and Ketelaar (2000) have shown, evolutionary theory can be regarded as a meta-theoretical research program in the sense of Lakotos (1978). According to Lakatos such research programs consist of a number of main assumptions that build the hard core of a meta-theory (in the case of evolutionary theory these assumptions mainly adhere to the concepts of genetic variation and natural selection). This hardcore is surrounded by a protective belt whose function is to defend the hard core of the research program from refutation. If for example empirical data seem to contradict some of the meta-theoretical assumptions it is tried to reinterpret these data so that they fit the main ideas of the research program or to prove that the data are actually not in contradiction with the basic assumptions of the research paradigm.

According to Lakatos (1978) meta-theoretical research programs can be evaluated by two core criteria. 1) Is the meta-theory able to integrate existing data into its main line of reasoning or are there more and more empirical findings that have to be regarded as anomalies ? 2) Is the research program able to develop new (medium level) theories and hypotheses that have not existed before ? As Ellis and Ketelaar (2000) argue, evolutionary theory has been successful with regard to both criteria.

An example for integrating data into an evolutionary framework that seemed to be a basic contradiction to its main promises are the studies of Daly and Wilson (1988) on homicides. From an evolutionary perspective human's tendencies to kill each other should be especially low with regard to one's own relatives because it would be highly maladaptive to kill one's own genetic vehicles. This assumption seemed to be falsified empirically given the fact that a large amount of murder cases occur within the family. However, as Daly and Wilson (1988) showed, these data were based on a sociological definition of family. When they reanalyzed the existing data they could show that only a small minority of all murder cases were directed towards victims which were genetically related to the perpetrator. To the contrary the vast majority of all

cases comprised husbands and wives on the one hand and stepchildren on the other hand.

An example for generating new hypotheses that have not been developed before can be taken from research investigating gender differences in spatial abilities. It was a well known fact for a very long time that men scored higher on spatial abilities than women. However, Silverman and Eals (1992) argued that this male superiority should be restricted to certain dimensions of spatial abilities. Throughout evolutionary history males have spent a lot of their time with hunting while females were mainly gathering and foraging. Thus, Silverman and Eals argued that men should outperform women in tasks like mental rotations or estimating space relations because these abilities were necessary to be a successful hunter. On the other hand, however, females should be better in remembering the location of certain goods because this ability was important for recognizing places where food (e.g. fruits) had been found before. Drawing on this reasoning McBurney *et al.* (1997) conducted an experiment where male and female subjects had to solve classical mental rotation tasks and had to play the game "memory" (in which the task is to remember the position of certain pictures). As in many other studies men outperformed women in the mental rotation tasks ($d = 0.67$). However, in line with the argument of Silverman and Eals (1992) women were significantly more successful in playing memory than men ($d = -0.89$). There now exist a number of studies showing that women are better in remembering both the location and the frequency of objects (for an overview see Silverman & Phillips, 1998). The hypotheses that led to these kinds of studies could only be derived from an evolutionary analysis and were never tested before.

To summarize the argument that evolutionary hypotheses can not be falsified by empirical data does not hold. The framework of evolutionary theory has stimulated the development of a vast number of new theories and new predictions that can be tested empirically. On the other hand proponents of evolutionary theories are surely well advised not to regard any plausible explanation of existing data as a proof of evolutionary theories.

Judgement and decision making from an evolutionary point of view

Up to now the main ideas and core elements of evolutionary thinking have been explained. This chapter deals with the question of how evolutionary theory can be used to explain various aspects of human judgement and decision making. At the end of this chapter, evolutionary explanations are compared with notions of rational decision making and the heuristics and biases approach in cognitive (social) psychology.

Automaticity in human cognition and decision making

In the last two decades a vast number of studies have been conducted in the field of cognitive (social) psychology constantly demonstrating that human cognition and behavior is to a large degree influenced by processes that people are not consciously aware of (for an overview see Bargh, 1997). In this paragraph some of these studies are briefly described. Then it will be discussed to which degree automaticity can be regarded as adaptive for human beings.

In a study by Debner and Jacoby (1994) subjects were presented certain words on a computer screen for different amounts of time (e.g. the word "spice"). Then they were given a certain word stem (e.g. spi__) and were asked to complete this word stem

with any word they wanted but not with the word they had seen before on the computer screen. When the words on the screen were presented for 500 milliseconds (i.e. were consciously perceived) subjects were able to solve the task considerably well (e.g. by choosing the word "spiral" as an answer). However, in another experimental condition the words were presented to the subjects only for a very short time (50 milliseconds). It is known from cognitive psychology that people are able to perceive and to process stimuli presented for such a short time but that subjects are not aware of these perceptions. In line with these findings, subjects in the 50 milliseconds condition used the preconsciously perceived words more often to solve the task than those subjects in a control condition. This study demonstrates that humans are able to perceive stimuli without being aware of these perceptions. Thus, they use preconsciously processed information even if they are explicitly told not to do so.

Another area that is influenced by preconscious perceptions are evaluations of different stimuli. In a classical article Zajonc (1980) stated that "preferences need no inferences" arguing that humans evaluate certain stimuli (on a dimension of "good" vs. "bad") before they become consciously aware of these stimuli. Bargh *et al*. (1989) tested this assumption in the following way. As in the study by Debner and Jacoby described above Bargh *et al*. presented their subjects words on the computer screen for such a short time that subjects were not able to consciously remember these stimuli. This was tested by asking the subjects whether another word was a synonym of the word the subjects had seen before. It turned out that subjects were not able to solve this task with a rate of success better than chance. However, subjects were able to indicate whether the subliminally presented word had a positive or negative connotation. Thus the experiment by Debner and Jacoby shows that we are able to evaluate a certain object before we have become consciously aware of it.

Not only our perceptions and judgements are influenced by subconsciously processed stimuli but also our behavior. One example for this effect can be derived from an experiment that was conducted by Bargh, Chen and Burrows (1996). In the first phase of this experiment subjects had the task to unscramble a series of scrambled sentences. The content of these sentences either was related to matters of rudeness, politeness or (in a control condition) to none of these two aspects. Subjects were left alone with this task and were told that they should go to the experimenter's office when they had finished. When they did so they found the experimenter in an endless conversation with another subject (actually a confederate of the experimenter) who obviously did not understand the instructions of the experiment. The experimenter pretended not to notice the subject that entered his room for a period of maximal 10 minutes. The dependent variable in this experiment was the question whether or not the subjects interrupted this conversation. It turned out that the different experimental conditions had a strong influence on the frequency of interruptions. Less than 20% of subjects in the "politeness" condition interrupted the conversation but more than 60% of subjects in the "rudeness" condition.

To summarize one can say that our cognitions, evaluations and behavior are often influenced by stimuli that we do not process in a conscious way. In many of the experiments that investigated such processes subjects were asked why they behaved in a certain way. Almost never were they aware of the subconscious influences on their behavior. Interestingly, in many of these situations subjects were able to name

a reason for their behavior that seems absolutely plausible to them. In a classical article Nisbett and Wilson (1977) demonstrated that subjects in social psychological experiments only had a very limited access to the causal determinants (i.e. the motives) of their own behavior in the experiments. Though they were obviously influenced by the experimental conditions (which they were not aware of during the experiment) they denied these influences even when they were informed about their consequences. Interestingly these results parallel findings from Neuropsychology with so called split brain patients (Kolk, 2000). These patients have no neurological connection between their left and right half of their brain because their corpus callosum has been split (often as a way to cure elilepsy). With these patients it is possible to activate one half of their brain without the other half noticing this activation. When these patients are told to do a certain thing (e.g. leave the room) via the right half of their brain they tend to follow these instructions automatically. When they are then asked why they are conducting a certain behavior (e.g. are leaving the room) they have no problems of giving a plausible reason for this (e.g. "I just wanted to get a coke"). Thus people very often do not have conscious access to the reasons of their behavior but are seldom aware of this fact.

