# A DISCUSSION OF THEORETICAL AND PRACTICAL RATIONALITY

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## 1 Introduction

Rationality has been discussed at length in philosophy, applied mathematics, economics, psychology and social sciences. One of the problems has been to combine a practical everyday rationality with various theoretical frameworks. A rational person is, according to a dictionary definition, someone who is agreeable to reason, sensible, sane, intelligent, enlightened, etc. Rationality is closely connected to the correctness of choice and decisions. The problem is then to find out when a decision can be considered correct.

A typical characteristic of decisions is that their correctness can be assessed only in hindsight. Correctness itself can therefore not be used as a criterion for defining rationality, because decisions have to be made with information available at the time of the decision. Rationality may therefore be said to be the use of available information in order to make the best possible decision.

Man is a social animal and rationality can therefore not be considered only from an individual point of view. A definition of rationality from a societal point of view is however problematic, because societal functions are always executed by individuals which may cause a conflict between individual and societal rationality. The paper discusses rationality from several angles of departure. A conclusion of the paper is that rationality as a concept is far more complicated than at first sight.

## 2 Efficient decision making as a survival function

Historical records of mankind are found from several thousands of years and prehistorical records of findings exist from more than twenty thousand years back. During its existence mankind has demonstrated a remarkable adaptation to various environments. The survival value for individuals and societies is therefore a practical approach towards a definition of correct decisions i.e. rationality.

### 2.1 Survival of the individual

Considering the survival of species there are many niches where a comparative gain can be found. Early man relied on two types of decisions, one to initiate a rapid sequence of actions in response to some stimuli and the other which could be made with more time and contemplation. In the first type of decision men rely on reflexes and prelearned sequences of actions. In the second type of decisions there is not the same time urgency, which means that alternatives can be assessed more systematically, it is possible to ask for advice and it may even be feasible to create new tools.

The most important quality of human decision making is reasoning about causes and consequences. This reasoning is based on the discovery of certain lawfulness in nature, which can be used to select the best action to take. Human decision making relies thus on an understanding of the world in relationships of causes and consequences. Some of this understanding is tacit and other is used more consciously in making decisions. In considering various world models, their survival value is evidently related to their predicting power.

Real world decisions do not appear one at a time, but there are continuously many decisions fighting for attention. A rational decision-maker should therefore be able to attend to urgent decisions before considering less important ones. This ability of allocating attention to decisions according to their importance has a survival value. In searching for a decision there are also criteria by which further effort are terminated when a good enough alternative has been found. Also the stopping criterion has a survival value by ending unreasonable efforts in finding minor improvements of a decision. Handling several decisions at a time has to rely on a consideration of the situation as a whole. In real world situations it is likely that versatility and flexibility are more important than optimality in single decisions.

The use of earlier experience can be the factor, which makes it possible to select a superior decision. The use of accumulated experience in choice and decision making therefore has an important survival value. Accumulation and use of experience depend on methods for information storage and retrieval. Man can remember events, but the collection of experience in a form, which makes it possible to pass it on between members of a society, and between generations

has an even larger survival value. Spoken language has therefore an important function in making communication and co-operation possible, but it also has an important function in making it possible to accumulate information. The use of written language further improved the possibility to store and retrieve information.

### 2.2 Survival of a society

Individual survival depends on the co-operation with other individuals in a society. It is therefore rational from an individual point of view to allocate efforts to support the society and its survival. Co-operation in small and large societies has been an important factor in ensuring survival of mankind. Individual specialisation brought a benefit to the society through the possibility of its individuals to reach higher efficiency in their tasks. Specialisation gave the possibility to conduct co-ordinated operations involving several individuals in different functions. Division of labour makes it also necessary to share the benefits of co-operation. If this sharing is not considered fair co-operation cannot continue. In a society people will help others in the expectation for later compensations in similar help. In a society there will always be an ongoing social game in giving and receiving various services.

Important innovations such as domestication of animals, agriculture, building technology and metals made it possible for civilisations to emerge. The creation of laws and social norms made further specialisation possible and co-operation easier. The society also included protection functions for its members against dangers. The emergence of societies moved competition from an individual level to a competition between societies. The risk to be invaded and enslaved by another society therefore becomes the largest threat. In this competition warfare become the mean to reach the ends of power. Efficient warfare depends on technology, but also on the skills of single soldiers and their leaders. An efficient army is not possible without societal surplus, because time has to be devoted to the production of arms and on drilling the soldiers for their tasks.

There is a benefit of building up service functions in a society, which can be used as a privilege by members of the society. Such services are usually taken care of by societal institutions. The benefit for the society is that a better efficiency is obtained if the services are arranged centrally. Resources for the services can be collected either through voluntary contributions or through a taxation system. In both cases the collection process and the use of the collected funds have to have its own administration. Typical service functions in a society are the protection from internal and external threats provided by the police and the army. Others are connected to education and the accumulation of knowledge. The creation of an interchangeable object of value, i.e. money is also commonly arranged through societal institutions.

In a society the co-ordination function becomes important. Typically it is executed by an individual given the power to lead. Leadership sometimes implies decisions, which in the interest of the society sacrifices the interest of some of its individuals. There are various ways to assign that leadership and in the early societies it was most likely a harsh process. For the society it is beneficial to get a strong leader who has the skills to create a vision and the charisma to get people to fulfil it. For the leader the power of a high position in a society seems to be a benefit of its own, not counting other benefits. Another important societal function is connected to the need for avoiding societal unrest and devastating power struggles in selecting leaders.

## 3 A theoretical discussion of rationality

Rationality in a theoretical sense can be defined as the selection of the best decision in a certain situation. Rationality therefore implies an order relation, which is used to compare decision alternatives. A comparison cannot be based on the outcome of the decision alone, because outcomes may be valued differently. There are always uncertainties associated to outcomes. The prediction of the outcome of a certain decision alternative relies on a systems model, which therefore becomes an integrated part of rationality. The benefit of a theoretical formulation of rationality is that it helps in identifying main components and their relationships.

### 3.1 Comparing decision alternatives

Rationality relies on the cause consequence relationship between a decision and its outcomes. A decision-maker has always some model for what the outcome will be if a certain decision alternative is selected. This model is an important part of any decision-making problem. Sometimes it is relatively straightforward to obtain this model is, but more often there are several difficulties involved. The systems model can never be perfect, but it will always involve uncertainties in structure and parameters. Recent results in mathematics demonstrate that also small changes in parameters or initial values may have large influences in the outcomes. Uncertainties will introduce probability distributions in the space of outcomes, which have to be taken into account assessing the relative merits of the decision.

The outcome of a decision will give the decision-maker some utility. This utility is seldom directly connected to the outcome, but it is instead converted to utility in a utility function. Utility functions are often normalised to give zero utility for a zero outcome. A utility function should be monotonous and a common assumption is that it is continuous. It is important also to note that there may be not only one, but several utility functions connected to one decision. Sometimes utilities may be converted to each other using a common object of value such as money. If both the outcomes of a decision and investments needed to reach that outcome can be measured in money, the costs and benefits of a certain action can be assessed. When a high benefit to cost ratio is reached the decision has a high utility. In considering various utilities there is sometimes a complication, because some output may have to be avoided and other assured.

### 3.2 Expected utility theory

Expected utility theory (EUT) builds on the principle that decision-makers select the decision alternative for which the expected utility is maximised. If for instance there are m decision alternatives $\{a_i \mid i=1, \ldots, m\}$ and n possible outcomes $\{c_j \mid j=1, \ldots, n\}$ such that $p_{ji}$ is the probability of the outcome $c_j$ given the decision $a_i$ then the decision maker is according to EUT supposed to select the decision $a_k$ for which $?_i\, p_{ki}u(c_i) \; ? \; ?_i\, p_{ji}u(c_i)$ for any j. When the outcome of a decision is obtained directly in monetary terms $\{x_i \mid i=1, \ldots, n\}$ the comparative merits $y_{kj}$ of a decision $a_k$ over the decision $a_j$ can be calculated as $y_{kj} = ?_i\, p_{ki}x_i - ?_i\, p_{ji}x_i$. This can be compared with a compensation $z_{kj}$ the decision-maker has to be paid for preferring the decision $a_j$ to the decision $a_k$. If $z_{kj} - y_{kj} = 0$ the decision maker is said to be risk neutral, if $z_{kj} - y_{kj} > 0$ he is said to be risk averse and if $z_{kj} - y_{kj} < 0$ he is said to be risk prone.