How can all these findings be interpreted from an evolutionary perspective? Such an evolutionary analysis would start with the question which adaptive value it has for an organism (e.g. a human) to do some things with conscious reflection and others without any conscious awareness at all. Kolk (2000) has recently addressed the question why humans do have a consciousness at all. Following ideas originally stated by William James (1890) more than a hundred years ago he argues that the adaptive function of the consciousness is that humans are able to react more flexible to environmental stimuli than if they process information without any awareness (as is done by most animals and all plants).

However, one main disadvantage of conscious and reflective decision making is that these processes need time – more time than there often is to react to certain environmental stimuli. Suppose for example that one of our ancestors approached a wild animal (say a lion) some 100,000 years ago. His chance to survive such an encounter heavily depended on the immediacy of his reaction (e.g. "flee") and surely not on his ability to think over this situation in much detail. Thus a first advantage of unconscious information processing is its speed. For that reason it seems plausible to assume that "automatic" reactions to environmental stimuli are the more frequent the more important it is to react very quickly (for example if we touch something very hot we put away our hand before consciously becoming aware that we have burned ourselves). This can explain why we are able to derive an evaluation of a certain stimulus before becoming aware of it as in the experiment by Debner and Jacoby.

Another aspect that has to be considered is the fact that conscious reasoning about a certain topic occupies a large amount of our working memory. This working memory however is very restricted in its capacity. Our mind is more like an old fashioned personal computer with very limited capacities than like a modern high speed computer which is able to run many programs at one time and has a huge working memory. Thus it is adaptive if our mind tries to automatize as much of its tasks as possible.

From that perspective it seems very plausible that we cannot control many of our body functions at all. For example (at least for most people) it is not possible to influence the activities of their cardio-

-vascular system. If we are sitting on a chair the pulse rate is approximately 70 beats per minute. If we get up and walk around our heart rate will increase to a level of ca. 100 beats per minute and it will dramatically increase if we start to run (for example if we have to flee for a dangerous animal). By increasing and decreasing our pulse rate our heart reacts to different demands of oxygen that our body needs at different level of physical activity. Unless we are ill this process functions at a level of perfection that could not be increased if we were able to consciously influence our heart rate. Thus it is adaptive that humans do not have to bother about things they could not do better even if they were able to influence them (Damasio, 1994).

The same logic can explain why many behaviors become more and more automatic once that we have learned how to conduct them. A very often cited example for such processes is learning how to drive a car (Bargh, 1997). At the beginning we have to do everything very consciously (turning the wheel, pushing the accelerator or the brake pedal with the right force or visually checking the traffic). However, after some experience, these processes become automatic so that our conscious cognitive resources can be used for something else (e.g. making conversation with our co-driver). Another example for the relation between skill acquisition and automaticity is the way small children learn to stand upright and walk.

To summarize it is very much in line with an evolutionary point of view that our behavior is heavily influenced by processes that we are not consciously aware of given the limited resources of our cognitive apparatus. Furthermore, from an evolutionary perspective it is possible to predict which kinds of information processes are more conscious than others and how effective we are in information processing with regard to different areas of cognition. This issue will further be elaborated in the next section.

An example for automatic processing: interpersonal perception

Will the person, with whom I am waiting alone for the next subway, try to rob me? Can my business partner be trusted or will he cheat on me? Is my wife still faithful or does she have another lover? Does a certain person take revenge if I try to exploit her? Will my lover be a good husband and father for our common children? Humans are to a great extent dependent on the behavior of other people like friends, marriage partners, competitors or enemies. For this reason being able to perceive others in a valid and accurate way appears extremely adaptive. Thus, evolutionary psychology predicts that people are reasonably good in predicting the behavior of others.

However, main stream social psychology paints a very different picture on people's ability of predicting others' behavior. Being very much influenced by the so called heuristics and biases approach (Nisbett & Ross, 1980), people are perceived as being fundamentally biased in their perceptions trapping into innumerous pitfalls. In a recent textbook on social cognition, Kunda (1999) emphasizes that people very often fail to realize the context dependency of human behavior. Therefore, Kunda concludes: "We cannot predict a person's behavior in one situation from that person's behavior in another situation with any confidence." (426) Thus, social psychology and many empirical studies seem to be in contradiction with the evolutionary psychological predictions. However, a closer look reveals a more differentiated picture.

Evolutionary psychology would argue that social perception is a fast and rather unconscious process because throughout human history speed was a very important

issue in categorizing social stimuli. Evidence for this reasoning can be derived from research that has worked with "thin slices" of behavior as stimulus material (Ambady *et al.*, 2000; Ambady & Rosenthal, 1992). In this paradigm subjects are presented short silent video tapes of different stimulus persons (very often less than one minute) and are then asked to estimate different attributes of these persons (e.g. personality dispositions, sexual orientation, aggressiveness or occupational success). As different meta-analyses revealed subjects are remarkably good in predicting different attributes when grounding their judgements on such "thin slices" of behavior (in the meta analysis by Ambady and Rosenthal the average correlation was $r = 0.39$). Remarkably, validity of judgements did not increase when the amount of information about the stimulus persons were enlarged (for example by increasing the length of the video or switching on the tone). Furthermore, in most cases subjects were not able to indicate which cues they used for their judgement.

Additionally, evolutionary psychology would predict that people's ability to identify other's attributes depends very much on the adaptive value of such an ability. Thus, humans should for example be more able to predict other's trustworthiness or aggressiveness than other's taste for classical music. This assumption was directly tested in an experiment by Gangestad *et al.* (1992). Subjects saw 30 second video tapes of 20 stimulus persons and had to estimate their degree of social potency, social closeness, stress reaction and sociosexuality (i.e. the degree to which a stimulus person was interested in casual and frequent sex without any emotional commitment). Gangestad *et al.* argued that identifying someone's sociosexuality is of higher importance in evolutionary terms than the three other attributes because both men and women should prefer partners with a low degree of sociosexuality when searching a long-term mate. In line with this argument, predicted sociosexuality correlated higher with stimulus persons' actual values (measured via self reports) than did the three other attributes.

These findings are very much in line with the evolutionary predictions derived above. Humans are able to predict the behavior of others, especially with regard to life domains and attributes that have been important throughout evolutionary history. However, these processes occur often unconsciously so that in many cases we do not know to say on which cues we ground our predictions. Above it was hypothesized that the degree to which our mind has automatized certain functions of our cognitions is the higher, the more important these functions were for survival and reproduction. The results of studies using "thin slices" as stimulus material are very much in line with this argument.

However, it has to be emphasized that people (at least in some situations) do have a strong interest in that their attributes or behavioral intentions are not identified by others (Frank, 1988). Everyone is interested in being perceived as trustworthy even if this is not really true. If one generalizes this argument it can be said that there is an arms' race going on between human's interest in identifying others and not wanting to be identified. Thus, it can be predicted that the accuracy of judgements about other's traits is negatively related to the willingness of these others to reveal these attributes. However, these issues have rarely been investigated in the past.

Furthermore it has to be emphasized that the ultimate criterion of personal perception is not accuracy in its own, but adaptiveness. This implies that systematic biases in perceptions may serve an adaptive function (Krebs & Denton, 1997). For

example many parents see their children in a positively biased manner (i.e. underestimating the degree of negative and overestimating the degree of positive attributes). The same holds true for sexual partners especially when they have just fallen in love. However, these biases serve the adaptive function of stabilizing attachment and care for one's children and partners.

Recently Haselton and Buss (2000) have emphasized that in human perception there is very often a trade-off between avoiding different kinds of mistakes. As an example they cite the tendency of males to overestimate the sexual interest of females with whom they are interacting. According to Haselton and Buss this systematic bias is highly adaptive because it does not cause a severe problem to a man if he overestimates the sexual intents of a female (just leading to a rejection). However, underestimating the sexual interest of a potential mate would lead to missed opportunities for reproduction – a consequence that would be highly maladaptive in evolutionary terms.

Automatic links between power and sexual desire

Another example for automatic information processing was investigated by Bargh *et al*. (1995). In a number of experiments they demonstrated that males' sexual desire can be stimulated by unconsciously activating concepts of influence and power. In one experiment male subjects had the task to pronounce words that were presented to them on a computer screen as fast as they could. The fastness with which they could pronounce words that were indirectly related to having sex (e.g. bed or motel) served as the dependent variable. Half of the subjects were presented power-related words like "boss" or "power" on the computer screen for a very short time (90 milliseconds) before they had to pronounce the words that they perceived consciously. It turned out that subjects were faster in pronouncing the sex-related words if they had been primed with power-related words and if they scored high on scales measuring a taste for sexual aggression.

In another experiment subjects had to complete 16 fragmented words. In the experimental group 6 of these 16 fragmented words were related to power while in the control group none of the 16 words were related to this issue. Afterwards subjects had to rate the attractiveness of another (female) participant (actually being a confederate of the experimenter). Those subjects that were primed with regard to power indicated the female stimulus person to be more attractive and felt a stronger desire to see her again than those subjects that were primed with neutral words. Again this effect was mainly restricted to subjects scoring high on sexual aggressiveness.

Bargh (1997) and Kunda (1999) discuss the practical implications of these findings mainly from the perspective of research in sexual harassment. They argue that many men force women to have sex with them if they are in a position of power (for example being the supervisor of a female subordinate) because being in a powerful position unconsciously activates issues of sexuality. This activation might then lead to a misperception of the women's behavior (for example taking a friendly smile as a sexual invitation).

As this is surely true, the question remains why such a link between power and sexual desire exists. An evolutionary analysis of the so called power-sex-link in males would start with the observation that throughout evolutionary history males' access to young and fertile women very often was related to a high social status (i.e. power). As Betzig (1998) has shown, in many cultures men do have more women

(and the more children) the higher their social status. In many primates the alpha male has an exclusive right to copulate with ovulating females (de Waal, 1996). From this perspective it appears highly adaptive if (at least some) men feel an increased sexual desire if they are in a position of power and influence. Interestingly a parallel pattern of behavior can be observed in crickets. Alexander (1961) showed that male crickets are more likely to seek the sexual favors of female crickets when they have succeeded in fights with other male crickets before (Buss, 1999). It is in line with this evolutionary interpretation of the male power-sex-link that it was not possible to prime the subjects in a reverse pattern: participants were not faster in pronouncing power related words when they had been primed with sex-related nouns before.

It speaks for itself that these findings should not be interpreted as an justification of sexual harassment by males at the workplace or in any other situation. Yet, the empirical results with regard to a power--sex-link in male behavior gives another good example of how patterns of unconscious information processing was shaped by evolutionary history.

Possible fields of further research

Evolutionary psychology and the research field of automaticity in human perception and behavior have rarely been linked to each other. Given this lack of mutual integration it seems worthwhile to stimulate systematic research in this area.

For example: how can the existing results with regard to automatic and unconscious perception and reasoning be analyzed and interpreted from an evolutionary perspective? One methodological problem in reinterpreting existing data is of cause the fact that you know the results in advance. For that reason – as has already been discussed – evolutionary psychologists should not only concentrate their efforts on such reinterpretations but should also try to stimulate genuine and new research paradigms and hypotheses on their own. For example, evolutionary psychology could be used to derive specific hypotheses about the question which kinds of stimuli can be primed more easily than others, or which stimuli are processed in a conscious or an unconscious manner.

Another field for further investigation lies in the area of interpersonal perception. As has been outlined above a number of specific hypotheses about interpersonal perception can be derived from evolutionary psychology that are at least partly in contradiction to main stream social psychology. One possible line of research could investigate to which degree people are able to predict the prosocial or antisocial behavior of others and which cues people use to derive their estimates of other's behaviors.

The modularity of cognition

Evolutionary cognitive psychologists emphasize that human information processing capacities were developed by means of natural selection very much the same like our physiology evolved. Thus they argue that human cognition is highly domain specific in quite the same way as the different sub-systems of the human body are domain specific: the heart is very good in pumping blood through the human body but is very bad in detoxicating poisonous food, while the liver is very good in the latter but is not able to do the former.

The idea that human cognition is highly domain specific has been illustrated by Cosmides and Tooby (1994) as comparing the human mind to a Swiss army knife with its many different several blades and tools

that are better able to fulfill different requirements than any single blade could do. In a similar vein Gigerenzer & Todd (1999) describe human problem solving as the usage of an adaptive tool box. In this box each tool can be used for the solution of a limited number of problems, but it is not suited for the solution of others.

To the contrary, many main stream psychologists (at least implicitly) follow the assumption that the human mind can be described as general purpose oriented and content free (Pinker, 1997). One consequence of this assumption is that psychologists very often do not pay attention to the kinds of stimuli they use in their experiments. For example in studies about the human memory it was very often not considered which kind of objects were used as stimulus material that the participants had to remember.

In opposition to this, evolutionary psychologists would emphasize the importance of whether the recognition of a certain stimulus was adaptive (i.e. increased the chance for survival and reproduction) throughout evolutionary history or not. For example it is predictable that humans are better in recognizing human faces than for example abstract words because for the survival of men it was very important to identify whether a certain person had been encountered in the past or not: if the answer was yes but no negative memories were activated by the sight of a certain person chances were high that this person was friendly and not hostile. However, if a certain character had never been seen before it was wise to treat this unknown person with caution. In line with this reasoning are results showing that humans are astonishingly good in recognizing human faces. In a study by Standing (1973) subjects had to look at 1,000 different pictures that were presented to them for less than five seconds. Two days later subjects were able to correctly identify more than three fourth of another set of pictures as to whether they had seen them before or not (this high percentage of correct recognition was already adjusted for guesses).

The idea that problem solving capacities are rather domain specific than domain general fits the observation that many animals have developed remarkably high "cognitive" abilities in one domain but not in others. Further above it was already mentioned that eels do have the ability to find their way from European and American lakes and rivers into the gulf of Mexico. This journey requires an astonishing capacity of geographical orientation. Other examples are birds that change their habitat from one continent to the other during winter and summer or bats that are able to use complicated echolocation systems to find their way through the darkness. Eagles are able to see potential prey from a distance of 2,000 m. This means that they could read a newspaper from a 1,000 m distance. Nevertheless they will never use their remarkable visual capacities for this purpose because they will never be able to understand the meaning of alphabetic characters.

A related argument can be derived from research in human intelligence that has been conducted by personal psychologists. This research has revealed large differences in cognitive abilities over different domains within the same person (Sternberg, 2000). For example to know the mathematical abilities of a certain person is only a very limited indicator of this person's visual abilities, her talent for playing an instrument or for drawing a picture.

The mind as an adaptive toolbox

As already discussed Gigerenzer & Todd (1999) compare the human mind with an adaptive tool box. According to Gigerenzer & Todd these tools mainly consist out of a

number of "fast and frugal" heuristics. The usage of such heuristics leads to reasonable good decisions in real life settings while demanding only a very limited amount of time in reaching a decision.