EUT is based on four axioms by which a decision-maker defines his preference between alternatives [1]. The first axiom assumes a cancellation principle which requires that if an alternative A is preferred to an alternative B then it shall be preferred also in the combined alternative A&C to the combined alternative B&C, where C is an arbitrary addition to the alternatives not depending on them. The second axiom postulates transitivity in the preference relation such that if an alternative A is preferred over an alternative B and B is preferred over C then A is preferred also over C. The third axiom assumes a dominance principle which means that if an alternative $A=\{a_1, \ldots, a_n\}$ is dominating an alternative $B=\{b_1, \ldots, b_n\}$ in such a way that each $a_i$ is preferred to each $b_i$, then A should be preferred over B. Finally an invariance principle is assumed to apply where the preference of an alternative A over an alternative B should be independent of how it is presented for the decision maker.

### 3.3 Extensions of the expected utility theory

The consideration of several decision-makers with completely or partly conflicting utilities has been treated in the theory of games [2]. The difficulty in the treatment of games is that each player has to take into account the possible actions of the other players in making his decision. In the theory of games a difference is made between zero-sum games where the gain of one player is the loss of another and non-zero-sum games where the utilities are conflicting only partly. An interesting result of the theory is that the decision-makers in some zero-sum games should establish a mixed strategy, where the players select random actions.

In many decisions costs and benefit occur at different times. Such situations can be handled by agreeing on an interest rate to be used and calculating the amortised present value for costs and benefits. The handling of multiple utilities are sometimes more problematic. For the case that the utilities can be converted to a single object of value the decision-making problem is reduced to the standard EUT formulation. If that cannot be done a reduction to the EUT formulation may still be obtained by defining the utility as a weighted sum of the original utilities. If the utilities are too incompatible a weaker theory, multi-attribute utility theory (MAUT), can be constructed. In this case an optimal decision should be Pareto-optimal which means that it is not possible to increase one of the utilities without decreasing another.

Repeated plays of non-zero sum games have shown to exhibit interesting properties [3]. The prisoners-dilemma game provides one example in this connection. This game is played between two opponents who both have the opportunity either to co-operate or to defect. If both co-operate they are paid a reward R, if one co-operates and the other defects, the co-operating party pays an amount S and the defector gains an amount T. If both defect both get a punishment P. The game gets its interesting properties when T>R>P>S and R>(T+S)/2. If a repeated co-operation is achieved then the reward for both players will be U=R+w*R+w*w*R+ ... = R/(1-w) which is positive when 0<w<1 for the discounting factor w. In repeated play it is clearly advantageous for both parties to co-operate, although a single play of the game would support defection as the most rational decision. The optimal strategy for the game is a simple tit-for-tat strategy in which one starts to co-operate and after that simply repeats the earlier decision of the opponent.

## 4 Limits of theoretical rationality

Ideally a theory of rationality should provide a descriptive, normative and predictive framework for decision making. Unfortunately EUT cannot do that, as several authors have pointed out. The reason is that human decision-making and rationality is far more complex than what a simple theory can explain. The complexity implies a need for several amendments to the EUT before any claims could be raised that the theory provides an accurate model of human rationality. These amendments will however make the theory complex and impractical.

### 4.1 Real world decisions

The largest difficulty in applying a theoretically defined rationality is that it is very hard to describe all aspects of a certain real world decision within the very restricted frame provided by EUT. There is seldom just one decision to be made, but instead an intricate web of decisions which all interact with each other. In a theoretical model decision makers have to stick to the rules of the game, but in a real world situation decision makers can apply their own rules by cheating, bluffing and forming coalitions. In real decision making situations outcomes are seldom possible to predict with a good accuracy and it is a decision making problem of its own to decide on what background information is needed. The involvement of several decision-makers either in co-operative or competitive situations bring in its own flavours, which are difficult to describe in a theoretical model.

A theory should at least in principle be possible to validate. Various experiments in decision making have been conducted and compared with predictions of the theory. For ethical reasons experiments in decision making are never able to match real decisions. Experiments are therefore by the subjects likely to be seen as games, which are undertaken for entertainment. Experimental design should in principle be able to control crucial variables, but in practice it is impossible to take all possible psychological and social factors in consideration.

The most serious critique of EUT is that people do not behave as the axioms assume. The axiomatic formulation got its first severe criticism by the observation that people tend to prefer a certain outcome as compared to a probabilistic payoff with a higher expected value. This deviation can be explained in many ways, but a believable explanation is that people are not used to be offered benefits in a continued fashion and a smaller but certain gain therefore is preferable. Another observation is that the framing of the decision-making problem has an influence on decision made in an experimental situation. A simple explanation is that the assumed expectation, which the experimenter places on his subject, has an influence on the decision made. A third type of violation has been observed in negotiations where parties fail to reach Pareto-optimality in their agreements [4]. Again there are many factors, which may influence the outcome such as the fear for loosing ones face, unwillingness to invest more time for a small expected gain or the expectation for a second round of negotiations where earlier decisions can be improved.