One of these heuristics has been described as the "recognition heuristic". This heuristic can be used when it has to be decided which of two alternatives has a higher value on a certain dimension (e.g. which is stronger or bigger). To decide such questions the recognition heuristic offers a very simple decision rule: "If one of two objects is recognized and the other is not, then infer that the recognized object has the higher value" (Goldstein & Gigerenzer, 1999, 41). Goldstein and Gigerenzer demonstrated the usage of the recognition heuristic with the following experiment: they asked a group of students at the university of Chicago and at the university of Munich which city has more inhabitants – San Diego or San Antonio. 100% of all German students gave the right answer (San Diego) as compared to only 62% of all American students. Goldstein and Gigerenzer interpret this finding by arguing that the German students had never heard of San Antonio but well of San Diego. By using the recognition heuristic they assumed that the name of a certain city is the more famous the more inhabitants it has and were thus able to solve the task. The American students however were not able to use the recognition heuristic – most of them had heard of both cities before.

Another example for the efficiency of the recognition heuristic is a study by Borges *et al.* (1999). In this study (simulated) investment decisions were based on the degree to which economic lay people had been able to recognize different share holder companies (i.e. it was only invested in such companies that had been recognized by a vast majority of all subjects). It could be shown that by using this simple method the return of investment was significantly higher than for a group of economic experts that had grounded their investment decisions on a huge variety of different parameters.

These experiments demonstrated that a) people actually use the recognition heuristic and that b) the usage of this simple heuristic leads to an adequate guess in many cases. Gigerenzer, Todd *et al.* (1999) describe a large number of such "fast and frugal heuristics". Their main argument is that by using such heuristics people save a lot of time and effort to come to a decision that is a roughly adequate reaction to the actual environment.

Possible fields of further research

Within the research area of judgemental heuristics there are a number of open questions that should tried to be answered in the future. For example it seems probable that humans (and other animals) do not only use those heuristics that have been discovered up to now but that there exist a large number of other heuristics used in various life domains. It seems sensible to ground this search for yet undetected heuristics on a thorough analysis of which problems our ancestors had to face in the EEA and which heuristics would have been helpful to solve these problems. As Todd and Gigerenzer (1999) emphasize, for each heuristic that is newly discovered there are a number of questions that need to be answered. 1) How efficient is the heuristic compared to a normative standard of decision making (if such a standard exists)? 2) In which situations is it adaptive to use the heuristic? 3) Do humans (and other species) really use this heuristic?

These research questions open a wide field for future investigations that try to explain how people can be able to behave in an adaptive manner without being able to maximize their expected utilities in the

way it would have been predicted by standard economic models of decision making (see above).

The role of emotions in decision making

In many standard psychology textbooks the topics of cognition, decision making and emotions (affects) are dealt with in different chapters that are only loosely connected with each other. However, recent studies in the field of neuropsychology suggests that emotions play a more important role in decision making than has presumed (for an overview see Damasio, 1994). Damasio investigated patients that had a brain damage being concentrated in the prefrontal cortex, an area that controls emotional reactions. Such patients show a strange kind of behavior. Their cognitive abilities are comparable to healthy persons but yet they constantly make disastrous decisions (e.g. quitting a well paid job or selling their house for a very bad price). Damasio speculated that this behavior might be due to the patients' damaged ability to anticipate emotional consequences of their behavior. Thus he argues that emotions play an important role in guiding human decision making. We avoid alternatives that are connected with the anticipation of bad emotions and feel attracted to alternatives that are connected with the anticipation of positive emotions.

A study by Bechera *et al.* (1997) lends support to this idea. In this study subjects played a game in which they had to choose game cards from four packets over a period of 100 trials. Each game card (that could not be seen by the subjects in advance) indicated either a win or a loss of some token money. Two of these packets implied high wins but also high losses that overall led to a total loss for the subject. The two other packets implied minor wins but also only minor losses. In the long rung always choosing from these two "safe" packets led to an overall win for the subjects. Thus the utility maximizing strategy was to always choose a card from one of the two "safe" packets and never to choose a card from one of the "risky" packets. All subjects were connected to a device that measured their skin-conductance when making their choices as a measure of their physiological arousal. Every ten trials subjects were asked about how they derived their decisions and whether they had any clue about the underlying scheme of the rewards.

Results showed that after a number of big losses (usually after 10 trials) subjects began to show strong physiological reactions when they approached one of the "risky" packets. As a consequence subjects started to choose for the "safe" options more often. However, when asked about the reasons for their choices at this stage most subjects indicated that they had no clue about the underlying scheme and that they were making their choices just by chance. On average it took subjects more than 50 trials before they consciously triggered out which alternatives would lead to the highest pay off in the long run. Put differently, by following their (subconscious) emotions subjects were able to make "rational" utility maximizing decisions before they became aware of the rationale for these decisions.

The same experiment was also run with subjects that had the same kind of brain damage than the patients in the studies of Damasio (see above). In contrast to the healthy participants, these subjects showed no physical arousal during the whole experiment. Moreover, even after they had become aware that to choose a card from the "save" packet was the only way to maximize the overall win they remained tempered by the chance to make a big win by choosing a

card from one of the "risky" packets and thus kept on making "irrational" decisions. To summarize one can say that emotions play an important role in human decision making. However, as opposed to normative models of decision making, such emotional influences do not lead to a decreased efficiency of decision making.

As Gigerenzer & Todd (1999) have noted, strong positive and negative emotions can serve the same purpose than the cognitive heuristics described above because they structure and shorten the process of decision making. If we feel a strong disgust for a certain food we do not have to think any further about the healthiness of its ingredients – we will simply eat something else. If we are passionately in love with someone we might ask this person to marry us simply because we love her without any further cognitive reflection.

Another function of emotions is to activate certain behavioral reactions by signaling to the human mind information about the current state of affairs. Feeling hungry leads to a search for food, feeling tired activates the search for a place to sleep etc. (Damasio, 1994). The same logic can be applied to feelings like jealousy (Buss, 2000) or self esteem. It is a well known fact to social psychologists that people do have a strong desire for a high self esteem. However, social psychologists have regarded high self esteem to be a goal in itself and have rarely asked which evolutionary purpose a high level of self esteem could serve. As Leary *et al.* (1994) have emphasized to assume that people strive for a high level of self-esteem because it feels good to have one can be compared with the assumption that people fill gasoline in their car because they have a desire "to keep the fuel gauge from touching E" (Kenrick *et al.*, 1998, 505). Leary *et al.* argued that high self esteem is so important to humans because it is connected to a high status in one's social group. However, a high status is related to having access to scarce resources and being attractive as a potential mate (Buss, 1999). Thus the strive for a high self esteem serves the function of informing a person about her social status and to trigger status enhancing strategies if its value goes beneath a certain level.

To summarize emotions help us to come to reasonable decisions within a limited amount of time. In addition, they inform the human mind about certain needs and thus stimulate certain actions. To serve this purpose, it is absolutely unnecessary that people are aware of these functions of their emotions. For example the ultimate function of sexual desire is sexual reproduction. However, this does not imply that people want to reproduce themselves when they engage in sex.

Possible fields of further research

The research that was conducted by Damasio (1994) and by Bechera *et al.* (1997) indicates that people tend to make false decisions if they are not guided by strong emotions signaling to them that certain harmful decisions should be avoided. They demonstrated this effect by comparing the behavior of healthy people with that of a special kind of brain patients. However, within the population of people who do not have brain damages there is still a large amount of variation in the propensity to engage in risky and dangerous behaviors. Within clinical psychology "psychopaths" are described as people that lack the ability to adequately react to negative consequences of their antisocial behavior (Widiger & Sankis, 2000). In a similar vein, Gottfredson and Hirschi (1990) describe typical criminals as people with low self control that are not able to consider the long-term negative effects of their criminal behavior. It seems worthwhile to investigate whether

psychopaths and people with low self control resemble Damasio's brain patients in that they fail to develop certain emotions that warn them to engage in self-harming behavior. Some hints in this direction can already derived from Eysenck's theory of criminal behavior (1977).

As Gigerenzer and Todd (1999) have emphasized, emotions very often serve the function of shortening processes of judgement and decision making. However, up to now it has rarely been investigated why such strong emotions of liking (e.g. love) or disliking (e.g. disgust) emerge. Furthermore, it has to be studied, whether decisions that are governed by such strong emotions are adaptive or rather maladaptive. For example, it could be studied whether the happiness of marriage partners is related to the time it took to fall in love with each other or to decide to marry respectively. Are those marriages more happy in which both partners hesitated to engage in a their sexual relation or those marriages where both partner fell "head over heels" in love?

Choice over time

Do I go to the dentist in time or should I postpone this unpleasant visit until my teeth start paining? Should I invest in a good isolation of my house? Should I go on learning for my exams or should I join my friends having a party tonight? Should I eat one more piece of cake or should I stick to my diet? In many situations our behavior has consequences that do not appear immediately but only after an expanded period of time (e.g. teeth pain or failed exams). Many harmful behaviors can be described as having pleasant consequences in the short run but severe negative consequences in the long run. These behaviors imply addictive behaviors like smoking, drinking or taking drugs or the engagement in criminal activities, where the negative consequences (e.g. a prison sentence) appear only quite a long time after the criminal behavior.

As many experiments have shown the problem of heavily discounting future events is not only prevalent for addicts or criminals but is a constant of human nature (Ainslee, 1992). For example if people are offered to get an amount of 100$ in 28 days or an amount of 120$ in 31 days most subjects choose for the latter alternative. If the same subjects have the alternative to get 100$ immediately or 120$ in three days many subjects switch to the first alternative (Frank, 1992). However, such a preference pattern hurts rules of normative decision making because discount functions should be stable over time (i.e. should be the same for a period of three days independent of the temporal distance to the potential rewards). However, people have problems to adequately consider the long-term consequences of their behavior.

Such problems of shortsightedness and self control have been investigated by many different social scienctists like psychologists (Ainslee, 1992; Herrnstein & Prelec, 1992; Mischel, 1986), sociologists (Lindenberg & Frey, 1993) and economists (Becker & Murphy, 1992) (for an overview see the reader of Loewenstein and Elster, 1992). 1990 Gottfredson and Hirschi published a "general theory of crime" stating that criminal behavior is mainly caused by a lack of self control in the minds of the perpetrators (i.e. their disability to foresee and consider the negative consequences of criminal behavior). This book has been one of the most often cited publications in the field of criminology during the last decade (Cohn & Farrington, 1999). Thus, problems of intertemporal choice and self control have been in the focus of different social sciences.

However, by and large the problem of why humans (and other species) have such

a strong tendency to neglect consequences of their behavior if these consequences occur only with a temporal delay has remained a puzzle up to now. One partial explanation is offered by Ainslee (1992, Ainslee & Herrnstein, 1981). He argues that heavily discounting the long-term consequences of one's behaviors serves the function of restricting the set of alternatives that have to be considered when deriving a decision. Thus if we evenly divided our attention to the immediate and far future the number of possible consequences of our behavior that had to be considered would grow exponentially and could not be calculated anymore.

Though, this argument by Ainslee is not able to explain why many species in many situations act as if they were considering the long-term consequences of their behavior to a high degree. For example many animals (e.g. hamster) gather large amounts of food during summer and autumn so that they do not have to starve during the winter when no adequate food can be found. Given the effort it takes to gather food that is consumed only at a point of time very far away these animals seem to show a remarkable degree of self control.

For humans it could be shown that females prefer males with a high social status (see above). This preference has been explained by the fact that throughout evolution mothers heavily depended on the resources of her mate after the birth of a child. The amount of resources that a male could invest in the care for his mate and their common children at least partly depended on his social status within the group. Thus it was adaptive for women to develop a preference for males with a large amount of resources (Buss, 1999). However, the negative consequences of mating with a male that is only able to offer limited resources occurs at a point of time quite far away in the future (at least nine months). Thus it seems that human females face a severe intertemporal choice problem when they choose between different mates, especially if one considers that it is usually no problem for females to find males that are willing to start a sexual relationship with them (Buss, 1999).

Another example is the extreme persistence of small babies in learning how to stand upright and how to walk on their two legs. Given the extreme effort it takes to learn such a behavior and the postponed benefits of such an ability it seems as if babies had an extreme level of foresightedness and self control in this regard.

To summarize on the one hand humans and other animals do have severe problems in considering the long-term consequences of their behavior. On the other hand in many situations they seem to reveal a remarkably amount of foresight and self control.

How can this puzzle be solved? From an evolutionary perspectives it seems reasonable to distinguish between three different kinds of problems organisms have to solve. 1) Problems that imply intertemporal decision problems and that occurred constantly during the evolution of a certain species. In these cases the chance is high that throughout evolution specific adaptations have emerged guiding the behavior in a certain situation by activating a specific behavioral pattern (e.g. gathering food during summer and autumn; preferring males with a high social status; babies learning how to stand and walk). In these cases the organism does not feel a motivational conflict because its immediate desires guide him to maximize its long-term goals. 2) Problems that are important for the survival of an organism but which can be solved without distinguishing between short-term and long-term consequences. For example most lethal toxic foods that could be encountered by our ancestors led to death quite immediately. Thus, it was not necessary to resist the temptation to eat

something that tastes good but would do harm to the body in the long run. 3) Problems that were either not very important throughout evolutionary history or that only showed up because of a rapid change in the environment of a certain species so that this species did not have the time to develop specific adaptations to this problem (e.g. humans' desire for fat and sweet dishes that only is harmful given the living conditions in Western industrialized countries). With regard to these kinds of problems, Ainslee's argument holds that the human mind (and that of other species) was designed to pay attention only to the short-term consequences of their behavior because heavily discounting future consequences disburdens an organism from cognitive overload.

Thus the way humans deals with the long-term consequences of their behavior gives another example of the modularity of human cognition. It also clarifies that some behavioral patterns that were adaptive in the EEA turn out to be maladaptive under conditions of living in modern industrialized societies. The long-term consequences of nicotine and other drugs were virtually no issue during the most time of human history.

Possible fields of further research

Following the line of argumentation above it seems worthwhile to investigate in which domains humans are better or worse in considering long-term consequences of their behavior. The results of such investigations could then be compared with the degree in that such behavioral domains have been important throughout human history. One possible field of research would be males' and females' short- and farsightedness with regard to different life domains. For example it could be hypothesized that males find it more difficult to forego sexual temptations than females because the possible negative effects of such a behavior was constantly less severe for males than for females.

Another line of research would be related to the question on how to interpret inter-individual differences in discounting future events. Within criminology (Gottfredson & Hirschi, 1990) as well as in economics it is often assumed that impulsive and shortsighted behavior is irrational. However, Wilson & Daly (1997) argue that an individual's shortsightedness can be an adaptive reaction to the very environment in which this individual is living. For example, a female teenager living in an environment with high rates of homicide and a short average life expectancy is possibly well guided to get her first child very early (because otherwise she might be dead before she can get children) and not to concentrate her parental efforts into one single child but in many children (because getting many children heightens the chance that at least some of them will survive). Up to now this argument by Wilson and Daly has only been tested on a rather aggregate levels (by comparing life expectancies, birth rates and homicide rates of different neighborhoods). It seems worth to study these issues on a more microscopic level as well investigating whether impulsiveness is adaptive or maladaptive on an individual level.

Rationality and utility maximization

In the last sections it was discussed how humans (and other species) make decisions. It was emphasized that human behavior is heavily influenced by automatic processes that never come consciously to our mind. Human cognition was compared to an adaptive tool box in which specific tools are used to solve specific behavioral problems. Some of these tools can be described as fast and frugal heuristics that enable us to come to adequate decisions in a short period of time. Furthermore it was emphasized

that our decisions are heavily influenced by positive or negative emotions that accompany the anticipation of different consequences of our decisions. The last paragraph dealt with the fact that in many situations people tend to ignore negative long-term consequences of their behavior but one-sidedly concentrate on the short--term consequences of their decisions.