### 4.2 Bounded rationality

The concept of bounded rationality [5] is an attempt to recognise the fact that decision making itself involves an effort. In a real world of decisions it is not optimal for a decision-maker to approach each single decision with the same vigour. To behave rationally he has instead to see the big picture and solve the problems in an order, which is based on their importance and urgency. There are continuously many different decisions, which are competing for attention, which is a scarce resource. Theoretically a decision-maker should use decision analysis to select which one of the decisions should be solved first and concentrate his resources on that. Such an approach may however lead to indecision, which certainly is not rational.

Utility functions are often far more complex than the simple theory assumes. Utilities are seldom linear with respect to outcome. This implies that it is very difficult to get reliable estimates of actual utility functions and their shape over a large domain of outcomes. In practice there are always several utilities, which should be balanced against each other. A simple approach is to agree on conversion factors between utilities, but the problem is then to find agreeable and stable conversion factors. For costs and benefits occurring at different times, a simple item of disagreement is the interest rate to be used for discounting future outcomes. Attempts to elicitate values of a decision-maker will easily fail and the theory can neither be validated nor falsificated.

A last point concerning the applicability of EUT is that any axiomatic theory has its own limitations with respect to problems, which can be handled. According to a famous theorem of Gödel there are only two possibilities for an axiomatic system, either there are contradictions in the system or there are problems which are undecidable within the system. Assuming that EUT axioms are not contradictory the implication of this theorem is that there are undecidable decision making problems which are possible to express within the axiomatic framework. The undecidable problems may be resolved by adding new axioms, but this will bring in new undecidable decision problems. The con-

sideration of different variations in the axioms has therefore a more theoretical than practical value.

# 5 Individual rationality

There are many psychological aspects to be considered in a treatment of a practical rationality. One aspect is concerned with the utilities people use. People are not interested in money alone and utilities vary over time and with the mood of the decision-maker. A second aspect is connected to cognitive processes. The internal model of how the world behaves will influence decisions and is therefore a part of rationality. Problem solving skills and the use of pre-learned solutions patterns can improve decision quality. Finally personality, self-image and the roles a decision-maker assumes will also influence his decisions.

## 5.1 Utility functions

An important observation in the study of human senses was that the effect of a change in stimulus is proportional to the absolute level of the stimulus. This observation applies to a stimulus effect relationships and a similar relationship can be assumed to apply also for the relationship between outcome and utility. The change in utility, du, is then proportional to the relative change in outcome dx, or $du = dx/(1+x)$ where 1 is the normalised present wealth of the decision-maker. This equation gives a logarithmic relationship between utility and outcome written as $u = \ln(1+x)$. The outcome of $x=1$ corresponds to a doubling of the present wealth of the decision-maker. The outcome $x=0$ represents status quo with the utility $u(0)=0$ and an outcome of $x=-1$ corresponds to a loss of everything and gives an infinite negative utility. A decision-maker that has a logarithmic utility is risk averse. The logarithmic utility is plausible for outcomes $x>0$, but for $x<0$ it may not be a good descriptive model.

Maslow provides an important insight in a discussion of human utility functions [6]. According to his theory, needs are addressed in a sequence starting with the most basic needs after which the other awake in a sequence. On the most basic level there are physiological needs, such as needs for food and water. On the second level safety needs are awakened, such as the need for protection against danger, threat and deprivation. On a third level social needs enter, among which needs for belonging, association, love and acceptance. The fourth category of needs is ego needs, which on one hand are concerned with self-esteem and self-confidence and on the other with status, recognition and appreciation. The highest category is the needs for self-fulfilment, which are concerned with the realising of own potentials.

## 5.2 Cognitive aspects of decisions

An understanding of how the world behaves is an important part of any decision. Cognitive aspects are therefore a crucial part of human rationality. Research in problem solving has identified various learning processes as important factors in the creation of skills. People learn in the exercise of a task and with learning the task is performed more smoothly. In learning a skill three stages have been identified. In the cognitive stage only the knowledge base of the task has been acquired, in the associative stage a procedural understanding of the task has been put in practice and in the autonomous stage the task is executed with a large skill [7]. The benefit for the individual is that the attentional load of the task is decreasing when it becomes more autonomous.