In this section the evolutionary perspective on human judgement and decision making is compared with two other meta--theoretical approaches : 1) rational choice theories of utility maximization and 2) the heuristics and biases approach in cognitive (social) psychology.

Rational choice theories

The way human behavior is described by evolutionary psychology appears to be in sharp contrast to theories of "rational choice" that are prevalent in many decision theories and that describe human decision making as rationally maximizing the expected utilities of the consequences of one's behavior. The core assumptions of these theories can be described as follows : When deciding between a number of possible alternatives, people regard many different dimensions simultaneously. On the one hand they evaluate all possible consequences of their decisions. On the other hand they consider the probabilities that these consequences actually will occur. If it is not possible to exactly calculate these probabilities they will use all relevant information available and will estimate these probabilities in a rational way (i.e. combine all information to a valid estimate). To come to a final decision people multiply the value of the possible consequences of each alternative with their probabilities and sum up these products. Eventually people will choose the alternative that reveals the highest "expected utility" (i.e. the alternative for which the sum of the multiplied values and probabilities is the highest).

These assumptions can be regarded to be the core of decision making models in many different social sciences. Within economics such models have been used to describe the behavior of economic agents (like producers and consumers). Gary Becker got a Nobel laureate for his attempts to expand this economic analysis of behavior to non-economic life domains like marriage behavior or criminality (Becker, 1976). In sociology similar models are used within the framework of "Rational Choice Theory" (Coleman, 1990). As economists rational choice theorists within sociology investigate how data measured on a macro level of analysis (e.g. divorce rates, number of people using their private car when going to work) can be explained by analyzing the decision making of rational individuals maximizing their expected utility (e.g. when deciding to divorce or stay with their partner). In (social) psychology similar models are often used. This is true for theories that explicitly deal with decision making (like the SEU-theory of Edwards, 1954) but also for theories in the domain of attitude research. For example in Ajzen's well known theory of planned behavior (1989) as well as in its predecessor, the theory of reasoned action (Fishbein & Ajzen, 1975) behavior is governed by the attitudes towards a certain behavior. These attitudes are assumed to be the summed products of the subjective value of each consequence of the behavior in question and the perceived probabilities of these consequences.

The "heuristics and biases" approach

The assumptions of such rational choice models have been criticized not only by evolutionary psychologists but also by many other (cognitive) psychologists. Kahneman and Tversky (1973, 1982) have argued that

humans do use a number of heuristics when making decisions that lead to systematic deviations from the notion of rational decision making. Their work has been very influential in the field and is often labeled as "heuristics and biases approach" to human decision making (for an overview of this work see Thaler, 1992; Kahneman & Tversky, 1982).

One example of such heuristics is the so called anchoring heuristic (Tversky & Kahneman, 1974) stating that people will estimate the value of a certain stimulus by adjusting their judgement to a certain starting point irrespectively of its diagnostic value. In their original study Kahneman and Tversky asked their subjects about the percentage of African countries in the United Nations. Before answering this question subject had to move a spin wheel that in one condition stopped at a value of 10 and in the other condition stopped at a value of 65. Subjects were first asked to estimate whether the percentage of African countries was lower or higher than the anchor value (i.e. 10% or 65%) and were then asked for a precise estimate. It turned out that those subjects in the 10% condition estimated the percentage of African countries in the UN to be 25% while those in the 65% condition estimated a value of 45% on average. Stephan & Kiell (2000) demonstrated that such anchoring effects are widely independent of subjects' expertise with regard to the value that has to be estimated. Subjects of their experiment were a sample of 142 professional and private investors presenting a capital of about 350 billion Euro. They were asked to estimate the DAX (the German equivalent to the Dow Jones Index) one year in advance. Before giving their precise estimate subjects in one condition had to indicate whether the DAX would be higher or lower than 4,500 points while the anchor value for the other condition was 6,500. It turned out that the estimates of these very experienced financial investors were significantly influenced by the anchor values (the values being 5765 vs. 5930).

Bazerman & Neale (1986) have summarized these and related results by concluding "biases … suggest that individuals are generally affected by systematic deviations form rationality" (p. 317). In a similar vein Thaler (1991) asserts that "mental illusions should be considered the rule rather than the exception" (p. 4).

An evolutionary perspective on judgement and decision making

From an evolutionary perspective rational choice theories appear to be of only limited value. Normative models of decision making are not able to describe real decision making of real people in real situations because they do not take into account the limited cognitive resources of human beings.

On the other hand the heuristics and biases approach has also been criticized by evolutionary psychologists. Gigerenzer (1991) has shown that at least a part of the identified biases in human decision making that have been demonstrated by Kahneman and Tversky have been due to presenting the subjects inadequate stimuli (for details of this discussion see Gigerenzer, 1996 and Kahneman & Tversky, 1996). More important however as these methodological aspects seems to be another point of criticism. Following the research tradition of Kahneman and Tversky many psychologists have conducted experiments whose main goal was to demonstrate how "foolish" people are and how prone they are to all kinds of mistakes and fallacies. Contrary to this evolutionary psychology emphasizes how people use their limited cognitive resources to make decisions in quite a successful way (consequently Gigerenzer and al., 1999, have titled their book "simple heuristics that make us smart").

However, at a closer look the heuristics and biases approach on the one hand and the conceptualization of heuristics from an evolutionary perspective on the other hand appear to be highly compatible. Both research paradigms emphasize that humans do use simple heuristics for judgement and decision making and that this usage is functional and adaptive. As you can describe a glass of wine as half full or half empty, scholars like Gigerenzer emphasize the adaptiveness of using heuristics, while the heuristics and biases approach tends to emphasize their flaws and drawbacks.

Prosocial and antisocial behavior

Fairness, cooperation and altruism

At first glance cooperative and prosocial behavior appears to be a miracle from an evolutionary perspective. Because reproductive success is bound to maximizing one's own resources it seems maladaptive to voluntarily give own resources away to other individuals. Therefore, it could be reasoned that evolutionary history rewarded selfishness and should have punished cooperation and altruism thus steadily decreasing altruistic tendencies in the human (and other) species.

However, as Hamilton (1964) has showed in his theory of "kin-selection" it can be adaptive for an organism to donate own resources to another individual if this individual is genetically related to the donator because such a behavior might help to spread one's genes more than pure selfishness. This theory of "inclusive fitness" is able to explain the behavior of species in which some individuals do not have the chance to reproduce themselves (e.g. aunts and bees). Hamilton's argument implies that people should invest more resources into their children (sharing 50% of one's genes) than into their nephews (sharing only 25% of one's genes) or into non-relatives ("blood is thicker than water"). This assumption could be confirmed in many studies (Buss, 1999). However, humans (and other species) are not able to directly identify the genetic relatedness of other individuals to themselves (Buss, 1999). Thus, they have to use valid indicators for deriving inferences about this issue. One valid indicator of genetic relatedness can be seen in the degree to which a certain person is similar to ourselves. Another indicator is the familiarity of others (if we know someone from his birth the chance is higher that we are genetically related to him than if we came to know someone when he or she was twenty). Thus, from evolutionary psychology it can be derived that we are the more willing to help someone the more this person is perceived as similar and familiar – a prediction that is very much in line with the empirical results concerning these two attributes (Bierhoff, in press). In social psychology, altruistic behavior is very often explained by the so called empathy--altruism hypothesis (Batson, 1991). This hypothesis states that people only help others who are in need when they experience empathic concern for the needy person. This "empathy altruism hypothesis" could be confirmed in many empirical studies and experiments (for an overview see Batson, 1991 ; Bierhoff, in press). Cialdini *et al.* (1997) have argued that empathic feelings are strongly determined by a feeling of "oneness" with the needy person. According to Cialdini *et al.* only if we feel as if suffering ourselves do we feel a need to help others. Furthermore, they could show that feelings of "oneness" are very much related to perceptions of similarity and familiarity with the victim. To summarize humans experience a higher level of empathy and a willingness to help for people that are

perceived as being similar and familiar to themselves. From an evolutionary perspective such a behavior is highly adaptive because similarity and familiarity are (at least rough) indicators of genetic relatedness.