One important observation from cognitive psychology is that it seems possible to learn generic problem solving skills. This indicates that methods can be learned and applied for wide ranges of tasks. Another cognitive aspect of decision making is that people tend to have difficulties in handling probabilities especially when they are small. A similar difficulty is connected to the understanding of very large costs.

Beliefs can be seen as internal models for how the world behaves. Beliefs may or may not be correct. Beliefs influence decisions in the same way as factual knowledge. The so-called cognitive dissonance theory has been suggested in social psychology [8]. It predicts how people will behave when they experience a contradiction in their own beliefs. When this occurs there will be a reorganisation of beliefs to make the contradiction to disappear. The reorganisation may sometimes change some of the beliefs and sometimes new beliefs are created to explain the contradiction. An understanding of how beliefs develop in the interaction with norms and values would be an important part of a deeper understanding of human rationality.

The allocation of attention and time for various purposes is not a well-researched subject. One may assume that demands of the external world determines very much of this allocation. On the other hand there is always some surplus which can be spent relatively freely. One way to spend surplus activities is to use them in the preparation for future challenges. A willingness to invest in the future is less likely if there are large uncertainties in the environment. This is also reflected in economics where a low discounting rate is a precondition for

long term investments. Attention and time is sometimes also allocated for purposes, which on a first sight may not seem rational at all. A closer examination may again demonstrate that the activity brings a certain utility on a shorter or longer scale.

### 5.3 Personality and self-image

Personality can be seen as a tendency, when all other factors are unchanged, to make certain behaviour more likely. Personality is a combination of inheritance and environment. The problem of considering personality in decision making are the difficulties associated with measurements of personality and predictions how personality will affect various decisions.

Decisions are often made in certain roles and social norms of these roles will thus be reflected in the decision. People have an image of themselves and these self-image influence decisions they make. There is also the process of rationalisation where people, when a decision has been made, very convincingly tell themselves various reasons for why it was correct. This will occur especially when an individual has made a decision, which is in conflict with his self-image. This rationalisation can be one mechanism by which regret is kept on a manageable level, not to interfere with later decisions. The self-image is further influenced by decisions and their outcomes in the forming of beliefs and norms in a continuously ongoing process.

## 6 Societal rationality

If the human mind is difficult to understand, the difficulties increase with several orders of magnitude when interactions of humans in a society and with the society have to be understood. There are always conflicts between individual and societal rationality, which are reflected in these interactions. One way to approach this conflict is to consider the society as an agent in its own right with its own rationality. The only problem with this interpretation is that societal decisions still have to be formulated and executed through individuals.

### 6.1 Common resources

A society relies on the collection and distribution of common resources, which at an individual level would be impractical to collect. The most important resource in this respect is a common language. Language is needed in all communication and, with an analogy from communications theory, language forms the transmission media for exchanging thoughts. If the language is efficient it is possible to share complex thoughts. Spoken and written language is important for maintaining law and order in a society. In generalising the concept of language, it can also include theories and models for how nature is constructed and how it responds to different actions. A society, which has an efficient language, is likely to be more competitive than a society with a less efficient language.

In a society there are resources which are not decreased by being shared and others which are decreasing every time someone uses his share. Knowledge is an example of the first kind of commons and seed stored for possible failure of the crops an example of the second kind. The management of the commons should be carried out in a rational way which implies that due consideration has to be taken both to the internal condition of the society and its environment. Resources spent to build the commons have to be taken from the individuals in the society according to applicable rules. It is in the interest of the society to discourage free riders in the use of the commons.

One important concept in forming a society is that individuals have certain rights [9]. The same rights are not necessarily given to everyone, but also the least individual has some rights. The rights of an individual are to a large extent concerned with the use of the commons.

### 6.2 Contracts within the society

A society can in principle be seen as making contracts with its members. They agree to follow the rules and they get services in return. If a member does not follow the rules he is punished. The rules can be explicit in a written contract or in the legislation, but more often they are hidden in norms and values of the society. Societal norms assume loyalty and good behaviour. Norms also assume asketism in the use of resources and a willingness to work for the common good. In return the society provides protection and access to common resources. Providing its members with equality before the law and various resources transferring mechanisms typically ensures the cohesion of a society. When a society becomes more complicated such contracts may emerge on several layers.