However, many cases of human cooperative behavior cannot be explained by the theory of kin-selection because they take place between genetically unrelated organisms. To explain the fact that humans (and other species as primates) engage in such behavior, Alexander developed the theory of "reciprocal altruism" stating that individuals will make their own level of cooperativeness towards a certain person dependent on that person's behavior towards themselves in the past. As a number of computer simulations have shown (Dawkins, 1976; Axelrod, 1984) organisms are able to maximize their own outcomes if they engage in a so called tit-for-tat strategy. This strategy implies to react to the cooperative behavior of others with behaving cooperatively oneself and to react to the non-cooperative behavior of others by behaving uncooperatively oneself. Two further conditions of such a tit-for-tat strategy are also important: 1) always start a relationship with a new interaction partner by behaving cooperatively and 2) do not react to the uncooperative behavior of others by endless retaliation but by acting uncooperatively oneself only once. The strategy of tit-for--tat is a good example of an efficient fast and frugal heuristic as they have been outlined above. Applying tit-for-tat only needs minimal computational capacities but has been shown to be a more effective strategy in iterated prisoner dilemmas than any other strategy (Axelrod, 1984). From this analysis of reciprocal altruism it can be derived that humans do have the ability to identify cheaters by keeping track of own and others' inputs and profits from an ongoing exchange relation (Buunk & Schaufeli, 1999; Cosmides & Tooby, 1992). Furthermore it can be predicted that people do have a strong preference for balanced relationships (i.e. those relationships in which the ratio of owns inputs and outcomes equals the ratio of one's interaction partners). This assumption could be confirmed in many different studies (for an overview see Buunk & Schaufeli, 1999). People feel guilty and ashamed when they get more than what they deserve; they feel angry and a desire for retaliation when they are exploited by others.

However, it is often neglected that tit-for-tat can only explain cooperative behavior under certain limited conditions. One crucial condition is a sufficient large "shadow of the future" (Axelrod) that is the perception of the interaction partners that their relationship will go on to exist for an (in principle) unlimited amount of time. Nevertheless, many people tend to cooperate with others even under conditions of total anonymity and when they know that there will be no further interactions in the future. To illustrate this point, suppose you participate in an experiment and are given $50 from the experimenter. Your task is to divide this money between yourself (person A) and another subject (person B). However, you don't know who this other person is and will never come to know her. The experimenter tells you that the other person will be informed about the distribution of the money that you are offering to her. This person then has two options. Either she can accept your offer – then the money is divided exactly the way you proposed. Or she rejects the offer – in this case the money is given back to the experimenter and both of you get nothing. How much of the money would you keep for yourself and how much would you offer to the other person? If you were person B in this experiment, what amount of money would person A have to

offer you to make you accepting the offer? Now suppose you participate in a related experiment. Again you have to divide $50 between yourself and another person. However, in this case the other person has no opportunity to reject your proposal. She is just given what you are offering to her. How much would you be willing to give to person B in such a situation?

The two situations described above are called „ultimatum games" and „dictator games" respectively. Empirical studies show that within ultimatum and dictator games offers of person A lie on average between approximately 40-50% (for an overview see Güth, 1995; Camerer & Thaler, 1995). In ultimatum games on average only offers that are above 25% of the whole amount of money are accepted by person B (Kahneman, Knetsch & Thaler, 1986), indicating that people are willing to "sacrifice considerable monetary amounts to punish someone who has been too greedy and that they do so even if it will be of any help for them in the future" (Güth & Tietz, 1990, 447). These results are remarkably independent of the amount of money that is to be distributed. In an ultimatum game experiment conducted in Indonesia, only 3 of 37 subjects made offers below 20% though subjects had to distribute an amount of money that equaled an average salary of three months (Cameron, 1999).

Frank (1988) has offered a theoretical solution to the fact that people often act cooperatively even in situations where no future interactions are to be expected. The main argument of Frank can be summarized as follows: if cooperative and prosocially oriented people are able to identify each other they will choose each other as interaction partners and will thus achieve a higher outcome than people who do not have a disposition to behave fair and cooperative. However, egoistic and non-cooperative people do have a strong incentive to *appear* as being trustworthy and cooperative. This had two effects: a) people do have a strong incentive to distinguish between those that are really trustworthy and cooperative and those who only pretend to be so; b) people that are cooperative and prosocial do have a strong incentive to send valid signals of their trustworthiness that cannot easily be imitated. According to Frank these incentives resulted in people being able to identify each other's trustworthiness. Thus prosocial individuals could survive and do have reproductive success because they were able to identify each other for mutual cooperation. However, to appear to be trustworthy one must act fair and honest regardless of the concrete situation in which one is acting because otherwise one's cooperation would be perceived to be caused by strategic considerations.

However, as Frank shows, the (reproductive) value of being cooperative or not is to a high degree dependent on the frequency of both strategies. Therefore, an equilibrium emerged with some people being cooperative and others being rather non-cooperative. The theory of Frank helps to explain why empirically both phenomena can be observed: On the one hand prosocial behavior with people being willing to sacrifice remarkable amounts of resources for the goodness of others and on the other hand selfish and egoistic attempts to exploit others.

To summarize one can say that there are at least three theories why an organism might be able to increase its reproductive success by being cooperative. 1) The theory of kin-selection arguing that by helping one's kin one is actually acting for the sake of one's own (selfish) genes. 2) The theory of reciprocal altruism arguing that in some situations it is profitable for selfish actors to cooperate with each other. 3) The theory of Frank arguing that an organism's ten-

dency to act fair and cooperative might increase one's reproductive success, if one is able to be identified as fair and identifying others with the same behavioral tendencies. Thus, in contrast to the selfishness axiom of "homo oeconomicus" it must not at all be irrational to care for justice and fairness in one's behavior.

It is important to note that these three theories are able to explain prosocial human behavior without referring to theories of groupselection, but by indicating which reproductive advantages prosocial behavior does have for single individuals.

Furthermore, it should be stressed that the underlying reasons for prosocial behavior do not have to be conscious at all. For example, parents do invest many resources (like time and caregiving) into their children without being aware that one reason for this is that their children serve as a transmitter for their own genes. Within the framework of Frank's "commitment model" one could even argue that getting aware of one's reason for cooperation might undermine one's prosocial behavior. Thus the realm of prosocial behavior can be regarded as another example of the adaptiveness of "irrationality" and automaticity of human behavior.

Possible fields of further research

As has been outlined above solidary and helpful behavior is very often related to feelings of empathy and oneness with the people in need. Given this ancient heritage of mankind the question emerges of how people can be stimulated to act solidarily with people(s) they have never seen or contacted in the past. Given the increasing globalization this question is not only of scientific but also of practical relevance.

As has been discussed above people do have a strong tendency to reject unfair offers by others even if such a behavior does not "pay" for them in the future (e.g. under conditions of interactions with an anonymous interaction partner). Bowles and Gintis (1999) have argued that one reason for prosocial behavior to occur is that people have to fear that their antisocial behavior will be sanctioned by others (see also Heckathorn, 1989, for a similar argument). For this reason it seems worthwhile to further investigate how such a proneness for retaliation could emerge throughout evolution and to study its situational determinants as well as interpersonal differences in the willingness to sanction the antisocial behavior of others.

The commitment model of Frank (1988) outlined above has rarely been empirically testes in the past (for an exception see Frank *et al.*, 1993). Given that it is able to solve a number of theoretical problems in the field of prosocial behavior, it seems worthwhile to investigate systematically whether it can be validated empirically. To do this a number of different research questions should be addressed. 1) Are people really stable in their tendency to act prosocial or antisocial (as Frank's theory implies)? 2) Are people with a prosocial orientation able to signal this attribute to others (i.e. are they perceived to be cooperative by others)? 3) What kind of cues do people use to estimate the trustworthiness of others (see above)? 4) If "cooperators" and "defectors" can be identified by others which consequences does this have (e.g. are cooperators chosen as interaction partners more often than defectors)?

Aggression and violence

Human aggression often appears to be maladaptive and pathological (for example if a man kills his wife because he suspected her to have a sexual relationship with another man). However, as Buss and Shackelford (1997) have shown, aggres-

sion serves a number of adaptive functions for humans (and other species).

First, aggression can be used to co-opt resources that are owned by others. Complementary, aggression can be used to defend oneself against being attacked by others and thus to prevent that one is losing resources by other's use of violence. Another function of aggression is to compete with rivals about success to members of the opposite sex. As Daly and Wilson (1988) have shown, many homicides occur because a man thinks that another man has had sex with his wife. Furthermore aggression can be used to gain status and power in one's own group. For example in many hunter and gatherer societies it can be observed that the social status of a man is positively related to the number of other men that he killed during warfare with other tribes (Chagnon, 1983). Additionally, men often use violence to deter their mates of having sex with other males. Many studies confirm that male sexual jealousy is one main reason for male wife battering (Buss, 1999). Moreover, Daly and Wilson (1988) have shown, that children are at a much higher risk of being beaten (or even killed) when they are living with stepparents (especially stepfathers) than when they are living with their biological parents. Cases of infanticide can not only be observed with humans but also with other species. If, for example, a young lion displaces another male and takes over his female, he very often kills all children of his predecessor. This brutal behavior serves the adaptive function of avoiding males to invest into offspring that is not genetically related to them.

Thus, aggression serves a number of adaptive functions. However, engaging in aggressive acts has been of different advantage for men and women throughout their evolutionary history because – as has been outlined in the "theory of parental investment" – males had to face much more intra-sexual competition than females (for an overview see Daly & Wilson, 1988 ; Buss, 1999). This is mainly due to sex differences in reproductive opportunities. While the maximum number of offspring for females is highly restricted, men theoretically have the chance to get hundreds of children. This difference did have two important consequences. On the one hand the variance in offspring was much bigger for males than for females giving some males the opportunity to have very many children while others did not have the chance to reproduce themselves at all. On the other hand females' parental investment was much higher than males' because they had to concentrate their resources on a smaller amount of children (and could be sure that it is really their *own* child for which they are sacrificing their own resources). Because females invested much more in their offspring than men access to fertile females became the limiting resource for the reproduction of males. For that reason males heavily competed for this resource. However, to be successful in the competition with other men (and to be attractive for females) males had to possess a high social status and acquire a position of superiority over other men. According to Buss & Shackleford (1997, 613) human evolution therefore has evolved men that engage in „risky strategies, including those that lead to violent combat with rivals and those that lead to increased risk taking to acquire the resources needed to attract members of the opposite sex". On the other hand it seems plausible that women were more successful in securing the survival of their offspring if they had a low level of aggressiveness and avoided possible dangers. Campbell (1999) has argued that it was more important for women than for men to stay alive for a long time because the survival of one's offspring was depending more on

the physical presence and care of the mother than of the father. Thus, evolution has resulted in relatively high levels of risk seeking and aggressiveness for men and relatively low levels of risk seeking and aggressiveness for women. In line with the theory of parental investment males engage more often in acts of violence than females. As Daly and Wilson (1988) have shown, in a large number of studies at different cultures, continents and at different centuries both the typical perpetrator and the typical victims of homicides have constantly been males.

Possible fields of further research

As Buss and Shackelford argue, the cross--cultural consistency of these results shows that acts of violence cannot solely be attributed to factors that are only apparent in modern cultures (like violence in television or in movies). However, while evolutionary psychology was able to demonstrate that aggression and violence did serve several adaptive functions throughout evolutionary history and why men are constantly more violent than women there are a number of questions that still remain open. On the one hand these questions are related to inter-individual and cross-cultural differences in aggressiveness. For example: Why are the homicide rates in the USA much higher than in European countries like the Netherlands? Why do some men react to their wife's infidelity with aggression and violence while other men just retreat themselves from their marriage? On the other hand, it has to be explained why in some (sub-)cultures violence is an accepted means of solving conflicts while in other (sub-)cultures this is not the case. For example: A university professor beating his colleague when discussing the distribution of research money would surely not increase his social status but would negatively be sanctioned by the other members of his faculty (Buss & Shackelford, 1997). Related to this is the question whether violence and aggression in today's Western societies is or is not an adaptive means to achieve social status. What is for example the relation between status and pupil's aggressiveness in their class at school?

Summary and outlook

The aim of this paper was to outline an evolutionary explanation of automaticity and irrationality in human behavior and decision making on the one hand and both prosocial and antisocial (aggressive) behavior on the other hand. The starting point of such an explanation was the question of which adaptive functions seemingly sub--optimal and irrational behaviors could have served in the evolutionary past. Following this approach it could be shown that many of the identified "anomalies" in human behavior make sense from an evolutionary point of view. However, to say that patterns of human behavior are mostly adaptive (or have at least been in the EEA) does not mean to say that humans do act "rational" (i.e. utility maximizing). Quite to the contrary, evolutionary psychologist hold that the terms of "rationality" and "irrationality" do not make very much sense at all but should be changed by the notion of "adaptiveness" analyzing how patterns of human cognition and decision making have been able to enhance the chance of survival and reproduction in the past. However, it has to be emphasized that adaptations in a given species at a certain point of time are always only one possible solution to a given problem. Better and more efficient solutions would be always possible.

In the last years evolutionary theories have already been applied to a vast number of research areas like aggression (Daly &

Wilson, 1988), sexual behavior and mating preferences (Buss, 1999), jealousy (Buss, 2000) aesthetics (Thornhill, 1998), attachment (Zeifman & Hazan, 1997), rape and coercive sex (Thornhill & Palmer, 2000 ; Malamuth & Heilmann, 1998) prosocial and altruistic behavior (Buunk & Schaufeli, 1999) or social identity (Caporael & Baron, 1997).

However, given the long past, but short history of applying evolutionary theories to the study of human behaviors, these attempts only build a starting point for further investigations. In the future, the logic of Darwinian thinking will further help to solve puzzles of human behavior also in areas where the paradigm of evolutionary psychology has not yet been applied.

Hopefully, this paper was able to provide some answers with regards to questions of automaticity and irrationality in human behavior. The ideas developed in this paper could help to guide some new research in the area of human judgement and decision making.

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Abstract

The rational choice theorists argue that human decision making can be regarded as rational and conscious. On the other hand researchers studying heuristics, biases and automatic processes emphasize human irrationality.

The aim of this paper is to show how this argument may be solved by another meta-theoretical paradigm that has emerged mainly within the last decade and that was labeled evolutionary psychology (for introductions see Buss, 1995, 1999 ; Gaulin & McBurney, 2001 ; Crawford & Krebs, 1998). This approach argues that human cognition and behavior is the result of an

ongoing adaptation of humans to their natural and social environment. While cognitive (social) psychologists during the last decades spent much time demonstrating the error proneness of human cognition and decision making, evolutionary psychology rather emphasizes the efficiency with which the human mind uses its specific cognitive capacities to behave in an adaptive way (Gigerenzer & Todd, 1999 ; Pinker, 1997).
In this paper the main elements of evolutionary thinking are described and it will be discussed how evolutionary theory may help to solve the puzzle of automaticity and irrationality in human cognition and behavior.

Primit la redacţie : aprilie 2004