For decision concerning the society there has to be persons with institutional power. That does not mean that they will not listen to others, but that the final decision in defined areas rests with them. This can be seen as a contract between the society and the person selected. The question is then how such institutional decision-makers should be selected. In the modern society the selection often is based on a democratic process. The contract with a leader may be fixed term or it may be indefinite. Indefinite contracts are problematic, because it may

be difficult to discharge a leader if his decisions are not anymore in the interest of the society. Being a leader involves benefits, which sometimes are well defined but often are not. The leader has a duty towards his society, but this duty may be overshadowed by personal gains obtained by the position. A leader, which has been elected by vote, can be assumed to have a contract with his supporters, which gives him certain responsibilities towards them.

Many decisions in a modern society are resolved in a voting process. One part of the process is the preceding debate, which is supposed to bring into the open all possible considerations to be taken into account in casting the vote. The debate has an important function in decision making both in the search for alternatives and in the elicitation of values. The voting ensures a backing of the alternative selected in the vote. A most common decision rule is to select the alternative supported by a majority. There are however certain complications in all voting processes. The famous theorem of Arrow can also be interpreted to say that no ideal procedure exists for weighting together individual values into a societal value function.

### 6.3 Social interactions and norms

Co-operation between people is built on trust. Trust is a belief that the other party will fulfil his part of a mutual contract. A society without trust is likely to dissolve. Trust creates a larger willingness for co-operation and increases thus the likelihood of win–win situations, which are in the interest of the society. Trust is important also in the selection of a leader. His supporters have to award him their trust that he has abilities to lead and a willingness to follow the rules of the position. Trust can be seen as a social capital, which can be increased or decreased by certain actions. A message from a person in an institutional position is more likely to be believed than the same message from another person. If trust is abused it may have a destabilising effect and it is therefore in the interest of society to discourage such behaviour.

It is in the interest of the society to force its members to follow the rules. Sometimes rules may be outdated and they should then be changed to reflect new needs. The rules for interactions in a society are based on a tricky balance between individual and societal needs. A society based on oppression is not likely to produce the same output as a society of individuals where everyone eagerly is doing his own share. Societal unrest can also take a heavy toll on common resources. Societal innovations which create better conditions for co-operation and a fair sharing of benefits have a potential to give the society a competitive edge. Sometimes it is not possible to change rigid societal structures in an evolutionary way, which may pave the way for a revolution.

Societal rules are reflected partly in the legislation and partly in societal norms. Group pressures can often be very effective, but they are usually further enforced by sanctions for failing members. In the early society sentencing a failing member to a life outside the society often was equal to a penalty of death. Group pressure can be very strong which the famous experiments of Milgram have shown [10]. In the experiments subjects yielded to group pressure and more or less unconsciously tried to please the experimenter against their own norms and beliefs. In considering norms and sanctions one can speculate what kind of qualities will be rational from a societal point of view.

Norms are often seen as generated by an ethic system and this would assume that some basic ethic principles could be formulated. Such principles cannot be absolute, in spite of the fact that very similar principles seem to apply in many societies. The ethic system can actually be seen as a way of the society to balance individual and societal benefit for the good of the society. Another observation is that an ethic system either is contradictory or may contain undecidable ethic dilemmas.

## 7 Conclusions

Theoretical rationality as defined in EUT and amended with other consideration gives a good basis for decision making. One should however always keep in mind that practical rationality often is far more complicated. People use their everyday experience when placed before new problems and this may lead to apparently irrational choices, which on a closer scrutiny may be completely rational. Theories in human decision making unfortunately becomes untestable, firstly because a theory taking all considerations into account would be to complex to be practical and secondly because the data needed to test the theory cannot be collected. The benefit of EUT is that it is simple and straightforward as compared with competing theories.

In the natural sciences rationality is often seen simply as a problem of optimisation. This view is practical, but it has to include also psychological and sociological considerations. The apparent controversy between natural and behavioural sciences could at least in principle be resolved by a better understanding of the complexity of human rationality. The human mind does not work in isolation, but it is adapted to a social community and a continuously changing environment.

Understanding all components of human rationality is a challenge, which cannot be solved on a short-term basis. An important part of human rationality is connected to the intricate balance between individual and societal utility. The human mind has over thousands of years learnt to resolve that balance, but in the modern society there are decisions which may not be solvable with an intuitive approach and a strategy of trial and error. For these decisions more solid theories of rationality will be needed. EUT can in spite of its dismerits be used as the backbone for such a theory, but it has to be extended with better explanations of both individual and social rationality. If this understanding of the practical aspects of human rationality can be reached there is a better possibility that the large decisions of our time can be solved in a way not creating regret for our future generations.

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